Buena Vista Landfill Redevelopment Project
Draft Environmental Impact Report
Appendices A-F

State Clearinghouse #2024020617

Prepared by

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Santa Cruz, California 95060

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With technical assistance from

Harris & Associates

Salinas, California

October 2026

County of Santa Cruz. 2026. *Draft Environmental Impact Report for the Buena Vista Landfill Redevelopment Project, Appendices A-F*. SCH #2024020617. October.

Appendices

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BUENA VISTA REDEVELOPMENT PROJECT

1231 BUENA VISTA DRIVE

WATSONVILLE, CA 95076

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X107	STRUCTURAL DETAILS



VICINITY MAP
SANTA CRUZ, CALIFORNIA

0 2000 4000 6000
SCALE IN FEET

CONTACT INFORMATION:

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DEPARTMENT OF PUBLIC WORKS
701 OCEAN STREET
SANTA CRUZ, CALIFORNIA 95060
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ATTN: NICOLE STEEL

ENGINEER: SCS ENGINEERS
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SUITE 450
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ATTN: KEN ARMENTROUT, P.E.
SEAN SULLIVAN, P.E.
PROJECT NO. 02221033.00

EXPLANATION OF "SECTION" OR "DETAIL" SYMBOL

SHEET NUMBER ON WHICH "SECTION" OR "DETAIL" IS REFERENCED. MAY BE MORE THAN ONE SHEET.

"SECTION" OR "DETAIL" IDENTIFICATION NUMBER OR LETTER.

SHEET NUMBER ON WHICH "SECTION" OR "DETAIL" IS DRAWN.

60% SET

NO.	REVISION	DATE

SHEET TITLE: TITLE SHEET

PROJECT TITLE: BUENA VISTA REDEVELOPMENT PROJECT
SANTA CRUZ COUNTY

CLIENT
SANTA CRUZ COUNTY
DEPARTMENT OF PUBLIC WORKS
701 OCEAN STREET
SANTA CRUZ, CA 95060

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS, INC.
1881 CAMPUS COMMONS DRIVE - RESTON, VA 20191
PH: (703) 471-6150 FAX: (703) 471-6676

PROJ. NO. 02221033.00
DSN. BY: SRS
DWN. BY: SRS
CHK. BY: KEA
Q/A PVW BY: KEA
APP. BY: KEA

CADD FILE:

DATE: AUGUST 2025

SCALE: AS SHOWN

DRAWING NO.
G100 of X

LEGEND

	EXISTING INTERMEDIATE CONTOUR
1230	EXISTING INDEX CONTOUR
X X X	EXISTING FENCE LINE
	EXISTING TREE LINE
	EXISTING ROAD
SS SS	EXISTING SANITARY SEWER
	EXISTING POND
	EXISTING STORM SEWER
W W W	EXISTING WATER LINE
E E E	EXISTING ELECTRIC LINE
	EXISTING LEACHATE TOE DRAIN COLLECTION LINE
	EXISTING LFG VENT TRENCH
EW-18	EXISTING LFG EXTRACTION WELL
LS-85	EXISTING LEACHATE SUMP
MW-4	EXISTING GROUNDWATER MONITORING WELL
GP-1	EXISTING PERIMETER GAS PROBE
	EXISTING WETLANDS
LOD LOD	PROPOSED LIMIT OF DISTURBANCE
	PROPOSED STORM SEWER
ES10	PROPOSED STORM STRUCTURE LABEL
	PROPOSED TREE LINE
	PROPOSED ROAD CENTERLINE
	PROPOSED INTERMEDIATE CONTOUR MINOR
1240	PROPOSED INTERMEDIATE CONTOUR MAJOR
	PROPOSED FINAL GRADE MINOR
1340	PROPOSED FINAL GRADE MAJOR
L	PROPOSED LEACHATE COLLECTION LINE
LFG-9	PROPOSED PASSIVE LFG VENT
CE	CONSTRUCTION ENTRANCE
CD	CHECK DAM
IP OP	INLET/OUTLET PROTECTION
CIP	CULVERT INLET PROTECTION
PS	PERMANENT SEEDING
SF SF SF SF	SILT FENCE
	DRAINAGE DIVIDE
	PROPOSED SOIL STABILIZATION MATTING

GENERAL NOTES:

1. EXISTING DATA SHOWN HEREON HAS BEEN REPRODUCED FROM DRAWINGS PROVIDED TO SCS ENGINEERS FROM SANTA CRUZ COUNTY, AND DOES NOT NECESSARILY REPRESENT AS-BUILT CONDITIONS, AND IS PROVIDED FOR INFORMATION ONLY.

2. THE AERIAL SURVEY COMPLETED BY TETRA TECH, WAS PERFORMED ON 11/20/2018.

3. EXISTING DATA SHOWN HEREON IS IN THE CALIFORNIA STATE PLANE COORDINATE SYSTEM, ZONE 3, NAD 83.

4. LOCATIONS OF EXISTING UTILITIES ALONG OR ACROSS PROPOSED PROJECT SITE ARE NOT NECESSARILY SHOWN ON THESE PLANS, AND WHERE SHOWN ARE ONLY APPROXIMATELY ACCURATE AND NOT NECESSARILY SURVEY LOCATED.

5. CONTRACTOR SHALL LOCATE UTILITIES AND OTHER EXISTING SITE FEATURES PRIOR TO BEGINNING CONSTRUCTION. UTILITIES AND SITE FEATURES DAMAGED BY THE CONTRACTOR DUE TO NEGLIGENCE SHALL BE REPAIRED AT THE CONTRACTORS EXPENSE.

6. CONTRACTOR SHALL CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS ON JOB SITE PRIOR TO COMMENCING WITH WORK. SPECIAL CARE SHALL BE GIVEN TO SITE LAYOUT THEREON. IN THE EVENT THE CONTRACTOR DISCOVERS AN ERROR, OMISSION, OR ANY OTHER POSSIBLE DISCREPANCY BETWEEN FIELD CONDITIONS AND DRAWINGS OR SPECIFICATIONS, NOTIFICATION TO ENGINEER SHALL BE IMMEDIATELY MADE PRIOR TO PROCEEDING WITH WORK.

7. CONTRACTOR SHALL REPAIR AT THEIR EXPENSE, ANY GROUNDWATER MONITORING WELLS, LANDFILL GAS MONITORING PROBES, UTILITIES, ETC., THAT ARE DAMAGED DURING CONSTRUCTION.

8. THE PROJECT SITE IS ZONED PF/CA, AND THE PARCEL IDENTIFICATION NUMBERS ARE 05253103 , 05202133, and 05253101. THE PROPERTY AREA IS 197.54± ACRES.

CONSTRUCTION NOTES

1. WORK IN THIS PROJECT SHALL CONFORM TO THE LATEST EDITIONS OF THE CALIFORNIA DEPARTMENT OF TRANSPORTATION (CALTRANS), THE CASQA STORMWATER BMP HANDBOOK, THE COUNTY OF SANTA CRUZ DESIGN CRITERIA, AND THE CALTRANS STANDARD PLAN 2018 DETAILS. IN THE EVENT OF CONFLICT BETWEEN ANY OF THESE STANDARDS, SPECIFICATIONS OR PLANS, THE MOST STRINGENT SHALL GOVERN.

2. EROSION AND SEDIMENT CONTROL MEASURES SHALL BE MAINTAINED CONTINUOUSLY, REPAIRED WHEN AND AS NECESSARY AND SHALL BE INSPECTED WITHIN 24 HOURS OF EACH RAINFALL EVENT. SEEDED AREAS SHALL BE CHECKED REGULARLY AND SHALL BE WATERED, FERTILIZED, RESEEDED AND MULCHED AS NECESSARY TO OBTAIN A DENSE STAND OF GRASS.

3. ALL DRAIN INLETS SHALL BE PROTECTED FROM SILTATION. INEFFECTIVE PROTECTION DEVICES SHALL BE IMMEDIATELY REPLACED AND THE INLET CLEANED. FLUSHING IS NOT AN ACCEPTABLE METHOD OF CLEANING.

4. WHEN THE CRUSHED STONE CONSTRUCTION ENTRANCE HAS BEEN COVERED WITH SOIL OR HAS BEEN PUSHED INTO THE SOIL BY CONSTRUCTION TRAFFIC, IT SHALL BE REPLACED WITH A DEPTH OF STONE EQUAL TO THAT OF ORIGINAL APPLICATION.

5. THE LOCATION OF EXISTING UTILITIES AS SHOWN IS APPROXIMATE ONLY. THE CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL PUBLIC OR PRIVATE UTILITIES THAT LIE IN OR ADJACENT TO THE CONSTRUCTION SITE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR REPAIRING, AT HIS EXPENSE, ALL EXISTING UTILITIES DAMAGED DURING CONSTRUCTION. FORTY-EIGHT (48) HOURS PRIOR TO ANY EXCAVATION CALL USA NORTH 811 AT (800) 642-2444 OR DIG ALERT AT (800) 422-4133.

6. ALL MATERIALS USED FOR FILL OR BACK-FILL SHALL BE FREE OF WOOD, ROOTS, ROCKS, BOULDERS OR ANY OTHER NON-COMPACTABLE SOIL TYPE MATERIAL. UNSATISFACTORY MATERIALS ALSO INCLUDE MAN-MADE FILLS AND REFUSE DEBRIS DERIVED FROM ANY SOURCE.

7. MATERIALS USED TO CONSTRUCT EMBANKMENTS FOR ANY PURPOSE, BACK-FILL AROUND DRAINAGE STRUCTURES OR IN UTILITY TRENCHES OR ANY OTHER DEPRESSION REQUIRING FILL OR BACK-FILL SHALL BE COMPACTED TO 95% OF MAXIMUM DENSITY AS DETERMINED BY THE STANDARD PROCTOR TEST AS SET OUT IN ASTM STANDARD D-698. THE CONTRACTOR SHALL, PRIOR TO ANY OPERATIONS INVOLVING FILLING OR BACKFILLING, SUBMIT THE RESULT OF THE PROCTOR TEST TO THE CITY'S ON-SITE INSPECTOR TOGETHER WITH A CERTIFICATION THAT THE SOIL TESTED IN REPRESENTATIVE OF THE MATERIALS TO BE USED ON THE PROJECT. TESTS SHALL BE CONDUCTED BY A CERTIFIED MATERIALS TESTING LABORATORY AND THE CERTIFICATIONS MADE BY A LICENSED PROFESSIONAL ENGINEER REPRESENTING THE LABORATORY.

8. CERTIFICATIONS FOR MATERIALS INCLUDING, BUT NOT LIMITED TO STONE, CONCRETE, PIPES, PRECAST UNITS, HANDRAILS, STABILIZATION MATS, TRAFFIC SIGNAL ITEMS, MUST BE PROVIDED TO THE COUNTY'S ON-SITE INSPECTOR AND APPROVED BY THE INSPECTOR PRIOR TO INSTALLATION. SEE INSPECTOR FOR MATERIALS CERTIFICATION CHECKLIST.

9. EMBANKMENT FILL AND TRENCH BACK-FILL SHALL BE PLACED IN LIFTS AT A MAXIMUM UNCOMPACTED DEPTH OF 8-INCHES AND 6-INCHES, RESPECTIVELY. DENSITY TESTS SHALL BE CONDUCTED AT THE FOLLOWING MINIMUM FREQUENCIES:
   (A) EMBANKMENT FOR ROADS, STREETS, DAMS, ETC.: ONE TEST PER LIFT PER 10,000 SQUARE FEET OF LIFT.
   (B) BACK-FILL AROUND STRUCTURES AND IN TRENCHES: ONE TEST PER LIFT PER 500 LINEAR FEET OF TRENCH..

10. ALL EXCAVATIONS, INCLUDING TRENCHES, SHALL BE KEPT DRY TO PROTECT THEIR INTEGRITY.

11. TEST RESULTS SHALL BE SUBMITTED TO THE COUNTY ENGINEER. FAILURE TO CONDUCT DENSITY TESTS AND SUBMIT TEST RESULTS SHALL BE CAUSE FOR NONACCEPTANCE OF THE FACILITY. TESTS SHALL BE CONDUCTED AT THE COST OF THE CONTRACTOR.

12. ANY DISCREPANCIES FOUND BETWEEN THE DRAWINGS AND SPECIFICATIONS AND SITE CONDITIONS OR ANY INCONSISTENCIES OR AMBIGUITIES IN DRAWINGS OR SPECIFICATIONS SHALL BE IMMEDIATELY REPORTED TO THE ENGINEER, IN WRITING, WHO SHALL PROMPTLY ADDRESS SUCH INCONSISTENCIES OR AMBIGUITIES. WORK DONE BY THE CONTRACTOR AFTER HIS DISCOVERY OF SUCH DISCREPANCIES, INCONSISTENCIES OR AMBIGUITIES SHALL BE DONE AT THE CONTRACTOR'S RISK.

SANTA CRUZ COUNTY LANDFILL SURVEY CONTROL POINTS (SEE NOTE 3)

POINT ID	NORTHING	EASTING	ELEVATION	COMMENTS
6	1794986.10	6179432.92	110.92	
7	1795719.81	6179370.48	113.86	
77	1795146.28	6178017.74	31.95	
725	1795297.57	6176611.12	28.14	
1002	1794079.12	6176974.54	101.04	
1004	1793924.30	6179452.91	106.64	
1023	1796355.10	6178130.35	62.39	

60% SET

NO.	REVISION	DATE

SHEET TITLE: GENERAL NOTES AND LEGEND

PROJECT TITLE: BUENA VISTA REDEVELOPMENT PROJECT SANTA CRUZ COUNTY

CLIENT: SANTA CRUZ COUNTY DEPARTMENT OF PUBLIC WORKS 701 OCEAN STREET SANTA CRUZ, CA 95060

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PROJ. NO. 02217065.00 | DSN. BY: SRS | DRW. BY: SRS | CHK. BY: KEA | Q/A PVW BY: MAK | APP. BY: KEA

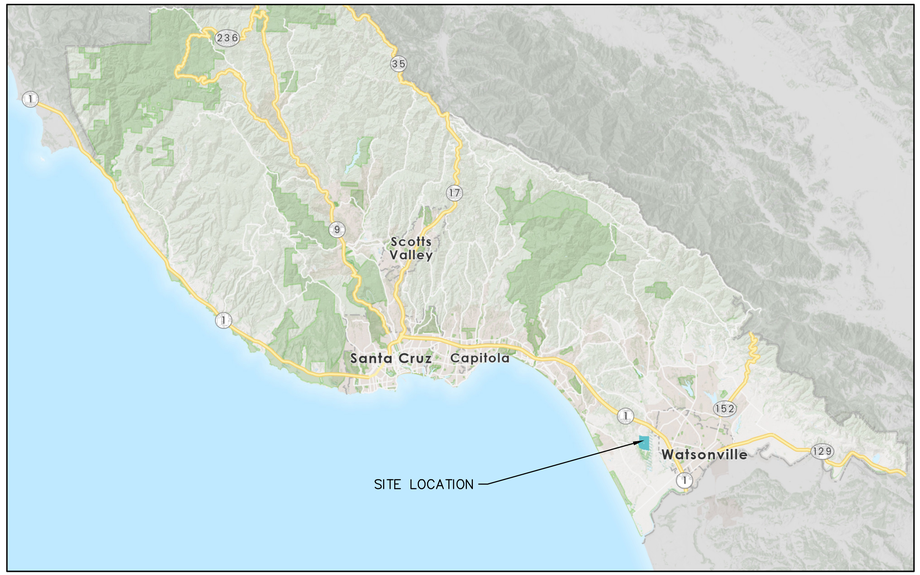
CADD FILE:

DATE: AUGUST 2025

SCALE: AS SHOWN

DRAWING NO. G101 of X

SANTA CRUZ COUNTY



September 28, 2023

1:276,564

0 2.25 4.5 9 mi

0 3.75 7.5 15 km

60% SET

NO.	REVISION	DATE

SHEET TITLE: OVERALL SITE MAP

PROJECT TITLE: BUENA VISTA REDEVELOPMENT PROJECT SANTA CRUZ COUNTY

CLIENT:
SANTA CRUZ COUNTY
DEPARTMENT OF PUBLIC WORKS
701 OCEAN STREET
SANTA CRUZ, CA 95060

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PROJ. NO.	DWN. BY:	G/A REV. BY:
02221033.00	SRS	KEA
DSN. BY:	CHK. BY:	APP. BY:
SRS	KEA	KEA

CADD FILE:

DATE: AUGUST 2025

SCALE: AS SHOWN

DRAWING NO.

C100 of X

60% SET

MATCHLINE SEE SHEET C102

PAVED HARKINS SLOUGH ROAD

DIRT LANDFILL PERIMETER ROAD

GP-21

INV. = 93.726'

24" 128.13' CULVERT

EXISTING CONCRETE DITCH (TYP.)

INV. = 99.690'

EXISTING CONCRETE SWALE

EXISTING ACTIVE BUENA VISTA LANDFILL

EXISTING COMPOST TRANSFER OPTION

APPROXIMATE LIMIT OF WASTE

EXISTING LEACHATE PUMPHOUSE (TYP.)

PERIMETER LANDFILL GAS PROBE TO BE RELOCATED

GP-20

COAST LIVE OAK (TO BE REMOVED)

PROPERTY LINE

EW-1601

EW-401

120 110 100 90 80 70

CURRENT VIEWPORT LOCATION

BUENA VISTA LANDFILL

KEY MAP INSET
SCALE: 1" = 1000'

N

0 30 60 90
SCALE IN FEET

NO.	REVISION	DATE

SHEET TITLE
EXISTING CONDITIONS I

PROJECT TITLE
BUENA VISTA REDEVELOPMENT PROJECT
SANTA CRUZ COUNTY

CLIENT
SANTA CRUZ COUNTY
DEPARTMENT OF PUBLIC WORKS
701 OCEAN STREET
SANTA CRUZ, CA 95060

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PROJ. NO.	DWN. BY:	D/A R'VW BY:
02221033.00	SRS	KEA
DSN. BY:	CHK. BY:	APP. BY:
SRS	KEA	KEA

CADD FILE:

DATE:
AUGUST 2025

SCALE:
AS SHOWN

DRAWING NO.
C101 of X

EW-32
EW-29A
T20
T10
EXISTING ACTIVE BUENA VISTA LANDFILL (CLOSED SECTION)
LANDFILL ACCESS ROAD
APPROXIMATE LIMIT OF CAPPED AREA
GAS PROBE (TO BE RELOCATED)
EXISTING WELL AND WATER TANK
GP-8
EXISTING MAINTENANCE SHOP (TO BE REMOVED)
EXISTING MAINTENANCE SHOP (TO BE REMOVED)
EXISTING OFFICE BUILDING (TO BE REMOVED)
APPROXIMATE LOCATION OF EXISTING LEACH FIELD (TO BE REMOVED)
VZ-2
VZ-1
EXISTING WATER SERVICE (TO BE REMOVED)
EW-39 AND 40
GAS PROBE (TO BE RELOCATED)
GP-7
GP-9
PAVED ROUNDTREE LANE
EW-38
GP-17
EXISTING MAINTENANCE AND OFFICE BUILDING
EXISTING COUNTY JAIL FACILITY
GP-1
EXISTING OVERHEAD ELECTRIC UTILITY
GP-2
GP-5
GP-3
N
0 20 40 60
SCALE IN FEET

BUENA VISTA LANDFILL
CURRENT VIEWPORT LOCATION
KEY MAP INSET
SCALE: 1" = 1000'

60% SET

NO.	REVISION	DATE

SHEET TITLE: EXISTING CONDITIONS III

PROJECT TITLE: BUENA VISTA REDEVELOPMENT PROJECT SANTA CRUZ COUNTY

CLIENT
SANTA CRUZ COUNTY
DEPARTMENT OF PUBLIC WORKS
701 OCEAN STREET
SANTA CRUZ, CA 95060

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PROJ. NO. 02221033.00
DSN. BY: SRS
DWN. BY: SRS
CHK. BY: KEA
Q/A PVW BY: KEA
APP. BY: KEA

CADD FILE:

DATE: AUGUST 2025

SCALE: AS SHOWN

DRAWING NO. C103 of X



KEY MAP INSET
SCALE: 1" = 1000'

N

0 80 160 240
SCALE IN FEET

60% SET

NO.	REVISION	DATE

SHEET TITLE
EXISTING CONDITIONS IV

PROJECT TITLE
BUENA VISTA REDEVELOPMENT PROJECT
SANTA CRUZ COUNTY

CLIENT
SANTA CRUZ COUNTY
DEPARTMENT OF PUBLIC WORKS
701 OCEAN STREET
SANTA CRUZ, CA 95060

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DSN. BY: SRS
DWN. BY: SRS
CHK. BY: KEA
Q/A PVW BY: KEA
APP. BY: KEA

CADD FILE:

DATE:
AUGUST 2025

SCALE:
AS SHOWN

DRAWING NO.
C104 of X

LFG
LFG
LFG
LFG
LFG
LFG
LFG
LFG
LFG
120
110
GP-12
GP-10
OH
ROUNTREE LANE
EXISTING ACTIVE SEPTIC FIELD
HARKINS SLOUGH ROAD
PROPERTY LINE
EXISTING LAND LEASE
TAXABLE PUBLIC LAND (APN # 05253102)
WASTEWATER EASEMENT
EASEMENT BOUNDARY
N
0
30
60
90
SCALE IN FEET
60% SET

BUENA VISTA LANDFILL
CURRENT VIEWPORT LOCATION
KEY MAP INSET
SCALE: 1" = 1000'

NO.	REVISION	DATE

SHEET TITLE
EXISTING CONDITIONS V

PROJECT TITLE
BUENA VISTA REDEVELOPMENT PROJECT
SANTA CRUZ COUNTY

CLIENT
SANTA CRUZ COUNTY
DEPARTMENT OF PUBLIC WORKS
701 OCEAN STREET
SANTA CRUZ, CA 95060

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CHK. BY: KEA
Q/A PPW BY:
APP. BY: KEA

CADD FILE:

DATE: AUGUST 2025

SCALE: AS SHOWN

DRAWING NO.
C105 of X

60% SET

HARKINS SLOUGH ROAD

GP-22

GP-21

VZ-7

EW-1606

EW-1605

EW-1601

EW-401

EW-1603

EW-400

EW-300

VC-RS4A

VZ-5

GP19EW1

GP19EW2

GP-19

EXISTING ACTIVE BUENA VISTA LANDFILL

EXISTING COMPOST TRANSFER OPTION

COAST LIVE OAK (TO BE REMOVED)

PROPER

LFG

CURRENT VIEWPORT LOCATION

BUENA VISTA LANDFILL

KEY MAP INSET
SCALE: 1" = 1000'

N

0 50 100 150
SCALE IN FEET

NO.	REVISION	DATE
1		
2		
3		
4		
5		

SHEET TITLE
EXISTING CONDITIONS VI

PROJECT TITLE
BUENA VISTA REDEVELOPMENT PROJECT
SANTA CRUZ COUNTY

CLIENT
SANTA CRUZ COUNTY
DEPARTMENT OF PUBLIC WORKS
701 OCEAN STREET
SANTA CRUZ, CA 95060

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DSN. BY: SRS	CHK. BY: KEA	APP. BY: KEA	

CADD FILE:

DATE:
AUGUST 2025

SCALE:
AS SHOWN

DRAWING NO.
C106 of X

60% SET

MATCHLINE SEE SHEET C201

RESTORATION TO EXISTING STORMWATER DITCH TO BE PROVIDED

REALIGNED HARKINS SLOUGH WITH TWO-WAY STOP CONTROL

NEW HARKINS SLOUGH ROAD

NEW LIMITS OF PAVING

HARKINS SLOUGH ROAD (TO BE REALIGNED)

COAST LIVE OAK (TO BE REMOVED)

NEW FENCE LINE

GUARDRAIL (TYP.)

RETAINING WALL (TYP.)

UNDERGROUND WASTEWATER HOLDING TANK

APPROXIMATE LIMIT OF WASTE

15' WIDE TRANSFER STATION TUNNEL

PUSH WALL (TYP.)

30' X 50' OFFICE SPACE

BURIED ELECTRIC FROM OLD HARKINS SLOUGH OVERHEAD UTILITY

TRANSFER STATION EXIT

TRANSFER STATION A
32,700 SF
FF. EL. = 108

EXISTING TREES (TO BE REMOVED)

PROPERTY LINE

LOADING DOCKS FOR BULK STORAGE

TRANSFER STATION ENTRANCE

EXISTING ACTIVE BUENA VISTA LANDFILL

EXISTING COMPOST TRANSFER OPTION

RELOCATED GAS PROBE

COUNTY EMPLOYEE PARKING

DROP OFF / TRANSFER TRAILER ENTRANCE

NEW WATER SERVICE LINES FOR DOMESTIC AND FIRE SUPPRESSION FROM EXISTING WATER TANKS

EW-501

EW-401

CURRENT VIEWPORT LOCATION

BUENA VISTA LANDFILL

KEY MAP INSET
SCALE: 1" = 1000'

N

0 30 60 90
SCALE IN FEET

NO.	REVISION	DATE

SHEET TITLE: SITE PLAN I

PROJECT TITLE: BUENA VISTA REDEVELOPMENT PROJECT
SANTA CRUZ COUNTY

CLIENT
SANTA CRUZ COUNTY
DEPARTMENT OF PUBLIC WORKS
701 OCEAN STREET
SANTA CRUZ, CA 95060

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STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS, INC.
1881 CAMPUS COMMONS DRIVE · RESTON, VA 20191
PH. (703) 471-6150 FAX (703) 471-6676

PROJ. NO. 02221033.00
DSN. BY: SRS
DWN. BY: SRS
CHK. BY: KEA
Q/A PVW BY:
APP. BY: KEA

CADD FILE:

DATE: AUGUST 2025

SCALE: AS SHOWN

DRAWING NO. C200 of X

EW-32
EW-29A
T20
EXISTING ACTIVE BUENA VISTA LANDFILL (CLOSED SECTION)
T10
APPROXIMATE LIMIT OF WASTE
LANDFILL ACCESS ROAD
WASTE TO BE RELOCATED WHERE NECESSARY
RETAINING WALL (TYP.)
MAINTENANCE BAY
GP-8
TRANSFER STATION EXIT
STORM DRAIN INLET
EL. = 107.8
INV. OUT = 106.4
NEW LIMITS OF PAVING
TRANSFER STATION B
26,000 SF
FF. EL. = 118
APPROXIMATELY NEW WASTE LIMIT
TRANSFER STATION ENTRANCE
12"ø 83' N-12 HDPE @1.0%
STORM DRAIN MANHOLE
EL. = 107.0
INV. IN = 105.6
INV. OUT = 105.5
STORM DRAIN EXIT
EL. = 104.0
VZ-1
VZ-2
3,800 ± S.F.
TWO STORY
OFFICE SPACE
15' WIDE TRANSFER
TRAILER TUNNEL
GP-7
GP-9
12"ø 117' N-12 HDPE @1.3%
NEW ACCESS FOR
FUELING/STAGING
AREA
NEW WATER SERVICE FOR
TSA DOMESTIC AND FIRE
SUPPRESSION
NEW WATER SERVICE FOR
TSB DOMESTIC AND FIRE
SUPPRESSION
EXISTING OVERHEAD
ELECTRIC UTILITY
PAVED EMPLOYEE
PARKING AREA
PAVED
ROUNDTREE
LANE
UNDERGROUND WASTEWATER
HOLDING TANK
NEW ELECTRIC SERVICE FOR
TRANSFER STATION
EXISTING MAINTENANCE AND OFFICE BUILDING
EXISTING LAND LEASE LIMIT
EXISTING COUNTY JAIL FACILITY
GP-1
GP-2
GP-3
GP-5
EW-38
EW-39 AND 40

BUENA VISTA LANDFILL
CURRENT VIEWPORT LOCATION
KEY MAP INSET
SCALE: 1" = 1000'

N

0 20 40 60
SCALE IN FEET

60% SET

NO.	REVISION	DATE

SHEET TITLE: SITE PLAN III

PROJECT TITLE: BUENA VISTA REDEVELOPMENT PROJECT
SANTA CRUZ COUNTY

CLIENT
SANTA CRUZ COUNTY
DEPARTMENT OF PUBLIC WORKS
701 OCEAN STREET
SANTA CRUZ, CA 95060

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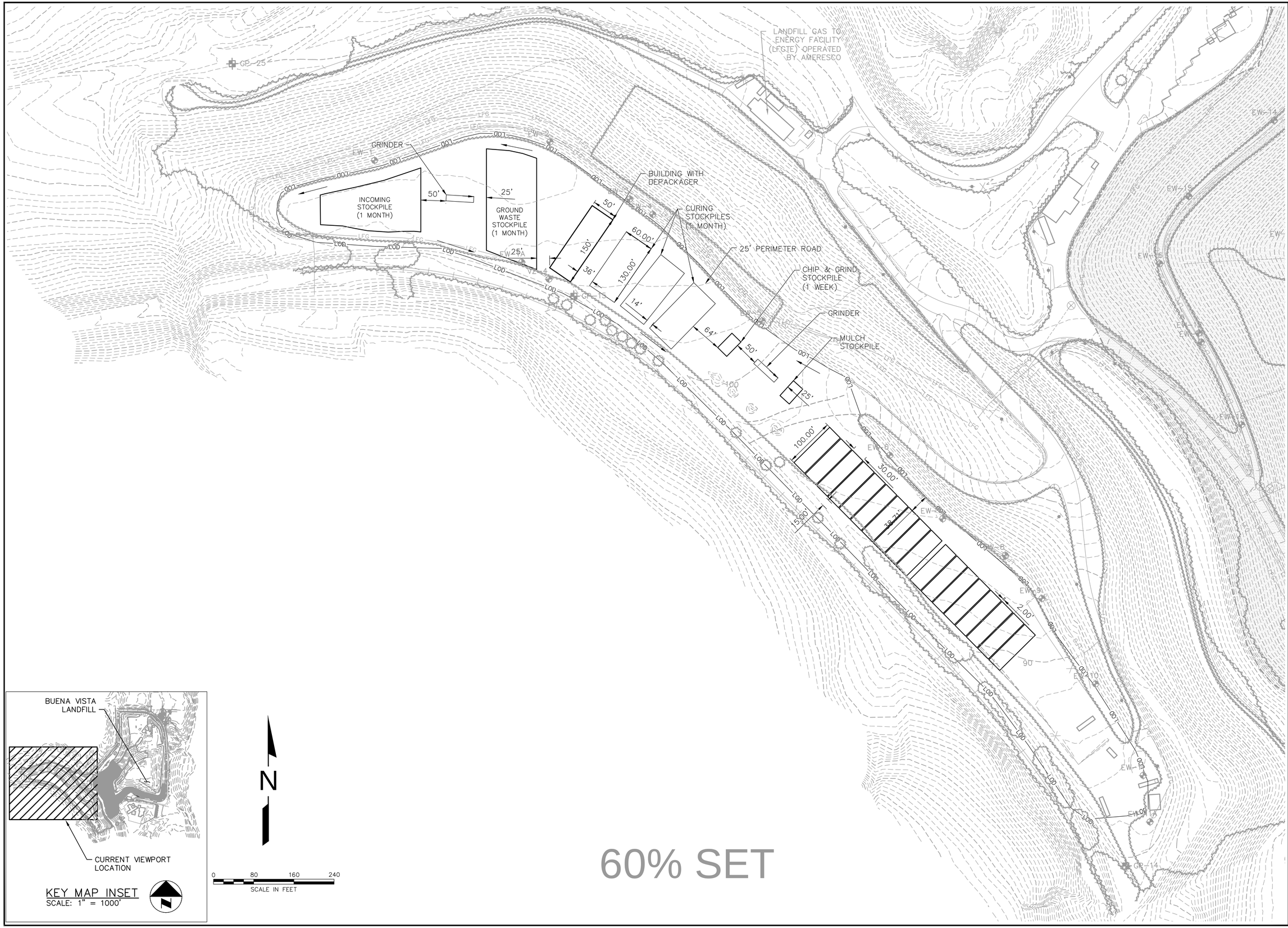
PROJ. NO. 02221033.00
DSN. BY: SRS
DRN. BY: SRS
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Q/A PERF. BY: KEA
APP. BY: KEA

CADD FILE:

DATE: AUGUST 2025

SCALE: AS SHOWN

DRAWING NO.
C202 of X



KEY MAP INSET
SCALE: 1" = 1000'

N

0 80 160 240
SCALE IN FEET

60% SET

NO.	REVISION	DATE
1		
2		
3		
4		
5		

SHEET TITLE: SITE PLAN IV

PROJECT TITLE: BUENA VISTA REDEVELOPMENT PROJECT
SANTA CRUZ COUNTY

CLIENT
SANTA CRUZ COUNTY
DEPARTMENT OF PUBLIC WORKS
701 OCEAN STREET
SANTA CRUZ, CA 95060

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PROJ. NO. 02221033.00
DSN. BY: SRS
DWN. BY: SRS
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O/A RVW BY: KEA
APP. BY: KEA

CADD FILE:

DATE: AUGUST 2025

SCALE: AS SHOWN

DRAWING NO.
C203 of X

GP-12

GP-10

ROUNTREE LANE

EXISTING ACTIVE SEPTIC FIELD

HARKINS SLOUGH ROAD

PROPERTY LINE

PARKING FOR FUELING/STAGING

EXISTING LAND LEASE

LOCATION FOR CHARGING/FUELING STATIONS

LIMITS OF PAVING

WASTEWATER EASEMENT

EASEMENT BOUNDARY

N

0 30 60 90

SCALE IN FEET

60% SET

BUENA VISTA LANDFILL

CURRENT VIEWPORT LOCATION

KEY MAP INSET

SCALE: 1" = 1000'

NO.	REVISION	DATE

SHEET TITLE: SITE PLAN V

PROJECT TITLE: BUENA VISTA REDEVELOPMENT PROJECT
SANTA CRUZ COUNTY

CLIENT
SANTA CRUZ COUNTY
DEPARTMENT OF PUBLIC WORKS
701 OCEAN STREET
SANTA CRUZ, CA 95060

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PROJ. NO. 02221033.00 | DSN. BY: SRS | DWN. BY: SRS | CHK. BY: KEA | Q/A PRM BY: KEA | APP. BY: KEA

CADD FILE:

DATE: AUGUST 2025

SCALE: AS SHOWN

DRAWING NO.

C204 of X

60% SET

HARKINS SLOUGH ROAD

APPROXIMATE LIMIT OF WASTE

PROPOSED LOCATION FOR OPTION 1 ORGANICS MANAGEMENT

EXISTING ACTIVE BUENA VISTA LANDFILL

TO BE REMOVED

EW-1606 EW-1605 EW-601 EW-401 EW-603 EW-400 EW-300 EW-106R EW-55 EW-56 EW-57

GP-22 GP-21 GP19EW1 GP19EW2 GP-13 GP-06 GP-05 GP-04A

VZ-7

CURRENT VIEWPORT LOCATION

BUENA VISTA LANDFILL

KEY MAP INSET
SCALE: 1" = 1000'

N

0 50 100 150
SCALE IN FEET

NO.	REVISION	DATE

SHEET TITLE: SITE PLAN VI

PROJECT TITLE: BUENA VISTA REDEVELOPMENT PROJECT
SANTA CRUZ COUNTY

CLIENT
SANTA CRUZ COUNTY
DEPARTMENT OF PUBLIC WORKS
701 OCEAN STREET
SANTA CRUZ, CA 95060

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CADD FILE:

DATE: AUGUST 2025

SCALE: AS SHOWN

DRAWING NO.
C205 of X

60% SET

MATCHLINE SEE SHEET C301

RESTORATION TO EXISTING STORMWATER DITCH TO BE PROVIDED

T.O.W.= 94
B.O.W.= 94

REALIGNED HARKINS SLOUGH WITH TWO-WAY STOP CONTROL

T.O.W.= 120
B.O.W.= 107

NEW HARKINS SLOUGH ROAD

NEW LIMITS OF PAVING

15' WIDE TRANSFER STATION TUNNEL

RETAINING WALL (TYP.)

T.O.W.= 96
B.O.W.= 96

NEW FENCE LINE

GUARDRAIL (TYP.)

BURIED ELECTRIC FROM OLD HARKINS SLOUGH OVERHEAD UTILITY

T.O.W.= 108
B.O.W.= 92

PUSH WALL (TYP.)

TRANSFER STATION A
32,700 SF
FF. EL. = 108

UNDERGROUND WASTEWATER HOLDING TANK

30'X50' OFFICE SPACE

APPROXIMATE LIMIT OF WASTE

LOADING DOCKS FOR BULK STORAGE

TRANSFER STATION ENTRANCE

T.O.W.= 108
B.O.W.= 104

PROPERTY LINE

NEW WATER SERVICE LINES FOR DOMESTIC AND FIRE SUPPRESSION FROM EXISTING WATER TANKS

T.O.W.= 108
B.O.W.= 108

T.O.W.= 110
B.O.W.= 104

EXISTING ACTIVE BUENA VISTA LANDFILL

COUNTY EMPLOYEE PARKING

24.00'

DROP OFF / TRANSFER TRAILER ENTRANCE

CURRENT VIEWPORT LOCATION

BUENA VISTA LANDFILL

KEY MAP INSET
SCALE: 1" = 1000'

N

0 30 60 90
SCALE IN FEET

NO.	REVISION	DATE

SHEET TITLE: GRADING PLAN I

PROJECT TITLE: BUENA VISTA REDEVELOPMENT PROJECT
SANTA CRUZ COUNTY

CLIENT
SANTA CRUZ COUNTY
DEPARTMENT OF PUBLIC WORKS
701 OCEAN STREET
SANTA CRUZ, CA 95060

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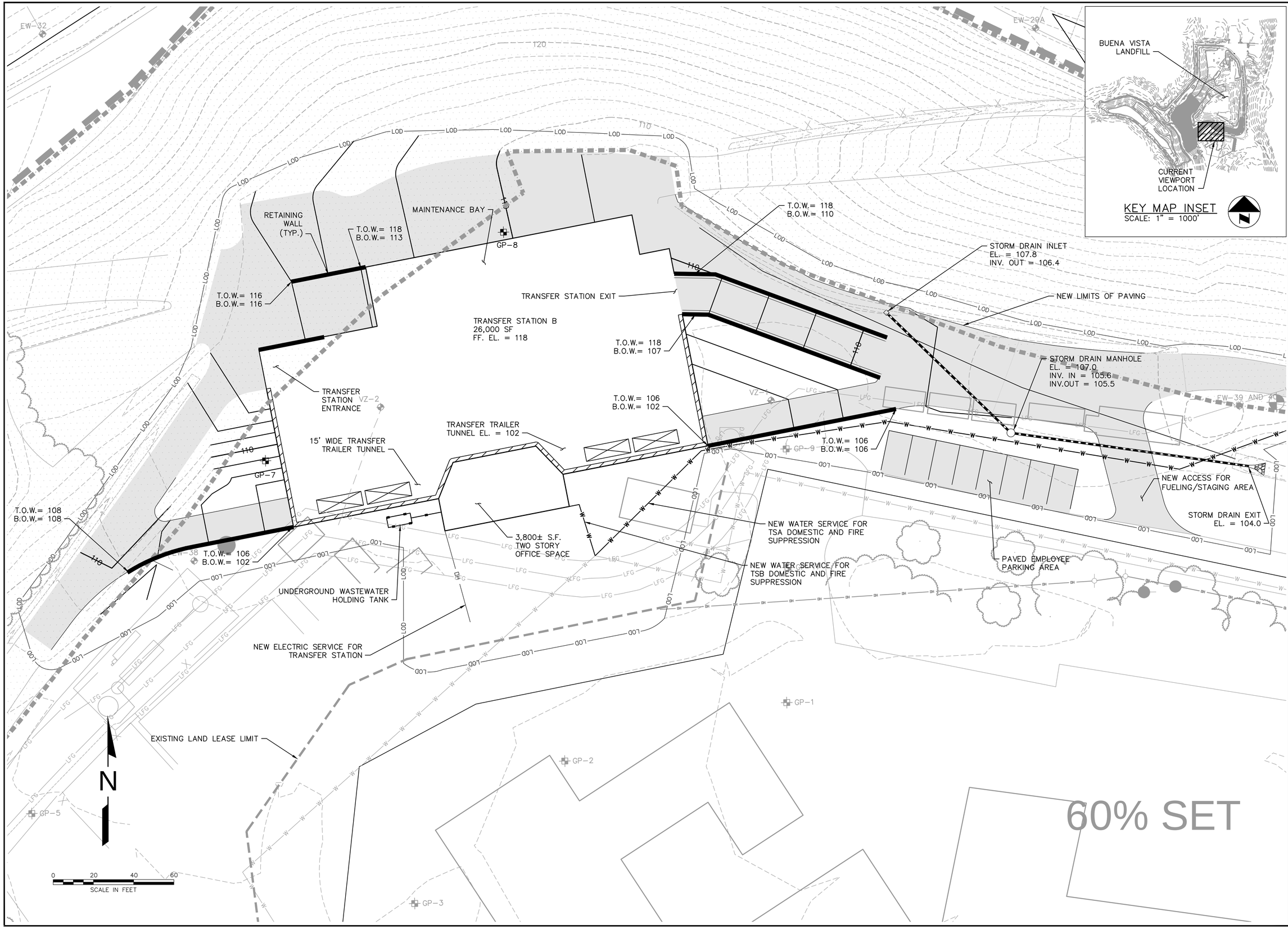
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DRN. BY: SRS
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Q/A R'VW BY: KEA
APP. BY: KEA

CADD FILE:

DATE: AUGUST 2025

SCALE: AS SHOWN

DRAWING NO.
C300 of X



NO.	REVISION	DATE

SHEET TITLE: GRADING PLAN III

PROJECT TITLE: BUENA VISTA REDEVELOPMENT PROJECT
SANTA CRUZ COUNTY

CLIENT
SANTA CRUZ COUNTY
DEPARTMENT OF PUBLIC WORKS
701 OCEAN STREET
SANTA CRUZ, CA 95060

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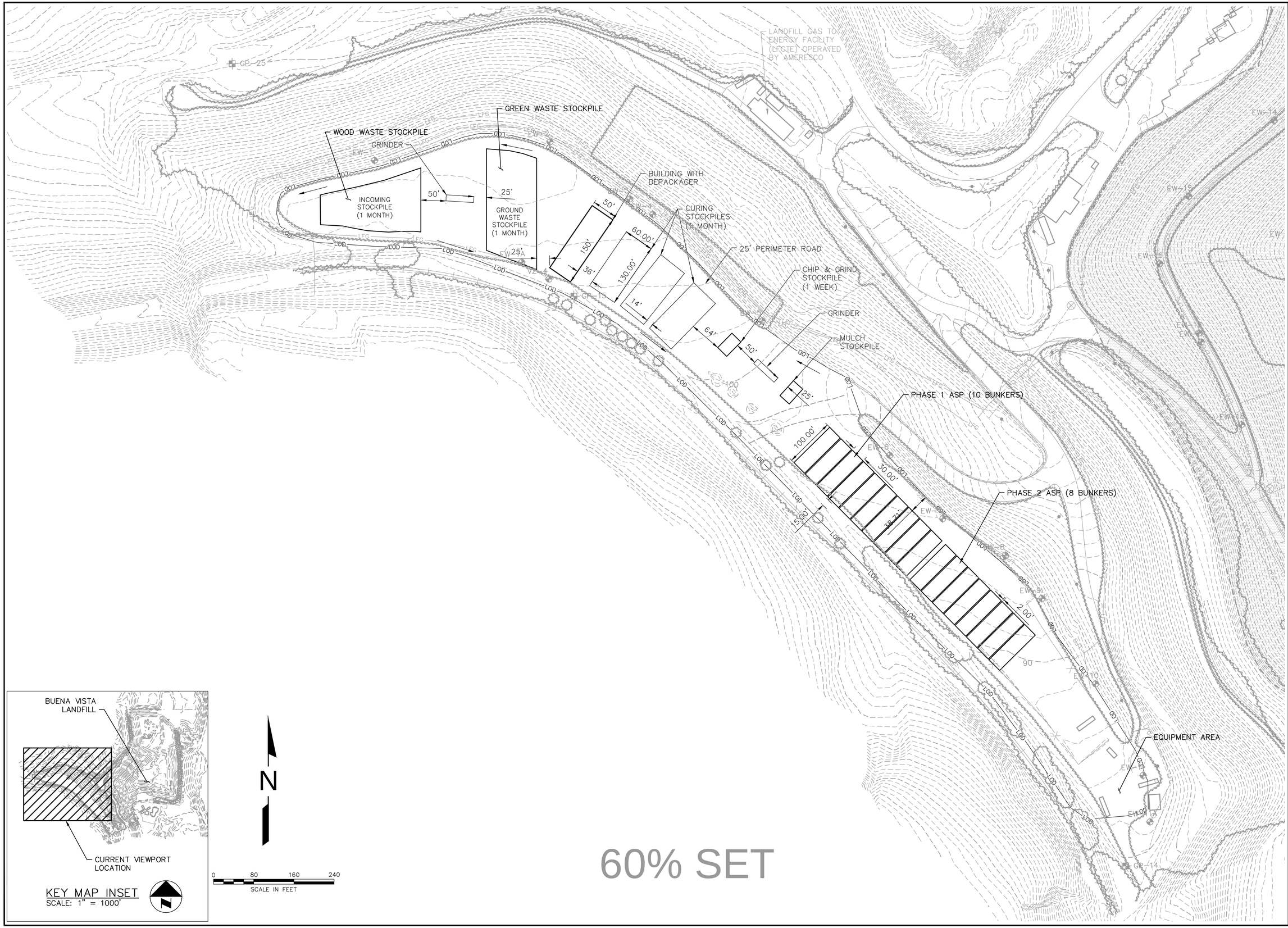
CADD FILE:

DATE: AUGUST 2025

SCALE: AS SHOWN

DRAWING NO.

C302 of X



N

0 80 160 240
SCALE IN FEET

60% SET

NO.	REVISION	DATE

SHEET TITLE: GRADING PLAN IV

PROJECT TITLE: BUENA VISTA REDEVELOPMENT PROJECT
SANTA CRUZ COUNTY

CLIENT:
SANTA CRUZ COUNTY
DEPARTMENT OF PUBLIC WORKS
701 OCEAN STREET
SANTA CRUZ, CA 95060

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PH. (703) 471-6150 FAX. (703) 471-6676

PROJ. NO.	DRN. BY:	CHK. BY:	Q/A REVIEW BY:	APP. BY:
02221033.00	SRS	KEA	KEA	KEA
DSN. BY: SRS				

CADD FILE:

DATE: AUGUST 2025

SCALE: AS SHOWN

DRAWING NO.
C303 of X

GP-12

GP-10

ROUNTREE LANE

PARKING FOR
CHARGING/FUELING AREA

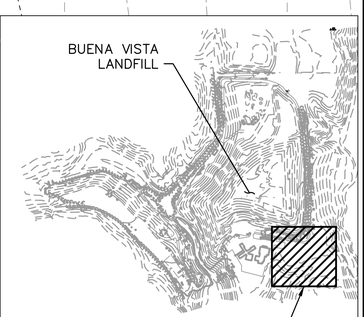
LOCATION FOR
CHARGING/FUELING
STATIONS

LIMITS OF PAVING FOR
PARKING/CHARGING AREA

N

0 30 60 90
SCALE IN FEET

60% SET



KEY MAP INSET
SCALE: 1" = 1000'

NO.	REVISION	DATE

SHEET TITLE
GRADING PLAN V

PROJECT TITLE
BUENA VISTA REDEVELOPMENT PROJECT
SANTA CRUZ COUNTY

CLIENT
SANTA CRUZ COUNTY
DEPARTMENT OF PUBLIC WORKS
701 OCEAN STREET
SANTA CRUZ, CA 95060

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PROJ. NO. 02221033.00
DSN. BY: SRS
DWN. BY: SRS
CHK. BY: KEA
Q/A PRM BY: KEA
APP. BY: KEA

CADD FILE:

DATE:
AUGUST 2025

SCALE:
AS SHOWN

DRAWING NO.
C304 of X

60% SET

HARKINS SLOUGH ROAD

PROPOSED LOCATION FOR OPTION 1 ORGANICS MANAGEMENT

PROPERTY LINE

24.00'

CURRENT VIEWPORT LOCATION

BUENA VISTA LANDFILL

KEY MAP INSET
SCALE: 1" = 1000'

0 30 60' 90
SCALE IN FEET

N

NO.	REVISION	DATE

SHEET TITLE
GRADING PLAN VI

PROJECT TITLE
BUENA VISTA REDEVELOPMENT PROJECT
SANTA CRUZ COUNTY

CLIENT
SANTA CRUZ COUNTY
DEPARTMENT OF PUBLIC WORKS
701 OCEAN STREET
SANTA CRUZ, CA 95060

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PROJ. NO. 02221033.00
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DRN. BY: SRS
CHK. BY: KEA
Q/A PERF. BY:
APP. BY: KEA

CADD FILE:

DATE:
AUGUST 2025

SCALE:
AS SHOWN

DRAWING NO.
C305 of X

TRAFFIC FLOW LEGEND	
	TRANSFER STATION A TRAFFIC
	TRANSFER STATION B TRAFFIC
	COMPOST FACILITY TRAFFIC OPTION 1
	COMPOST FACILITY TRAFFIC OPTION 2
	FUELING/STAGING TRAFFIC
	HARKINS SLOUGH TRAFFIC

TRANSFER STATION A

OPTION 1
ORGANICS MANAGEMENT
LOCATION

BUENA VISTA LANDFILL

TRANSFER STATION B

OPTION 2 NEW
COMPOST FACILITY

N

0 150 300 450
SCALE IN FEET

60% SET

NO.	REVISION	DATE

SHEET TITLE
OVERALL TRAFFIC PLAN

PROJECT TITLE
BUENA VISTA REDEVELOPMENT PROJECT
SANTA CRUZ COUNTY

CLIENT
SANTA CRUZ COUNTY
DEPARTMENT OF PUBLIC WORKS
701 OCEAN STREET
SANTA CRUZ, CA 95060

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SRS	KEA	KEA

CADD FILE:

DATE:
AUGUST 2025

SCALE:
AS SHOWN

DRAWING NO.
C400 of X

60% SET

TRAFFIC FLOW LEGEND

- TRANSFER TRAILER TRAFFIC
- DROP OFF TRAFFIC
- HARKINS SLOUGH 2-WAY TRAFFIC
- COMPOST FACILITY TRAFFIC OPTION 1

HARKINS SLOUGH NORMAL TRAFFIC (2-WAY)

PROPOSED HARKINS SLOUGH RE-ALIGNMENT

HARKINS SLOUGH ROAD (TO BE REALIGNED)

RESIDENTIAL DROP OFF TRAFFIC

COAST LIVE OAK (TO BE REMOVED)

PROPOSED TRANSFER STATION A

EXISTING TREES (TO BE REMOVED)

PROPERTY LINE

OPTION 1 ORGANICS FACILITY TRAFFIC

PROPOSED ORGANICS MANAGEMENT OPTION 1

TRANSFER TRAILER TRAFFIC

CURRENT VIEWPORT LOCATION

BUENA VISTA LANDFILL

KEY MAP INSET
SCALE: 1" = 1000'

N

0 30 60 90
SCALE IN FEET

NO.	REVISION	DATE

SHEET TITLE: TRAFFIC PLAN I

PROJECT TITLE: BUENA VISTA REDEVELOPMENT PROJECT
SANTA CRUZ COUNTY

CLIENT
SANTA CRUZ COUNTY
DEPARTMENT OF PUBLIC WORKS
701 OCEAN STREET
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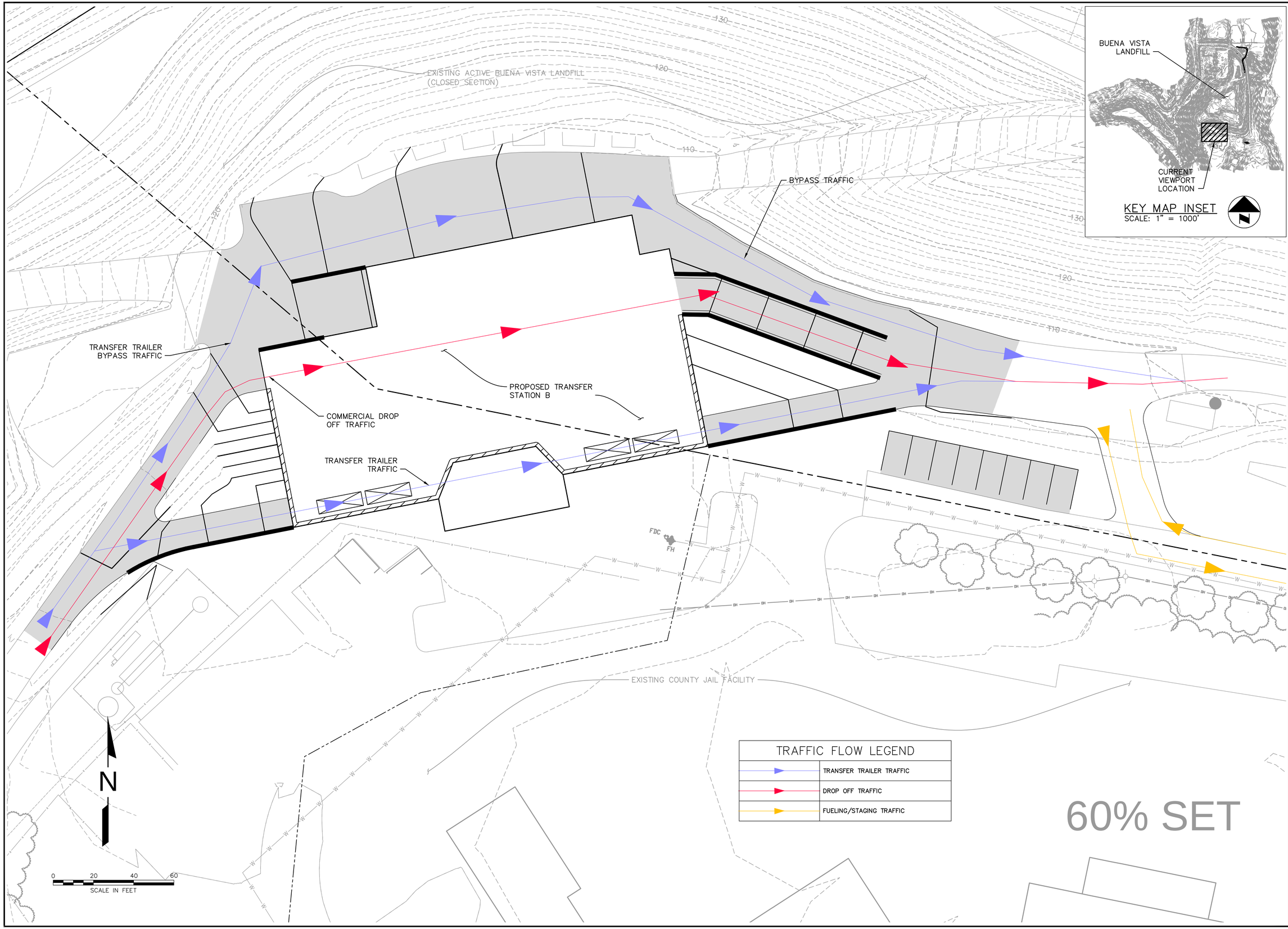
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DSN. BY: SRS
DWN. BY: SRS
CHK. BY: KEA
Q/A PWP BY:
APP. BY: KEA

CADD FILE:

DATE: AUGUST 2025

SCALE: AS SHOWN

DRAWING NO.
C401 of X



NO. | REVISION | DATE

SHEET TITLE: TRAFFIC PLAN II

PROJECT TITLE: BUENA VISTA REDEVELOPMENT PROJECT
SANTA CRUZ COUNTY

CLIENT
SANTA CRUZ COUNTY
DEPARTMENT OF PUBLIC WORKS
701 OCEAN STREET
SANTA CRUZ, CA 95060

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APP. BY: KEA

CADD FILE:

DATE: AUGUST 2025

SCALE: AS SHOWN

DRAWING NO.
C402 of X

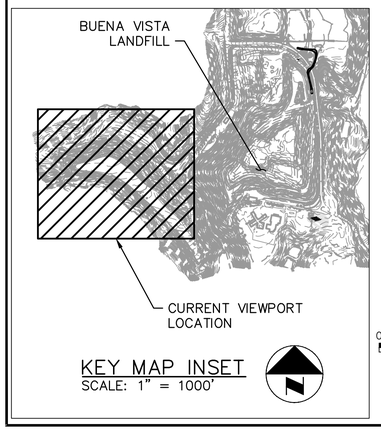
EXISTING SITE ENTRANCE

ALTERNATE COMPOST DROP OFF ENTRANCE AND EXIT

COMPOST DROP OFF TRAFFIC OPTION 1

OPTION 2 NEW COMPOST FACILITY

TRAFFIC FLOW LEGEND	
	COMPOST DROP OFF TRAFFIC
	ALTERNATE DROP OFF TRAFFIC



KEY MAP INSET
SCALE: 1" = 1000'

N

0 80 160 240
SCALE IN FEET

60% SET

NO.	REVISION	DATE

SHEET TITLE: TRAFFIC PLAN III

PROJECT TITLE: BUENA VISTA REDEVELOPMENT PROJECT SANTA CRUZ COUNTY

CLIENT:
SANTA CRUZ COUNTY
DEPARTMENT OF PUBLIC WORKS
701 OCEAN STREET
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CADD FILE:

DATE: AUGUST 2025

SCALE: AS SHOWN

DRAWING NO.
C403 of X

60% SET

EXISTING ACTIVE BUENA VISTA LANDFILL
(CLOSED SECTION)

EXISTING COUNTY JAIL FACILITY

LANDFILL PERIMETER ROAD

TOURTREE LANE

SOUTH HARRIS

130

120

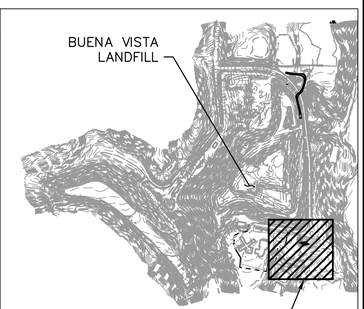
110

N

0 40 80 120
SCALE IN FEET

TRAFFIC FLOW LEGEND

FUELING/STAGING TRAFFIC



KEY MAP INSET
SCALE: 1" = 1000'

NO.	REVISION	DATE

SHEET TITLE: TRAFFIC PLAN IV

PROJECT TITLE: BUENA VISTA REDEVELOPMENT PROJECT
SANTA CRUZ COUNTY

CLIENT
SANTA CRUZ COUNTY
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SCALE: AS SHOWN

DRAWING NO.
C404 of X

60% SET

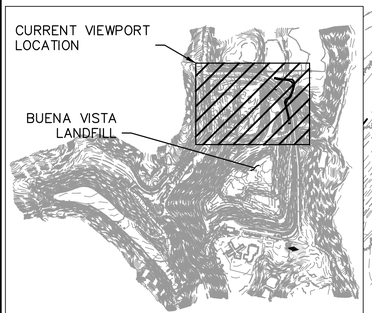
N

0 60 120 180
SCALE IN FEET

HARKINS SLOUGH ROAD

TRAFFIC FLOW LEGEND

	TRANSFER TRAILER TRAFFIC
	DROP OFF TRAFFIC
	HARKINS SLOUGH 2-WAY TRAFFIC
	COMPOST FACILITY TRAFFIC OPTION 1



KEY MAP INSET
SCALE: 1" = 1000'

NO.	REVISION	DATE

SHEET TITLE: TRAFFIC PLAN V

PROJECT TITLE: BUENA VISTA REDEVELOPMENT PROJECT
SANTA CRUZ COUNTY

CLIENT
SANTA CRUZ COUNTY
DEPARTMENT OF PUBLIC WORKS
701 OCEAN STREET
SANTA CRUZ, CA 95060

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DWN. BY: SRS
CHK. BY: KEA
QA RVW BY:
APP. BY: KEA

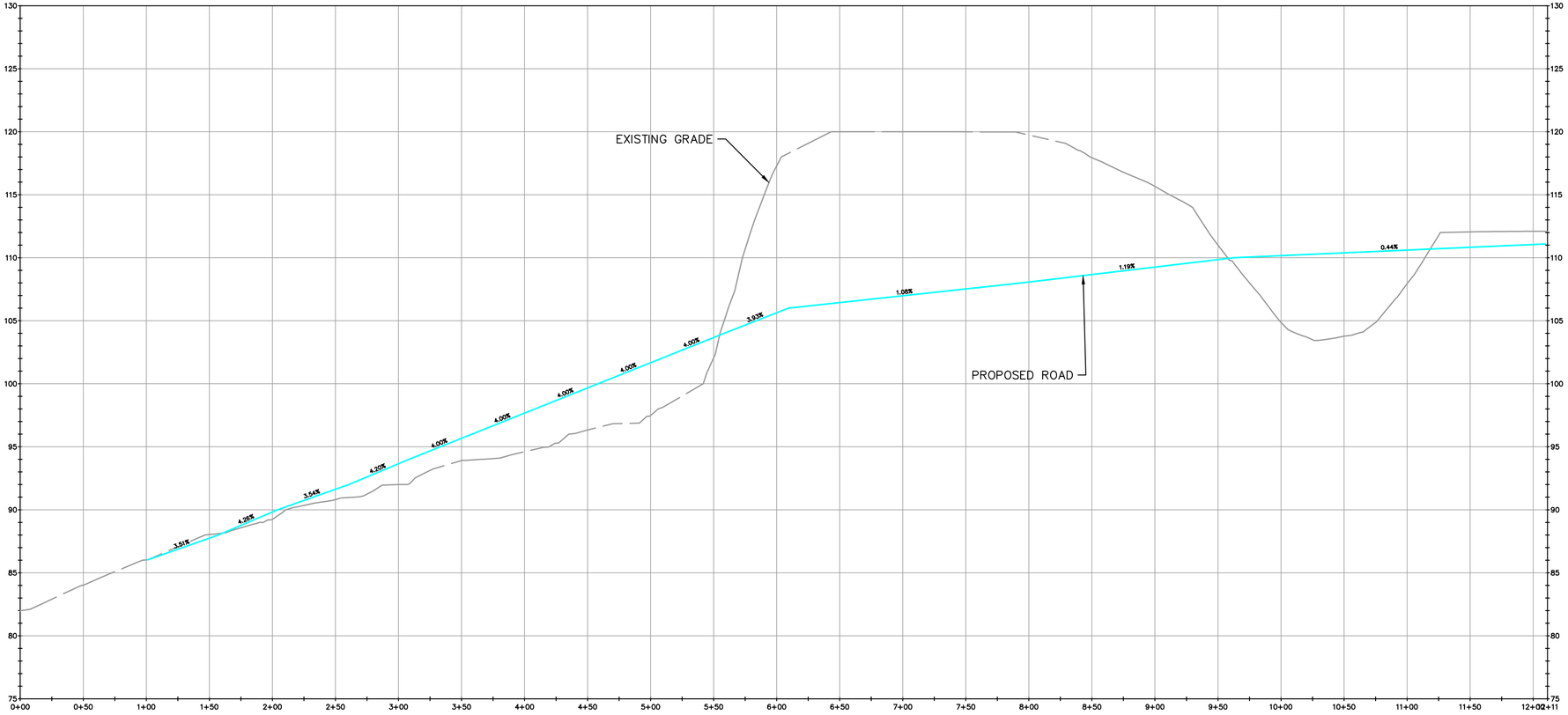
CADD FILE:

DATE: AUGUST 2025

SCALE: AS SHOWN

DRAWING NO.
C405 of X

60% SET



HS V2 PROFILE

VERTICAL SCALE

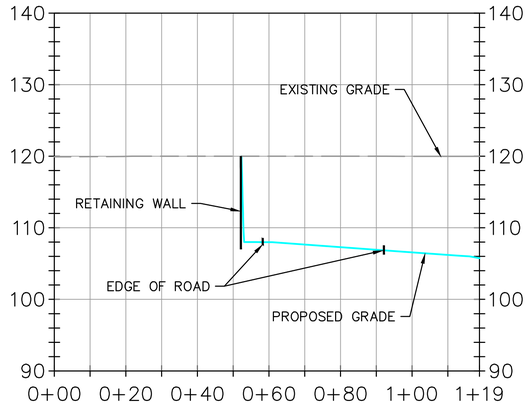
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SCALE IN FEET

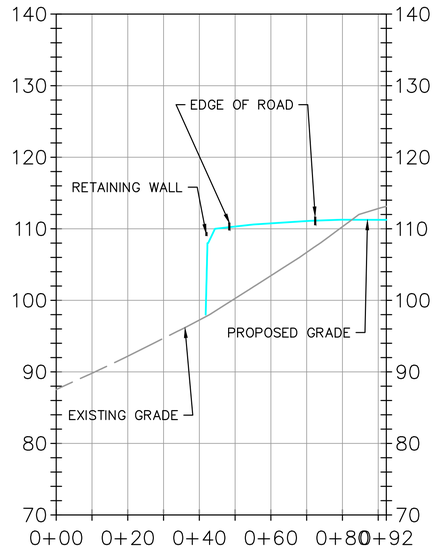
HORIZONTAL SCALE

0 50 100 150

SCALE IN FEET



NE TSA PROFILE



SE TSA PROFILE

NO.	REVISION	DATE

SHEET TITLE
HARKINGS SLOUGH PROFILE

PROJECT TITLE
BUENA VISTA REDEVELOPMENT PROJECT
SANTA CRUZ COUNTY

CLIENT
SANTA CRUZ COUNTY
DEPARTMENT OF PUBLIC WORKS
701 OCEAN STREET
SANTA CRUZ, CA 95060

SCS ENGINEERS
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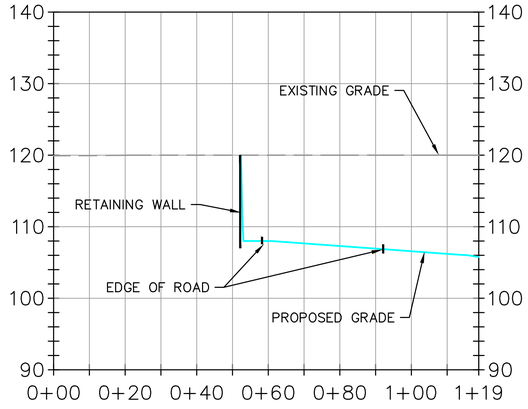
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DRN. BY: SRS
CHK. BY: KEA
Q/A MGR BY: KEA
APP. BY: KEA

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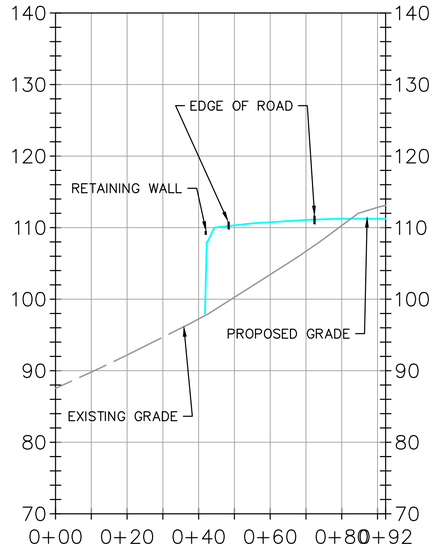
DATE:
AUGUST 2025

SCALE:
AS SHOWN

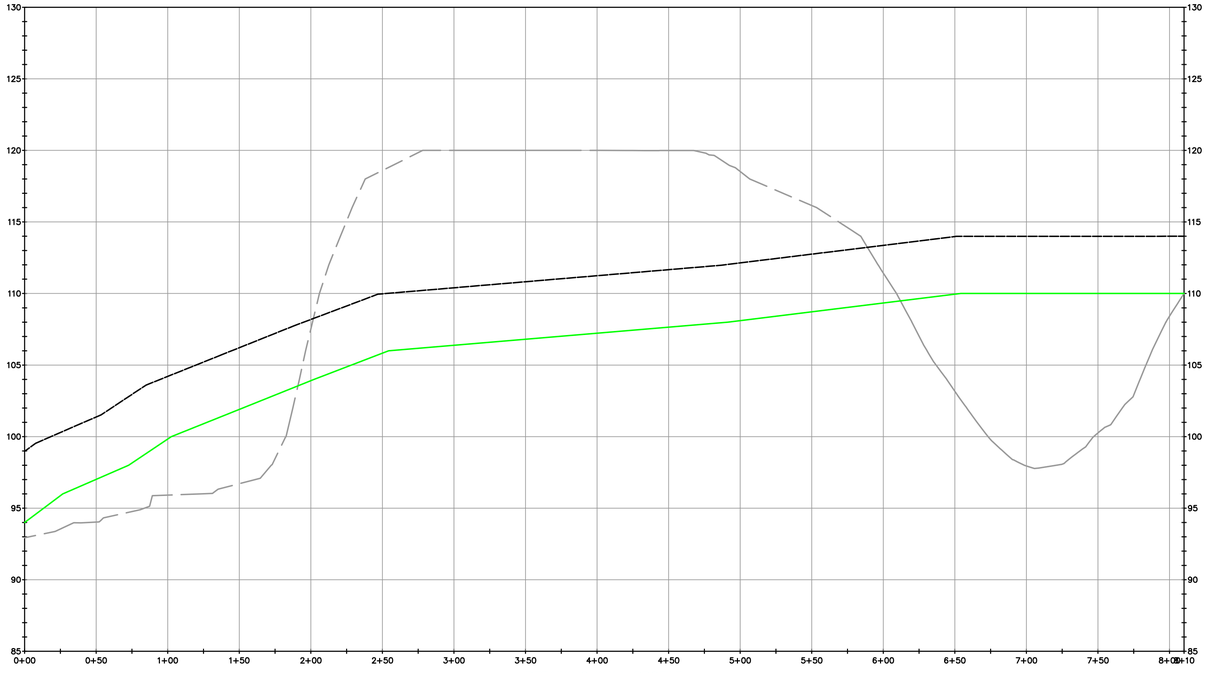
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NE TSA PROFILE



SE TSA PROFILE



RETAINING WALL PROFILE

60% SET

NO.	
REVISION	
DATE	

SHEET TITLE: HARKINGS SLOUGH PROFILE II

PROJECT TITLE: BUENA VISTA REDEVELOPMENT PROJECT
SANTA CRUZ COUNTY

CLIENT
SANTA CRUZ COUNTY
DEPARTMENT OF PUBLIC WORKS
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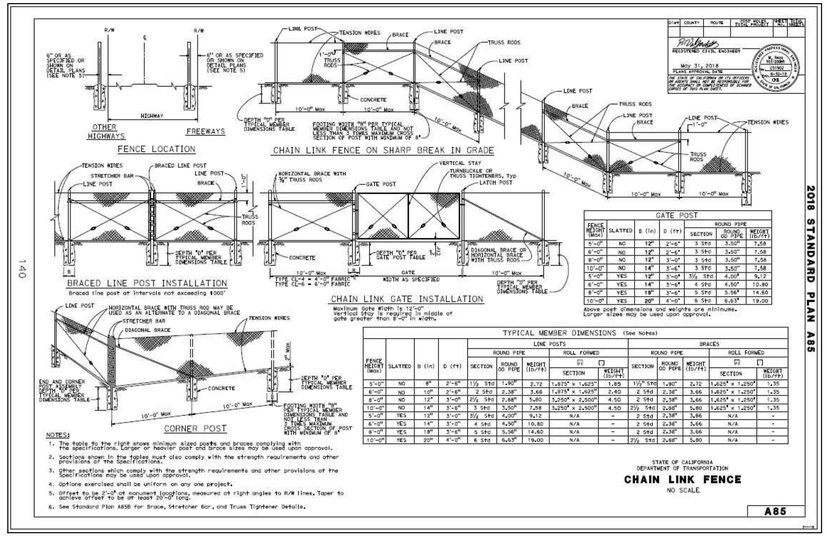
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DSN. BY: SRS
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CHK. BY: KEA
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APP. BY: KEA

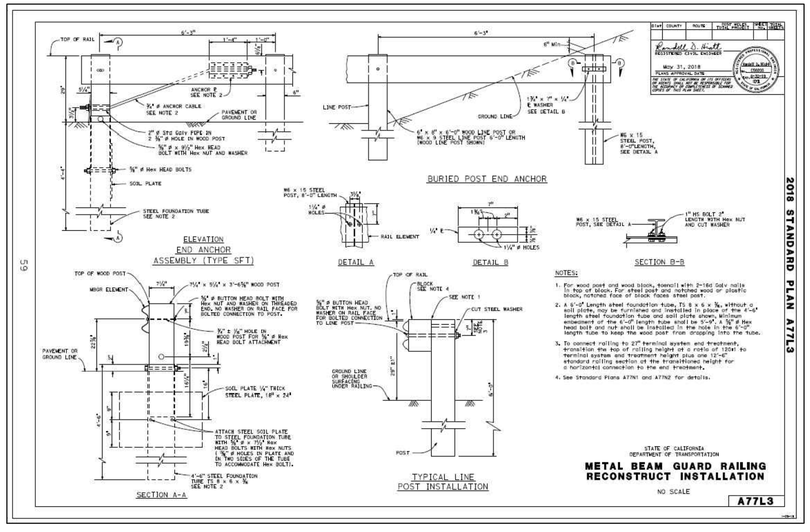
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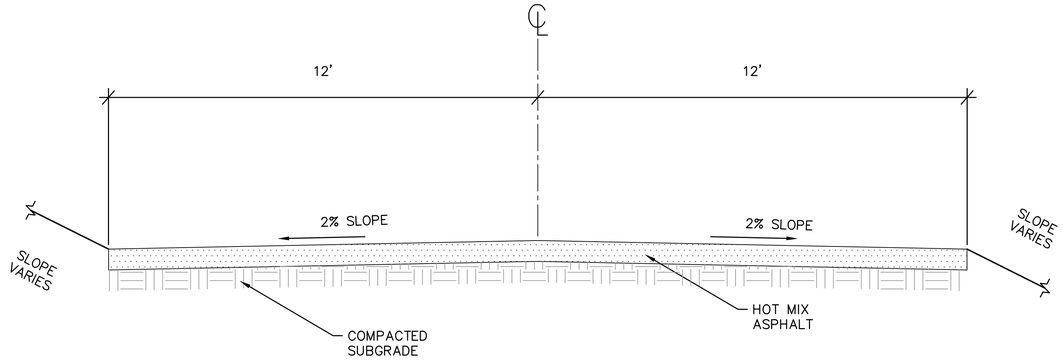
DATE: AUGUST 2025

SCALE: AS SHOWN

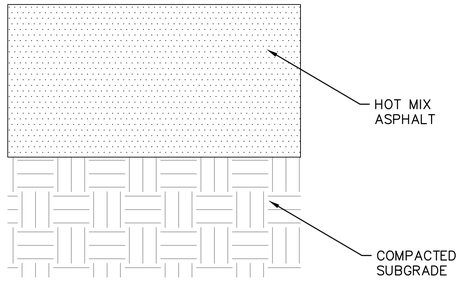
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HARKINS SLOUGH TYPICAL SECTION
SCALE = NOT TO SCALE



ASPHALT PAVING SECTIION
SCALE = NOT TO SCALE

60% SET

NO.	REVISION	DATE

SHEET TITLE: ROAD DETAILS

PROJECT TITLE: BUENA VISTA REDEVELOPMENT PROJECT, SANTA CRUZ COUNTY

CLIENT: SANTA CRUZ COUNTY, DEPARTMENT OF PUBLIC WORKS, 701 OCEAN STREET, SANTA CRUZ, CA 95060

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PROJ. NO: 02221033.00
DSN. BY: SRS
DWN. BY: SRS
CHK. BY: KEA
QA RVW BY: KEA
APP. BY: KEA

CADD FILE:

DATE: AUGUST 2025

SCALE: AS SHOWN

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C501 of X

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Appendix B. Agriculture Viability Study for Proposed Project

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Dale W. Rush, Ph.D.
Gary W. Osteen, CPAg
Albert Stoddard, III PhD
Steven L. Morrison, PhD

RUSH and ASSOCIATES

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January 19, 2021 File No. 202098.07

Nicole Steel
Project Manager, Capital Projects
County of Santa Cruz • Department of Public Works
701 Ocean Street, Room 410 • Santa Cruz, CA 95060

Re: Review of the agricultural potential of land within APN 052-021-33, currently identified as the Buena Vista Landfill, Watsonville CA.

At the request of Ms. Steel, and in accordance of requirements of the Santa Cruz County administrative codes, an agriculture-based evaluation of the condition, and status of the eastern portion of land within APN 052-021-33 was undertaken. The subject eastern portion area is apparently designated as "Commercial Agriculture (CA)" although the subject parcel is within land owned by the county and used for decades as a regional landfill, aka Buena Vista Landfill, generally located between Buena Vista Drive, and Harkins Slough Road (1231 Buena Vista Drive), west of the city of Watsonville, CA (Exhibit 1). The subject CA zoned parcel is approaching capacity as a landfill, and could not now be used for commercial agriculture regardless of zoning status (see below). This report will review the soils, historic topography, current status, and appropriateness of the subject APN, including the landfill portion zoned CA and remaining northeast corner of the parcel, in general and specifically, for "Commercial Agriculture" use. According to information provided by Department of Public Works personnel, the Buena Vista landfill occupies approximately 69 acres as described above, of which approximately 35 acres within the eastern portion are currently zoned CA (Exhibit 2).

Qualifications
I am an agricultural consultant and have resided in Monterey County since 1994. As a part of my normal work, I evaluate agriculture-related issues including losses or damage to crops, land and/or related property. In addition, I have evaluated properties in the region including Santa Cruz, Monterey and San Benito Counties with respect to agricultural land suitability studies and comparative land uses, where agricultural, commercial, residential and other alternate uses were considered under requests to local planning commissions, departments and review boards, and submitted analyses on behalf of my clients. I also provide expert witness services in hearings and litigation. I have a Bachelor's degree in Environmental Biology, a Master's degree in Soil Science, a Doctorate degree in Soil Science, from the University of California, and more than 40 years of international, national, regional, and local professional, applicable field expertise. I am a nationally and regionally Certified Professional Agronomist, Soil Scientist and Crop Advisor (CPAg/SSc, CCA, ARCPACS #04904), and California licensed pest control advisor, and qualified applicator.

Background
The issue as reported, pertains to the eventual proposed use as a transfer station of a 2.6-acre area that lies within the northeast corner of a larger parcel, of which approximately 35 acres was originally designated as CA. Regardless of designated CA status, the county has used and is using approximately 69 acres that includes the eastern 35-acre portion, as a primary regional landfill. Review of Google Earth imagery back to 1993 revealed there has been no conventional commercial agricultural activities within the designated parcel, nor have there been conventional farming activities on adjacent and contiguous otherwise open, variably undulating woodlands. There have been various agricultural activities within the general vicinity, on variably level land, mostly toward the north and west. Immediately north of the northeast corner of the parcel there are approximately five acres of greenhouses on level land that have been in place since at least 1993, which have reportedly been used probably sporadically, for typical production to include various agricultural and horticultural species.

Limited review of historical use of the subject parcel revealed that while it was not farmed, the northeastern corner was in nearly continuous use as a storage area for equipment, stockpiles of various materials and waste containers (Exhibit 3). While the total area of the northeast corner is approximately 2.6 acres, only a portion could be used for essentially any purpose due to the lay of the land which amounts to two (more or less) leveled areas (0.56 and 1.42 acres) bifurcated in the middle by a 0.61-acre steep slope area, that could not be used for any purpose such as storage or agriculture due to the slope of the land (Exhibit 4). The variable topography of the northeast corner is similar to the "before condition" of at least the eastern portion of the landfill, based upon review of the USDA NRCS Soil survey for the 35-acre CA designated portion of the landfill (see below). Therefore, the now and historically potentially usable area of the remaining open northeast corner is less than two acres in two separated blocks. The potentially historically useable area is further reduced by approximately half an acre occupied by various sizes of coast live oak (Quercus agrifolia) trees (Exhibit 5).

Soils and Farmability (APN northeast corner)

Observations and review of historical imagery revealed there has been no conventional farming, based in part upon the lack of evidence of cultivation, crops, or residues on the subject parcel, or adjacent and contiguous lands. Part of the reason is that much of the subject and surrounding land is/was made up of variably steep, wooded slopes that cannot be used for agricultural purposes. Further, the area does not qualify as prime rangelands due to relative lack of open grasslands that define prime rangeland, as well as parcel size, location, topography, vegetation, and surrounding land uses including riparian estuary habitat. The use as grazing land would be highly restricted or de-facto prohibited due to the immediate border with a designated national wildlife refuge and riparian estuary (Exhibit 6).

However, perhaps the best evidence for the lack of farming history for the northeast corner of the parcel and surrounding lands is revealed within the USDA NRCS Soils Report (Exhibit 7). This report includes land to the east down to the riparian estuary and south parallel to the southern border of the landfill, as well as the northeast corner which is part of the focus of this evaluation.

The report revealed there were three soil series identified within the corner area of the subject APN:
Tierra-Watsonville Complex 15 to 30 percent slopes (174), land capability Class 4e, Grade 4 – poor.
Tierra-Watsonville Complex 30 to 50 percent slopes (175), land capability Class 6e, Grade 4 – poor.
Watsonville loam, 2 to 15 percent slopes (177), land capability Class 3e, Grade 5 – very poor.

None of the soils within the northeast corner area are classified or considered either prime farmland or soils of importance to the state. The combination of variably poor soil qualities, high erosion potential, and a claypan subsurface that limits vertical drainage, and promotes horizonal subsurface drainage toward the riparian estuary, are significant negative issues, and also explain and confirm the non-farmability of the northeast corner of the parcel. There is no agricultural source of water, such as a well or surface conveyance located within the non-landfill portion of the parcel.

Soils and Farmability (eastern 35-acre portion of the landfill)

Review of the USDA NRCS Soils Report for the 35-acre eastern portion of the landfill revealed a mix of native soils and conditions prior to the loading from the landfill to be variable from Class 2e or 3e (irrigated/non irrigated) to Class 8 (pits-dump Complex) (Exhibit 8). Prior to utilization as a landfill, the southern portion (approximately half) was Elkhorn sandy loam 2 to 9 percent slopes (133), land capability either Class 2e or 3e, would have been considered prime farmland of the state based solely upon the Soil Survey information.

The remainder is comprised of various soils to include:
Pits-dumps Complex (164), land capability Class 8e, not otherwise graded regarding land capability
Tierra-Watsonville Complex 15 to 30 percent slopes (174), land capability Class 4e, Grade 4 – poor.
Tierra-Watsonville Complex 30 to 50 percent slopes (175), land capability Class 6e, Grade 4 – poor.
Watsonville loam, 2 to 15 percent slopes (177), land capability Class 3e, Grade 5 – very poor.

There were also very small areas of other low-grade, poor capability soils that are too small for overall consideration as farmable soils. However, the soils report lists the "before" condition, and has essentially no relevance regarding the potential use following loading of very substantial amounts of waste debris.

Regardless of pre-landfill conditions, post-landfill use does not include potential for commercial agriculture for numerous reasons. From a mechanical farming approach, land must be both deep and shallow tilled to be properly prepared for cropping either annual or permanent crops. Such tillage would be prohibited or certainly ill advised. The chemically reduced (anerobic) conditions and decomposing of organic matter create phytotoxic gases and compounds that damage crops and create odor problems. The disturbance and moving to the surface of previously buried refuse by tillage also contaminates surface soils and causes mechanical hazards to crops, equipment, and farm personnel.

Essentially all crops grown within the region require irrigation. Irrigation would cause numerous substantial problems to include erosion, leaching, and vertical and lateral movement of toxic substances, yet leaching is an absolute requirement to manage salt build up and mineral imbalances in the rootzone of essentially any crop. For theses and other reasons, post-landfill use of the subject property for commercial agricultural purposes is not recommended or considered feasible. Seasonal dry land grazing of native vegetation might be feasible, but potential toxicity to grazing animals and erosion-damage potential are serious inhibitions.

Comments
There is no evidence noted that the eastern 35-acre parcel including the northeast corner of the subject property has ever been or might be farmed as either a stand-alone parcel, or as part of the larger landfill APN. There are numerous, very substantial impediments as to whether the remainder of the subject APN could now or in the future be used for commercial agriculture as reported above.

The soils of the northeast corner area in their native state are not farmable due to inherent soil qualities (mostly Class 4 or worse with severe erosion potential) and impeded vertical water penetration potential. At the time of inspection and probably previously, there have been efforts to clear and scrape to provide semi-level areas for equipment and material storage, which removed and displaced surface soils, and exposed even less fertile subsoils, that based upon recent review, are not conducive to the growth of native or seeded grass and broadleaf species (Exhibit 9).

Another significant impediment to essentially any conventional agricultural use is the immediate proximity to both the federal wildlife refuge and the nearby downslope riparian estuary along the eastern border of the subject APN. The contiguous wildlife refuge is problematic for several reasons. First, it is a protected haven for various animals to include rodents (mice, rats, squirrels, gophers, moles, etc.), skunks, racoons, deer, coyotes, etc., all of which damage, destroy or contaminate growing crops, whether out in the open or in growing shelters such as greenhouses. In addition to animals, the refuge is also prime habitat for insects and fungal disease organisms that also damage nearby crops. Although there are very limited (or no allowed) methods to manage invasion, prevention or protection (especially under organic certification), there is an endless potential for intrusion and invasion of various species from the refuge that are known physical and biological hazards to essentially any growing crops.

Alternately, the use of pesticides, either conventional or organically acceptable, is highly regulated and limited near sensitive sites including refuges and riparian areas, where substantial buffer zones are usually required if such materials are allowed at all. Further, essentially all pesticide use includes non-treated buffer zones that would in some instances, severely inhibit adequate pest control over parts of the subject APN to include the whole of the relatively small areas of the upper terrace of the northeast corner.

The proximity to the downslope riparian estuary is also a serious impediment to any agricultural use of the eastern portion of the APN and certainly the upper corner. There are substantial restrictions and prohibitions on the use of pesticides and fertilizers that may migrate to sensitive areas to include both the riparian and refuge areas, which are down slope from the refuse-laden terraces. The claypan subsoils as reported in the USDA NRCS Soils Report would also promote lateral down slope of movement of moisture with contained contaminants and applied pesticides and fertilizers toward both the refuge and estuary.

General Plan Policy 5.13.20 & 5.13.21, and related to 16.50.040 and .050 Types 1-3 Agricultural lands

The Santa Cruz County General Plan addresses the issues of ag land conversions and general agricultural viability. Under 5.13.20, there are three criteria to consider.

(a) Addresses the viability of use for agriculture purposes, and it is opined based on both the above listed disqualifying criteria and substantial professional experience that much of the APN and certainly the corner of the parcel was never viable agricultural land, and existing and planned modifications will further degrade soil conditions for agricultural use.

(b) Addresses any new information that might affect commercial agricultural use, and I refer to the removal and displacement of surface soils to expose subsurface parent material that is not suitable for agricultural use, regardless of non-viability of the native soils after landfill use, and either before or after surface grading.

(c) Addresses the effects of conversion of land regarding conflicts with other commercial agriculture in the area. To the contrary, attempts to use the subject landfill and/or remaining corner of the parcel for agriculture would potentially harm the nearby, adjacent wildlife refuge and estuary, but would have no effect on the adjacent (north) greenhouse property.

Under 5.13.21, there are also three criteria to consider.

(a) Addresses gross revenue from the agricultural products generated prior to conversion of the subject property. Regarding the subject APN parcel, there has been no agricultural production or revenue generation within the past five years, or since owned by the county. The observed and reported use has been refuse accumulation, except within the remaining corner, where storage of refuse containers and raw construction materials such as gravel have occurred, all for internal use by county entities. With respect to revenue generated, the only close entity is the intermittently used greenhouse structures and revenue generated is private and proprietary. There has been no expansion of those facilities since at least 1993, regardless of open land in the immediate vicinity of those structures.

(b) Addresses operational costs and production expenses for previous years for crops grown in the area. Review of aerial imagery revealed that there has been no agricultural production within the immediate area, other than intermittent operation of the greenhouse facilities to the north of the APN. Such operational expenses are proprietary and not disclosed or available. What is notable is that there is substantial open land in the immediate vicinity of the greenhouses that has not been farmed or used to install additional greenhouse structures, suggesting there is no demand for additional growing facilities within the region.

(c) Addresses the geographic area in the vicinity of the subject APN. The land to the east is wooded, steep sloped, brushy wildlands within the national wildlife refuge and riparian estuary, and has no agricultural value. The areas to the west and south are either landfill or building facilities to support other county

agencies and also have no agricultural value. The lands to the north are either occupied by a greenhouse facility, or otherwise idle with no observable history of farming activity. Further north and northwest, there is farmland of mixed use planted to various crops. However, those farmed areas are generally level, larger, open tracks of farmable soils, away from the wildlife refuge and riparian estuary, are not comparable, and cannot be compared agriculturally with the subject APN.

There appears to be substantial overlap of the above code sections regarding the various criteria and issues addressing preservation and use of various agriculture land designations as referenced above within both sections. Regardless of current code sections, the current and future condition and (lack of) commercial agricultural potential uses of the landfill site and perimeter areas has been determined by prior use and proximity.

There is also a question regarding the criteria for prime rangeland. In my professional experience, prime rangeland is mostly oak savanna, consisting of substantial contiguous acreage of relatively open, hilly grasslands with enough annual rainfall to sustain the growth of annual and perennial forage species, occasional pockets of drought-tolerant broadleafs and trees, but not enough moisture to support forests. The criteria also include accessible topography, and (relatively large) parcel size to allow economical use as grazing land. The subject APN does not appear to meet traditional assessments for prime rangeland either in the pre- or post-landfill use conditions, and is not considered prime rangeland.

Summary

The subject APN including the corner of the parcel, was never wholly appropriate for use as designated "Commercial Agriculture". The poor and highly variable soil quality, native vegetation, and topography were not and are not suitable for farming, including the remaining small area that could be manipulated to create semi level land, which is only suitable for equipment or properly engineered structures. It is opined that regardless of the historic designation of the subject APN as "Commercial Agriculture", much of the subject land was never suitable for commercial agriculture prior to use as a landfill, and certainly is not now suitable for such use. Inclusion of the northeast corner and along the estuary was initially inappropriate, since those areas were never viable agricultural land.

Dale W Rush

Dale W. Rush, PhD, CPAg/SSc, PCA, CCA, QAL

EXHIBIT 1


Buena Vista Landfill
Legend
Freedom
Freedom Blvd
Green Valley Rd
Holohan Rd
Airport Blvd
S Green Valley Rd
E Lake Ave
Lake View Rd
Buena Vista Dr
Buena Vista Landfill
Ohlone Pkwy
152
Watsonville
W Beach St
Cabrillo Hwy
W Riverside Dr
Pajaro
G12
G11
1
129
San Andreas Rd
Salinas Rd
Google Earth
Data CSUMB SFML, CA OPC
© 2020 Google
N
2 mi

Scope for Agricultural Viability Study for the Buena Vista Landfill Site (APN 052-021-33)

Current and proposed use of site

The Buena Vista Landfill (APN 052-021-33), located at the intersection of Harkins Slough Road and Buena Vista Drive in Santa Cruz, has been in operation at this site for several decades. The eastern half of the landfill parcel is zoned Commercial Agriculture (CA).



The landfill is expected to reach capacity in the next 8-10 years. The County is proposing to transition the site to a transfer station, will allow for small commercial haulers and the community within the County to continue bringing recyclable materials and solid waste to a County site. The solid waste would be loaded into transfer trucks and transported to the Monterey Peninsula Landfill in Marina or another location. The area in the north east portion of the parcel, on Commercial Agricultural land, offers the best opportunity to accommodate the size and layout of an efficient transfer station. This portion of the site has been used by landfill for storage of roll off boxes, etc.

The County is proposing to hydroseed the remainder of the parcel after the landfill use ceases, but does not anticipate that it would be feasible to use the remainder of the site for agriculture. The County is considering rezoning the entire site to Public Facility (PF) to support the transfer station use, considering the public health and safety need for a transfer station to accommodate waste disposal needs, and considering the history of the site for use as a transfer station.

12/1/2020

EXHIBIT 3


Buena Vista Landfill, 2018
Legend
Harkins Slough Rd
Google Earth
N
200 ft


Buena Vista Landfill, 2009
Legend
Harkins Slough Rd
Google Earth
N
200 ft


Buena Vista Landfill, 2003
Legend
Harkins Slough Rd
Google Earth
Image © 2020 Maxar Technologies
N
200 ft

EXHIBIT 4


Transfer Station use area, 2.6 acres
Legend
0.56 acres
Harkins Slough Rd
0.61 acres of steep slopes
1.42 acres
Google Earth
N
300 ft









EXHIBIT 5


Transfer Station use area, 2.6 acres
Legend
Polygon Measure
Harkins Slough Rd
Google Earth
N

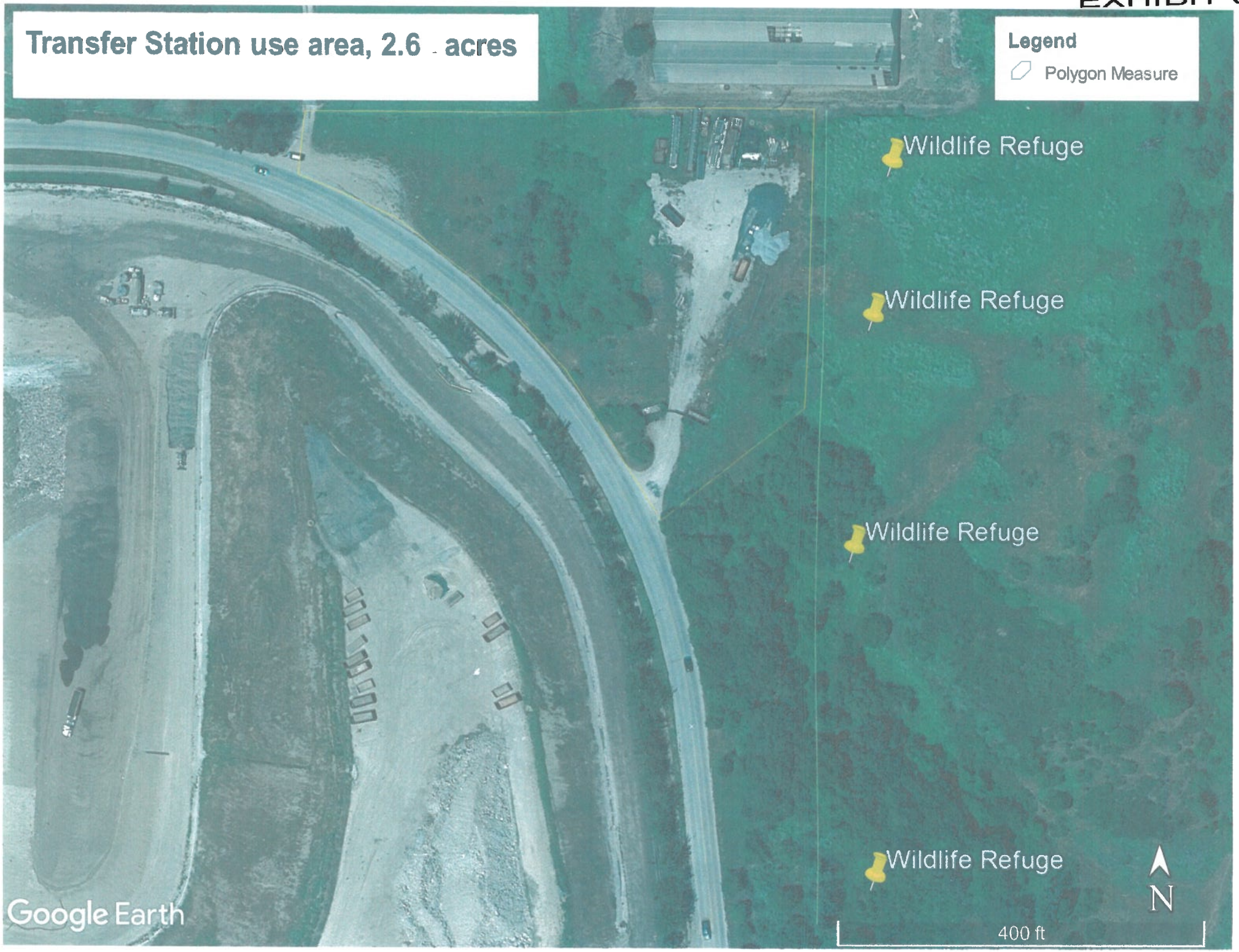








EXHIBIT 6


Transfer Station use area, 2.6 - acres
Legend
Polygon Measure
Wildlife Refuge
Wildlife Refuge
Wildlife Refuge
Wildlife Refuge
Google Earth
N
400 ft


NATIONAL
WILDLIFE
REFUGE
UNAUTHORIZED ENTRY
PROHIBITED
U.S. DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
¡PROHIBIDA
LA ENTRADA!
Zona Biologicamente
Delicada
Obtenga Permiso
de Entrada















EXHIBIT 7

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Santa Cruz County, California



January 4, 2021

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

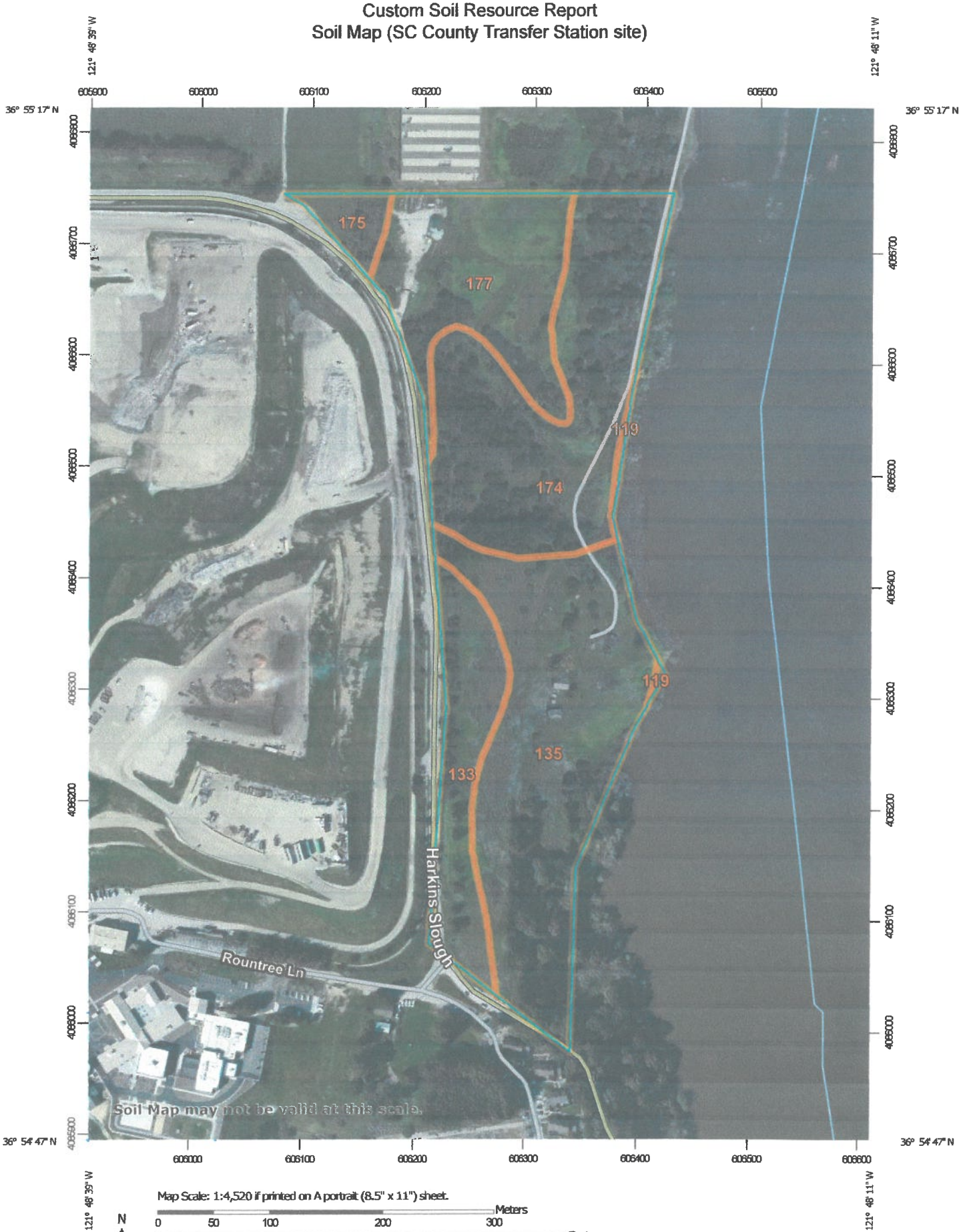
Soil Survey Area: Santa Cruz County, California
Survey Area Data: Version 14, May 29, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 16, 2019—Apr 7, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Custom Soil Resource Report
Soil Map (SC County Transfer Station site)



Map Scale: 1:4,520 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

Map Unit Legend (SC County Transfer Station site)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
119	Clear Lake clay, drained, 0 to 1 percent slopes, MLRA 14	0.1	0.4%
133	Elkhorn sandy loam, 2 to 9 percent slopes	3.9	11.8%
135	Elkhorn sandy loam, 15 to 30 percent slopes	11.7	35.5%
174	Tierra-Watsonville complex, 15 to 30 percent slopes	10.1	30.7%
175	Tierra-Watsonville complex, 30 to 50 percent slopes	0.9	2.6%
177	Watsonville loam, 2 to 15 percent slopes	6.2	18.9%
Totals for Area of Interest		32.9	100.0%

Map Unit Descriptions (SC County Transfer Station site)

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a

given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Santa Cruz County, California

119—Clear Lake clay, drained, 0 to 1 percent slopes, MLRA 14

Map Unit Setting

National map unit symbol: 2vbtb
Elevation: 0 to 250 feet
Mean annual precipitation: 19 to 29 inches
Mean annual air temperature: 55 to 58 degrees F
Frost-free period: 245 to 275 days
Farmland classification: Prime farmland if irrigated and drained

Map Unit Composition

Clear lake, drained, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Clear Lake, Drained

Setting

Landform: Basin floors
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Basin alluvium derived from igneous, metamorphic and sedimentary rock

Typical profile

Apg - 0 to 7 inches: clay
Bssg1 - 7 to 21 inches: clay
Bssg2 - 21 to 35 inches: clay
Bssg3 - 35 to 44 inches: clay
Bssg4 - 44 to 62 inches: clay

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 36 to 72 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Calcium carbonate, maximum content: 2 percent
Maximum salinity: Nonsaline to very slightly saline (0.5 to 3.0 mmhos/cm)
Sodium adsorption ratio, maximum: 7.0
Available water capacity: Moderate (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: D
Hydric soil rating: Yes

Minor Components

Conejo, loam

Percent of map unit: 8 percent
Hydric soil rating: No

Unnamed

Percent of map unit: 7 percent
Landform: Basin floors
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

133—Elkhorn sandy loam, 2 to 9 percent slopes

Map Unit Setting

National map unit symbol: h9dr
Elevation: 50 to 5,000 feet
Mean annual precipitation: 14 to 22 inches
Mean annual air temperature: 57 degrees F
Frost-free period: 245 to 275 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Elkhorn and similar soils: 85 percent
Minor components: 11 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Elkhorn

Setting

Landform: Alluvial fans, terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Marine deposits

Typical profile

H1 - 0 to 21 inches: sandy loam
H2 - 21 to 61 inches: sandy clay loam, clay loam
H2 - 21 to 61 inches:

Properties and qualities

Slope: 2 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very high (about 15.8 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: R014XD034CA - FINE LOAMY
Hydric soil rating: No

Minor Components

Elder, sandy loam

Percent of map unit: 5 percent
Hydric soil rating: No

Baywood, loamy sand

Percent of map unit: 2 percent
Hydric soil rating: No

Elkhorn

Percent of map unit: 1 percent
Hydric soil rating: No

Pinto, loam

Percent of map unit: 1 percent
Hydric soil rating: No

Soquel, loam

Percent of map unit: 1 percent
Hydric soil rating: No

Watsonville

Percent of map unit: 1 percent
Landform: Marine terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Hydric soil rating: Yes

135—Elkhorn sandy loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: h9dt
Elevation: 50 to 5,000 feet
Mean annual precipitation: 14 to 22 inches
Mean annual air temperature: 57 degrees F
Frost-free period: 245 to 275 days
Farmland classification: Not prime farmland

Map Unit Composition

Elkhorn and similar soils: 85 percent
Minor components: 12 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Elkhorn

Setting

Landform: Alluvial fans, terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Marine deposits

Typical profile

H1 - 0 to 21 inches: sandy loam
H2 - 21 to 61 inches: sandy clay loam, clay loam
H2 - 21 to 61 inches:

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very high (about 15.8 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Baywood, loamy sand

Percent of map unit: 5 percent
Hydric soil rating: No

Tierra, sandy loam

Percent of map unit: 4 percent
Hydric soil rating: No

Pfeiffer, sandy loam

Percent of map unit: 2 percent
Hydric soil rating: No

Watsonville

Percent of map unit: 1 percent
Landform: Marine terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread

Hydric soil rating: Yes

174—Tierra-Watsonville complex, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: h9g2
Elevation: 20 to 1,200 feet
Mean annual precipitation: 14 to 28 inches
Mean annual air temperature: 57 to 59 degrees F
Frost-free period: 245 to 275 days
Farmland classification: Not prime farmland

Map Unit Composition

Tierra and similar soils: 55 percent
Watsonville and similar soils: 30 percent
Minor components: 12 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tierra

Setting

Landform: Marine terraces, fan terraces
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile

H1 - 0 to 14 inches: sandy loam
H2 - 14 to 66 inches: clay, clay loam, sandy clay
H2 - 14 to 66 inches:
H2 - 14 to 66 inches:

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 1.6 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Ecological site: R015XD115CA - CLAYPAN
Hydric soil rating: No

Description of Watsonville

Setting

Landform: Marine terraces, fan terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile

H1 - 0 to 18 inches: loam
H2 - 18 to 39 inches: clay, clay loam
H2 - 18 to 39 inches: sandy clay loam, clay loam
H3 - 39 to 63 inches:
H3 - 39 to 63 inches:

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Ecological site: R014XD089CA - CLAYPAN
Hydric soil rating: Yes

Minor Components

Elkhorn, sandy loam

Percent of map unit: 5 percent
Hydric soil rating: No

Pfeiffer, gravelly sandy loam

Percent of map unit: 4 percent
Hydric soil rating: No

Los osos, loam

Percent of map unit: 2 percent
Hydric soil rating: No

Tierra

Percent of map unit: 1 percent
Hydric soil rating: No

175—Tierra-Watsonville complex, 30 to 50 percent slopes

Map Unit Setting

National map unit symbol: h9g3
Elevation: 20 to 1,200 feet
Mean annual precipitation: 14 to 28 inches
Mean annual air temperature: 57 to 59 degrees F
Frost-free period: 245 to 275 days
Farmland classification: Not prime farmland

Map Unit Composition

Tierra and similar soils: 50 percent
Watsonville and similar soils: 30 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tierra

Setting

Landform: Fan terraces, marine terraces
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile

H1 - 0 to 14 inches: sandy loam
H2 - 14 to 66 inches: clay, clay loam, sandy clay
H2 - 14 to 66 inches:
H2 - 14 to 66 inches:

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 1.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R015XD115CA - CLAYPAN
Hydric soil rating: No

Description of Watsonville

Setting

Landform: Fan terraces, marine terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile

H1 - 0 to 18 inches: loam
H2 - 18 to 39 inches: clay, clay loam
H2 - 18 to 39 inches: sandy clay loam, clay loam
H3 - 39 to 63 inches:
H3 - 39 to 63 inches:

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R014XD089CA - CLAYPAN
Hydric soil rating: Yes

Minor Components

Elkhorn, sandy loam

Percent of map unit: 5 percent
Hydric soil rating: No

Los osos, loam

Percent of map unit: 4 percent
Hydric soil rating: No

Diablo, clay

Percent of map unit: 2 percent
Hydric soil rating: No

Baywood

Percent of map unit: 2 percent
Hydric soil rating: No

Pfeiffer, gravelly sandy loam

Percent of map unit: 1 percent
Hydric soil rating: No

Tierra

Percent of map unit: 1 percent
Hydric soil rating: No

177—Watsonville loam, 2 to 15 percent slopes

Map Unit Setting

National map unit symbol: h9g5
Elevation: 20 to 1,200 feet
Mean annual precipitation: 28 inches
Mean annual air temperature: 57 degrees F
Frost-free period: 245 to 275 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Watsonville and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Watsonville

Setting

Landform: Marine terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 18 inches: loam
H2 - 18 to 39 inches: clay, clay loam
H2 - 18 to 39 inches: sandy clay loam, clay loam
H3 - 39 to 63 inches:
H3 - 39 to 63 inches:

Properties and qualities

Slope: 2 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Ecological site: R014XD089CA - CLAYPAN
Hydric soil rating: Yes

Minor Components

Elkhorn, sandy loam

Percent of map unit: 5 percent
Hydric soil rating: No

Pinto, loam

Percent of map unit: 4 percent
Hydric soil rating: No

Watsonville, thick surface

Percent of map unit: 3 percent
Landform: Marine terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Hydric soil rating: Yes

Danville

Percent of map unit: 1 percent
Hydric soil rating: No

Elder

Percent of map unit: 1 percent
Hydric soil rating: No

Cropley, silty clay

Percent of map unit: 1 percent
Hydric soil rating: No

Soil Information for All Uses

Suitabilities and Limitations for Use

The Suitabilities and Limitations for Use section includes various soil interpretations displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each interpretation.

Land Classifications

Land Classifications are specified land use and management groupings that are assigned to soil areas because combinations of soil have similar behavior for specified practices. Most are based on soil properties and other factors that directly influence the specific use of the soil. Example classifications include ecological site classification, farmland classification, irrigated and nonirrigated land capability classification, and hydric rating.

California Revised Storie Index (CA) (SC County Transfer Station site)

The Revised Storie Index is a rating system based on soil properties that govern the potential for soil map unit components to be used for irrigated agriculture in California.

The Revised Storie Index assesses the productivity of a soil from the following four characteristics:

- Factor A: degree of soil profile development

- Factor B: texture of the surface layer

- Factor C: steepness of slope

- Factor X: drainage class, landform, erosion class, flooding and ponding frequency and duration, soil pH, soluble salt content as measured by electrical conductivity, and sodium adsorption ratio

Revised Storie Index numerical ratings have been combined into six classes as follows:

- Grade 1: Excellent (81 to 100)

- Grade 2: Good (61 to 80)

- Grade 3: Fair (41 to 60)

- Grade 4: Poor (21 to 40)

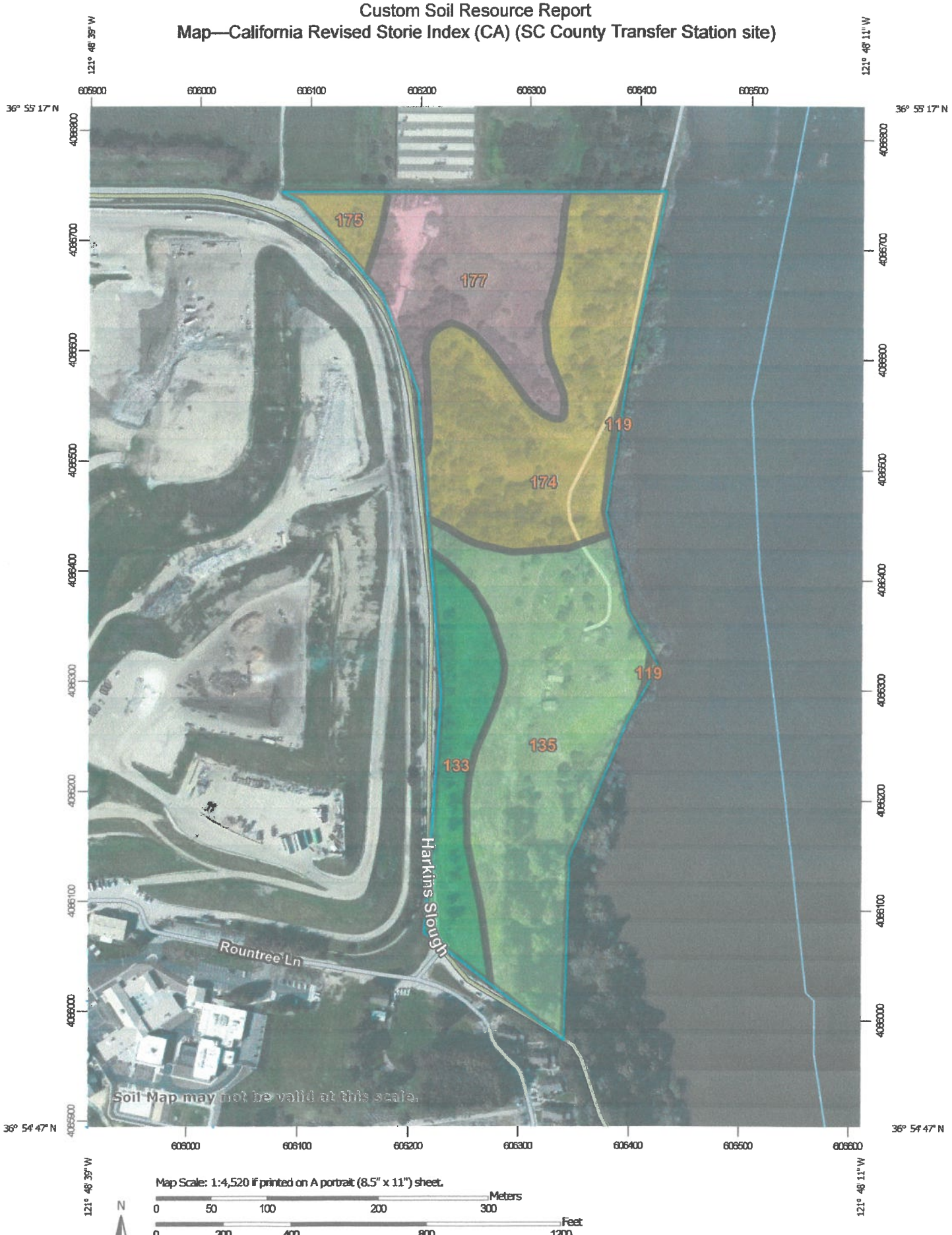
- Grade 5: Very poor (11 to 20)

- Grade 6: Nonagricultural (10 or less)

The components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as the one shown for the map unit. The percent composition of each component in a particular map unit is given to help the user better understand the extent to which the rating applies to the map unit.

Other components with different ratings may occur in each map unit. The ratings for all components, regardless the aggregated rating of the map unit, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Custom Soil Resource Report
Map—California Revised Storie Index (CA) (SC County Transfer Station site)



Map Scale: 1:4,520 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 50, 100, 200, 300

Feet: 0, 200, 400, 800, 1200

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- Grade 1 - Excellent
- Grade 2 - Good
- Grade 3 - Fair
- Grade 4 - Poor
- Grade 5 - Very Poor
- Grade 6 - Nonagricultural
- Not rated
- Not rated or not available

Soil Rating Lines

- Grade 1 - Excellent
- Grade 2 - Good
- Grade 3 - Fair
- Grade 4 - Poor
- Grade 5 - Very Poor
- Grade 6 - Nonagricultural
- Not rated
- Not rated or not available

Soil Rating Points

- Grade 1 - Excellent
- Grade 2 - Good
- Grade 3 - Fair
- Grade 4 - Poor
- Grade 5 - Very Poor
- Grade 6 - Nonagricultural
- Not rated
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Santa Cruz County, California
Survey Area Data: Version 14, May 29, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 16, 2019—Apr 7, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—California Revised Storie Index (CA) (SC County Transfer Station site)

Map unit symbol	Map unit name	Rating	Component name (percent)	Acres in AOI	Percent of AOI
119	Clear Lake clay, drained, 0 to 1 percent slopes, MLRA 14	Grade 4 - Poor	Clear Lake, drained (85%)	0.1	0.4%
133	Elkhorn sandy loam, 2 to 9 percent slopes	Grade 1 - Excellent	Elkhorn (85%)	3.9	11.8%
135	Elkhorn sandy loam, 15 to 30 percent slopes	Grade 2 - Good	Elkhorn (85%)	11.7	35.5%
174	Tierra-Watsonville complex, 15 to 30 percent slopes	Grade 4 - Poor	Tierra (55%)	10.1	30.7%
175	Tierra-Watsonville complex, 30 to 50 percent slopes	Grade 4 - Poor	Tierra (50%)	0.9	2.6%
177	Watsonville loam, 2 to 15 percent slopes	Grade 5 - Very Poor	Watsonville (85%)	6.2	18.9%
Totals for Area of Interest				32.9	100.0%

Rating Options—California Revised Storie Index (CA) (SC County Transfer Station site)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Nonirrigated Capability Subclass (SC County Transfer Station site)

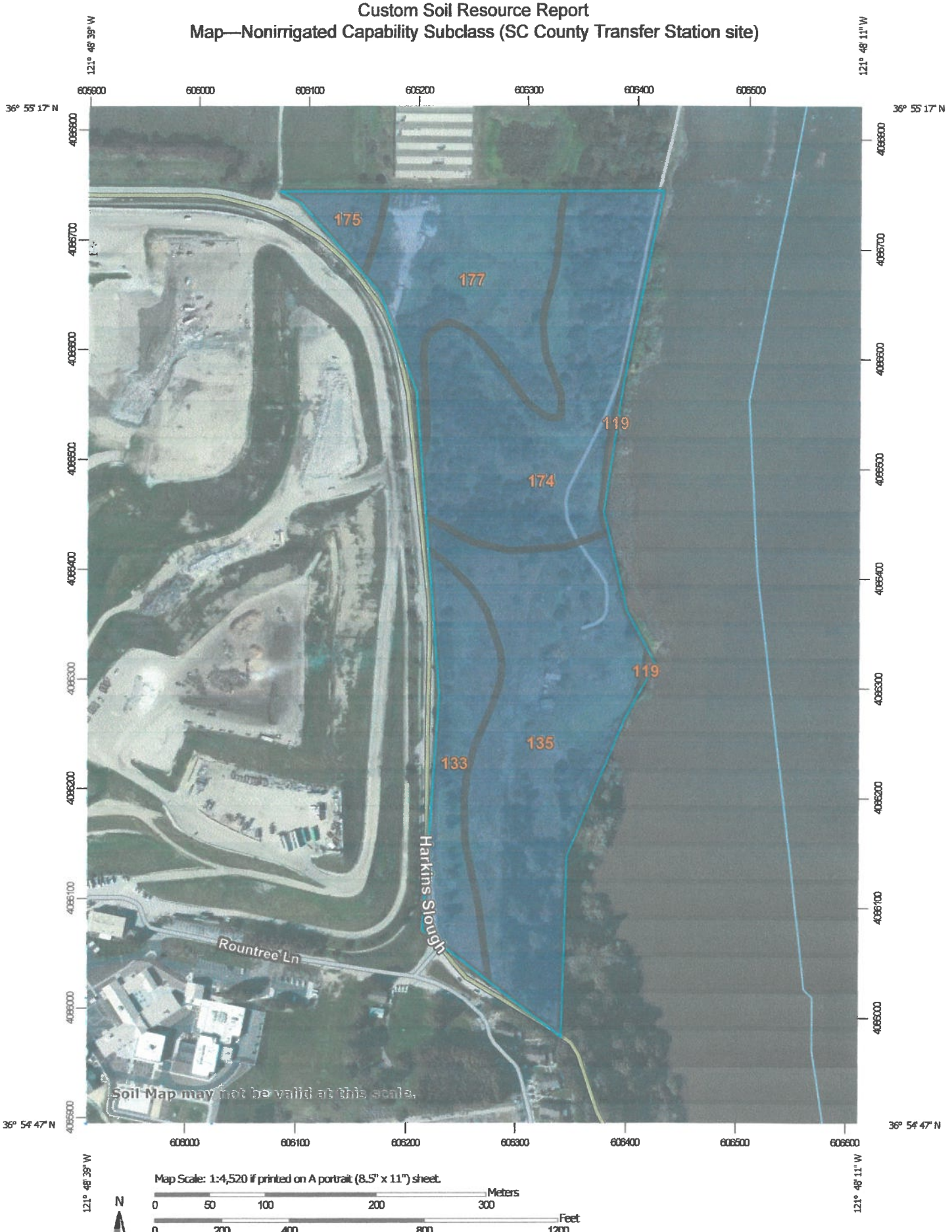
Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations that show suitability and limitations of groups of soils for rangeland, for woodland, or for engineering purposes.

In the capability system, soils are generally grouped at three levels-capability class, subclass, and unit. Only class and subclass are included in this data set.

Capability subclasses are soil groups within one capability class. They are designated by adding a small letter, "e," "w," "s," or "c," to the class numeral, for example, 2e. The letter "e" shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; "w" shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); "s" shows that the soil is limited mainly because it is shallow, droughty, or stony; and "c," used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class 1 there are no subclasses because the soils of this class have few limitations. Class 5 contains only the subclasses indicated by "w," "s," or "c" because the soils in class 5 are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, forestland, or wildlife habitat.

Custom Soil Resource Report
Map—Nonirrigated Capability Subclass (SC County Transfer Station site)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- Erosion
- Soil limitation within the rooting zone
- Excess water
- Climate condition
- Not rated or not available

Soil Rating Lines
- Erosion
- Soil limitation within the rooting zone
- Excess water
- Climate condition
- Not rated or not available

Soil Rating Points
- Erosion
- Soil limitation within the rooting zone
- Excess water
- Climate condition
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Santa Cruz County, California
Survey Area Data: Version 14, May 29, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 16, 2019—Apr 7, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Nonirrigated Capability Subclass (SC County Transfer Station site)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
119	Clear Lake clay, drained, 0 to 1 percent slopes, MLRA 14	w	0.1	0.4%
133	Elkhorn sandy loam, 2 to 9 percent slopes	e	3.9	11.8%
135	Elkhorn sandy loam, 15 to 30 percent slopes	e	11.7	35.5%
174	Tierra-Watsonville complex, 15 to 30 percent slopes	e	10.1	30.7%
175	Tierra-Watsonville complex, 30 to 50 percent slopes	e	0.9	2.6%
177	Watsonville loam, 2 to 15 percent slopes	e	6.2	18.9%
Totals for Area of Interest			32.9	100.0%

Rating Options—Nonirrigated Capability Subclass (SC County Transfer Station site)

Aggregation Method: Dominant Condition

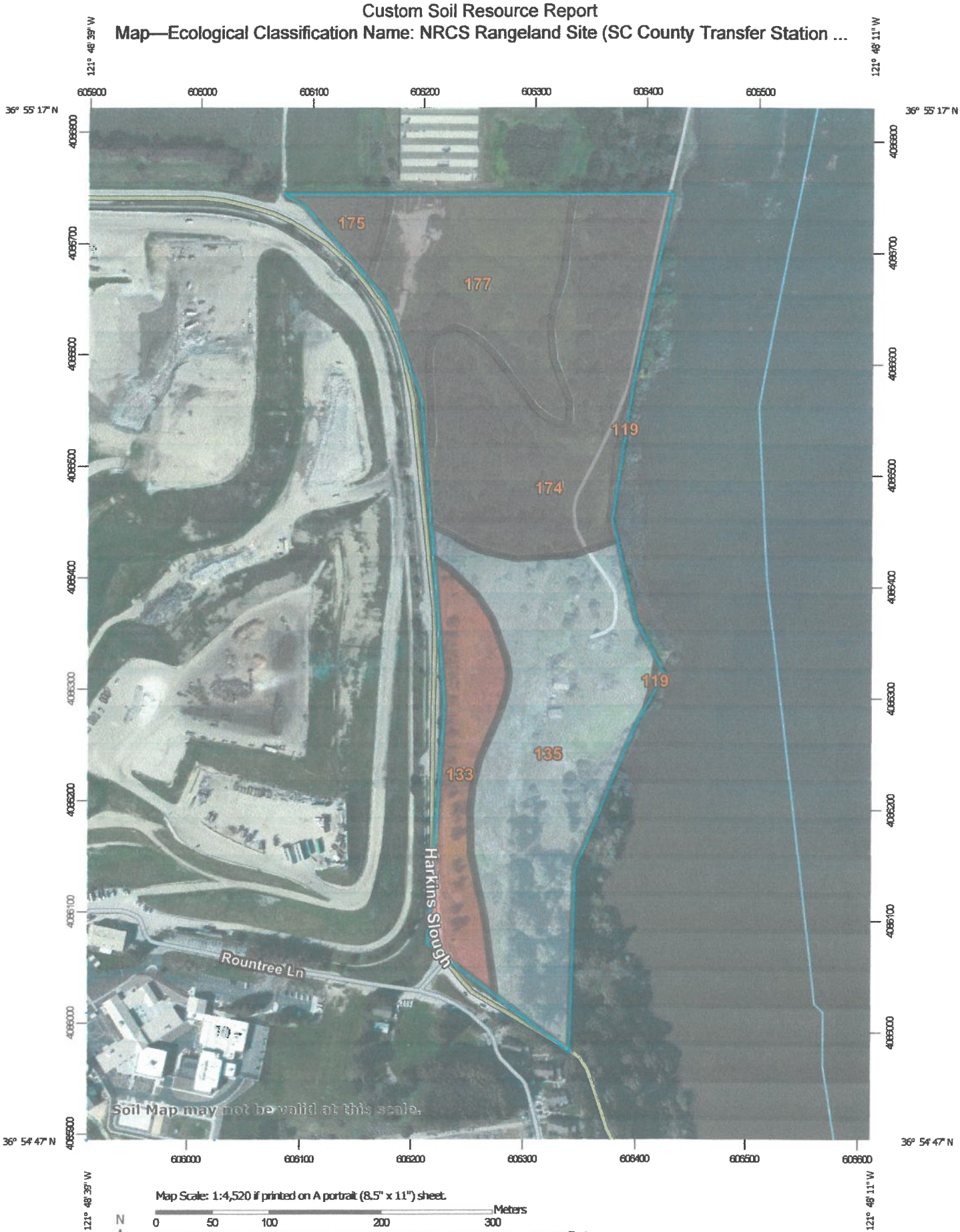
Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Ecological Classification Name: NRCS Rangeland Site (SC County Transfer Station site)

Ecological classifications consist of a series of vegetative classification systems developed by various partners in the National Cooperative Soil Survey. The classifications include, but are not limited to, systematic vegetative groupings. Examples include NRCS ecological sites, United States Forest Service plant associations, and forage suitability groups. The classifications systems are identified by the Ecological Classification Type Name field, which is in the Component Ecological Classification table.

Map—Ecological Classification Name: NRCS Rangeland Site (SC County Transfer Station ...



Map Scale: 1:4,520 if printed on A portrait (8.5" x 11") sheet.

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- CLAYPAN
- FINE LOAMY
- Not rated or not available

Soil Rating Lines
- CLAYPAN
- FINE LOAMY
- Not rated or not available

Soil Rating Points
- CLAYPAN
- FINE LOAMY
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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Soil Survey Area: Santa Cruz County, California
Survey Area Data: Version 14, May 29, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 16, 2019—Apr 7, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Ecological Classification Name: NRCS Rangeland Site (SC County Transfer Station site)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
119	Clear Lake clay, drained, 0 to 1 percent slopes, MLRA 14		0.1	0.4%
133	Elkhorn sandy loam, 2 to 9 percent slopes	FINE LOAMY	3.9	11.8%
135	Elkhorn sandy loam, 15 to 30 percent slopes		11.7	35.5%
174	Tierra-Watsonville complex, 15 to 30 percent slopes	CLAYPAN	10.1	30.7%
175	Tierra-Watsonville complex, 30 to 50 percent slopes	CLAYPAN	0.9	2.6%
177	Watsonville loam, 2 to 15 percent slopes	CLAYPAN	6.2	18.9%
Totals for Area of Interest			32.9	100.0%

Rating Options—Ecological Classification Name: NRCS Rangeland Site (SC County Transfer Station site)

Class: NRCS Rangeland Site

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

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United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Santa Cruz County, California



January 14, 2021

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Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

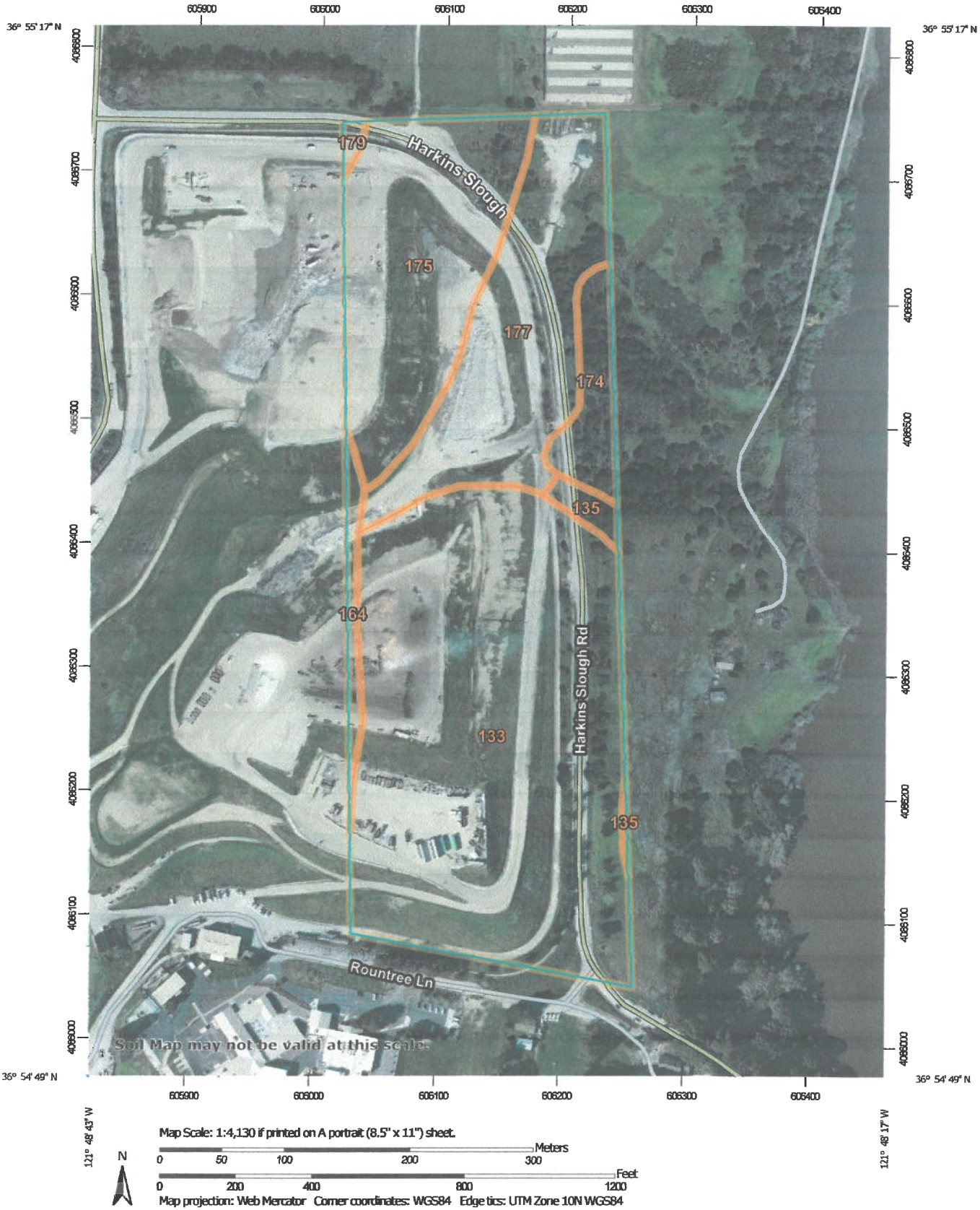
Soil Survey Area: Santa Cruz County, California
Survey Area Data: Version 14, May 29, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 13, 2020—Jun 3, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Custom Soil Resource Report
Soil Map (Buena Vista Landfill)



given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Santa Cruz County, California

133—Elkhorn sandy loam, 2 to 9 percent slopes

Map Unit Setting

National map unit symbol: h9dr
Elevation: 50 to 5,000 feet
Mean annual precipitation: 14 to 22 inches
Mean annual air temperature: 57 degrees F
Frost-free period: 245 to 275 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Elkhorn and similar soils: 85 percent
Minor components: 11 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Elkhorn

Setting

Landform: Alluvial fans, terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Marine deposits

Typical profile

H1 - 0 to 21 inches: sandy loam
H2 - 21 to 61 inches: sandy clay loam, clay loam
H2 - 21 to 61 inches:

Properties and qualities

Slope: 2 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very high (about 15.8 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: R014XD034CA - FINE LOAMY
Hydric soil rating: No

Minor Components

Elder, sandy loam

Percent of map unit: 5 percent
Hydric soil rating: No

Baywood, loamy sand
Percent of map unit: 2 percent
Hydric soil rating: No

Elkhorn
Percent of map unit: 1 percent
Hydric soil rating: No

Pinto, loam
Percent of map unit: 1 percent
Hydric soil rating: No

Soquel, loam
Percent of map unit: 1 percent
Hydric soil rating: No

Watsonville
Percent of map unit: 1 percent
Landform: Marine terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Hydric soil rating: Yes

135—Elkhorn sandy loam, 15 to 30 percent slopes

Map Unit Setting
National map unit symbol: h9dt
Elevation: 50 to 5,000 feet
Mean annual precipitation: 14 to 22 inches
Mean annual air temperature: 57 degrees F
Frost-free period: 245 to 275 days
Farmland classification: Not prime farmland

Map Unit Composition
Elkhorn and similar soils: 85 percent
Minor components: 12 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Elkhorn

Setting
Landform: Alluvial fans, terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Marine deposits

Typical profile
H1 - 0 to 21 inches: sandy loam
H2 - 21 to 61 inches: sandy clay loam, clay loam

H2 - 21 to 61 inches:

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very high (about 15.8 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Baywood, loamy sand

Percent of map unit: 5 percent
Hydric soil rating: No

Tierra, sandy loam

Percent of map unit: 4 percent
Hydric soil rating: No

Pfeiffer, sandy loam

Percent of map unit: 2 percent
Hydric soil rating: No

Watsonville

Percent of map unit: 1 percent
Landform: Marine terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Hydric soil rating: Yes

164—Pits-Dumps complex

Map Unit Setting

National map unit symbol: h9fr
Frost-free period: 245 to 275 days
Farmland classification: Not prime farmland

Map Unit Composition

Pits: 50 percent
Dumps: 45 percent
Minor components: 5 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pits

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8e
Hydric soil rating: No

Description of Dumps

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8e
Hydric soil rating: No

Minor Components

Rock outcrop

Percent of map unit: 5 percent
Hydric soil rating: No

174—Tierra-Watsonville complex, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: h9g2
Elevation: 20 to 1,200 feet
Mean annual precipitation: 14 to 28 inches
Mean annual air temperature: 57 to 59 degrees F
Frost-free period: 245 to 275 days
Farmland classification: Not prime farmland

Map Unit Composition

Tierra and similar soils: 55 percent
Watsonville and similar soils: 30 percent
Minor components: 12 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tierra

Setting

Landform: Marine terraces, fan terraces
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile

H1 - 0 to 14 inches: sandy loam

H2 - 14 to 66 inches: clay, clay loam, sandy clay
H2 - 14 to 66 inches:
H2 - 14 to 66 inches:

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 1.6 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Ecological site: R015XD115CA - CLAYPAN
Hydric soil rating: No

Description of Watsonville

Setting

Landform: Marine terraces, fan terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile

H1 - 0 to 18 inches: loam
H2 - 18 to 39 inches: clay, clay loam
H2 - 18 to 39 inches: sandy clay loam, clay loam
H3 - 39 to 63 inches:
H3 - 39 to 63 inches:

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Ecological site: R014XD089CA - CLAYPAN
Hydric soil rating: Yes

Minor Components

Elkhorn, sandy loam
Percent of map unit: 5 percent
Hydric soil rating: No

Pfeiffer, gravelly sandy loam
Percent of map unit: 4 percent
Hydric soil rating: No

Los osos, loam
Percent of map unit: 2 percent
Hydric soil rating: No

Tierra
Percent of map unit: 1 percent
Hydric soil rating: No

175—Tierra-Watsonville complex, 30 to 50 percent slopes

Map Unit Setting
National map unit symbol: h9g3
Elevation: 20 to 1,200 feet
Mean annual precipitation: 14 to 28 inches
Mean annual air temperature: 57 to 59 degrees F
Frost-free period: 245 to 275 days
Farmland classification: Not prime farmland

Map Unit Composition
Tierra and similar soils: 50 percent
Watsonville and similar soils: 30 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tierra

Setting
Landform: Fan terraces, marine terraces
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile
H1 - 0 to 14 inches: sandy loam
H2 - 14 to 66 inches: clay, clay loam, sandy clay
H2 - 14 to 66 inches:
H2 - 14 to 66 inches:

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 1.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R015XD115CA - CLAYPAN
Hydric soil rating: No

Description of Watsonville

Setting

Landform: Fan terraces, marine terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile

H1 - 0 to 18 inches: loam
H2 - 18 to 39 inches: clay, clay loam
H2 - 18 to 39 inches: sandy clay loam, clay loam
H3 - 39 to 63 inches:
H3 - 39 to 63 inches:

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R014XD089CA - CLAYPAN
Hydric soil rating: Yes

Minor Components

Elkhorn, sandy loam
Percent of map unit: 5 percent
Hydric soil rating: No

Los osos, loam
Percent of map unit: 4 percent
Hydric soil rating: No

Diablo, clay
Percent of map unit: 2 percent
Hydric soil rating: No

Baywood
Percent of map unit: 2 percent
Hydric soil rating: No

Pfeiffer, gravelly sandy loam
Percent of map unit: 1 percent
Hydric soil rating: No

Tierra
Percent of map unit: 1 percent
Hydric soil rating: No

177—Watsonville loam, 2 to 15 percent slopes

Map Unit Setting
National map unit symbol: h9g5
Elevation: 20 to 1,200 feet
Mean annual precipitation: 28 inches
Mean annual air temperature: 57 degrees F
Frost-free period: 245 to 275 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Watsonville and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Watsonville

Setting
Landform: Marine terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 18 inches: loam
H2 - 18 to 39 inches: clay, clay loam
H2 - 18 to 39 inches: sandy clay loam, clay loam
H3 - 39 to 63 inches:
H3 - 39 to 63 inches:

Properties and qualities

Slope: 2 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Ecological site: R014XD089CA - CLAYPAN
Hydric soil rating: Yes

Minor Components

Elkhorn, sandy loam

Percent of map unit: 5 percent
Hydric soil rating: No

Pinto, loam

Percent of map unit: 4 percent
Hydric soil rating: No

Watsonville, thick surface

Percent of map unit: 3 percent
Landform: Marine terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Hydric soil rating: Yes

Danville

Percent of map unit: 1 percent
Hydric soil rating: No

Elder

Percent of map unit: 1 percent
Hydric soil rating: No

Cropley, silty clay

Percent of map unit: 1 percent
Hydric soil rating: No

179—Watsonville loam, thick surface, 2 to 15 percent slopes

Map Unit Setting

National map unit symbol: h9g7
Elevation: 20 to 1,200 feet
Mean annual precipitation: 28 inches
Mean annual air temperature: 57 degrees F
Frost-free period: 245 to 275 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Watsonville and similar soils: 85 percent
Minor components: 13 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Watsonville

Setting

Landform: Marine terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 18 inches: loam
H2 - 18 to 39 inches: clay, clay loam
H2 - 18 to 39 inches: sandy clay loam, clay loam
H3 - 39 to 63 inches:
H3 - 39 to 63 inches:

Properties and qualities

Slope: 2 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Hydric soil rating: Yes

Minor Components

Danville, loam
Percent of map unit: 5 percent
Hydric soil rating: No

Elder, sandy loam
Percent of map unit: 4 percent
Hydric soil rating: No

Elkhorn, sandy loam
Percent of map unit: 2 percent
Hydric soil rating: No

Pinto, loam
Percent of map unit: 2 percent
Hydric soil rating: No

Soil Information for All Uses

Suitabilities and Limitations for Use

The Suitabilities and Limitations for Use section includes various soil interpretations displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each interpretation.

Land Classifications

Land Classifications are specified land use and management groupings that are assigned to soil areas because combinations of soil have similar behavior for specified practices. Most are based on soil properties and other factors that directly influence the specific use of the soil. Example classifications include ecological site classification, farmland classification, irrigated and nonirrigated land capability classification, and hydric rating.

Farmland Classification (Buena Vista Landfill)

Farmland classification identifies map units as prime farmland, farmland of statewide importance, farmland of local importance, or unique farmland. It identifies the location and extent of the soils that are best suited to food, feed, fiber, forage, and oilseed crops. NRCS policy and procedures on prime and unique farmlands are published in the "Federal Register," Vol. 43, No. 21, January 31, 1978.

Map Unit Legend (Buena Vista Landfill)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
133	Elkhorn sandy loam, 2 to 9 percent slopes	19.7	53.4%
135	Elkhorn sandy loam, 15 to 30 percent slopes	0.4	1.2%
164	Pits-Dumps complex	0.6	1.7%
174	Tierra-Watsonville complex, 15 to 30 percent slopes	1.5	4.1%
175	Tierra-Watsonville complex, 30 to 50 percent slopes	7.4	19.9%
177	Watsonville loam, 2 to 15 percent slopes	7.2	19.4%
179	Watsonville loam, thick surface, 2 to 15 percent slopes	0.1	0.4%
Totals for Area of Interest		37.0	100.0%

Map Unit Descriptions (Buena Vista Landfill)

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a

Custom Soil Resource Report
Map—Farmland Classification (Buena Vista Landfill)



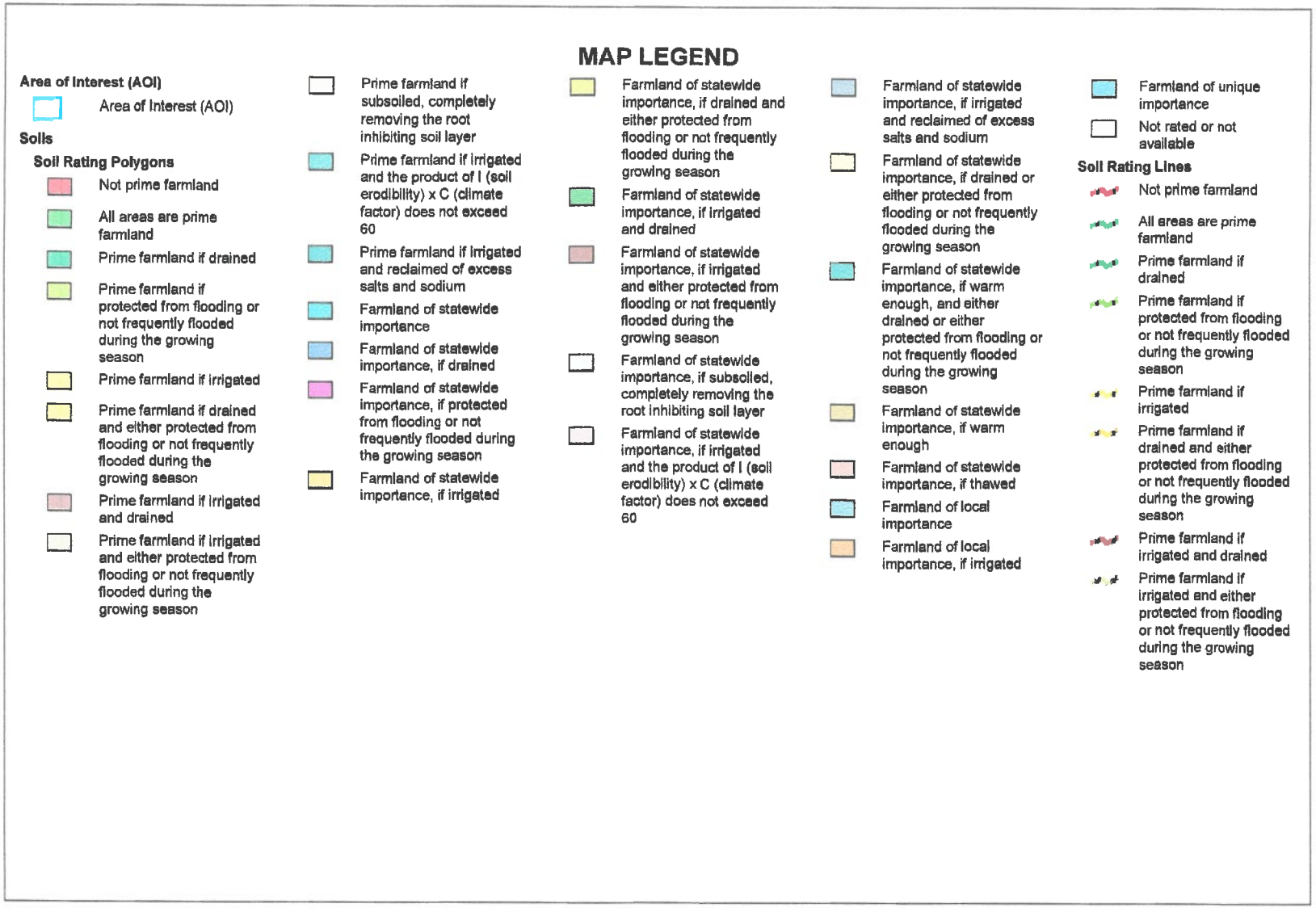
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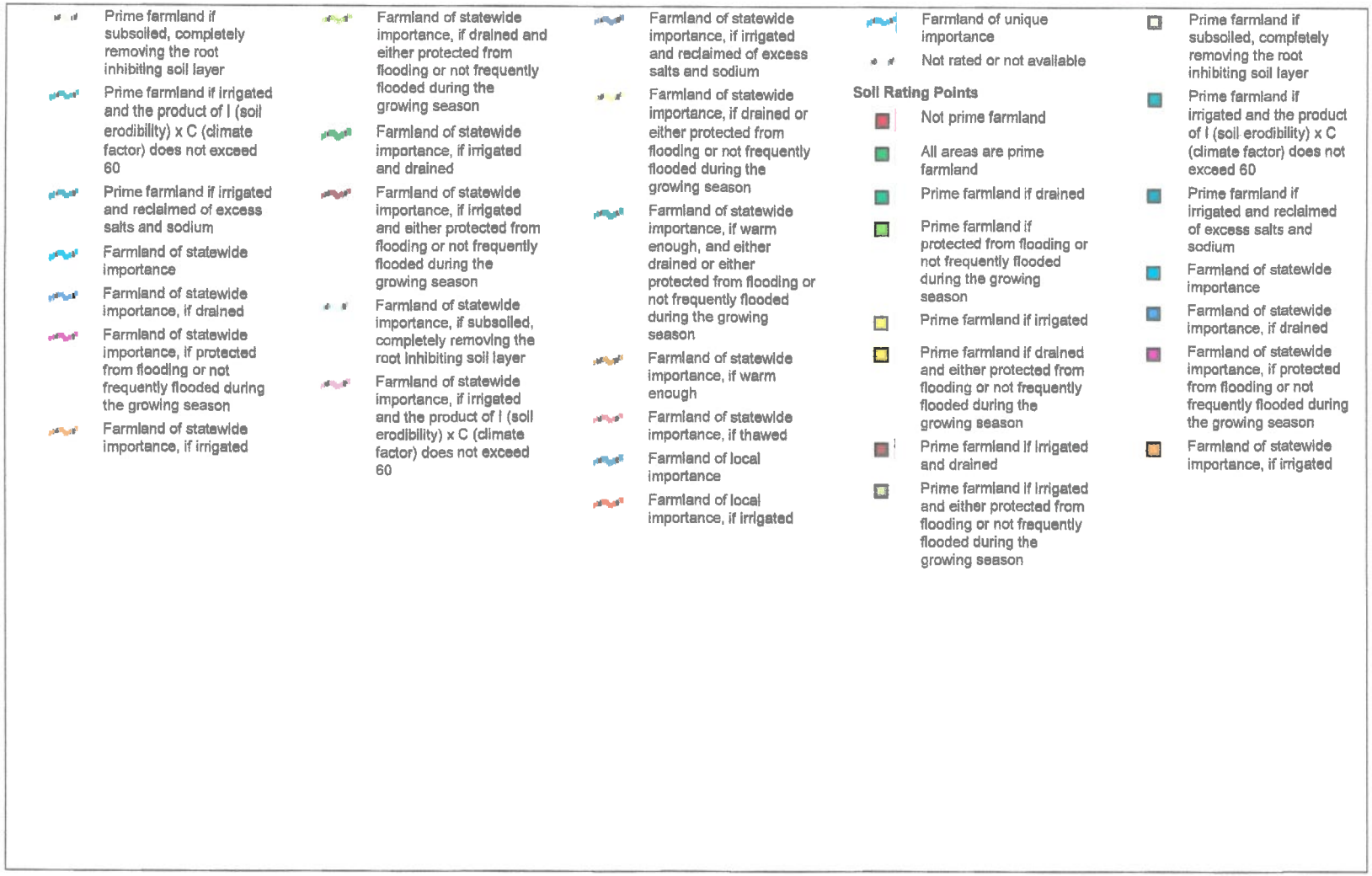
N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84


MAP LEGEND
Area of Interest (AOI)
Area of Interest (AOI)
Soils
Soil Rating Polygons
Not prime farmland
All areas are prime farmland
Prime farmland if drained
Prime farmland if protected from flooding or not frequently flooded during the growing season
Prime farmland if irrigated
Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season
Prime farmland if irrigated and drained
Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season
Prime farmland if subsoiled, completely removing the root inhibiting soil layer
Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
Prime farmland if irrigated and reclaimed of excess salts and sodium
Farmland of statewide importance
Farmland of statewide importance, if drained
Farmland of statewide importance, if protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if irrigated
Farmland of statewide importance, if drained and either protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if irrigated and drained
Farmland of statewide importance, if irrigated and either protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if subsoiled, completely removing the root inhibiting soil layer
Farmland of statewide importance, if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
Farmland of statewide importance, if irrigated and reclaimed of excess salts and sodium
Farmland of statewide importance, if drained or either protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if warm enough, and either drained or either protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if warm enough
Farmland of statewide importance, if thawed
Farmland of local importance
Farmland of local importance, if irrigated
Farmland of unique importance
Not rated or not available
Soil Rating Lines
Not prime farmland
All areas are prime farmland
Prime farmland if drained
Prime farmland if protected from flooding or not frequently flooded during the growing season
Prime farmland if irrigated
Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season
Prime farmland if irrigated and drained
Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season


Prime farmland if subsoiled, completely removing the root inhibiting soil layer
Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
Prime farmland if irrigated and reclaimed of excess salts and sodium
Farmland of statewide importance
Farmland of statewide importance, if drained
Farmland of statewide importance, if protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if irrigated
Farmland of statewide importance, if drained and either protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if irrigated and drained
Farmland of statewide importance, if irrigated and either protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if subsoiled, completely removing the root inhibiting soil layer
Farmland of statewide importance, if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
Farmland of statewide importance, if irrigated and reclaimed of excess salts and sodium
Farmland of statewide importance, if drained or either protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if warm enough, and either drained or either protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if warm enough
Farmland of statewide importance, if thawed
Farmland of local importance
Farmland of local importance, if irrigated
Farmland of unique importance
Not rated or not available
Soil Rating Points
Not prime farmland
All areas are prime farmland
Prime farmland if drained
Prime farmland if protected from flooding or not frequently flooded during the growing season
Prime farmland if irrigated
Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season
Prime farmland if irrigated and drained
Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season
Prime farmland if subsoiled, completely removing the root inhibiting soil layer
Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
Prime farmland if irrigated and reclaimed of excess salts and sodium
Farmland of statewide importance
Farmland of statewide importance, if drained
Farmland of statewide importance, if protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if irrigated

- Farmland of statewide importance, if drained and either protected from flooding or not frequently flooded during the growing season
- Farmland of statewide importance, if irrigated and drained
- Farmland of statewide importance, if irrigated and either protected from flooding or not frequently flooded during the growing season
- Farmland of statewide importance, if subsoiled, completely removing the root inhibiting soil layer
- Farmland of statewide importance, if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
- Farmland of statewide importance, if irrigated and reclaimed of excess salts and sodium
- Farmland of statewide importance, if drained or either protected from flooding or not frequently flooded during the growing season
- Farmland of statewide importance, if warm enough, and either drained or either protected from flooding or not frequently flooded during the growing season
- Farmland of statewide importance, if warm enough
- Farmland of statewide importance, if thawed
- Farmland of local importance
- Farmland of local importance, if irrigated
- Farmland of unique importance
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Santa Cruz County, California
Survey Area Data: Version 14, May 29, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 13, 2020—Jun 3, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Farmland Classification (Buena Vista Landfill)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
133	Elkhorn sandy loam, 2 to 9 percent slopes	Prime farmland if irrigated	19.7	53.4%
135	Elkhorn sandy loam, 15 to 30 percent slopes	Not prime farmland	0.4	1.2%
164	Pits-Dumps complex	Not prime farmland	0.6	1.7%
174	Tierra-Watsonville complex, 15 to 30 percent slopes	Not prime farmland	1.5	4.1%
175	Tierra-Watsonville complex, 30 to 50 percent slopes	Not prime farmland	7.4	19.9%
177	Watsonville loam, 2 to 15 percent slopes	Farmland of statewide importance	7.2	19.4%
179	Watsonville loam, thick surface, 2 to 15 percent slopes	Farmland of statewide importance	0.1	0.4%
Totals for Area of Interest			**37.0**	**100.0%**

Rating Options—Farmland Classification (Buena Vista Landfill)

Aggregation Method: No Aggregation Necessary

Tie-break Rule: Lower

California Revised Storie Index (CA) (Buena Vista Landfill)

The Revised Storie Index is a rating system based on soil properties that govern the potential for soil map unit components to be used for irrigated agriculture in California.

The Revised Storie Index assesses the productivity of a soil from the following four characteristics:

- Factor A: degree of soil profile development

- Factor B: texture of the surface layer

- Factor C: steepness of slope

- Factor X: drainage class, landform, erosion class, flooding and ponding frequency and duration, soil pH, soluble salt content as measured by electrical conductivity, and sodium adsorption ratio

Revised Storie Index numerical ratings have been combined into six classes as follows:

- Grade 1: Excellent (81 to 100)

- Grade 2: Good (61 to 80)

- Grade 3: Fair (41 to 60)

- Grade 4: Poor (21 to 40)

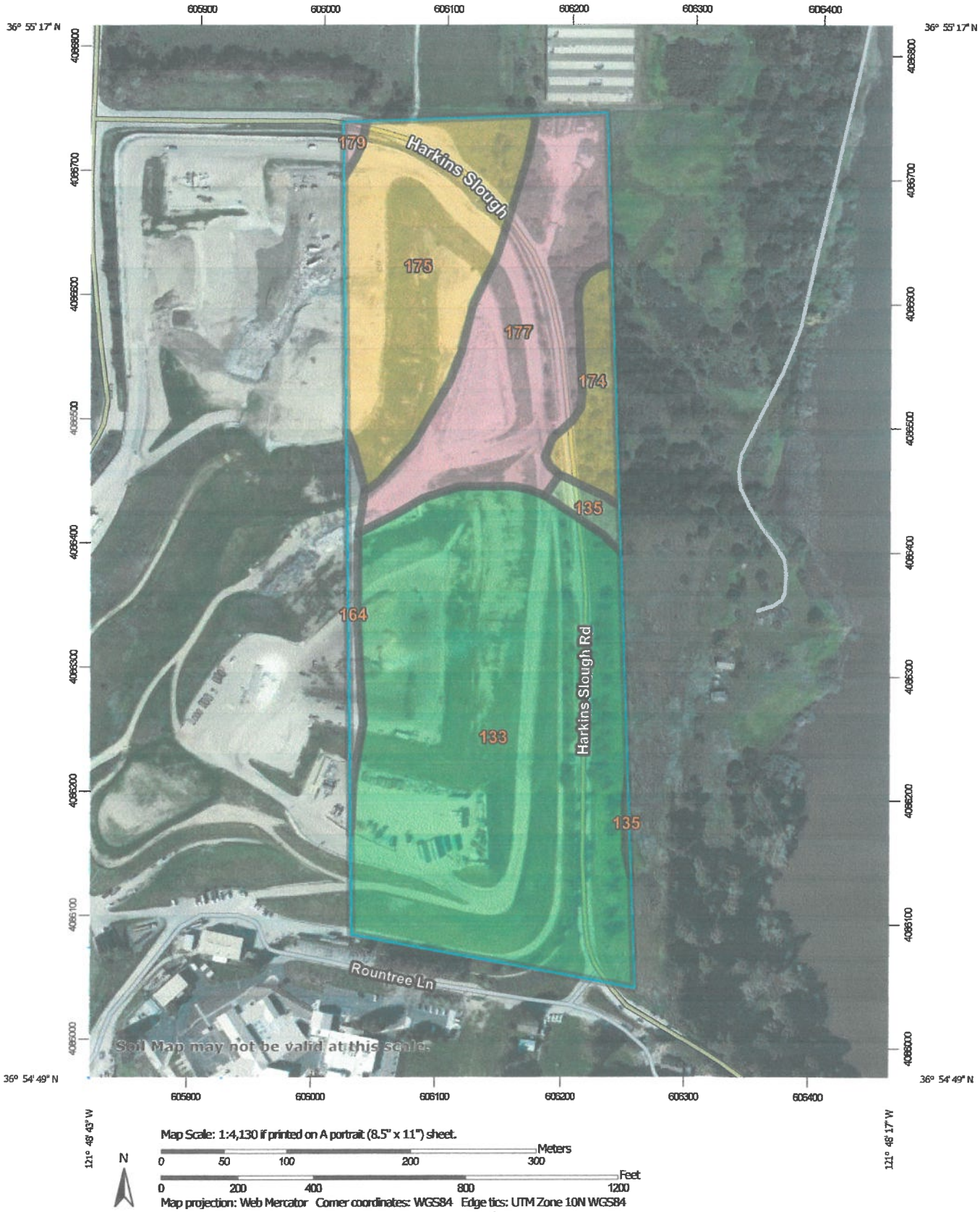
- Grade 5: Very poor (11 to 20)

- Grade 6: Nonagricultural (10 or less)

The components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as the one shown for the map unit. The percent composition of each component in a particular map unit is given to help the user better understand the extent to which the rating applies to the map unit.

Other components with different ratings may occur in each map unit. The ratings for all components, regardless the aggregated rating of the map unit, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Custom Soil Resource Report
Map—California Revised Storie Index (CA) (Buena Vista Landfill)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- Grade 1 - Excellent
- Grade 2 - Good
- Grade 3 - Fair
- Grade 4 - Poor
- Grade 5 - Very Poor
- Grade 6 - Nonagricultural
- Not rated
- Not rated or not available

Soil Rating Lines
- Grade 1 - Excellent
- Grade 2 - Good
- Grade 3 - Fair
- Grade 4 - Poor
- Grade 5 - Very Poor
- Grade 6 - Nonagricultural
- Not rated
- Not rated or not available

Soil Rating Points
- Grade 1 - Excellent
- Grade 2 - Good
- Grade 3 - Fair
- Grade 4 - Poor
- Grade 5 - Very Poor
- Grade 6 - Nonagricultural
- Not rated
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Santa Cruz County, California
Survey Area Data: Version 14, May 29, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 13, 2020—Jun 3, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—California Revised Storie Index (CA) (Buena Vista Landfill)

Map unit symbol	Map unit name	Rating	Component name (percent)	Acres in AOI	Percent of AOI
133	Elkhorn sandy loam, 2 to 9 percent slopes	Grade 1 - Excellent	Elkhorn (85%)	19.7	53.4%
135	Elkhorn sandy loam, 15 to 30 percent slopes	Grade 2 - Good	Elkhorn (85%)	0.4	1.2%
164	Pits-Dumps complex	Not Applicable for Storie Index	Pits (50%)	0.6	1.7%
			Dumps (45%)		
			Rock outcrop (5%)		
174	Tierra-Watsonville complex, 15 to 30 percent slopes	Grade 4 - Poor	Tierra (55%)	1.5	4.1%
175	Tierra-Watsonville complex, 30 to 50 percent slopes	Grade 4 - Poor	Tierra (50%)	7.4	19.9%
177	Watsonville loam, 2 to 15 percent slopes	Grade 5 - Very Poor	Watsonville (85%)	7.2	19.4%
179	Watsonville loam, thick surface, 2 to 15 percent slopes	Grade 5 - Very Poor	Watsonville (85%)	0.1	0.4%
Totals for Area of Interest				37.0	100.0%

Rating Options—California Revised Storie Index (CA) (Buena Vista Landfill)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Nonirrigated Capability Class (Buena Vista Landfill)

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations that show suitability and limitations of groups of soils for rangeland, for woodland, or for engineering purposes.

In the capability system, soils are generally grouped at three levels-capability class, subclass, and unit. Only class and subclass are included in this data set.

Capability classes, the broadest groups, are designated by the numbers 1 through 8. The numbers indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class 1 soils have few limitations that restrict their use.

Class 2 soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class 3 soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class 4 soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

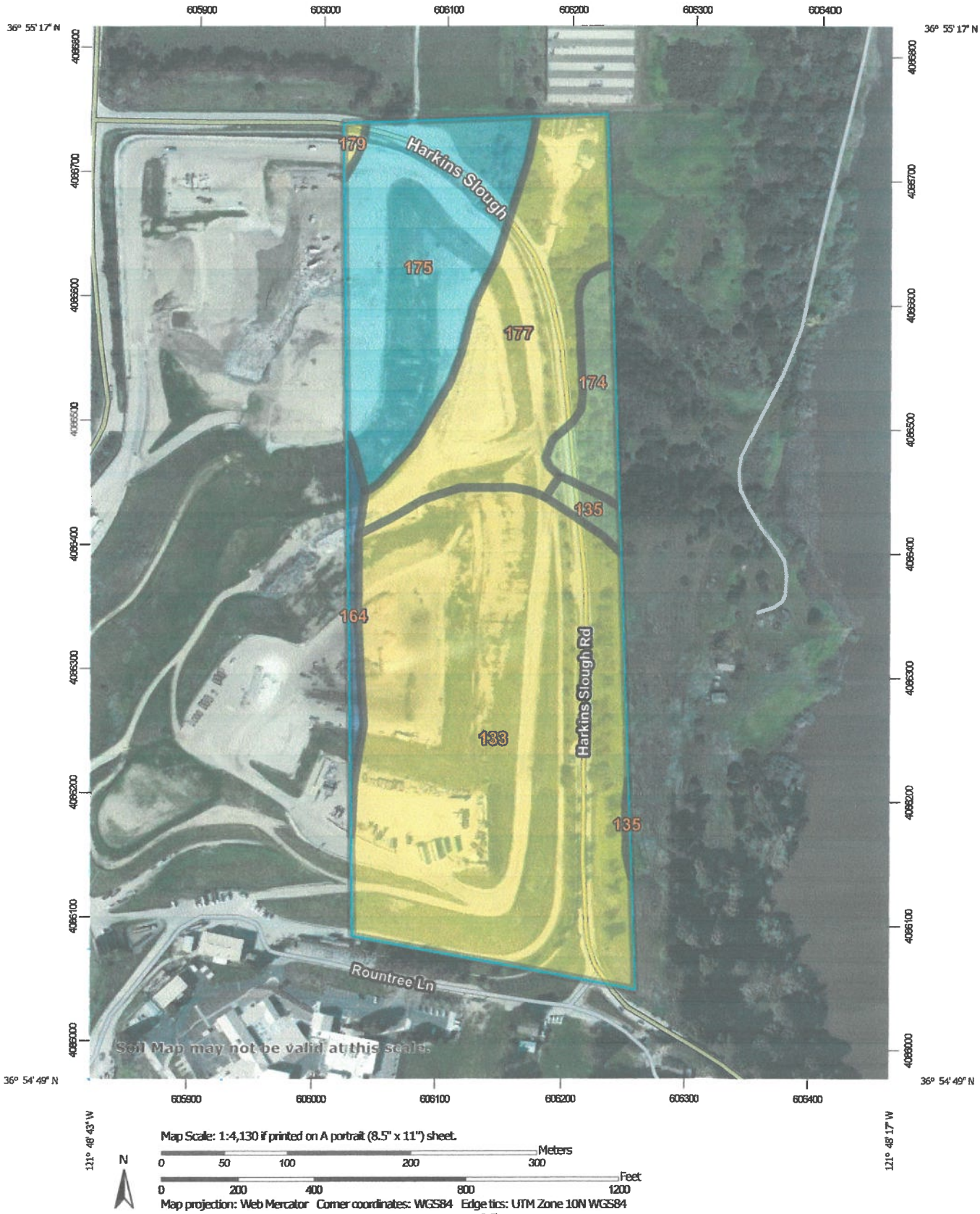
Class 5 soils are subject to little or no erosion but have other limitations, impractical to remove, that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.

Class 6 soils have severe limitations that make them generally unsuitable for cultivation and that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.

Class 7 soils have very severe limitations that make them unsuitable for cultivation and that restrict their use mainly to grazing, forestland, or wildlife habitat.

Class 8 soils and miscellaneous areas have limitations that preclude commercial plant production and that restrict their use to recreational purposes, wildlife habitat, watershed, or esthetic purposes.

Custom Soil Resource Report
Map—Nonirrigated Capability Class (Buena Vista Landfill)



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- Capability Class - I
- Capability Class - II
- Capability Class - III
- Capability Class - IV
- Capability Class - V
- Capability Class - VI
- Capability Class - VII
- Capability Class - VIII
- Not rated or not available

Soil Rating Lines

- Capability Class - I
- Capability Class - II
- Capability Class - III
- Capability Class - IV
- Capability Class - V
- Capability Class - VI
- Capability Class - VII
- Capability Class - VIII
- Not rated or not available

Soil Rating Points

- Capability Class - I
- Capability Class - II
- Capability Class - III
- Capability Class - IV
- Capability Class - V
- Capability Class - VI
- Capability Class - VII
- Capability Class - VIII
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Santa Cruz County, California
Survey Area Data: Version 14, May 29, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 13, 2020—Jun 3, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Nonirrigated Capability Class (Buena Vista Landfill)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
133	Elkhorn sandy loam, 2 to 9 percent slopes	3	19.7	53.4%
135	Elkhorn sandy loam, 15 to 30 percent slopes	4	0.4	1.2%
164	Pits-Dumps complex	8	0.6	1.7%
174	Tierra-Watsonville complex, 15 to 30 percent slopes	4	1.5	4.1%
175	Tierra-Watsonville complex, 30 to 50 percent slopes	6	7.4	19.9%
177	Watsonville loam, 2 to 15 percent slopes	3	7.2	19.4%
179	Watsonville loam, thick surface, 2 to 15 percent slopes	3	0.1	0.4%
Totals for Area of Interest			37.0	100.0%

Rating Options—Nonirrigated Capability Class (Buena Vista Landfill)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

EXHIBIT 9













Appendix C. Notice of Preparation and Scoping Comments

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Notice of Completion & Environmental Document Transmittal

Mail to: State Clearinghouse, P.O. Box 3044, Sacramento, CA 95812-3044 (916) 445-0613
For Hand Delivery/Street Address: 1400 Tenth Street, Sacramento, CA 95814

SCH #

Project Title: Buena Vista Landfill Redevelopment Project

Lead Agency: County of Santa Cruz | Contact Person: Nicole Steel

Mailing Address: 701 Ocean Street, Room 410 | Phone: (831) 454-5139

City: Santa Cruz | Zip: 95060 | County: Santa Cruz

Project Location: County: Santa Cruz | City/Nearest Community: Watsonville

Cross Streets: Harkins Slough Road and Buena Vista Drive (1231 Buena Vista Drive) | Zip Code: 95076

Longitude/Latitude (degrees, minutes and seconds): ____° ____′ ____″ N / ____° ____′ ____″ W | Total Acres: 120

Assessor's Parcel No.: 052-531-01, 052-531-03, 052-021-33 | Section: ____ | Twp.: ____ | Range: ____ | Base: ____

Within 2 Miles: State Hwy #: 1 | Waterways: Harkins Slough

Airports: Watsonville Municipal Airport | Railways: Santa Cruz Branch Rail Line | Schools: Pajaro Valley High School

Document Type:

CEQA: ☒ NOP ☐ Draft EIR | NEPA: ☐ NOI | Other: ☐ Joint Document
☐ Early Cons ☐ Supplement/Subsequent EIR ☐ EA ☐ Final Document
☐ Neg Dec (Prior SCH No.) ____ ☐ Draft EIS ☐ Other: ____
☐ Mit Neg Dec Other: ____ ☐ FONSI

Local Action Type:

☐ General Plan Update ☐ Specific Plan ☒ Rezone ☐ Annexation
☒ General Plan Amendment ☐ Master Plan ☐ Prezone ☐ Redevelopment
☐ General Plan Element ☐ Planned Unit Development ☐ Use Permit ☒ Coastal Permit
☐ Community Plan ☐ Site Plan ☐ Land Division (Subdivision, etc.) ☐ Other: ____

Development Type:

☐ Residential: Units ____ Acres ____
☐ Office: Sq.ft. ____ Acres ____ Employees ____
☐ Commercial: Sq.ft. ____ Acres ____ Employees ____
☐ Industrial: Sq.ft. ____ Acres ____ Employees ____
☐ Educational: ____
☐ Recreational: ____
☐ Water Facilities: Type ____ MGD ____
☐ Transportation: Type ____
☐ Mining: Mineral ____
☐ Power: Type ____ MW ____
☐ Waste Treatment: Type ____ MGD ____
☐ Hazardous Waste: Type ____
☒ Other: Landfill

Project Issues Discussed in Document:

☐ Aesthetic/Visual	☐ Fiscal	☐ Recreation/Parks	☒ Vegetation
☒ Agricultural Land	☐ Flood Plain/Flooding	☐ Schools/Universities	☒ Water Quality
☒ Air Quality	☐ Forest Land/Fire Hazard	☐ Septic Systems	☐ Water Supply/Groundwater
☒ Archeological/Historical	☒ Geologic/Seismic	☐ Sewer Capacity	☒ Wetland/Riparian
☒ Biological Resources	☐ Minerals	☐ Soil Erosion/Compaction/Grading	☐ Growth Inducement
☒ Coastal Zone	☒ Noise	☒ Solid Waste	☒ Land Use
☐ Drainage/Absorption	☐ Population/Housing Balance	☒ Toxic/Hazardous	☐ Cumulative Effects
☐ Economic/Jobs	☒ Public Services/Facilities	☒ Traffic/Circulation	☐ Other: ____

Present Land Use/Zoning/General Plan Designation:

Public Facilities - Airport Influence Area; (PF-AIA) Commercial Agriculture - Airport Influence Area (CA-AIA)

Project Description: *(please use a separate page if necessary)*

The Buena Vista Landfill is projected to reach its capacity between 2030-2034. The proposed Project includes three primary components: 1) Developing two new waste transfer stations at the existing landfill site to implement transfer station operations for waste handling and transport; 2) Developing an organics diversion facility to support organics waste processing and diversion; and 3) Implementing the landfill closure plan once site capacity is reached. The Project is planned to be implemented by 2028.

Note: The State Clearinghouse will assign identification numbers for all new projects. If a SCH number already exists for a project (e.g. Notice of Preparation or previous draft document) please fill in.

Reviewing Agencies Checklist

Lead Agencies may recommend State Clearinghouse distribution by marking agencies below with and "**X**".
If you have already sent your document to the agency please denote that with an "**S**".

_____	Air Resources Board	X	Office of Historic Preservation
_____	Boating & Waterways, Department of	_____	Office of Public School Construction
_____	California Emergency Management Agency	_____	Parks & Recreation, Department of
_____	California Highway Patrol	_____	Pesticide Regulation, Department of
_____	Caltrans District # 5	_____	Public Utilities Commission
_____	Caltrans Division of Aeronautics	X	Regional WQCB # 3
_____	Caltrans Planning	_____	Resources Agency
_____	Central Valley Flood Protection Board	X	Resources Recycling and Recovery, Department of
_____	Coachella Valley Mtns. Conservancy	_____	S.F. Bay Conservation & Development Comm.
X	Coastal Commission	_____	San Gabriel & Lower L.A. Rivers & Mtns. Conservancy
_____	Colorado River Board	_____	San Joaquin River Conservancy
_____	Conservation, Department of	_____	Santa Monica Mtns. Conservancy
_____	Corrections, Department of	_____	State Lands Commission
_____	Delta Protection Commission	_____	SWRCB: Clean Water Grants
_____	Education, Department of	_____	SWRCB: Water Quality
_____	Energy Commission	_____	SWRCB: Water Rights
X	Fish & Game Region # 3	_____	Tahoe Regional Planning Agency
X	Food & Agriculture, Department of	X	Toxic Substances Control, Department of
_____	Forestry and Fire Protection, Department of	_____	Water Resources, Department of
_____	General Services, Department of		
_____	Health Services, Department of	_____	Other: _____
_____	Housing & Community Development	_____	Other: _____
X	Native American Heritage Commission		

Local Public Review Period (to be filled in by lead agency)

Starting Date February 16, 2024 Ending Date March 18, 2024

Lead Agency (Complete if applicable):

Consulting Firm: Harris & Associates
Address: 60 W Alisal, Suite 200
City/State/Zip: Salinas, CA 93901
Contact: Kate Elliott
Phone: (831) 419-6800

Applicant: _____
Address: _____
City/State/Zip: _____
Phone: _____

Signature of Lead Agency Representative: DocuSigned by: Nicole Steel 4FB518B472E1456... **Date:** 2/12/2024

Authority cited: Section 21083, Public Resources Code. Reference: Section 21161, Public Resources Code.

County of Santa Cruz

Department of Community Development and Infrastructure

701 Ocean Street, Fourth Floor, Santa Cruz, CA 95060
Planning (831) 454-2580 Public Works (831) 454-2160
sccoplanning.com dpw.co.santa-cruz.ca.us

Matt Machado - Deputy CAO / Director

Jocelyn Drake	Stephanie Hansen	Vacant	Steve Wiesner	Damon Adlao	Kim Moore
Assistant Director	Assistant Director	Assistant Director	Assistant Director	Director	Assistant Director
Permit Division	Housing & Policy	Special Services	Transportation	Capital Projects	Administration

NOTICE

Date:	February 15, 2024
To:	Interested Parties All Recipients on the Distribution List
Lead Agency:	County of Santa Cruz
Contact:	Nicole Steel, Project Manager 701 Ocean Street, Room 410, Santa Cruz CA 95060 (831) 454-5139, BuenaVistaProject@santacruzcountyca.gov
Subject:	Notice of Preparation of an Environmental Impact Report (EIR) and Scoping Meeting
Project Title:	Buena Vista Landfill Redevelopment Project

NOTICE IS HEREBY GIVEN THAT the County of Santa Cruz (County) will be the Lead Agency and will host a scoping meeting and prepare an Environmental Impact Report (EIR) to assess the potential project impacts of the project described below on the environment, pursuant to the requirements of the California Environmental Quality Act (CEQA).

THE PURPOSE OF THIS NOTICE IS to solicit public input on environmental concerns and alternatives to be evaluated in the EIR for the Buena Vista Landfill Redevelopment Project (Project). Responsible agencies may need to use the EIR when considering permits or other approvals for the project, and trustee agencies should plan to review and comment on the EIR with respect to trust resources within their jurisdiction.

The focus of this notice and the scoping meeting is specifically to gather input on potential environmental issues and project alternatives to be evaluated in the environmental review process, not the merits of the project itself or the project design.

THE PURPOSE OF THIS PROJECT IS to ensure an orderly landfill closure program that meets State requirements and provides on-going solid waste handling capabilities to allow the

County to meet State required waste management goals for waste reduction, source separation, materials recycling, and organics diversion.

PUBLIC INPUT DUE DATE: Written comments should be submitted or postmarked to the locations below within 30 days of the receipt of this Notice, as provided by State law, and thus should be received no later than **5:00 p.m. on March 18, 2024**. Please include the commenter's name, agency, or organization (if applicable), phone number, and email (typed or written legibly) in your response. The focus of the NOP and your comments is specifically to gather input on potential environmental issues and project alternatives to be evaluated in the EIR, not the merits of the project itself or the project design.

Nicole Steel, Project Manager
County of Santa Cruz, Department of Public Works
701 Ocean Street, Room 410
Santa Cruz, California 95060
Email: BuenaVistaProject@santacruzcountyca.gov
Comment form on project website: bit.ly/buena-vista-comment

PROJECT LOCATION AND DESCRIPTION:
The Buena Vista Landfill Redevelopment Project site is the County's Buena Vista Landfill, located at the intersection of Harkins Slough Road and Buena Vista Drive in unincorporated southern Santa Cruz County, within the California Coastal Zone (Figure 1). The Buena Vista Landfill is projected to reach its capacity between 2030-2034 depending on the rate of the annual tonnage of waste disposed at the landfill. The purpose of the redevelopment Project is to ensure an orderly landfill closure program that meets State requirements and provides on-going solid waste handling capabilities to allow the County to meet State required waste management goals for waste reduction, source separation, materials recycling, and organics diversion.

The proposed Project includes three primary components: 1) Developing two new waste transfer stations at the existing landfill site to implement transfer station operations for waste handling and transport; 2) Developing an organics diversion facility to support organics waste processing and diversion; and 3) Implementing the landfill closure plan once site capacity is reached. The Project is planned to be implemented by 2028.

The EIR will include an evaluation and disclosure of the potential impacts associated with the Project, in accordance with State law and the CEQA Guidelines. As required by CEQA, the County will also consider other project alternatives, which must meet most of the project objectives while substantially lessening or avoiding any of the significant impacts of the proposed project. As part of this scoping process, the County is soliciting input from agencies and the public on additional alternatives that should be considered. Comments regarding suggested alternatives should include a clear description in narrative and graphic formats to the extent possible, and the commenter's thoughts on how it would reduce impacts.

PROBABLE ENVIRONMENTAL EFFECTS:
Although, at this very early stage of the environmental review process, it is impossible to know with certainty the precise nature and extent of the environmental effects that will be identified as preparation of the Draft EIR gets underway, it is possible to identify key categories of environmental effects that the proposed Project may affect. These include Agricultural Resources, Air Quality, Biological Resources, Cultural Resources, Geology/Soils, Greenhouse Gas Emissions/Climate Change, Hazards and Hazardous Materials, Hydrology and Water Quality, Land Use and Planning, Noise, Transportation/Circulation, and Tribal Resources.

SCOPING MEETING:
Pursuant to the public participation goals of CEQA, as set forth in particular in Public Resources Code section 21083.9, subdivision (a), the County will host an EIR Scoping Meeting at the date, time and location indicated below to share information about the project and gather additional input on the scope of the EIR analysis. The meeting will be hybrid, whereby people may attend either in person or virtually.

WEDNESDAY, FEBRUARY 28, 2024, 5:00 PM

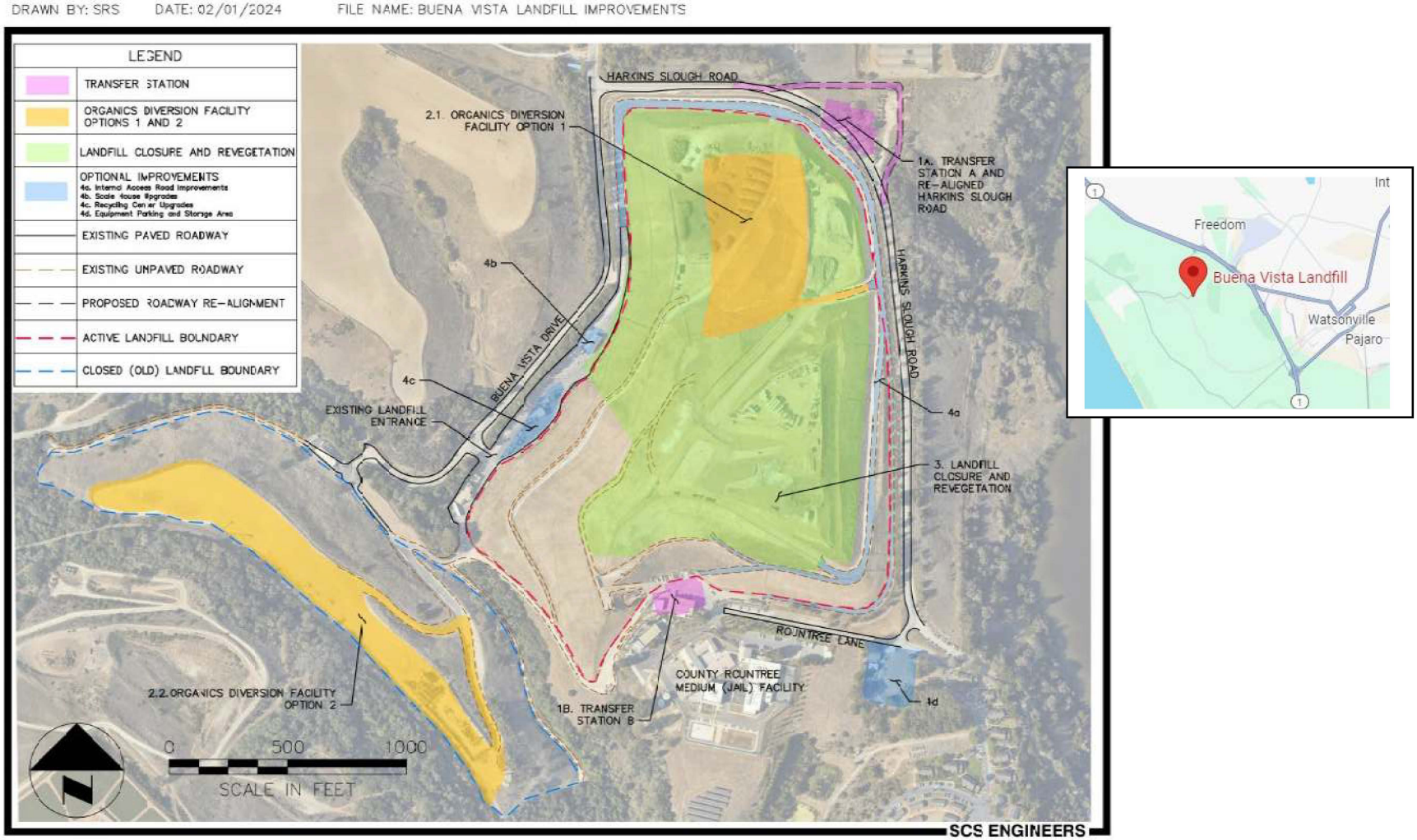
Aptos Library Community Room
7695 Soquel Drive, Aptos, California 95003

Click the link below to join the webinar:
https://us02web.zoom.us/j/86862334085
Meeting ID: 868 6233 4085

Call-in Options via Telephone:
• +1 669 900 6833 US (San Jose)
Meeting ID: 868 6233 4085
Find your local number: https://us02web.zoom.us/u/kQPNM3WzJ

ACCOMMODATIONS FOR PERSONS WITH DISABILITIES:
The County of Santa Cruz does not discriminate on the basis of disability, and no person shall, by reason of a disability, be denied the benefits of its services, programs, or activities. If you are a person with a disability, specifically a communication disability, and you would like to request a reasonable modification or accommodation to fully participate in the meeting via videoconference or telephone, please contact the Department of Public Works at (831) 454-2160 or nicole.steel@santacruzcounty.us at least 24 hours in advance of the meeting to discuss your accessibility needs. Persons with disabilities may request a copy of the agenda and presentation in an alternative format.

Figure 1. Buena Vista Landfill Redevelopment Project Area Map



From:	Limon, Jessica@Wildlife
To:	BuenaVistaProject; Nicole Steel
Cc:	OPR State Clearinghouse; Stokes, Wesley@Wildlife; Weightman, Craig@Wildlife; Galli, Emily@Wildlife; Culpepper, Amanda(Mandy)@Wildlife
Subject:	Buena Vista Landfill Redevelopment Project-SCH2024020617
Date:	Thursday, March 14, 2024 4:12:01 PM
Attachments:	image001.png image002.png Buena Vista Landfill Redevelopment Project-SCH2024020617-Steel-GALLI03142024.pdf

****CAUTION:This is an EXTERNAL email. Exercise caution. DO NOT open attachments or click links from unknown senders or unexpected email.****

Good afternoon,

Please see the attached letter for your records. If you have any questions, contact Emily Galli, cc'd above.

Thank you,

Jessica Limon
Staff Services Analyst/ Administrative Support Analyst
California Department of Fish and Wildlife – Bay Delta Region

2109 Arch Airport Rd., Stockton, CA 95206
209-616-6011
jessica.limon@wildlife.ca.gov

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State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Bay Delta Region
2825 Cordelia Road, Suite 100
Fairfield, CA 94534
(707) 428-2002
www.wildlife.ca.gov

GAVIN NEWSOM, Governor
CHARLTON H. BONHAM, Director

March 14, 2024

Nicole Steel
County of Santa Cruz
701 Ocean Street, Room 410
Santa Cruz, CA 95060
BuenaVistaProject@santacruzcountyca.gov

Subject: Buena Vista Landfill Redevelopment Project, Notice of Preparation of a Draft Environmental Impact Report, SCH No. 2024020617, City of Watsonville, Santa Cruz County

Dear Ms. Steel:

The California Department of Fish and Wildlife (CDFW) has reviewed the County of Santa Cruz (County) Notice of Preparation (NOP) of a draft Environmental Impact Report (EIR) for the Buena Vista Landfill Redevelopment Project (Project) pursuant the California Environmental Quality Act (CEQA) and CEQA Guidelines.[1]

Thank you for the opportunity to provide comments and recommendations regarding those activities involved in the Project that may affect fish and wildlife resources of the State. Please be advised, by law, CDFW may be required to carry out or approve through the exercise of its own regulatory authority under the Fish and Game Code.

CDFW is providing the County, as the Lead Agency, with specific detail about the scope and content of the environmental information related to CDFW's area of statutory responsibility that must be included in the EIR (Cal. Code Regs., tit. 14, § 15082, subd. (b)).

CDFW ROLE

CDFW is California's **Trustee Agency** for fish and wildlife resources and holds those resources in trust by statute for all the people of the State. (Fish & G. Code, §§ 711.7, subd. (a) & 1802; Pub. Resources Code, § 21070; CEQA Guidelines § 15386, subd. (a)). CDFW, in its trustee capacity, has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and habitat necessary for biologically sustainable populations of those species. (*Id.*, § 1802.) For purposes of CEQA, CDFW is charged by law to provide, as available, biological expertise during public agency

[1] CEQA is codified in the California Public Resources Code in section 21000 et seq. The "CEQA Guidelines" are found in Title 14 of the California Code of Regulations, commencing with section 15000.

environmental review efforts, focusing specifically on projects and related activities that have the potential to adversely affect fish and wildlife resources.

CDFW is also submitting comments as a **Responsible Agency** under CEQA. (Pub. Resources Code, § 21069; CEQA Guidelines, § 15381). CDFW expects that it may need to exercise regulatory authority over the Project pursuant to the Fish and Game Code. For example, the Project may be subject to CDFW's Lake and Streambed Alteration (LSA) regulatory authority, if the Project impacts the bed, channel or bank of any river, stream or lake within the State (Fish & G. Code, § 1600 et seq.). Likewise, to the extent the Project may result in "take" as defined by State law of any species protected under the California Endangered Species Act (CESA) (Fish & G. Code, § 2050 et seq.), the Project proponent may seek related take authorization as provided by the Fish and Game Code.

REGULATORY REQUIREMENTS

California Endangered Species Act

A CESA Incidental Take Permit (ITP) must be obtained from CDFW if the Project has the potential to result in "take" of plants or animals listed under CESA, either during construction or over the life of the Project. Under CESA, "take" means "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill." (Fish & G. Code, § 86). CDFW's issuance of an ITP is subject to CEQA and to facilitate permit issuance, any Project modifications and mitigation measures must be incorporated into the CEQA document analysis, discussion, and mitigation monitoring and reporting program. If the Project will impact CESA listed species, early consultation is enc Vouraged, as significant modification to the Project and mitigation measures may be required in order to obtain a CESA Permit.

CEQA requires a mandatory finding of significance if a project is likely to substantially impact threatened or endangered species. Pub. Resources Code, §§ 21001, subd. (c) & 21083; CEQA Guidelines, §§ 15380, 15064 & 15065). In addition, pursuant to CEQA, the Lead Agency cannot approve a project unless all impacts to the environment are avoided or mitigated to less-than-significant levels, or the Lead Agency makes and supports Findings of Overriding Consideration for impacts that remain significant despite the implementation of all feasible mitigation. FOC under CEQA, however, do not eliminate the Project proponent's obligation to comply with the Fish and Game Code.

Lake and Streambed Alteration

CDFW requires an LSA Notification, pursuant to Fish and Game Code section 1600 et seq., for Project activities affecting rivers, lakes or streams and associated riparian habitat. Notification is required for any activity that may substantially divert or obstruct the natural flow; change or use material from the bed, channel, or bank (including

associated riparian or wetland resources); or deposit or dispose of material where it may pass into a river, lake, or stream. Work within ephemeral streams, drainage ditches, washes, watercourses with a subsurface flow, and floodplains is generally subject to notification requirements. In addition, infrastructure installed beneath such aquatic features, such as through hydraulic directional drilling, is also generally subject to notification requirements**.** Therefore, any impact to the mainstems, tributaries, or floodplains or associated riparian habitat caused by the proposed Project will likely require an LSA Notification. CDFW may not execute a final LSA Agreement until it has considered the final EIR and complied with its responsibilities as a responsible agency under CEQA.

Migratory Birds and Raptors

CDFW has authority over actions that may result in the disturbance or destruction of active bird nest sites or the unauthorized take of birds. Fish and Game Code sections protecting birds, their eggs, and nests include section 3503 (regarding unlawful take, possession, or needless destruction of the nests or eggs of any bird), section 3503.5 (regarding the take, possession, or destruction of any birds-of-prey or their nests or eggs), and section 3513 (regarding unlawful take of any migratory nongame bird). Migratory birds are also protected under the federal Migratory Bird Treaty Act.

Fully Protected Species

Fully protected species, such as Santa Cruz long-toed salamander (*Ambystoma macrodactylum croceum*), may not be taken or possessed at any time and no licenses or permits may be issued for their take except as follows:

- Take is for necessary scientific research;
- Efforts to recover a fully protected, endangered, or threatened species, live capture and relocation of a bird species for the protection of livestock; or
- They are a covered species whose conservation and management is provided for in a Natural Community Conservation Plan (Fish & G. Code, §§ 3511, 4700, 5050, & 5515).

Specified types of infrastructure projects may be eligible for an ITP for unavoidable impacts to fully protected species if certain conditions are met (see Fish & G. Code §2081.15). Project proponents should consult with CDFW early in the Project planning process.

PROJECT DESCRIPTION AND LOCATION SUMMARY

Proponent: County of Santa Cruz

Objective: The objective of the Project includes three primary components: 1) Developing two new waste transfer stations at the existing landfill site to implement transfer station operations for waste handling and transport; 2) Developing an organics diversion facility to support organics waste processing and diversion; and 3) Implementing the landfill closure plan once site capacity is reached.

Location: City of Watsonville, Santa Cruz County, and Harkins Slough Road and Buena Vista Drive, and GPS Latitude 36.918300, Longitude -121.810584.

Timeframe: The Project is planned to be implemented by 2028.

The CEQA Guidelines (§§15124 & 15378) require that the draft EIR incorporate a full Project description, including reasonably foreseeable future phases of the Project, and that contains sufficient information to evaluate and review the Project's environmental impact. Please include a complete description of the following Project components in the Project description including, but not limited to the below information.

- Land use changes resulting from, for example, rezoning certain areas.
- Footprints of permanent Project features and temporarily impacted areas, such as staging areas and access routes.
- Area and plans for any proposed buildings/structures, ground-disturbing activities, fencing, paving, stationary machinery, landscaping, and stormwater systems.
- Operational features of the Project, including level of anticipated human presence (describe seasonal or daily peaks in activity, if relevant), artificial lighting/light reflection, noise, traffic generation, and other features.
- Construction schedule, activities, equipment, and crew sizes.

ENVIRONMENTAL SETTING

Sufficient information regarding the environmental setting is necessary to understand any potentially significant impacts on the environment of the proposed Project and any alternatives identified in the draft EIR (CEQA Guidelines, §§15125 & 15360). CDFW recommends the draft EIR provide baseline habitat assessments for special-status plant, fish and wildlife species located and potentially located within the Project area and surrounding lands, including all rare, threatened, and endangered species (CEQA Guidelines, §15380). The draft EIR should describe aquatic habitats, such as wetlands or waters of the U.S. or State, and any sensitive natural communities or riparian habitat occurring on or adjacent to the Project site (for sensitive natural communities see:https://wildlife.ca.gov/Data/VegCAMP/NaturalCommunities#sensitive%20natural%2

0communities), and any stream or wetland set back distances the County may require. Fully protected, threatened or endangered, candidate, and other special-status species or sensitive natural communities that are known to occur, or have the potential to occur in or near the Project site, include, but are not limited to: the species listed in Attachment A.

Habitat descriptions and species profiles included in the draft EIR should include robust information from multiple sources: aerial imagery; historical and recent survey data; field reconnaissance; scientific literature and reports; U.S. Fish and Wildlife Service's (USFWS) Information, Planning, and Consultation System; California Aquatic Resources Inventory; and findings from "positive occurrence" databases such as California Natural Diversity Database (CNDDB). Only with sufficient data and information can the County adequately assess which special-status species are likely to occur in the Project vicinity.

CDFW recommends surveys be conducted for special-status species with potential to occur, following recommended survey protocols if available. Survey and monitoring protocols and guidelines are available at: https://www.wildlife.ca.gov/Conservation/Survey-Protocol.

Botanical surveys for special-status plant species, including those listed by the California Native Plant Society (http://www.cnps.org/cnps/rareplants/inventory/), should also be conducted during the blooming period for all sensitive plant species potentially occurring within the Project area and include the identification of reference populations. Please refer to CDFW protocols for surveying and evaluating impacts to rare plants available at: https://www.wildlife.ca.gov/Conservation/Plants.

IMPACT ANALYSIS AND MITIGATION MEASURES

The CEQA Guidelines (§15126.2) necessitate the draft EIR discuss all direct and indirect impacts (temporary and permanent) that may occur with implementation of the Project. This includes evaluating and describing impacts such as:

- Land use changes that would reduce open space or agricultural land uses and increase residential or other land use involving increased development;
- Changes in hydrological conditions that could alter the timing and magnitude of streamflows both during construction and operation of the Project;
- Potential for impacts to special-status species;
- Loss or modification of breeding, nesting, dispersal and foraging habitat, including vegetation removal, alternation of soils and hydrology, and removal of habitat structural features (e.g., snags, roosts, overhanging banks);

- Permanent and temporary habitat disturbances associated with ground disturbance, noise, lighting, reflection, air pollution, traffic or human presence; and

- Obstruction of movement corridors, fish passage, or access to water sources and other core habitat features.

- Water quality impacts resulting from construction and operation of the Project;

- Impacts both from construction and operation of the Project;

- Impacts to the bed, channel, and bank, in the reservoirs and creeks downstream of the Project;

- Impacts to bed, channel, bank, and riparian habitat, and the direct and indirect effects to fish, wildlife, and their habitat;

The CEQA document also should identify existing and reasonably foreseeable future projects in the Project vicinity, disclose any cumulative impacts associated with these projects, determine the significance of each cumulative impact, and assess the significance of the Project's contribution to each impact (CEQA Guidelines, §15355). Although a project's impacts may be insignificant individually, its contributions to a cumulative impact may be considerable; a contribution to a significant cumulative impact (e.g., reduction of available habitat for a listed species) should be considered cumulatively considerable without mitigation to minimize or avoid the impact.

The CEQA Guidelines direct the County, as the Lead Agency, to consider and describe in the draft EIR all feasible mitigation measures to avoid and/or mitigate potentially significant impacts of the Project on the environment based on comprehensive analysis of the potential direct, indirect, and cumulative impacts of the Project. (CEQA Guidelines, §§ 15021, 15063, 15071, 15126.2, 15126.4 & 15370.) This should include a discussion of take avoidance and minimization measures for special-status species, which are recommended to be developed in early consultation with the USFWS, the National Marine Fisheries Service and CDFW. These measures can then be incorporated as enforceable Project conditions to reduce potential impacts to biological resources to less-than-significant levels.

ENVIRONMENTAL DATA

CEQA requires that information developed in environmental impact reports and negative declarations be incorporated into a database which may be used to prepare subsequent CEQA documents or to make supplemental environmental determinations. (Pub. Resources Code, § 21003, subd. (d) & (e)). Accordingly, please report any

special-status species and natural communities detected during Project surveys to the CNDDB. The CNNDB field survey form can be filled out and submitted online here: https://wildlife.ca.gov/Data/CNDDB/Submitting-Data. The types of information reported to CNDDB can be found here: https://www.wildlife.ca.gov/Data/CNDDB/Plants-and-Animals.

ENVIRONMENTAL DOCUMENT FILING FEES

CDFW anticipates that the proposed Project, will have an impact on fish and/or wildlife, and assessment of environmental document filing fees is necessary. Fees are payable upon filing of the Notice of Determination by the Lead Agency and serve to help defray the cost of environmental review by CDFW. Payment of the environmental document filing fee is required in order for the underlying project approval to be operative, vested, and final. (Cal. Code Regs, tit. 14, § 753.5; Fish & G. Code, § 711.4; Pub. Resources Code, § 21089).

CONCLUSION

CDFW appreciates the opportunity to comment on the NOP in order to assist the County in identifying and mitigating Project impacts on biological resources.

Questions regarding this letter or further coordination should be directed to Emily Galli, Environmental Scientist at 707-210-4531 or Emily.Galli@wildlife.ca.gov or Wes Stokes, Senior Environmental Scientist (Supervisory) at (707) 339-6066 or Wesley.Stokes@wildlife.ca.gov.

Sincerely,

DocuSigned by:
Erin Chappell
B77E9A6211EF486...

Erin Chappell
Regional Manager
Bay Delta Region

Attachment A: California Natural Diversity Database: Species in Watsonville West Quad

ec: Office of Planning and Research, State Clearinghouse (SCH No.2024020617)

Species in a 9-Quad Radius from Project Site

Table extracted from California Natural Diversity Database (CNDDB) on 03/11/2024

Element_Type	Scientific_Name	Common_Name	Element_Code	Federal_Status	State_Status	CDFW_Status	CA_Rare_Plant_Rank	Quad_Code	Quad_Name	Data_Status	Taxonomic_
Animals - Amphibians	Ambystoma californiense pop. 1	California tiger salamander - central California DPS	AAAAA01181	Threatened	Threatened	WL	-	3712116	MT. MADONNA	Mapped and Unprocessed	Animals - Amphibians - Ambystomati Ambystoma californiense 1
Animals - Amphibians	Ambystoma californiense pop. 1	California tiger salamander - central California DPS	AAAAA01181	Threatened	Threatened	WL	-	3612187	WATSONVILLE WEST	Mapped and Unprocessed	Animals - Amphibians - Ambystomati Ambystoma californiense 1
Animals - Amphibians	Ambystoma californiense pop. 1	California tiger salamander - central California DPS	AAAAA01181	Threatened	Threatened	WL	-	3612186	WATSONVILLE EAST	Mapped	Animals - Amphibians - Ambystomati Ambystoma californiense 1
Animals - Amphibians	Ambystoma californiense pop. 1	California tiger salamander - central California DPS	AAAAA01181	Threatened	Threatened	WL	-	3612177	MOSS LANDING	Mapped and Unprocessed	Animals - Amphibians - Ambystomati Ambystoma californiense 1
Animals - Amphibians	Ambystoma californiense pop. 1	California tiger salamander - central California DPS	AAAAA01181	Threatened	Threatened	WL	-	3612176	PRUNEDALE	Mapped and Unprocessed	Animals - Amphibians - Ambystomati Ambystoma californiense 1
Animals - Amphibians	Ambystoma macrodactylum croceum	Santa Cruz long-toed salamander	AAAAA01082	Endangered	Endangered	FP	-	3612176	PRUNEDALE	Mapped and Unprocessed	Animals - Amphibians - Ambystomati Ambystoma macrodactylu croceum
Animals - Amphibians	Ambystoma macrodactylum croceum	Santa Cruz long-toed salamander	AAAAA01082	Endangered	Endangered	FP	-	3612177	MOSS LANDING	Mapped and Unprocessed	Animals - Amphibians - Ambystomati Ambystoma macrodactylu croceum
Animals - Amphibians	Ambystoma macrodactylum croceum	Santa Cruz long-toed salamander	AAAAA01082	Endangered	Endangered	FP	-	3612187	WATSONVILLE WEST	Mapped and Unprocessed	Animals - Amphibians - Ambystomati Ambystoma macrodactylu croceum
Animals - Amphibians	Ambystoma macrodactylum croceum	Santa Cruz long-toed salamander	AAAAA01082	Endangered	Endangered	FP	-	3612188	SOQUEL	Mapped and Unprocessed	Animals - Amphibians - Ambystomati Ambystoma macrodactylu croceum
Animals - Amphibians	Ambystoma macrodactylum croceum	Santa Cruz long-toed salamander	AAAAA01082	Endangered	Endangered	FP	-	3712117	LOMA PRIETA	Mapped	Animals - Amphibians - Ambystomati

											Ambystoma macrodactylu croceum
Animals - Amphibians	Dicamptodon ensatus	California giant salamander	AAAAH01020	None	None	SSC	-	3712117	LOMA PRIETA	Mapped and Unprocessed	Animals - Amphibians - Dicamptodon - Dicamptodo ensatus
Animals - Amphibians	Dicamptodon ensatus	California giant salamander	AAAAH01020	None	None	SSC	-	3712118	LAUREL	Mapped and Unprocessed	Animals - Amphibians - Dicamptodon - Dicamptodo ensatus
Animals - Amphibians	Dicamptodon ensatus	California giant salamander	AAAAH01020	None	None	SSC	-	3712116	MT. MADONNA	Mapped	Animals - Amphibians - Dicamptodon - Dicamptodo ensatus
Animals - Amphibians	Dicamptodon ensatus	California giant salamander	AAAAH01020	None	None	SSC	-	3612188	SOQUEL	Mapped and Unprocessed	Animals - Amphibians - Dicamptodon - Dicamptodo ensatus
Animals - Amphibians	Dicamptodon ensatus	California giant salamander	AAAAH01020	None	None	SSC	-	3612187	WATSONVILLE WEST	Mapped and Unprocessed	Animals - Amphibians - Dicamptodon - Dicamptodo ensatus
Animals - Amphibians	Dicamptodon ensatus	California giant salamander	AAAAH01020	None	None	SSC	-	3612186	WATSONVILLE EAST	Mapped and Unprocessed	Animals - Amphibians - Dicamptodon - Dicamptodo ensatus
Animals - Amphibians	Aneides niger	Santa Cruz black salamander	AAAAD01070	None	None	SSC	-	3612186	WATSONVILLE EAST	Mapped	Animals - Amphibians - Plethodontida Aneides niger
Animals - Amphibians	Aneides niger	Santa Cruz black salamander	AAAAD01070	None	None	SSC	-	3612187	WATSONVILLE WEST	Mapped	Animals - Amphibians - Plethodontida Aneides niger
Animals - Amphibians	Aneides niger	Santa Cruz black salamander	AAAAD01070	None	None	SSC	-	3712116	MT. MADONNA	Mapped	Animals - Amphibians - Plethodontida Aneides niger
Animals - Amphibians	Aneides niger	Santa Cruz black salamander	AAAAD01070	None	None	SSC	-	3712118	LAUREL	Mapped and Unprocessed	Animals - Amphibians - Plethodontida Aneides niger
Animals - Amphibians	Aneides niger	Santa Cruz black salamander	AAAAD01070	None	None	SSC	-	3712117	LOMA PRIETA	Mapped and Unprocessed	Animals - Amphibians - Plethodontida Aneides niger
Animals - Amphibians	Rana boylii pop. 4	foothill yellow-legged frog - central coast DPS	AAABH01054	Threatened	Endangered	-	-	3712117	LOMA PRIETA	Mapped and Unprocessed	Animals - Amphibians - Ranidae - Ra boylii pop. 4

Animals - Amphibians	Rana boylii pop. 4	foothill yellow-legged frog - central coast DPS	AAABH01054	Threatened	Endangered	-	-	3712118	LAUREL	Mapped and Unprocessed	Animals - Amphibians - Ranidae - Ra boylii pop. 4
Animals - Amphibians	Rana boylii pop. 4	foothill yellow-legged frog - central coast DPS	AAABH01054	Threatened	Endangered	-	-	3712116	MT. MADONNA	Mapped	Animals - Amphibians - Ranidae - Ra boylii pop. 4
Animals - Amphibians	Rana boylii pop. 4	foothill yellow-legged frog - central coast DPS	AAABH01054	Threatened	Endangered	-	-	3612187	WATSONVILLE WEST	Mapped	Animals - Amphibians - Ranidae - Ra boylii pop. 4
Animals - Amphibians	Rana boylii pop. 4	foothill yellow-legged frog - central coast DPS	AAABH01054	Threatened	Endangered	-	-	3612188	SOQUEL	Mapped	Animals - Amphibians - Ranidae - Ra boylii pop. 4
Animals - Amphibians	Rana boylii pop. 4	foothill yellow-legged frog - central coast DPS	AAABH01054	Threatened	Endangered	-	-	3612186	WATSONVILLE EAST	Mapped	Animals - Amphibians - Ranidae - Ra boylii pop. 4
Animals - Amphibians	Rana draytonii	California red-legged frog	AAABH01022	Threatened	None	SSC	-	3612186	WATSONVILLE EAST	Mapped and Unprocessed	Animals - Amphibians - Ranidae - Ra draytonii
Animals - Amphibians	Rana draytonii	California red-legged frog	AAABH01022	Threatened	None	SSC	-	3612188	SOQUEL	Mapped and Unprocessed	Animals - Amphibians - Ranidae - Ra draytonii
Animals - Amphibians	Rana draytonii	California red-legged frog	AAABH01022	Threatened	None	SSC	-	3612187	WATSONVILLE WEST	Mapped and Unprocessed	Animals - Amphibians - Ranidae - Ra draytonii
Animals - Amphibians	Rana draytonii	California red-legged frog	AAABH01022	Threatened	None	SSC	-	3712116	MT. MADONNA	Mapped and Unprocessed	Animals - Amphibians - Ranidae - Ra draytonii
Animals - Amphibians	Rana draytonii	California red-legged frog	AAABH01022	Threatened	None	SSC	-	3712118	LAUREL	Mapped and Unprocessed	Animals - Amphibians - Ranidae - Ra draytonii
Animals - Amphibians	Rana draytonii	California red-legged frog	AAABH01022	Threatened	None	SSC	-	3712117	LOMA PRIETA	Mapped and Unprocessed	Animals - Amphibians - Ranidae - Ra draytonii
Animals - Amphibians	Rana draytonii	California red-legged frog	AAABH01022	Threatened	None	SSC	-	3612177	MOSS LANDING	Mapped and Unprocessed	Animals - Amphibians - Ranidae - Ra draytonii
Animals - Amphibians	Rana draytonii	California red-legged frog	AAABH01022	Threatened	None	SSC	-	3612176	PRUNEDALE	Mapped and Unprocessed	Animals - Amphibians - Ranidae - Ra draytonii
Animals - Amphibians	Taricha torosa	Coast Range newt	AAAAF02032	None	None	SSC	-	3612176	PRUNEDALE	Unprocessed	Animals - Amphibians - Salamandrida Taricha torosa

Animals - Birds	Accipiter cooperii	Coopers hawk	ABNKC12040	None	None	WL	-	3712118	LAUREL	Unprocessed	Animals - Birc Accipitridae - Accipiter coop
Animals - Birds	Accipiter cooperii	Coopers hawk	ABNKC12040	None	None	WL	-	3612187	WATSONVILLE WEST	Mapped and Unprocessed	Animals - Birc Accipitridae - Accipiter coop
Animals - Birds	Accipiter cooperii	Coopers hawk	ABNKC12040	None	None	WL	-	3612186	WATSONVILLE EAST	Unprocessed	Animals - Birc Accipitridae - Accipiter coop
Animals - Birds	Accipiter striatus	sharp-shinned hawk	ABNKC12020	None	None	WL	-	3712118	LAUREL	Unprocessed	Animals - Birc Accipitridae - Accipiter stria
Animals - Birds	Accipiter striatus	sharp-shinned hawk	ABNKC12020	None	None	WL	-	3712117	LOMA PRIETA	Unprocessed	Animals - Birc Accipitridae - Accipiter stria
Animals - Birds	Aquila chrysaetos	golden eagle	ABNKC22010	None	None	FP | WL	-	3712117	LOMA PRIETA	Mapped and Unprocessed	Animals - Birc Accipitridae - Aquila chrysa
Animals - Birds	Aquila chrysaetos	golden eagle	ABNKC22010	None	None	FP | WL	-	3712116	MT. MADONNA	Mapped	Animals - Birc Accipitridae - Aquila chrysa
Animals - Birds	Aquila chrysaetos	golden eagle	ABNKC22010	None	None	FP | WL	-	3712118	LAUREL	Unprocessed	Animals - Birc Accipitridae - Aquila chrysa
Animals - Birds	Aquila chrysaetos	golden eagle	ABNKC22010	None	None	FP | WL	-	3612187	WATSONVILLE WEST	Unprocessed	Animals - Birc Accipitridae - Aquila chrysa
Animals - Birds	Aquila chrysaetos	golden eagle	ABNKC22010	None	None	FP | WL	-	3612188	SOQUEL	Unprocessed	Animals - Birc Accipitridae - Aquila chrysa
Animals - Birds	Aquila chrysaetos	golden eagle	ABNKC22010	None	None	FP | WL	-	3612177	MOSS LANDING	Unprocessed	Animals - Birc Accipitridae - Aquila chrysa
Animals - Birds	Elanus leucurus	white-tailed kite	ABNKC06010	None	None	FP	-	3612176	PRUNEDALE	Mapped	Animals - Birc Accipitridae - Elanus leucur
Animals - Birds	Elanus leucurus	white-tailed kite	ABNKC06010	None	None	FP	-	3612188	SOQUEL	Unprocessed	Animals - Birc Accipitridae - Elanus leucur
Animals - Birds	Elanus leucurus	white-tailed kite	ABNKC06010	None	None	FP	-	3612187	WATSONVILLE WEST	Unprocessed	Animals - Birc Accipitridae - Elanus leucur
Animals - Birds	Elanus leucurus	white-tailed kite	ABNKC06010	None	None	FP	-	3712118	LAUREL	Unprocessed	Animals - Birc Accipitridae - Elanus leucur
Animals - Birds	Elanus leucurus	white-tailed kite	ABNKC06010	None	None	FP	-	3712117	LOMA PRIETA	Unprocessed	Animals - Birc Accipitridae - Elanus leucur
Animals - Birds	Haliaeetus leucocephalus	bald eagle	ABNKC10010	Delisted	Endangered	FP	-	3712117	LOMA PRIETA	Unprocessed	Animals - Birc Accipitridae - Haliaeetus leucocephalu
Animals - Birds	Haliaeetus leucocephalus	bald eagle	ABNKC10010	Delisted	Endangered	FP	-	3712118	LAUREL	Unprocessed	Animals - Birc Accipitridae - Haliaeetus leucocephalu

Animals - Birds	Haliaeetus leucocephalus	bald eagle	ABNKC10010	Delisted	Endangered	FP	-	3712116	MT. MADONNA	Unprocessed	Animals - Birc Accipitridae - Haliaeetus leucocephalu
Animals - Birds	Ptychoramphus aleuticus	Cassins auklet	ABNNN08010	None	None	SSC	-	3612188	SOQUEL	Unprocessed	Animals - Birc Alcidae - Ptychoramph aleuticus
Animals - Birds	Ptychoramphus aleuticus	Cassins auklet	ABNNN08010	None	None	SSC	-	3612187	WATSONVILLE WEST	Unprocessed	Animals - Birc Alcidae - Ptychoramph aleuticus
Animals - Birds	Ptychoramphus aleuticus	Cassins auklet	ABNNN08010	None	None	SSC	-	3612177	MOSS LANDING	Unprocessed	Animals - Birc Alcidae - Ptychoramph aleuticus
Animals - Birds	Chaetura vauxi	Vauxs swift	ABNUA03020	None	None	SSC	-	3612188	SOQUEL	Unprocessed	Animals - Birc Apodidae - Chaetura vau
Animals - Birds	Chaetura vauxi	Vauxs swift	ABNUA03020	None	None	SSC	-	3712117	LOMA PRIETA	Unprocessed	Animals - Birc Apodidae - Chaetura vau
Animals - Birds	Chaetura vauxi	Vauxs swift	ABNUA03020	None	None	SSC	-	3712118	LAUREL	Unprocessed	Animals - Birc Apodidae - Chaetura vau
Animals - Birds	Cypseloides niger	black swift	ABNUA01010	None	None	SSC	-	3712118	LAUREL	Unprocessed	Animals - Birc Apodidae - Cypseloides r
Animals - Birds	Cypseloides niger	black swift	ABNUA01010	None	None	SSC	-	3712117	LOMA PRIETA	Unprocessed	Animals - Birc Apodidae - Cypseloides r
Animals - Birds	Ardea alba	great egret	ABNGA04040	None	None	-	-	3712116	MT. MADONNA	Unprocessed	Animals - Birc Ardeidae - Ar alba
Animals - Birds	Ardea alba	great egret	ABNGA04040	None	None	-	-	3612187	WATSONVILLE WEST	Unprocessed	Animals - Birc Ardeidae - Ar alba
Animals - Birds	Ardea alba	great egret	ABNGA04040	None	None	-	-	3612177	MOSS LANDING	Unprocessed	Animals - Birc Ardeidae - Ar alba
Animals - Birds	Ardea herodias	great blue heron	ABNGA04010	None	None	-	-	3612177	MOSS LANDING	Unprocessed	Animals - Birc Ardeidae - Ar herodias
Animals - Birds	Ardea herodias	great blue heron	ABNGA04010	None	None	-	-	3612187	WATSONVILLE WEST	Unprocessed	Animals - Birc Ardeidae - Ar herodias
Animals - Birds	Ardea herodias	great blue heron	ABNGA04010	None	None	-	-	3712116	MT. MADONNA	Unprocessed	Animals - Birc Ardeidae - Ar herodias
Animals - Birds	Nycticorax nycticorax	black-crowned night heron	ABNGA11010	None	None	-	-	3612177	MOSS LANDING	Unprocessed	Animals - Birc Ardeidae - Nycticorax nycticorax
Animals - Birds	Gymnogyps californianus	California condor	ABNKA03010	Endangered	Endangered	FP	-	3612188	SOQUEL	Unprocessed	Animals - Birc Cathartidae - Gymnogyps californianus

Animals - Birds	Charadrius montanus	mountain plover	ABNNB03100	None	None	SSC	-	3612177	MOSS LANDING	Unprocessed	Animals - Birc Charadriidae Charadrius montanus
Animals - Birds	Charadrius nivosus nivosus	western snowy plover	ABNNB03031	Threatened	None	SSC	-	3612177	MOSS LANDING	Mapped and Unprocessed	Animals - Birc Charadriidae Charadrius nivosus nivos
Animals - Birds	Charadrius nivosus nivosus	western snowy plover	ABNNB03031	Threatened	None	SSC	-	3612187	WATSONVILLE WEST	Mapped and Unprocessed	Animals - Birc Charadriidae Charadrius nivosus nivos
Animals - Birds	Falco peregrinus anatum	American peregrine falcon	ABNKD06071	Delisted	Delisted	-	-	3712117	LOMA PRIETA	Unprocessed	Animals - Birc Falconidae - I peregrinus anatum
Animals - Birds	Falco peregrinus anatum	American peregrine falcon	ABNKD06071	Delisted	Delisted	-	-	3712118	LAUREL	Unprocessed	Animals - Birc Falconidae - I peregrinus anatum
Animals - Birds	Falco peregrinus anatum	American peregrine falcon	ABNKD06071	Delisted	Delisted	-	-	3612177	MOSS LANDING	Mapped and Unprocessed	Animals - Birc Falconidae - I peregrinus anatum
Animals - Birds	Gavia immer	common loon	ABNBA01030	None	None	SSC	-	3612177	MOSS LANDING	Unprocessed	Animals - Birc Gaviidae - Ga immer
Animals - Birds	Progne subis	purple martin	ABPAU01010	None	None	SSC	-	3712118	LAUREL	Unprocessed	Animals - Birc Hirundinidae - Progne subis
Animals - Birds	Progne subis	purple martin	ABPAU01010	None	None	SSC	-	3712117	LOMA PRIETA	Unprocessed	Animals - Birc Hirundinidae - Progne subis
Animals - Birds	Progne subis	purple martin	ABPAU01010	None	None	SSC	-	3612188	SOQUEL	Unprocessed	Animals - Birc Hirundinidae - Progne subis
Animals - Birds	Riparia riparia	bank swallow	ABPAU08010	None	Threatened	-	-	3612187	WATSONVILLE WEST	Mapped	Animals - Birc Hirundinidae - Riparia riparia
Animals - Birds	Riparia riparia	bank swallow	ABPAU08010	None	Threatened	-	-	3612186	WATSONVILLE EAST	Mapped	Animals - Birc Hirundinidae - Riparia riparia
Animals - Birds	Riparia riparia	bank swallow	ABPAU08010	None	Threatened	-	-	3612177	MOSS LANDING	Mapped and Unprocessed	Animals - Birc Hirundinidae - Riparia riparia
Animals - Birds	Agelaius tricolor	tricolored blackbird	ABPBXB0020	None	Threatened	SSC	-	3612177	MOSS LANDING	Mapped and Unprocessed	Animals - Birc Icteridae - Agelaius trico
Animals - Birds	Agelaius tricolor	tricolored blackbird	ABPBXB0020	None	Threatened	SSC	-	3612176	PRUNEDALE	Mapped	Animals - Birc Icteridae - Agelaius trico
Animals - Birds	Agelaius tricolor	tricolored blackbird	ABPBXB0020	None	Threatened	SSC	-	3612186	WATSONVILLE EAST	Mapped	Animals - Birc Icteridae - Agelaius trico
Animals - Birds	Agelaius tricolor	tricolored blackbird	ABPBXB0020	None	Threatened	SSC	-	3612187	WATSONVILLE WEST	Mapped	Animals - Birc Icteridae - Agelaius trico

Animals - Birds	Icteria virens	yellow-breasted chat	ABPBX24010	None	None	SSC	-	3612188	SOQUEL	Unprocessed	Animals - Birc Icteriidae - Ict virens
Animals - Birds	Lanius ludovicianus	loggerhead shrike	ABPBR01030	None	None	SSC	-	3612188	SOQUEL	Unprocessed	Animals - Birc Laniidae - Lar ludovicianus
Animals - Birds	Lanius ludovicianus	loggerhead shrike	ABPBR01030	None	None	SSC	-	3712117	LOMA PRIETA	Unprocessed	Animals - Birc Laniidae - Lar ludovicianus
Animals - Birds	Lanius ludovicianus	loggerhead shrike	ABPBR01030	None	None	SSC	-	3712116	MT. MADONNA	Unprocessed	Animals - Birc Laniidae - Lar ludovicianus
Animals - Birds	Lanius ludovicianus	loggerhead shrike	ABPBR01030	None	None	SSC	-	3712118	LAUREL	Unprocessed	Animals - Birc Laniidae - Lar ludovicianus
Animals - Birds	Hydroprogne caspia	Caspian tern	ABNNM08020	None	None	-	-	3612177	MOSS LANDING	Unprocessed	Animals - Birc Laridae - Hydroprogne caspia
Animals - Birds	Sternula antillarum browni	California least tern	ABNNM08103	Endangered	Endangered	FP	-	3612177	MOSS LANDING	Unprocessed	Animals - Birc Laridae - Ster antillarum bro
Animals - Birds	Pandion haliaetus	osprey	ABNKC01010	None	None	WL	-	3712118	LAUREL	Mapped	Animals - Birc Pandionidae - Pandion halia
Animals - Birds	Geothlypis trichas sinuosa	saltmarsh common yellowthroat	ABPBX1201A	None	None	SSC	-	3712118	LAUREL	Unprocessed	Animals - Birc Parulidae - Geothlypis tri sinuosa
Animals - Birds	Geothlypis trichas sinuosa	saltmarsh common yellowthroat	ABPBX1201A	None	None	SSC	-	3712117	LOMA PRIETA	Unprocessed	Animals - Birc Parulidae - Geothlypis tri sinuosa
Animals - Birds	Geothlypis trichas sinuosa	saltmarsh common yellowthroat	ABPBX1201A	None	None	SSC	-	3612187	WATSONVILLE WEST	Unprocessed	Animals - Birc Parulidae - Geothlypis tri sinuosa
Animals - Birds	Ammodramus savannarum	grasshopper sparrow	ABPBXA0020	None	None	SSC	-	3612186	WATSONVILLE EAST	Unprocessed	Animals - Birc Passerellidae Ammodramus savannarum
Animals - Birds	Artemisiospiza belli belli	Bells sparrow	ABPBX97021	None	None	WL	-	3712117	LOMA PRIETA	Unprocessed	Animals - Birc Passerellidae Artemisiospiz belli belli
Animals - Birds	Passerculus sandwichensis alaudinus	Bryants savannah sparrow	ABPBX99011	None	None	SSC	-	3612177	MOSS LANDING	Unprocessed	Animals - Birc Passerellidae Passerculus sandwichensi alaudinus
Animals - Birds	Pelecanus occidentalis californicus	California brown pelican	ABNFC01021	Delisted	Delisted	-	-	3612177	MOSS LANDING	Unprocessed	Animals - Birc Pelecanidae - Pelecanus occidentalis californicus
Animals - Birds	Pelecanus occidentalis	California brown pelican	ABNFC01021	Delisted	Delisted	-	-	3612176	PRUNEDALE	Unprocessed	Animals - Birc Pelecanidae -

	californicus										Pelecanus occidentalis californicus
Animals - Birds	Pelecanus occidentalis californicus	California brown pelican	ABNFC01021	Delisted	Delisted	-	-	3612188	SOQUEL	Unprocessed	Animals - Birc Pelecanidae - Pelecanus occidentalis californicus
Animals - Birds	Nannopterum auritum	double-crested cormorant	ABNFD01020	None	None	WL	-	3612188	SOQUEL	Unprocessed	Animals - Birc Phalacrocora - Nannopteru auritum
Animals - Birds	Nannopterum auritum	double-crested cormorant	ABNFD01020	None	None	WL	-	3612187	WATSONVILLE WEST	Unprocessed	Animals - Birc Phalacrocora - Nannopteru auritum
Animals - Birds	Nannopterum auritum	double-crested cormorant	ABNFD01020	None	None	WL	-	3612177	MOSS LANDING	Unprocessed	Animals - Birc Phalacrocora - Nannopteru auritum
Animals - Birds	Coturnicops noveboracensis	yellow rail	ABNME01010	None	None	SSC	-	3612188	SOQUEL	Mapped	Animals - Birc Rallidae - Coturnicops noveboracens
Animals - Birds	Coturnicops noveboracensis	yellow rail	ABNME01010	None	None	SSC	-	3712118	LAUREL	Mapped	Animals - Birc Rallidae - Coturnicops noveboracens
Animals - Birds	Rallus obsoletus obsoletus	California Ridgways rail	ABNME05011	Endangered	Endangered	FP	-	3612177	MOSS LANDING	Mapped	Animals - Birc Rallidae - Ral obsoletus obsoletus
Animals - Birds	Rallus obsoletus obsoletus	California Ridgways rail	ABNME05011	Endangered	Endangered	FP	-	3612176	PRUNEDALE	Mapped	Animals - Birc Rallidae - Ral obsoletus obsoletus
Animals - Birds	Numenius americanus	long-billed curlew	ABNNF07070	None	None	WL	-	3612176	PRUNEDALE	Unprocessed	Animals - Birc Scolopacidae Numenius americanus
Animals - Birds	Numenius americanus	long-billed curlew	ABNNF07070	None	None	WL	-	3612177	MOSS LANDING	Unprocessed	Animals - Birc Scolopacidae Numenius americanus
Animals - Birds	Asio flammeus	short-eared owl	ABNSB13040	None	None	SSC	-	3612177	MOSS LANDING	Mapped	Animals - Birc Strigidae - As flammeus
Animals - Birds	Athene cunicularia	burrowing owl	ABNSB10010	None	None	SSC	-	3612177	MOSS LANDING	Mapped and Unprocessed	Animals - Birc Strigidae - Ath cunicularia
Animals - Birds	Athene cunicularia	burrowing owl	ABNSB10010	None	None	SSC	-	3612176	PRUNEDALE	Mapped	Animals - Birc Strigidae - Ath cunicularia
Animals - Birds	Athene cunicularia	burrowing owl	ABNSB10010	None	None	SSC	-	3712116	MT. MADONNA	Mapped and Unprocessed	Animals - Birc Strigidae - Ath cunicularia

Animals - Birds	Athene cunicularia	burrowing owl	ABNSB10010	None	None	SSC	-	3612187	WATSONVILLE WEST	Unprocessed	Animals - Birc Strigidae - Ath cunicularia
Animals - Birds	Athene cunicularia	burrowing owl	ABNSB10010	None	None	SSC	-	3612186	WATSONVILLE EAST	Unprocessed	Animals - Birc Strigidae - Ath cunicularia
Animals - Birds	Contopus cooperi	olive-sided flycatcher	ABPAE32010	None	None	SSC	-	3612186	WATSONVILLE EAST	Unprocessed	Animals - Birc Tyrannidae - Contopus coo
Animals - Birds	Contopus cooperi	olive-sided flycatcher	ABPAE32010	None	None	SSC	-	3712117	LOMA PRIETA	Unprocessed	Animals - Birc Tyrannidae - Contopus coo
Animals - Birds	Contopus cooperi	olive-sided flycatcher	ABPAE32010	None	None	SSC	-	3712118	LAUREL	Unprocessed	Animals - Birc Tyrannidae - Contopus coo
Animals - Crustaceans	Linderiella occidentalis	California linderiella	ICBRA06010	None	None	-	-	3612188	SOQUEL	Mapped	Animals - Crustaceans - Chirocephalid Linderiella occidentalis
Animals - Fish	Cottus gulosus	riffle sculpin	AFC4E02140	None	None	SSC	-	3712116	MT. MADONNA	Unprocessed	Animals - Fish Cottidae - Cot gulosus
Animals - Fish	Hesperoleucus venustus subditus	southern coastal roach	AFCJB19032	None	None	SSC	-	3712116	MT. MADONNA	Mapped and Unprocessed	Animals - Fish Cyprinidae - Hesperoleucu venustus sub
Animals - Fish	Lavinia exilicauda harengus	Monterey hitch	AFCJB19013	None	None	SSC	-	3612187	WATSONVILLE WEST	Mapped	Animals - Fish Cyprinidae - Lavinia exilica harengus
Animals - Fish	Lavinia exilicauda harengus	Monterey hitch	AFCJB19013	None	None	SSC	-	3712116	MT. MADONNA	Mapped	Animals - Fish Cyprinidae - Lavinia exilica harengus
Animals - Fish	Lavinia exilicauda harengus	Monterey hitch	AFCJB19013	None	None	SSC	-	3612177	MOSS LANDING	Mapped and Unprocessed	Animals - Fish Cyprinidae - Lavinia exilica harengus
Animals - Fish	Lavinia exilicauda harengus	Monterey hitch	AFCJB19013	None	None	SSC	-	3612186	WATSONVILLE EAST	Mapped	Animals - Fish Cyprinidae - Lavinia exilica harengus
Animals - Fish	Eucyclogobius newberryi	tidewater goby	AFCQN04010	Endangered	None	-	-	3612177	MOSS LANDING	Mapped and Unprocessed	Animals - Fish Gobiidae - Eucyclogobiu newberryi
Animals - Fish	Eucyclogobius newberryi	tidewater goby	AFCQN04010	Endangered	None	-	-	3612187	WATSONVILLE WEST	Mapped and Unprocessed	Animals - Fish Gobiidae - Eucyclogobiu newberryi
Animals - Fish	Eucyclogobius newberryi	tidewater goby	AFCQN04010	Endangered	None	-	-	3612188	SOQUEL	Mapped and Unprocessed	Animals - Fish Gobiidae - Eucyclogobiu newberryi
Animals - Fish	Spirinchus thaleichthys	longfin smelt	AFCHB03010	Proposed Endangered	Threatened	-	-	3612177	MOSS LANDING	Mapped and Unprocessed	Animals - Fish Osmeridae -

											Spirinchus thaleichthys
Animals - Fish	Thaleichthys pacificus	eulachon	AFCHB04010	Threatened	None	-	-	3612188	SOQUEL	Mapped	Animals - Fish Osmeridae - Thaleichthys pacificus
Animals - Fish	Entosphenus tridentatus	Pacific lamprey	AFBAA02100	None	None	SSC	-	3612188	SOQUEL	Unprocessed	Animals - Fish Petromyzonti Entosphenus tridentatus
Animals - Fish	Entosphenus tridentatus	Pacific lamprey	AFBAA02100	None	None	SSC	-	3612187	WATSONVILLE WEST	Unprocessed	Animals - Fish Petromyzonti Entosphenus tridentatus
Animals - Fish	Entosphenus tridentatus	Pacific lamprey	AFBAA02100	None	None	SSC	-	3712116	MT. MADONNA	Unprocessed	Animals - Fish Petromyzonti Entosphenus tridentatus
Animals - Fish	Entosphenus tridentatus	Pacific lamprey	AFBAA02100	None	None	SSC	-	3712118	LAUREL	Unprocessed	Animals - Fish Petromyzonti Entosphenus tridentatus
Animals - Fish	Oncorhynchus kisutch pop. 4	coho salmon - central California coast ESU	AFCHA02034	Endangered	Endangered	-	-	3712118	LAUREL	Mapped and Unprocessed	Animals - Fish Salmonidae - Oncorhynchu kisutch pop. 4
Animals - Fish	Oncorhynchus kisutch pop. 4	coho salmon - central California coast ESU	AFCHA02034	Endangered	Endangered	-	-	3612188	SOQUEL	Unprocessed	Animals - Fish Salmonidae - Oncorhynchu kisutch pop. 4
Animals - Fish	Oncorhynchus mykiss irideus pop. 8	steelhead - central California coast DPS	AFCHA0209G	Threatened	None	-	-	3612188	SOQUEL	Mapped and Unprocessed	Animals - Fish Salmonidae - Oncorhynchu mykiss irideus pop. 8
Animals - Fish	Oncorhynchus mykiss irideus pop. 8	steelhead - central California coast DPS	AFCHA0209G	Threatened	None	-	-	3612187	WATSONVILLE WEST	Mapped and Unprocessed	Animals - Fish Salmonidae - Oncorhynchu mykiss irideus pop. 8
Animals - Fish	Oncorhynchus mykiss irideus pop. 8	steelhead - central California coast DPS	AFCHA0209G	Threatened	None	-	-	3712118	LAUREL	Mapped and Unprocessed	Animals - Fish Salmonidae - Oncorhynchu mykiss irideus pop. 8
Animals - Fish	Oncorhynchus mykiss irideus pop. 8	steelhead - central California coast DPS	AFCHA0209G	Threatened	None	-	-	3712117	LOMA PRIETA	Mapped and Unprocessed	Animals - Fish Salmonidae - Oncorhynchu mykiss irideus pop. 8
Animals - Fish	Oncorhynchus mykiss irideus pop. 9	steelhead - south-central California coast DPS	AFCHA0209H	Threatened	None	-	-	3712117	LOMA PRIETA	Mapped and Unprocessed	Animals - Fish Salmonidae - Oncorhynchu mykiss irideus pop. 9

Animals - Fish	Oncorhynchus mykiss irideus pop. 9	steelhead - south-central California coast DPS	AFCHA0209H	Threatened	None	-	-	3712116	MT. MADONNA	Mapped and Unprocessed	Animals - Fish Salmonidae - Oncorhynchu mykiss irideus pop. 9
Animals - Fish	Oncorhynchus mykiss irideus pop. 9	steelhead - south-central California coast DPS	AFCHA0209H	Threatened	None	-	-	3612187	WATSONVILLE WEST	Mapped and Unprocessed	Animals - Fish Salmonidae - Oncorhynchu mykiss irideus pop. 9
Animals - Fish	Oncorhynchus mykiss irideus pop. 9	steelhead - south-central California coast DPS	AFCHA0209H	Threatened	None	-	-	3612186	WATSONVILLE EAST	Unprocessed	Animals - Fish Salmonidae - Oncorhynchu mykiss irideus pop. 9
Animals - Fish	Oncorhynchus mykiss irideus pop. 9	steelhead - south-central California coast DPS	AFCHA0209H	Threatened	None	-	-	3612177	MOSS LANDING	Unprocessed	Animals - Fish Salmonidae - Oncorhynchu mykiss irideus pop. 9
Animals - Fish	Oncorhynchus mykiss irideus pop. 9	steelhead - south-central California coast DPS	AFCHA0209H	Threatened	None	-	-	3612176	PRUNEDALE	Unprocessed	Animals - Fish Salmonidae - Oncorhynchu mykiss irideus pop. 9
Animals - Insects	Trimerotropis infantilis	Zayante band-winged grasshopper	IIORT36030	Endangered	None	-	-	3612188	SOQUEL	Mapped	Animals - Inse Acrididae - Trimerotropis infantilis
Animals - Insects	Trimerotropis infantilis	Zayante band-winged grasshopper	IIORT36030	Endangered	None	-	-	3712118	LAUREL	Mapped and Unprocessed	Animals - Inse Acrididae - Trimerotropis infantilis
Animals - Insects	Adela oplerella	Oplers longhorn moth	IILEE0G040	None	None	-	-	3712118	LAUREL	Mapped and Unprocessed	Animals - Inse Adelidae - Ad oplerella
Animals - Insects	Adela oplerella	Oplers longhorn moth	IILEE0G040	None	None	-	-	3712116	MT. MADONNA	Mapped	Animals - Inse Adelidae - Ad oplerella
Animals - Insects	Bombus caliginosus	obscure bumble bee	IIHYM24380	None	None	-	-	3712117	LOMA PRIETA	Mapped and Unprocessed	Animals - Inse Apidae - Bom caliginosus
Animals - Insects	Bombus caliginosus	obscure bumble bee	IIHYM24380	None	None	-	-	3712118	LAUREL	Mapped and Unprocessed	Animals - Inse Apidae - Bom caliginosus
Animals - Insects	Bombus caliginosus	obscure bumble bee	IIHYM24380	None	None	-	-	3612188	SOQUEL	Mapped and Unprocessed	Animals - Inse Apidae - Bom caliginosus
Animals - Insects	Bombus caliginosus	obscure bumble bee	IIHYM24380	None	None	-	-	3612186	WATSONVILLE EAST	Unprocessed	Animals - Inse Apidae - Bom caliginosus
Animals - Insects	Bombus caliginosus	obscure bumble bee	IIHYM24380	None	None	-	-	3612187	WATSONVILLE WEST	Mapped and Unprocessed	Animals - Inse Apidae - Bom caliginosus
Animals - Insects	Bombus caliginosus	obscure bumble bee	IIHYM24380	None	None	-	-	3612176	PRUNEDALE	Unprocessed	Animals - Inse Apidae - Bom caliginosus

Animals - Insects	Bombus caliginosus	obscure bumble bee	IIHYM24380	None	None	-	-	3612177	MOSS LANDING	Mapped	Animals - Inse Apidae - Bom caliginosus
Animals - Insects	Bombus crotchii	Crotchs bumble bee	IIHYM24480	None	Candidate Endangered	-	-	3612177	MOSS LANDING	Mapped	Animals - Inse Apidae - Bom crotchii
Animals - Insects	Bombus crotchii	Crotchs bumble bee	IIHYM24480	None	Candidate Endangered	-	-	3612187	WATSONVILLE WEST	Mapped	Animals - Inse Apidae - Bom crotchii
Animals - Insects	Bombus crotchii	Crotchs bumble bee	IIHYM24480	None	Candidate Endangered	-	-	3712118	LAUREL	Mapped	Animals - Inse Apidae - Bom crotchii
Animals - Insects	Bombus crotchii	Crotchs bumble bee	IIHYM24480	None	Candidate Endangered	-	-	3712117	LOMA PRIETA	Mapped	Animals - Inse Apidae - Bom crotchii
Animals - Insects	Bombus occidentalis	western bumble bee	IIHYM24252	None	Candidate Endangered	-	-	3612187	WATSONVILLE WEST	Mapped	Animals - Inse Apidae - Bom occidentalis
Animals - Insects	Bombus occidentalis	western bumble bee	IIHYM24252	None	Candidate Endangered	-	-	3612188	SOQUEL	Mapped and Unprocessed	Animals - Inse Apidae - Bom occidentalis
Animals - Insects	Bombus occidentalis	western bumble bee	IIHYM24252	None	Candidate Endangered	-	-	3712116	MT. MADONNA	Mapped	Animals - Inse Apidae - Bom occidentalis
Animals - Insects	Bombus occidentalis	western bumble bee	IIHYM24252	None	Candidate Endangered	-	-	3612177	MOSS LANDING	Mapped and Unprocessed	Animals - Inse Apidae - Bom occidentalis
Animals - Insects	Bombus occidentalis	western bumble bee	IIHYM24252	None	Candidate Endangered	-	-	3612186	WATSONVILLE EAST	Mapped	Animals - Inse Apidae - Bom occidentalis
Animals - Insects	Bombus pensylvanicus	American bumble bee	IIHYM24260	None	None	-	-	3612187	WATSONVILLE WEST	Mapped and Unprocessed	Animals - Inse Apidae - Bom pensylvanicus
Animals - Insects	Cicindela ohlone	Ohlone tiger beetle	IICOL026L0	Endangered	None	-	-	3612188	SOQUEL	Mapped and Unprocessed	Animals - Inse Carabidae - Cicindela ohlo
Animals - Insects	Cicindela ohlone	Ohlone tiger beetle	IICOL026L0	Endangered	None	-	-	3712118	LAUREL	Mapped and Unprocessed	Animals - Inse Carabidae - Cicindela ohlo
Animals - Insects	Scaphinotus behrensi	Behrens snail-eating beetle	IICOL4L070	None	None	-	-	3712118	LAUREL	Mapped	Animals - Inse Carabidae - Scaphinotus behrensi
Animals - Insects	Scaphinotus behrensi	Behrens snail-eating beetle	IICOL4L070	None	None	-	-	3612188	SOQUEL	Mapped	Animals - Inse Carabidae - Scaphinotus behrensi
Animals - Insects	Euphilotes enoptes smithi	Smiths blue butterfly	IILEPG2026	Endangered	None	-	-	3712118	LAUREL	Unprocessed	Animals - Inse Lycaenidae - Euphilotes enoptes smith
Animals - Insects	Euphilotes enoptes smithi	Smiths blue butterfly	IILEPG2026	Endangered	None	-	-	3712117	LOMA PRIETA	Mapped and Unprocessed	Animals - Inse Lycaenidae - Euphilotes enoptes smith

Animals - Insects	Danaus plexippus plexippus pop. 1	monarch - California overwintering population	IILEPP2012	Candidate	None	-	-	3612188	SOQUEL	Mapped and Unprocessed	Animals - Inse Nymphalidae Danaus plexi plexippus pop
Animals - Insects	Danaus plexippus plexippus pop. 1	monarch - California overwintering population	IILEPP2012	Candidate	None	-	-	3612187	WATSONVILLE WEST	Mapped and Unprocessed	Animals - Inse Nymphalidae Danaus plexi plexippus pop
Animals - Insects	Danaus plexippus plexippus pop. 1	monarch - California overwintering population	IILEPP2012	Candidate	None	-	-	3612177	MOSS LANDING	Mapped and Unprocessed	Animals - Inse Nymphalidae Danaus plexi plexippus pop
Animals - Insects	Euphydryas editha bayensis	Bay checkerspot butterfly	IILEPK4055	Threatened	None	-	-	3712116	MT. MADONNA	Mapped	Animals - Inse Nymphalidae Euphydryas e bayensis
Animals - Insects	Polyphylla barbata	Mount Hermon (=barbate) June beetle	IICOL68030	Endangered	None	-	-	3712118	LAUREL	Unprocessed	Animals - Inse Scarabaeidae Polyphylla ba
Animals - Insects	Coelus globosus	globose dune beetle	IICOL4A010	None	None	-	-	3612177	MOSS LANDING	Mapped	Animals - Inse Tenebrionidae Coelus globo
Animals - Mammals	Microtus californicus halophilus	Monterey vole	AMAFF11036	None	None	-	-	3612177	MOSS LANDING	Unprocessed	Animals - Mammals - Cricetidae - Microtus californicus halophilus
Animals - Mammals	Neotoma fuscipes annectens	San Francisco dusky-footed woodrat	AMAFF08082	None	None	SSC	-	3612176	PRUNEDALE	Unprocessed	Animals - Mammals - Cricetidae - Neotoma fusc annectens
Animals - Mammals	Neotoma fuscipes annectens	San Francisco dusky-footed woodrat	AMAFF08082	None	None	SSC	-	3712118	LAUREL	Mapped and Unprocessed	Animals - Mammals - Cricetidae - Neotoma fusc annectens
Animals - Mammals	Neotoma fuscipes annectens	San Francisco dusky-footed woodrat	AMAFF08082	None	None	SSC	-	3712116	MT. MADONNA	Unprocessed	Animals - Mammals - Cricetidae - Neotoma fusc annectens
Animals - Mammals	Neotoma fuscipes annectens	San Francisco dusky-footed woodrat	AMAFF08082	None	None	SSC	-	3712117	LOMA PRIETA	Unprocessed	Animals - Mammals - Cricetidae - Neotoma fusc annectens
Animals - Mammals	Neotoma fuscipes annectens	San Francisco dusky-footed woodrat	AMAFF08082	None	None	SSC	-	3612187	WATSONVILLE WEST	Unprocessed	Animals - Mammals - Cricetidae - Neotoma fusc annectens
Animals - Mammals	Neotoma macrotis luciana	Monterey dusky-footed woodrat	AMAFF08083	None	None	SSC	-	3612176	PRUNEDALE	Unprocessed	Animals - Mammals - Cricetidae - Neotoma mac luciana

Animals - Mammals	Neotoma macrotis luciana	Monterey dusky-footed woodrat	AMAFF08083	None	None	SSC	-	3612177	MOSS LANDING	Unprocessed	Animals - Mammals - Cricetidae - Neotoma mac luciana
Animals - Mammals	Reithrodontomys megalotis distichlis	Salinas harvest mouse	AMAFF02032	None	None	-	-	3612177	MOSS LANDING	Mapped and Unprocessed	Animals - Mammals - Cricetidae - Reithrodontor megalotis distichlis
Animals - Mammals	Reithrodontomys megalotis distichlis	Salinas harvest mouse	AMAFF02032	None	None	-	-	3612176	PRUNEDALE	Mapped and Unprocessed	Animals - Mammals - Cricetidae - Reithrodontor megalotis distichlis
Animals - Mammals	Dipodomys venustus venustus	Santa Cruz kangaroo rat	AMAFD03042	None	None	-	-	3612187	WATSONVILLE WEST	Mapped	Animals - Mammals - Heteromyidae Dipodomys venustus ven
Animals - Mammals	Dipodomys venustus venustus	Santa Cruz kangaroo rat	AMAFD03042	None	None	-	-	3712117	LOMA PRIETA	Mapped and Unprocessed	Animals - Mammals - Heteromyidae Dipodomys venustus ven
Animals - Mammals	Dipodomys venustus venustus	Santa Cruz kangaroo rat	AMAFD03042	None	None	-	-	3712118	LAUREL	Mapped	Animals - Mammals - Heteromyidae Dipodomys venustus ven
Animals - Mammals	Enhydra lutris nereis	southern sea otter	AMAJF09012	Threatened	None	FP	-	3612187	WATSONVILLE WEST	Unprocessed	Animals - Mammals - Mustelidae - Enhydra lutris nereis
Animals - Mammals	Enhydra lutris nereis	southern sea otter	AMAJF09012	Threatened	None	FP	-	3612188	SOQUEL	Unprocessed	Animals - Mammals - Mustelidae - Enhydra lutris nereis
Animals - Mammals	Enhydra lutris nereis	southern sea otter	AMAJF09012	Threatened	None	FP	-	3612176	PRUNEDALE	Unprocessed	Animals - Mammals - Mustelidae - Enhydra lutris nereis
Animals - Mammals	Enhydra lutris nereis	southern sea otter	AMAJF09012	Threatened	None	FP	-	3612177	MOSS LANDING	Unprocessed	Animals - Mammals - Mustelidae - Enhydra lutris nereis
Animals - Mammals	Taxidea taxus	American badger	AMAJF04010	None	None	SSC	-	3612186	WATSONVILLE EAST	Unprocessed	Animals - Mammals - Mustelidae - Taxidea taxus
Animals - Mammals	Taxidea taxus	American badger	AMAJF04010	None	None	SSC	-	3612176	PRUNEDALE	Unprocessed	Animals - Mammals -

											Mustelidae - Taxidea taxus
Animals - Mammals	Taxidea taxus	American badger	AMAJF04010	None	None	SSC	-	3612188	SOQUEL	Unprocessed	Animals - Mammals - Mustelidae - Taxidea taxus
Animals - Mammals	Taxidea taxus	American badger	AMAJF04010	None	None	SSC	-	3612187	WATSONVILLE WEST	Mapped and Unprocessed	Animals - Mammals - Mustelidae - Taxidea taxus
Animals - Mammals	Taxidea taxus	American badger	AMAJF04010	None	None	SSC	-	3712118	LAUREL	Unprocessed	Animals - Mammals - Mustelidae - Taxidea taxus
Animals - Mammals	Taxidea taxus	American badger	AMAJF04010	None	None	SSC	-	3712116	MT. MADONNA	Mapped and Unprocessed	Animals - Mammals - Mustelidae - Taxidea taxus
Animals - Mammals	Sorex ornatus salarius	Monterey shrew	AMABA01105	None	None	SSC	-	3612187	WATSONVILLE WEST	Unprocessed	Animals - Mammals - Soricidae - So ornatus salari
Animals - Mammals	Sorex ornatus salarius	Monterey shrew	AMABA01105	None	None	SSC	-	3612176	PRUNEDALE	Unprocessed	Animals - Mammals - Soricidae - So ornatus salari
Animals - Mammals	Sorex ornatus salarius	Monterey shrew	AMABA01105	None	None	SSC	-	3612177	MOSS LANDING	Mapped	Animals - Mammals - Soricidae - So ornatus salari
Animals - Mammals	Sorex vagrans paludivagus	Monterey vagrant shrew	AMABA01072	None	None	-	-	3612177	MOSS LANDING	Unprocessed	Animals - Mammals - Soricidae - So vagrans paludivagus
Animals - Mammals	Sorex vagrans paludivagus	Monterey vagrant shrew	AMABA01072	None	None	-	-	3612176	PRUNEDALE	Unprocessed	Animals - Mammals - Soricidae - So vagrans paludivagus
Animals - Mammals	Antrozous pallidus	pallid bat	AMACC10010	None	None	SSC	-	3612188	SOQUEL	Mapped	Animals - Mammals - Vespertilionid Antrozous pa
Animals - Mammals	Antrozous pallidus	pallid bat	AMACC10010	None	None	SSC	-	3712116	MT. MADONNA	Unprocessed	Animals - Mammals - Vespertilionid Antrozous pa
Animals - Mammals	Antrozous pallidus	pallid bat	AMACC10010	None	None	SSC	-	3712117	LOMA PRIETA	Unprocessed	Animals - Mammals - Vespertilionid Antrozous pa
Animals - Mammals	Antrozous pallidus	pallid bat	AMACC10010	None	None	SSC	-	3712118	LAUREL	Mapped and Unprocessed	Animals - Mammals - Vespertilionid Antrozous pa

Animals - Mammals	Corynorhinus townsendii	Townsends big-eared bat	AMACC08010	None	None	SSC	-	3612188	SOQUEL	Mapped	Animals - Mammals - Vespertilionid Corynorhinus townsendii
Animals - Mammals	Lasiurus cinereus	hoary bat	AMACC05032	None	None	-	-	3712118	LAUREL	Unprocessed	Animals - Mammals - Vespertilionid Lasiurus cine
Animals - Mammals	Lasiurus cinereus	hoary bat	AMACC05032	None	None	-	-	3712117	LOMA PRIETA	Unprocessed	Animals - Mammals - Vespertilionid Lasiurus cine
Animals - Mammals	Lasiurus frantzii	western red bat	AMACC05080	None	None	SSC	-	3712117	LOMA PRIETA	Unprocessed	Animals - Mammals - Vespertilionid Lasiurus frant
Animals - Mammals	Lasiurus frantzii	western red bat	AMACC05080	None	None	SSC	-	3712118	LAUREL	Unprocessed	Animals - Mammals - Vespertilionid Lasiurus frant
Animals - Mammals	Myotis thysanodes	fringed myotis	AMACC01090	None	None	-	-	3712117	LOMA PRIETA	Unprocessed	Animals - Mammals - Vespertilionid Myotis thysan
Animals - Mammals	Myotis yumanensis	Yuma myotis	AMACC01020	None	None	-	-	3712117	LOMA PRIETA	Unprocessed	Animals - Mammals - Vespertilionid Myotis yumanensis
Animals - Mammals	Myotis yumanensis	Yuma myotis	AMACC01020	None	None	-	-	3712118	LAUREL	Unprocessed	Animals - Mammals - Vespertilionid Myotis yumanensis
Animals - Mammals	Myotis yumanensis	Yuma myotis	AMACC01020	None	None	-	-	3712116	MT. MADONNA	Unprocessed	Animals - Mammals - Vespertilionid Myotis yumanensis
Animals - Mammals	Myotis yumanensis	Yuma myotis	AMACC01020	None	None	-	-	3612187	WATSONVILLE WEST	Unprocessed	Animals - Mammals - Vespertilionid Myotis yumanensis
Animals - Mollusks	Haliotis kamtschatkana	pinto abalone	IMGASV2040	None	None	-	-	3612188	SOQUEL	Unprocessed	Animals - Mollusks - Haliotidae - Haliotis kamtschatkar
Animals - Mollusks	Tryonia imitator	mimic tryonia (=California brackishwater snail)	IMGASJ7040	None	None	-	-	3612188	SOQUEL	Mapped	Animals - Mollusks - Hydrobiidae - Tryonia imitat
Animals - Mollusks	Tryonia imitator	mimic tryonia (=California brackishwater snail)	IMGASJ7040	None	None	-	-	3612176	PRUNEDALE	Mapped	Animals - Mollusks - Hydrobiidae - Tryonia imitat

Animals - Mollusks	Tryonia imitator	mimic tryonia (=California brackishwater snail)	IMGASJ7040	None	None	-	-	3612177	MOSS LANDING	Mapped	Animals - Mollusks - Hydrobiidae - Tryonia imitat
Animals - Mollusks	Anodonta californiensis	California floater	IMBIV04220	None	None	-	-	3612187	WATSONVILLE WEST	Unprocessed	Animals - Mollusks - Unionidae - Anodonta californiensis
Animals - Mollusks	Anodonta californiensis	California floater	IMBIV04220	None	None	-	-	3612186	WATSONVILLE EAST	Unprocessed	Animals - Mollusks - Unionidae - Anodonta californiensis
Animals - Mollusks	Gonidea angulata	western ridged mussel	IMBIV19010	None	None	-	-	3612186	WATSONVILLE EAST	Mapped	Animals - Mollusks - Unionidae - Gonidea angu
Animals - Reptiles	Anniella pulchra	Northern California legless lizard	ARACC01020	None	None	SSC	-	3612187	WATSONVILLE WEST	Mapped and Unprocessed	Animals - Rep - Anniellidae - Anniella pulch
Animals - Reptiles	Anniella pulchra	Northern California legless lizard	ARACC01020	None	None	SSC	-	3612177	MOSS LANDING	Mapped and Unprocessed	Animals - Rep - Anniellidae - Anniella pulch
Animals - Reptiles	Anniella pulchra	Northern California legless lizard	ARACC01020	None	None	SSC	-	3612176	PRUNEDALE	Mapped	Animals - Rep - Anniellidae - Anniella pulch
Animals - Reptiles	Emys marmorata	western pond turtle	ARAAD02030	Proposed Threatened	None	SSC	-	3612176	PRUNEDALE	Mapped and Unprocessed	Animals - Rep - Emydidae - Emys marmo
Animals - Reptiles	Emys marmorata	western pond turtle	ARAAD02030	Proposed Threatened	None	SSC	-	3612177	MOSS LANDING	Mapped and Unprocessed	Animals - Rep - Emydidae - Emys marmo
Animals - Reptiles	Emys marmorata	western pond turtle	ARAAD02030	Proposed Threatened	None	SSC	-	3612186	WATSONVILLE EAST	Mapped and Unprocessed	Animals - Rep - Emydidae - Emys marmo
Animals - Reptiles	Emys marmorata	western pond turtle	ARAAD02030	Proposed Threatened	None	SSC	-	3612187	WATSONVILLE WEST	Mapped and Unprocessed	Animals - Rep - Emydidae - Emys marmo
Animals - Reptiles	Emys marmorata	western pond turtle	ARAAD02030	Proposed Threatened	None	SSC	-	3612188	SOQUEL	Mapped and Unprocessed	Animals - Rep - Emydidae - Emys marmo
Animals - Reptiles	Emys marmorata	western pond turtle	ARAAD02030	Proposed Threatened	None	SSC	-	3712118	LAUREL	Mapped and Unprocessed	Animals - Rep - Emydidae - Emys marmo
Animals - Reptiles	Emys marmorata	western pond turtle	ARAAD02030	Proposed Threatened	None	SSC	-	3712117	LOMA PRIETA	Mapped and Unprocessed	Animals - Rep - Emydidae - Emys marmo
Animals - Reptiles	Emys marmorata	western pond turtle	ARAAD02030	Proposed Threatened	None	SSC	-	3712116	MT. MADONNA	Mapped and Unprocessed	Animals - Rep - Emydidae - Emys marmo
Animals - Reptiles	Phrynosoma blainvillii	coast horned lizard	ARACF12100	None	None	SSC	-	3712116	MT. MADONNA	Mapped	Animals - Rep - Phrynosomat - Phrynosoma blainvillii

Animals - Reptiles	Phrynosoma blainvillii	coast horned lizard	ARACF12100	None	None	SSC	-	3712117	LOMA PRIETA	Unprocessed	Animals - Rep - Phrynosomat - Phrynosoma blainvillii
Animals - Reptiles	Phrynosoma blainvillii	coast horned lizard	ARACF12100	None	None	SSC	-	3612187	WATSONVILLE WEST	Unprocessed	Animals - Rep - Phrynosomat - Phrynosoma blainvillii
Animals - Reptiles	Phrynosoma blainvillii	coast horned lizard	ARACF12100	None	None	SSC	-	3612177	MOSS LANDING	Unprocessed	Animals - Rep - Phrynosomat - Phrynosoma blainvillii
Community - Aquatic	North Central Coast Drainage Sacramento Sucker/Roach River	North Central Coast Drainage Sacramento Sucker/Roach River	CARA2623CA	None	None	-	-	3712118	LAUREL	Mapped	Community - Aquatic - Nort Central Coast Drainage Sacramento Sucker/Roach River
Community - Terrestrial	Central Dune Scrub	Central Dune Scrub	CTT21320CA	None	None	-	-	3612187	WATSONVILLE WEST	Mapped	Community - Terrestrial - Central Dune Scrub
Community - Terrestrial	Central Dune Scrub	Central Dune Scrub	CTT21320CA	None	None	-	-	3612177	MOSS LANDING	Mapped	Community - Terrestrial - Central Dune Scrub
Community - Terrestrial	Central Maritime Chaparral	Central Maritime Chaparral	CTT37C20CA	None	None	-	-	3612176	PRUNEDALE	Mapped	Community - Terrestrial - Central Mariti Chaparral
Community - Terrestrial	Coastal and Valley Freshwater Marsh	Coastal and Valley Freshwater Marsh	CTT52410CA	None	None	-	-	3612177	MOSS LANDING	Mapped	Community - Terrestrial - Coastal and V Freshwater M
Community - Terrestrial	Coastal and Valley Freshwater Marsh	Coastal and Valley Freshwater Marsh	CTT52410CA	None	None	-	-	3612187	WATSONVILLE WEST	Mapped	Community - Terrestrial - Coastal and V Freshwater M
Community - Terrestrial	Coastal Brackish Marsh	Coastal Brackish Marsh	CTT52200CA	None	None	-	-	3612177	MOSS LANDING	Mapped	Community - Terrestrial - Coastal Brack Marsh
Community - Terrestrial	Coastal Brackish Marsh	Coastal Brackish Marsh	CTT52200CA	None	None	-	-	3612176	PRUNEDALE	Mapped	Community - Terrestrial - Coastal Brack Marsh
Community - Terrestrial	Northern Coastal Salt Marsh	Northern Coastal Salt Marsh	CTT52110CA	None	None	-	-	3612176	PRUNEDALE	Mapped	Community - Terrestrial - Northern Coa Salt Marsh
Community - Terrestrial	Northern Coastal Salt Marsh	Northern Coastal Salt Marsh	CTT52110CA	None	None	-	-	3612177	MOSS LANDING	Mapped	Community - Terrestrial - Northern Coa Salt Marsh

Community - Terrestrial	Northern Maritime Chaparral	Northern Maritime Chaparral	CTT37C10CA	None	None	-	-	3712118	LAUREL	Mapped	Community - Terrestrial - Northern Mar Chaparral
Plants - Bryophytes	Anomobryum julaceum	slender silver moss	NBMUS80010	None	None	-	4.2	3712118	LAUREL	Unprocessed	Plants - Bryophytes - Bryaceae - Anomobryum julaceum
Plants - Bryophytes	Fissidens pauperculus	minute pocket moss	NBMUS2W0U0	None	None	-	1B.2	3712118	LAUREL	Mapped	Plants - Bryophytes - Fissidentacea Fissidens pauperculus
Plants - Vascular	Eryngium aristulatum var. hooveri	Hoovers button-celery	PDAPI0Z043	None	None	-	1B.1	3712116	MT. MADONNA	Mapped	Plants - Vascı Apiaceae - Eryngium aristulatum va hooveri
Plants - Vascular	Lomatium parvifolium	small-leaved lomatium	PDAPI1B1F0	None	None	-	4.2	3612176	PRUNEDALE	Unprocessed	Plants - Vascı Apiaceae - Lomatium parvifolium
Plants - Vascular	Perideridia gairdneri ssp. gairdneri	California Gairdners yampah	PDAPI1N062	None	None	-	4.2	3612186	WATSONVILLE EAST	Unprocessed	Plants - Vascı Apiaceae - Perideridia gairdneri ssp. gairdneri
Plants - Vascular	Centromadia parryi ssp. congdonii	Congdons tarplant	PDAST4R0P1	None	None	-	1B.1	3612186	WATSONVILLE EAST	Mapped	Plants - Vascı Asteraceae - Centromadia parryi ssp. congdonii
Plants - Vascular	Centromadia parryi ssp. congdonii	Congdons tarplant	PDAST4R0P1	None	None	-	1B.1	3612187	WATSONVILLE WEST	Mapped	Plants - Vascı Asteraceae - Centromadia parryi ssp. congdonii
Plants - Vascular	Centromadia parryi ssp. congdonii	Congdons tarplant	PDAST4R0P1	None	None	-	1B.1	3612176	PRUNEDALE	Mapped	Plants - Vascı Asteraceae - Centromadia parryi ssp. congdonii
Plants - Vascular	Centromadia parryi ssp. congdonii	Congdons tarplant	PDAST4R0P1	None	None	-	1B.1	3612177	MOSS LANDING	Mapped	Plants - Vascı Asteraceae - Centromadia parryi ssp. congdonii
Plants - Vascular	Cirsium fontinale var. campylon	Mt. Hamilton thistle	PDAST2E163	None	None	-	1B.2	3712116	MT. MADONNA	Mapped	Plants - Vascı Asteraceae - Cirsium fontin var. campylor
Plants - Vascular	Ericameria fasciculata	Eastwoods goldenbush	PDAST3L080	None	None	-	1B.1	3612176	PRUNEDALE	Mapped	Plants - Vascı Asteraceae - Ericameria fasciculata
Plants - Vascular	Holocarpha macradenia	Santa Cruz tarplant	PDAST4X020	Threatened	Endangered	-	1B.1	3612176	PRUNEDALE	Mapped	Plants - Vascı Asteraceae -

											Holocarpha macradenia
Plants - Vascular	Holocarpha macradenia	Santa Cruz tarplant	PDAST4X020	Threatened	Endangered	-	1B.1	3712118	LAUREL	Mapped	Plants - Vascı Asteraceae - Holocarpha macradenia
Plants - Vascular	Holocarpha macradenia	Santa Cruz tarplant	PDAST4X020	Threatened	Endangered	-	1B.1	3612187	WATSONVILLE WEST	Mapped and Unprocessed	Plants - Vascı Asteraceae - Holocarpha macradenia
Plants - Vascular	Holocarpha macradenia	Santa Cruz tarplant	PDAST4X020	Threatened	Endangered	-	1B.1	3612186	WATSONVILLE EAST	Mapped	Plants - Vascı Asteraceae - Holocarpha macradenia
Plants - Vascular	Holocarpha macradenia	Santa Cruz tarplant	PDAST4X020	Threatened	Endangered	-	1B.1	3612188	SOQUEL	Mapped and Unprocessed	Plants - Vascı Asteraceae - Holocarpha macradenia
Plants - Vascular	Lasthenia californica ssp. macrantha	perennial goldfields	PDAST5L0C5	None	None	-	1B.2	3612188	SOQUEL	Mapped	Plants - Vascı Asteraceae - Lasthenia californica ssp macrantha
Plants - Vascular	Lessingia hololeuca	woolly-headed lessingia	PDAST5S030	None	None	-	3	3612176	PRUNEDALE	Unprocessed	Plants - Vascı Asteraceae - Lessingia hololeuca
Plants - Vascular	Lessingia micradenia var. glabrata	smooth lessingia	PDAST5S062	None	None	-	1B.2	3712116	MT. MADONNA	Mapped and Unprocessed	Plants - Vascı Asteraceae - Lessingia micradenia va glabrata
Plants - Vascular	Lessingia micradenia var. glabrata	smooth lessingia	PDAST5S062	None	None	-	1B.2	3712117	LOMA PRIETA	Mapped	Plants - Vascı Asteraceae - Lessingia micradenia va glabrata
Plants - Vascular	Micropus amphibolus	Mt. Diablo cottonweed	PDAST6D030	None	None	-	3.2	3712118	LAUREL	Unprocessed	Plants - Vascı Asteraceae - Micropus amphibolus
Plants - Vascular	Monolopia gracilens	woodland woollythreads	PDAST6G010	None	None	-	1B.2	3712118	LAUREL	Mapped	Plants - Vascı Asteraceae - Monolopia gracilens
Plants - Vascular	Monolopia gracilens	woodland woollythreads	PDAST6G010	None	None	-	1B.2	3712117	LOMA PRIETA	Mapped	Plants - Vascı Asteraceae - Monolopia gracilens
Plants - Vascular	Monolopia gracilens	woodland woollythreads	PDAST6G010	None	None	-	1B.2	3712116	MT. MADONNA	Mapped	Plants - Vascı Asteraceae - Monolopia gracilens
Plants - Vascular	Monolopia gracilens	woodland woollythreads	PDAST6G010	None	None	-	1B.2	3612188	SOQUEL	Mapped	Plants - Vascı Asteraceae - Monolopia gracilens

Plants - Vascular	Monolopia gracilens	woodland woollythreads	PDAST6G010	None	None	-	1B.2	3612186	WATSONVILLE EAST	Mapped	Plants - Vascı Asteraceae - Monolopia gracilens
Plants - Vascular	Monolopia gracilens	woodland woollythreads	PDAST6G010	None	None	-	1B.2	3612187	WATSONVILLE WEST	Mapped	Plants - Vascı Asteraceae - Monolopia gracilens
Plants - Vascular	Monolopia gracilens	woodland woollythreads	PDAST6G010	None	None	-	1B.2	3612177	MOSS LANDING	Mapped	Plants - Vascı Asteraceae - Monolopia gracilens
Plants - Vascular	Pentachaeta bellidiflora	white-rayed pentachaeta	PDAST6X030	Endangered	Endangered	-	1B.1	3612188	SOQUEL	Mapped	Plants - Vascı Asteraceae - Pentachaeta bellidiflora
Plants - Vascular	Pentachaeta bellidiflora	white-rayed pentachaeta	PDAST6X030	Endangered	Endangered	-	1B.1	3712118	LAUREL	Mapped	Plants - Vascı Asteraceae - Pentachaeta bellidiflora
Plants - Vascular	Amsinckia lunaris	bent-flowered fiddleneck	PDBOR01070	None	None	-	1B.2	3712118	LAUREL	Mapped	Plants - Vascı Boraginaceae Amsinckia lur
Plants - Vascular	Plagiobothrys chorisianus var. chorisianus	Choris popcornflower	PDBOR0V061	None	None	-	1B.2	3712118	LAUREL	Mapped and Unprocessed	Plants - Vascı Boraginaceae Plagiobothrys chorisianus va chorisianus
Plants - Vascular	Plagiobothrys chorisianus var. chorisianus	Choris popcornflower	PDBOR0V061	None	None	-	1B.2	3612187	WATSONVILLE WEST	Mapped	Plants - Vascı Boraginaceae Plagiobothrys chorisianus va chorisianus
Plants - Vascular	Plagiobothrys chorisianus var. chorisianus	Choris popcornflower	PDBOR0V061	None	None	-	1B.2	3612177	MOSS LANDING	Mapped	Plants - Vascı Boraginaceae Plagiobothrys chorisianus va chorisianus
Plants - Vascular	Plagiobothrys chorisianus var. hickmanii	Hickmans popcornflower	PDBOR0V062	None	None	-	4.2	3612186	WATSONVILLE EAST	Unprocessed	Plants - Vascı Boraginaceae Plagiobothrys chorisianus va hickmanii
Plants - Vascular	Plagiobothrys chorisianus var. hickmanii	Hickmans popcornflower	PDBOR0V062	None	None	-	4.2	3712118	LAUREL	Unprocessed	Plants - Vascı Boraginaceae Plagiobothrys chorisianus va hickmanii
Plants - Vascular	Plagiobothrys diffusus	San Francisco popcornflower	PDBOR0V080	None	Endangered	-	1B.1	3712118	LAUREL	Mapped	Plants - Vascı Boraginaceae Plagiobothrys diffusus
Plants - Vascular	Plagiobothrys diffusus	San Francisco popcornflower	PDBOR0V080	None	Endangered	-	1B.1	3612187	WATSONVILLE WEST	Mapped	Plants - Vascı Boraginaceae Plagiobothrys diffusus

Plants - Vascular	Erysimum ammophilum	sand-loving wallflower	PDBRA16010	None	None	-	1B.2	3612187	WATSONVILLE WEST	Mapped	Plants - Vascı Brassicaceae Erysimum ammophilum
Plants - Vascular	Erysimum ammophilum	sand-loving wallflower	PDBRA16010	None	None	-	1B.2	3612177	MOSS LANDING	Mapped	Plants - Vascı Brassicaceae Erysimum ammophilum
Plants - Vascular	Erysimum teretifolium	Santa Cruz wallflower	PDBRA160N0	Endangered	Endangered	-	1B.1	3712118	LAUREL	Mapped	Plants - Vascı Brassicaceae Erysimum teretifolium
Plants - Vascular	Streptanthus albidus ssp. peramoenus	most beautiful jewelflower	PDBRA2G012	None	None	-	1B.2	3712116	MT. MADONNA	Mapped and Unprocessed	Plants - Vascı Brassicaceae Streptanthus albidus ssp. peramoenus
Plants - Vascular	Dudleya abramsii ssp. setchellii	Santa Clara Valley dudleya	PDCRA040Z0	Endangered	None	-	1B.1	3712116	MT. MADONNA	Mapped and Unprocessed	Plants - Vascı Crassulaceae Dudleya abra ssp. setchellii
Plants - Vascular	Carex comosa	bristly sedge	PMCYP032Y0	None	None	-	2B.1	3712118	LAUREL	Mapped	Plants - Vascı Cyperaceae - Carex comos
Plants - Vascular	Arctostaphylos andersonii	Andersons manzanita	PDERI04030	None	None	-	1B.2	3712118	LAUREL	Mapped	Plants - Vascı Ericaceae - Arctostaphylo andersonii
Plants - Vascular	Arctostaphylos andersonii	Andersons manzanita	PDERI04030	None	None	-	1B.2	3712116	MT. MADONNA	Mapped	Plants - Vascı Ericaceae - Arctostaphylo andersonii
Plants - Vascular	Arctostaphylos andersonii	Andersons manzanita	PDERI04030	None	None	-	1B.2	3712117	LOMA PRIETA	Mapped and Unprocessed	Plants - Vascı Ericaceae - Arctostaphylo andersonii
Plants - Vascular	Arctostaphylos andersonii	Andersons manzanita	PDERI04030	None	None	-	1B.2	3612187	WATSONVILLE WEST	Mapped	Plants - Vascı Ericaceae - Arctostaphylo andersonii
Plants - Vascular	Arctostaphylos andersonii	Andersons manzanita	PDERI04030	None	None	-	1B.2	3612186	WATSONVILLE EAST	Mapped	Plants - Vascı Ericaceae - Arctostaphylo andersonii
Plants - Vascular	Arctostaphylos andersonii	Andersons manzanita	PDERI04030	None	None	-	1B.2	3612188	SOQUEL	Mapped	Plants - Vascı Ericaceae - Arctostaphylo andersonii
Plants - Vascular	Arctostaphylos hookeri ssp. hookeri	Hookers manzanita	PDERI040J1	None	None	-	1B.2	3612187	WATSONVILLE WEST	Mapped	Plants - Vascı Ericaceae - Arctostaphylo hookeri ssp. hookeri
Plants - Vascular	Arctostaphylos hookeri ssp. hookeri	Hookers manzanita	PDERI040J1	None	None	-	1B.2	3612176	PRUNEDALE	Mapped and Unprocessed	Plants - Vascı Ericaceae - Arctostaphylo

											hookeri ssp. hookeri
Plants - Vascular	Arctostaphylos pajaroensis	Pajaro manzanita	PDERI04100	None	None	-	1B.1	3612176	PRUNEDALE	Mapped and Unprocessed	Plants - Vasc Ericaceae - Arctostaphylo pajaroensis
Plants - Vascular	Arctostaphylos pajaroensis	Pajaro manzanita	PDERI04100	None	None	-	1B.1	3612177	MOSS LANDING	Mapped	Plants - Vasc Ericaceae - Arctostaphylo pajaroensis
Plants - Vascular	Arctostaphylos pajaroensis	Pajaro manzanita	PDERI04100	None	None	-	1B.1	3612187	WATSONVILLE WEST	Mapped	Plants - Vasc Ericaceae - Arctostaphylo pajaroensis
Plants - Vascular	Arctostaphylos pajaroensis	Pajaro manzanita	PDERI04100	None	None	-	1B.1	3612186	WATSONVILLE EAST	Mapped	Plants - Vasc Ericaceae - Arctostaphylo pajaroensis
Plants - Vascular	Arctostaphylos silvicola	Bonny Doon manzanita	PDERI041F0	None	None	-	1B.2	3712118	LAUREL	Mapped and Unprocessed	Plants - Vasc Ericaceae - Arctostaphylo silvicola
Plants - Vascular	Hoita strobilina	Loma Prieta hoita	PDFAB5Z030	None	None	-	1B.1	3712118	LAUREL	Mapped	Plants - Vasc Fabaceae - H strobilina
Plants - Vascular	Hoita strobilina	Loma Prieta hoita	PDFAB5Z030	None	None	-	1B.1	3712117	LOMA PRIETA	Mapped	Plants - Vasc Fabaceae - H strobilina
Plants - Vascular	Hoita strobilina	Loma Prieta hoita	PDFAB5Z030	None	None	-	1B.1	3712116	MT. MADONNA	Mapped	Plants - Vasc Fabaceae - H strobilina
Plants - Vascular	Hosackia gracilis	harlequin lotus	PDFAB2A0D0	None	None	-	4.2	3612186	WATSONVILLE EAST	Unprocessed	Plants - Vasc Fabaceae - Hosackia gra
Plants - Vascular	Hosackia gracilis	harlequin lotus	PDFAB2A0D0	None	None	-	4.2	3712117	LOMA PRIETA	Unprocessed	Plants - Vasc Fabaceae - Hosackia gra
Plants - Vascular	Hosackia gracilis	harlequin lotus	PDFAB2A0D0	None	None	-	4.2	3712116	MT. MADONNA	Unprocessed	Plants - Vasc Fabaceae - Hosackia gra
Plants - Vascular	Hosackia gracilis	harlequin lotus	PDFAB2A0D0	None	None	-	4.2	3612176	PRUNEDALE	Unprocessed	Plants - Vasc Fabaceae - Hosackia gra
Plants - Vascular	Trifolium buckwestiorum	Santa Cruz clover	PDFAB402W0	None	None	-	1B.1	3712117	LOMA PRIETA	Mapped	Plants - Vasc Fabaceae - Trifolium buckwestioru
Plants - Vascular	Trifolium buckwestiorum	Santa Cruz clover	PDFAB402W0	None	None	-	1B.1	3612188	SOQUEL	Mapped	Plants - Vasc Fabaceae - Trifolium buckwestioru
Plants - Vascular	Trifolium hydrophilum	saline clover	PDFAB400R5	None	None	-	1B.2	3612177	MOSS LANDING	Mapped	Plants - Vasc Fabaceae - Trifolium hydrophilum
Plants - Vascular	Trifolium polyodon	Pacific Grove clover	PDFAB402H0	None	Rare	-	1B.1	3712118	LAUREL	Mapped	Plants - Vasc Fabaceae -

											Trifolium poly
Plants - Vascular	Iris longipetala	coast iris	PMIRI092E0	None	None	-	4.2	3612186	WATSONVILLE EAST	Unprocessed	Plants - Vascı Iridaceae - Iris longipetala
Plants - Vascular	Iris longipetala	coast iris	PMIRI092E0	None	None	-	4.2	3612176	PRUNEDALE	Unprocessed	Plants - Vascı Iridaceae - Iris longipetala
Plants - Vascular	Monardella sinuata ssp. nigrescens	northern curly-leaved monardella	PDLAM18162	None	None	-	1B.2	3712118	LAUREL	Mapped	Plants - Vascı Lamiaceae - Monardella sinuata ssp. nigrescens
Plants - Vascular	Fritillaria liliacea	fragrant fritillary	PMLIL0V0C0	None	None	-	1B.2	3612176	PRUNEDALE	Mapped	Plants - Vascı Liliaceae - Fritillaria liliac
Plants - Vascular	Fritillaria liliacea	fragrant fritillary	PMLIL0V0C0	None	None	-	1B.2	3612186	WATSONVILLE EAST	Mapped	Plants - Vascı Liliaceae - Fritillaria liliac
Plants - Vascular	Malacothamnus arcuatus	arcuate bush-mallow	PDMAL0Q0E0	None	None	-	1B.2	3712118	LAUREL	Mapped and Unprocessed	Plants - Vascı Malvaceae - Malacothamn arcuatus
Plants - Vascular	Malacothamnus arcuatus	arcuate bush-mallow	PDMAL0Q0E0	None	None	-	1B.2	3712117	LOMA PRIETA	Mapped and Unprocessed	Plants - Vascı Malvaceae - Malacothamn arcuatus
Plants - Vascular	Malacothamnus arcuatus	arcuate bush-mallow	PDMAL0Q0E0	None	None	-	1B.2	3712116	MT. MADONNA	Mapped and Unprocessed	Plants - Vascı Malvaceae - Malacothamn arcuatus
Plants - Vascular	Malacothamnus hallii	Halls bush-mallow	PDMAL0Q0F0	None	None	-	1B.2	3712117	LOMA PRIETA	Mapped	Plants - Vascı Malvaceae - Malacothamn hallii
Plants - Vascular	Sidalcea malachroides	maple-leaved checkerbloom	PDMAL110E0	None	None	-	4.2	3712118	LAUREL	Unprocessed	Plants - Vascı Malvaceae - Sidalcea malachroides
Plants - Vascular	Sidalcea malachroides	maple-leaved checkerbloom	PDMAL110E0	None	None	-	4.2	3612188	SOQUEL	Unprocessed	Plants - Vascı Malvaceae - Sidalcea malachroides
Plants - Vascular	Calandrinia breweri	Brewers calandrinia	PDPOR01020	None	None	-	4.2	3712118	LAUREL	Unprocessed	Plants - Vascı Montiaceae - Calandrinia breweri
Plants - Vascular	Calandrinia breweri	Brewers calandrinia	PDPOR01020	None	None	-	4.2	3712117	LOMA PRIETA	Unprocessed	Plants - Vascı Montiaceae - Calandrinia breweri
Plants - Vascular	Calyptridium parryi var. hesseae	Santa Cruz Mountains pussypaws	PDPOR09052	None	None	-	1B.1	3712117	LOMA PRIETA	Mapped	Plants - Vascı Montiaceae - Calyptridium parryi var. hesseae
Plants - Vascular	Abronia maritima	red sand-verbena	PDNYC010E0	None	None	-	4.2	3612187	WATSONVILLE WEST	Unprocessed	Plants - Vascı Nyctaginacea

											Abronia marit
Plants - Vascular	Clarkia breweri	Brewers clarkia	PDONA05080	None	None	-	4.2	3712117	LOMA PRIETA	Unprocessed	Plants - Vascı Onagraceae - Clarkia brewe
Plants - Vascular	Clarkia concinna ssp. automixa	Santa Clara red ribbons	PDONA050A1	None	None	-	4.3	3712117	LOMA PRIETA	Mapped and Unprocessed	Plants - Vascı Onagraceae - Clarkia concir ssp. automixa
Plants - Vascular	Cypripedium fasciculatum	clustered ladys-slipper	PMORC0Q060	None	None	-	4.2	3712117	LOMA PRIETA	Unprocessed	Plants - Vascı Orchidaceae Cypripedium fasciculatum
Plants - Vascular	Cypripedium fasciculatum	clustered ladys-slipper	PMORC0Q060	None	None	-	4.2	3712118	LAUREL	Unprocessed	Plants - Vascı Orchidaceae Cypripedium fasciculatum
Plants - Vascular	Cypripedium montanum	mountain ladys-slipper	PMORC0Q080	None	None	-	4.2	3712118	LAUREL	Unprocessed	Plants - Vascı Orchidaceae Cypripedium montanum
Plants - Vascular	Piperia michaelii	Michaels rein orchid	PMORC1X110	None	None	-	4.2	3612187	WATSONVILLE WEST	Unprocessed	Plants - Vascı Orchidaceae Piperia micha
Plants - Vascular	Piperia michaelii	Michaels rein orchid	PMORC1X110	None	None	-	4.2	3612176	PRUNEDALE	Unprocessed	Plants - Vascı Orchidaceae Piperia micha
Plants - Vascular	Piperia yadonii	Yadons rein orchid	PMORC1X070	Endangered	None	-	1B.1	3612176	PRUNEDALE	Mapped	Plants - Vascı Orchidaceae Piperia yadon
Plants - Vascular	Piperia yadonii	Yadons rein orchid	PMORC1X070	Endangered	None	-	1B.1	3612177	MOSS LANDING	Mapped	Plants - Vascı Orchidaceae Piperia yadon
Plants - Vascular	Castilleja latifolia	Monterey Coast paintbrush	PDSCR0D1P0	None	None	-	4.3	3612177	MOSS LANDING	Unprocessed	Plants - Vascı Orobanchace Castilleja latif
Plants - Vascular	Castilleja latifolia	Monterey Coast paintbrush	PDSCR0D1P0	None	None	-	4.3	3612187	WATSONVILLE WEST	Unprocessed	Plants - Vascı Orobanchace Castilleja latif
Plants - Vascular	Cordylanthus rigidus ssp. littoralis	seaside birds-beak	PDSCR0J0P2	None	Endangered	-	1B.1	3612177	MOSS LANDING	Mapped	Plants - Vascı Orobanchace Cordylanthus rigidus ssp. littoralis
Plants - Vascular	Cordylanthus rigidus ssp. littoralis	seaside birds-beak	PDSCR0J0P2	None	Endangered	-	1B.1	3612176	PRUNEDALE	Mapped	Plants - Vascı Orobanchace Cordylanthus rigidus ssp. littoralis
Plants - Vascular	Pedicularis dudleyi	Dudleys lousewort	PDSCR1K180	None	Rare	-	1B.2	3612187	WATSONVILLE WEST	Mapped	Plants - Vascı Orobanchace Pedicularis dudleyi
Plants - Vascular	Pedicularis dudleyi	Dudleys lousewort	PDSCR1K180	None	Rare	-	1B.2	3612188	SOQUEL	Mapped	Plants - Vascı Orobanchace Pedicularis dudleyi

Plants - Vascular	Eschscholzia hypecoides	San Benito poppy	PDPAP0A060	None	None	-	4.3	3712117	LOMA PRIETA	Unprocessed	Plants - Vascı Papaveracea Eschscholzia hypecoides
Plants - Vascular	Collinsia multicolor	San Francisco collinsia	PDSCR0H0B0	None	None	-	1B.2	3712116	MT. MADONNA	Unprocessed	Plants - Vascı Plantaginacea Collinsia multicolor
Plants - Vascular	Penstemon rattanii var. kleei	Santa Cruz Mountains beardtongue	PDSCR1L5B1	None	None	-	1B.2	3712116	MT. MADONNA	Mapped	Plants - Vascı Plantaginacea Penstemon rattanii var. kl
Plants - Vascular	Penstemon rattanii var. kleei	Santa Cruz Mountains beardtongue	PDSCR1L5B1	None	None	-	1B.2	3712117	LOMA PRIETA	Mapped	Plants - Vascı Plantaginacea Penstemon rattanii var. kl
Plants - Vascular	Elymus californicus	California bottle-brush grass	PMPOA2H0W0	None	None	-	4.3	3712117	LOMA PRIETA	Unprocessed	Plants - Vascı Poaceae - Ely californicus
Plants - Vascular	Elymus californicus	California bottle-brush grass	PMPOA2H0W0	None	None	-	4.3	3712118	LAUREL	Unprocessed	Plants - Vascı Poaceae - Ely californicus
Plants - Vascular	Elymus californicus	California bottle-brush grass	PMPOA2H0W0	None	None	-	4.3	3612188	SOQUEL	Unprocessed	Plants - Vascı Poaceae - Ely californicus
Plants - Vascular	Elymus californicus	California bottle-brush grass	PMPOA2H0W0	None	None	-	4.3	3612187	WATSONVILLE WEST	Unprocessed	Plants - Vascı Poaceae - Ely californicus
Plants - Vascular	Eriastrum virgatum	virgate eriastrum	PDPLM030D0	None	None	-	4.3	3612176	PRUNEDALE	Unprocessed	Plants - Vascı Polemoniacea Eriastrum virgatum
Plants - Vascular	Gilia tenuiflora ssp. arenaria	Monterey gilia	PDPLM041P2	Endangered	Threatened	-	1B.2	3612177	MOSS LANDING	Mapped and Unprocessed	Plants - Vascı Polemoniacea Gilia tenuiflora ssp. arenaria
Plants - Vascular	Gilia tenuiflora ssp. arenaria	Monterey gilia	PDPLM041P2	Endangered	Threatened	-	1B.2	3612187	WATSONVILLE WEST	Mapped and Unprocessed	Plants - Vascı Polemoniacea Gilia tenuiflora ssp. arenaria
Plants - Vascular	Leptosiphon ambiguus	serpentine leptosiphon	PDPLM09020	None	None	-	4.2	3712116	MT. MADONNA	Unprocessed	Plants - Vascı Polemoniacea Leptosiphon ambiguus
Plants - Vascular	Leptosiphon ambiguus	serpentine leptosiphon	PDPLM09020	None	None	-	4.2	3712117	LOMA PRIETA	Unprocessed	Plants - Vascı Polemoniacea Leptosiphon ambiguus
Plants - Vascular	Leptosiphon grandiflorus	large-flowered leptosiphon	PDPLM090K0	None	None	-	4.2	3712117	LOMA PRIETA	Unprocessed	Plants - Vascı Polemoniacea Leptosiphon grandiflorus
Plants - Vascular	Leptosiphon grandiflorus	large-flowered leptosiphon	PDPLM090K0	None	None	-	4.2	3712118	LAUREL	Unprocessed	Plants - Vascı Polemoniacea Leptosiphon grandiflorus

Plants - Vascular	Leptosiphon grandiflorus	large-flowered leptosiphon	PDPLM090K0	None	None	-	4.2	3712116	MT. MADONNA	Unprocessed	Plants - Vascı Polemoniacea Leptosiphon grandiflorus
Plants - Vascular	Leptosiphon grandiflorus	large-flowered leptosiphon	PDPLM090K0	None	None	-	4.2	3612188	SOQUEL	Unprocessed	Plants - Vascı Polemoniacea Leptosiphon grandiflorus
Plants - Vascular	Leptosiphon grandiflorus	large-flowered leptosiphon	PDPLM090K0	None	None	-	4.2	3612186	WATSONVILLE EAST	Unprocessed	Plants - Vascı Polemoniacea Leptosiphon grandiflorus
Plants - Vascular	Chorizanthe pungens var. hartwegiana	Ben Lomond spineflower	PDPGN040M1	Endangered	None	-	1B.1	3712118	LAUREL	Mapped	Plants - Vascı Polygonaceae Chorizanthe pungens var. hartwegiana
Plants - Vascular	Chorizanthe pungens var. pungens	Monterey spineflower	PDPGN040M2	Threatened	None	-	1B.2	3712118	LAUREL	Mapped	Plants - Vascı Polygonaceae Chorizanthe pungens var. pungens
Plants - Vascular	Chorizanthe pungens var. pungens	Monterey spineflower	PDPGN040M2	Threatened	None	-	1B.2	3712117	LOMA PRIETA	Mapped and Unprocessed	Plants - Vascı Polygonaceae Chorizanthe pungens var. pungens
Plants - Vascular	Chorizanthe pungens var. pungens	Monterey spineflower	PDPGN040M2	Threatened	None	-	1B.2	3612186	WATSONVILLE EAST	Mapped	Plants - Vascı Polygonaceae Chorizanthe pungens var. pungens
Plants - Vascular	Chorizanthe pungens var. pungens	Monterey spineflower	PDPGN040M2	Threatened	None	-	1B.2	3612187	WATSONVILLE WEST	Mapped and Unprocessed	Plants - Vascı Polygonaceae Chorizanthe pungens var. pungens
Plants - Vascular	Chorizanthe pungens var. pungens	Monterey spineflower	PDPGN040M2	Threatened	None	-	1B.2	3612177	MOSS LANDING	Mapped and Unprocessed	Plants - Vascı Polygonaceae Chorizanthe pungens var. pungens
Plants - Vascular	Chorizanthe pungens var. pungens	Monterey spineflower	PDPGN040M2	Threatened	None	-	1B.2	3612176	PRUNEDALE	Mapped	Plants - Vascı Polygonaceae Chorizanthe pungens var. pungens
Plants - Vascular	Chorizanthe robusta var. hartwegii	Scotts Valley spineflower	PDPGN040Q1	Endangered	None	-	1B.1	3712118	LAUREL	Mapped and Unprocessed	Plants - Vascı Polygonaceae Chorizanthe robusta var. hartwegii
Plants - Vascular	Chorizanthe robusta var. robusta	robust spineflower	PDPGN040Q2	Endangered	None	-	1B.1	3712118	LAUREL	Mapped and Unprocessed	Plants - Vascı Polygonaceae Chorizanthe robusta var. robusta

Plants - Vascular	Chorizanthe robusta var. robusta	robust spineflower	PDPGN040Q2	Endangered	None	-	1B.1	3612187	WATSONVILLE WEST	Mapped and Unprocessed	Plants - Vascı Polygonaceae Chorizanthe robusta var. robusta
Plants - Vascular	Chorizanthe robusta var. robusta	robust spineflower	PDPGN040Q2	Endangered	None	-	1B.1	3612188	SOQUEL	Mapped	Plants - Vascı Polygonaceae Chorizanthe robusta var. robusta
Plants - Vascular	Chorizanthe robusta var. robusta	robust spineflower	PDPGN040Q2	Endangered	None	-	1B.1	3612177	MOSS LANDING	Mapped	Plants - Vascı Polygonaceae Chorizanthe robusta var. robusta
Plants - Vascular	Eriogonum nudum var. decurrens	Ben Lomond buckwheat	PDPGN08492	None	None	-	1B.1	3712118	LAUREL	Mapped	Plants - Vascı Polygonaceae Eriogonum nu var. decurrens
Plants - Vascular	Polygonum hickmanii	Scotts Valley polygonum	PDPGN0L310	Endangered	Endangered	-	1B.1	3712118	LAUREL	Mapped and Unprocessed	Plants - Vascı Polygonaceae Polygonum hickmanii
Plants - Vascular	Ranunculus lobbii	Lobbs aquatic buttercup	PDRAN0L1J0	None	None	-	4.2	3712118	LAUREL	Unprocessed	Plants - Vascı Ranunculacea Ranunculus lo
Plants - Vascular	Ranunculus lobbii	Lobbs aquatic buttercup	PDRAN0L1J0	None	None	-	4.2	3612186	WATSONVILLE EAST	Unprocessed	Plants - Vascı Ranunculacea Ranunculus lo
Plants - Vascular	Ceanothus ferrisiae	Coyote ceanothus	PDRHA041N0	Endangered	None	-	1B.1	3712117	LOMA PRIETA	Mapped	Plants - Vascı Rhamnaceae Ceanothus ferrisiae
Plants - Vascular	Ceanothus rigidus	Monterey ceanothus	PDRHA04067	None	None	-	4.2	3612186	WATSONVILLE EAST	Unprocessed	Plants - Vascı Rhamnaceae Ceanothus rig
Plants - Vascular	Ceanothus rigidus	Monterey ceanothus	PDRHA04067	None	None	-	4.2	3612176	PRUNEDALE	Unprocessed	Plants - Vascı Rhamnaceae Ceanothus rig
Plants - Vascular	Horkelia cuneata var. sericea	Kelloggs horkelia	PDROS0W043	None	None	-	1B.1	3612176	PRUNEDALE	Unprocessed	Plants - Vascı Rosaceae - Horkelia cune var. sericea
Plants - Vascular	Horkelia cuneata var. sericea	Kelloggs horkelia	PDROS0W043	None	None	-	1B.1	3712118	LAUREL	Mapped	Plants - Vascı Rosaceae - Horkelia cune var. sericea
Plants - Vascular	Horkelia cuneata var. sericea	Kelloggs horkelia	PDROS0W043	None	None	-	1B.1	3612187	WATSONVILLE WEST	Mapped	Plants - Vascı Rosaceae - Horkelia cune var. sericea
Plants - Vascular	Rosa pinetorum	pine rose	PDROS1J0W0	None	None	-	1B.2	3612176	PRUNEDALE	Mapped	Plants - Vascı Rosaceae - R pinetorum
Plants - Vascular	Galium andrewsii ssp. gatense	phlox-leaf serpentine bedstraw	PDRUB0N032	None	None	-	4.2	3712116	MT. MADONNA	Unprocessed	Plants - Vascı Rubiaceae -

											Galium andre ssp. gatense
Plants - Vascular	Galium andrewsii ssp. gatense	phlox-leaf serpentine bedstraw	PDRUB0N032	None	None	-	4.2	3712117	LOMA PRIETA	Unprocessed	Plants - Vasc Rubiaceae - Galium andre ssp. gatense

Notes:
FT = listed as threatened under the federal Endangered Species Act; FE = listed as endangered under the federal Endangered Species Act; ST = listed as threatened under CESA; SE = listed as endangered under CESA; SSC = state species of special concern; SP = state listed as fully protected.

From:	Mcroberts, Ingrid@DOT
To:	Nicole Steel
Cc:	OPR State Clearinghouse
Subject:	Comment Letter_NOP for EIR for the Buena Vista Landfill Redevelopment Project_SCH 2024020617
Date:	Friday, March 8, 2024 9:07:46 AM
Attachments:	Buena Vista Landfill_NOP_Aeronautics_Comment Letter.pdf

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Hello Ms. Steel:

Attached please find Caltrans Aeronautics comment letter for the NOP of an Environmental Impact Report for the Buena Vista Landfill Redevelopment Project. We appreciate the opportunity to review and comment and look forward to continued coordination with the County of Santa Cruz.

Thank you,
Ingrid McRoberts
Office of Aviation Planning
Caltrans Aeronautics Program
Phone: (805) 835-6555

California Department of Transportation

AERONAUTICS PROGRAM
DIVISION OF TRANSPORTATION PLANNING
P.O. BOX 942873, MS–40 | SACRAMENTO, CA 94273–0001
(916) 654-4959
www.dot.ca.gov

March 8, 2024

Nicole Steel, Project Manager
County of Santa Cruz, Department of Public Works
701 Ocean Street, Room 401
Santa Cruz, CA 95060
Electronically Sent <Nicole.steel@santacruzcounty.us>

SCH 2024020617

Dear Ms. Steel:

The California Department of Transportation (Caltrans), Aeronautics Program has reviewed the Notice of Preparation (NOP)of an Environmental Impact Report (EIR) for the Buena Vista Landfill Redevelopment Project. One of the goals of the California Department of Transportation (Caltrans), Aeronautics Program, is to assist cities, counties, and Airport Land Use Commissions (ALUC) or their equivalent, to understand and comply with the State Aeronautics Act pursuant to the California Public Utilities Code (PUC), Section 21001 et seq. Caltrans encourages collaboration with our partners in the planning process and thanks you for including Caltrans Aeronautics in the review of the NOP.

Please be aware that portions identified in the NOP and project sites may be located within an Airport Influence Area (AIA), or safety zones, as principally guided by the California Airport Land Use Planning Handbook (Handbook). Density and Intensity compatibility around airports should also be considered as a potential impact given the long-range nature of the plan. Given the anticipated amount of development and increased pressures of housing in the state approaching to 2050, increased density surrounding airports can lead to adverse impacts on communities and should be reviewed for potential consequences to health and safety. Sensitive land uses such as residential areas, schools, hospitals, senior homes, and other facilities should also be reviewed for airport land use compatibility.

Per the California Public Utilities Code Section 21001 et seq. relating to the State Aeronautics Act, Section 21676(b) prior to the amendment of a general plan, within the planning boundary established by the airport land use commission, or equivalent, pursuant to Section 21675, the local agency shall first refer the proposed action to the commission, or equivalent. If it is determined that the proposed action is inconsistent with the commission's plan, the referring agency shall be notified. Any proposed development in the defined safety zones, therefore, must adhere to the safety criteria and restrictions defined in the Handbook.

Proposed projects may also be subject to 14 CFR Part 77 Conical Surface standards and CNEL contours noise compatibility of an airport, which may require noise reduction measures. Please be aware, Public Utilities Code, Section 21659, "Hazards Near Airports Prohibited" prohibits structural hazards near airports. To ensure compliance with Federal Aviation Regulation, Part 77, "Objects Affecting Navigable Airspace," submission of a Notice of Proposed Construction or Alteration (Form 7460-1) to the Federal Aviation Administration (FAA) may be required. In addition, any proposed projects identified as hazardous material sites compiled pursuant to Government Code Section 65962.5, compatibility restrictions should be reviewed per the Handbook.

Please consider the regional scale of the environmental impact analysis and ensure impacts to airport-related noise and safety hazards are fully mitigated, therefore project-level agencies should consider project-level mitigation measures and adherence to the Handbook compatibility guidelines and restrictions. Additional detail and background can be found be in the California Airport Land Use Planning Handbook https://dot.ca.gov/programs/aeronautics/airport-land-use-planning.

The Aeronautics Program commends the County of Santa Cruz and encourages the continued collaboration with aviation stakeholders on regional aviation planning issues.

If you have any questions or need additional information, please contact me by email at ingrid.mcroberts@dot.ca.gov.

Sincerely,

Ingrid McRoberts

Ingrid McRoberts
Aviation Planner
Caltrans Aeronautics Program

c: State Clearinghouse

From:	Bowers, Joy@CalRecycle
To:	BuenaVistaProject; Office of Planning and Research - State Clearinghouse; Nicole Steel
Cc:	kate.elliott@weareharris.com; Brian Fontes; Escotto, Benjamin@CalRecycle; Blair, Catherine@CalRecycle; Weathers, Jared@CalRecycle; Worcester, Alfred@CalRecycle; Fletcher, Martin@Waterboards; Kasey Kolassa; Robert Leporini Jr.
Subject:	Buena Vista LF Redevelopment Project - NOP Comment Letter SCH#2024020617 (SWIS# 44-AA-0004)
Date:	Wednesday, March 13, 2024 11:00:08 AM
Attachments:	NOP Comment Letter Buena Vista Redevelopment SCH 2024020617.pdf

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Good morning,
Attached is CalRecycle's comment letter on the Buena Vista Landfill Redevelopment Project. A paper copy will not be mailed unless requested. Please contact me if you have any questions or comments. We look forward to continuing working with you on this project.

Best,

Joy Bowers, Environmental Scientist
Permitting & Assistance Branch
CalRecycle
(916) 341-6772

March 13, 2024

Nicole Steel, Project Manager
County of Santa Cruz, Department of Public Works
701 Ocean Street, Room 410
Santa Cruz, California 95060

Subject: **SCH No. 2024020617 –** Notice of Preparation of a Draft EIR for the Buena Vista Landfill Redevelopment Project, SWIS No. 44-AA-0004, Santa Cruz County

Dear Ms. Steel:

Thank you for allowing the Department of Resources Recycling and Recovery (CalRecycle) staff to provide comments on the proposed project and for your agency's consideration of these comments as part of the California Environmental Quality Act (CEQA) process.

PROJECT DESCRIPTION

The County of Santa Cruz, acting as Lead Agency, has prepared and circulated a Notice of Preparation (NOP) for a Draft Environmental Impact Report (EIR) in order to comply with CEQA and to provide information to, and solicit consultation with, Responsible Agencies in the approval of the proposed project.

Buena Vista Drive Sanitary Landfill is an existing solid waste disposal site located on 126 acres at 1231 Buena Vista Drive, in unincorporated southern Santa Cruz County. The facility is owned and operated by the County of Santa Cruz Department of Public Works.

Buena Vista Landfill is projected to reach its capacity between 2030-2034. The proposed Project would: develop two new solid waste transfer stations at the existing landfill site; develop an organics diversion facility to support organics waste processing and diversion; and implement the landfill closure plan once site capacity is reached. The proposed Project would be implemented by 2028.

COMMENTS

Solid Waste Regulatory Oversight:

- CalRecycle is the Enforcement Agency (EA) for Santa Cruz County and responsible for providing regulatory oversight of solid waste handling activities, including inspections and permitting. The proposed Project may require a permit action for the current Solid Waste Facilities Permit (SWFP), SWIS No. 44-AA-

0004, and/or may require a new SWFP(s). Please work with CalRecycle on the SWFP process.

Facility Address/Entrance:

- The current facility entrance and address for the landfill on the SWFP is 1231 Buena Vista Drive. Will the facility entrance and/or address change?

Name of Facility:

- The permitted name of the facility is Buena Vista Drive Sanitary Landfill. Please be consistent with facility names in the Draft EIR.

Specifications & Key Design Parameters:

- For **each** solid waste activity (e.g., transfer/processing, composting, in-vessel digestion) the Draft EIR will need to include analysis for the following:
    - Hours of operation, including hours of receipt of waste and ancillary hours;
    - Maximum allowed daily tonnage;
    - Maximum allowed daily traffic flow;
    - Total permitted acreage of each activity; and
    - Types and quanites of waste types allowed.

- Will the permitted boundary for the Landfill change or remain as in the current SWFP?

Transfer/Processing:

- Please see CalRecycle's CEQA homepage for more information on environmental review for solid waste handling activities: https://calrecycle.ca.gov/SWFacilities/Permitting/CEQA/.
- Please see CalRecycle's website for more information on permitting a transfer/processing activity: https://calrecycle.ca.gov/SWFacilities/Permitting/FacilityType/Transfer/.

Organics Diversion:

- The NOP states that there will be "an organics diversion facility." Specifically what type of solid waste activity will this be (e.g. composting, in-vessel digestion, biomass conversion, etc.)?
- The Draft EIR will need to include an analysis of all anticipated types of organics diversion facilities, including information specified in the above "Specification & Key Design Parameters" section of the comments.
- Please see CalRecycle's website for more information on organics diversion: https://calrecycle.ca.gov/Organics/.

Closure and Postclosure Land Use:

- A closure SWFP will be required for final closure of the landfill. Please see CalRecycle's website for more information: https://calrecycle.ca.gov/SWFacilities/Closure/. The analysis should include potential impacts related to the closure construction and postclosure maintenance.
- CalRecycle's Engineering Support Branch (ESB) has indicated that the entire site should be included in the Final Closure and Postclosure Maintenace Plan (FCPCMP) as one landfill – not multiple. If final cover has been placed on the previous parts that met the standards at the time, then further closure would not be necessary unless there were issues. However, the entire site should be under the FCPCMP.
- The Redevelopment Project will need to comply with Postclosure Land Use requirements, per Title 27 California Code of Regulations (27 CCR) Section 21190. Please see CalRecycle's website for more information: https://calrecycle.ca.gov/SWFacilities/Closure/PostClosure/.
- For assistance with Closure, please contact ESB staff, Alfred Worcester at Alfred.Worcester@Calrecycle.ca.gov or (916) 341-6353.

Substitute Public Meeting:

- Pursuant to 27 CCR Section 21660.2, CalRecycle, as the EA, shall conduct an informational meeting for new and/or revised solid waste facility permits. Pursuant to 27 CCR Section 21660.4, the EA may substitute the informational meeting with a previously held public meeting on the same project. The County of Santa Cruz will need to conduct public hearings as part of the EIR certification process. Please work with CalRecycle staff on allowing attendance of the public hearings in order for CalRecycle to possibly use the public hearings as a substitute meeting, as part of the permit process.

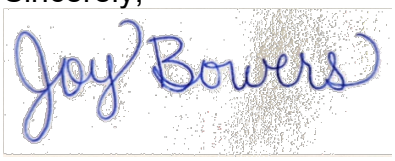
CONCLUSION

CalRecycle staff thanks the Lead Agency for the opportunity to review and comment on the environmental document and hopes that this comment letter will be useful to the Lead Agency preparing the Draft EIR and in carrying out their responsibilities in the CEQA process. CalRecycle also looks forward to working with the Lead Agency on the public meeting process.

CalRecycle staff requests copies of any subsequent environmental documents, copies of public notices and any Notices of Determination for this proposed project.

If you have any questions regarding these comments, please contact me at (916) 641-6772 or by e-mail at joy.bowers@calrecycle.ca.gov.

Sincerely,



Joy Bowers, Environmental Scientist
Permitting & Assistance Branch – South Unit
Waste Permitting, Compliance & Mitigation Division
CalRecycle

cc: Benjamin Escotto, Supervisor, PAB, CalRecycle.
Jared Weathers, WEEB, CalRecycle
Cathy Blair, Manager, WEEB, CalRecycle
Alfred Worcester, ESB, CalRecycle
Brian Fontes, Santa Cruz County
Martin Fletcher, RWQCB

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February 16, 2024

FEB 2024
RECEIVED
PUBLIC WORKS DEPT
SANTA CRUZ

Nicole Steel
County of Santa Cruz
701 Ocean Street
Room 410
Santa Cruz, CA 95060

Re: 2024020617, Buena Vista Landfill Redevelopment Project

Dear Ms. Steel:

The Native American Heritage Commission (NAHC) has received the Notice of Preparation (NOP), Draft Environmental Impact Report (DEIR) or Early Consultation for the project referenced above. The California Environmental Quality Act (CEQA) (Pub. Resources Code §21000 et seq.), specifically Public Resources Code §21084.1, states that a project that may cause a substantial adverse change in the significance of a historical resource, is a project that may have a significant effect on the environment. (Pub. Resources Code § 21084.1; Cal. Code Regs., tit.14, §15064.5 (b) (CEQA Guidelines §15064.5 (b)). If there is substantial evidence, in light of the whole record before a lead agency, that a project may have a significant effect on the environment, an Environmental Impact Report (EIR) shall be prepared. (Pub. Resources Code §21080 (d); Cal. Code Regs., tit. 14, § 5064 subd.(a)(1) (CEQA Guidelines §15064 (a)(1)). In order to determine whether a project will cause a substantial adverse change in the significance of a historical resource, a lead agency will need to determine whether there are historical resources within the area of potential effect (APE).

CEQA was amended significantly in 2014. Assembly Bill 52 (Gatto, Chapter 532, Statutes of 2014) (AB 52) amended CEQA to create a separate category of cultural resources, "tribal cultural resources" (Pub. Resources Code §21074) and provides that a project with an effect that may cause a substantial adverse change in the significance of a tribal cultural resource is a project that may have a significant effect on the environment. (Pub. Resources Code §21084.2). Public agencies shall, when feasible, avoid damaging effects to any tribal cultural resource. (Pub. Resources Code §21084.3 (a)). **AB 52 applies to any project for which a notice of preparation, a notice of negative declaration, or a mitigated negative declaration is filed on or after July 1, 2015.** If your project involves the adoption of or amendment to a general plan or a specific plan, or the designation or proposed designation of open space, on or after March 1, 2005, it may also be subject to Senate Bill 18 (Burton, Chapter 905, Statutes of 2004) (SB 18). **Both SB 18 and AB 52 have tribal consultation requirements.** If your project is also subject to the federal National Environmental Policy Act (42 U.S.C. § 4321 et seq.) (NEPA), the tribal consultation requirements of Section 106 of the National Historic Preservation Act of 1966 (154 U.S.C. 300101, 36 C.F.R. §800 et seq.) may also apply.

The NAHC recommends consultation with California Native American tribes that are traditionally and culturally affiliated with the geographic area of your proposed project as early as possible in order to avoid inadvertent discoveries of Native American human remains and best protect tribal cultural resources. Below is a brief summary of portions of AB 52 and SB 18 as well as the NAHC's recommendations for conducting cultural resources assessments.

Consult your legal counsel about compliance with AB 52 and SB 18 as well as compliance with any other applicable laws.

AB 52

AB 52 has added to CEQA the additional requirements listed below, along with many other requirements:

1. Fourteen Day Period to Provide Notice of Completion of an Application/Decision to Undertake a Project: Within fourteen (14) days of determining that an application for a project is complete or of a decision by a public agency to undertake a project, a lead agency shall provide formal notification to a designated contact of, or tribal representative of, traditionally and culturally affiliated California Native American tribes that have requested notice, to be accomplished by at least one written notice that includes:

- **a.** A brief description of the project.
- **b.** The lead agency contact information.
- **c.** Notification that the California Native American tribe has 30 days to request consultation. (Pub. Resources Code §21080.3.1 (d)).
- **d.** A "California Native American tribe" is defined as a Native American tribe located in California that is on the contact list maintained by the NAHC for the purposes of Chapter 905 of Statutes of 2004 (SB 18). (Pub. Resources Code §21073).

2. Begin Consultation Within 30 Days of Receiving a Tribe's Request for Consultation and Before Releasing a Negative Declaration, Mitigated Negative Declaration, or Environmental Impact Report: A lead agency shall begin the consultation process within 30 days of receiving a request for consultation from a California Native American tribe that is traditionally and culturally affiliated with the geographic area of the proposed project. (Pub. Resources Code §21080.3.1, subds. (d) and (e)) and prior to the release of a negative declaration, mitigated negative declaration or Environmental Impact Report. (Pub. Resources Code §21080.3.1(b)).

- **a.** For purposes of AB 52, "consultation shall have the same meaning as provided in Gov. Code §65352.4 (SB 18). (Pub. Resources Code §21080.3.1 (b)).

3. Mandatory Topics of Consultation If Requested by a Tribe: The following topics of consultation, if a tribe requests to discuss them, are mandatory topics of consultation:

- **a.** Alternatives to the project.
- **b.** Recommended mitigation measures.
- **c.** Significant effects. (Pub. Resources Code §21080.3.2 (a)).

4. Discretionary Topics of Consultation: The following topics are discretionary topics of consultation:

- **a.** Type of environmental review necessary.
- **b.** Significance of the tribal cultural resources.
- **c.** Significance of the project's impacts on tribal cultural resources.
- **d.** If necessary, project alternatives or appropriate measures for preservation or mitigation that the tribe may recommend to the lead agency. (Pub. Resources Code §21080.3.2 (a)).

5. Confidentiality of Information Submitted by a Tribe During the Environmental Review Process: With some exceptions, any information, including but not limited to, the location, description, and use of tribal cultural resources submitted by a California Native American tribe during the environmental review process shall not be included in the environmental document or otherwise disclosed by the lead agency or any other public agency to the public, consistent with Government Code §6254 (r) and §6254.10. Any information submitted by a California Native American tribe during the consultation or environmental review process shall be published in a confidential appendix to the environmental document unless the tribe that provided the information consents, in writing, to the disclosure of some or all of the information to the public. (Pub. Resources Code §21082.3 (c)(1)).

6. Discussion of Impacts to Tribal Cultural Resources in the Environmental Document: If a project may have a significant impact on a tribal cultural resource, the lead agency's environmental document shall discuss both of the following:

- **a.** Whether the proposed project has a significant impact on an identified tribal cultural resource.
- **b.** Whether feasible alternatives or mitigation measures, including those measures that may be agreed to pursuant to Public Resources Code §21082.3, subdivision (a), avoid or substantially lessen the impact on the identified tribal cultural resource. (Pub. Resources Code §21082.3 (b)).

7. Conclusion of Consultation: Consultation with a tribe shall be considered concluded when either of the following occurs:

a. The parties agree to measures to mitigate or avoid a significant effect, if a significant effect exists, on a tribal cultural resource; or

b. A party, acting in good faith and after reasonable effort, concludes that mutual agreement cannot be reached. (Pub. Resources Code §21080.3.2 (b)).

8. Recommending Mitigation Measures Agreed Upon in Consultation in the Environmental Document: Any mitigation measures agreed upon in the consultation conducted pursuant to Public Resources Code §21080.3.2 shall be recommended for inclusion in the environmental document and in an adopted mitigation monitoring and reporting program, if determined to avoid or lessen the impact pursuant to Public Resources Code §21082.3, subdivision (b), paragraph 2, and shall be fully enforceable. (Pub. Resources Code §21082.3 (a)).

9. Required Consideration of Feasible Mitigation: If mitigation measures recommended by the staff of the lead agency as a result of the consultation process are not included in the environmental document or if there are no agreed upon mitigation measures at the conclusion of consultation, or if consultation does not occur, and if substantial evidence demonstrates that a project will cause a significant effect to a tribal cultural resource, the lead agency shall consider feasible mitigation pursuant to Public Resources Code §21084.3 (b). (Pub. Resources Code §21082.3 (e)).

10. Examples of Mitigation Measures That, If Feasible, May Be Considered to Avoid or Minimize Significant Adverse Impacts to Tribal Cultural Resources:

a. Avoidance and preservation of the resources in place, including, but not limited to:

i. Planning and construction to avoid the resources and protect the cultural and natural context.

ii. Planning greenspace, parks, or other open space, to incorporate the resources with culturally appropriate protection and management criteria.

b. Treating the resource with culturally appropriate dignity, taking into account the tribal cultural values and meaning of the resource, including, but not limited to, the following:

i. Protecting the cultural character and integrity of the resource.

ii. Protecting the traditional use of the resource.

iii. Protecting the confidentiality of the resource.

c. Permanent conservation easements or other interests in real property, with culturally appropriate management criteria for the purposes of preserving or utilizing the resources or places.

d. Protecting the resource. (Pub. Resource Code §21084.3 (b)).

e. Please note that a federally recognized California Native American tribe or a non-federally recognized California Native American tribe that is on the contact list maintained by the NAHC to protect a California prehistoric, archaeological, cultural, spiritual, or ceremonial place may acquire and hold conservation easements if the conservation easement is voluntarily conveyed. (Civ. Code §815.3 (c)).

f. Please note that it is the policy of the state that Native American remains and associated grave artifacts shall be repatriated. (Pub. Resources Code §5097.991).

11. Prerequisites for Certifying an Environmental Impact Report or Adopting a Mitigated Negative Declaration or Negative Declaration with a Significant Impact on an Identified Tribal Cultural Resource: An Environmental Impact Report may not be certified, nor may a mitigated negative declaration or a negative declaration be adopted unless one of the following occurs:

a. The consultation process between the tribes and the lead agency has occurred as provided in Public Resources Code §21080.3.1 and §21080.3.2 and concluded pursuant to Public Resources Code §21080.3.2.

b. The tribe that requested consultation failed to provide comments to the lead agency or otherwise failed to engage in the consultation process.

c. The lead agency provided notice of the project to the tribe in compliance with Public Resources Code §21080.3.1 (d) and the tribe failed to request consultation within 30 days. (Pub. Resources Code §21082.3 (d)).

The NAHC's PowerPoint presentation titled, "Tribal Consultation Under AB 52: Requirements and Best Practices" may be found online at: http://nahc.ca.gov/wp-content/uploads/2015/10/AB52TribalConsultation_CalEPAPDF.pdf

SB 18

SB 18 applies to local governments and requires local governments to contact, provide notice to, refer plans to, and consult with tribes prior to the adoption or amendment of a general plan or a specific plan, or the designation of open space. (Gov. Code §65352.3). Local governments should consult the Governor's Office of Planning and Research's "Tribal Consultation Guidelines," which can be found online at: https://www.opr.ca.gov/docs/09_14_05_Updated_Guidelines_922.pdf.

Some of SB 18's provisions include:

1. Tribal Consultation: If a local government considers a proposal to adopt or amend a general plan or a specific plan, or to designate open space it is required to contact the appropriate tribes identified by the NAHC by requesting a "Tribal Consultation List." If a tribe, once contacted, requests consultation the local government must consult with the tribe on the plan proposal. **A tribe has 90 days from the date of receipt of notification to request consultation unless a shorter timeframe has been agreed to by the tribe.** (Gov. Code §65352.3 (a)(2)).
2. No Statutory Time Limit on SB 18 Tribal Consultation. There is no statutory time limit on SB 18 tribal consultation.
3. Confidentiality: Consistent with the guidelines developed and adopted by the Office of Planning and Research pursuant to Gov. Code §65040.2, the city or county shall protect the confidentiality of the information concerning the specific identity, location, character, and use of places, features and objects described in Public Resources Code §5097.9 and §5097.993 that are within the city's or county's jurisdiction. (Gov. Code §65352.3 (b)).
4. Conclusion of SB 18 Tribal Consultation: Consultation should be concluded at the point in which:
    a. The parties to the consultation come to a mutual agreement concerning the appropriate measures for preservation or mitigation; or
    b. Either the local government or the tribe, acting in good faith and after reasonable effort, concludes that mutual agreement cannot be reached concerning the appropriate measures of preservation or mitigation. (Tribal Consultation Guidelines, Governor's Office of Planning and Research (2005) at p. 18).

Agencies should be aware that neither AB 52 nor SB 18 precludes agencies from initiating tribal consultation with tribes that are traditionally and culturally affiliated with their jurisdictions before the timeframes provided in AB 52 and SB 18. For that reason, we urge you to continue to request Native American Tribal Contact Lists and "Sacred Lands File" searches from the NAHC. The request forms can be found online at: http://nahc.ca.gov/resources/forms/.

NAHC Recommendations for Cultural Resources Assessments

To adequately assess the existence and significance of tribal cultural resources and plan for avoidance, preservation in place, or barring both, mitigation of project-related impacts to tribal cultural resources, the NAHC recommends the following actions:

1. Contact the appropriate regional California Historical Research Information System (CHRIS) Center (https://ohp.parks.ca.gov/?page_id=30331) for an archaeological records search. The records search will determine:
    a. If part or all of the APE has been previously surveyed for cultural resources.
    b. If any known cultural resources have already been recorded on or adjacent to the APE.
    c. If the probability is low, moderate, or high that cultural resources are located in the APE.
    d. If a survey is required to determine whether previously unrecorded cultural resources are present.

2. If an archaeological inventory survey is required, the final stage is the preparation of a professional report detailing the findings and recommendations of the records search and field survey.
    a. The final report containing site forms, site significance, and mitigation measures should be submitted immediately to the planning department. All information regarding site locations, Native American human remains, and associated funerary objects should be in a separate confidential addendum and not be made available for public disclosure.
    b. The final written report should be submitted within 3 months after work has been completed to the appropriate regional CHRIS center.

3. Contact the NAHC for:

   a. A Sacred Lands File search. Remember that tribes do not always record their sacred sites in the Sacred Lands File, nor are they required to do so. A Sacred Lands File search is not a substitute for consultation with tribes that are traditionally and culturally affiliated with the geographic area of the project's APE.

   b. A Native American Tribal Consultation List of appropriate tribes for consultation concerning the project site and to assist in planning for avoidance, preservation in place, or, failing both, mitigation measures.

4. Remember that the lack of surface evidence of archaeological resources (including tribal cultural resources) does not preclude their subsurface existence.

   a. Lead agencies should include in their mitigation and monitoring reporting program plan provisions for the identification and evaluation of inadvertently discovered archaeological resources per Cal. Code Regs., tit. 14, §15064.5(f) (CEQA Guidelines §15064.5(f)). In areas of identified archaeological sensitivity, a certified archaeologist and a culturally affiliated Native American with knowledge of cultural resources should monitor all ground-disturbing activities.

   b. Lead agencies should include in their mitigation and monitoring reporting program plans provisions for the disposition of recovered cultural items that are not burial associated in consultation with culturally affiliated Native Americans.

   c. Lead agencies should include in their mitigation and monitoring reporting program plans provisions for the treatment and disposition of inadvertently discovered Native American human remains. Health and Safety Code §7050.5, Public Resources Code §5097.98, and Cal. Code Regs., tit. 14, §15064.5, subdivisions (d) and (e) (CEQA Guidelines §15064.5, subds. (d) and (e)) address the processes to be followed in the event of an inadvertent discovery of any Native American human remains and associated grave goods in a location other than a dedicated cemetery.

If you have any questions or need additional information, please contact me at my email address: Cody.Campagne@nahc.ca.gov.

Sincerely,

Cody Campagne

Cody Campagne
Cultural Resources Analyst

cc: State Clearinghouse

From: BuenaVistaCommentForm.donotreply@santacruzcountyca.gov
To: Tom Melkonian; BuenaVistaProject
Subject: Buena Vista Landfill Comment Form Submission
Date: Tuesday, March 5, 2024 1:45:58 PM

Name: Angie Richman
Address: 165 Taylor Road Ben Lomond 95005
Email Address: arichman@rcdsantacruz.org
Share a Comment: I work for the Santa Cruz Resource Conservation District (RCD) doing forest health project management. Having a biomass processing facility in the County that could take large wood for a low cost would be hugely beneficial to our work which is focused on improving forest health and increasing wildfire resiliency. Often the largest costs associated with our projects are from biomass disposal and lack of feasible options.
Subscribe to Our Newsletter: False
Receive Future Project Notices: False

From: BuenaVistaCommentForm.donotreply@santacruzcountyca.gov
To: Tom Melkonian; BuenaVistaProject
Subject: Buena Vista Landfill Comment Form Submission
Date: Sunday, March 17, 2024 11:29:28 PM

Name: Anne Howard
Address: 1177 Buena Vista Drive
Email Address: ahowardpt@gmail.com
Share a Comment: I am concerned with the expansion of the dump margins even closer to my equestrian facility. I am concerned that the public transfer station may create more unpredictable noise and disturbance for our sensitive equestrian business.

I am concerned that the composting area will generate more unpleasant smells than our current dump arrangement.

It may be that it will be less disruptive than the current situation, but since the constant encroachment of the dump in the direction of direction our property since we bought it 1981, I hope my concerns are appreciated.

I al also concerned that the traffic level will be increased and while I hear there is a plan to have Buena VIsta improved to manage it, we would prefer to know this is in place as the current pothole level, metal plates, and woefully insufficient patches make navigating the road from the dump to the freeway an art form in avoiding significant holes. I have clients who say they make the Boulder Creek potholes look like nothing.
Subscribe to Our Newsletter: True
Receive Future Project Notices: True

From: BuenaVistaCommentForm.donotreply@santacruzcountyca.gov
To: Tom Melkonian; BuenaVistaProject
Subject: Buena Vista Landfill Comment Form Submission
Date: Monday, March 18, 2024 7:47:07 PM

Name: Carol Latta
Address: PO Box 1449, Aptos 95001
Email Address: lattac@gmail.com
Share a Comment: How I rate the Proposals. I feel composting is very important.

1A - (12K) YES - Good composting (?), good routing: entrance@ Harkins, exit on Buena Vista.

1B - (14.6K) BEST - Good composting area, Works w. new Buena Vista and good size, simple routing: entrance@ Harkins, exit on Buena Vista.

2A&B - (15.3K) NO - Little room for compost. Very complicated routing.

3 (12.5K) OK - Good compost area, routing really labored, surrounds land fill - wasteful.

4. (14.8K) NO - Not as good compost, Routing hampers Harkins Rd but better than 2A & B

Subscribe to Our Newsletter: True
Receive Future Project Notices: True

From: Miyashita Nursery
To: BuenaVistaProject
Subject: Comment
Date: Monday, March 18, 2024 9:35:11 AM
Attachments: BV Landfill.docx

****CAUTION:This is an EXTERNAL email. Exercise caution. DO NOT open attachments or click links from unknown senders or unexpected email.****

Please find attached my comments regarding the proposed landfill project.

Thanks,

David Miyashita

Sent from Mail for Windows

3/17/2024

Buena Vista Landfill Redevelopment Project
County of Santa Cruz

Hello,

I am responding to the NOP letter sent to neighbors of the redevelopment project. We own the parcel adjacent to the proposed project and are adamantly opposed to the location of transfer station 1. Due to the proximity of proposed transfer station 1, this will negatively impact the use and value of our property because of excessive noise, windblown debris, excessive bird droppings and concentrated vehicular activity associated with transfer station.

Being in a “scenic corridor”, no consideration is attributed to impacts to the view scape for our neighboring hillside businesses and residences due to the elevated location of the facility.

David Miyashita
Miyashita Nursery.
1203 Buena Vista Drive
Watsonville, CA 95076

miyashitanursery@gmail.com

From: BuenaVistaCommentForm.donotreply@santacruzcountyca.gov
To: Tom Melkonian; BuenaVistaProject
Subject: Buena Vista Landfill Comment Form Submission
Date: Tuesday, February 20, 2024 11:31:07 AM

Name: Susan Petrie
Address: 222 High Street
Email Address: spetrie@openspacetrust.org
Share a Comment: The landfill redevelopment plan should seriously consider adding facilities to process the large volumes of woody biomass being generated through forestry/fuel reduction work, storm debris cleanup in our creeks/beaches, and construction debris. There are opportunities to consider processing this biomass into hydrogen to fuel the city's bus fleets and create biochar to augment local agricultural producers and keep water ways clean. Furthermore, the landfill's proximity to the rail line makes producing a value added byproduct especially appealing, since biochar (or other byproducts) could be affordably hauled to existing (or anticipated) markets in the central valley or other locations.
Subscribe to Our Newsletter: True
Receive Future Project Notices: True

From: BuenaVistaCommentForm.donotreply@santacruzcountyca.gov
To: Tom Melkonian; BuenaVistaProject
Subject: Buena Vista Landfill Comment Form Submission
Date: Tuesday, March 19, 2024 9:10:09 PM

Name: Wendy Weil
Address: 148Crest Dr La Selva Beach
Email Address: zewt4@sbcglobal.net
Share a Comment: What will the environmental umpact of the project be for neighbors
Subscribe to Our Newsletter: True
Receive Future Project Notices: True

Appendix D. Preliminary Landfill Closure Plan

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Preliminary Closure and Postclosure Maintenance Plan

Buena Vista Drive Sanitary Landfill

Santa Cruz County, California

Prepared by

Geosyntec Consultants, Inc.
1111 Broadway, 6th Floor
Oakland, California 94607



Fabrizio Settepani, P.E., G.E. (CA)
Principal

Project Number: WG2726
April 2021

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1. INTRODUCTION

1.1 Terms of Reference

This Preliminary Closure and Postclosure Maintenance Plans (PCPMP) for the Buena Vista Landfill (BVLF) in Santa Cruz County, California, has been prepared by Geosyntec Consultants, Inc. (Geosyntec). The vicinity map for the landfill is shown on Figure 1. The PCPMP has been prepared on behalf of the County of Santa Cruz (County), the owner and operator of the landfill, to meet requirements of the Waste Discharge Requirements (WDRs) (CRWQCB, 2006), Title 27 of the California Code of Regulations (CCR), and Title 40 of the Code of Federal Regulations (CFR).

The initial *Preliminary Closure and Postclosure Maintenance Plans* (PCPMP) for BVL was prepared in 1993 (EMCON Associates, 1993) and was referenced in the Joint Technical Document (JTD) submitted to CalRecycle and the California Regional Water Quality Control Board – Central Coast Region (CRWQCB) in 2005 (County of Santa Cruz, 2005). In 2006, the CRWQCB issued the WDR, Order No. R3-2006-0002 requiring a PCPMP for BVL by 31 July 2008. The PCPMP was submitted in July 2008 and comments[1] were addressed by the County and Geosyntec in May 2011. A five-year permit review update to the PCPMP was prepared in 2016. On September 25, 2020, the CRWQCB issued *General Waste Discharge Requirements Order No. R3-2020-0001 for Active Class III Landfills in the Central Coast Region* (2020 General Order) This version of the PCPMP dated April 2021 updates information provided in the 2016 PCPMP revision and addresses requirements in the 2020 General Order.

The objective of the PCPMP is to provide preliminary design and construction guidelines for closing the Class III facility and establish an economical and environmentally sound postclosure maintenance program, so that public health and the environment are protected and adequate financial resources will be available to properly accomplish closure and postclosure maintenance. Final closure and postclosure maintenance plans will be submitted 2 years before the anticipated date of closure or partial closure.

[1] The main comment required updating Appendices H (Preliminary Closure Cost Estimate) and I (Preliminary Postclosure Cost Estimate).

1.2 Regulatory Framework

1.2.1 General

The applicable federal regulations, which fall under Subtitle D of the Resource Conservation and Recovery Act (RCRA) and contained in Part 258, Title 40 of the CFR, are referred to in this report as "Subtitle D" regulations. The set of applicable state regulations, contained in Title 27 of the CCR, and enforced by CalRecycle and the State Water Resources Control Board (SWRCB), is referred to in this report as "Title 27" regulations. The specific regulatory requirements cited in this report are shown in italics.

State and federal regulations for design of municipal solid waste (MSW) landfills include both prescriptive minimum construction standards and alternative, performance-based standards for final cover design. Performance-based designs must be approved by the governing regulatory agencies. The California regulatory program for MSW landfills was approved by the United States Environmental Protection Agency (USEPA), as being in conformance with Subtitle D, on 9 October 1993. Because the California regulatory program has been approved by USEPA, California state agencies have the authority to approve performance-based design alternatives for MSW landfills without federal review. Therefore, only the approval of the state and local regulatory agencies is required for implementation of a non-prescriptive final cover design for MSW landfills in California based upon the performance standards in state and federal regulations.

In California, regulatory responsibility for design of final covers for MSW landfills is jointly held by the CRWQCB, EA, and CalRecycle.

1.2.2 Landfill Closure

Federal closure requirements are included in Part 258 of Title 40 of the CFR (Subtitle D).

The state requirements, related to closure of MSW landfills in California, are described in Division 2 (Solid Waste), Chapter 3 (Criteria for All Waste Management Units, Facilities and Disposal Sites), Subchapter 5 (Closure and Postclosure Maintenance) of Title 27 (Environmental Protection) of the CCR.

1.3 CEQA Considerations

The California Environmental Quality Act (CEQA) requires that environmental impacts be considered prior to the issuance of any governmental agency permits or approvals related to the operation of a solid waste facility. An Environmental Impact Report was prepared for the Buena Vista Landfill Expansion in 1984 (Gilchrist and Associates, 1984). The landfill is operating under Conditional Use Permit No. 83-1507-GPA/LCPA adopted by the Santa Cruz County Planning Commission in 1985.

1.4 Report Organization

The remainder of this report is organized as follows:

- General site information, including a description of the environmental monitoring systems at BVL, site development plans, site life, postclosure land use, and maximum extent of closure are included in Section 2;
- Background information on regulatory requirements for the PCPMP and proposed final cover is included in Section 3;
- The closure activities are presented in Section 4;
- The postclosure maintenance activities are included in Section 5;
- Preliminary Closure and Postclosure Maintenance cost estimates and funding mechanisms are discussed in Section 6;
- A list of references cited in the report is included in Section 7; and
- Limitations on the applicability of information presented in this report are described in Section 8.

In addition, tables, figures and appendices, listed in the Table of Contents, provide supplemental information required by the regulations, such as topography, engineering analyses, final closure and postclosure cost estimates, etc.

2. GENERAL SITE INFORMATION

2.1 Facility Introduction

The Buena Vista Drive Sanitary Landfill (BVLF) (SWIS Number 44-AA-0004) is an active, permitted municipal solid waste landfill, which is owned and operated by the County of Santa Cruz (County). BVLF is a Class III facility as defined by Sections 20260 of Title 27 and comprises 126 acres, divided into three portions known as the closed landfill, Old Module 1, and active landfill. A site plan is provided in Figure 2.

Please note that the following landfill and parcel acreage calculations and allocations are based upon parcel size records listed by the County's Tax Assessors Office and revised topographic measurements taken from current aerial maps. The 2021 JTD includes copies of the Assessor's parcel maps for each landfill parcel described below and a printout of the Assessor's records including estimated acreage. These numbers vary from those contained in the previous reports of disposal site information (RDSI) for this facility, but do not reflect any changes in landfill footprint or acquisition of new lands, only a more accurate recalculation of parcel size and landfill footprint. In addition, it should be noted that the parcels numbering has changed over the years and the prior parcel numbers were 052-021-33, 052-061-01, and 052-061-25.

The 2021 JTD includes a single legal description of the entire landfill site encompassing all or part of parcels 052-021-33, 052-531-01, and 052-531-03, as described in further detail below.

The entire site includes a closed landfill on a 37 acre parcel (APN #052-531-01) of which 31 acres have been landfilled and certified closed. This site stopped receiving refuse in 1981 and was certified closed in 1986. The closure report and certification from the RWQCB were amended into the Preliminary Closure and Postclosure Plan, dated December 9, 1993 (EMCON Associates, 1993).

Adjacent to the active landfill is a 96 acre parcel (APN #052-531-03) shared by the landfill and Sheriff's detention facilities. For purposes of this report approximately 20 acres are dedicated to landfill activities and the remainder is used by the County Sheriff's Department. Of the 20 acres dedicated to landfill uses, 15 acres have been landfilled and certified closed as of December 1995. This site stopped receiving waste in 1985. This closed landfill section (commonly referred to as "Old Module 1") is concurrent with the southwest perimeter of the current active site, the subject of the

2021 JTD. The current permitted disposal site is a 69 acre parcel (APN #052-021-33) with 61 acres permitted for landfilling operations. This Preliminary Closure and Postclosure Maintenance Plan has been prepared for the BVLF Expansion Area.

The site development plan for the BVLF Expansion Area consists of six modules. The landfill footprint area (Modules 1 to 6) occupies approximately 54 acres of the 61 acres permitted for landfill operations. Because the Expansion Area and the Old Expansion Area are contiguous, the combined landfill footprint area is approximately 67 acres. Approximately 17 acres of Modules 1 and 2 and the Old Module 1 were closed with a final cover in the early 1990s (CH2M Hill 1995), leaving approximately 50 acres (53 acres with slope correction) of the combined expansion area remaining to be closed.

2.2 Current Permits

In March 2021 as required by the General Waste Discharge Requirements Order No. R3-2020-0001, the County updated the Joint Technical Document (JTD) (2021 JTD) and submitted it to CalRecycle and the Central Coast Region, Regional Water Quality Control Board (RWQCB). The 2021 JTD lists the current permits for the Landfill.

2.3 Site Location

The landfill is located approximately 2.5-miles west of the City of Watsonville, California (Figure 1). The landfill site is bounded by Harkins Slough to the east, Buena Vista Drive to the west, a railroad line and Watsonville Landfill to the south, and privately-owned property to the north. The landfill site is also traversed by Gallighan Slough which runs in an approximately east-west direction in the southern portion of the site. Figure 3 also depicts structures and facilities within a 1,000-ft of the property boundary.

Public access to BVLF is from Buena Vista Drive, which bounds the western limit of the site. A site personnel and maintenance entrance is located on Rountree Lane, on the eastern side of the site and adjacent to the Sheriff's Rehabilitation Facility.

2.4 Geology and Hydrogeology

The site is a naturally occurring valley within an uplifted marine terrace. It lies within a broad band of gently rolling hills of the Monterey Bay coastal plain. This gentle terrain

has been incised by numerous small streams draining southward to the Pajaro River, including Harkins Slough east of the site and Gallighan Slough to the southwest.

Portions of BVLF are underlain by recent fluvial terrace deposits consisting of poorly consolidated, heterogeneous deposits of gravels, sands and silts. The fluvial terrace deposits are underlain by the Aromas Formation. The Aromas Formation consists of clean, coarse- to medium-grained sands. The Aromas Formation is underlain by the Purisima Formation.

The Aromas Sand formation is the primary water-bearing unit beneath the BVLF and consists of aeolian (wind blown) and fluvial sand, silt, clay and gravel. Underlying the Aromas Sand formation is the Tertiary Purisima formation, which is too deep to be relevant to site hydrogeologic conditions. Groundwater beneath the site occurs in the Aromas Sand formation, but also occurs in the overlying aeolian and terrace deposits. Perched groundwater zones occur in the aeolian and terrace deposits where the percolation of rainfall and irrigation is inhibited by low permeability horizons in near-surface deposits.

Groundwater flow conditions are influenced regionally by agricultural and municipal pumping wells (CH2M Hill, 1996). Near BVLF, the direction of groundwater flow is southeast and water levels range between –5 feet and +5 feet MSL. Water levels that were +5 to +15 feet MSL in the 1940s have declined to –5 feet MSL and lower in recent years. The groundwater monitoring reports for the site present the complete information.

2.5 Land Use

Land use in the surrounding area consists of Public Facilities including: Sheriff's Rehabilitation Facility, to the south, seasonal farm workers housing to the southeast, scattered residential/agricultural uses to the east and north, and agricultural/open space (which is predominant). Surrounding agricultural uses consist of a combination of row crops, grazing and greenhouses. Grazing has historically occurred on the lands east and north of the project site. However, greenhouses and row crops have increased over time and are now interspersed with grazing activities in the surrounding area. .

The active landfill site is buffered on all sides by public roadways with 50 foot wide easements including Buena Vista Drive, Harkins Slough Road, and Rountree Lane. In addition to the roadway buffers, the landfill footprint is set back from the roadways

approximately 50 to 100 feet. The closed landfill area, southwest of the active site, is surrounded by Gallighan Slough to the east and north, and a biotic conservation easement and the Watsonville City Landfill to the south and west. The slough and conservation easement areas provide an additional buffer around the closed landfill.

2.6 Waste Types

Based on information provided by the County, waste types accepted at BVLF are:

a. General (municipal solid waste)

In general municipal solid waste received at the Buena Vista Landfill for disposal consists of: mixed municipal refuse, both compacted and self-hauled; mixed construction/ demolition debris; mixed commercial and industrial wastes; and mixed inerts. Mixed inerts include soil, broken asphalt and concrete, and brick that are either processed into road base materials destined for off-site markets or used on site for road construction and winterization of refuse receiving areas.

b. High Liquid Content Wastes

The only high liquid content wastes received on site are primary and/or secondary wastewater treatment sludge from the City of Scotts Valley. Currently most Scotts Valley sludge is not being disposed at the BVLF. However, the BVLF has previously received up to 1,500 to 2,000 tons of dewatered sludge from Scotts Valley annually. As a requirement for disposal of sludge at the Buena Vista landfill, each load of sludge must be accompanied by signed laboratory reports for percent solids by weight (must exceed 20% for disposal) and all NPDES required sludge analysis must be submitted yearly. Ongoing NPDES monitoring results indicate that the sludge poses no health hazard and as such is handled as general refuse. Sludge is accepted 6 days per week, usually in single 6-10 ton loads. There are no seasonal fluctuations. No other known high liquid wastes are accepted at the site.

c. Designated Wastes

Contaminated soils are accepted at this site under guidelines established in the site's Waste Acceptance Plan. All loads of contaminated soil must be pre-approved by the Solid Waste Administrative staff prior to acceptance including but not limited to review

of laboratory testing results, confirmation of County Environmental Health approval, and request for added testing.

Although the statute (Health and Safety Code (HSC) 25150.7 and regulations (California Code of Regulations, Title 22, section 67386.1 et seq.) that authorized treated wood waste (TWW) to be handled with alternative management standards expired on December 31, 2020, General WDR Order R3-2020-0001 allows TTW to be discharged to WMUs equipped with a composite liner and LCRS, if handled in accordance with California HSC 25143.1.5 and 25150.7. In addition, in February 2021 DTSC allowed disposal facilities to apply for a variance to accept TTW; Buena Vista Landfill received the disposal facility variance (TWW-2021-DF-00060).

d. Hazardous Wastes

The County's Household Hazardous Waste (HHW) Collection and Load Checking Program has been in operation since May 1991. The facility began accepting hazardous waste from Small Quantity Generators in Fall 2002. A permanent HHW facility was constructed and began operations in 2005. This facility collects all types of common hazardous household products and chemicals, excluding radioactive, ammunition, explosives, medical/infectious waste, and compressed gas (e.g., propane) in excess of 5 gallons. The facility also collects Universal Wastes including batteries and fluorescent light tubes. The Load Checking Program ensures no hazardous wastes are discharged in the landfill.

e. Other Wastes Requiring Special Handling, Supervised Burial or Processing

Other special wastes handled or processed on-site include dead animals, autoclaved infectious waste, empty pesticide containers, yardwaste/woodwaste, scrap metal, tires, E-waste (Cathode Ray Tubes, Flat Panel Displays), mattresses/box springs, concrete/asphalt/brick, Sheriff's confiscations, animal processing wastes (e.g., fish/chicken entrails), agricultural plastics, oversized stumps and rootballs, large non-recyclable metal items, rancid wastes, or any waste requiring supervised burial.

f. Ash

Incinerator ash discharge does not occur at the Buena Vista Landfill.

2.7 Landfill Development Plans, Maximum Extent of Closure, and Postclosure Land Use

The active portion of the landfill is known as the Expansion Area and encompasses approximately 69-acres. The Expansion Area comprises seven existing modules, Modules 1, 2, 3, 4A, 4B, 5 and 6, which have been constructed and completely or partially filled with waste.

Figure 2 shows the approximate locations of the existing Modules. Disposal operations will continue, over all the modules, to the maximum permitted elevation of 200 feet; Figures 4a and 4b show the remaining landfill construction sequence. Figure 4c shows two cross section through the landfill.

Modules 1 and 2 were constructed prior to the Subtitle D regulations and have a clay liner and leachate collection system. Approximately 17 acres of final cover has been placed on completed portions of the Modules 1 and 2 side slopes and the Old Module 1 area (EMCON Associates, 1993, CH2M Hill, 1995). The final cover system consists of 2 feet of compacted foundation layer, at least 1 foot of low permeability clay, and at least 1 foot of vegetative soil. For this closed area, the vegetative soil was hydroseeded and permanent drainage and erosion control structures were constructed. Details of the construction of this closure are described in CH2M Hill (1995); the document was transmitted to CalRecycle in December 1995.

Figures 4d show sample details of the waste containment system for Module 3; similar composite liner systems were constructed for Modules 4A and 4B. Figure 4e shows details for one of the constructed leachate collection and removal system (LCRS) sump.

Exterior, inactive slopes of Modules 1 through 6 have been covered with intermediate cover and sloped for proper drainage. The County also hydroseeds the slopes as part of landfill operations and maintenance.

The maximum extent of closure for the site will be the final phase, as shown on Figure 4b. The acreage to be closed is approximately 53 acres, including a slope correction factor.

The postclosure land use of BVLF will be consistent with the surrounding terrain, land uses, and zoning. The site will generally be used as open space and grazing. Recreational uses may also be considered. Applications to permit recreational use of

selected portions of the closed landfill will be filed before using the site. Portions of the site may remain operational following closure of the landfill. This includes several of the onsite facilities, including the recycle areas, scale house, hazardous material building, maintenance building, and offices.

2.8 Existing Monitoring and Control Systems

Current monitoring and control systems at BVLF include systems for leachate, drainage and erosion, groundwater, and landfill gas. Figure 2 depicts the location of each of these systems.

2.8.1 Leachate Control

1. Leachate Collection and Removal System (LCRS)

The leachate collection and removal system (LCRS) for each module at BVLF includes a blanket drainage layer, perforated pipes, non-perforated riser pipes, pumps, and leachate storage tanks.

The landfill floor LCRS consists of a blanket drainage layer with a dendritic piping system for increased efficiency. On the side slopes, the leachate flows along the slopes. Side slope benches are sloped to drain towards the inside of the module.

The Module 1 and 2 LCRS overlie a clay liner, while the Module 3, 4A, 4B, 5 and 6 overlie a composite lining system (clay overlain by HDPE geomembrane).

Other than Module 5, which drains to Modules 4B and 6, each module's LCRS drains to a separate collection sump. Access to each sump is through a side slope riser. Submersible pumps are placed at the base of the risers and equipped with load sensors to allow automatic pump control. Pumped leachate is stored in double-contained storage tanks for transfer to a tank truck and disposal to the POTW or, during the dry season,for use as onsite dust control within composite-lined modules.

2. Monitoring System

Leachate risers serve as both a conduit for the automated pumping system and an access point for inspection of collection system. Leachate samples are collected during pump cycles prior to discharging into the storage tanks. Each sump is equipped with a load

controlled submersible pump designed to operate in harsh chemical environments, such as leachate. The pumps are scheduled to cycle on every 2-4 hours and will pump until no load is encountered. The system is videotaped annually.

3. Monitoring and Reporting

Leachate collection systems are checked weekly and fully inspected annually. The automatic pumping system in each collection sump ensures that the leachate level above the liner system meets the regulatory requirements. The pumps are placed at the bottom of the sump and cycle on every 2-4 hours until no load is encountered. Leachate is collected and stored in double-contained tanks and periodically transported by truck to the publically owned treatment works (POTW). Records of leachate volumes collected are obtained from trucking records and kept on file at the site.

Leachate from each module is sampled twice a year in accordance with 40CFR Part 258 Appendix II Constituents of Concern. Samples are collected in October and again in April. The April samples are tested only for analytes detected in the October sampling to confirm their presence.

As required by the site WDRs, semi-annual reports are submitted for all monitoring conducted on site including leachate. Two semi-annual and one annual summary reports are submitted to the RWQCB and copied to CalRecycle.

2.8.2 Drainage and Erosion Control

1. Drainage and Erosion Control

Drainage control facilities consist of perimeter and bench ditches and down drains. Because of site development constraints, the site has changed its stormwater management from temporary sedimentation basins to flow-based systems such as water quality units with bypass features and aggressive erosion and sediment control practices (e.g., wattles, hydroseeding, etc.). A water quality unit is located at the north end of the entrance facility and additional water quality units will be added as needed.. The

following criteria are used for the surface water drainage and erosion control features for BVLF:[2]

- Surface water control facilities designed to prevent waste washout during peak discharge from a 100-year, 24-hr design storm.
- For water quality purposes, a flow-based approach was followed.[3]
- Design rainfall depth from rainfall data at nearby rain gauges maintained by the Department of Water Resources.
- Ditches crossing over areas of previously disposed waste that has been inactive for one year or more will be lined with clay (approx. 10-6 cm/s or less hydraulic conductivity) or synthetic barrier materials, such as geomembranes. . Erosion control will be provided on exposed slopes with liners and at culvert inlets and outlets.

The potential for soil erosion from the proposed landfill slopes during the active landfill life was evaluated using the Universal Soil Loss Equation developed by the USDA Soil Conservation Service. This evaluation method determines soil erosion based on the rainfall and runoff factor, the soil erodibility factor, the topographic factor derived from the slope gradient and the slope length, the cover and management factor and the support practice factor. Soil erosion calculations are included in the 2021 JTD (County of Santa Cruz, 2021).

The conceptual surface water facilities and erosion control plan for Modules 3, 4A, 4B, 5 and 6 are shown on the Site Development Plans along with the site drainage patterns for Module 1 and 2 and closed areas (GeoSyntec, 2005).

A water quality unit was installed as part of Module 5 construction and controls sediment; other potential, additional water quality units may be added. After closure,

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[2] The landfill is currently active; therefore, the permanently constructed facilities design criteria apply to the closed areas of Modules 1 and 2; the design of the surface water control (pipes, culverts, ditches) for active areas is presented in the design reports for the various modules. When the active areas are closed, the surface water design criteria listed will be followed.

[3] See Appendix H (Surface Water Management – Module 5) in Revised Module 5: Design Report, Buena Vista Drive Sanitary Landfill; prepared for County of Santa Cruz Department of Public Works, prepared by Geosyntec Consultants, Inc.; project WG1654-01; January 2014, Revised May 2014.

runoff and sediment are expected to decrease because the slopes will be vegetated with the final cover.

Outer landfill slopes and temporary excavation cut slopes are hydroseeded annually as needed. Storm flows from these areas are conveyed directly to the perimeter ditch which discharges to roadside drainage facilities. Run-on from surrounding roads is also intercepted by these perimeter drainage facilities. The erosion control measures incorporated in the site design include:

- Collection and control of runoff, diverting it away from highly erodible areas.
- Construction of intermediate and final landfill slopes with drainage benches at intervals designed to control slope runoff velocities and volumes.
- Vegetation of intermediate surfaces that will be exposed for more than 180 days and surfaces at final grade.
- Periodic hydroseeding of intermediate cover slopes, slope repairs and other potential high erosion areas.

2. Monitoring and Reporting

Four surface monitoring points have been established at the landfill to meet the surface water monitoring requirement in the site WDRs. Surface water monitoring points R-1 and R-4 monitor the surface water upstream of the landfill. Monitoring point R-1 is located in Gallighan Slough northwest of the closed Watsonville Landfill. Monitoring point R-4 is located in the northern drainage channel for the landfill, along Buena Vista Drive. Monitoring points R-2 and R-3 are located at the north and south points of Gallighan Slough between the closed and active landfill areas.

Nine monitoring points have been established at the landfill to meet the stormwater monitoring requirements for compliance with the site's stormwater Industrial General Permit. These points monitor the water quality discharging from the different drainage areas identified at the site. Sample location STM WQU1 monitors the water discharging from the water quality unit which collects water from the modules located in the northern portion of the site. Sample location STM SW-2 monitors stormwater discharging from Module 2 and the maintenance shop area. STM SW-6 is located along one of the V-ditches that drain the Old Expansion Area (Closed) landfill. STM SW-1 and STM SW-9 are located in the area of the entrance facilities (i.e., public recycling

facility, household hazardous facility, scalehouse, and closed/inactive landfill). STM SW-7 monitors the stormwater discharging from the closed old landfill. STM SW-8 is located across the co-gen facility at Gallighan Slough. STM SW-10 and STM SW-11 are located along the western side of the Old Landfill (Closed).

2.8.3 Groundwater Monitoring

1. Monitoring Systems

The groundwater monitoring well network for the Buena Vista Landfill consists of thirteen monitoring wells screened in the Aromas Sand formation (MW-01, MW-02, MW-03, MW-04, MW-05, MW-06, MW-07, MW-08, MW-09, MW-10, MW-11, MW-12,[4] and Tierra Alta).. In addition, three monitoring wells are not included in the monitoring well network described in the WDRs but are monitored routinely. These monitoring wells include:

1. MW-12R, installed on March 1, 2019 to replace MW-12, located east of Module 4A;
2. MW-13, installed on July 25, 2007 and located east of Module 4B; and
3. MW-14, installed on September 6, 2019 and located northeast of Module 5.

The locations of the groundwater monitoring wells are shown on Figure 2. Geologic logs and well construction diagrams for the monitoring wells are submitted to the RWQCB following completion of each monitoring well. Copies of the logs and well construction diagrams are included in the JTD (County of Santa Cruz, 2021) and are also maintained at the site.

Groundwater monitoring well MW-01 is located hydraulically upgradient of the landfill and serves as a background monitoring point. Groundwater monitoring wells MW-02, MW-03, MW-06, MW-09, MW-10, MW-12R, MW-13, MW-14 and the Tierra Alta well monitor downgradient flows south and southeast of the active landfill. Wells MW-04, MW-05, MW-07 and MW-08 are located hydraulically downgradient or cross-gradient of the closed landfill area. Monitoring well MW-11 is located southwest and downgradient of the closed landfill, on property owned by the City of Watsonville.

[4] Destroyed and replaced by MW-12R.

2. Sampling and Reporting

Water levels are measured at the monitoring wells listed above, as well as four piezometers, on a quarterly basis. Tables of historical water levels are included in semi-annual groundwater monitoring reports for the landfill.

Groundwater samples are collected quarterly in February, May, August, and November of each year for monitoring wells MW-03, MW-06, and MW-09. The remaining monitoring wells are sampled semiannually in February and August of each year..

The standard operating procedures for groundwater sample collection, including purging techniques, sample preservation and shipment, analytical procedures, and chain of custody control, are included in the Sampling Plan in the JTD (County of Santa Cruz, 2021).

Field parameters, including pH, electrical conductivity, temperature, and turbidity are measured during sample collection at each monitoring well/point. The groundwater and surface water samples are analyzed by a California-certified analytical laboratory for the following parameters:

- Total organic carbon (SM 5310D);
- Total alkalinity (as CaCO3), carbonate (as CO3), and bicarbonate (HCO3) (SM 2320B);
- Chloride, sulfate, nitrate as nitrogen (EPA Method 300.0);
- Ammonia as nitrogen (SM 4500C/B);
- Sulfide (SM 5600_S2_D);
- Iron, calcium, magnesium, manganese, sodium, potassium, boron (EPA Method 200.7);
- Total petroleum hydrocarbons as gasoline, diesel, and crude oil (EPA Method 8015B);
- Volatile organic compounds (VOCs) (EPA Method 8260); and
- Cation/Anion balance (various methods).

In addition to the above analytes, the samples are also required to be analyzed for constituents that are detected in the samples collected during semi-annual leachate sampling (October and April of each year). Due to the results from the semi-annual leachate sampling, the samples are also analyzed for barium, cobalt, chromium, copper, nickel, and zinc (EPA Method 200.7) and chlorinated herbicides (EPA Method 8151).

Starting with the monitoring event in August 2001, samples from the landfill have been analyzed for chromium, an analyte not required by the WDRs. The County voluntarily added the chromium analysis to routine monitoring in response to a regional concern of chromium in groundwater. Chromium has been consistently detected monitoring wells MW-01, MW-08, and the Tierra Alta well, and MW-08 routinely has the highest detections of any wells analyzed. MW-01 and MW-08 are upgradient of the landfill, indicating that the source of the chromium is not the landfill.

Results of the quarterly groundwater and surface water sampling are submitted to the RWQCB on a semi-annual basis, in January and July of each year. The report submitted in January also includes a summary of the data from the previous year. Included in the reports is a description of the activities performed during the reporting period, data evaluation, tables summarizing groundwater elevation and analyte concentrations, and analytical data reports from the laboratory.

Stormwater samples are collected following the requirements of California's General Permit for Stormwater Discharges Associated with Industrial Activities (Industrial General Permit; IGP) Order No. 2014-0057-DWQ, as amended by Order No. 2015-0122-DWQ (NPDES No. CAS000001), issued by the State Water Resources Control Board (State Water Board). The landfill has a Waste Discharge Identification (WDID) of 344I001258.

The stormwater sampling locations are labeled as followed: STM WQU-1, STM SW-1, STM SW-2, STM SW-6, STM SW-7, STM SW-8, STM SW-9, STM SW-10, and STM SW-11. The stormwater samples are analyzed by a California-certified analytical laboratory for the following parameters:

- pH (Field Probe)
- Oil and grease (O&G) (EPA Method 1664A)
- Total suspended solids (TSS) (SM 2540D)

- Chemical oxygen demand (COD) (SM 5220C)
- Total Iron (EPA Method 200.7)
- Total Aluminum (EPA Method 200.8)
- Total Lead (EPA Method 200.8)
- Total Zinc (EPA Method 200.8)
- Chloride (EPA Method 300.0)
- E. Coli (SM 9221 F) (WQU1 only)
- Enterococcus (SM 9230A-B) (WQU1 only)

Stormwater samples at the above sampling locations are collected and analyzed from two Qualified Storm Events (QSEs) within the first half of each reporting year (July 1 to December 31) and two QSEs within the second half of each reporting year (January 1 to June 30). Results of the stormwater sampling are submitted to the State Water Board via the Stormwater Multi Application and Report Tracking System (SMARTS).

The Annual Report is prepared, certified, and electronically submitted to SMARTS no later than July 15th following each reporting year (July 1 through June 30), using the standardized format and checklists in SMARTS based on the reporting requirements identified in the Industrial General Permit.

Additionally, the landfill is subject to inspection and rainfall data analysis requirements in the General Waste Discharge Requirements, Order No. R3-2020-0001 for Active Class III Landfills in the Central Coast Region, adopted by the Central Coast Regional Water Quality Control Board on September 25, 2020. Inspections of the landfill are required at least monthly and during or following each storm event that produces stormwater runoff and/or a storm event that produces a minimum of 1-inch of rain within a 24-hour period. The County must also collect the following rainfall data:

1. Total daily precipitation, in inches, each month.
2. Precipitation, in inches, and return period (25-year, 100-year, etc.) of the most intense 24-hour rainfall event occurring each month.
3. Number and date of storms (greater than or equal to one inch in 24 hours) received each month.

The detection monitoring program also includes groundwater and surface water sampling for the complete constituents of concern (COC) analyte list every 5 years. The COC sampling event was last performed at the landfill in May 2017.

3. Concentration Limits

Order No. R3-2006-0002 for the Buena Vista Landfill and General Order No. R3-2020-0001 requires the County to submit concentration limits for sampled parameters for the groundwater monitoring wells and surface water monitoring points. The limits are to be constructed in such a way that a potential release from the landfill would be indicated if the limit was exceeded. As required by both Orders, concentration limits are re-evaluated and new limits are proposed every year. The new limits are included in the monitoring reports submitted every January.

4. Point of Compliance

The point of compliance for the landfill is the downgradient edge of the landfill disposal area, along the southern and eastern property boundaries.

2.8.4 Landfill Gas Control

1. Gas Control System

The BVLF landfill gas (LFG) control system was originally installed for the purpose of controlling LFG migrating off site towards the Sheriff's Rehabilitation Facility. A flare and blower system was designed to handle the anticipated migration control needs for future landfill development. As the landfill expanded, the collection well system also expanded to protect all adjacent buildings and facilities.

The LFG control system included perimeter t-collector type wells installed at 200 foot intervals above the landfill liner at 40 and 80 feet below grade. Each well tee'd off at benches installed at the 40 and 80 foot level and a 100' x 3" perforated lateral was attached to each arm of the tee. The perforated laterals were enclosed in a three foot diameter pile of drain rock wrapped in filter fabric and overlaid with high permeability sand and gravel. The wells were attached to a common header and gas is extracted under vacuum via a blower system. Gas was then directed to an enclosed ground flare for destruction. The flare station contained back-up blowers, control valves, condensate traps, flame arrestor, fire-eye unit and continuous temperature and flow recorder.

In the early 2000s, the landfill gas system was expanded to include a series of deep internal vertical wells and horizontal wells, specifically designed for extraction of higher quality landfill gas for use in the landfill gas cogeneration facility and to comply with federal and state air quality and operating standards for existing landfill facilities as mandated by BVLF's Federal Title V Permit # TV 19-02.

A flare system with 1,800 cfm throughput was installed and became operational in spring 1997. This flaring facility serves both the Buena Vista Landfill (1,300 cfm capacity) and the adjacent Watsonville City Landfill (500 cfm capacity). The current Buena Vista Landfill gas collection system includes collection and perimeter migration control wells. A network of gas header pipes that consolidate at the flaring facility interconnects these wells. New wells are added or taken off line as needed in order to meet regulatory gas control guidelines and manage the system in a sound manner.

The County received Authorities to Construct and completed construction of a landfill gas-to-energy power plant that began operation December 2005. The co-generation facility is owned and operated by Ameresco, Inc. under a landfill gas purchase agreement with the County of Santa Cruz. Up to 1,200 cfm of landfill gas derived from the higher quality internal gas collection wells is diverted from the flare and piped to the on-site electrical co-generation facility. The co-generation facility generates 3 megawatts of electricity at peak output. Flaring operations continue to operate as needed in order to serve the City of Watsonville Landfill and to handle excess landfill gas generated at the Buena Vista Landfill. As indicated in Figure 2, the cogeneration facility is located near the exit area of the Old Buena Vista Landfill.

Appendix A includes the landfill gas system information as of 2019. More recently (2021), a new flare system was added to the existing landfill gas control system. The new flare (mini-flare) is located adjacent to the existing flare and has variable flow capacity in the range of 50-400 CFM and will allow County additional control to address landfill gas management needs.

2. Monitoring Program

The BVLF LFG monitoring system consists of wells which are strategically located at points both at the facility property line and on adjacent properties to monitor potentially impacted buildings. Additional wells are located near landfilled areas to provide control monitoring and optimization of the collection system. Each well is designed to ensure

monitoring at depths contiguous with the landfill design and subsurface geological features. .

Onsite buildings have subfloor venting systems to prevent gas build-up in the structure and also have continuous gas monitoring and alarm systems. A continuous monitoring/alarm system and subfloor venting system is installed in the maintenance building on site to provide a high level of safety for this building due to its close proximity to the landfill. The scalehouse is equipped with an epoxy sealed floor and landfill gas monitoring/alarm system. The office trailer for the HHW is lifted above ground so that LFG does not accumulate under it. The HHW flammables storage building is equipped with a LEL detector and exhaust fan system.

Perimeter landfill gas probe monitoring and collection well gas quality are monitored a minimum of once per month and more frequently if system controls or parameters have been altered, or when there is reason to believe migration may be occurring. Samples are taken with a Landtec GEM-2000 and utilizing Landtec wellheads for more accurate measurement of extraction volumes. Periodic inspections and monitoring are conducted for all structures on-site and at the Sheriff's Rehabilitation Center, Medium Security Jail, County Housing Authority and County Skills Center.

The perimeter gas monitoring system consists of 22 single, double and triple level probes placed along the landfill perimeter and adjacent to buildings located both on-site and off-site. Fifteen of these probes are compliance probes required by CalRecycle. All triple level probes are screened at 10' to 25', 30' to 55', and 60' to 85' approximately. Double level probes are screened at 10' to 25' and 30' to 45' approximately. Single level probes are all screened at 10' to 25'. The triple and double level probes were sited and installed to measure landfill gas levels from the bottom of fill to near surface. Single level probes are designed to provide immediate monitoring near buildings or in areas where depth to refuse is less than 30' at grade. The well logs are included in Appendix K.

The placement and design of the landfill gas monitoring system was based on the proximity of adjacent buildings both on and off-site and in relation to the existing subsurface geology. Additional probes will be installed along the perimeter if locations of off-site structures warrant extra protection.. Locations of the current landfill gas monitoring probes are shown on Figure 2.

All field and summary report monitoring records for landfill gas migration probes and extraction wells are maintained in the Public Works, Solid Waste Administration Division office and with the Environmental Programs Coordinator located at the BVLF. Monthly landfill monitoring data and reports are submitted with the quarterly monitoring reports transmitted to CalRecycle.

3. Gas Condensate Collection System

The entire site has a condensate collection, removal and storage system. Condensate is collected and stored in a 2,000 gallon, double contained tank and treated either at the City of Watsonville POTW or through direct injection into the operating flare. Currently condensate knockouts are located at the flare station and at three low point locations along the landfill gas system headers. They are equipped with QED pneumatic or Grundfos electrical pumps installed in sumps designed for condensate removal. Each unit is piped directly into a condensate header system that discharges into dedicated storage tank for eventual testing and destruction or off-site treatment.

2.9 Site Capacity

Annual aerial surveys are performed for BVL. The most recent survey was performed in October 2020. Based on the October 2020 survey and topographic mapping and the most recent final grading plan for the site (see Figure 4b), the remaining refuse capacity is approximately 1.9 million cubic yards.

2.10 Site Life Projection and Closure Date

The Solid Waste Facility Permit (SWFP) permits BVL to receive a maximum of 838 tons of refuse per day in 2005, with a 2% annual increase thereafter. Table 1 presents the site life summary and assumptions. Based on Table 1, the remaining life of the currently permitted portion of the BVLF is approximately 10 years (i.e., through 2031).

A final closure and postclosure maintenance plan will be submitted between two and five years prior to the anticipated date of closure, in accordance with 27 CCR Section 21780(c)(3). To the extent feasible, partial closure may be initiated on portions of the site that will no longer receive waste. CalRecycle will be notified at least two years prior to the partial final closure of any discrete waste management units or cells. The notice will include a developed partial final closure plan.

3. REGULATORY BACKGROUND

This section reviews federal and state requirements related to closure plans and final cover systems for MSW landfills.

3.1 Regulatory Criteria for Closure Plans

3.1.1 Federal Regulations

The Subtitle D regulations specify that a closure plan must be prepared for all MSW landfills. The minimum requirements for the closure plan are contained in Section 258.60(c):

> *"(c) The owner or operator must prepare a written closure plan that describes the steps necessary to close all MSWLF units at any point during its active life in accordance with the design requirements in §258.60 (a) or (b) as applicable. The closure plan, at a minimum, must include the following information:*
>
> *(1) A description of the final cover, designed in accordance with §258.60 (a) and the methods and procedures to be used to install the cover;*
>
> *(2) An estimate of the largest area of the MSWLF unit ever requiring a final cover as required under §258.60(a) at any time during the active life;*
>
> *(3) An estimate of the maximum inventory of wastes ever on-site over the active life of the landfill facility; and*
>
> *(4) A schedule for completing all activities necessary to satisfy the closure criteria in §258.60."*

3.1.2 State Regulations

California regulatory criteria for preliminary closure and postclosure maintenance plans are included in Division 2 (Solid Waste), Chapter 4 (Documentation and Reporting for Regulatory Tiers, Permits, WDRs, and Plans), Subchapter 4 (Development of

Closure/Postclosure Maintenance Plans) of Title 27 of the CCR, and in the SWRCB, Orders No. 93-62 and 93-100 (SWRCB, 1993a, 1993b).

The SWRCB requirements for preliminary closure and postclosure maintenance plans are defined in Section 21769(b) of Title 27. The purpose of the plan is to *"... provide a reasonable estimate of the maximum expected cost that would be incurred at any time during the Unit's projected life for a third party both to close the Unit and to carry out the first thirty years of post-closure maintenance, pursuant to all applicable SWRCB-promulgated requirements of this subdivision, including but not limited to the closure and post-closure requirements under Subchapter 5 of Chapter 3..."*

CalRecycle requirements for the preliminary closure plans are contained in Section 21790 of Title 27. The purpose of the plan is to *"... provide a basis for the operator to establish a preliminary estimate of closure costs... enable CalRecycle to assess the reasonableness of the cost estimate for non-water quality aspects of closure."*

Section 21790(b) of Title 27 requires that "*The plan shall identify the steps necessary to perform either partial final closure,...or complete landfill closure and shall include, but is not limited to, the following information:"*

(1) a closure cost estimate...;

(2) location maps indicating property boundaries and the existing, permitted, and proposed final limits of waste placement; entry roads, and structures outside the property boundary but within 1000 feet of the property boundary. A location map shall also be included showing the general location of the landfill;

(3) (Reserved);

(4) a location map of the current monitoring and control systems...;

(5) a description of proposed postclosure land uses;

(6) an estimate of the maximum extent of the landfill that will ever require closure at any given time during the life of the landfill;

(7) an estimate of the closure date...; and

(8) a preliminary description of closure activities including schedules for implementation. The activities described shall include...:

(A) site security and structure removal...;

(B) final cover and grading...;

(C) construction quality assurance methods...;

(D) drainage and erosion control systems...;

(E) landfill gas monitoring and control systems...;

(F) leachate monitoring and control measures...

CalRecycle requirements for the preliminary postclosure maintenance plans are contained in Section 21825 of Title 27. As stated in Section 21825(a), the purpose of the preliminary postclosure maintenance plan is to *"provide a basis for the operator to establish a preliminary estimate of postclosure monitoring, maintenance, and inspection costs,…and enable CalRecycle to assess the reasonableness of the estimate."*

Section 21825(b) states that "*the preliminary postclosure maintenance plan shall include, but is not limited to the following information:*

(1) a description of the planned uses of the property during the postclosure maintenance period...;

(2) a preliminary description of the methods, procedures, and processes that will be used to maintain, monitor and inspect the closed landfill during the postclosure maintenance period…and;

(3) a postclosure maintenance cost estimate…"

3.2 Regulatory Criteria for Final Covers

3.2.1 General

The federal (Subtitle D) regulations, as a minimum, require two layers in the final cover system for a MSW landfill including an infiltration (barrier) layer and an erosion (vegetation, protective) layer. The State of California requires that, as a minimum, three layers be included in the final cover system for a Class III landfill including a foundation layer, low-permeability (barrier) layer, and a vegetation (erosion) layer. Thus, the federal and state requirements will be discussed for each layer separately.

Both federal and state regulations allow for engineered alternatives to prescriptive standards.

3.2.2 Prescriptive Standards

3.2.2.1 Foundation Layer

The foundation layer for the final cover is to provide a firm, smooth surface for the placement of the barrier layer and is to limit the effects of subsequent differential settlement and subsidence on the barrier layer.

Subtitle D does not require a foundation layer for the final cover. However, Section 21090(a)(1) of Title 27 requires that:

"Closed landfills shall be provided with not less than two feet of appropriate materials as a foundation layer for the final cover. These materials may be soil, contaminated soil, incinerator ash, or other waste materials provided that such materials have appropriate engineering properties to be used for a foundation layer. The foundation layer shall be compacted to the maximum density obtainable at optimum moisture content using methods that are in accordance with accepted civil engineering practice. A lesser thickness may be allowed for Units if the RWQCB finds that differential settlement of waste, and ultimate land use will not affect the structural integrity of the final cover."

Also, Condition C.39.a of the site WDRs (CRWQCB, 2006) requires *"Minimum two-foot foundation layer placed over waste, compacted to maximum density obtainable at optimum moisture conditions."*

3.2.2.2 Barrier Layer

The barrier layer of the final cover system is to minimize the potential for significant infiltration of moisture into the landfill and to control and contain landfill gas.

Subtitle D requirements for the barrier (infiltration) layer in the final cover are contained in §258.60(a)(1) and (b)(1). Applicable portions of these regulations are given below.

> *"(a) Owner or operator of all MSWLF units must install...an infiltration layer as follows:*
>
> *(1) The infiltration layer must be comprised of a minimum of 18 inches of earthen material that has a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1 x 10-5 cm/sec, whichever is less...*
>
> *(b) The Director of an approved State may approve an alternative final cover design that includes:*
>
> *(1) An infiltration layer that achieves an equivalent reduction in infiltration as the infiltration layer specified in paragraph (a)(1) of this section..."*

State requirements for the barrier layer of the final cover are contained in Section 21090(a)(2) of Title 27:

"In order to protect water quality by minimizing the generation of leachate and landfill gas, closed landfills shall be provided with a low-hydraulic-conductivity (or low through-flow rate) layer consisting of not less than one foot of soil containing no waste or leachate, that is placed on top of the foundation layer and compacted to attain an hydraulic conductivity of either 1 x 10-6 cm/sec (i.e., 1 ft/year) or less, or equal to the hydraulic conductivity of any bottom liner system or underlying natural geologic materials, whichever is less permeable, or another design which provides a correspondingly low through-flow rate throughout the post-closure maintenance period. Hydraulic conductivity determinations for cover materials shall be as specified in Article 4, Subchapter 2, Chapter 3 of this subdivision..., but using water as the

permeant, and shall be appended to the closure and post-closure maintenance report. For landfills or portions of thereof in which the final cover is installed after July 18, 1997, as part of the final closure plan for the Unit, the discharger shall provide a plan... for protecting the low-hydraulic-conductivity layer from foreseeable sources of damage that could impair its ability to prevent the thorough flow of water (e.g., desiccation, burrowing rodents, or heavy equipment damage)."

Also, Condition C.39.a of the site WDRs (CRWQCB, 2006) requires the following:

- *"For units that have not been equipped with a Subtitle D composite liner system, a low hydraulic conductivity layer, consisting of compacted clay with a hydraulic conductivity of 1 x 10-6 cm/sec or less. Compacted clay may not be suitable for sites with VOC detections in point of compliance wells. In such cases a geosynthetic clay liner or geomembrane may be more appropriate."*
- *"For units that have been equipped with a Subtitle D composite liner system, a low hydraulic conductivity layer equal to or less than the hydraulic conductivity of the bottom liner system."*

3.2.2.3 Drainage Layer

State and federal regulations do not specifically require a drainage layer in the final cover system. As will be discussed, the need for a drainage layer in the final cover is dependent on the permeability of the materials used to construct the vegetative layer and also on the need to drain the vegetative soil to maintain stability after rainfall events. Since the vegetative soils may vary, testing for the minimum requirements will be performed as part of preparing the final construction for the closure activities.

3.2.2.4 Vegetative Layer

Subtitle D requirements for the vegetative (protective, erosion) layer of the final cover are contained in §258.60(a)(2) and §258.60(b)(2). Applicable portions of these regulations are given below.

> *"(a) Owner or operator of all MSWLF units must install... an erosion layer... as follows:...*

(2) The erosion layer must consist of a minimum of 6 inches of earthen material that is capable of sustaining native plant growth.

(b) The Director of an approved State may approve an alternative final cover design that includes:...

(2) An erosion layer that provides equivalent protection from wind and water erosion as the erosion layer specified in paragraph (a)(2) of this section."

Section 21090(a)(3) of Title 27 requires that *"The low-hydraulic-conductivity layer... shall be directly overlain by an erosion-resistant layer, as follows.*

(A) Closed landfills shall be provided with an uppermost cover layer consisting of either:

1 Erosion-Resistance Via a Vegetative Layer - a vegetative layer consisting of not less than one foot of soil which:

a. contains no waste (including leachate;

b. is placed on top of all portions of the low-hydraulic conductivity layer...;

c. is capable of sustaining native, or other suitable, plant growth;

d. is initially planted... with native or other suitable vegetation having a rooting depth not exceed the depth to the top of the low-hydraulic-conductivity layer...; and

e. by virtue of its composition, its maintained vegetation density, and its finished-and-maintained grade, will be resistant to foreseeable erosion effects by wind-scour, raindrop impact, and runoff; or

2. Mechanically Erosion-Resistant Layer - an erosion-and ultraviolet light-resistant layer which, by virtue of its composition

and finished-and-maintained grade, resists foreseeable erosion effects by wind-scour, raindrop impact, and runoff (e.g., a 1-foot thick layer of cobbles, the interstices of which are filled with gravel)."

3.2.2.5 Interpretation

Both state and federal criteria for the design of final covers contain the requirement that the final cover system be designed and constructed to have a hydraulic conductivity that is less than or equal to the hydraulic conductivity of any bottom liner system or natural subsoils present. The California prescriptive barrier layer of 12 in. (300 mm) of soil, with a maximum saturated hydraulic conductivity of 1 x 10-6 cm/s, can be demonstrated to be a more effective infiltration barrier than the prescriptive soil barrier layer in the federal regulations of 18 in. (450 mm) of soil with a maximum hydraulic conductivity of 1 x 10-5 cm/s. Therefore, a prescriptive final cover for a California landfill may be inferred to consist of a vegetation layer with a minimum thickness of 12 in. (300 mm), a low-permeability compacted soil layer, with a minimum thickness of 12 in. (300 mm) and a maximum saturated hydraulic conductivity of 1 x 10-6 cm/s, and a foundation layer with a minimum thickness of 24 in. (600 mm).

3.2.3 Alternative Standards

3.2.3.1 Federal Regulations

Section 258.60(b) of Subtitle D states that: *"The Director of an approved State may approve an alternative final cover design that includes:*

(1) An infiltration layer that achieves an equivalent reduction in infiltration as the infiltration layer specified in paragraph (a)(1) of this section, and

(2) An erosion layer that provides equivalent protection from wind and water erosion as the erosion layer specified in paragraph (a)(2) of this section."

3.2.3.2 State Regulations

Section 21140(b) of Title 27 provides the following requirements for design of an alternative final cover:

"Engineered alternatives to the prescriptive standard under subsection (b) shall only be approved when the operator demonstrates, to the satisfaction of the Board and local enforcement agency, that:

(1) The prescriptive standard is not feasible as provided in subsection (d) of this section, and

(2) There is a specific engineered alternative that:

(A) is consistent with the performance goal addressed by the prescriptive standard under subsection (b) of this section, and

(B) affords equivalent protection against water quality impairment."

In addition, Specification C.39.b of the WDRs (CRWQCB, 2006) states that *"Performance of the alternative composite cover's components, in combination, shall equal or exceed the waste containment capability of the prescriptive design..."*

3.2.3.3 Interpretation

Both state and federal criteria for the design of final covers contain the requirement that the final cover system be designed and constructed to have a permeability that is less than or equal to the permeability of any bottom liner system or natural subsoils present. This requirement has been widely interpreted as a prescriptive standard that requires a geomembrane in the final cover over all areas of the landfill that have a geomembrane in the bottom liner. This interpretation is substantiated by comments contained in the "Final rule: corrections" for Subtitle D issued by USEPA, published in the Federal Register of 25 June 1992 (Vol. 57, No. 124, pages 28626-28628). In the "Summary" section, USEPA states that the agency is *"... clarifying its interpretation of the final cover requirements for the Criteria."* In the Supplement Information section, USEPA states that *"... the Agency has always interpreted this rule language to mean if there was a synthetic membrane in the bottom of a MSWLF, a synthetic membrane would, given today's technologies, be necessary as part of the final cover."* As an *"... illustration of the correct interpretation of this rule language..."*, a final cover consisting of a *"... minimum infiltration layer of 18-inches of $1x10^{-5}$ cm/s earthen material overlain by a synthetic liner (Agency recommends minimum 20 mils; if HDPE or LLDPE, 60 mils) overlain by a minimum 6-inch erosion layer..."* is presented as the "minimum final cover" in areas underlain by a prescriptive composite bottom liner.

Both state and federal regulations provide for engineered alternatives to the prescriptive final cover. The state provides explicit requirements for a final cover, as summarized in Section 3.2.2 of this report. Subtitle D requirements for an alternative final cover are less clear. However, from the USEPA comments in the Subtitle D "Final rule; corrections", it seems clear that there is flexibility in the Subtitle D final cover design criteria to allow for a performance-based alternative final cover design tailored to site specific conditions. Discussing the design criteria for final covers in the "Final rule; corrections" for Subtitle D, USEPA states that *"... EPA intended, and has always interpreted, the language in this section to be a performance standard..."* USEPA further states that the purpose of the permeability standard for the final cover infiltration layer was to *"... prevent the 'bathtub effect' from occurring. The 'bathtub effect' occurs when a landfill fills up with liquids because the infiltration layer of the final cover is more permeable than the bottom liner system or natural subsoils present."* This language suggests a final cover infiltration performance standard whereby surface-water infiltration through the final cover must be less than the liquid flux through the base of the landfill.

USEPA states that while the clarifying language of the "Final rule; corrections" includes prescribed minimum final cover standards *"... intended to eliminate any confusion regarding the correct interpretation of this rule language. This clarification language does not remove any of the flexibility in §258.60(b) regarding alternative final cover designs approved by the Director of a State/Tribal program that has been deemed adequate by EPA."* Thus, it seems clear that there is flexibility in the Subtitle D final cover design criteria to allow for an alternative final cover design on the basis of an implied performance standard whereby surface-water infiltration through the final cover is less than the liquid flux through the bottom liner.

Because the site does not have a large enough onsite source of low permeability soil having a hydraulic conductivity of 1×10^{-6} cm/sec, the Operator will use a geomembrane to replace the infiltration layer in all areas that have not yet been closed. Further details are provided in Section 4.

4. CLOSURE ACTIVITIES

4.1 Introduction

Final closure activities for the site include placement and CQA (see Appendix B for CQA Plan) of the final cover and associated grading, providing site security and structure removal, constructing permanent drainage and erosion control facilities, and providing environmental monitoring and control systems for leachate and landfill gas.

To comply with the state (Title 27, Orders No.93-62) and federal (Subtitle D) regulations, this document and its revisions, will be kept by the County in the BVLF operating record and updated as appropriate.

4.2 Previously Closed Areas

As discussed in Section 2, portions of the site have been closed. These include the areas known as the Closed Landfill and Old Module 1. Final cover has also been placed on portions of the Expansion Area in the Module 1 and 2 areas (CH2M Hill, 1995).

4.3 Description of Final Cover System

4.3.1 Introduction

A final cover will be placed at BVLF to perform the following functions:

- Separate the waste from the environment;
- Control erosion by conveying run-off at non-scouring flow rates;
- Minimize infiltration into the waste and the production of leachate; and
- Control and contain LFG.

The final cover will consist of the following layers:

Foundation Layer: 24 inches minimum including existing interim cover and soil obtained from onsite/offsite borrow sources placed and compacted to a minimum of 90% of maximum dry density in general accordance with ASTM D1557. The lower 12-inches of the foundation layer may consist of re-compacted interim cover material.

Low-Hydraulic Conductivity Layer (Barrier layer): 60-mil high density[5] polyethylene (HDPE) or linear low density polyethylene (LLDPE)4 double-sided textured geomembrane and a Geosynthetic Clay Liner (GCL) on the top deck. A double-sided textured HDPE geomembrane without a GCL is proposed on side slopes because a GCL overlain by an HDPE geomembrane is not expected to provide satisfactory stability on the slopes. A drainage layer will be added to the slopes to aid in vegetative layer slope stability while reducing potential head and infiltration through the geomembrane.

Drainage Layer: 6 inches of high permeability sand or gravel or a geocomposite drainage layer where flow calculations indicate that a drainage layer is required for slope stability or to prevent raveling. A collection piping network would also be necessary.

Protective/Vegetative Layer: 12 inches of vegetative layer material suitable for supporting native grasses.

4.3.2 Foundation Layer

The main purpose of the foundation layer in the final cover system is to provide a stable working and supporting surface, on which the overlying low-permeability layer can be constructed. Furthermore, the foundation layer may reduce the effects of differential settlement and subsidence of the refuse on the barrier layer. The foundation layer may be composed of soil or suitable waste materials exhibiting acceptable engineering properties.

Where soil and compaction characteristics are considered satisfactory, the existing interim cover soil may also serve as the foundation layer material. However, the use of existing interim cover as foundation layer may require some reworking of the soil, such as stripping, scarification, and re-compaction, to obtain the desired properties. Generally, the key properties of the foundation layer are related to its strength and compressibility characteristics.

[5] At this time, the report considers HDPE will be used; however, Linear Low Density Polyethylene (LLDPE) geomembrane may also be used by the County because LLDPE geomembranes exhibit a high degree of flexibility which is useful to accommodate subsidence and differential settlement.

4.3.3 Barrier Layer

The low-permeability (barrier) layer of the cover system provides primary control of surface-water infiltration into the landfill. Requirements summarized below were originally presented in Section 3.2.3.

Subtitle D (for lined sites) requires that the barrier (or low hydraulic conductivity) layer in the final cover have:

- Minimum thickness of 18-in. (450-mm); and
- Hydraulic conductivity no greater than 1 x 10-5 cm/s or a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present, whichever is less.

Title 27 (California) requires that the barrier (or low hydraulic conductivity) layer in the final cover have:

- Minimum thickness of 12-in. (450-mm); and
- Hydraulic conductivity no greater than 1 x 10-6 cm/s or a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present, whichever is less.

Both federal and state regulations allow for engineered alternatives to the prescriptive standard. Furthermore, Section 21090 of 27CCR states that the RWQCB can allow any alternative final cover design that it finds will continue to isolate the waste from precipitation and irrigation waters at least as well as would a final cover built in accordance with the applicable prescriptive standard.

Based on site conditions,[6] the County proposes using a 40- to 60-mil-thick geomembrane[7] over the foundation layer on the side slopes. Infiltration through the geomembrane was not modeled because rain water is not expected to pond on 3:1 (horizontal to vertical) slopes because of their steepness.

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[6] For example: lack of onsite clayey materials, steepness of slopes, seismic environment, and ease of construction.

[7] Commonly used geomembrane thicknesses are 40-mil for LLDPE or 60-mil for HDPE.

For the top deck, because of lack of onsite clayey materials, the County is proposing to use a geomembrane underlain by a GCL as the barrier layer for the landfill top deck whereas for the side slopes, the County is proposing to use a geomembrane only.

To demonstrate the equivalency of the proposed alternative for the top deck, Geosyntec performed HELP analyses comparing the leakage through the geomembrane for the following final cover configurations (i.e., the flattest portion of the landfill):[8]

Prescriptive Final Cover	**Alternative Final Cover**
2-foot-thick foundation layer	2-foot-thick foundation layer
1-foot-thick low-permeability clay layer (varying permeability depending on liner system at the base of the landfill – for modeling assumed k < 1 x 10-7 cm/sec)	GCL
Geomembrane	Geomembrane
1-foot-thick vegetative layer	1-foot-thick vegetative layer

The results of the HELP analyses presented in Appendix C show that the leakage through the final cover's top deck geomembrane is lower for the Alternative Final Cover. In addition, the leachate generation after closure can be considered to be effectively zero once the final cover is placed; the additional HELP analyses are presented in Appendix C.

4.3.4 Drainage Layer

The drainage layer of the cover system intercepts water entering the cover system and conveys it to surface-water control structures. This reduces pressure build-up on the low-permeability layer, thus decreasing the potential for infiltration into the refuse, and improves the stability of the cover system during storm events.

A drainage layer will be constructed over portions of the closure area where necessary to reduce infiltration into the landfill and/or promote stability of the final cover system.

[8] The flattest area is expected to result in a higher water head within the vegetative layer of the final cover which would correspondingly result in more infiltration through the final cover. However, the use of a geomembrane in the final cover minimizes infiltration.

Based on the information available for the site, Geosyntec assumed that the soils used to construct the vegetative layer will primarily consist of silty to clayey sands from onsite or nearby sources.[9] Since the permeability varies depending on fines content and degree of compaction, Geosyntec assumed that the permeability of the vegetative layer soils would be approximately 1 x 10-4 cm/sec or lower[10] based on testing of materials collected from onsite sources (see Appendix D); with this permeability and a 3H:1V (horizontal to vertical) slope, a blanket drainage layer consisting of: (i) a drainage geocomposite and pipes, or (ii) gravel and pipes will be needed to drain the vegetative soil layer.

Geosyntec estimated that for a drainage geocomposite layer with a transmissivity of 9 x 10-4 m2/s, perforated collection pipes spaced every 100 ft along the 3:1 (horizontal to vertical) slopes will be necessary.[11]

4.3.5 Vegetative Layer

The vegetative (protective, erosion) layer minimizes wind and water erosion, minimizes percolation of water into the underlying elements of the final cover system, maximizes evapotranspiration, provides resistance to animal or plant burrows, and improves aesthetics.

A vegetative protection layer is one, which consists of material of sufficient thickness to promote the growth of the selected vegetation. Plants will be selected for their suitability to local climate (drought resistance), percentage of surface coverage, root zone depths less than one foot, hardiness and low maintenance requirements.

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[9] Assuming that borrow sources would be onsite or located within approximately 1 mile of the site (i.e., neighboring properties, etc.), Geosyntec assumed that the geologic information applicable to the site also applies to surrounding areas. The site is in a naturally occurring valley within an uplifted marine terrace in the Pajaro Valley. The regional deposits include the Manresa dune sands and the Aromas Sand formation.

[10] Based on the site-specific material permeability testing, Geosyntec modeled the material as Default Material 10 in the HELP3 model. Geosyntec assumed that similar materials would be available from regional sources at the time of constructing the final cover. As part of final design, the material source used will need to be evaluated to confirm the permeability assumed herein for the vegetative layer is appropriate.

[11] The spacing of the pipes is a function of the transmissivity of the geocomposite and the permeability of the vegetative layer and the transmissivity of the geocomposite. A geotextile against the flat stud side of an Agru Supergripnet geomembrane may also be used as a drainage geocomposite. At the time of constructing the final cover, these variables will need to be re-evaluated.

The protective layer will be the upper-most layer of the final cover system and will serve to protect the underlying elements from damage. The protective layer will be a minimum 12-in. (300-mm) thick. Soil similar to the existing interim cover soil will be used for the vegetative layer. This soil will be placed at a moisture content and relative compaction to meet strength and permeability requirements.

As discussed, the permeability of the onsite soils may vary by an order of magnitude depending on fines content and degree of compaction. As described earlier, Geosyntec assumed that the permeability of the vegetative layer soils would be approximately 1 x 10-4 cm/sec or lower.

4.4 Final Site Face (Grading)

4.4.1 Final Grading

Subtitle D regulations do not specifically address final grading of the landfill cover. Section 21090(a) of Title 27 requires that *"Final cover slopes shall not be steeper than a horizontal to vertical ratio of one and three quarters to one, and shall have a minimum of one fifteen-foot wide bench for every fifty feet of vertical height. Designs having any slopes steeper than a horizontal to vertical ratio of three to one, or having a geosynthetic component..., shall have these aspects of their design specifically supported in the slope stability report..."* Further, Section 21142(a) of Title 27 requires that *"Final grades must be designed and maintained to reduce impacts to health and safety and take into consideration any post-closure land use."*

The final grading plan is shown on Figure 4b. This final grading plan was also presented in the JTD (County of Santa Cruz, 2006). Figure 4b shows that the final cover slopes will be constructed at a slope of approximately 3H:1V and at approximately 3% on the landfill top deck. Some slopes, particularly on the west side, are currently steeper than 3:1 (horizontal to vertical). The slopes will be flattened to 3:1 (horizontal to vertical) at least two years prior to the final cover being placed.

As discussed, for further slope protection and erosion control, the final site will be hydroseeded and watered as required during the germination period. The vegetative cover will be a mixture of grasses.

4.4.2 Settlement Analyses

Settlement was evaluated to verify that positive drainage in the flatter areas of the site (e.g., the top deck) is maintained after settlement and to evaluate if the strains induced by settlement affect the geosynthetics. Two settlements were estimated: primary (caused by the fill placement required to meet positive drainage) and secondary (caused by the decomposition of the underlying existing waste during the 30-year postclosure period). The total settlements of the landfill are presented in Appendix E.

The analyses indicate that positive drainage of the final cover is maintained after settlement. The geosynthetics will be able to accommodate the effects of differential settlement. Should localized settlement cause areas of ponding on the final cover, these areas will be readily observable and repaired as part of postclosure maintenance.

4.4.3 Slope Stability Analyses

4.4.3.1 General

In general, the steepest side-slopes for active areas of the BVLF are 3H:1V (horizontal to vertical); in localized areas some slopes are currently as steep as 2H:1V, however, these slopes may flatten slightly with time. If these steeper slopes do not flatten to 3H:1V and the underlying module is Subtitle D-lined, the County will regrade these slopes to a maximum inclination of 3H:1V (horizontal to vertical) at least two years prior to final cover placement. If these steeper slopes do not flatten to 3H:1V and the underlying module is not Subtitle D-lined, a final cover system similar to the one constructed for the closed portions of the site (CH2M Hill, 1995) may need to be constructed.

To demonstrate that the final cover system is stable, static and seismic slope stability analyses were performed for the proposed cover system on the 3:1 (horizontal to vertical) side-slopes. Components of the final cover systems were described in Section 4.3 of this report.

Static stability analyses evaluated the cover system under short-term static conditions (i.e., after storms) and long-term (i.e., when the vegetative layer is dry). The analyzed factors of safety are: 1.3 for short-term and 1.5 for long-term, respectively (see Appendix D).

Seismic stability analysis evaluated the potential displacements caused by the design earthquake (Appendix F).

Waste Discharge Order No. R3-2006-0002 (WDR), states: *"Unless otherwise approved by the Executive Officer, for seismic deformation analysis, the acceptable limit for permanent slope displacement is 6 inches for bottom liners and slopes, and 12 inches for final cover system slopes. Up to 12 inches of slope displacement may be acceptable for bottom liners and slopes and up to 36 inches of slope displacement may be acceptable for final cover system slopes, if a report approved the Executive Officer documents that the foundation, bottom liner, slopes, final cover system, and/or the structures, which control leachate, surface drainage, erosion, or gas can accommodate the permanent slope displacement without jeopardizing the integrity of the containment structures or be reasonably repaired to perform as originally intended."*

In view of the above, Geosyntec assumed that seismic deformations between 6 inches and 12 inches are acceptable for the base liner (Sharma and Lewis, 1994; Seed and Bonaparte, 1992). Since the final cover can be repaired as part of post-earthquake maintenance activities, seismic deformations up to 36 inches were deemed acceptable by Geosyntec for the final cover.

4.4.3.2 Regulatory Requirements

Subtitle D requirements for design of landfills located in seismic impact zones state that the containment structures must resist the maximum horizontal acceleration in lithified earth material. "Seismic impact zones" and "maximum horizontal acceleration in lithified earth material" are defined as follows (Section 258.14(b)):

> *"(1) Seismic impact zone means an area with a ten percent or greater probability that the maximum horizontal acceleration in lithified earth material...will exceed 0.10g in 250 years."*
>
> *(2) Maximum horizontal acceleration in lithified earth material means the maximum expected horizontal acceleration depicted on a hazard map, with a 90 percent or greater probability that the acceleration will not be exceeded in 250 years, or the maximum expected horizontal acceleration based on a site-specific seismic risk assessment."*

State regulations contained in Section 20370(a) of Title 27 require that *"...Class III Units shall be designed to withstand the maximum probable earthquake (MPE) without damage to the foundation or to the structures which control leachate, surface drainage, or erosion, or gas."*

Regulatory requirements for landfill slope stability contained in Section 21750(f)(5)(A) of Title 27 state that *"The stability analysis shall ensure the integrity of the Unit, including... final slopes and containment systems under both static and dynamic conditions..."*

Section 21750(f)(5) of Title 27 requires that a slope stability report be prepared which indicates a factor of safety of at least 1.5 for the critical slope under dynamic conditions. Alternatively, in lieu of a factor of safety of 1.5, a deformation analysis may be used. In the deformation analysis, the magnitude of movement should be quantified and a demonstration should be provided that the calculated amount of movement can be accommodated without jeopardizing the integrity of the final cover or environmental control systems in a manner than can be readily repaired.

Specification C.34 of the WDRs (CRWQCB, 2006) requires that *"Unless otherwise approved by the Executive Officer, for seismic deformation analysis, the acceptable limit for permanent slope displacement is…12 inches for final cover system slopes. Up to…36 inches of slope displacement may be acceptable for final cover system slopes, if a report approved by the Executive Officer documents that the foundation, bottom liner, slopes, final cover system, and/or the structures, which control leachate, surface drainage, erosion, or gas can accommodate the permanent slope displacement without jeopardizing the integrity of the containment structures or be reasonable repaired to perform as originally intended."*

4.4.3.3 Final Cover Static Slope Stability Analyses

The proposed final cover system minimizes any significant infiltration of water into the underlying waste. This system, however, needs to be analyzed for its static and seismic stability. Since the cover length thickness ratio is very large, infinite slope analysis approach was followed. Geosyntec followed the procedures developed by Matasovic (1991) which incorporates a seismic coefficient and assumes that seepage is parallel to the slope.

The static factor of safety is calculated by setting ks = 0. Static factors of safety were calculated for two cases: (i) long term conditions where no head of water is present in the vegetative layer; and (ii) short-term conditions where the vegetative layer has free water within itself during or soon after rainstorms. To drain the vegetative layer, a blanket drainage geocomposite or a blanket drainage layer would be needed. As discussed in Section 4.3.4, if a blanket geocomposite were used, perforated collection pipes in gravel-filled trenches would need to be spaced every 100 feet along the 3:1 (horizontal to vertical) slopes located across the slope; these recommendations may need to be revised when final design is performed using more site-specific information.

Geosyntec assumed that the vegetative soil layer was 12 in. (300 mm) thick and that potential movements may primarily involve the interface between geosynthetic layers or the vegetative soils above the foundation layer.

As shown in Appendix D, to achieve acceptable factors of safety, the minimum required interface strength for a 3:1 (horizontal to vertical) final cover slope is 26 degrees and no cohesion to normal stresses of 500 psf for the various interfaces in the final cover. Interface tests (ASTM D5321/ASTM D6243) using site-specific materials would be recommended for final design.

The results of slope stability indicate that the static long-term factors of safety are greater than or equal to 1.5 and the short-term factors of safety are greater than or equal to 1.3. Both these values are within the acceptable range for the assumed strength and assuming that a drainage layer which is expected to be effective in reducing the water head to zero in the vegetative layer is incorporated below the vegetative layer.

4.4.3.4 Final Cover Seismic Slope Stability Analyses

During a seismic event, the propagation of bedrock motions induces a sequence of cyclic shear stresses on the soil and the waste in a landfill. These cyclic shear stresses result in cyclic strains. When the stress levels exceed the yield stress level, a certain level of strain produces permanent deformations in the soil.

As described earlier, Geosyntec has assumed that since the final cover system is accessible repairs can be made to the final cover system prior to any potential release of waste to the environment; therefore, the acceptable seismic deformation of the final cover system may be up to 36 inches.

4.4.3.4.1 Design Earthquake

According to Section 21750(f)(5)(C)7 of Title 27, a Class III landfill needs to be designed for Maximum Probable Earthquake (MPE). The MPE is based on definitions provided in California Division of Mines and Geology's (CDMG) Note Number 42, (CDMG, 1986a) and CDMG Note Number 44 (CDMG, 1986b).

Appendix F presents the site-specific seismic hazard evaluation for the site and concluded that the MPE for the site has moment magnitudes (Mw) of 7.9.

4.4.3.4.2 Seismic Response Analyses

The theory of one dimensional wave propagation through layered media can be used to model the response of the landfill mass to the rock motions associated with the design earthquake at the site. Geosyntec used the SHAKE computer program originally developed by Idriss and Sun (1992) to predict the response of the landfill mass to the input base rock motions.

SHAKE models the one dimensional response of individual vertical columns of material(s), waste or soil, representative of actual field conditions. The vertical column can consist of layers of different materials or one material. Accordingly, the modeling for a landfill consists of columns with layers of waste and soil. The shear wave velocities are used to compute the maximum dynamic shear modulus of each layer of the vertical column. The strain dependent modulus and damping relationships are entered into the SHAKE program for each layer in the modeled column. Because the modulus and damping values are strain dependent and are not known at the outset, an iterative procedure is required to estimate these values for each layer. The strain in each layer of the vertical column is estimated and the strain dependent values of modulus and damping are calculated for that layer. Based on the computed strain in each iteration, new values of modulus and damping are obtained. The iterative analysis is continued until the values of modulus and damping are compatible with the strain developed in each layer. After the strain compatible shear modulus and damping for each layer are determined, horizontal displacements at each layer are calculated using the closed form wave equation. The SHAKE computer program uses these displacements to calculate the accelerations at the top of each layer.

Appendix F presents the results of the estimated deformations at the top of the waste for 100 ft and 160 ft high columns of waste.

4.4.3.4.3 Seismic Deformations

This section presents the results of seismic deformation analysis for the final cover system caused by lateral cyclic loads imposed by the design earthquake.

Deformation analysis for the landfill is based on the concept originally proposed by Newmark (1965) and modified by Makdisi and Seed (1977) for calculating permanent deformations in dams and embankments. The method assumes that a failure occurs on a well defined slip surface, and that the material behaves elastically at stress levels below yield and develops a plastic behavior above yield. For a given potential sliding mass, when the induced acceleration in the failure mass exceeds the yield acceleration, movements are assumed to occur along the failure plane. The overall deformation is obtained by summing the strains over the failure surface. The yield acceleration, ky, is defined as the average acceleration producing a horizontal inertial force on a sliding mass that will result in a static factor of safety of unity (1.0). The ky for different cross sections will vary depending on the length of the base, the length of the backslope, the configuration of each cross section and strength of the materials.

Using the procedure outlined in Matasovic (1991), values for seismic coefficient (ks or ky) were computed for a range of possible values of cohesion assuming zero friction angle. The results of the analyses are presented in Appendix D.

For the 3:1 (H:V) slope and the minimum required strengths also assumed in the static analysis, the estimated seismic coefficient (ky) was 0.13g. Using the charts presented in Appendix D, the estimated deformation in the final cover is about 19 inches which is less than the acceptable value of 36 inches.

4.4.3.5 Waste Mass and Foundation Stability

The mass slope stability analysis for the landfill was presented in Geosyntec (2005); due the requirements in the 2006 WDRs for the site, the seismicity and the seismic deformation analyses were updated and re-evaluated using the latest available information.

Appendix F presents the seismicity re-evaluation and the seismic deformation analyses for the site.

Appendix G includes the static stability analyses for the site and the updated deformation estimates using the information presented in Appendix F.[12]

The results show that the final grades meet a static factor of safety of at least 1.5 and a seismic deformation is about 6 inches or less and meets the criteria in the 2006 WDRs of between 6 inches and 12 inches.

4.5 Surface-Water Management System

4.5.1 General

The proposed surface-water management system (SWMS) for BVLF will:

- Control flows on the landfill surface after the final cover has been placed;
- Prevent infiltration, inundation, and ponding on the landfill final cover;
- Minimize erosion of final cover;
- Minimize erosion, slope failure, washout, and over-topping of associated surface-water conveyances; and
- Minimize sediments carried off-site.

4.5.2 Regulatory Requirements

The design of the SWMS will comply with the applicable federal, state and county requirements. Federal regulatory requirements pertaining to surface-water drainage, contained in Part 258 of Subtitle D, present operating criteria for MSW landfills. State of California regulatory requirements for precipitation and drainage controls are contained in Sections 20365, 21090(b)(1), and 21150 of Title 27 of the CCR.

[12] Slope stability evaluations were also performed as part of designing Module 4B (Geosyntec, 2007) and Module 5 (Geosyntec, 2014). Design strengths were verified as part of construction quality assurance for each module (refer to Vector Engineering (2007) for Module 4B and BSK & Associates (2015) for Module 5).

4.5.3 Surface-Water Management System Components

4.5.3.1 Introduction

Surface water is currently managed at BVL by routing drainage within the landfill area to a water quality unit using ditches and channels. In addition, a drainage ditch currently exists around the landfill perimeter. Landfill areas that do not drain to the water quality unit are hydroseeded.

A water quality unit was installed as part of Module 5 construction to replace the former sedimentation basin that used to occupy the Module 5 area. As the landfill starts to approach final grades, additional water quality units may be installed, as necessary. (). The water quality units will be sized as part of final closure for the site.

At final closure, run-off of non-contact water will be diverted through a network of ditches, culverts, and downchutes to water quality unit(s). Figures 2 and 4b presents the location of the current and proposed water quality units.[13]

Surface water calculations for the final landfill cover will be performed during preparation of the Final Closure and Postclosure Maintenance Plan for the site in accordance with 27 CCR Section 20365 and using the 100-year, 24-hour precipitation event. Preliminary calculations are presented in the prior site development plans (CH2M Hill, 1999) and are generally applicable to the current site development plans because the final grades have not been significantly altered.

4.6 Environmental Monitoring and Control Systems at Closure

As discussed in Section 2, environmental monitoring and control systems at BVLF include the following:

- Groundwater monitoring;
- Leachate control and monitoring;
- Surface-water control and monitoring; and

[13] A water quality unit has replaced the proposed sediment removal tank as part of Module 5 construction improvements.

- LFG control and monitoring.

Closure of the landfill will not require modifications to existing environmental monitoring and control systems. The SWMS for closure will be designed in accordance with the Regulations.

4.7 Final Cover Construction

4.7.1 General

The final cover will be constructed under the supervision of a California-registered civil engineer. The cover will be designed and constructed to function with the minimum maintenance possible. The final cover components were discussed in Section 4.3.

4.7.2 Construction Quality Assurance

A construction quality assurance (CQA) program will be instituted prior to the time of placement of the final cover to ensure that proper construction techniques and procedures are used, and to verify that the materials and installation techniques used meet the project and regulatory agency specifications. Project Construction Specifications will be developed and submitted to the CRWQCB for review and approval prior to construction. The CQA program will be carried out to meet the requirements of Sections 20323 and 20324 of Title 27.

After completion of the area of the final cover, a CQA report will be prepared and submitted as appropriate to the CRWQCB, CalRecycle, and EA for approval. The final CQA report will be signed and sealed by a State of California registered civil engineer.

4.8 Additional Closure Activities

4.8.1 Decommissioning of Environmental Monitoring and Control Systems

The groundwater and landfill gas monitoring systems will remain in service through closure and will be monitored through the postclosure maintenance period. When determined by local, state, and federal agencies that the monitoring systems are no longer required, the system will be decommissioned consistent with applicable local and state agencies.

The leachate collection system will continue to be monitored and pumped during closure and postclosure, until such time that leachate is no longer produced. Once leachate production ceases, the pumps will be removed from the leachate risers and the risers capped and locked. The leachate storage tanks will also be removed.

The landfill gas control system will continue to remain operational until such time that landfill gas can no longer be extracted from the landfill when it will be decommissioned by the operator.

4.8.2 Survey Monuments

Section 20950(d) of Title 27 requires that *"Closed Units shall be provided with at least two permanent monuments..."* The purpose of these monuments is to establish the *"...location and elevation of wastes, containment structures, and monitoring facilities...throughout the post-closure maintenance period."*

As required by the regulations, the County's Land Surveyor will install at least two permanent survey monuments at appropriate locations prior to closure. The northings, eastings, and elevations will be surveyed by a Licensed Surveyor.

4.8.3 Initial Survey and Map

Section 21090(e)(1) of Title 27 requires that *"... upon completion of all closure activities for the Unit (or portion thereof...), the discharger shall conduct an aerial photographic survey... of the closed portions of the Unit and its immediate surrounding area, including at least the surveying monuments... For landfills undergoing incremental closure..., the survey for each closed portion of the landfill shall be carried out immediately following completion of closure activities for that portion of the landfill; such data shall be used to create or augment a map showing the closure date and as-closed topography of each portion of the Unit..."*

Upon completion of closure, the County will conduct an aerial photographic survey, or use an alternative surveying technique meeting the requirements of Section 21090(e)(4) of Title 27, to create a map showing the closure date and as-closed topography of the area.

4.8.4 Site Security

Section 21135 of Title 27 requires that *"Sign(s) shall be posted at all points of access to a site sixty (60) days prior to the last receipt of waste at the site and for a period of not less than one hundred eighty (180) days after the facility has received the final shipment of waste..."*

The landfill site is currently secured by a fence surrounding the site, a gate with a lock at each of the entrances, and signs identifying the site as a landfill. These facilities will remain in-place during the landfill closure period. All groundwater and gas monitoring wells are secured with locking caps.

4.8.5 Structure Removal

Section 21137(a) of Title 27 requires that *"...the operator shall dismantle and remove site structures at the time of closure to protect public health and safety..."*

Portions of the site may remain operational following closure of the landfill. This includes several of the onsite facilities, including the recycle areas, scale house, household hazardous waste material building, maintenance building, and offices. Therefore, no structures are planned to be removed following landfill closure.

4.9 Schedule for Closure

As discussed in Section 2.10, the remaining life of the currently permitted portion of the BVLF is approximately 10 years (i.e., through 2031). Discrete portions of the landfill may be closed prior to the final closure date. The County will notify CalRecycle, the CRWQCB, and the EA of closure at least two years prior to the closure of any discrete unit at BVLF. Notice will include a developed partial final closure plan.

4.10 Cost Estimate for Closure

Subtitle D requirements pertaining to financial assurance for closure are included in Section 258.71(a). They require that:

"The owner or operator must have a detailed written estimate, in current dollars, of the cost of hiring a third party to close the largest area of all MSWLF units ever requiring final cover... at any time during the active life in accordance with the closure plan...

(1) The cost estimate must equal the cost of closing the largest area of all MSWLF unit ever requiring a final cover at any time during the active life..."

Section 21815(a) of Title 27 requires that *"Cost estimates shall be based on costs the state may incur if the state would have to assume responsibility for the closure or postclosure maintenance..."*

Section 21820(b) states that *"Closure cost estimates shall include, but are not limited to, the following information:*

(1) If the documents are preliminary closure and postclosure maintenance plans, an estimate of the cost of developing final closure and postclosure maintenance plans.

(2) an estimate of the cost to prepare plans and specifications, bidding documents, and other construction related documents; and

(3) an estimate of the cost of closure activities including schedule for implementation activities. The activities described shall include, but are not limited to, an estimate of the cost:

(A) to install or upgrade site security;

(B) for structure removal;

(C) to install or upgrade the monitoring and control systems, including landfill gas, leachate, and ground water systems;

(D) to install the final cover; and

(E) to install or upgrade drainage and erosion control systems."

The preliminary closure cost estimate for closure of BVLF is included in Appendix H. The major cost for closure is construction and CQA of the final cover and the drainage and erosion control system. There are no costs for installing or upgrading site security, structure removal, or installing or upgrading monitoring and control systems, as these items are already in place. As required by Section 21820(a)(4) of Title 27, a 20% contingency factor has been included in the total partial final closure cost estimate.

Table 2 presents a preliminary cost estimate for closure of BVLF. The preliminary cost estimates are based on quotes from suppliers, vendor information, prior experience by Owner or Geosyntec, and/or conventional cost-estimating guides. Actual costs will vary because of factors beyond the reasonable control of the County, including market conditions, construction conditions, material availability, labor relations, and other unforeseeable events.

5. POSTCLOSURE MAINTENANCE ACTIVITIES

5.1 General

BVLF will be maintained and monitored for a period of not less than 30 years after closure is completed. Maintenance and monitoring activities include oversight of the site face and final cover, site security, and the environmental monitoring and control systems.

5.2 Objective

According to Sections 21769 and 21825 of Title 27 of the CCR, the main objectives of the postclosure maintenance plan are:

- To provide a basis for the operator to establish a preliminary estimate of postclosure monitoring, maintenance, and inspection costs;
- To allow a registered civil engineer or certified engineering geologist to certify to the accuracy of the cost estimate;
- To enable the regulatory agencies to assess the reasonableness of the cost estimate; and
- To provide a description of the planned uses of the property and a preliminary description of the methods, procedures, and processes that will be used to maintain, monitor and inspect the closed landfill.

5.3 Postclosure Landfill Inspection and Maintenance

5.3.1 General

This section describes the inspection and maintenance procedures and methods to be used during postclosure maintenance of the BVLF. These procedures will be used for the final cover, surface-water management system (SWMS), leachate management system, landfill gas (LFG) management system, and water quality monitoring systems.

Section 21090(c) of Title 27 requires that "Throughout the post-closure maintenance period, the discharger shall:

(1) maintain the structural integrity and effectiveness of all containment structures...;

(2) continue to operate the leachate collection and removal system as long as leachate is generated and detected;

(3) maintain monitoring systems monitor the ground water, surface water, and the unsaturated zone...;

(4) prevent erosion and related damage of the final cover due to drainage; and

(5) protect and maintain surveyed monuments...".

Section 21180(a) of Title 27 requires that postclosure *"Maintenance and monitoring shall include...:*

(1) site security;

(2) gas monitoring and control system maintenance..."

During the 30-year postclosure maintenance period, the closure area will be periodically inspected, maintained and repaired, as necessary. Inspection of the closed portion of the BVLF will be performed by County personnel to ensure that all postclosure requirements have been met.

5.3.2 Inspection Frequency

Generally, during the first years after landfill closure, the frequency of inspections will be at least quarterly and adjusted as necessary based on results of initial inspections and landfill conditions. After conditions begin to stabilize, semiannual and then annual general inspections will be performed throughout the postclosure maintenance period.

Additional inspections will be scheduled prior to the rainy season (i.e., 15 October – 15 April), after first significant rainfall (i.e., 0.5 in. or greater), after periods of extremely wet or dry weather, major storm events, and major seismic events to verify there has been no damage from the event.

5.3.3 Reporting Procedures

The inspection and maintenance procedures depend upon timely and accurate reporting of inspections and timely implementation of maintenance and repair actions. An inspection report shall be prepared following each inspection giving a detailed description and approximate location of deficiencies. Corrective measures taken to remedy each deficiency shall also be described in the inspection report.

Postclosure inspection reports will be generated and entered into the operating record of the BVLF. A Postclosure Inspection Log presented in Table 3 (or similar) will be used to document inspection activities.

If the periodic inspection indicates that corrective action is required to repair or restore a component, maintenance will be performed. A Postclosure Maintenance Log presented in Table 4 (or similar) will be used to document maintenance and repair activities. The table lists specific problems that may occur and the corresponding maintenance procedures, heavy equipment, and materials that may be required to perform maintenance.

When a problem is noted, corrective action should be taken as soon as practicable. All maintenance work will be documented and all documentation physically attached to the inspection records that noted the required work. This documentation should include the type of maintenance performed, how it was performed, and a list of materials and equipment used to perform the maintenance.

The operating record shall be maintained on site by County personnel for the duration of the postclosure maintenance period. The operating record will be made available to local, state, and federal regulatory agencies when appropriate or upon request.

5.3.4 Postclosure Maintenance Equipment

Because the recycle center and household hazardous waste management facility will remain operational, some onsite equipment will be available. The County will obtain any other necessary construction equipment, such as dozers, graders, backhoes, etc., and other resources from local rental agencies or contractors to perform required postclosure maintenance activities. Alternatively, the County may retain certain construction equipment on-site solely designated to BVLF during the postclosure maintenance period.

Additional equipment or other resources, such as light equipment, tools, and inspection equipment, necessary for inspection and maintenance procedures will be available during the BVLF postclosure maintenance period.

5.3.5 Final Cover

5.3.5.1 General

The Subtitle D requirements in Section 258.61(a)(1) state that postclosure care should include: *"...maintaining the integrity and effectiveness of any final cover, including making repairs to the cover as necessary to correct the effects of settlement, subsidence, erosion, or other events, and preventing run-on and run-off from eroding or otherwise damaging the final cover..."* Further, Section 21090(c)(4) of Title 27 requires that throughout the postclosure maintenance period, the discharger shall "*...prevent erosion and related damage of the final cover due to drainage."*

The functions of the final cover are to (i) control liquid infiltration; (ii) contain and control LFG; (iii) isolate the buried wastes; and (iv) promote surface -water runoff and control erosion while accommodating settlement and subsidence. The purpose of the postclosure maintenance procedures described herein is to maintain the integrity of the completed final cover system throughout the postclosure maintenance period.

Postclosure maintenance activities are anticipated as a result of the following conditions:

- Elective intrusion into or through the final cover system associated with maintenance of the LFG management system or the SWMS;
- Settlement-related sags and SWMS interruptions, which interfere with the controlled runoff of surface waters from the closed landfill surface;
- Surface erosion as a result of high runoff velocities associated with intense rains or malfunctioning drainage or temporary irrigation systems;
- Cracking of final cover soils as a result of differential settlement; and
- Local surficial slumping on slopes resulting from intense seasonal rainfall, a malfunctioning drainage or temporary irrigation system, or seismic loading.

5.3.5.2 Inspection Procedures

Routine inspection of the final cover will be conducted to identify areas where maintenance is required to minimize the effect and extent of the above conditions. In addition, a periodic leak search will be performed to evaluate the integrity of the low hydraulic conductivity layer. To the extent feasible, the LFG control system may be turned off and LFG emissions through the final cover monitored to assess potential areas of damage to the low hydraulic conductivity layer.

During cover inspections, the following particular areas will be noted:

- Areas where vegetation has died off;
- Areas where erosion is apparent;
- Areas where the seepage or lack of free drainage is apparent;
- Areas damaged by equipment;
- Areas of localized subsidence or differential settlement (may be based on iso-settlement surveys);
- Areas where odors are emitted from the surface; and
- Areas where underlying layers of the cover are exposed.

The following action items and inspection practices and procedures will be instituted following closure:

- A final cover performance officer will be designated who will be responsible for inventorying, monitoring, and coordinating repair of final cover irregularities;
- Employees with access to the site will be trained and instructed to identify, notice, and report, in writing, to the final cover performance officer any surface cracking, ponding, surface drainage interruptions or unusual surface conditions at the time they are observed; and
- Deck and slope areas will be visually inspected in detail by grid walking by a County representative instructed in inspection procedures following unusual events such as earthquakes, landfill fires, vehicle accidents, and heavy rainstorms; a report of findings will be prepared following any such unusual event.

To maintain the integrity of the final cover and prevent ponding and minimize infiltration, a program will be implemented to inspect and repair the cover to correct effects of settling, subsidence, erosion, or other events.

5.3.5.3 Maintenance and Repair Procedures

Final cover maintenance, repair and/or reconstruction activities will be conducted in a manner to maintain the integrity of the as-built final cover system. Repair materials will be placed in a manner consistent with the original final cover design. In the event that repairs to the final cover impact the LFG control system, repairs to the gas management system will be conducted.

Three of the most common circumstances requiring repair of the final cover system include the following:

- Elective intrusion into the final cover;
- Sags, ponding, drainage interruptions, and evidence of surface erosion; and
- Repair of LFG headers and LFG wells as well as leachate collection wells and associated facilities.

5.3.5.3.1 Elective Intrusion

Elective intrusive into the final cover system will be avoided whenever possible. Final cover excavation will be conducted in coordination with the appropriate regulatory agencies and applicable regulations.

For removal of the final cover for the purpose of elective intrusion, the applicable geosynthetic components of the final cover system shall be cut to dimensions exceeding those of the excavation by at least 12 in. (300 mm). The edges of the cut geosynthetics shall be temporarily protected using plywood sheets or other appropriate materials (e.g., scrap geomembrane) during the excavation. Once the excavation and repair of the foundation layer has been completed, new pieces of the applicable geosynthetic components shall be used to replace the cut out area. The geosynthetic materials and installation shall conform to the requirements of the final cover construction specifications and drawings. The geomembrane shall be fitted with prefabricated boots where penetrations are required (e.g., for LFG wells). The boots shall be approved by the final cover performance officer or his designated representative. Repairs of the

geosynthetics shall be subjected to construction quality assurance (CQA) testing in accordance with the CQA Plan for construction of the final cover.

5.3.5.3.2 Sags, Ponding, Drainage Interruptions, and Surface Erosion

Sags, ponding, surface erosion, or other settlement features, which could interfere with the function and integrity of the final cover system will be repaired immediately.

Sags and ponding, due to non-uniform displacements will be repaired by excavating the vegetative (erosion) layer and if necessary removing the applicable geosynthetics and rebuilding grades by placing additional foundation soil. Once the grades have been re-established, new pieces of applicable geosynthetics shall be used to replace the cut out area. In no event will grade recovery in areas of non-uniform displacement of the applicable geosynthetics be completed solely by placement of additional soil on top of vegetative layer. Reconstruction materials and practices will be consistent with those utilized during final cover system construction.

5.3.5.3.3 Repair of LFG Headers and LFG Wells

Repairs of LFG headers and LFG wells may be necessary to maintain proper functioning of the environmental monitoring and control systems. Such repairs may necessitate intrusion into the final cover system. Repair procedures for LFG headers and LFG wells are included in Section 5.3.8.2.

5.3.6 Final Grading, Slope Protection, and Erosion Control

5.3.6.1 General

Repair or amending grades, slope protection, or erosion control will be conducted in accordance with the specifications and repair procedures for final cover presented below and in Section 5.3.5. Maintaining sufficient vegetation over the surface of the landfill is an integral component in maintaining adequate erosion protection.

5.3.6.2 Inspection Procedures

The vegetation will be inspected for landfill surface coverage and stress indications. The causes of these irregularities or deficiencies shall be ascertained at the time of environmental monitoring wherever possible. Landscaping monitoring parameters also

include soil quality control, rodent control, and a reseeding program, if necessary. Corrective action will be taken to remedy observed deficiencies.

Inspections of the vegetative (erosion control) layer will be conducted in conjunction with the final cover inspections discussed in Section 5.3.5.2. The final cover system performance officer shall also be responsible for documenting and monitoring the following procedures:

- Employees with access to the site will be instructed to notice and report in writing to the County officer in charge at the time of observation of any landfill surface cracking, liquid ponding, SWMS interruptions, or unusual landfill surface conditions;
- The vegetative layer of the landfill will be visually inspected by a County representative trained in inspection procedures and a report of findings will be prepared; and
- The vegetative layer of the landfill will be visually inspected by a County representative trained in inspection procedures following unusual events such as landfill fires and a report of findings will be prepared following any such unusual event.

The landscaping and temporary irrigation system (if used) will be inspected for landfill surface coverage and stress indications, such as stunted growth, discolorations, and dead or dying plant material. The causes of these irregularities shall be ascertained at the time of environmental monitoring whenever possible. Landscaping monitoring and maintenance parameters also include weed control, reseeding, fire control, and rodent control.

The temporary irrigation system (if required) shall be monitored routinely to facilitate efficiency and proper operation of equipment. Temporary irrigation system inspections shall include checks of the sprinkler or bubbler heads, irrigation lateral and main lines, control valves, pressure relief valves, pressure regulating valves, air relief valves, and pumps. The operation of the irrigation control station will be monitored as well.

5.3.6.3 Maintenance and Repair Procedures

Maintenance of the vegetative layer, the landscaping, and the temporary irrigation system will be conducted by the County or contractor personnel. Maintenance efforts

are expected to be greatest during the vegetation establishment period and are projected to lessen thereafter. The inspection schedule after the establishment period is expected to decrease accordingly.

5.3.6.3.1 Vegetative (Erosion Control) Layer

It is anticipated that the 12 in. (300 mm) thick vegetative (erosion control) layer will require periodic maintenance throughout the postclosure maintenance period. The conditions that may contribute to the need for maintenance of the vegetative layer correspond to those outlined for final cover maintenance and include the following:

- Elective intrusion into or through the vegetative erosion control layer associated with maintenance of the LFG control system or the SWMS;
- Sags related to settlement and SWMS interruptions, which may interfere with the controlled runoff of surface waters from the closed landfill surface;
- Surface erosion as a result of high runoff velocities associated with intense rains or a malfunctioning temporary irrigation system;
- Vertical cracking of the vegetative layer as a result of landfill differential settlement; and
- Local surficial slumping on slopes resulting from intense seasonal rainfall, a malfunctioning temporary irrigation system, or seismic loading.

Repairs to the vegetative layer will be performed in a manner consistent with the original vegetative layer construction procedures. Clean fill will be placed in loose lifts of 6 to 8 in. (150 to 200 mm) in thickness to re-establish grades to appropriate elevations, as necessary.

5.3.6.3.2 Landscaping

Landscaping will be established to promote long-term erosion control and to protect the final cover system. The landscaping will require selective weed removal to eliminate competition between the weeds and the established native vegetation. Routine inspection of the vegetation should be conducted during and after the plant establishment period. Unwanted weeds should be removed by hand, if possible, or with appropriate hand tools.

Reseeding of the vegetated area will occur on an as needed basis. Reseeding may be necessary if slope reworking has occurred or in the event that weed pulling has caused the death or sparseness of the native vegetation. The reseeding efforts should begin in the fall and should be consistent with the intent of the original vegetation.

Buildup of dry grasses, plants, and shrubs can lead to a fire hazard, especially in the California climate. Tall grass, if any, should be mowed as needed to minimize the potential for fire.

Inspection of the rodent population at the BVLF will be made routinely. Landfill personnel should be aware of the rodent population when conducting other routine inspections, such as vegetation inspection and final cover inspection. If it is suspected that the rodents are threatening the integrity of the vegetative (erosion control) layer, extermination procedures should commence. A licensed pest control professional shall be contracted to perform the necessary services.

5.3.6.3.3 Temporary Irrigation

If a temporary irrigation system is required, its monitoring will be ongoing during the vegetation establishment period and will cease once the vegetation has been established and the temporary irrigation system has been decommissioned. Specific monitoring and maintenance procedures shall be as specified by the contractor or outside agency, which is contracted to install the temporary irrigation system. Maintenance crews should be trained as part of their normal maintenance procedures to repair and report defects in the temporary irrigation system when they are observed.

5.3.7 Surface-Water Management System

5.3.7.1 General

Postclosure maintenance of the surface-water management system (SWMS) is intended to ensure adequate performance of the system. Therefore, the inspection and maintenance programs for the SWMS will continue to be implemented throughout the postclosure maintenance period. The inspection and maintenance programs outlined below provide a comprehensive set of procedures to monitor and maintain the integrity of the SWMS as necessary during the postclosure maintenance period.

Control of runoff, erosion and sediment during the landfill postclosure maintenance period will be accomplished through the use of drainage ditches, channels and culverts, temporary diversion dikes, straw bale barriers, temporary and permanent seeding, and water quality units. The channels and the water quality unit(s) may be subject to siltation and must be periodically maintained. Erosion will also be controlled during the landfill postclosure maintenance period by using temporary and permanent seeding of landfill slopes.

5.3.7.2 Inspection Procedures

5.3.7.2.1 Bench Drains and Bench Channels

The final grading plan (Figure 4b) generally provides for a minimum 15 ft (4.6 m) wide bench for approximately every 50 vertical ft (15 vertical m). Benches collect drainage from the slopes and provide access for maintenance and repair activities. Rainfall, which lands on the slopes, will be collected at the inside edge of the benches at bench drains. The benches are sloped to drain inward to the toe of the slope to the bench drains, which drain laterally along the toe of the slope towards the downdrain system.

Inspection of the bench drains and bench channels will be required during the rainy season after each major storm. Benches will also be inspected during the summer, and necessary repairs will be made next to the rainy season. Bench inspections will include checking for erosion ruts, settlement cracks, and proper (i.e., positive) grading to verify the integrity of the bench channels and culverts.

It should be noted that over-watering or malfunction of the temporary irrigation system, if applicable, may cause additional erosion on the benches. Such erosion will be evaluated during inspections and recorded in accordance with the procedures outlined in Section 5.3.6.

5.3.7.2.2 Culverts

A number of culverts will be used in the BVLF. Typically, the culverts will be comprised of corrugated steel pipe (CSP) or smooth HDPE pipe. The culvert system serves three functions: (i) it conveys surface-water runoff from the top deck drains (ii) collects runoff from the bench drains; and (iii) conveys surface-water through road crossings.

A visual inspection of each culvert will be conducted to identify any of the following deficiencies:

- Joint separation;
- Invert failure;
- Structural failure;
- Perforations; and
- Presence of silt and/or debris.

An inspection report should include a detailed description and approximate location of deficiencies. Corrective measures taken to remedy each deficiency shall also be described in the inspection report.

5.3.7.2.3 Downchutes

The downchute (downdrain) conveys storm flow from the top deck and bench drains into a perimeter drainage channel. The storm drains traversing down the surface of the landfill slopes will be comprised of lined ditches and/or pipe networks. These downdrains are constructed on the exterior face of the finished slopes.

An inlet apron will be constructed of resistant materials (e.g., sand bags, concrete) around each inlet to serve as a non-erodible approach for deck and bench runoff.

A visual inspection of each downdrain will be conducted to identify any of the following deficiencies:

- Joint separation;
- Invert failure;
- Structural failure; and
- Presence of silt and/or debris.

An inspection report shall be prepared following each inspection giving a detailed description and approximate location of deficiencies. Corrective measures taken to remedy each deficiency shall also be described in the inspection report.

5.3.7.2.4 Deck Drainage System

The deck areas will be graded to allow for sheet flow away from the center of the deck area to the edges of the deck. Along the edges of the slope, a drainage swale and berm will be constructed to intercept the flow and direct the surface water into the downdrains placed along the top of the slope. The drainage swale and berms help reduce the possibility of surface water run-off breaching the top edge of the slopes, thereby mitigating erosion. These downdrains will convey surface-water flow down the slopes and into perimeter drainage structures.

The swales and berms on the top deck will be inspected and repaired with soil of suitable properties in a manner consistent with the repair of the final cover system and the vegetation (erosion control) later.

5.3.7.2.5 Water Quality Unit

Water quality units will be located throughout the perimeter of the facility.. Water quality units will be equipped with low-level water outlets and an emergency spillway. A visual inspection of these facilities will be conducted to identify any of the following deficiencies:

- Joint separation;
- Invert failure;
- Structural failure; and
- Presence of silt and/or debris.

An inspection report will be prepared following each inspection giving a detailed description and approximate location of deficiencies. Corrective measures taken to remedy each deficiency will also be described in the inspection report.

5.3.7.3 Maintenance and Repair Procedures

Bench maintenance will consist of erosion control along the toe of the slope and regrading of areas, which have been subjected to differential settlement. Re-grading will control ponding and help maintain drainage into the inlet structures. A grader, dozer, and compactor will be utilized to grade the benches, repair erosion ruts, and maintain the integrity and compaction of the final cover system. In areas where landfill

settlement affects the bench grades, additional vegetative layer soil cover material will be placed and compacted to re-establish positive drainage, as needed.

Maintenance activities will include, as necessary, drainage channel and downchute repairs, removal of silt and debris along drainage channels and in the water quality unit(s), repair and replacement of erosion and sediment controls (e.g., silt fences, straw bales, riprap), and grading of the final cover erosion layer.

Typical culvert, downdrain and perimeter channel corrective measures for deficiencies include the following:

- Joint separation:
    - Use wider CSP band couplers with mastic or pumped grout; and
    - Attach patches with self-drilling/self-tapping screws or welds.
- Invert failure:
    - Replace piping; and
    - Rotate pipe 180 degrees and patch as required.
- Structural failure:
    - Reinstall pipe anchor supports; and
    - Replace section of drain.
- Clogging by silt/debris:
    - Use vacuum pumps to clear extensively clogged culverts; or
    - Use a waterjet spray to force debris out of the drain; or
    - For smaller amounts of debris, use a bucket line; or
    - Use a fire hose to flush out debris.

Access to the buried section of the culvert under each bench can be gained through the removable inlet grate. Mirrors can then be lowered into this section and, with sufficient lighting, a visual inspection can be conducted. The pipe fittings at the upper end of the exposed portion of each culvert can also be removed for inspection and cleaning.

Small amounts of silt and debris may be removed by buckets or fire hose flushing. Extensive clogging may require either vacuum pump or waterjet spray.

A vacuum pump may be used to remove sediment from pipes and can be mounted on a vehicle. It requires a 200 300 gal (760 1,140 L) holding tank and a vacuum pump that has a 10 in. (250-mm) diameter flexible hose with a serrated metal end for breaking up caked sediment. This vacuum pump system can remove stones, leaves, litter, and sediment deposits. (Normal working depth of the vacuum pump system is up to 20 ft (6 m).)

A waterjet spray can be used to clear debris from the culvert system. Waterjet equipment is usually mounted on a self-contained vehicle with a high-pressure pump and a 200 300 gal (760 1,140 L) water supply. A 3 in. (75-mm) flexible hose line with a metal nozzle that directs jets of water out in front is used to loosen debris in pipes or trenches. The nozzle can also emit umbrella-like jets of water at a reverse angle, which propels the nozzle forward as well as blasting debris backward. As the hose line is reeled in, the jetting action forces the debris downstream where it is removed by the vacuum pump equipment. (The typical length of hose is approximately 200 ft (60 m).)

Access roads for maintenance will be provided on the decks to reduce interference with any surface flows. It is important that maintenance vehicles utilize access roads and benches whenever possible to reduce surface rutting that could interfere with normal drainage patterns.

For open channels, the following corrective measures can be taken for deficiencies identified during the inspection:

- Cracking:
    - Construction of expansion/control joints; and
    - Placement of sealants such as epoxy resins, asphaltic material, thermoplastics or silicones.
- Settlement:
    - Grouting injection; or
    - Removal of modular concrete blocks; and/or
    - Completion of replacement with subgrade work.

5.3.7.4 Surface-Water Monitoring System

The surface water monitoring system at the BVLF is governed by the National Pollutant Discharge Elimination System (NPDES) general permit requirements. The maintenance required for the surface-water monitoring system is that required for the SWMS (Section 5.3.7.3). The required inspection and maintenance programs will maintain the drainage system in proper working order and facilitate postclosure surface water monitoring activities.

5.3.8 Landfill Gas Management System

5.3.8.1 General

The federal requirements in Section 258.61(a)(4) of Subtitle D require *"... maintaining and operating the gas monitoring system..."* during the 30-year postclosure maintenance care period.

Section 21160(a) of Title 27 states that throughout the postclosure maintenance period *"The operator shall implement and maintain landfill gas control and prevent leachate contact with public or animals..."* Section 17783(b) requires that the landfill gas monitoring and management program *"... shall be conducted during the closure and postclosure maintenance period..."*

The LFG management system is a vital environmental control system at the BVLF. For landfills located in the central/northern California environment, operation of the LFG collection system is generally required throughout the 30-year postclosure maintenance period. The corresponding inspection and maintenance program includes maintenance requirements for pipe breakage due to landfill settlement and pipe blockage due to the formation of gas condensate, as well as management of the LFG condensate.

5.3.8.2 Landfill Gas Extraction System

The LFG extraction system at the BVLF is presented in Appendix A. It is composed of the gas extraction wells, horizontal collectors, and associated piping. The system will be inspected and maintained throughout the 30-year postclosure period, or as long as gas continues to be detected at levels requiring control.

5.3.8.2.1 Inspection Procedures

The LFG management system will be inspected with a focus on well head assemblies, pipeline couplings, connections, pipeline leaks (which may be indicated by a gas odor, hissing sounds, elevated gas concentrations in surface air samples or elevated oxygen readings in the collection system), pipeline breakage, cracking, abnormalities, or deformations. Regular inspections of the blower/flare and LFG energy station will also be performed to ensure adequate and safe operation.

The LFG collection system maintenance procedures will include provisions for minimizing the probability of elevated subsurface temperatures. These elevated subsurface temperatures are caused by LFG combustion, which may result from excessive oxygen intake. The abundance of oxygen usually occurs from the application of excess vacuum to a portion of the LFG collection system. The elevated subsurface temperatures can jeopardize the integrity of the LFG collection system, create unpredictable LFG generation rates, and cause rapid and/or uneven refuse settlement.

In addition, monitoring data will be reviewed for suction losses, which may indicate collection system leaks, and for combustion efficiency. Based on the results of the inspections, repairs and/or replacement of components of the active LFG extraction system can be made as necessary.

5.3.8.2.2 Maintenance Procedures

Maintenance procedures for elevated subsurface temperatures regulations pertain to surface emissions monitoring and sealing of landfill cracks. Sealing surface cracks greatly reduces the ability of oxygen intrusion to occur. Well head monitoring of the LFG temperature and composition serves as an indicator of elevated subsurface temperatures. Well head readings with methane contents below 40% (by volume), temperatures at or above the 120 to 130□F (49 to 54□C) range, or oxygen contents greater than 4% to 5% indicate possible excessive oxygen intrusion and elevated subsurface temperatures.

Routine inspection and maintenance of the LFG extraction system will include adjustment to valves, testing of well pressures, checking for gas leakage at the well head, and checking the integrity of well penetrations through the final cover.

Surface repairs will be conducted in accordance with the final cover repair procedures given in Section 5.3.5. Gas well head flows can be reduced or completely shut off by valve adjustments to reduce oxygen intrusion and therefore lower subsurface temperatures.

Cracked, broken, or malfunctioning portions of the LFG collection system will be repaired upon detection in accordance with industry standards. LFG well repairs are dependent on the nature and extent of damages to the LFG collection system and may include removal and replacement of solid-wall sections of polyethylene (PE) pipe, soil backfill, bentonite grout, and/or geomembrane boots. If it is determined that LFG wells are damaged beyond repair, they will be abandoned and/or re-drilled. Repairs to the LFG headers may include removal and replacement of damaged header pipe. These repair activities will be conducted in compliance with applicable MBUAPCD and CIWMB regulations.

5.3.8.3 Landfill Gas Monitoring System

5.3.8.3.1 Inspection Procedures

The current LFG monitoring system consists of 21 LFG monitoring probes installed along the landfill perimeter (Figure 2). Where feasible (e.g., due to topography), the lateral spacing between the adjacent perimeter LFG probes is 1,000 ft (300 m) or less. Visual inspections of the LFG monitoring probes will be conducted during the postclosure maintenance period with attention to broken probes, end caps, sampling ports and valve boxes.

LFG monitoring during the postclosure maintenance period will consist of monitoring the perimeter gas monitoring probes on a quarterly basis. During the postclosure period, probes that show "zero" combustible gas readings for 1 year will then be monitored on an annual basis.

All monitoring probes and on site structures will be sampled for methane. The results of LFG monitoring will be submitted to the EA and CalRecycle within 90 days of sampling unless compliance levels are exceeded. If compliance levels required by Section 17783(a) of Title 27 are exceeded, immediate steps will be taken to protect public health and safety and the environment and written notification of the EA and CIWMB will be made within 5 days.

5.3.8.3.2 Maintenance Procedures

Repairs will be conducted upon detection. Monitoring probes may be re-drilled if they have sustained excessive damage. Repairs will be conducted in accordance with industry standards.

Data from surface monitoring and perimeter gas monitoring probes will be used to adjust the active LFG extraction system to meet standards presented in Title 27 and MBUAPCD regulations. The flare stations will be stack tested each year and adjusted or modified to meet applicable MBUAPCD standards.

5.3.8.4 Landfill Gas Condensate

5.3.8.4.1 Inspection Procedures

The LFG condensate management system will be inspected monthly, in conjunction with the monthly inspections of the LFG collection system. Gas condensate piping and storage tanks will be visually inspected for leaks or breakage, and condensate pumps will be checked for proper operation. Detection of odor and evidence of condensate drippage or minor spillage are indicators of the malfunctioning of the LFG condensate management system.

5.3.8.4.2 Maintenance Procedures

Maintenance and repairs to the LFG condensate management system will be made upon detection. Cracked, broken, or malfunctioning portions of the LFG condensate management system will be repaired in accordance with industry standards. If significant maintenance requirements such as storage tank repair is required, County personnel may be assisted by contractors as necessary to complete repairs as rapidly as possible.

5.3.9 Leachate Management System

5.3.9.1 General

The federal requirements in Section 258.61(a)(2) of Subtitle D state that postclosure care, which must be conducted for at least 30 years, should include *"...maintaining and operating the leachate collection system in accordance with requirements of §258.40.*

The Director of an approved State may allow the owner or operator to stop managing leachate if the owner or operator demonstrates that leachate no longer poses a threat to human health and the environment."

Section 21160(a) of Title 27 states that throughout the postclosure maintenance period *"The operator shall implement and maintain landfill gas control and prevent leachate contact with public or animals..."* Further Section 21160(c) of Title 27 requires that *"During the closure/postclosure maintenance period, the owner/operator shall ensure that leachate collection and control is done in a manner which prevents public contact and controls vector, nuisance, and odors."*

The current leachate management system (LMS) at BVLF consists of HDPE pipes, transfer pumps designed to transfer leachate from leachate collection sumps to leachate tanks, and trucks used to periodically transport leachate from the tanks to the POTW.

LCRS side-slope risers and sump pumps will be operated, inspected, maintained, and tested regularly as long as there appears to be a potential for liquid flow into the LCRS sumps. Monitoring during postclosure will vary depending on conditions encountered during the year. In this regard, leachate production generally decreases with time after a final cover has been installed. Nonetheless, a certain period of time may be necessary for the moisture content to stabilize and for actual decreases in leachate production to occur.

Both the quantity and quality of leachate shall be monitored. The frequency of monitoring and testing will be in accordance with the Monitoring and Reporting Program (MARP) attached to the WDRs (CRWQCB, 2006) and may be adjusted in the future based on results of current monitoring and only after approval by the CRWQCB. Leachate samples will be analyzed as required by the MARP (CRWQCB, 2006). The results of the monitoring will be presented in reports submitted to the CRWQCB.

5.3.9.2 Inspection Procedures

A visual inspection of the LMS will be made by qualified County personnel or contracted maintenance crews. If repairs to the system are required, the necessary personnel will be notified. The focus of the inspections will be on the leachate collection and removal system (LCRS) pumping equipment and leachate tanks.

As part of the visual inspection, the following items will be checked:

- Motor/pump electrical control panel for tripped breakers;
- Compressors for proper operation;
- Float switch for proper calibration;
- Leachate piping for evidence of any pipe leakage;
- Valve inspection for damage and leak
- Leachate tanks for integrity and any evidence of leakage or damage;
- Discharge piping for clogging or buildup of particulate matter on pipe walls; and
- Sump riser pipe for excessive debris buildup.

5.3.9.3 Maintenance and Repair Procedures

Based on the results of the inspection activities, repairs and/or replacement of components of the LMS will be made as necessary. Identified worn or malfunctioning elements of the BVLF LMS will be repaired or replaced, as appropriate. The repair will be performed by qualified County personnel or contracted firm.

Pumps that do not function properly will be repaired or replaced. If a sediment buildup occurs at the base of the risers, the risers will be flushed. The LCRS system will be tested to demonstrate proper operation on an annual basis; sediments will. be removed and dried and disposed appropriately depending on chemical test results.

5.3.10 Groundwater Monitoring System

5.3.10.1 General

Section 20380(a) of Title 27 states that the owners/operators *"... shall comply with the provisions of this article for purposes of detecting, characterizing, and responding to releases to ground water, surface water or the unsaturated zone..."*

Water quality monitoring and reporting during the postclosure maintenance period will initially be conducted with the same frequency, at the same monitoring points, and for the same constituents as for the landfill when active. Adjustments to the number of monitoring points and/or monitoring frequencies may be proposed by the County during the postclosure maintenance period, if a review and analysis of data obtained from initial monitoring activities indicate that a lesser number of points or a lesser frequency

is technically justified. No adjustments will be made, however, without approval of the CRWQCB. As currently required, for each monitoring point, it will be determined whether there is statistically significant evidence of a release from the landfill for any monitoring parameter. If there is statistically significant evidence of a release, an evaluation monitoring and corrective action program will be implemented.

The existing groundwater monitoring wells have been designed to ease operation and facilitate minimal maintenance during and after landfilling operations and additional wells will be designed to meet this same criteria.

Figure 2 presents the current groundwater monitoring well network at the BVLF.

5.3.10.2 Inspection Procedures

The groundwater monitoring network will be inspected each time groundwater samples are collected from the wells. The sampling technician will inspect well caps, casings, and protective post-structures for signs of damage or deterioration and missing padlocks.

5.3.10.3 Maintenance and Repair Procedures

Depending upon the extent of deterioration or damage, the monitoring well will be either repaired or replaced as soon as practical after detecting the problem.

If a pump malfunctions during the 30-year postclosure care period, it will be replaced. Damaged or inoperative caps and locks will be replaced as required. Other repairs, including possible well abandonment and re-drilling, will be conducted in accordance with regulatory standards.

5.4 Security

Section 21135(g) of Title 27 requires that *"Once closure activities are complete, site access by the public may be allowed in accordance with the postclosure maintenance plan, as approved by the EA."*

During the postclosure maintenance period for the landfill area, the site will continue to be used for household hazardous waste management, recycling, and other approved activities. Site security will be provided for these ongoing activities and fences and

gates will be maintained to prevent access of the general public or unauthorized personnel. Should anyone enter the landfill closure area, no exposed waste will be observable and no uncontrolled health hazards will exist.

5.5 Iso-Settlement Map

Section 21090(e)(2) of Title 27 requires *"...at least every five years after completing closure.... the discharger shall produce and submit to RWQCB an iso settlement map accurately depicting the estimated total change in elevation of each portion of the final cover's low-hydraulic-conductivity layer..."*

After completing final closure activities, a photogrammetric survey of the site will be made (Section 4.6.5). Using this survey, a base topographic map will be produced at a scale of 1 in. (25 mm) to 200 ft (60 m) (i.e., 1:2400) and at a maximum contour interval of 2 ft (600 mm). Subsequently, an aerial photographic survey will be completed every five (5) years throughout the 30 year postclosure maintenance period to update the original topographic map. These updates will be used to produce a 2-ft (600-mm) contour iso-settlement map to show the changes in elevation between consecutive aerial surveys of the landfill. The iso-settlement maps will be submitted to the CRWQCB, CIWMB, and the EA.

5.6 Postclosure Land Use

Section 21190(a) of Title 27 requires that *"Proposed postclosure land uses shall be designed and maintained to:*

(1) protect public health and safety...;

(2) prevent public contact with waste, landfill gas and leachate; and

(3) prevent landfill gas explosions…"

Further, Section 21190(d) states that *"Construction on the site shall maintain the integrity of the final cover, drainage and erosion control systems, and gas monitoring and control systems…"*

As discussed in section 2.7, the landfill will be used as open space and for uses consistent such as recreational activities or grazing.

Portions of the site may remain operational following closure of the landfill. This includes several of the onsite facilities, including the recycle areas, scale house, household hazardous waste material building, maintenance building, and offices.

5.7 Postclosure Cost Estimate

Part 258.72 of Subtitle D requires that *"The owner or operator must have a detailed written estimate, in current dollars, of the cost of hiring a third party to conduct post-closure care for the MSWLF unit in compliance with the post-closure plan developed under §258.61 of this part. The post-closure cost estimate used to demonstrate financial assurance in paragraph (b) of this section must account for the total costs of conducting post-closure care, including annual and periodic costs as described in the post-closure plan over the entire post-closure care period...*

> *(1) The cost estimate for post-closure care must be based on the most expensive costs of post-closure care during the post-closure care period."*

Section 21840(a) of Title 27 requires that *"The operator shall provide a written estimate, in current dollars, of the cost of hiring a third party to maintain, monitor, and inspect the closed landfill in accordance with the postclosure maintenance plan requirements."* Section 21825(b)(3) of Title 27 requires that a PCPMP includes *"... the postclosure maintenance cost estimates… "*

The costs of postclosure maintenance at the BVLF will be primarily attributable to the inspection and maintenance of:

- Vegetation;
- Final cover;
- Leachate management system;
- Water quality monitoring network;
- Surface-water management system;
- LFG management system;
- Site security;

- Other systems maintenance; and
- Site monitoring and reporting.

Table 5 presents a summary of the preliminary costs for postclosure maintenance. Appendix I details the preliminary postclosure maintenance cost estimate.

The preliminary postclosure maintenance cost estimate is based on vendor information, prior experience, and conventional cost-estimating guides. Actual costs will vary as the details of the postclosure maintenance plan are finalized and because of factors beyond the reasonable control of the County, including market conditions, construction conditions, material availability, labor relations, and other unforeseeable events. Therefore, the estimate will be amended for those factors or changes in landfill operations, the change in the anticipated closure date, a change in the approved financial mechanism, or at a minimum, annually to adjust for inflation.

As required by the regulations, postclosure maintenance cost estimates are based on the cost of hiring a third party to maintain, monitor, and inspect the closed landfill in accordance with the PCPMP and reflect the costs for design, materials, equipment, labor, administration, and quality assurance. The cost estimate used to demonstrate financial assurance was obtained by multiplying the annual cost of maintenance and monitoring anticipated during the postclosure period by 30 years. The cost estimate will be modified when changes to the landfill indicate an increase or decrease in postclosure maintenance costs.

Pursuant to Section 22236 of Title 27, a report is required to be submitted to CalRecycle by 1 June of each year, calculating the increase in the postclosure maintenance cost estimates due to inflation for the previous year. It is Geosyntec's understanding that the County provides such a report to CalRecycle and the EA annually.

5.8 Maintenance of Postclosure Plan

Title 27 regulations, which pertain to the maintenance of the postclosure maintenance plans, require that the most recently approved preliminary or final closure and postclosure maintenance plans be maintained at the landfill during operation, closure and postclosure periods. If there are no offices located at the landfill, then the plans may be maintained at an alternate, designated location, approved by the EA that is accessible to the EA on a daily basis.

This PCPMP will be maintained at the BVLF during the closure and the postclosure maintenance period.

6. CLOSURE AND POSTCLOSURE MAINTENANCE FUND

The federal (Subtitle D) and state (Titles 27) regulations require that the County demonstrate the availability of financial resources to conduct closure and postclosure maintenance activities. Financial responsibility is essential for providing long-term assurance that the site will be closed and maintained during the 30-year postclosure period in a manner that protects public health and safety, and the environment from pollution due to disposal of solid waste at the BVLF.

Part 258.74 of Subtitle D states that *"The mechanisms used to demonstrate financial assurance... must ensure that the funds necessary to meet the costs of closure, post-closure... will be available whenever they are needed... Owners and operators must choose from the options specified in paragraphs (a) through (j) of this section.*

(a) Trust Fund...

(b) Surety Bond Guaranteeing Payment or Performance...

(c) Letter of Credit...

(d) Insurance...

(e) Corporate Financial Test...

(f) Local Government Financial Test...

(g) Corporate Guarantee...

(h) Local Government Guarantee...

(i) State-Approved Mechanism...

(j) State Assumption of Responsibility..."

Section 22210(a) of Title 27 *"... requires operators of solid waste landfills to demonstrate the availability of financial resources to conduct closure and postclosure maintenance activities..."* Sections 22240 through 22254 of Title 27 further identify acceptable mechanisms to be used to demonstrate financial responsibility for a solid waste landfill, subject to the limitations of Section 22228. These include:

- Trust Fund (Section 22240);
- Enterprise Fund (Section 22241);
- Government Securities (Section 22242);
- Letter of Credit (Section 22243);
- Surety Bond (Section 22244);
- Pledge of Revenue (Section 22245);
- Financial Means Test (Section 22246);
- Guarantee (Section 22247);
- Corrective Action Insurance (Section 22248);
- Federal Certification (Section 22450);
- Liability Insurance (Section 22251);
- Self-Insurance and Risk Management (Section 22252); and
- Insurance and Environmental Fund (Section 22251).

The mechanism for financial assurance being used by the County for closure is an Enterprise Fund. Future payments to the fund will be made in accordance with Section 22225 of Title 27. A Pledge of Revenue is the financial assurance mechanism for postclosure maintenance.

Appendix J includes a copy of the financial mechanism for closure and postclosure maintenance used by the County for BVL. The financial mechanisms were established in 1993 including the corrective action plan. The non-water quality corrective action plan is included in Appendix L; the costs associated with the estimated water release corrective action are sufficiently high that the water release costs are not likely to be exceeded by the non-water release cost estimate. As are result, additional financial assurance for possible non-water releases at the Buena Vista Landfill is not required.

7. REFERENCES

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8. LIMITATIONS

This report was prepared in general accordance with the accepted standard of practice which existed in Northern California at the time the project was performed. It should be recognized that definition and evaluation of environmental conditions is a difficult and inexact art. The soil conditions only represent the location and type(s) of tests performed. Judgments leading to conclusions and recommendations are generally made with an incomplete knowledge of the conditions present. Our firm has prepared this report for the Client's exclusive use for this particular project and in accordance with generally accepted engineering practices within the area at the time of our investigation. No other representations, expressed or implied, and no warranty or guarantee is included or intended.

This report may be used only by the Client and only for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both onsite and offsite) or other factors may change over time, and additional work may be required with the passage of time. Any party other than the Client who wishes to use this report shall notify Geosyntec Consultants of such intended use. Based on the intended use of the report, Geosyntec Consultants may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the Client or anyone else will release Geosyntec Consultants from any liability resulting from the use of this report by any unauthorized party.

TABLES

TABLE 1 - SITE LIFE SUMMARY AND ASSUMPTIONS; BUENA VISTA LANDFILL PRELIMINARY CLOSURE AND POSTCLOSURE MAINTENANCE PLAN; SANTA CRUZ COUN

(Disposal Tonnage)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
1985					8,040	9,362	9,041	8,965	8,763	8,255	8,835	6,922	68,183
1986	7,059	5,906	7,455	7,960	8,359	8,876	9,067	10,679	9,690	10,471	8,623	8,669	102,814
1987	7,973	7,163	8,748	9,287	9,361	9,585	11,636	9,783	10,304	10,764	8,382	7,997	110,983
1988	8,414	9,242	11,033	9,046	9,468	9,477	11,014	10,386	10,215	9,359	8,323	7,739	113,716
1989	8,624	7,351	8,647	8,917	9,530	9,983	9,675	9,684	9,253	14,937	18,853	10,210	125,664
1990	17,045	9,244	9,937	8,605	9,661	9,347	11,302	9,173	8,923	9,517	7,788	7,226	117,768
1991	6,973	6,546	8,506	8,409	9,506	9,796	12,028	10,196	9,105	9,774	10,028	9,240	110,107
1992	9,566	8,065	9,926	10,570	10,594	10,447	10,408	9,802	10,095	10,767	9,485	8,589	118,314
1993	8,928	7,642	10,799	10,871	12,887	11,194	11,163	10,540	9,954	9,898	9,730	9,617	123,223
1994	9,449	7,948	10,399	9,571	10,379	9,985	10,074	12,053	11,247	11,944	10,055	9,375	122,479
1995	9,121	9,001	9,625	8,890	11,328	10,444	10,952	10,331	9,396	9,525	9,141	8,797	116,551
1996	9,147	8,035	8,791	8,384	9,801	8,541	9,935	9,638	10,503	10,336	9,734	9,182	112,027
1997	10,490	9,495	10,727	10,723	11,607	10,842	12,072	11,431	11,974	12,136	10,372	10,356	132,225
1998	9,127	9,996	11,498	10,621	10,894	12,359	12,973	12,719	12,636	12,334	11,163	11,983	138,303
1999	9,929	9,248	11,272	10,920	12,304	11,925	12,508	13,025	12,626	12,922	12,467	10,864	140,010
2000	10,285	11,577	12,098	11,269	13,641	14,072	12,830	13,571	12,389	12,353	12,438	11,023	147,546
2001	11,013	9,258	11,995	11,570	12,400	11,995	13,309	14,192	11,853	12,978	11,837	10,046	142,446
2002	11,161	10,570	10,744	12,347	12,556	13,154	13,115	13,294	12,330	12,992	12,213	9,690	144,166
2003	12,352	11,247	12,435	12,153	12,379	12,305	13,203	12,785	12,365	12,132	11,684	10,404	145,444
2004	10,208	9,410	12,264	11,603	11,845	12,102	12,644	13,357	12,189	12,817	11,734	10,086	140,259
2005	10,605	9,918	11,694	11,262	12,296	12,755	12,597	12,042	10,829	10,773	10,313	8,895	133,979
2006	9,871	8,105	8,549	8,479	10,204	9,903		31,302			28,625		115,038
2007		24,153			21,696			21,646			20,320		87,815
2008	8,158	7,096	7,091	7,891	7,106	7,907	10,768	8,979	8,339	7,429	6,473	6,281	93,518
2009	6,017	5,301	6,186	6,387	6,014	6,469	6,876	6,257	6,792	6,620	5,983	5,555	74,457
2010	5,353	4,814	6,310	5,407	5,590	6,143	6,321	6,227	6,180	5,574	5,919	6,122	69,960
2011	5,511	4,791	5,824	6,294	6,488	6,221	6,401	6,720	6,133	5,905	5,614	5,439	71,341
2012	5,131	2,896	4,364	4,029	4,122	4,749	6,340	8,138	4,203	4,435	4,575	4,710	57,692
2013	4,920	3,716	4,325	4,460	5,722	5,431	7,108	5,866	5,519	4,886	4,982	4,629	61,564
2014	4,612	2,998	4,649	4,120	5,092	5,353	6,198	5,717	5,513	6,303	5,271	5,593	61,419
2015	6,446	5,561	6,196	5,431	5,666	5,795	6,800	6,235	5,558	7,105	6,577	6,130	73,500
2016	5,683	5,876	7,087	7,263	8,364	9,095	9,254	10,284	10,381	8,427	9,368	8,136	99,218
2017	8,735	8,088	9,235	7,890	9,454	10,025	8,599	9,421	8,555	9,141	8,499	8,209	105,851
2018	6,997	7,797	8,177	9,151	9,146	9,375	9,405	9,446	8,285	9,206	8,108	7,929	103,023
2019	6,134	6,383	7,119	8,851	9,849	9,381	10,314	9,991	8,722	8,765	7,239	7,183	99,932
2020	6,115	6,986	6,591	6,679	8,548	8,628	8,962	8,654	10,309	9,069	8,121	7,674	96,336
												TOTAL:	3,876,870

10/28/20 digitally calculated remaining refuse capacity[3] =	1,861,422	cy
Refuse capacity filled from 5/85 to 10/20 =	6,435,126	cy
Estimated refuse capacity from 5/85 to 10/20 =	8,296,548	cy
Estimated capacity remaining as of 12/31/20 =	1,887,747	cy

1. Utilizing in-place refuse conversion rate of: 1200 lbs/cy
2. Remaining refuse capacity, Letter dated Dec 21, 2020, Geosyntec Consultants.
3. Estimated waste generation annual growth index: 2.0% per year

Year	Proj. Tonnage	Proj. Cubic Yards[4]	Capacity Balance (CY)
2020	96,336 (final)	160,560	1,887,747
2021	98,263	163,771	1,723,976
2022	100,228	167,047	1,556,929
2023	102,233	170,388	1,386,542
2024	104,277	173,795	1,212,746
2025	106,363	177,271	1,035,475
2026	108,490	180,817	854,658
2027	110,660	184,433	670,225
2028	112,873	188,122	482,104
2029	115,130	191,884	290,220
2030	117,433	195,722	94,498
2031	119,782	199,636	-105,138
2032	122,177	203,629	-308,767
2033	124,621	207,701	-516,469
2034	127,113	211,856	-728,324
2035	129,656	216,093	-944,417
2036	132,249	220,414	-1,164,831
2037	134,894	224,823	-1,389,654
2038	137,592	229,319	-1,618,973
2039	140,343	233,906	-1,852,879
2040	143,150	238,584	-2,091,462

Table 2
Preliminary Final Closure Cost Estimate
Preliminary Closure and PostClosure Maintenance Plan
Buena Vista Drive Sanitary Landfill

Item	Cost	
A. FINAL COVER	$	12,193,636
B. EROSION CONTROL/REVEGETATION	$	427,828
C. LEACHATE AND LANDFILL GAS MONITORING AND CONTROL	$	30,000
D. GROUNDWATER MONITORING SYSTEM	$	-
E. STORM-WATER MANAGEMENT SYSTEM	$	400,000
F. SECURITY INSTALLATION	$	9,315
G. STRUCTURE REMOVAL	$	40,000
H. ENVIRONMENTAL SYSTEM DECOMMISSIONING	$	-
SUBTOTAL	$	13,100,779
20% CONTINGENCY	$	2,620,156
TOTAL CLOSURE COSTS:	$	15,720,935

Table 3
FINAL POSTCLOSURE INSPECTION LOG
Preliminary Closure and PostClosure Maintenance Plan
Buena Vista Drive Sanitary Landfill

Item	Problem	Acceptable	Unacceptable	Observations	Date and Nature of Repairs/Action
Cover Material	Uneven settlement, subsidence, erosion, inadequate protective vegetation				
Low Permeability Barrier	Exposed material, damaged material, inadequate cover				
Run-off Diversion Channels	Obstructions to flow, bank erosion, deterioration, excessive silting, inadequate protective vegetation				
Drainage Ditches	Erosion clogging, obstruction of culverts, inadequate protective vegetation				
Area Inlet to Storm-Water Piping System	Corrosion, deterioration, silting,blockage, clogging				
Storm-Water Runoff Piping	Silting, corrosion, deterioration, blockage, clogging				
Leachate Collection & Removal System	Cracks, deterioration, clogging, and blockage causing severe inoperative conditions and sudden drop in flows				
Liquid Level Indicator Gauges	Inoperative, sticking, calibration error				
Benchmarks	Dislocation, damage				
Facility Fence	Corrosion, damage to chain-link fence, vandalism				
Gates and Locks	Corrosion, damage to chain-link fence, vandalism				
Access Roads	Erosion, cracks, deterioration, excessive rutting, loss of aggregate (where used)				
Warning Signs	Damaged, corroded, missing				
Locks on Groundwater and Gas Monitoringg Wells	Corroded, broken				
Water Quality Units	Sediment level, riprap at inlet and outlet				
Landfill Gas Control System	Cracks, deterioration, corrosion, damaged, leaks, inoperative, questionable flow reading				
Landfill Gas Blower/Flare Station	Questionable flow and combustion readings, cracks, leaks, sticking, calibration error, inoperative alarms/valves/temperature control device, pipe deterioration, filter clogging				

Table 4
FINAL POSTCLOSURE MAINTENANCE LOG
Preliminary Closure and PostClosure Maintenance Plan
Buena Vista Drive Sanitary Landfill

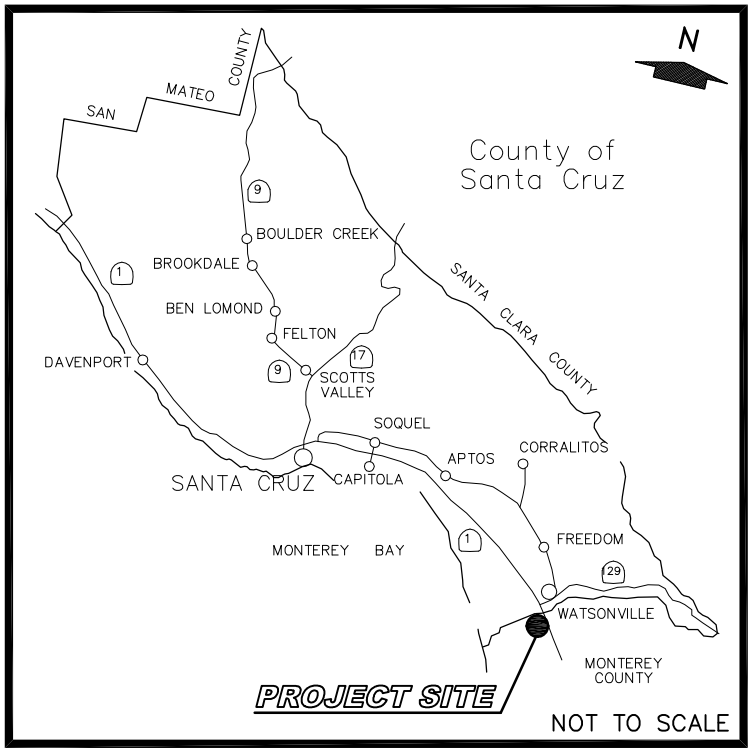
Problem	Maintenance Procedure	Equipment Requirements	Materials Requirements
SECURITY CONTROL:			
Fallen or broken fence	Repair or replace fence. Add fence post(s), if necessary	None	Fence, fence post, wire, concrete
EROSION DAMAGE:			
Bare spots on final cover	Revegetate; if unsuccessful use erosion mat and revegetate, check for landfill gas.	None	Erosion mat, seed, fertilizer mulch
Soil loss	Backfill and place erosion mat and revegetate	Backhoe, front end loader, or grader	Backfill, erosion mat, seed, backfill mulch
CAP DEFORMATION:			
Cracks or Fissures	Backfill, revegetate	Grader, backhoe, front end loader	Backfill, seed, fertilizer mulch
Ponding	Backfill, revegetate	Grader, backhoe, front end loader	Backfill, seed, fertilizer mulch
RUNOFF CONTROL STRUCTURES:			
Clogged soil drainage ditches and water quality units (WQU)	Clear debris and sediment	Backhoe, grader, hand tools, vacuum truck	Backfill, riprap (none for WQUs)
	Clear debris		None
Clogged concrete channel	Fill cracks with mortar	Hand tools	Mortar
Cracks in concrete channel	Regrade, place riprap or erosion mat, revegetate	Mixer	Backfill soil, seed, fertilizer, mulch, erosion mat, riprap, geotextile
Eroded soil drainage ditches		Bulldozer, grader, or backhoe	
LEACHATE COLLECTION AND REMOVAL SYSTEM:			
Leachate header clogged	Flush, clear obstruction	Water truck or sewer rodder	Water
Broken sump pump	Repair or replace	Light crane	Sump pump
Faulty liquid level indicator gauges	Repair or replace	None	New gauges
Cracked or deteriorating structures	Fill cracks with mortar	None	Mortar
GROUND-WATER MONITORING			
Faulty pump operation	Repair of pump	Hand tools	Pump, wiring
Corroded, broken well cap, or lock	Repair or replace	Hand tools	New cap, lock, lubricant
SURVEY MONUMENTS			
Covered with debris, sod, etc.	Relocate, clean around, mark with visible marker	Hand tools	Wooden or metal markers
Damaged, destroyed	Replace, resurvey	Mixer, hand tools	Monument, concrete

TABLE 5: PRELIMINARY FINAL POSTCLOSURE MAINTENANCE COST ESTIMATE
SUMMARY OF COSTS
Buena Vista Sanitary Landfill

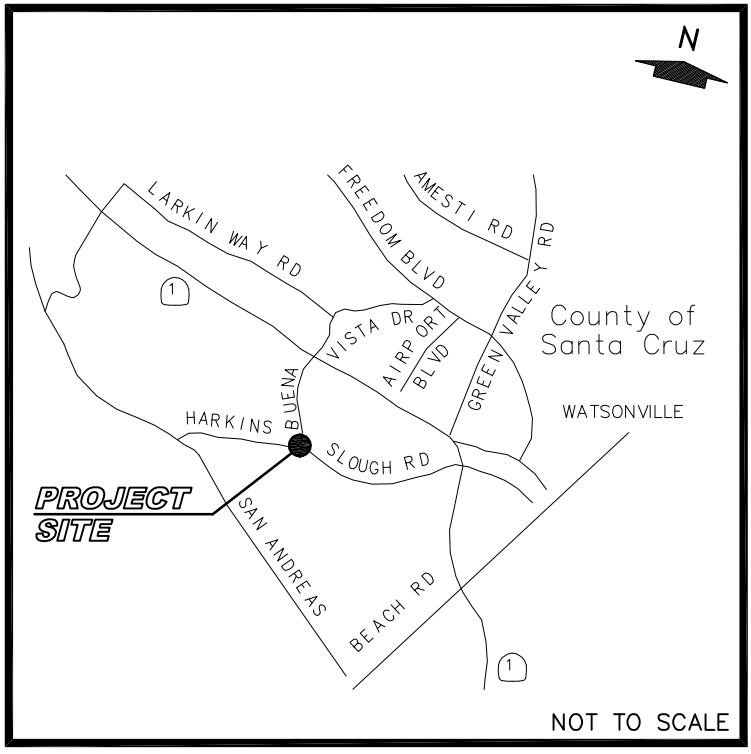
Work Element	Annual Cost ($)
A. WORK ELEMENT - FINAL COVER INSPECTION	2,964
B. WORK ELEMENT - FINAL COVER MAINTENANCE AND REPAIR	44,883
C. WORK ELEMENT - REVEGETATION	20,195
D. WORK ELEMENT - LEACHATE MANAGEMENT SYSTEM MAINTENANCE AND REPAIR	28,363
E. WORK ELEMENT - LEACHATE MONITORING	5,302
F. WORK ELEMENT - LFG EXTRACTION SYSTEM MONITORING, MAINTENANCE AND REPAIR	91,023
G. WORK ELEMENT - LFG MONITORING	28,287
H. WORK ELEMENT - GROUNDWATER NETWORK MONITORING, MAINTENANCE AND REPAIR	58,834
I. WORK ELEMENT - STORMWATER MONITORING	3,743
J. WORK ELEMENT - SITE SECURITY INSPECTION AND MAINTENANCE	3,996
K. WORK ELEMENT - SETTLEMENT MONITORING AND SURVEY MONUMENT MAINTENANCE	5,899
L. WORK ELEMENT - POSTCLOSURE CERTIFICATION	624
Annual Postclosure Costs	**246,266**
30-YR POSTCLOSURE COSTS	**7,387,969**

General Notes:
- Prices in 2021 dollars
- Assumes approximately 52 acres in-plan area or 53 acres adjusted for slope
- Assumes an average slope of 3H:1V (horizontal to vertical) and top deck
- For contractors, use Caltrans 1Apr2021-31Mar22 rates for equipment
- For contractor equipment, labor, and material, add surcharges for Force Account work
  see Section 9-1.04B-D (Labor, Materials, Equipment) of Caltrans 2018 Standard Specifications
- For contractors labor rates use 2021 prevailing wages by the Director of Industrial Relations
  for Santa Cruz County and pay scales of wages plus benefits
- Estimated costs for services such as engineering inspections, surveying, monitoring, and sampling
  are based on consultants and laboratory 2021 rate schedules
- Water available on-site at no cost

FIGURES



VICINITY MAP

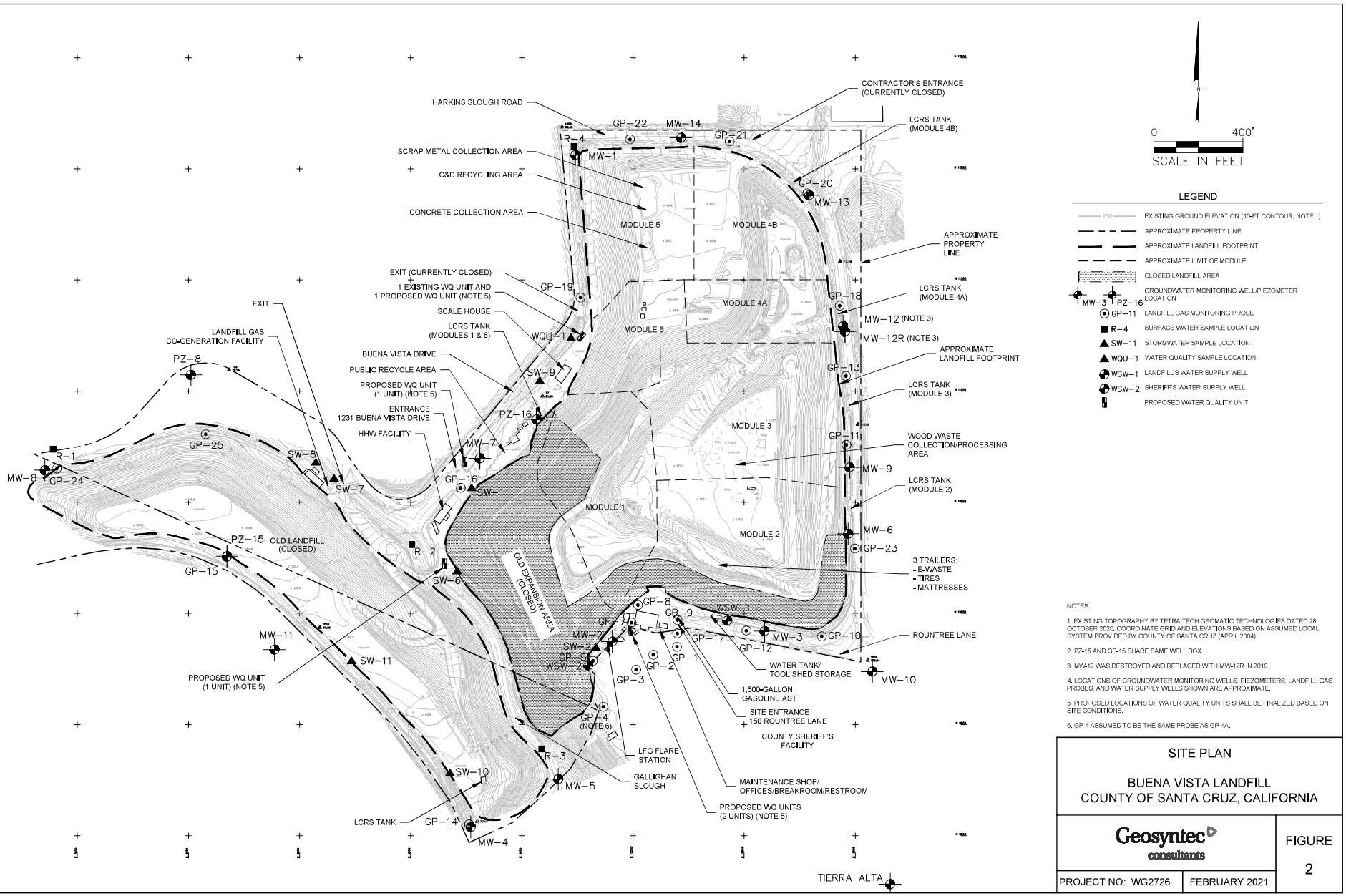


SITE LOCATION
1231 BUENA VISTA DRIVE, WATSONVILLE
COUNTY OF SANTA CRUZ, CALIFORNIA

P:\CADD\Land Projects 3\Santa Cruz County\Buena Vista Site Development\dwg\Site Map.dwg 7-11-08 02:43:30 PM jbernardini

Geosyntec consultants

SITE LOCATION AND VICINITY MAP BUENA VISTA LANDFILL WATSONVILLE, COUNTY OF SANTA CRUZ, CALIFORNIA	FIGURE NO. 1 PROJECT NO. WG1019 DATE: JULY 2008



NOTES:

1. EXISTING TOPOGRAPHY BY TETRA TECH GEOMATIC TECHNOLOGIES DATED 28 OCTOBER 2020. COORDINATE GRID AND ELEVATIONS BASED ON ASSUMED LOCAL SYSTEM PROVIDED BY COUNTY OF SANTA CRUZ (APRIL 2004).
2. PZ-15 AND GP-15 SHARE SAME WELL BOX.
3. MW-12 WAS DESTROYED AND REPLACED WITH MW-12R IN 2019.
4. LOCATIONS OF GROUNDWATER MONITORING WELLS, PIEZOMETERS, LANDFILL GAS PROBES, AND WATER SUPPLY WELLS SHOWN ARE APPROXIMATE.
5. PROPOSED LOCATIONS OF WATER QUALITY UNITS SHALL BE FINALIZED BASED ON SITE CONDITIONS.
6. GP-4 ASSUMED TO BE THE SAME PROBE AS GP-4A.

SITE PLAN

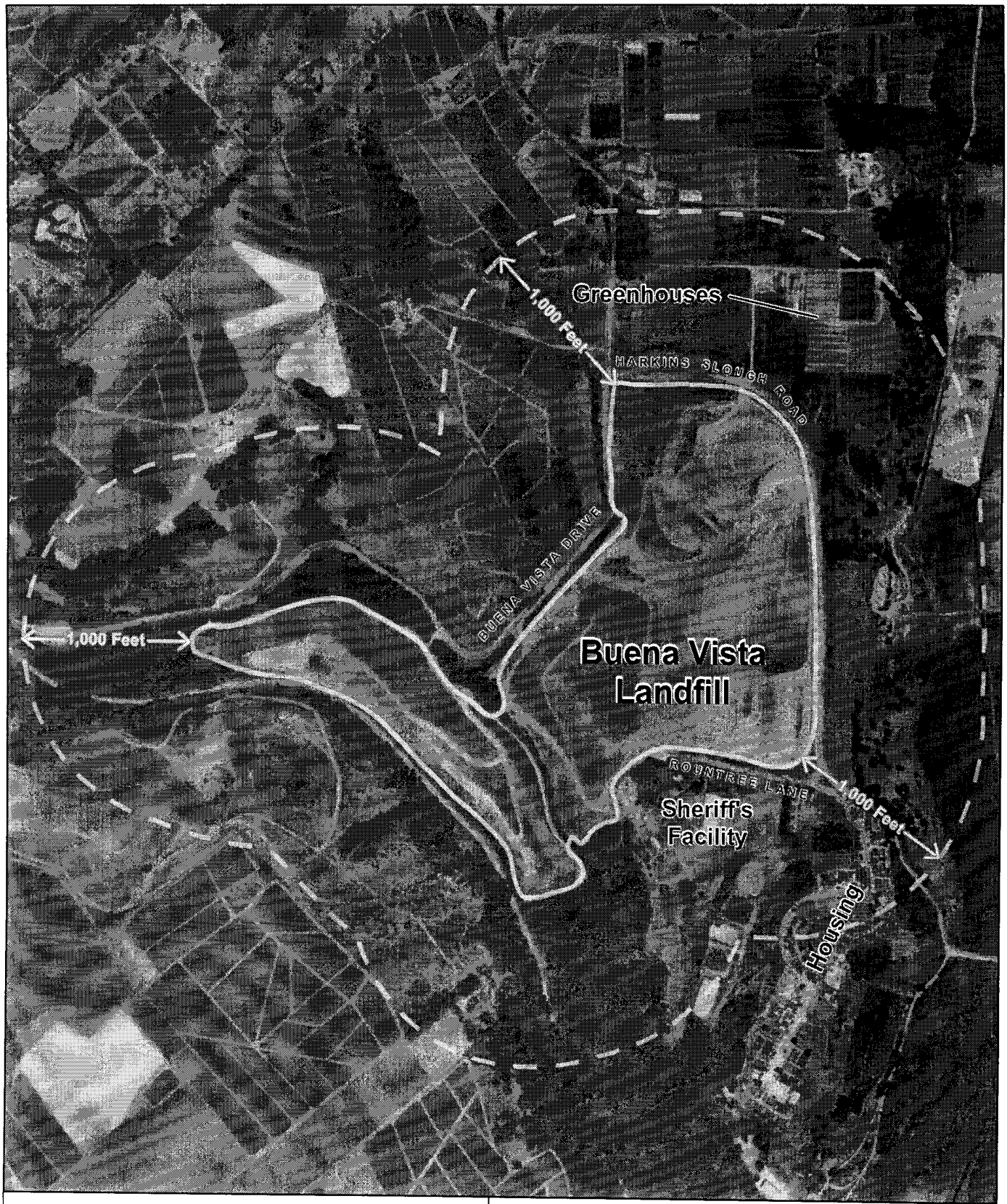
BUENA VISTA LANDFILL
COUNTY OF SANTA CRUZ, CALIFORNIA

Geosyntec consultants

PROJECT NO: WG2726 | FEBRUARY 2021

FIGURE 2

P:\CADD\CIVIL 3D\SANTA CRUZ COUNTY\BUENA VISTA\2021 TASKS\UTD UPDATE\UTD FIGURES 2 AND 3 - Last Saved by: Xiaoyue.Wang on 2/5/21



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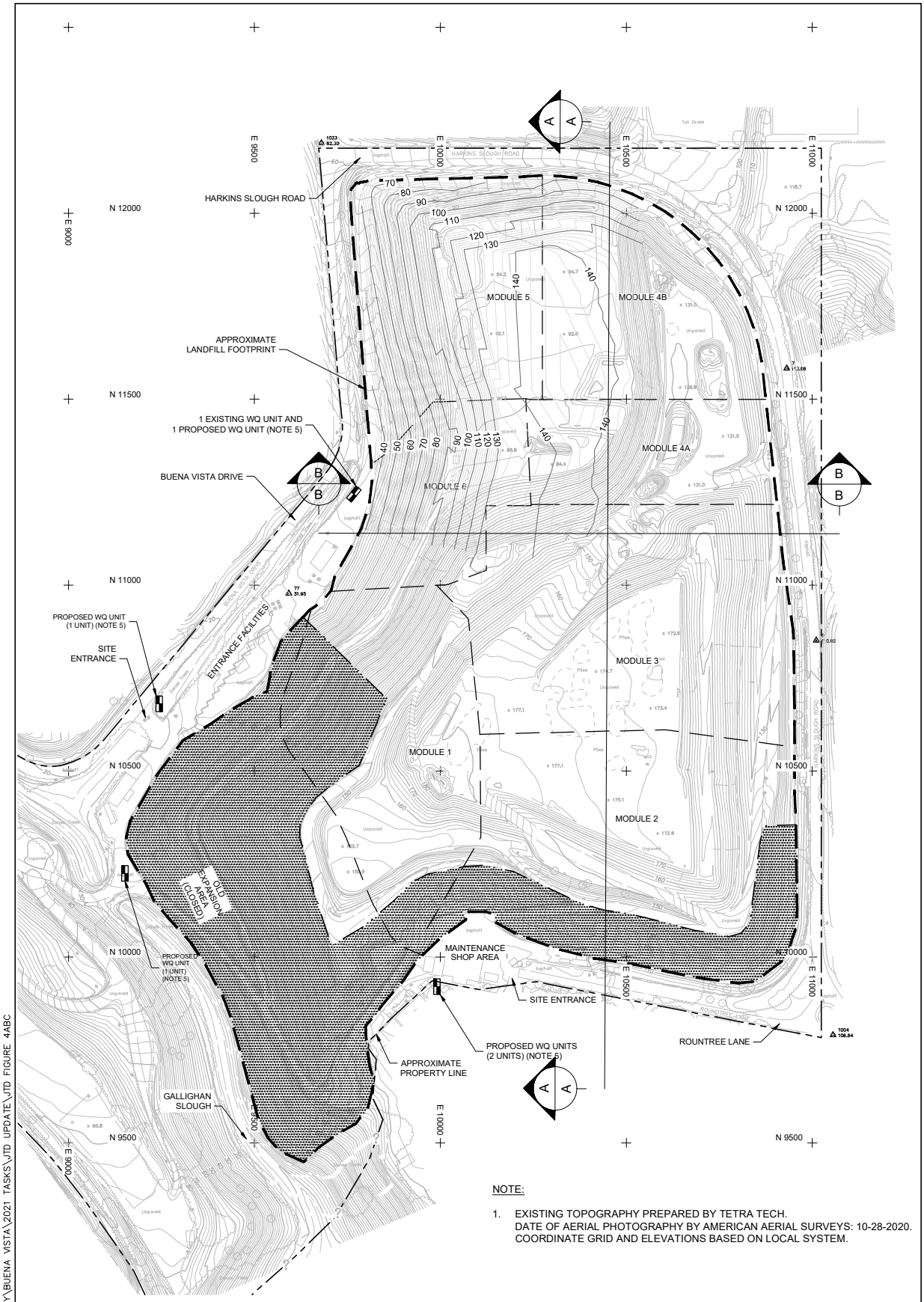
0 400 800 1,600 Feet

Image Source: TerraServer, Saturday, June 12, 1993.

Figure 3
Structures and Facilities within 1,000 ft of Property Boundary
Buena Vista Landfill
1231 Buena Vista Drive
Watsonville, California

Project: WG1019	July 2008	Geosyntec

P:\GIS\santacruz\buenavista\project\2008July\site_buffer.mxd



NOTE:

1. EXISTING TOPOGRAPHY PREPARED BY TETRA TECH.
   DATE OF AERIAL PHOTOGRAPHY BY AMERICAN AERIAL SURVEYS: 10-28-2020.
   COORDINATE GRID AND ELEVATIONS BASED ON LOCAL SYSTEM.

LEGEND

- 170 — EXISTING GROUND 10-FT CONTOUR
- EXISTING GROUND 2-FT CONTOUR
- 190 — TOP OF INTERIM FILL GRADES 10-FT CONTOUR
- TOP OF INTERIM FILL GRADES 2-FT CONTOUR
- APPROXIMATE PROPERTY LINE
- APPROXIMATE LANDFILL FOOTPRINT
- APPROXIMATE LIMIT OF MODULE
- CLOSED LANDFILL AREA

N

0 250

SCALE IN FEET

PHASE IV - INTERIM GRADING PLAN

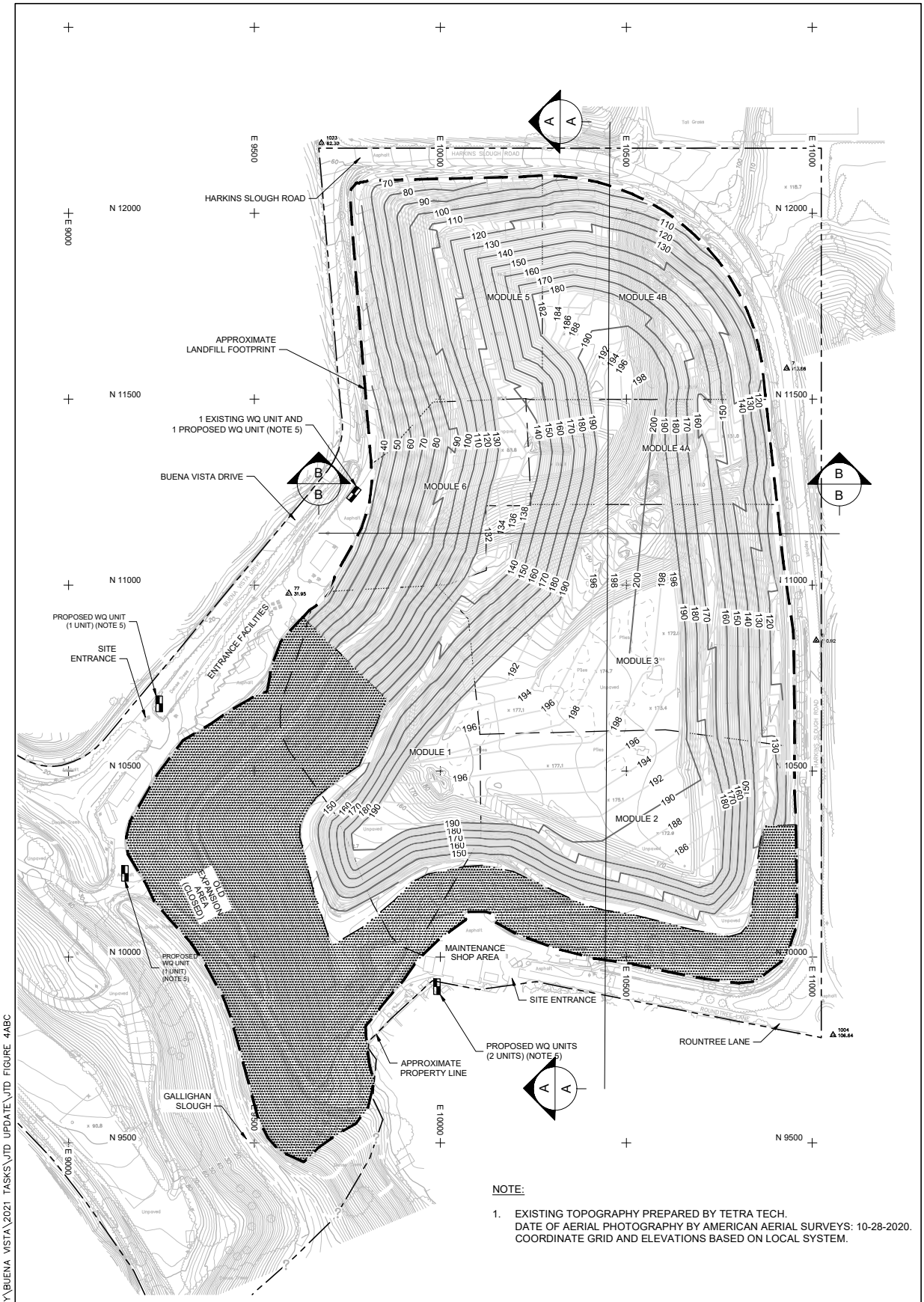
BUENA VISTA LANDFILL
SANTA CRUZ COUNTY, CALIFORNIA

Geosyntec consultants

FIGURE 4A

PROJECT NO: WG2726 | APRIL 2021

P:\CADD\CIVIL 3D\SANTA CRUZ COUNTY\BUENA VISTA\2021 TASKS\JTD UPDATE\JTD FIGURE 4ABC



NOTE:

1. EXISTING TOPOGRAPHY PREPARED BY TETRA TECH.
   DATE OF AERIAL PHOTOGRAPHY BY AMERICAN AERIAL SURVEYS: 10-28-2020.
   COORDINATE GRID AND ELEVATIONS BASED ON LOCAL SYSTEM.

LEGEND

- EXISTING GROUND 10-FT CONTOUR
- EXISTING GROUND 2-FT CONTOUR
- TOP OF FINAL COVER 10-FT CONTOUR
- TOP OF FINAL COVER 2-FT CONTOUR
- APPROXIMATE PROPERTY LINE
- APPROXIMATE LANDFILL FOOTPRINT
- APPROXIMATE LIMIT OF MODULE
- CLOSED LANDFILL AREA

N

0 250

SCALE IN FEET

PHASE V - FINAL GRADING PLAN

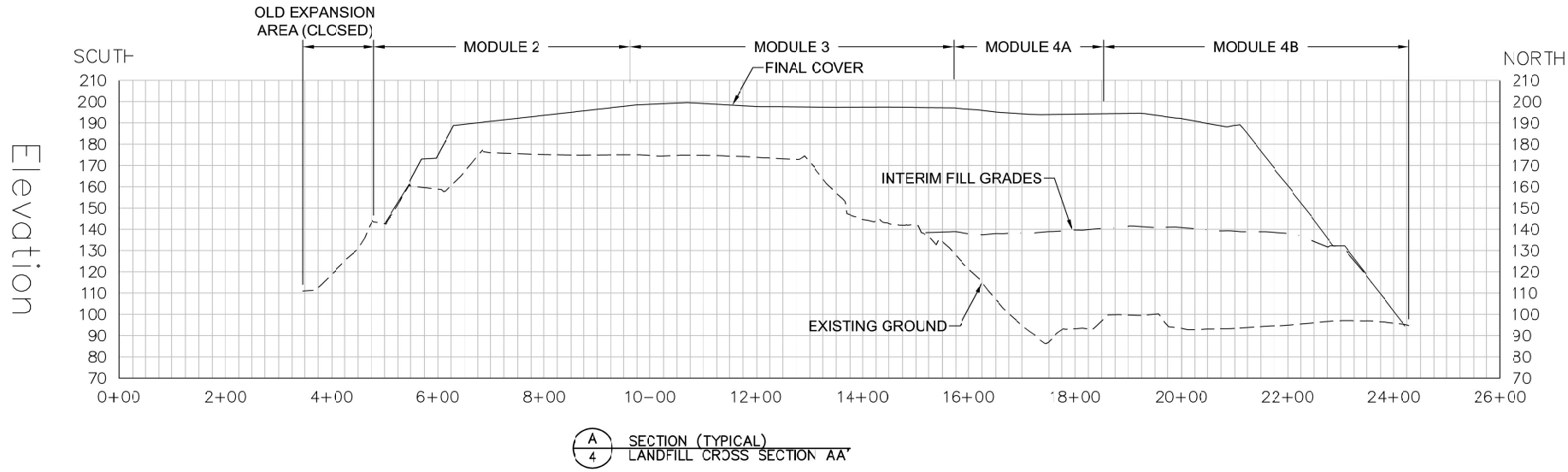
BUENA VISTA LANDFILL
SANTA CRUZ COUNTY, CALIFORNIA

Geosyntec consultants

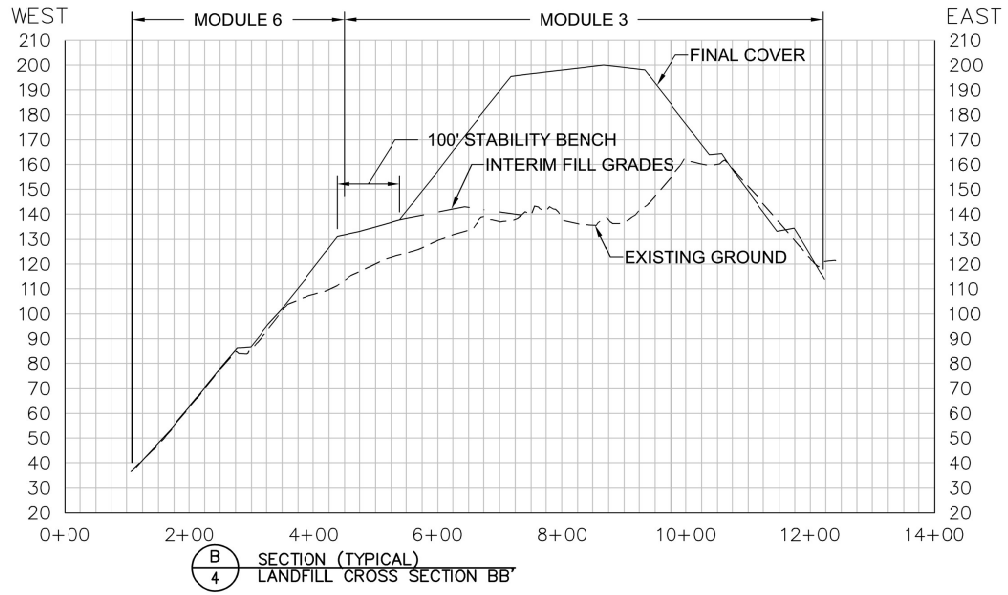
PROJECT NO: WG2726 | APRIL 2021

FIGURE 4B

P:\CADD\CIVIL 3D\SANTA CRUZ COUNTY\BUENA VISTA\2021 TASKS\JTD UPDATE\JTD FIGURE 4ABC



A/4 SECTION (TYPICAL)
LANDFILL CROSS SECTION AA'



B/4 SECTION (TYPICAL)
LANDFILL CROSS SECTION BB'

LEGEND

- EXISTING GROUND (SEE NOTE 1)
- PROPOSED INTERIM FILL (SEE NOTE 3)
- PROPOSED FINAL COVER (SEE NOTE 3)

NOTES:

1. TOPOGRAPHIC DATA FROM 28 OCTOBER 2020 AERIAL PHOTOGRAPHY BY TETRA TECH, INC.
2. ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL.
3. PROPOSED INTERIM FILL/FINAL COVER SHOWN FOR TOP OF INTERIM/FINAL COVER SYSTEM.

0 200
SCALE IN FEET

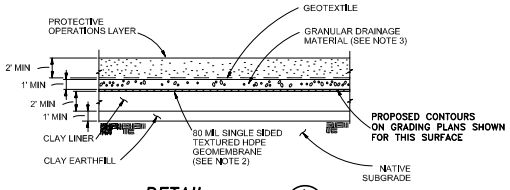
LANDFILL CROSS-SECTIONS
BUENA VISTA LANDFILL
COUNTY OF SANTA CRUZ, CA

Geosyntec consultants

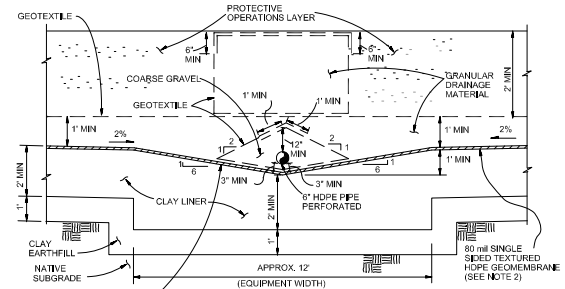
PROJECT NO: WG2726 | APRIL 2021

FIGURE 4C

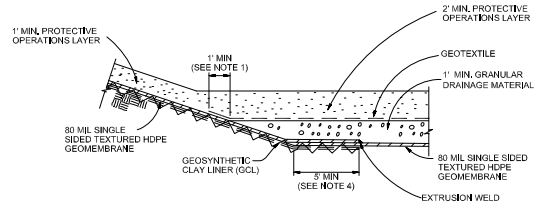
P:\CADD\CIVIL 3D\SANTA CRUZ COUNTY\BUENA VISTA\2021 TASKS\UTD UPDATE\UTD FIGURE 4ABC - Last Saved by: ABektur on 4/26/21

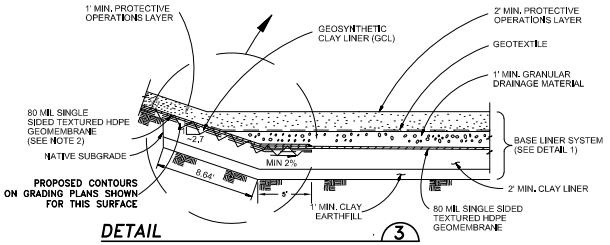


DETAIL 1
FLOOR CONTAINMENT SYSTEM
NTS

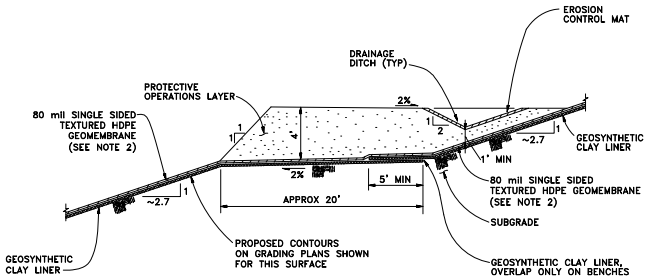


DETAIL 2
LEACHATE COLLECTION PIPE TRENCH
NTS

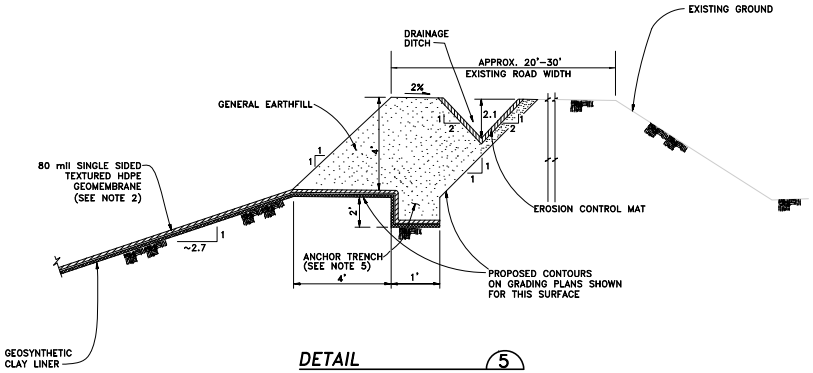




DETAIL 3
SIDE SLOPE TO FLOOR CONTAINMENT SYSTEM TRANSITION
NTS



DETAIL 4
LINED SIDE SLOPE BENCH (TYP.)
NTS



DETAIL 5
SIDE SLOPE CONTAINMENT SYSTEM TERMINATION AND DRAINAGE
NTS

NOTES:

1. EXTEND GEOTEXTILE UPSLOPE A MINIMUM OF 1 FOOT.
2. USE SINGLE SIDED TEXTURED GEOMEMBRANE WITH TEXTURED SIDE PLACED DOWN.
3. GRANULAR DRAINAGE MATERIAL SHALL BE PLACED IN A MANNER THAT DOES NOT DAMAGE THE GEOMEMBRANE.
4. THE CONNECTION OF THE SIDE SLOPE AND BASE GEOMEMBRANE SHALL NOT BE WITHIN 5 FEET OF THE TOE OF SLOPE AND SHALL NOT BE LOCATED IN LEACHATE COLLECTION PIPE TRENCH.
5. ANCHOR TRENCH DIMENSIONS WILL BE FINALIZED WHEN CONSTRUCTION DRAWINGS ARE PREPARED.

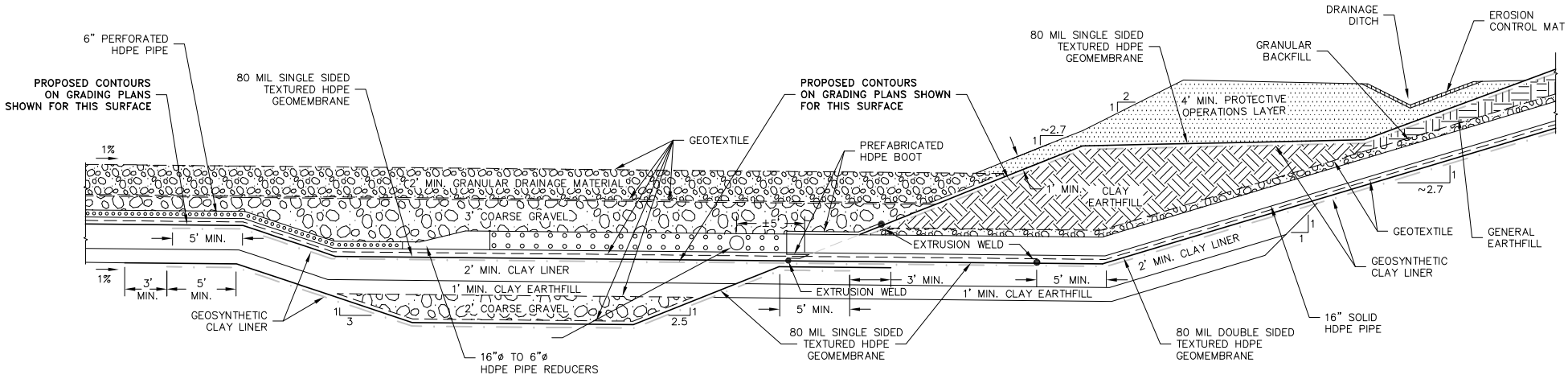
DETAILS I
CONTAINMENT SYSTEM
BUENA VISTA LANDFILL
COUNTY OF SANTA CRUZ, CALIFORNIA

Geosyntec consultants

FIGURE 4D

PROJECT NO: WG2726 | APRIL 2021

P:\CADD\CIVIL 3D\SANTA CRUZ COUNTY\BUENA VISTA\2021 TASKS\UTD UPDATE\UTD FIGURE 4DE - Last Saved by: ABektur on 4/26/21



DETAIL 6

SUMP WITH LCRS PIPE RISER

0 1

SCALE IN FEET

DETAILS II
LCRS SUMP
BUENA VISTA LANDFILL
COUNTY OF SANTA CRUZ, CALIFORNIA

Geosyntec consultants

FIGURE 4E

PROJECT NO: WG2726 | APRIL 2021

P:\CADD\CIVIL 3D\SANTA CRUZ COUNTY\BUENA VISTA\2021 TASKS\UTD UPDATE\UTD FIGURE 4DE - Last Saved by: ABektur on 4/26/21

APPENDIX A
Landfill Gas Control Master Plan (2019)

BUENA VISTA DRIVE SANITARY LANDFILL
GAS MIGRATION CONTROL WORKPLAN

150 ROUNTREE LANE, WATSONVILLE, CA 95076

FOR

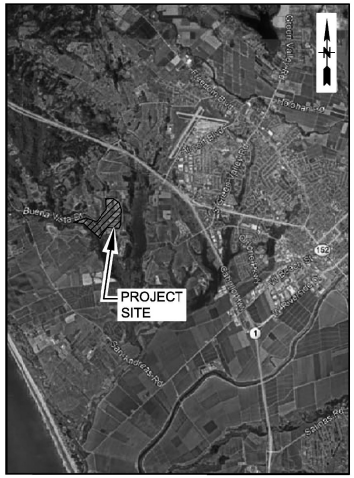
COUNTY OF SANTA CRUZ RECYCLING AND SOLID WASTE

701 OCEAN STREET, ROOM 410, SANTA CRUZ, CA 95060

VICINITY MAP
N.T.S.



LOCATION MAP
N.T.S.



INDEX OF SHEETS

DRAWING NO.	DESCRIPTION
1	TITLE SHEET–LOCATION MAP
2	EXISTING GCCS SYSTEM AND PROBE LOCATION MAP
3	MIGRATION CONTROL IMPROVEMENTS NORTH SITE AREA (GP–23)
4	MIGRATION CONTROL IMPROVEMENTS SOUTH SITE AREA (GP–15)
5	MIGRATION CONTROL IMPROVEMENTS SOUTH SITE AREA (GP–14)
6	LFG WELL, VADOSE ZONE WELL AND MISCELLANEOUS DETAILS
7	TECHNICAL SPECIFICATIONS

SPECIAL PROVISIONS

THE SCOPE OF WORK INCLUDES THE FOLLOWING SPECIAL PROVISIONS:

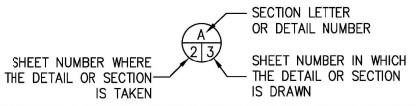
1) LANDFILL GAS (LFG) EXTRACTION WELLS OCCUR ON BOTH LINED AND UNLINED PORTIONS OF THE LANDFILL.
2) CONTRACTOR TO ENSURE THAT ALL VERTICAL EXTRACTION WELLS ARE NOT INSTALLED TO DEPTHS WHERE LINED AREAS EXST. AS SUCH, THE CONTRACTOR AND CQA SHALL OBSERVE THE LAST 10 FEET OF DRILLING OF ANY WELL AND IDENTIFY REFUSE NEAR THE BOTTOM OF THE BORING.
3) ALL WELLS ARE TO BE VERIFIED FOR DEPTHS UPON DRILLING. THE ENGINEER MAY INCREASE OR DECREASE ANY INSTALLATION UPON FOELD FINDINGS DURING DRILLING.
4) WARNING: LFG GAS WELL DEPTHS IN THE SOUTH SITE LANDFILL AREA INCLUDE EW–1B AND EW–1C (GP–15 AREA); AND, EW–11B (GP–14 AREA). THE FINAL DEPTH OF THESE WELLS SHALL NOT EXCEED THE DEPTH OF ADJACENT EXISTING WELLS EW–1A (GP–15 AREA); AND, EW–1C (GP–14 AREA).
5) WARNING: VERTICAL LFG EXTRACTION WELLS, EW–58A AND EW–58B, ARE LOCATED NEAR THE EDGE OF A CLAY LINED CELL. AS SUCH, THE CONTRACTOR AND DRILLER SHALL OBSERVE THE FINAL 10 FEET OF EACH BORING AND IDENTIFY REFUSE AT 2–FOOT INTERVALS FOR THE LAST 10 FEET OF DRILLING. THE CONTRACTOR SHALL CEASE DRILLING AT ANY DEPTH IF NO REFUSE IS DISCOVERED IN ABOVE IDENTIFIED WELL LOCATION AREAS.

SCOPE OF WORK

THE SCOPE OF WORK UNDER THIS PROJECT INCLUDES, BUT IS NOT LIMITED TO, THE FOLLOWING:

1) PROCURE & INSTALL MATERIALS FOR FOR LANDFILL GAS (LFG) EXTRACTION WELLS AND VADOSE ZONE WELLS AND ASSOCIATED COMPONENTS TO AIDE IN CONTROL OF LFG PRIOR TO MIGRATION OUTSIDE OF THE REFUSE BOUNDARY AND IMPACTING COMPLIANCE GAS MONITORING PROBES.
2) PROCURE AND INSTALL ASSOCIATED LFG LATERAL AND HEADER PIPING AT LOCATIONS SHOWN AND CONNECT IT TO THE NEAREST VACUUM SOURCE FOR THE ACTIVE GAS COLLECTION AND CONTROL SYSTEM (GCCS) FOR THE SITE OR AT LOCATIONS SHOWN ON THE DRAWINGS.
3) CONTRACTOR SHALL PROCURE DRILLER AND PAY FOR THEIR SERVICES DURING THE PERFORMANCE OF THE WORK.
4) CONTRACTOR TO PROVIDE ALL PERMITS, NOT ALREADY PROCURED BY THE COUNTY OF SANTA CRUZ (COUNTY), REQUIRED FOR THE PERFORMANCE OF WORK.
5) INSTALLATION OF LFG MIGRATION CONTROL FACILITIES ARE BEING COMPLETED PER THE SEPTEMBER 2019 NOTICE AND ORDER NO. EA–2019–2 FROM THE CALIFORNIA DEPARTMENT OF RESOURCES, RECYCLING AND RECOVERY (CALRECYCLE), THE LOCAL ENFORCEMENT AGENCY (LEA) FOR THE SITE. AS SUCH, THE CONTRACTOR SHALL ACCOMMODATE THE INSTALLATION SCHEDULE PROVIDED BY THE COUNTY OF SANTA CRUZ (COUNTY) DURING THE PERFORMANCE OF THE WORK.
6) CONTRACTOR SHALL PROVIDE, AND BE RESPONSIBLE FOR, THEIR OWN HEALTH & SAFETY DURING THE PERFORMANCE OF THE WORK, AS WELL AS, THE SAFETY OF OTHERS WITHIN THE PROJECT AREA(S) THROUGHOUT THE DURATION OF THE PROJECT.

DETAIL AND SECTION LABELING CONVENTION*



* STRUCTURAL & ELECTRICAL DRAWINGS FOLLOW THEIR OWN LABELING CONVENTION.

APPLICABLE CODES

STATE, NATIONAL, AND LOCAL CODES APPLICABLE TO THIS PROJECT INCLUDE THE FOLLOWING:

1) CALIFORNIA BUILDING CODE, 2016.
2) CALIFORNIA FIRE CODE, 2016 OR LATEST ADDITION.
3) NATIONAL FIRE PROTECTION ASSOCIATION (NFPA), 2016, NFPA 58 & 67.

ISSUED FOR REVIEW

REV	DATE	DESCRIPTION	CK. BY

SHEET TITLE: TITLE SHEET – LOCATION MAP

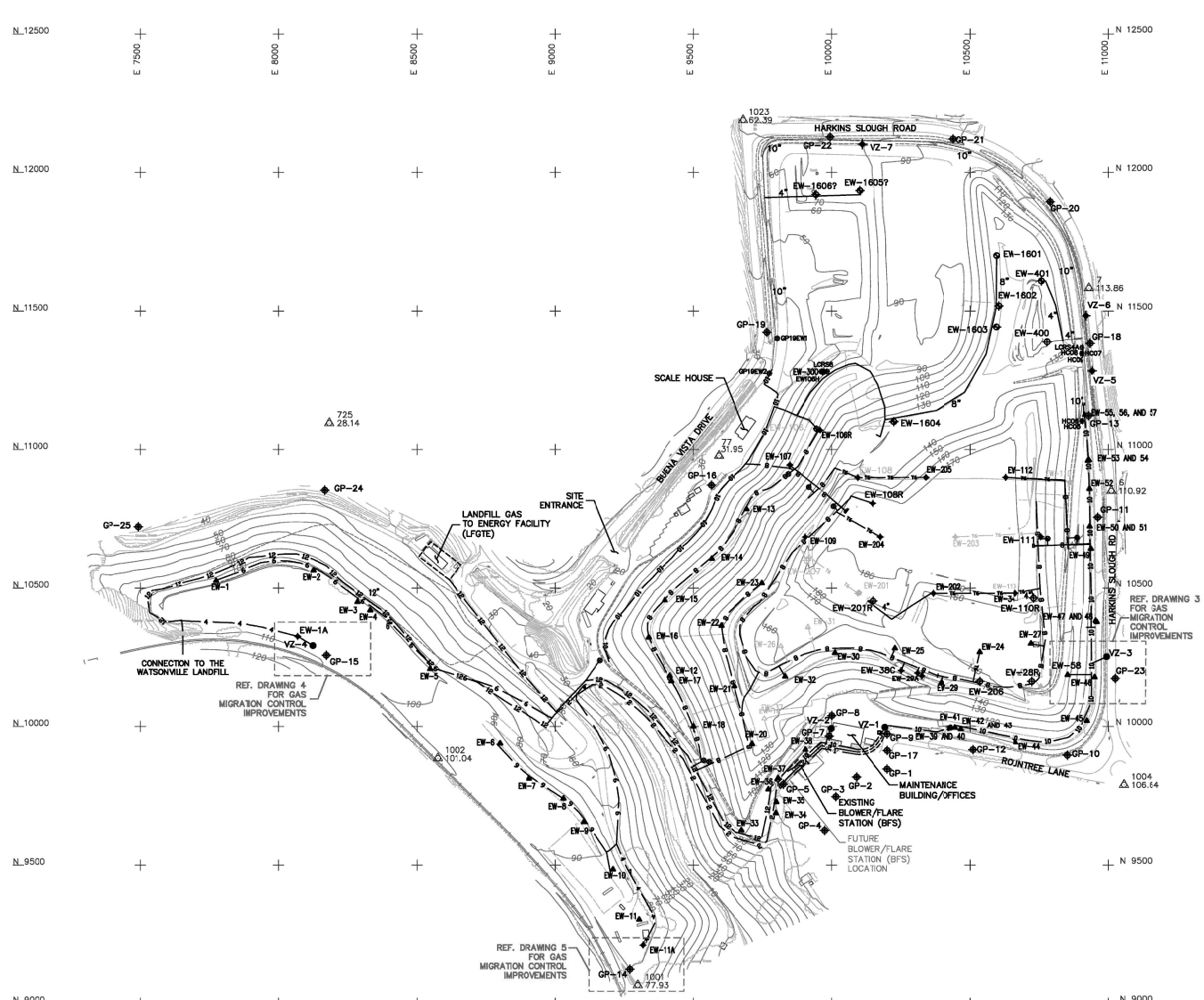
PROJECT TITLE: GAS MIGRATION CONTROL WORKPLAN
BUENA VISTA SANITARY LANDFILL
WATSONVILLE, CALIFORNIA

CLIENT: SANTA CRUZ COUNTY
RECYCLING AND SOLID WASTE
701 OCEAN STREET, ROOM 410
SANTA CRUZ, CA 95060

SCS ENGINEERS
STEARNS, CONRAD, AND SCHMIDT, CONSULTING ENGINEERS AND CONTRACTORS
3417 FAIR OAKS BLVD., SUITE 108
SACRAMENTO, CA 95864
PH. (916) 361-1297 FAX. (916) 361-1299

PROJ. NO. 01219101.00 | DSN. BY: MJE | DRN. BY: MJE | CHK. BY: WJM | APP. BY: WJM | ACAD FILE: SHT1_TSLP_111919

CADD FILE: SHT-1_TSLP_111919
DATE: 11-14-19
SCALE: AS SHOWN
DRAWING: 1



200 0 200
SCALE 1"=200'

DRAWING IS HALF-SIZE AT 11x17

LEGEND

- MAJOR TOPOGRAPHIC CONTOURS
- GP-23 — GAS MIGRATION PROBE
- EW-52 EW-112 EW-110R — LFG EXTRACTION WELL
- VZ-6 — VADOSE ZONE (VZ) WELL
- 12 — 12" HDPE LFG PIPE
- 10 — 10" HDPE LFG PIPE
- 8 — 8" HDPE LFG PIPE
- 4 — 4" HDPE LFG PIPE
- 2 — 2" HDPE CONDENSATE PIPE
- 1 — 1" HDPE SDR 11 COMPRESSED AIR LINE
- T6 — TEMPORARY 6" LFG PIPE 6" SCH. 40 PVC
- HC07 LCRS4A — HORIZONTAL COLLECTOR OR LEACHATE CONDENSATE RETURN SYSTEM (LCRS) UPRISER
- ISOLATION VALVE
- △1002 101.04, △6 110.92, △1004 106.64, △7 113.86, △1023 52.39, △77 31.95, △725 28.14 — SURVEY CONTROL MONUMENT

SURVEY CONTROL COORDINATES

MONUMENT #	ELEVATION	NORTHING	EASTING
6	110.92	10850.93	11010.96
7	113.86	11582.96	10931.17
77	31.95	10977.57	9592.39
725	28.14	11095.52	8182.58
1002	101.04	9886.02	8574.74
1004	106.64	9789.90	11056.08
1023	62.39	12188.72	9680.24

TOPOGRAPHIC NOTES:

1. TOPOGRAPHIC MAP SHOWN WAS SUPPLIED BY TETRA TECH GEOMATIC TECHNOLOGIES, LAFAYETTE, CALIFORNIA.
2. AERIAL DATE: NOVEMBER 20, 2018.

ISSUED FOR REVIEW

REV	DATE	DESCRIPTION	CK. BY

SHEET TITLE: EXISTING GCCS SYSTEM AND PROBE LOCATION MAP

PROJECT TITLE: GAS MIGRATION CONTROL WORKPLAN BUENA VISTA LANDFILL WATSONVILLE, CALIFORNIA

CLIENT: SANTA CRUZ COUNTY PUBLIC WORKS DEPARTMENT SOLID WASTE DIVISION

SCS ENGINEERS
STEARNS, CONRAD, AND SCHMIDT CONSULTING ENGINEERS AND CONTRACTORS
3117 FITE CIRCLE, SUITE 108 SACRAMENTO, CA 95827
PH. (916) 361-1297 FAX. (916) 361-1299

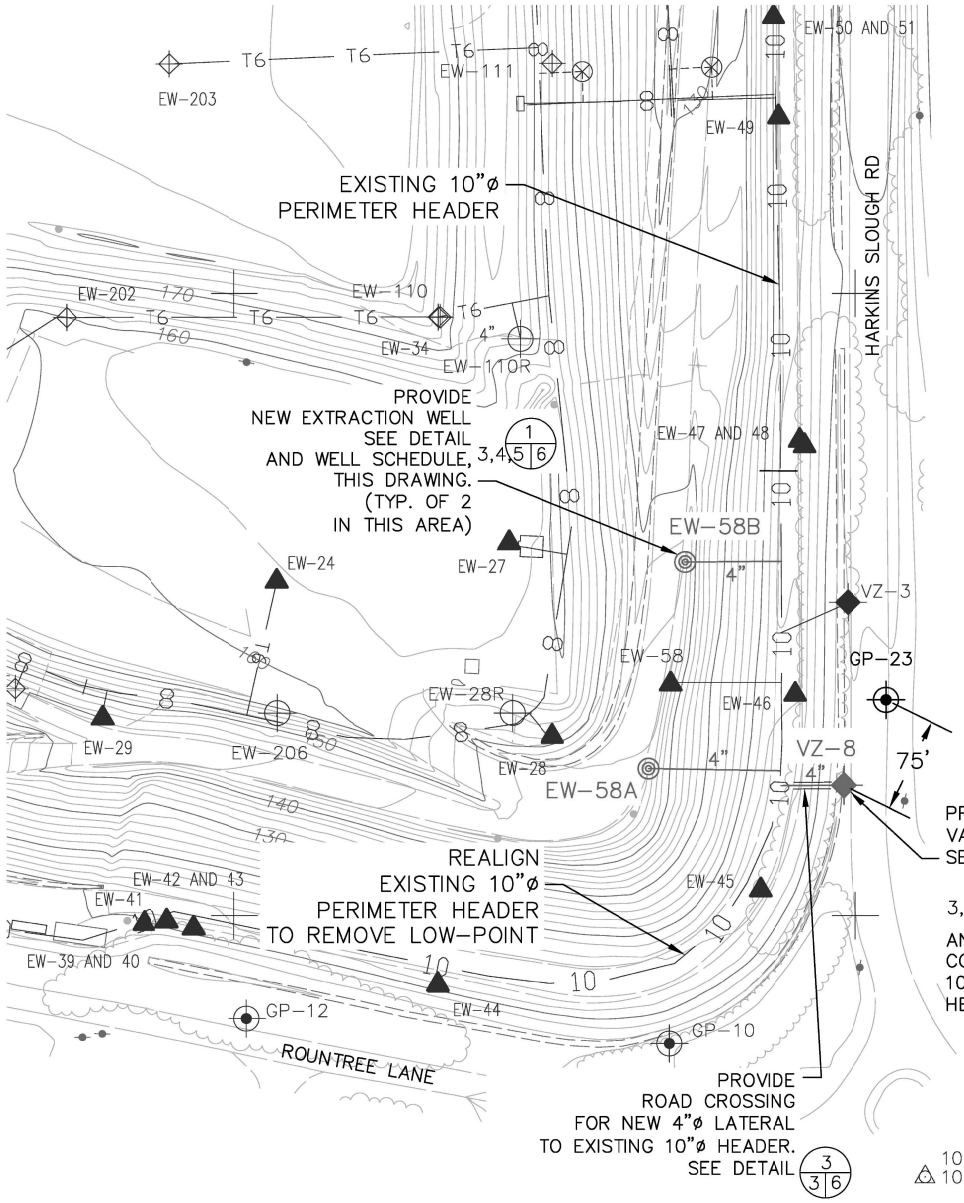
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CADD FILE: SHT-2 EGCCS_111919

DATE: 11-14-19

SCALE: AS SHOWN

DRAWING: 2



SURVEY CONTROL COORDINATES

MONUMENT #	ELEVATION	NORTHING	EASTING
6	110.92	10850.93	11010.96
7	113.86	11582.96	10931.17
77	31.95	10977.57	9592.39
725	28.14	11095.52	8182.58
1001	77.93	9065.38	9298.44
1002	101.04	9886.02	8574.74
1004	106.64	9789.90	11056.08

50 0 50
SCALE 1"=50'

DRAWING IS HALF-SIZE AT 11x17

LEGEND

- 100 — MAJOR TOPOGRAPHIC CONTOURS
- GP-23 — GAS MIGRATION PROBE (MIGRATION CONCERN PROBE)
- EW-52 EW-112 EW-110R — EXISTING LFG EXTRACTION WELL
- VZ-3 — EXISTING VADOSE ZONE (VZ) WELL
- 12 — EXISTING 12" HDPE LFG PIPE
- 10 — EXISTING 10" HDPE LFG PIPE
- 6 — EXISTING 6" HDPE LFG PIPE
- 4 — EXISTING 4" HDPE LFG PIPE
- EW-58A — PROPOSED LFG EXTRACTION WELL
- VZ-8 — PROPOSED VADOSE ZONE (VZ) WELL
- 4" — PROPOSED LANDFILL GAS (LFG) HDPE SDR-17 LATERAL PIPE
- PROPOSED ROAD CROSSING
- 1004 106.64 — SURVEY CONTROL MONUMENT

TOPOGRAPHIC NOTES:

1. TOPOGRAPHIC MAP SHOWN WAS SUPPLIED BY TETRA TECH GEOMATIC TECHNOLOGIES, LAFAYETTE, CALIFORNIA.
2. AERIAL DATE: NOVEMBER 20, 2018.

ISSUED FOR REVIEW

WELL SCHEDULE

WELL No.	LOCATION COORDINATES		EXISTING GRADE ELEVATION (FT MSL)	LINER GRADE ELEV. (FT MSL)	WELL DEPTH 'D' FT.	PERFORATED PIPE 'D1' FT.	REMARKS
	NORTHING	EASTING					
EW-58A	10118.10	10833.33	147	77	55	40	OVER CLAY LINER
EW-58B	10284.15	10862.66	144	84	45	30	OVER CLAY LINER
VZ-8	10104.61	10990.69	+/-107	N/A	90	70	OVER NATIVE SOILS

WELL SCHEDULE NOTES:

1. CONTRACTOR, DRILLER, AND CQA PERSONNEL SHALL VERIFY THE FINAL 10 FEET IN BORING IN 2-FOOT INTERVALS TO ENSURE THAT THE FINAL LFG EXTRACTION WELLS, EW-58A AND EW-58B ARE COMPLETED IN REFUSE AND DOCUMENT AS SUCH. WARNING: WELL INSTALLATIONS RESIDE OVER THE MODULE 2 CLAY LINER SYSTEM–PERFORM INSTALLATIONS WITH CARE.
2. SHOULD THERE BE ANY DISCREPANCY TO ANY INSTALLATION LOCATION, THE CONTRACTOR SHALL NOTIFY THE ENGINEER – NO EXCEPTIONS.
3. ANY CHANGE IN LOCATION OF ANY WELL SHOWN SHALL BE REVIEWED AND APPROVED BY THE ENGINEER PRIOR TO COMPLETING SAID WORK. CONTRACTOR SHALL WAIT FOR NEW COORDINATES AND ELEVATIONS FROM ENGINEER SHOULD THAT BE THE CASE.

REV	DATE	DESCRIPTION	CK. BY

SHEET TITLE
MIGRATION CONTROL IMPROVEMENTS
NORTH SITE AREA (GP-23)

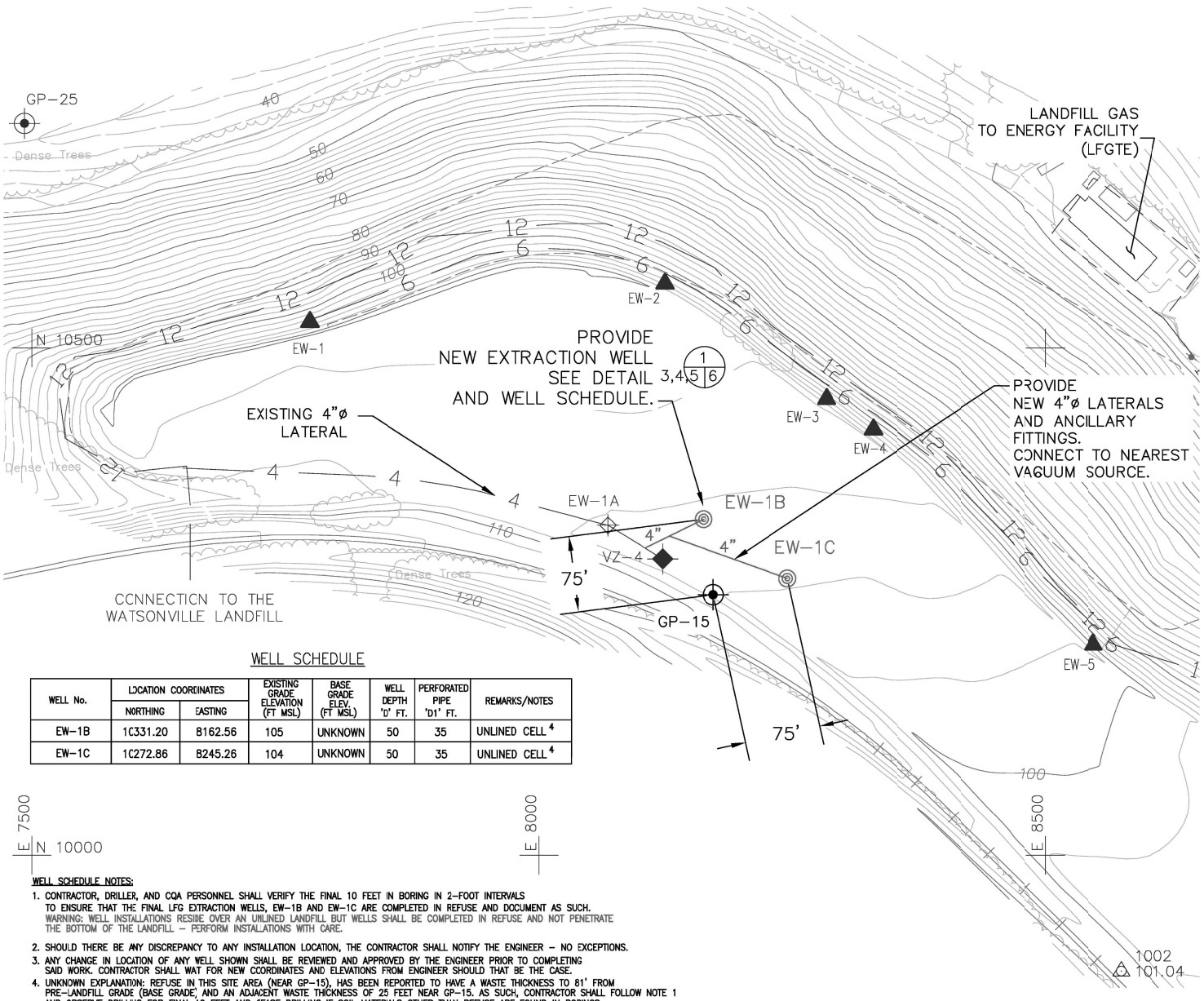
PROJECT TITLE
GAS MIGRATION CONTROL WORKPLAN
BUENA VISTA LANDFILL
WATSONVILLE, CALIFORNIA

CLIENT
SANTA CRUZ COUNTY
PUBLIC WORKS DEPARTMENT
SOLID WASTE DIVISION

SCS ENGINEERS
STEARNS, CONRAD, AND SCHMIDT
CONSULTING ENGINEERS AND CONTRACTORS
3117 FITE CIRCLE, SUITE 108
SACRAMENTO, CA 95827
PH. (916) 361-1297 FAX. (916) 361-1299

PROJ. NO. 01219101.00 | DSN. BY: MJE | DWN. BY: MJE | CHK. BY: WJM | APP. BY: WJM | ACAD FILE: SHT3MWPLO.112019

CADD FILE: SHT-3 MWPLOCS.112019
DATE: 11-14-19
SCALE: AS SHOWN
DRAWING: 3



50 0 50
SCALE 1"=50'

DRAWING IS HALF-SIZE AT 11x17

LEGEND

- 110 — MAJOR TOPOGRAPHIC CONTOURS
- GP-15 — GAS MIGRATION PROBE (MIGRATION CONCERN PROBE)
- EW-2 — EXISTING LFG EXTRACTION WELL
- VZ-4 — VADOSE ZONE (VZ) WELL
- 12 — EXISTING 12" HDPE LFG PIPE
- 10 — EXISTING 10" HDPE LFG PIPE
- 6 — EXISTING 6" HDPE LFG PIPE
- 4 — EXISTING 4" HDPE LFG PIPE
- EW-1B — PROPOSED LFG EXTRACTION WELL
- 4" — PROPOSED LANDFILL GAS (LFG) HDPE SDR-17 LATERAL PIPE
- 1002 / 101.04 — SURVEY CONTROL MONUMENT

WELL SCHEDULE

WELL No.	LOCATION COORDINATES		EXISTING GRADE ELEVATION (FT MSL)	BASE GRADE ELEV. (FT MSL)	WELL DEPTH 'D' FT.	PERFORATED PIPE 'D1' FT.	REMARKS/NOTES
	NORTHING	EASTING					
EW-1B	10331.20	8162.56	105	UNKNOWN	50	35	UNLINED CELL [4]
EW-1C	10272.86	8245.26	104	UNKNOWN	50	35	UNLINED CELL [4]

WELL SCHEDULE NOTES:

1. CONTRACTOR, DRILLER, AND CQA PERSONNEL SHALL VERIFY THE FINAL 10 FEET IN BORING IN 2-FOOT INTERVALS TO ENSURE THAT THE FINAL LFG EXTRACTION WELLS, EW-1B AND EW-1C ARE COMPLETED IN REFUSE AND DOCUMENT AS SUCH. WARNING: WELL INSTALLATIONS RESIDE OVER AN UNLINED LANDFILL BUT WELLS SHALL BE COMPLETED IN REFUSE AND NOT PENETRATE THE BOTTOM OF THE LANDFILL - PERFORM INSTALLATIONS WITH CARE.
2. SHOULD THERE BE ANY DISCREPANCY TO ANY INSTALLATION LOCATION, THE CONTRACTOR SHALL NOTIFY THE ENGINEER - NO EXCEPTIONS.
3. ANY CHANGE IN LOCATION OF ANY WELL SHOWN SHALL BE REVIEWED AND APPROVED BY THE ENGINEER PRIOR TO COMPLETING SAID WORK. CONTRACTOR SHALL WAT FOR NEW CCORDINATES AND ELEVATIONS FROM ENGINEER SHOULD THAT BE THE CASE.
4. UNKNOWN EXPLANATION: REFUSE IN THIS SITE AREA (NEAR GP-15), HAS BEEN REPORTED TO HAVE A WASTE THICKNESS TO 81' FROM PRE-LANDFILL GRADE (BASE GRADE) AND AN ADJACENT WASTE THICKNESS OF 25 FEET NEAR GP-15. AS SUCH, CONTRACTOR SHALL FOLLOW NOTE 1 AND OBSERVE DRILLING FOR FINAL 10 FEET AND CEASE DRILLING IF SOIL MATERIALS OTHER THAN REFUSE ARE FOUND IN BORINGS.

SURVEY CONTROL COORDINATES

MONUMENT #	ELEVATION	NORTHING	EASTING
6	110.92	10850.93	11010.96
7	113.86	11582.96	10931.17
77	31.95	10977.57	9592.39
725	28.14	11095.52	8182.58
1001	77.93	9065.38	9298.44
1002	101.04	9886.02	8574.74
1004	106.64	9789.90	11056.08

TOPOGRAPHIC NOTES:

1. TOPOGRAPHIC MAP SHOWN WAS SUPPLIED BY TETRA TECH GEOMATIC TECHNOLOGIES, LAFAYETTE, CALIFORNIA.
2. AERIAL DATE: NOVEMBER 20, 2018.

ISSUED FOR REVIEW

REV	DATE	DESCRIPTION	CK. BY

SHEET TITLE
MIGRATION CONTROL IMPROVEMENTS
SOUTH SITE AREA (GP-15)

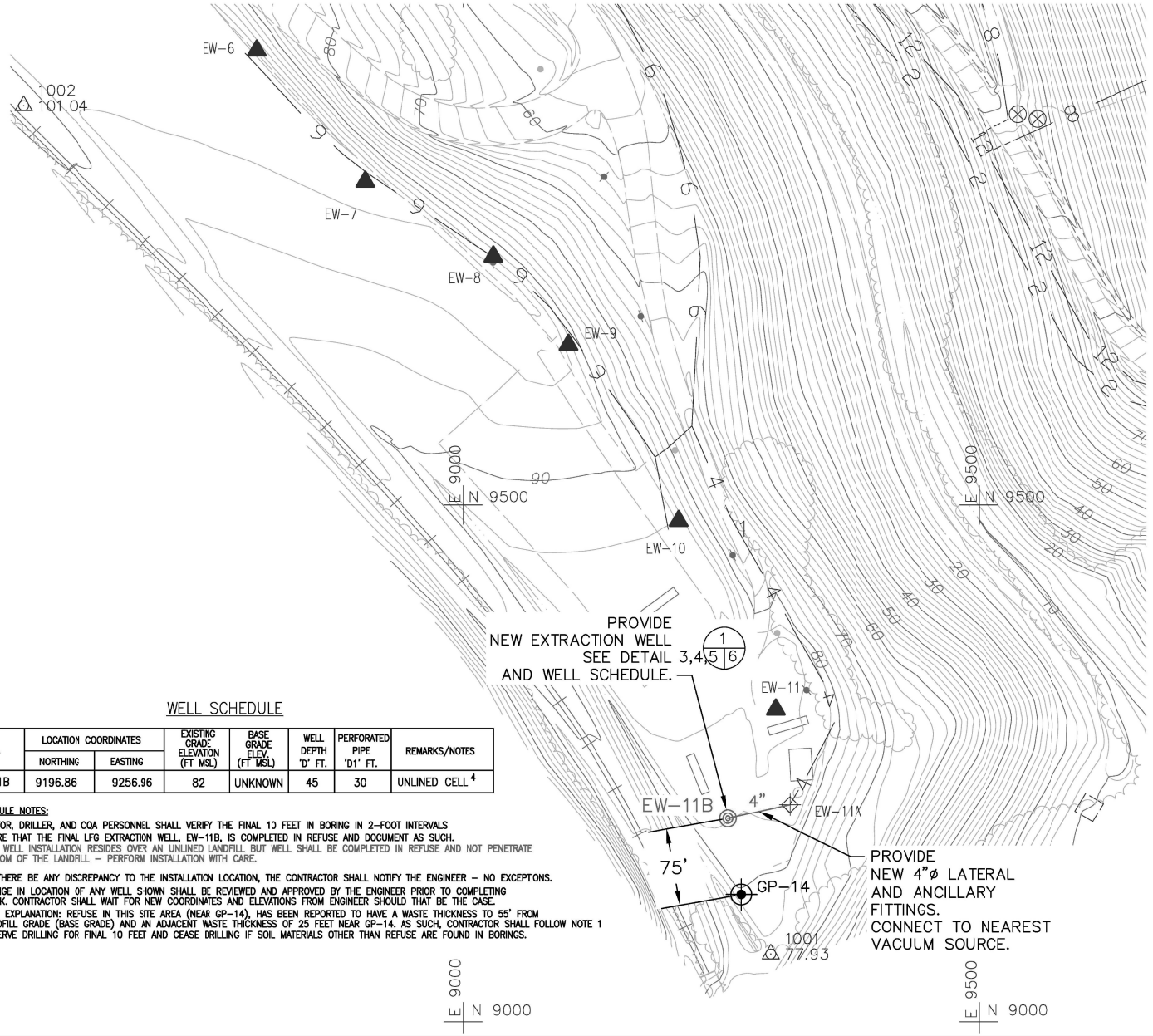
PROJECT TITLE
GAS MIGRATION CONTROL WORKPLAN
BUENA VISTA LANDFILL
WATSONVILLE, CALIFORNIA

CLIENT
SANTA CRUZ COUNTY
PUBLIC WORKS DEPARTMENT
SOLID WASTE DIVISION

SCS ENGINEERS
STEARNS, CONRAD, AND SCHMIDT
CONSULTING ENGINEERS AND CONTRACTORS
3117 FITE CIRCLE, SUITE 108
SACRAMENTO, CA 95827
PH. (916) 361-1297 FAX. (916) 361-1299

PROJ. NO. 01219101.00 DSN. BY: MJE DWN. BY: MJE CHK. BY: WJM
ACAD FILE: SHT3MWPLO.112019 APP. BY: WJM

CADD FILE: SHT-3 MWPLOCS.112019
DATE: 11-14-19
SCALE: AS SHOWN
DRAWING: 4



WELL SCHEDULE

WELL No.	LOCATION COORDINATES		EXISTING GRADE ELEVATION (FT MSL)	BASE GRADE ELEV. (FT MSL)	WELL DEPTH 'D' FT.	PERFORATED PIPE 'D1' FT.	REMARKS/NOTES
	NORTHING	EASTING					
EW-11B	9196.86	9256.96	82	UNKNOWN	45	30	UNLINED CELL [4]

WELL SCHEDULE NOTES:

1. CONTRACTOR, DRILLER, AND CQA PERSONNEL SHALL VERIFY THE FINAL 10 FEET IN BORING IN 2-FOOT INTERVALS TO ENSURE THAT THE FINAL LFG EXTRACTION WELL, EW-11B, IS COMPLETED IN REFUSE AND DOCUMENT AS SUCH.
   WARNING: WELL INSTALLATION RESIDES OVER AN UNLINED LANDFILL BUT WELL SHALL BE COMPLETED IN REFUSE AND NOT PENETRATE THE BOTTOM OF THE LANDFILL – PERFORM INSTALLATION WITH CARE.
2. SHOULD THERE BE ANY DISCREPANCY TO THE INSTALLATION LOCATION, THE CONTRACTOR SHALL NOTIFY THE ENGINEER – NO EXCEPTIONS.
3. ANY CHANGE IN LOCATION OF ANY WELL SHOWN SHALL BE REVIEWED AND APPROVED BY THE ENGINEER PRIOR TO COMPLETING SAID WORK. CONTRACTOR SHALL WAIT FOR NEW COORDINATES AND ELEVATIONS FROM ENGINEER SHOULD THAT BE THE CASE.
4. UNKNOWN EXPLANATION: REFUSE IN THIS SITE AREA (NEAR GP-14), HAS BEEN REPORTED TO HAVE A WASTE THICKNESS TO 55' FROM PRE-LANDFILL GRADE (BASE GRADE) AND AN ADJACENT WASTE THICKNESS OF 25 FEET NEAR GP-14. AS SUCH, CONTRACTOR SHALL FOLLOW NOTE 1 AND OBSERVE DRILLING FOR FINAL 10 FEET AND CEASE DRILLING IF SOIL MATERIALS OTHER THAN REFUSE ARE FOUND IN BORINGS.

50 0 50
SCALE 1"=50'

DRAWING IS HALF-SIZE AT 11x17

LEGEND

- 110 — MAJOR TOPOGRAPHIC CONTOURS
- GP-14 — GAS MIGRATION PROBE (MIGRATION CONCERN PROBE)
- EW-11 — EXISTING LFG EXTRACTION WELL
- EW-11A — EXISTING LFG EXTRACTION WELL
- VZ-4 — VADOSE ZONE (VZ) WELL
- 12 — EXISTING 12" HDPE LFG PIPE
- 10 — EXISTING 10" HDPE LFG PIPE
- 6 — EXISTING 6" HDPE LFG PIPE
- 4 — EXISTING 4" HDPE LFG PIPE
- EW-11B — PROPOSED LFG EXTRACTION WELL
- 4" — PROPOSED LANDFILL GAS (LFG) HDPE SDR-17 LATERAL PIPE
- 1002 101.04 — SURVEY CONTROL MONUMENT

SURVEY CONTROL COORDINATES

MONUMENT #	ELEVATION	NORTHING	EASTING
6	110.92	10850.93	11010.96
7	113.86	11582.96	10931.17
77	31.95	10977.57	9592.39
725	28.14	11095.52	8182.58
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1002	101.04	9886.02	8574.74
1004	106.64	9789.90	11056.08

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2. AERIAL DATE: NOVEMBER 20, 2018.

ISSUED FOR REVIEW

REV	DATE	DESCRIPTION	CK. BY

SHEET TITLE
MIGRATION CONTROL IMPROVEMENTS
SOUTH SITE AREA (GP-14)

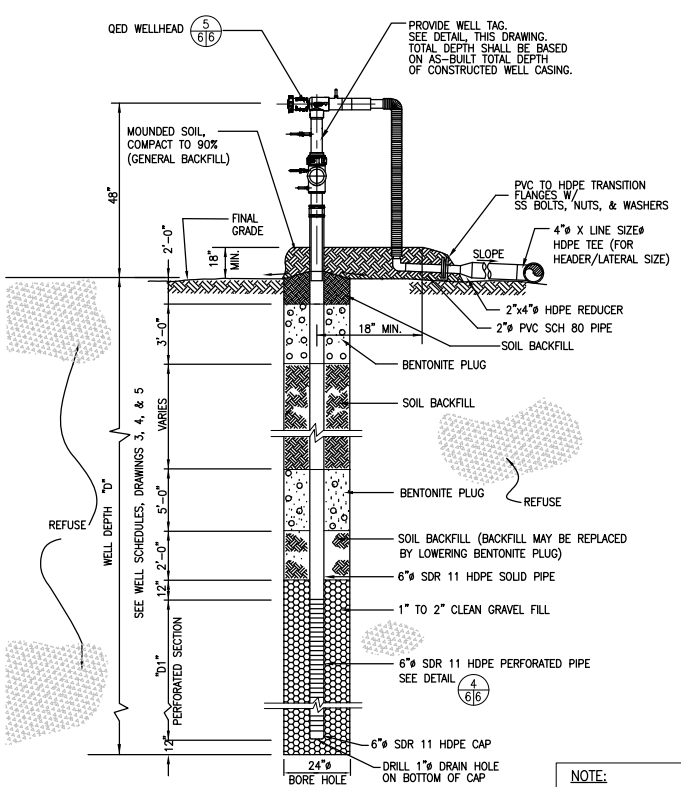
PROJECT TITLE
GAS MIGRATION CONTROL WORKPLAN
BUENA VISTA LANDFILL
WATSONVILLE, CALIFORNIA

CLIENT
SANTA CRUZ COUNTY
PUBLIC WORKS DEPARTMENT
SOLID WASTE DIVISION

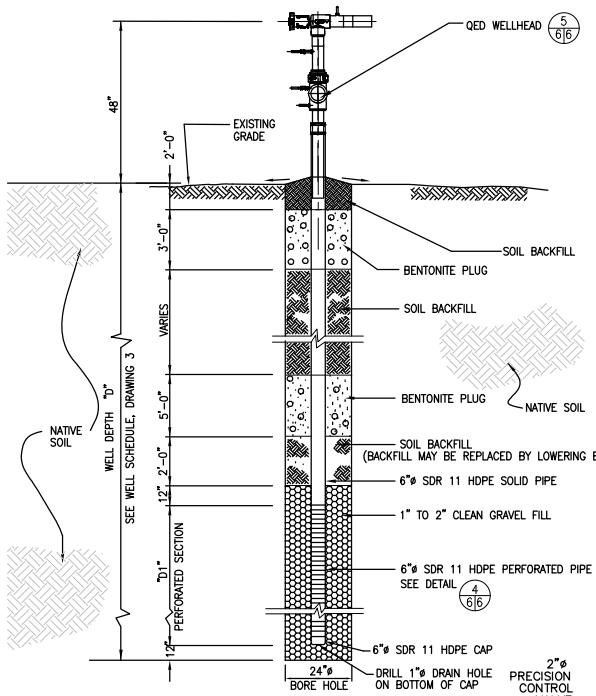
SCS ENGINEERS
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PH. (916) 361-1297 FAX. (916) 361-1299
PROJ. NO. 01219101.00
DSN. BY: M.JE
DWN. BY: M.JE
CHK. BY: W.J.M
ACAD FILE: SHT3MWPLO.112019
APP. BY: W.J.M

CADD FILE:
SHT-3 MWPLOCS.112019
DATE:
11-14-19
SCALE:
AS SHOWN
DRAWING:
5

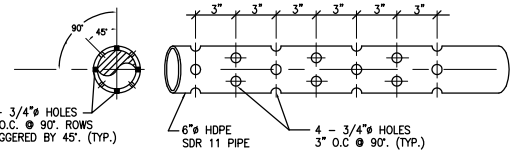
DRAWING IS HALF-SIZE AT 11x17



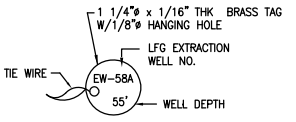
DETAIL – LFG EXTRACTION WELL
N.T.S. EW-58A & EW-58B (NORTH AREA) 1/3,4,5|6
EW-1B, EW-1C, & EW 11B (SOUTH AREA)



DETAIL – VADOSE ZONE WELL VZ-8
N.T.S. 2/3|6

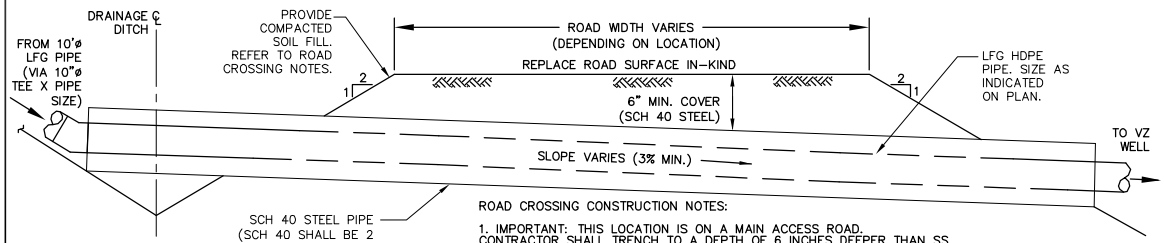


DETAIL – PERFORATED PIPE 4/6|6
N.T.S.



DETAIL – IDENTIFICATION TAG
N.T.S.

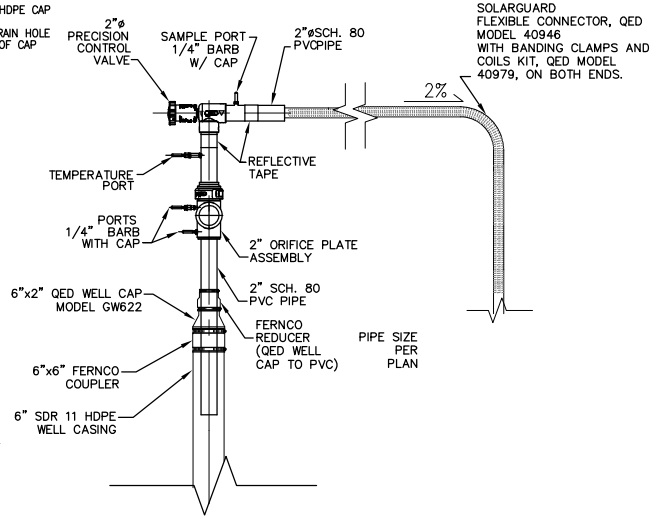
NOTE:
WELL DEPTHS ARE SHOWN ON THE WELL SCHEDULES (DRAWING 3 THROUGH 5) AND HAVE BEEN COMPUTED BASED ON LATEST TOPOGRAPHY, AS PROVIDED TO SCS BY THE COUNTY OF SANTA CRUZ. WELL DESIGN MAY BE MODIFIED BASED ON THE ACTUAL FIELD CONDITIONS ENCOUNTERED DURING DRILLING AND THE ENGINEER WILL IMMEDIATELY REVISE THE WELL DESIGN AND FURNISH INFORMATION TO THE CONTRACTOR.



ROAD CROSSING CONSTRUCTION NOTES:

1. IMPORTANT: THIS LOCATION IS ON A MAIN ACCESS ROAD. CONTRACTOR SHALL TRENCH TO A DEPTH OF 6 INCHES DEEPER THAN SS PIPE DIAMETER TO ALLOW FOR THE EXISTING GRADE OF THE ROAD TO BE MAINTAINED.
2. ROAD WIDTH FOR CROSSING SHALL MATCH EXISTING ROAD WIDTH ON EITHER SIDE OF CROSSING.
3. STEEL SLEEVE SHALL EXTEND ACROSS DRAINAGE DITCH(ES), IF APPLICABLE.

DETAIL – ROAD CROSSING 3/3|6
N.T.S.



QED WELLHEAD-TYPICAL 5/6|6
N.T.S.

ISSUED FOR REVIEW

REV	DATE	DESCRIPTION	CK. BY

SHEET TITLE
LFG WELL, VADOSE ZONE WELL AND MISCELLANEOUS DETAILS

PROJECT TITLE
GAS MIGRATION CONTROL WORKPLAN
BUENA VISTA LANDFILL
WATSONVILLE, CALIFORNIA

CLIENT
SANTA CRUZ COUNTY
PUBLIC WORKS DEPARTMENT
SOLID WASTE DIVISION

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT, CONSULTING ENGINEERS AND CONTRACTORS
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SACRAMENTO, CA 95827
PH. (916) 361-1297 FAX. (916) 361-1299
PROJ. NO. 01219101.00 DSN. BY: MJE
DWN. BY: MJE CHK. BY: WLM
ACAD FILE: SHT6STDTS.112119 APP. BY: WLM

CADD FILE: SHT-6SECTSDETS.112119
DATE: 11-14-19
SCALE: AS SHOWN
DRAWING: 6

MATERIAL SPECIFICATIONS:

All materials shall be of new stock of the highest grade available, free from defects and imperfections, of recent manufacture, and unused. These materials shall conform to the following requirements:

1) Pipes and Fittings:

a) High Density Polyethylene (HDPE) Pipe and Fittings.
All HDPE pipe and fittings shall be made from a high density, extra molecular weight polyethylene resin, conforming to ASTM D-1248 (Type III, Class C). Minimum cell classification values shall be PE 345434C, as referenced in ASTM D-3350. The standard dimension ratio (SDR) for HDPE pipe and fittings shall be 17 unless shown otherwise.

Fittings shall be butt fusion type, meeting the requirements of ASTM D-3261. All fittings shall be rated to match the pipes to which they are fused. Cast steel back up flanges shall be compatible for joining with ANSI Class 125 PVC flanges and shall be epoxy coated. Stainless Steel (SS) bolts, nuts, and washers shall be used at any flange connection.

b) PVC Pipes and Fittings:

PVC pipes and fittings shall be 80 as shown on the drawings conforming to the requirements of ASTM D1785, D2464, and D2466, and shall have been approved by the National Sanitation Foundation (NSF).

2) Pipe Jointing:

a) HDPE Pipes

HDPE pipe and pipe fitting joints shall be made by means of thermal butt-fusion. HDPE pipes, fittings and flanged connections to be joined by thermal butt-fusion shall be of the same type, grade and class of polyethylene compound and supplied from the same raw material supplier.

b) PVC Pipes

i) Except where noted, PVC pipe shall be joined by solvent cementing.

ii) Joining of pipes shall be in accordance with the manufacturer's recommendations.

3) TESTING:

All installed HDPE pipes and fittings shall be subjected to air test pressure of 10 psig for a period of 1 hour (at County discretion). During this period, no loss of pressure shall be observed. Testing of limited amounts of pipe will not be required (i.e., Lateral piping connected to existing header pipe).

4) VALVES (IF APPLICABLE):

All valves shall be of manufacture and model which is easy to replace.

a) PVC Gate Valves:

PVC gate valves shall be threaded type, manufactured of the same PVC Type I, Grade 1 molding as fittings to assure compatibility. The valve stem shall be non-rising type and oversized to provide added strength to resist distortion or cracking on heavy usage applications. The wedge or gate, shall be top quality polypropylene material for positive sealing and smoother operation. Viton 'O' ring shall be used at the stem and bonnet nut to eliminate the need for continued retightening. Valve shall withstand a cold water pressure of 20 psi. Valves shall be manufactured by Chemtrol, Asahi/America, or approved equal.

b) PVC Cock Valves:

PVC Cock Valves: Gas sampling valves shall be 1/4-inch PVC cock valves. Valves seat and seals shall be EPDM. Valves shall have a 1/4-inch MPT on one end, and hose connection on the other end, and shall be manufactured by Chemtrol, Asahi/America, or approved equal.

c) Metal Butterfly Valves:

Metal butterfly valves shall have cast-iron wafer-style, body, contoured valve disc with hard chrome plating or stainless steel around the periphery, stainless steel shaft, nickel cast-iron retainers, stainless steel screws and self lubricating bronze shaft bearing. The valve seat shall be Buna-N, suitable for air service at upto 200°F with nickel cast-iron segmented retaining rings and Monel metal pins or angular cast-iron seating valve for wedge-type closure.

Valves shall be hand-lever or gear operated suitable for fitting between 125-pound ANSI flanges. The valve shall be manufactured by Clow Valve Company or approved equal.

All butterfly valves shall be wafer style. 6-in and smaller valves shall be PVC, and 8-in and larger shall be cast-iron. All 8-in and larger butterfly valves shall have spacers when installed on HDPE header.

5) LANDFILL GAS EXTRACTION WELL (EW)/VADOSE ZONE WELL (VZ):

a) HDPE pipe and fittings used for well construction shall be SDR-11

b) The perforated section of the well casing shall be constructed at depths shown Drawings 3 through 5 of the Contract Drawings and drilled per perforation detail shown on Drawing 6.

c) The bore for the well shall be vertical, and the well casing shall be installed plumbed as shown on the Contract Drawings. The Contractor shall take all necessary precautions to maintain the well casings vertically plumbed during backfilling of the borehole. If the well casing are installed out of plumb, the Contractor shall correct the alignment at his own cost.

d) The borehole backfilling and completion shall be as shown on the Contract Drawings.

6) FLEXIBLE CONNECTORS:

a) Flexible connectors use for connecting wellhead to LFG laterals shall be PVC reinforced PVC hose (Solarguard), if not shown otherwise. The flexible connectors shall be capable of withstanding a vacuum of 29.8 inches and a pressure of 5 psi, have an operating range of 65 to 325 Degrees F, and provide 50 percent contraction and 20 percent extension. The connector bend radius shall be, at minimum 1.5 times the diameter of the hose. The Contractor may use an approved equal for hose and fittings.

7) GRAVEL:

Gravel used in well construction shall be clean, river run or unbroken round gravel with size ranging from 1 to 2 inch. Material shall meet ASTM C-33 paragraph 9.1 requirements. Gravel shall consist of hard, durable stone, essentially free from loam and clay, uniformly graded in accordance with ASTM C136 and containing no stone having any dimension greater than 2-inches. The grading of sizes and material shall be such that the gravel may be thoroughly consolidated. The grading shall conform to the following requirements:

SEIVE SIZE	PERCENT PASSING
2 inches	100
1 inch	95
3/4 inch	0-5

8) BENTONITE:

The bentonite material shall be granular bentonite and shall be 'Benseal' as manufactured by Baroid Drilling Fluids, Inc. of Houston, Texas, 'Crumbles 8 Mesh' as manufactured by Colloid Environmental Technologies Company (CETCO), or approved equal.

Bentonite plug shall consist of a mixture of bentonite and water. The mixture shall consist of 1 gallon of water per 3 pounds of bentonite. The method of hydration for bentonite shall be as recommended by the manufacturer.

9) WELLHEAD ASSEMBLY

Each new EW or VZ well, replacement or other, shall be equipped with QED wellhead assemblies Model ORP-215, as shown on the Contract Drawings, and specified herein.

a) Wellhead assemblies shall be provided by Contractor and include a removable quick charge orifice plate system, including 6 orifice plates that meet ASME MFC-3M-2004 Design Criteria. Wellheads shall include 0.40", 0.50", 0.75", 1.00", 1.25" and 1.40" orifice plates.

b) 2" diameter fine-tune control valve (QED Model CV 2000).

c) Wellhead shall be constructed of SCH 80 PVC throughout.

d) Brass Hose barb kit, QED Model 40629, that includes (4) $\frac{1}{4}$" hose barbs x $\frac{1}{4}$" MPT fittings for gas, temperature, and pressure readings. Temperature barb to include 2-1/2" extension nipple.

e) Flex connection tubing shall be Solargard w/ 2.38" ID with yellow tint and UV inhibitors and include banding kit, QED Model 40979.

f) Gas Header adapter kit shall be QED Model 40676, and include 4"x2" flexible coupling, 6"x4" HDPE Reducer, and 2"x12" PVC pipe stub.

g) The wellhead shall be constructed as shown on the Contract Drawings.

GENERAL NOTES:

1) Existing grades:

The Contract Drawings depict surface elevations on the date of the last annual flyover (11/20/19). Maintenance activities, re-grading, refuse filling, and routine settlement may occurred in the LF3 Well Installation area since that survey. Contractor shall verify existing grades in work area(s) prior to work in said area(s).

2) The contractor shall base all measurements, both horizontal and vertical, from established Survey Control benchmarks. The Contractor is responsible for field verification of all dimensions and conditions at the job site. The Contractor must verify the ground surface elevation of all Vertical Extraction Wells and Vadose Zone Wells, prior to initial drilling activities.

3) The contractor shall verify the locations of the existing utilities in the area. Unless shown otherwise, all existing utilities shall be left in place and the contractor shall conduct his operation in such a manner that the utilities are protected at all times. In case where utilities are damaged, the contractor shall replace them to their original locations or as directed by the Engineer, without any cost to the Buena Vista Landfill (County of Santa Cruz (County)).

4) The contractor shall dispose of surplus materials, waste products, and debris, and shall make necessary arrangements for such disposal. All construction spoils (which includes landfill trash, material that is mixed with landfill trash, material that has been in contact with landfill trash, or odorous material that is removed from well holes and/or trenches) shall not be stockpiled on the site. All construction spoils shall be deposited directly into the truck or trailer bed, which shall be hauled and disposed off on the active face of the landfill.

5) The contractor shall solely be responsible for furnishing, erecting, maintaining, and removing all the protecting barriers (constructing fencing), signs, temporary lighting etc., required for the protection of the persons and the property.

6) Above grade LFG header/lateral:
The contractor shall maintain a minimum of 1 percent slope along the above grade LFG header and laterals, unless otherwise noted on plans.

Below grade LFG header/lateral:
The contractor shall maintain a minimum 2 percent slope for below grade LFG header when condensate is flowing in the direction of landfill gas and 3 percent for pipes when landfill gas is flowing opposite to the flow direction of condensate.

7) The contractor shall be responsible for dust and noise control during construction.

8) The LFG header or lateral alignment and LFG extraction well locations shall be staked out by the Contractor and approved by the Engineer. Adjustments to the alignment and location may be required to suit the field conditions.

SAFETY AND PROTECTION:

1) The contractor is advised that the Contract Work for the expansion of existing LFG collection and control systems (CCCS) will be performed on an active landfill. Excavation into waste, contact with refuse, exposure to landfill gas, and confined space entry may be rquired. The Contractor shall take all necessary precautions and provide all necessary safeguards to prevent personal injury and property damage. The contractor shall comply with all Federal, State, and Local Safety Codes, Ordinances, and Regulations, including the requirements of the Occupational Safety and Health Administration (OSHA), the Division of Industrial Safety, and other such safety measures as may be required by the above mentioned regulatory agencies during the duration of the Contract Work.

2) The contractor shall prepare and make available for on-site reference, a site specific Health and Safety Plan in accordance with Code of Federal Regulations sections 29 1910.120 (29 CFR 1910.120) and 1926 (29 CFR 1926) and the safety provisions as outlined in the Solid Waste Association of North America "Compilation of LFG Laboratory and Field Practices and Procedures", current version.

3) Landfill gas is colorless, can be odorless, may contain hydrogen sulfide, is combustible, and contains no oxygen. Landfill gas may also migrate through soil near the landfill. The contractor is; therefore, advised of the need for precautions against fire, explosion, and asphyxiation when working on or near refuse-filled areas.

4) First aid facilities conforming at least to the minimum requirements of OSHA shall be provided by the contractor and be available in a readily accessible location(s).

5) The contractor shall be prepared to respond to potential injuries, illnesses, or situations of imminent hazard to employees or public health and safety. Personnel from local medical facilities shall be contacted in case of medical need, and the quickest route to these facilities shall be determined by the contractor in advance of performing the Contract Work.

6) Any trenching, excavation, or other work below grade is subject to gas infiltration from the soil, which could create a potential hazard to personnel. Special safety precautions shall be employed. The contractor shall be responsible for obtaining all required permits, including trenching permit required by Cal OSHA.

ISSUED FOR REVIEW

REV	DATE	DESCRIPTION	CK. BY

SHEET TITLE
TECHNICAL SPECIFICATIONS

PROJECT TITLE
GAS MIGRATION CONTROL WORKPLAN
BUENA VISTA LANDFILL
WATSONVILLE, CALIFORNIA

CLIENT
SANTA CRUZ COUNTY
PUBLIC WORKS DEPARTMENT
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PROJECT NO. 01219101.00 | DSN. BY: M.JE | DRWN. BY: M.JE | CHK. BY: W.L.M | APP. BY: W.L.M
FILE NO. SHT7_SPECS112119

CADD FILE:
SHT-7_SPECS_112119

DATE:
11-21-19

SCALE:
AS SHOWN

DRAWING:
7

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APPENDIX B
CQA Plan

Prepared for:

County of Santa Cruz
Department of Public Works
701 Ocean Street, Room 410
Santa Cruz, California 95060-4070
(831) 454-2160

CONSTRUCTION QUALITY ASSURANCE PLAN

Buena Vista Drive Sanitary Landfill
1231 Buena Vista Drive
Watsonville, California 95076

Prepared by:

Geosyntec consultants

475 14th Street, Suite 400
Oakland, California 94612
(510) 836-3034
Project Number: WG1019
July 2008

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PRELIMINARY CONSTRUCTION QUALITY ASSURANCE (CQA) PLAN

1. Introduction

The performance of the waste containment system, final cover system and related facilities is a function of the quality of construction. Implementation of a construction quality assurance (CQA) program is an established method for improving the performance of constructed facilities as well as for documenting the quality of the construction. In order to facilitate CQA activities, a CQA Plan is needed that outlines the necessary work.

State regulations in Sections 20323, 20324, 21710, and 21090 of Title 27 give requirements for construction quality assurance. Specifically, Section 20323 states that "... *RWQCB shall require construction for all liner systems and final cover systems to be carried out in accordance with a CQA Plan certified by an appropriately registered professional to satisfy the requirements of Section 20324.*" Thus, this document serves as a preliminary CQA Plan describing key elements of the final cover system construction CQA program.

A detailed CQA Plan for each construction project will be prepared prior to final cover system and related facilities construction. The detailed CQA Plan will contain field and laboratory monitoring, testing, and documentation procedures to establish that the cover system construction is performed in compliance with the construction drawings and specifications. The CQA Plan will be a comprehensive, site-specific document prepared and/or reviewed by a registered civil engineer or certified engineering geologist in the State of California. The CQA Plan will address matters pertaining to the implementation and documentation of the CQA program.

The following subsections of this preliminary CQA Plan provide an outline of the minimum requirements of the CQA program. The items in the outline will be addressed in the detailed CQA Plans. These revised CQA Plans will be submitted at least two weeks before beginning construction of any final cover system in accordance with Section 21710(5)(A) of Title 27.

2. CQA Personnel

2.1 Introduction

Buena Vista Drive Sanitary Landfill (BVL) will manage the overall CQA program and its implementation. An independent CQA consultant will act as the CQA engineer-of-record per Section 20324 of Title 27. As such, the CQA consultant shall supervise the implementation of the CQA activities. Actual field and laboratory CQA work shall be performed by the independent CQA consultant.

The CQA consultant will be an established engineering firm incorporated or otherwise registered in the United States with a documented history of successfully providing similar services on other landfill projects. The CQA consultant will have the practical experience necessary to effectively implement the CQA Plan for the project.

The minimum qualifications for the CQA personnel are described below.

2.2 Qualifications

CQA personnel will be experienced in: (i) geology and geotechnical engineering; (ii) landfill design and preparation of construction drawings and specifications, and CQA Plans; (iii) surveying; (iv) earthwork construction, including excavation, fill placement, and construction of high- and low-permeability soil layers; (v) geosynthetics, including geomembranes, geonets and geotextiles; and (vi) landfill piping and appurtenant structures. At a minimum, the CQA consultant will have provided services similar to those that will be required at closure on five (5) other recent municipal solid waste (MSW) landfill projects.

2.3 Key Personnel

Personnel representing BVL will include the overall Project/Construction Manager, CQA engineer-of-record, CQA site manager, CQA monitors, and CQA surveyor. The Project/Construction Manager (PM) will be a BVL employee responsible for overall management of the project, of which CQA is an integral component. The CQA engineer-of-record will be an independent consultant with responsibility for CQA program implementation. The remaining CQA personnel will be located at the site during various phases of construction to assist the PM. A single person may fill more than one role on a given project.

The CQA engineer-of-record will be a registered civil engineer or certified engineering geologist in the State of California. The CQA engineer-of-record will be required to communicate effectively, be experienced in landfill construction, and be familiar with the preparation and execution of CQA Plans. The remaining CQA personnel will have formal training and practical experience in the testing and monitoring of landfill construction including performing field observations and testing, and preparing CQA documentation. The CQA engineer-of-record, as well as the CQA site manager, will be required to have at least 2 years of landfill-related CQA experience, and at least 2 years of experience on projects involving significant earthwork construction. CQA monitors will be required to have a minimum of one year experience documenting construction work related to earthwork and/or geosynthetics installation.

2.4 Responsibility and Authority

The CQA engineer-of-record or officer will be responsible for the implementation of the CQA Plan which will include:

- reviewing the CQA Plan and construction documents for accuracy and completeness;
- becoming familiar with the project design;
- attending meetings as required;
- preparing a schedule of CQA monitoring and testing activities and ensuring that a sufficient number of CQA personnel are on-site to perform the required monitoring, testing, and documentation activities;
- reviewing and interpreting data and reports prepared by CQA personnel;
- assuring that contractor submittals are reviewed and that the contractor's quality control program is monitored for compliance with the project requirements;
- resolving non-compliance issues;
- assuring that CQA activities are executed; and
- preparing and signing the final CQA report, including record drawings in accordance with 40 CFR 258 and Title 27 CCR.

The on-site CQA personnel's (both BVL and CQA consultant) responsibilities will include:

- becoming familiar with the project's CQA Plan and construction documents;
- attending meetings as required;
- performing and/or documenting equipment calibrations;
- checking material certifications provided by the Contractor;
- obtaining material samples for conformance testing and performing conformance testing as required by the CQA Plan;
- checking the results of the contractor's quality control testing;
- recording test results and observations on CQA forms; and
- reporting non-compliance issues to the CQA engineer-of-record.

3. Project Meetings

3.1 Introduction

Project meetings will be required as part of CQA Plan implementation at closure. At a minimum, three types of meetings will be required by the CQA Plan:

- pre-construction meetings;

- progress meetings; and
- non-compliance meetings.

Descriptions of these three types of meetings, and the key personnel that will be required to attend each, are provided below. The specific topics to be considered in each type of meeting will be enumerated in the final CQA Plan. The CQA engineer-of-record will be responsible for preparing written minutes for project meetings.

3.2 Pre-Construction Meeting

The purpose of the pre-construction meeting is to coordinate tasks between the parties involved in construction, delineate areas of responsibility, present a schedule and sequence of work, agree on procedures to avoid difficulties and delays in construction, review the construction documents, and review the CQA Plan. At a minimum, the meeting will be attended by the design engineer, general contractor, subcontractors (e.g., geosynthetics installer), CQA engineer-of-record, CQA site manager, CQA surveyor, and BVL PM.

3.3 Progress Meetings

During construction, weekly progress meetings will be held on-site between the general contractor, subcontractors, CQA engineer-of-record, CQA site manager, CQA surveyor, BVL PM, and, if necessary, design engineer. The purpose of the progress meetings will be to review the previous week's activities, review the upcoming week's activities, review conformance with the CQA Plan requirements, and discuss anticipated upcoming needs or potential construction issues.

3.4 Non-Compliance Meetings

If a non-compliance issue arises, a special meeting may be convened by the CQA engineer-of-record, CQA Site Manager, or BVL PM. The purpose of the meeting will be to discuss the non-compliance issue, review alternative solutions, and implement an action Plan to resolve the non-compliance issue. At a minimum, the meeting will be attended by the appropriate contractors, CQA engineer-of-record, CQA site manager, and BVL PM. If the non-compliance issue is related to the design, the design engineer may also be required to attend.

4. Field Monitoring and Testing Activities

4.1 Introduction

Field monitoring and testing activities will be performed by CQA personnel in accordance with the requirements of the CQA Plan. Field monitoring and/or testing will be performed for: (i) earthwork; (ii) geosynthetics; and (iii) piping and appurtenant structures.

As part of their assignment, CQA personnel will document that the materials and construction operations used meet the requirements of the construction drawings and specifications. Testing will be performed as required by the CQA Plan. Non-compliance with the construction drawings and specifications, or accepted industry standards, identified through observation or test results, will be brought to the attention of the CQA engineer-of-record and BVL PM. The non-compliance will be fully documented, as will all actions taken to resolve it. A description of the minimum CQA field monitoring and testing activities that will be carried out for the closure is provided in the following subsections.

4.2 Earthwork

As part of CQA program implementation, field monitoring and testing activities will be performed in conjunction with earthwork construction. At a minimum, field monitoring and/or testing activities will be performed by CQA consultant personnel associated with:

- construction quality control (CQC) field testing (e.g., soil unit weights, moisture contents, classifications, and compaction characteristics);
- field hydraulic conductivity testing;
- on-site conformance sampling and testing of earth materials;
- earth material processing operations;
- construction of low-permeability compacted soil barrier layers;
- construction of the drainage layer; and
- placement of the operations and vegetative layer;.

4.3 Geosynthetics and Related Materials

As part of CQA program implementation, field monitoring and testing activities will be performed by CQA consultant in conjunction with geosynthetics installation. At a minimum, field monitoring and/or testing activities will be associated with:

- manufacturing pant visit for off-site conformance sampling and testing;
- quality control documentation;
- conformance sampling and testing;

- geosynthetic storage;
- geosynthetic deployment;
- field seaming;
- nondestructive and destructive field CQC testing;
- joining and connecting adjacent geosynthetics; and
- geosynthetics repairs.

4.4 Piping and Appurtenant Structures

As part of CQA program implementation, field monitoring and testing activities will be performed in conjunction with installation of pipes and appurtenant structures used in closure. At a minimum, field monitoring and/or testing activities will be performed by CQA consultant associated with:

- quality control (QC) documentation;
- conformance sampling and testing;
- pipe storage;
- pipe placement;
- welding of pipe sections;
- installation of piping details such as wyes and tees; and
- nondestructive hydrostatic testing of pipes.

5. Laboratory Testing Activities

5.1 Introduction

Laboratory testing of the various earth and geosynthetic materials used during construction will be performed as part of CQA Plan implementation. Laboratory testing will be performed to ensure that the materials used in construction meet the requirements of the construction drawings and specifications.

5.2 Soils CQA Laboratory

Testing of earth materials will be conducted at a soils CQA laboratory (CQA consultant). CQA field personnel will obtain samples of earth materials at specified frequencies for conformance testing. Laboratory test results will be fully-documented and reported to the CQA engineer-of-record. The soils CQA laboratory will be required to have experience in the testing of earth materials and will be familiar with standards established by the American Society of Testing and Materials (ASTM) as well as other applicable test standards. The soils CQA laboratory will be required to maintain a consistent standard of testing throughout the project.

5.3 Geosynthetics CQA Laboratory

Geosynthetics testing will be performed at the geosynthetics CQA laboratory (CQA consultant). CQA personnel will obtain representative samples for conformance testing from geosynthetics delivered to the site, as well as from seams between adjacent sections of installed geosynthetics. Testing will be performed at the frequencies specified in the CQA Plan. Laboratory results will be fully-documented and reported to the CQA engineer-of-record. The geosynthetics CQA laboratory will have experience in the testing of geosynthetics and will be familiar with ASTM standards as well as other applicable test standards. The geosynthetics CQA laboratory will be required to maintain a consistent standard of testing throughout the project.

6. Surveying

The CQA Plan will contain minimum construction surveying requirements. Surveying of completed work will be performed (by County) for engineered earthwork layers, pipes, and structures. Surveying tolerances will be in accordance with industry standards. Surveying data will be presented in the final CQA report. The data will enable preparation of "*as-built*" documentation (i.e., record drawings), as required by §258 of Title 40 of the Code of Federal Regulations (CFR) (aka Subtitle D) and Title 27 of the California Code of Regulations (CCR).

7.1 Documentation

7.1 General

The CQA Plan for closure construction will include specific requirements for documentation of construction and CQA activities. The CQA Plan will also include blank copies of the specific forms that will be used for CQA documentation. The CQA Plan will require, at a minimum, the following documentation:

- project administration records;
- CQA field records;
- laboratory test records;
- photographic documentation;
- record drawings;
- supplemental specifications or addenda; and
- a final CQA report certified by the CQA engineer-of-record.

These documentation requirements are described in the following subsections.

7.2 Project Administration Records

The following project administration records will be maintained as part of CQA Plan implementation:

- daily records;
- contractor and installer personnel log;
- material certifications;
- minutes of meetings; and
- weekly field report.

Daily records will be maintained in daily field reports prepared each day by CQA personnel, and in a summary daily report prepared by the CQA site manager. The daily field report will include, at a minimum, date, site and project information, weather information, daily observations, and specific testing results. The daily summary report prepared by the CQA site manager will be submitted to the CQA engineer-of-record. Also, the CQA site manager will be responsible for preparing a weekly field report that will be maintained in the project administration records.

7.3 CQA Field Records

CQA field records will consist of construction quality control (CQC) testing logs, equipment calibration certifications, and CQA monitoring forms. At a minimum, the following CQA records will be maintained by the CQA site manager:

- earthwork CQA/CQC records, such as:
  - soil sample logs,
  - field compaction test logs,
  - field moisture content logs, and
  - nuclear gauge and sand cone calibration logs; and
  - geosynthetic CQA/CQC records, such as:
    - material inventory logs,
    - certificate of subgrade acceptance forms,
    - panel placement logs,
    - trial seam logs,
    - production seam logs,
    - destructive test logs,
    - nondestructive test logs, and
    - seam and panel repair logs.

7.4 Laboratory Test Records

Laboratory test records will consist of test results submitted by the soils and geosynthetics CQA laboratories, laboratory certifications, on-site laboratory test results, and on-site equipment calibrations.

7.5 Photographic Documentation

CQA personnel will document work progress, issues, and resolution activities in photographs. Photographic documentation will be in the form of color photographs of key landfill closure construction and field CQA activities. Photographic documentation will be included in the final CQA report.

7.6 Record Drawings

Record drawings will be prepared for closure. Record drawings will be prepared to show the actual surveyed limits of the closure cover system footprint, the elevations of the system components, and construction details that differ from the construction drawings. Record drawings will be included in the final CQA report.

7.7 Supplemental Specifications or Addenda

Supplemental specifications or addenda may be issued by the design engineer during construction due to design and/or specification changes or clarifications. The CQA site manager will be required to maintain an on-site record of the approved supplemental specifications or addenda.

7.8 Final CQA Report

At the completion of closure construction, a final CQA report will be submitted to the California Regional Water Quality Control Board – San Francisco Bay Region (CRWQCB), California Integrated Waste Management Board (CIWMB), and the Enforcement Agency (EA), as appropriate, for review and approval. The final report will include, at a minimum, a set of record drawings and the documentation listed in the previous subsections. The report will indicate that the work has been performed in general compliance with the construction drawings, specifications, CQA Plan, and supplemental specifications or addenda. Any acceptance of non-compliance with the construction drawings and specifications will be described. The CQA engineer-of-record will seal and sign the final CQA report. The project will not be deemed complete until the final CQA report addressing all components of construction has been approved by the regulatory agencies and placed in the operating record as required by Subtitle D and Title 27.

* * * * *

APPENDIX C
Final Cover Comparison - HELP Analyses

GEOSYNTEC CONSULTANTS

Written by: JAB Date: 11 (YY) 11 (MM) 8 (DD) Reviewed by: _____ Date: ____ (YY) ____ (MM) ____ (DD)

Client: Santa Cruz Project: Site Development PLan Project/Proposal No.: WG1394 Task No.: 05

COMPUTATION COVER SHEET

Client: **Santa Cruz Co.** Project: **Site Development Plan** Project/ Proposal No.: **WG1394** Task No. **05**

Title of Computations: **HELP Analysis for Alternative Cover System**

Computations by:	Signature		11/10/11
	Printed Name	Jessica Bernardini	Date
	Title	Sr. Staff Engineer	
Assumptions and Procedures Checked by: (peer reviewer)	Signature		29 NOV 11
	Printed Name	F. SETTEPANI	Date
	Title		
Computations Checked by:	Signature		29 NOV 11
	Printed Name	F. SETTEPANI	Date
	Title		
Computations backchecked by: (originator)	Signature		
	Printed Name		Date
	Title		
Approved by: (pm or designate)	Signature		
	Printed Name		Date
	Title		

Approval notes: _____

Revisions (number and initial all revisions)

No.	Sheet	Date	By	Checked by	Approval

Written by: JAB Date: 11 11 08 Reviewed by: MJS Date: 29NOV11
YY MM DD YY MM DD

Client: Santa Cruz Co. Project: Site Development Plan Project/Proposal No.: WG1394 Task No.: 5

Buena Vista Site Development Plan
Santa Cruz, California
HELP Analysis Summary

ABSTRACT

The USEPA approved water-balance model Hydrologic Evaluation of Landfill Performance (HELP) analysis was used to perform the infiltration analyses for the Buena Vista Landfill in Santa Cruz, CA. The purpose of the analysis was to estimate the time in years that would be required for the leachate generation to reach zero. The HELP can run a maximum of 30 years; therefore, we performed analyses for 30 years, the post-closure maintenance period and the maximum amount of time the HELP model can run an analysis. Two representative columns were modeled:

a) Top deck over floor liner.
b) Side slope over side slope liner.

For reference, the proposed final cover for the landfill includes a geomembrane and a geosynthetic clay liner (GCL) on the top deck and a geomembrane on the side slopes. Since the geosynthetics are the layers that minimize infiltration water after closure, we evaluated leachate generation after closure assuming two conditions for the geomembrane: good and excellent placement. In HELP, good placement quality assumes that 1 hole per acre and 1 installation defect per acre are present; perfect placement quality assumes no holes per acre and no installation defects - that is: if perfect placement quality is achieved, then leachate generation would be expected to effectively decrease to zero since no liquid would infiltrate through the geomembrane. The findings presented below show that even for perfect placement of the geomembrane, a minor amount of liquid is expected in the leachate collection and removal system. Furthermore, the post-closure maintenance cost estimate includes leachate management in its breakdown to dispose of leachate generated after closure.

MODELLING

Scenarios

Two representative columns were modeled for the closed landfill:

a) Top deck over floor liner.
b) Side slope over side slope liner.

Properties for the various layers are presented in subsequent sections.

Weather Data

Built-in weather generation routines in HELP use parameters developed for 31 locations around the country to predict average daily weather based on mean monthly values. The user selects the most representative of the 31 locations to the project site (i.e., nearest geographical proximity and weather patterns) and then enters locally measured mean monthly temperature and precipitation values. The result is a combination of the general weather patterns of the location selected, scaled to the measured weather near the site.

Input weather parameters are summarized as follows:

1. Evapotranspiration: The values were obtained from the HELP database for San Francisco, CA and adjusted to the site's latitude of approximately 36.9 degrees:

    - Evaporative Zone Depth = 12 inches
    - Maximum Leaf Area Index = 1.0 (poor stand of grass)
    - Average Annual Wind Speed = 10.5, HELP default value
    - Other Values provided by HELP database: start and end of growing season and relative humidity

2. Precipitation: Synthetic precipitation data was generated by the model using coefficients for San Francisco, CA. The mean monthly precipitation for one year is used to generate 30 years of data.

3. Temperature: Synthetic temperature data was generated by the model for San Francisco, CA. The mean monthly temperatures for one year are used to generate 30 years of data.

4. Solar Radiation: Synthetic data for 30 years was generated by the model for San Francisco adjusted for a site latitude of approximately 36.9 degrees.

Material Data

The following liner systems were modeled in the HELP analysis. For the top deck with floor liner system, the liner system modeled was:

- Vegetative layer: 12-in
- Geomembrane: 0.06-in
- Geosynthetic clay liner: 0.24-in

- Foundation layer: 24-in
- Waste: 170-ft
- Operations layer: 24-in
- LCRS Drainage Granular Layer: 12-in
- HDPE Geomembrane: 0.06-in
- Geosynthetic Clay Liner (GCL): 0.24-in
- Compacted Clay liner: 12-in

For the side slopes of the final cover system with the side slopes of the base grades, the liner system modeled was:

- Vegetative layer: 12-in
- Geomembrane: 0.06-in
- Foundation layer: 24-in
- Waste: 90-ft
- Operations layer: 12-in
- HDPE Geomembrane: 0.06-in
- Geosynthetic Clay Liner (GCL): 0.24-in
- HDPE Geomembrane: 0.06-in
- Geosynthetic Clay Liner (GCL): 0.24-in

Table 1 and 2 present the material properties used in the HELP analyses. The initial moisture content for each material was estimated by the HELP model.

Written by: JAB Date: 11 11 08 (YY MM DD) Reviewed by: Date: 28 Nov 11 (YY MM DD)

Client: Santa Cruz Co. Project: Site Development Plan Project/Proposal No.: WG1394 Task No.: 5

Table 1: Material Properties used in HELP Analysis – Floor Area

Layer #	Material Description	HELP Layer Type[1]	Material Texture #[2]	Saturated Hydr. Cond. (cm/sec)	Layer Thickness (in)
1	Vegetative Layer	1	10	2.00E-04	12
2	GM	4	35	2.00E-13	0.06
3	GCL	3	17	3.00E-09	0.24
4	Foundation Layer	1	3	3.10E-03	24
5	Waste	1	18	1.00E-03	2040
6	Operations Layer	1	3	3.10E-03	24
8	Granular Drainage	2	21	0.3	12
9	SST GM	4	35	2.00E-13	0.06
10	GCL	3	17	3.00E-09	0.24
11	CCL	3	16	1.00E-07	12

Table 2: Material Properties used in HELP Analysis - Slide Slope

Layer #	Material Description	HELP Layer Type[1]	Material Texture #[2]	Saturated Hydr. Cond. (cm/sec)	Layer Thickness (in)
1	Vegetative Layer	1	10	2.00E-04	12
2	GM[3]	4	35	2.00E-13	0.06
3	Foundation Layer	1	3	3.00E-09	24
4	Waste	1	18	1.00E-03	1080
5	Operations Layer	1	3	3.10E-03	12
7	SST GM	4	35	2.00E-13	0.06
8	GCL	3	17	3.00E-09	0.24

Notes:

1. Layer types are as follows: 1 = vertical percolation layer; 2 = lateral drainage layer; 3 = barrier soil liner; 4 = flexible membrane liner. **For the floor area (Table 1), the clay liner below the GCL could not be modeled as a barrier layer because of a restriction within the HELP model.**
2. Material Texture #'s are included on attached sheets from HELP Manual.
3. Geomembrane (GM) was modeled for **two scenarios**: 1 pinhole/acre, 1 defect/acre, and **good** placement quality, and 0 pinhole/acre, 0 defect/acre, and **excellent** placement quality.

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/ YY MM DD YY MM DD

Client: Santa Cruz Co. Project: Site Development Plan Project/Proposal No.: WG1394 Task No.: 5

Other Assumptions

The purpose of this analysis was to quantify the time at which zero leachate production would occur; therefore, typical thicknesses of waste for the top deck and side slopes were estimated. Evaluating the difference in elevation of the top deck and the base grades across the site, Module 3 was selected as typical.

To estimate the drainage path for the final grades, the final cover grading plan from the Site Development Plan was used. Figure 2 presents the final grades with a peak elevation of 200-ft MSL within Module 3. From the peak to the eastern edge of Module 3 where the top deck meets the side slope, a drainage length of approximately 300-ft was measured. The top deck of this area was modeled at a 3% slope. The final grade slope of 5% was decreased to account for possible settlement effects that would lower the slope and allow more infiltration of rain. The waste column for the top deck was estimated to be 170-ft.

The waste column for the side slopes was estimated to be 90-ft, based on the final and base grades of Module 3. The side slopes of the final grades were modeled at 3H:1V or 33% slope. The drainage length for the side slopes was the longest path from the top of the slope to a bench, 158-ft.

The model was performed for a 1 acre area.

Cases Analyzed

Four cases described below were analyzed to represent the closure scenarios for the site:

Case 1 – Top Deck: 170-ft of waste has been placed over the 1-acre cell floor of the cell (all of which flows to one sump), representing the final closure grades. 100% of surface water runoff is allowed to runoff.

- Base: drainage length = 480-ft, 1% slope assuming longest path for drainage if LCRS is not functioning well.
- Top Deck: drainage length = 300 ft, 3% slope, Vegetative layer= poor stand of grass.
- **Geomembrane installation: 1 pinhole/acre, 1 defect/acre, and good placement quality.**

Case 2 – Top Deck: 170-ft of waste has been placed over the 1-acre cell floor of the cell (all of which flows to one sump), representing the final closure grades. 100% of surface water runoff is allowed to runoff.

- Base: drainage length = 150-ft, 2% slope assuming shortest path for drainage when LCRS is functioning.
- Top Deck: drainage length = 300 ft, 3% slope, Vegetative layer= poor stand of grass.
- **Geomembrane installation: 1 pinhole/acre, 1 defect/acre, and good placement quality.**

Case 3 – Top Deck: 170-ft of waste has been placed over the 1-acre cell floor of the cell (all of which flows to one sump), representing the final closure grades. 100% of surface water runoff is allowed to runoff.

- Base: drainage length = 150-ft, 2% slope assuming shortest path for drainage when LCRS is functioning.
- Top Deck: drainage length = 300 ft, 3% slope, Vegetative layer= poor stand of grass.
- **Geomembrane installation: 0 pinhole/acre, 0 defect/acre, and excellent placement quality.**

Case 4 – Side Slope: 90-ft of waste has been placed (all of which flows to one sump), representing the final closure grades. 100% of surface water runoff is allowed to runoff.

- Side slope: drainage length = 300 ft, 33% slope, Vegetative layer= poor stand of grass.
- **Geomembrane installation: 0 pinhole/acre, 0 defect/acre, and excellent placement quality.**

Results

For cases 1, 2, and 3, the maximum heads on the liner system are very low (i.e., less than 0.10 inch). The results for case 4 (the side slope) show that the average head is also less than 0.10 inch. Table 3 summarizes the results of the analyses for cases 1, 2, and 3 (i.e., the floor area) which is the flatter area of the landfill.

As can be observed, the HELP model predicts that liquid will be collected in the LCRS even when the geomembrane in the final cover is assumed to be installed without holes or defects (i.e., Excellent); however, since the volumes estimated are very low, the leachate generation after closure with the proposed final cover system can be considered to be effectively zero as soon as the final cover is placed. Furthermore, the post-closure maintenance cost estimate includes leachate management in its breakdown to dispose of leachate generated after closure.

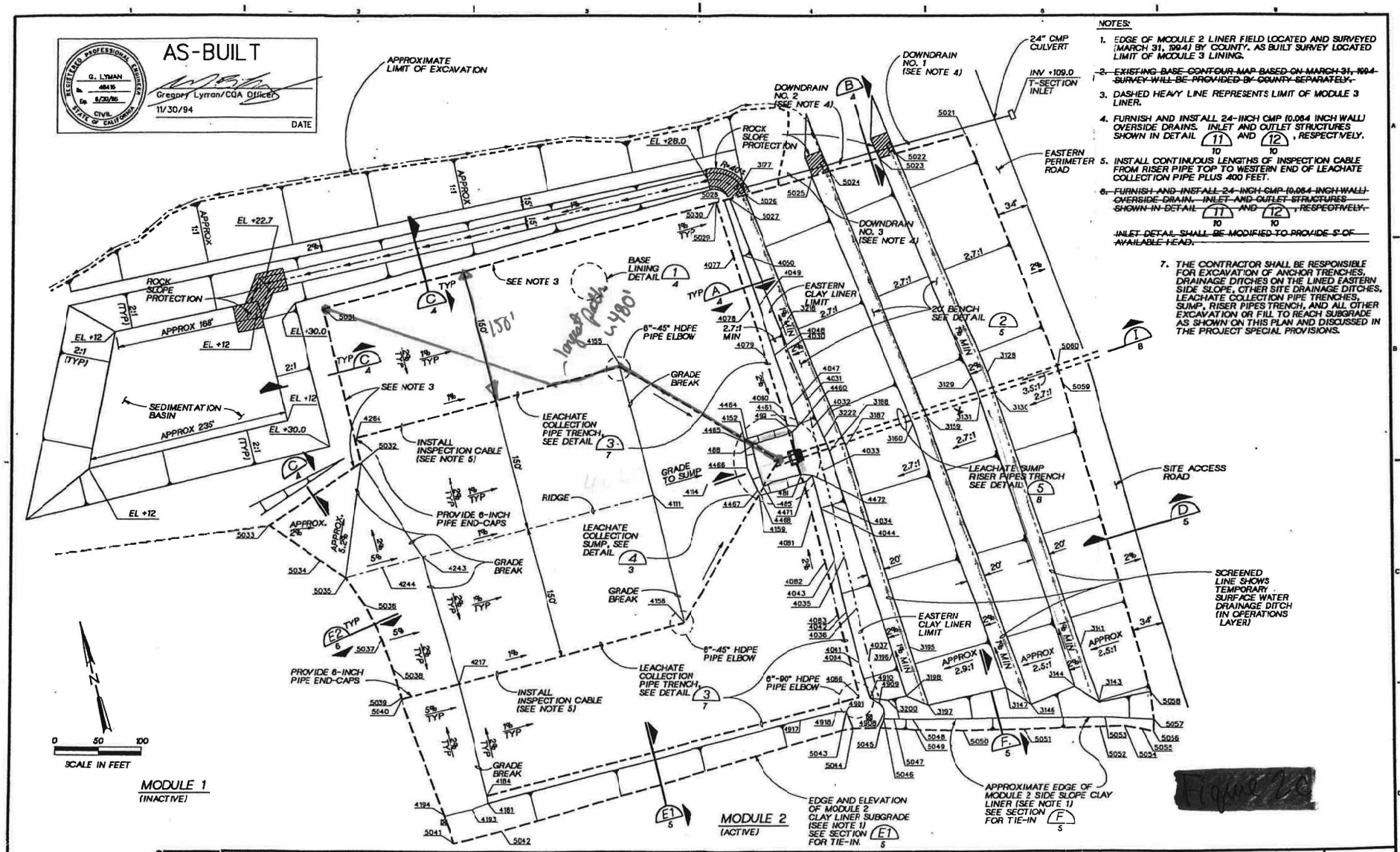
Table 3: Summary of Results (per acre) for 30 years

Case #	Output Filename	Final Cover Geomembrane Installation	Avg. Annual Total Lateral Drainage Collected in LCRS Layer	Peak Daily Drainage Collected in LCRS Layer
1	BVL30	Good	1.673 cubic feet	0.01537 cubic foot
2	BVL30a	Good	1.673 cubic feet	0.01579 cubic foot
3	BVLGM	Excellent	0.589 cubic foot	0.00486 cubic foot

Reference

Schroeder, P.R., Lloyd, C.M., Zappi, P.A., and Aziz, N.M. (1997) "The Hydrologic Evaluation of Landfill Performance (HELP) Model – User's Guide for Version 3.07," United States Environmental Protection Agency.

FIGURE 1



DSGN	M. HOMOLKA						
DR	F. POON						
CHK	S. LEWIS						
APVD	G. LYMAN	1	Nov 94	AS-BUILT REVISIONS	MH	GL	
		NO.	DATE	REVISION	BY	APVD	

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BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

CONSTRUCTION DRAWINGS
BUENA VISTA LANDFILL
COUNTY OF SANTA CRUZ, CALIFORNIA

MODULE 3
GEOMEMEBRANE LINING
SUBGRADE PLAN

SHEET [redacted]
DATE NOV 1994
PROJ NO. BAE39803.CO

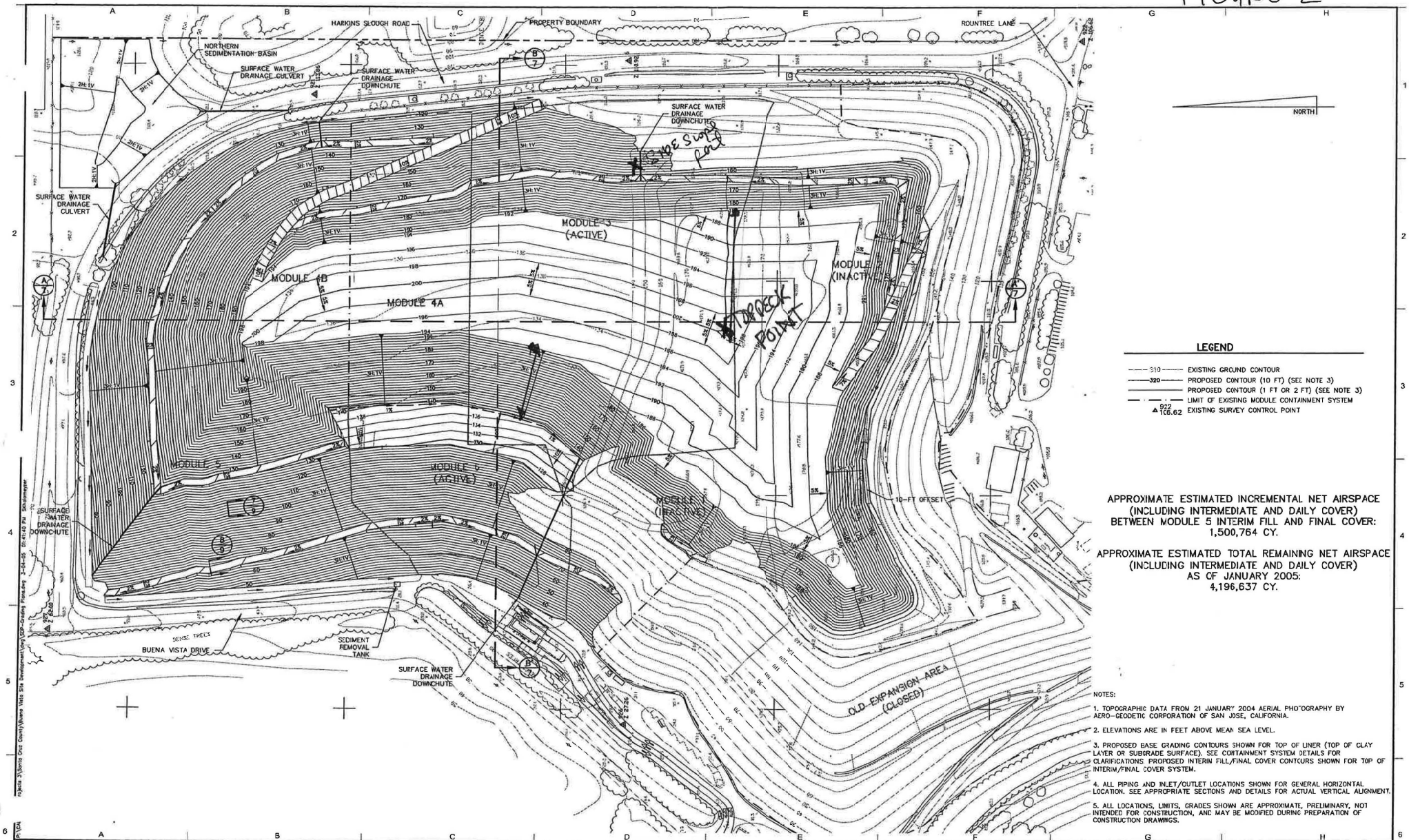
7-Dec-1994 39503W22.DLV

AS-BUILT

OVERLAY SCREEN

PROJECT FILE

FIGURE 2



LEGEND

- 310 — EXISTING GROUND CONTOUR
- 320 — PROPOSED CONTOUR (10 FT) (SEE NOTE 3)
- PROPOSED CONTOUR (1 FT OR 2 FT) (SEE NOTE 3)
- LIMIT OF EXISTING MODULE CONTAINMENT SYSTEM
- 922 / 166.62 EXISTING SURVEY CONTROL POINT

APPROXIMATE ESTIMATED INCREMENTAL NET AIRSPACE (INCLUDING INTERMEDIATE AND DAILY COVER) BETWEEN MODULE 5 INTERIM FILL AND FINAL COVER: 1,500,764 CY.

APPROXIMATE ESTIMATED TOTAL REMAINING NET AIRSPACE (INCLUDING INTERMEDIATE AND DAILY COVER) AS OF JANUARY 2005: 4,196,637 CY.

NOTES:

1. TOPOGRAPHIC DATA FROM 21 JANUARY 2004 AERIAL PHOTOGRAPHY BY AERO-GEODETIC CORPORATION OF SAN JOSE, CALIFORNIA.
2. ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL.
3. PROPOSED BASE GRADING CONTOURS SHOWN FOR TOP OF LINER (TOP OF CLAY LAYER OR SUBGRADE SURFACE). SEE CONTAINMENT SYSTEM DETAILS FOR CLARIFICATIONS. PROPOSED INTERIM FILL/FINAL COVER CONTOURS SHOWN FOR TOP OF INTERIM/FINAL COVER SYSTEM.
4. ALL PIPING AND INLET/OUTLET LOCATIONS SHOWN FOR GENERAL HORIZONTAL LOCATION. SEE APPROPRIATE SECTIONS AND DETAILS FOR ACTUAL VERTICAL ALIGNMENT.
5. ALL LOCATIONS, LIMITS, GRADES SHOWN ARE APPROXIMATE, PRELIMINARY, NOT INTENDED FOR CONSTRUCTION, AND MAY BE MODIFIED DURING PREPARATION OF CONSTRUCTION DRAWINGS.

100 50 0 100 200
SCALE IN FEET

REVISIONS			
NO.	DESCRIPTION	DATE	BY

SOLID WASTE AND RECYCLING SERVICES DIVISION
DEPARTMENT OF PUBLIC WORKS
COUNTY OF SANTA CRUZ, CALIFORNIA

GeoSyntec Consultants
475 14th Street, Suite 450
Oakland, CA 94612

FINAL COVER GRADING PLAN

SITE DEVELOPMENT PLAN
BUENA VISTA LANDFILL
WATSONVILLE, COUNTY OF SANTA CRUZ, CALIFORNIA

NOT FOR CONSTRUCTION

DES BY: SPL	DATE:	4 MARCH 2005	DRAWING NO.
DRN BY: ABK	SCALE:	AS SHOWN	
CHK BY: FWS	PROJECT:	WL0653	
REV BY: HDS	DOCUMENT:	RO	
APP BY: SPL			

TABLE 4. DEFAULT SOIL, WASTE, AND GEOSYNTHETIC CHARACTERISTICS

Classification			Total Porosity	Field Capacity	Wilting Point	Saturated Hydraulic Conductivity
HELP	USDA	USCS	vol/vol	vol/vol	vol/vol	cm/sec
1	CoS	SP	0.417	0.045	0.018	1.0×10^{-2}
2	S	SW	0.437	0.062	0.024	5.8×10^{-3}
3	FS	SW	0.457	0.083	0.033	3.1×10^{-3}
4	LS	SM	0.437	0.105	0.047	1.7×10^{-3}
5	LFS	SM	0.457	0.131	0.058	1.0×10^{-3}
6	SL	SM	0.453	0.190	0.085	7.2×10^{-4}
7	FSL	SM	0.473	0.222	0.104	5.2×10^{-4}
8	L	ML	0.463	0.232	0.116	3.7×10^{-4}
9	SiL	ML	0.501	0.284	0.135	1.9×10^{-4}
10	SCL	SC	0.398	0.244	0.136	1.2×10^{-4}
11	CL	CL	0.464	0.310	0.187	6.4×10^{-5}
12	SiCL	CL	0.471	0.342	0.210	4.2×10^{-5}
13	SC	SC	0.430	0.321	0.221	3.3×10^{-5}
14	SiC	CH	0.479	0.371	0.251	2.5×10^{-5}
15	C	CH	0.475	0.378	0.265	1.7×10^{-5}
16	Barrier Soil		0.427	0.418	0.367	1.0×10^{-7}
17	Bentonite Mat (0.6 cm)		0.750	0.747	0.400	3.0×10^{-9}
18	Municipal Waste (900 lb/yd^3 or 312 kg/m^3)		0.671	0.292	0.077	1.0×10^{-3}
19	Municipal Waste (channeling and dead zones)		0.168	0.073	0.019	1.0×10^{-3}
20	Drainage Net (0.5 cm)		0.850	0.010	0.005	$1.0 \times 10^{+1}$
21	Gravel		0.397	0.032	0.013	3.0×10^{-1}
22	L*	ML	0.419	0.307	0.180	1.9×10^{-5}
23	SiL*	ML	0.461	0.360	0.203	9.0×10^{-6}
24	SCL*	SC	0.365	0.305	0.202	2.7×10^{-6}
25	CL*	CL	0.437	0.373	0.266	3.6×10^{-6}
26	SiCL*	CL	0.445	0.393	0.277	1.9×10^{-6}
27	SC*	SC	0.400	0.366	0.288	7.8×10^{-7}
28	SiC*	CH	0.452	0.411	0.311	1.2×10^{-6}
29	C*	CH	0.451	0.419	0.332	6.8×10^{-7}
30	Coal-Burning Electric Plant Fly Ash*		0.541	0.187	0.047	5.0×10^{-5}
31	Coal-Burning Electric Plant Bottom Ash*		0.578	0.076	0.025	4.1×10^{-3}
32	Municipal Incinerator Fly Ash*		0.450	0.116	0.049	1.0×10^{-2}
33	Fine Copper Slag*		0.375	0.055	0.020	4.1×10^{-2}
34	Drainage Net (0.6 cm)		0.850	0.010	0.005	$3.3 \times 10^{+1}$

* Moderately Compacted (Continued)

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**                                                                  **
**                                                                  **
**          HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE           **
**             HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)           **
**             DEVELOPED BY ENVIRONMENTAL LABORATORY                **
**          USAE WATERWAYS EXPERIMENT STATION                       **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY         **
**                                                                  **
**                                                                  **
**********************************************************************
**********************************************************************

PRECIPITATION DATA FILE:    c:\help3\BVL4.D4
TEMPERATURE DATA FILE:      c:\help3\BVL7.D7
SOLAR RADIATION DATA FILE:  c:\help3\BVL13.D13
EVAPOTRANSPIRATION DATA:    C:\HELP3\BVL11.D11
SOIL AND DESIGN DATA FILE:  c:\help3\BVL10.D10
OUTPUT DATA FILE:           c:\help3\BVL30.OUT

TIME:  11:47     DATE:  11/10/2011

**********************************************************************

     TITLE:  BVL: Zero Leachate

**********************************************************************

     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
            COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

                              LAYER  1
                              --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
               MATERIAL TEXTURE NUMBER  10
THICKNESS                     =      12.00   INCHES
POROSITY                      =       0.3980 VOL/VOL
FIELD CAPACITY                =       0.2440 VOL/VOL
WILTING POINT                 =       0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT    =       0.3560 VOL/VOL
EFFECTIVE SAT. HYD. COND.     =  0.119999997000E-03 CM/SEC
     NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
            FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                              LAYER  2
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          TYPE 4 - FLEXIBLE MEMBRANE LINER
               MATERIAL TEXTURE NUMBER  35
THICKNESS                     =       0.06   INCHES
POROSITY                      =       0.0000 VOL/VOL
FIELD CAPACITY                =       0.0000 VOL/VOL
WILTING POINT                 =       0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT    =       0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.     =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY           =       1.00   HOLES/ACRE
FML INSTALLATION DEFECTS      =       1.00   HOLES/ACRE
FML PLACEMENT QUALITY         =  3 - GOOD

                              LAYER  3
                              --------

          TYPE 3 - BARRIER SOIL LINER
               MATERIAL TEXTURE NUMBER  17
THICKNESS                     =       0.24   INCHES
POROSITY                      =       0.7500 VOL/VOL
FIELD CAPACITY                =       0.7470 VOL/VOL
WILTING POINT                 =       0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT    =       0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND.     =  0.300000003000E-08 CM/SEC

                              LAYER  4
                              --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
               MATERIAL TEXTURE NUMBER  3
THICKNESS                     =      24.00   INCHES
POROSITY                      =       0.4570 VOL/VOL
FIELD CAPACITY                =       0.0830 VOL/VOL
WILTING POINT                 =       0.0330 VOL/VOL
INITIAL SOIL WATER CONTENT    =       0.0830 VOL/VOL
EFFECTIVE SAT. HYD. COND.     =  0.310000009000E-02 CM/SEC

                              LAYER  5
                              --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
               MATERIAL TEXTURE NUMBER  18
THICKNESS                     =    2040.00   INCHES
POROSITY                      =       0.6710 VOL/VOL
FIELD CAPACITY                =       0.2920 VOL/VOL
WILTING POINT                 =       0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT    =       0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND.     =  0.100000005000E-02 CM/SEC

                              LAYER  6
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          TYPE 1 - VERTICAL PERCOLATION LAYER
               MATERIAL TEXTURE NUMBER  3
THICKNESS                     =      24.00   INCHES
POROSITY                      =       0.4570 VOL/VOL
FIELD CAPACITY                =       0.0830 VOL/VOL
WILTING POINT                 =       0.0330 VOL/VOL
INITIAL SOIL WATER CONTENT    =       0.0830 VOL/VOL
EFFECTIVE SAT. HYD. COND.     =  0.310000009000E-02 CM/SEC

                              LAYER  7
                              --------

          TYPE 2 - LATERAL DRAINAGE LAYER
               MATERIAL TEXTURE NUMBER  21
THICKNESS                     =      12.00   INCHES
POROSITY                      =       0.3970 VOL/VOL
FIELD CAPACITY                =       0.0320 VOL/VOL
WILTING POINT                 =       0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT    =       0.0320 VOL/VOL
EFFECTIVE SAT. HYD. COND.     =  0.300000012000     CM/SEC
SLOPE                         =       1.00   PERCENT
DRAINAGE LENGTH               =     480.0    FEET

                              LAYER  8
                              --------

          TYPE 4 - FLEXIBLE MEMBRANE LINER
               MATERIAL TEXTURE NUMBER  35
THICKNESS                     =       0.06   INCHES
POROSITY                      =       0.0000 VOL/VOL
FIELD CAPACITY                =       0.0000 VOL/VOL
WILTING POINT                 =       0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT    =       0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.     =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY           =       1.00   HOLES/ACRE
FML INSTALLATION DEFECTS      =       1.00   HOLES/ACRE
FML PLACEMENT QUALITY         =  3 - GOOD

                              LAYER  9
                              --------

          TYPE 3 - BARRIER SOIL LINER
               MATERIAL TEXTURE NUMBER  17
THICKNESS                     =       0.24   INCHES
POROSITY                      =       0.7500 VOL/VOL
FIELD CAPACITY                =       0.7470 VOL/VOL
WILTING POINT                 =       0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT    =       0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND.     =  0.300000003000E-08 CM/SEC
```



```
                             LAYER 10
                             --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
               MATERIAL TEXTURE NUMBER  16
THICKNESS                     =      12.00   INCHES
POROSITY                      =       0.4270 VOL/VOL
FIELD CAPACITY                =       0.4180 VOL/VOL
WILTING POINT                 =       0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT    =       0.4065 VOL/VOL
EFFECTIVE SAT. HYD. COND.     =  0.100000001000E-06 CM/SEC

          GENERAL DESIGN AND EVAPORATIVE ZONE DATA
          ----------------------------------------

     NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
            SOIL DATA BASE USING SOIL TEXTURE #10 WITH A
            POOR STAND OF GRASS, A SURFACE SLOPE OF  3.%
            AND A SLOPE LENGTH OF  300. FEET.

SCS RUNOFF CURVE NUMBER       =      90.10
FRACTION OF AREA ALLOWING RUNOFF  =  100.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE  =  1.000  ACRES
EVAPORATIVE ZONE DEPTH        =      12.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE  =  4.272   INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE  =  4.776  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE  =  1.632  INCHES
INITIAL SNOW WATER            =       0.000  INCHES
INITIAL WATER IN LAYER MATERIALS  =  609.557  INCHES
TOTAL INITIAL WATER           =     609.557  INCHES
TOTAL SUBSURFACE INFLOW       =       0.00   INCHES/YEAR

          EVAPOTRANSPIRATION AND WEATHER DATA
          -----------------------------------

     NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
            SAN FRANCISCO          CALIFORNIA

     STATION LATITUDE             =  36.90 DEGREES
     MAXIMUM LEAF AREA INDEX      =   1.00
     START OF GROWING SEASON (JULIAN DATE)  =  78
     END OF GROWING SEASON (JULIAN DATE)    =  328
     EVAPORATIVE ZONE DEPTH       =  12.0  INCHES
     AVERAGE ANNUAL WIND SPEED    =  10.50 MPH
     AVERAGE 1ST QUARTER RELATIVE HUMIDITY  =  75.00 %
     AVERAGE 2ND QUARTER RELATIVE HUMIDITY  =  71.00 %
     AVERAGE 3RD QUARTER RELATIVE HUMIDITY  =  73.00 %
     AVERAGE 4TH QUARTER RELATIVE HUMIDITY  =  74.00 %

     NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR    SAN FRANCISCO        CALIFORNIA

          NORMAL MEAN MONTHLY PRECIPITATION (INCHES)
```

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.15	3.43	3.60	1.83	0.26	0.12
0.09	0.07	0.30	1.13	3.20	3.55

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SAN FRANCISCO CALIFORNIA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
49.40	51.80	53.00	55.30	57.60	60.50
61.80	62.50	62.60	59.90	54.30	49.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SAN FRANCISCO CALIFORNIA
AND STATION LATITUDE = 36.92 DEGREES

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.02	3.24	3.70	1.95	0.36	0.11
	0.06	0.08	0.25	0.92	3.06	4.16
STD. DEVIATIONS	1.77	2.17	1.82	1.32	0.38	0.13
	0.12	0.11	0.41	0.92	1.88	2.07
RUNOFF						
TOTALS	2.323	1.518	0.983	0.223	0.007	0.000
	0.000	0.000	0.007	0.037	0.730	2.043
STD. DEVIATIONS	1.706	1.740	1.165	0.416	0.031	0.000
	0.000	0.000	0.033	0.074	1.008	1.501
EVAPOTRANSPIRATION						
TOTALS	1.762	2.080	2.899	2.482	1.172	0.679
	0.071	0.074	0.106	0.329	0.893	1.496
STD. DEVIATIONS	0.085	0.273	0.630	1.209	0.445	0.372
	0.117	0.112	0.170	0.349	0.495	0.333
PERCOLATION/LEAKAGE THROUGH LAYER 3						
TOTALS	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001

STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 7						
TOTALS	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 9						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 10						
TOTALS	0.0013	0.0011	0.0012	0.0011	0.0011	0.0010
	0.0006	0.0000	0.0000	0.0001	0.0005	0.0010
STD. DEVIATIONS	0.0019	0.0016	0.0016	0.0014	0.0013	0.0011
	0.0007	0.0001	0.0000	0.0002	0.0005	0.0011

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 2						
AVERAGES	9.9771	8.7666	7.7496	5.4789	2.9945	0.4829
	0.0000	0.0000	0.0000	0.2355	3.3388	8.6198
STD. DEVIATIONS	1.2213	1.5035	1.8099	1.3569	1.0165	0.6173
	0.0001	0.0000	0.0000	0.6108	2.5650	2.0338
DAILY AVERAGE HEAD ON TOP OF LAYER 8						
AVERAGES	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	21.91 (3.732)	79527.3	100.00
RUNOFF	7.872 (3.0810)	28574.94	35.931

EVAPOTRANSPIRATION	14.043 (1.8179)	50977.03	64.100
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.00046 (0.00006)	1.678	0.00211
AVERAGE HEAD ON TOP OF LAYER 2	3.970 (0.435)		
LATERAL DRAINAGE COLLECTED FROM LAYER 7	0.00046 (0.00006)	1.673	0.00210
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.00000 (0.00000)	0.006	0.00001
AVERAGE HEAD ON TOP OF LAYER 8	0.000 (0.000)		
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.00900 (0.01069)	32.653	0.04106
CHANGE IN WATER STORAGE	-0.016 (0.6014)	-59.04	-0.074

PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	3.36	12196.800
RUNOFF	3.353	12172.9766
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.000004	0.01605
AVERAGE HEAD ON TOP OF LAYER 2	12.000	
DRAINAGE COLLECTED FROM LAYER 7	0.00000	0.01537
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.000000	0.00002
AVERAGE HEAD ON TOP OF LAYER 8	0.000	
MAXIMUM HEAD ON TOP OF LAYER 8	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 7 (DISTANCE FROM DRAIN)	0.0 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.000331	1.20264
SNOW WATER	0.00	1.1433

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3980

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1360

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	4.0535	0.3378
2	0.0000	0.0000
3	0.1800	0.7500
4	1.9920	0.0830
5	595.6799	0.2920
6	1.9920	0.0830
7	0.3840	0.0320
8	0.0000	0.0000
9	0.1800	0.7500
10	4.6076	0.3840
SNOW WATER	0.000	

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 **                                                                          **
 **              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
 **                   HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)             **
 **                   DEVELOPED BY ENVIRONMENTAL LABORATORY                  **
 **                   USAE WATERWAYS EXPERIMENT STATION                      **
 **              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
 **                                                                          **
 **                                                                          **
 ******************************************************************************
 ******************************************************************************


 PRECIPITATION DATA FILE:    c:\help3\BVL4.D4
 TEMPERATURE DATA FILE:      c:\help3\BVL7.D7
 SOLAR RADIATION DATA FILE:  c:\help3\BVL13.D13
 EVAPOTRANSPIRATION DATA:    C:\HELP3\BVL11.D11
 SOIL AND DESIGN DATA FILE:  c:\help3\BVL10A.D10
 OUTPUT DATA FILE:           c:\help3\BVL30a.OUT


 TIME:  11:48     DATE:  11/10/2011

 ******************************************************************************

     TITLE:  BVL: Zero Leachate

 ******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
            COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER  10
 THICKNESS                    =      12.00   INCHES
 POROSITY                     =       0.3980 VOL/VOL
 FIELD CAPACITY               =       0.2440 VOL/VOL
 WILTING POINT                =       0.1360 VOL/VOL
 INITIAL SOIL WATER CONTENT   =       0.3560 VOL/VOL
 EFFECTIVE SAT. HYD. COND.    =  0.119999997000E-03 CM/SEC
 NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
        FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                  LAYER  2
                                  --------
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                TYPE 4 - FLEXIBLE MEMBRANE LINER
                    MATERIAL TEXTURE NUMBER  35
 THICKNESS                    =       0.06   INCHES
 POROSITY                     =       0.0000 VOL/VOL
 FIELD CAPACITY               =       0.0000 VOL/VOL
 WILTING POINT                =       0.0000 VOL/VOL
 INITIAL SOIL WATER CONTENT   =       0.0000 VOL/VOL
 EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
 FML PINHOLE DENSITY          =       1.00   HOLES/ACRE
 FML INSTALLATION DEFECTS     =       1.00   HOLES/ACRE
 FML PLACEMENT QUALITY        =  3 - GOOD


                                  LAYER  3
                                  --------

                TYPE 3 - BARRIER SOIL LINER
                    MATERIAL TEXTURE NUMBER  17
 THICKNESS                    =       0.24   INCHES
 POROSITY                     =       0.7500 VOL/VOL
 FIELD CAPACITY               =       0.7470 VOL/VOL
 WILTING POINT                =       0.4000 VOL/VOL
 INITIAL SOIL WATER CONTENT   =       0.7500 VOL/VOL
 EFFECTIVE SAT. HYD. COND.    =  0.300000003000E-08 CM/SEC


                                  LAYER  4
                                  --------

                TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER  3
 THICKNESS                    =      24.00   INCHES
 POROSITY                     =       0.4570 VOL/VOL
 FIELD CAPACITY               =       0.0830 VOL/VOL
 WILTING POINT                =       0.0330 VOL/VOL
 INITIAL SOIL WATER CONTENT   =       0.0830 VOL/VOL
 EFFECTIVE SAT. HYD. COND.    =  0.310000009000E-02 CM/SEC


                                  LAYER  5
                                  --------

                TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER  18
 THICKNESS                    =    2040.00   INCHES
 POROSITY                     =       0.6710 VOL/VOL
 FIELD CAPACITY               =       0.2920 VOL/VOL
 WILTING POINT                =       0.0770 VOL/VOL
 INITIAL SOIL WATER CONTENT   =       0.2920 VOL/VOL
 EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC


                                  LAYER  6
                                  --------
```



```
                TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER  3
 THICKNESS                    =      24.00   INCHES
 POROSITY                     =       0.4570 VOL/VOL
 FIELD CAPACITY               =       0.0830 VOL/VOL
 WILTING POINT                =       0.0330 VOL/VOL
 INITIAL SOIL WATER CONTENT   =       0.0830 VOL/VOL
 EFFECTIVE SAT. HYD. COND.    =  0.310000009000E-02 CM/SEC


                                  LAYER  7
                                  --------

                TYPE 2 - LATERAL DRAINAGE LAYER
                    MATERIAL TEXTURE NUMBER  21
 THICKNESS                    =      12.00   INCHES
 POROSITY                     =       0.3970 VOL/VOL
 FIELD CAPACITY               =       0.0320 VOL/VOL
 WILTING POINT                =       0.0130 VOL/VOL
 INITIAL SOIL WATER CONTENT   =       0.0320 VOL/VOL
 EFFECTIVE SAT. HYD. COND.    =  0.300000012000          CM/SEC
 SLOPE                        =       2.00   PERCENT
 DRAINAGE LENGTH              =     150.0    FEET


                                  LAYER  8
                                  --------

                TYPE 4 - FLEXIBLE MEMBRANE LINER
                    MATERIAL TEXTURE NUMBER  35
 THICKNESS                    =       0.06   INCHES
 POROSITY                     =       0.0000 VOL/VOL
 FIELD CAPACITY               =       0.0000 VOL/VOL
 WILTING POINT                =       0.0000 VOL/VOL
 INITIAL SOIL WATER CONTENT   =       0.0000 VOL/VOL
 EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
 FML PINHOLE DENSITY          =       1.00   HOLES/ACRE
 FML INSTALLATION DEFECTS     =       1.00   HOLES/ACRE
 FML PLACEMENT QUALITY        =  3 - GOOD


                                  LAYER  9
                                  --------

                TYPE 3 - BARRIER SOIL LINER
                    MATERIAL TEXTURE NUMBER  17
 THICKNESS                    =       0.24   INCHES
 POROSITY                     =       0.7500 VOL/VOL
 FIELD CAPACITY               =       0.7470 VOL/VOL
 WILTING POINT                =       0.4000 VOL/VOL
 INITIAL SOIL WATER CONTENT   =       0.7500 VOL/VOL
 EFFECTIVE SAT. HYD. COND.    =  0.300000003000E-08 CM/SEC
```



```
                TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER  16
 THICKNESS                    =      12.00   INCHES
 POROSITY                     =       0.4270 VOL/VOL
 FIELD CAPACITY               =       0.4180 VOL/VOL
 WILTING POINT                =       0.3670 VOL/VOL
 INITIAL SOIL WATER CONTENT   =       0.4088 VOL/VOL
 EFFECTIVE SAT. HYD. COND.    =  0.100000001000E-06 CM/SEC


                GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                ----------------------------------------

     NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
            SOIL DATA BASE USING SOIL TEXTURE #10 WITH A
            POOR STAND OF GRASS, A SURFACE SLOPE OF  3.%
            AND A SLOPE LENGTH OF  300. FEET.

 SCS RUNOFF CURVE NUMBER              =     90.10
 FRACTION OF AREA ALLOWING RUNOFF     =    100.0    PERCENT
 AREA PROJECTED ON HORIZONTAL PLANE   =      1.000  ACRES
 EVAPORATIVE ZONE DEPTH               =     12.0    INCHES
 INITIAL WATER IN EVAPORATIVE ZONE    =      4.272  INCHES
 UPPER LIMIT OF EVAPORATIVE STORAGE   =      4.776  INCHES
 LOWER LIMIT OF EVAPORATIVE STORAGE   =      1.632  INCHES
 INITIAL SNOW WATER                   =      0.000  INCHES
 INITIAL WATER IN LAYER MATERIALS     =    609.585  INCHES
 TOTAL INITIAL WATER                  =    609.585  INCHES
 TOTAL SUBSURFACE INFLOW              =      0.00   INCHES/YEAR


                EVAPOTRANSPIRATION AND WEATHER DATA
                -----------------------------------

     NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
            SAN FRANCISCO          CALIFORNIA

     STATION LATITUDE                     =  36.90 DEGREES
     MAXIMUM LEAF AREA INDEX              =   1.00
     START OF GROWING SEASON (JULIAN DATE)=     78
     END OF GROWING SEASON (JULIAN DATE)  =    328
     EVAPORATIVE ZONE DEPTH               =  12.0  INCHES
     AVERAGE ANNUAL WIND SPEED            =  10.50 MPH
     AVERAGE 1ST QUARTER RELATIVE HUMIDITY=  75.00 %
     AVERAGE 2ND QUARTER RELATIVE HUMIDITY=  71.00 %
     AVERAGE 3RD QUARTER RELATIVE HUMIDITY=  73.00 %
     AVERAGE 4TH QUARTER RELATIVE HUMIDITY=  74.00 %


     NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR    SAN FRANCISCO          CALIFORNIA

            NORMAL MEAN MONTHLY PRECIPITATION (INCHES)
```

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.15	3.43	3.60	1.83	0.26	0.12
0.09	0.07	0.30	1.13	3.20	3.55

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SAN FRANCISCO CALIFORNIA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
49.40	51.80	53.00	55.30	57.60	60.50
61.80	62.50	62.60	59.90	54.30	49.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SAN FRANCISCO CALIFORNIA
AND STATION LATITUDE = 36.92 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.02	3.24	3.70	1.95	0.36	0.11
	0.06	0.08	0.25	0.92	3.06	4.16
STD. DEVIATIONS	1.77	2.17	1.82	1.32	0.38	0.13
	0.12	0.11	0.41	0.92	1.88	2.07
RUNOFF						
TOTALS	2.323	1.518	0.983	0.223	0.007	0.000
	0.000	0.000	0.007	0.037	0.730	2.043
STD. DEVIATIONS	1.706	1.740	1.165	0.416	0.031	0.000
	0.000	0.000	0.033	0.074	1.008	1.501
EVAPOTRANSPIRATION						
TOTALS	1.762	2.080	2.899	2.482	1.172	0.679
	0.071	0.074	0.106	0.329	0.893	1.496
STD. DEVIATIONS	0.085	0.273	0.630	1.209	0.445	0.372
	0.117	0.112	0.170	0.349	0.495	0.333
PERCOLATION/LEAKAGE THROUGH LAYER 3						
TOTALS	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001

STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 7						
TOTALS	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 9						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 10						
TOTALS	0.0016	0.0014	0.0015	0.0013	0.0012	0.0005
	0.0000	0.0000	0.0000	0.0001	0.0006	0.0012
STD. DEVIATIONS	0.0026	0.0021	0.0020	0.0018	0.0013	0.0008
	0.0000	0.0000	0.0000	0.0002	0.0006	0.0015

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 2						
AVERAGES	9.9771	8.7666	7.7496	5.4789	2.9945	0.4829
	0.0000	0.0000	0.0000	0.2355	3.3388	8.6198
STD. DEVIATIONS	1.2213	1.5035	1.8099	1.3569	1.0165	0.6173
	0.0001	0.0000	0.0000	0.6108	2.5650	2.0338
DAILY AVERAGE HEAD ON TOP OF LAYER 8						
AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	21.91 (3.732)	79527.3	100.00
RUNOFF	7.872 (3.0810)	28574.94	35.931

EVAPOTRANSPIRATION	14.043 (1.8179)	50977.03	64.100
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.00046 (0.00006)	1.678	0.00211
AVERAGE HEAD ON TOP OF LAYER 2	3.970 (0.435)		
LATERAL DRAINAGE COLLECTED FROM LAYER 7	0.00046 (0.00006)	1.673	0.00210
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.00000 (0.00000)	0.005	0.00001
AVERAGE HEAD ON TOP OF LAYER 8	0.000 (0.000)		
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.00953 (0.01202)	34.593	0.04350
CHANGE IN WATER STORAGE	-0.017 (0.6014)	-60.97	-0.077

****

PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	3.36	12196.800
RUNOFF	3.353	12172.9766
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.000004	0.01605
AVERAGE HEAD ON TOP OF LAYER 2	12.000	
DRAINAGE COLLECTED FROM LAYER 7	0.00000	0.01579
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.000000	0.00002
AVERAGE HEAD ON TOP OF LAYER 8	0.000	
MAXIMUM HEAD ON TOP OF LAYER 8	0.003	
LOCATION OF MAXIMUM HEAD IN LAYER 7 (DISTANCE FROM DRAIN)	0.0 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.000474	1.72069
SNOW WATER	0.00	1.1433

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3980

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1360

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

****

FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	4.0535	0.3378
2	0.0000	0.0000
3	0.1800	0.7500
4	1.9920	0.0830
5	595.6799	0.2920
6	1.9920	0.0830
7	0.3840	0.0320
8	0.0000	0.0000
9	0.1800	0.7500
10	4.6200	0.3850
SNOW WATER	0.000	

****

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0
**********************************************************************
**********************************************************************
**                                                                  **
**                                                                  **
**        HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE             **
**             HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)           **
**             DEVELOPED BY ENVIRONMENTAL LABORATORY                **
**          USAE WATERWAYS EXPERIMENT STATION                       **
**        FOR USEPA RISK REDUCTION ENGINEERING LABORATORY           **
**                                                                  **
**                                                                  **
**********************************************************************
**********************************************************************

PRECIPITATION DATA FILE:    c:\help3\BVL4.D4
TEMPERATURE DATA FILE:      c:\help3\BVL7.D7
SOLAR RADIATION DATA FILE:  c:\help3\BVL13.D13
EVAPOTRANSPIRATION DATA:    c:\HELP3\BVL11.D11
SOIL AND DESIGN DATA FILE:  c:\help3\BVL10GM.D10
OUTPUT DATA FILE:           c:\help3\bvlgm.OUT

TIME:  11:50     DATE:  11/10/2011

**********************************************************************

 TITLE:  BVL: Zero Leachate

**********************************************************************

    NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
           COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

                              LAYER  1
                              --------

                TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER  10
 THICKNESS                    =     12.00   INCHES
 POROSITY                     =      0.3980 VOL/VOL
 FIELD CAPACITY               =      0.2440 VOL/VOL
 WILTING POINT                =      0.1360 VOL/VOL
 INITIAL SOIL WATER CONTENT   =      0.3560 VOL/VOL
 EFFECTIVE SAT. HYD. COND.    =  0.1199999997000E-03 CM/SEC
 NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
        FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                              LAYER  2
                              --------
```


12" VEG


```
                TYPE 4 - FLEXIBLE MEMBRANE LINER
                    MATERIAL TEXTURE NUMBER  35
 THICKNESS                    =      0.06   INCHES
 POROSITY                     =      0.0000 VOL/VOL
 FIELD CAPACITY               =      0.0000 VOL/VOL
 WILTING POINT                =      0.0000 VOL/VOL
 INITIAL SOIL WATER CONTENT   =      0.0000 VOL/VOL
 EFFECTIVE SAT. HYD. COND.    =  0.1999999960000E-12 CM/SEC
 FML PINHOLE DENSITY          =      0.00   HOLES/ACRE
 FML INSTALLATION DEFECTS     =      0.00   HOLES/ACRE
 FML PLACEMENT QUALITY        =  1 - PERFECT

                              LAYER  3
                              --------

                TYPE 3 - BARRIER SOIL LINER
                    MATERIAL TEXTURE NUMBER  17
 THICKNESS                    =      0.24   INCHES
 POROSITY                     =      0.7500 VOL/VOL
 FIELD CAPACITY               =      0.7470 VOL/VOL
 WILTING POINT                =      0.4000 VOL/VOL
 INITIAL SOIL WATER CONTENT   =      0.7500 VOL/VOL
 EFFECTIVE SAT. HYD. COND.    =  0.300000003000E-08 CM/SEC

                              LAYER  4
                              --------

                TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER  3
 THICKNESS                    =     24.00   INCHES
 POROSITY                     =      0.4570 VOL/VOL
 FIELD CAPACITY               =      0.0830 VOL/VOL
 WILTING POINT                =      0.0330 VOL/VOL
 INITIAL SOIL WATER CONTENT   =      0.0830 VOL/VOL
 EFFECTIVE SAT. HYD. COND.    =  0.310000009000E-02 CM/SEC

                              LAYER  5
                              --------

                TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER  18
 THICKNESS                    =   2040.00   INCHES
 POROSITY                     =      0.6710 VOL/VOL
 FIELD CAPACITY               =      0.2920 VOL/VOL
 WILTING POINT                =      0.0770 VOL/VOL
 INITIAL SOIL WATER CONTENT   =      0.2920 VOL/VOL
 EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC

                              LAYER  6
                              --------
```


60 mil GM

EXCELLENT

24" foundation

170' MSW


```
                TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER  3
 THICKNESS                    =     24.00   INCHES
 POROSITY                     =      0.4570 VOL/VOL
 FIELD CAPACITY               =      0.0830 VOL/VOL
 WILTING POINT                =      0.0330 VOL/VOL
 INITIAL SOIL WATER CONTENT   =      0.0830 VOL/VOL
 EFFECTIVE SAT. HYD. COND.    =  0.310000009000E-02 CM/SEC

                              LAYER  7
                              --------

                TYPE 2 - LATERAL DRAINAGE LAYER
                    MATERIAL TEXTURE NUMBER  21
 THICKNESS                    =     12.00   INCHES
 POROSITY                     =      0.3970 VOL/VOL
 FIELD CAPACITY               =      0.0320 VOL/VOL
 WILTING POINT                =      0.0130 VOL/VOL
 INITIAL SOIL WATER CONTENT   =      0.0320 VOL/VOL
 EFFECTIVE SAT. HYD. COND.    =  0.300000001200      CM/SEC
 SLOPE                        =      2.00   PERCENT
 DRAINAGE LENGTH              =    150.0    FEET

                              LAYER  8
                              --------

                TYPE 4 - FLEXIBLE MEMBRANE LINER
                    MATERIAL TEXTURE NUMBER  35
 THICKNESS                    =      0.06   INCHES
 POROSITY                     =      0.0000 VOL/VOL
 FIELD CAPACITY               =      0.0000 VOL/VOL
 WILTING POINT                =      0.0000 VOL/VOL
 INITIAL SOIL WATER CONTENT   =      0.0000 VOL/VOL
 EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
 FML PINHOLE DENSITY          =      0.00   HOLES/ACRE
 FML INSTALLATION DEFECTS     =      0.00   HOLES/ACRE
 FML PLACEMENT QUALITY        =  1 - PERFECT

                              LAYER  9
                              --------

                TYPE 3 - BARRIER SOIL LINER
                    MATERIAL TEXTURE NUMBER  17
 THICKNESS                    =      0.24   INCHES
 POROSITY                     =      0.7500 VOL/VOL
 FIELD CAPACITY               =      0.7470 VOL/VOL
 WILTING POINT                =      0.4000 VOL/VOL
 INITIAL SOIL WATER CONTENT   =      0.7500 VOL/VOL
 EFFECTIVE SAT. HYD. COND.    =  0.300000003000E-08 CM/SEC
```


24" drainage

12" LCRS

Short

60 mil GM

EXCELLENT

GCL


```
                TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER  16
 THICKNESS                    =     12.00   INCHES
 POROSITY                     =      0.4270 VOL/VOL
 FIELD CAPACITY               =      0.4180 VOL/VOL
 WILTING POINT                =      0.3670 VOL/VOL
 INITIAL SOIL WATER CONTENT   =      0.4088 VOL/VOL
 EFFECTIVE SAT. HYD. COND.    =  0.100000001000E-06 CM/SEC

          GENERAL DESIGN AND EVAPORATIVE ZONE DATA
          ---------------------------------------

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
        SOIL DATA BASE USING SOIL TEXTURE #10 WITH A
        POOR STAND OF GRASS, A SURFACE SLOPE OF  3.%
        AND A SLOPE LENGTH OF  300. FEET.

 SCS RUNOFF CURVE NUMBER             =    90.10
 FRACTION OF AREA ALLOWING RUNOFF    =   100.0    PERCENT
 AREA PROJECTED ON HORIZONTAL PLANE  =     1.000  ACRES
 EVAPORATIVE ZONE DEPTH              =    12.0    INCHES
 INITIAL WATER IN EVAPORATIVE ZONE   =     4.272  INCHES
 UPPER LIMIT OF EVAPORATIVE STORAGE  =     4.776  INCHES
 LOWER LIMIT OF EVAPORATIVE STORAGE  =     1.632  INCHES
 INITIAL SNOW WATER                  =     0.000  INCHES
 INITIAL WATER IN LAYER MATERIALS    =   609.586  INCHES
 TOTAL INITIAL WATER                 =   609.586  INCHES
 TOTAL SUBSURFACE INFLOW             =     0.00   INCHES/YEAR

          EVAPOTRANSPIRATION AND WEATHER DATA
          -----------------------------------

 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
          SAN FRANCISCO          CALIFORNIA

     STATION LATITUDE                  =  36.90 DEGREES
     MAXIMUM LEAF AREA INDEX           =   1.00
     START OF GROWING SEASON (JULIAN DATE) =  78
     END OF GROWING SEASON (JULIAN DATE)   = 328
     EVAPORATIVE ZONE DEPTH            =  12.0  INCHES
     AVERAGE ANNUAL WIND SPEED         =  10.50 MPH
     AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  75.00 %
     AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  71.00 %
     AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  73.00 %
     AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  74.00 %

 NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
          COEFFICIENTS FOR    SAN FRANCISCO       CALIFORNIA

          NORMAL MEAN MONTHLY PRECIPITATION (INCHES)
```


12" clay liner (modelled as wet geolayer instead of barrier)

HELP limitation

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.15	3.43	3.60	1.83	0.26	0.12
0.09	0.07	0.30	1.13	3.20	3.55

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SAN FRANCISCO CALIFORNIA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
49.40	51.80	53.00	55.30	57.60	60.50
61.80	62.50	62.60	59.90	54.30	49.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SAN FRANCISCO CALIFORNIA
AND STATION LATITUDE = 36.92 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.02	3.24	3.70	1.95	0.36	0.11
	0.06	0.08	0.25	0.92	3.06	4.16
STD. DEVIATIONS	1.77	2.17	1.82	1.32	0.38	0.13
	0.12	0.11	0.41	0.92	1.88	2.07
RUNOFF						
TOTALS	2.324	1.518	0.983	0.224	0.007	0.000
	0.000	0.000	0.007	0.037	0.730	2.043
STD. DEVIATIONS	1.707	1.740	1.165	0.416	0.031	0.000
	0.000	0.000	0.033	0.074	1.008	1.501
EVAPOTRANSPIRATION						
TOTALS	1.761	2.079	2.899	2.480	1.171	0.682
	0.071	0.074	0.107	0.330	0.893	1.495
STD. DEVIATIONS	0.085	0.273	0.630	1.208	0.443	0.371
	0.117	0.112	0.171	0.349	0.494	0.333
PERCOLATION/LEAKAGE THROUGH LAYER 3						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 7						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 9						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 10						
TOTALS	0.0017	0.0014	0.0015	0.0014	0.0012	0.0005
	0.0000	0.0000	0.0000	0.0001	0.0006	0.0012
STD. DEVIATIONS	0.0026	0.0021	0.0020	0.0018	0.0013	0.0008
	0.0000	0.0000	0.0000	0.0002	0.0006	0.0015

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 2						
AVERAGES	9.9787	8.7671	7.7509	5.4879	3.0056	0.4855
	0.0000	0.0000	0.0000	0.2355	3.3379	8.6192
STD. DEVIATIONS	1.2209	1.5043	1.8075	1.3543	1.0152	0.6171
	0.0001	0.0000	0.0000	0.6117	2.5649	2.0342
DAILY AVERAGE HEAD ON TOP OF LAYER 8						
AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	21.91 (3.732)	79527.3	100.00
RUNOFF	7.873 (3.0805)	28577.30	35.934

EVAPOTRANSPIRATION	14.043 (1.8184)	50975.77	64.098
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.00016 (0.00002)	0.594	0.00075
AVERAGE HEAD ON TOP OF LAYER 2	3.972 (0.436)		
LATERAL DRAINAGE COLLECTED FROM LAYER 7	0.00016 (0.00002)	0.589	0.00074
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.00000 (0.00000)	0.005	0.00001
AVERAGE HEAD ON TOP OF LAYER 8	0.000 (0.000)		
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.00952 (0.01201)	34.564	0.04346
CHANGE IN WATER STORAGE	-0.017 (0.6013)	-60.98	-0.077

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	3.36	12196.800
RUNOFF	3.353	12172.9385
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.000001	0.00494
AVERAGE HEAD ON TOP OF LAYER 2	12.000	
DRAINAGE COLLECTED FROM LAYER 7	0.00000	0.00486
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.000000	0.00002
AVERAGE HEAD ON TOP OF LAYER 8	0.000	
MAXIMUM HEAD ON TOP OF LAYER 8	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 7 (DISTANCE FROM DRAIN)	0.0 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.000474	1.72069
SNOW WATER	0.00	1.1433

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3980

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1360

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	4.0536	0.3378
2	0.0000	0.0000
3	0.1800	0.7500
4	1.9920	0.0830
5	595.6799	0.2920
6	1.9920	0.0830
7	0.3840	0.0320
8	0.0000	0.0000
9	0.1800	0.7500
10	4.6203	0.3850
SNOW WATER	0.000	

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HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 3.07 (1 NOVEMBER 1997)
DEVELOPED BY ENVIRONMENTAL LABORATORY
USAE WATERWAYS EXPERIMENT STATION
FOR USEPA RISK REDUCTION ENGINEERING LABORATORY

PRECIPITATION DATA FILE: c:\help3\BVL4.D4
TEMPERATURE DATA FILE: c:\help3\BVL7.D7
SOLAR RADIATION DATA FILE: c:\help3\BVL13.D13
EVAPOTRANSPIRATION DATA: c:\HELP3\BVL11.D11
SOIL AND DESIGN DATA FILE: c:\help3\BVLSIDE.D10
OUTPUT DATA FILE: c:\help3\bvlside.OUT

TIME: 11:52 DATE: 11/10/2011

TITLE: BVL: Zero Leachate

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 10

THICKNESS	=	12.00 INCHES
POROSITY	=	0.3980 VOL/VOL
FIELD CAPACITY	=	0.2440 VOL/VOL
WILTING POINT	=	0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3558 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.119999997000E-03 CM/SEC

NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 1.80 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06 INCHES
POROSITY	=	0.0000 VOL/VOL
FIELD CAPACITY	=	0.0000 VOL/VOL
WILTING POINT	=	0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY	=	0.00 HOLES/ACRE
FML INSTALLATION DEFECTS	=	0.00 HOLES/ACRE
FML PLACEMENT QUALITY	=	1 - PERFECT

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 3

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.0830 VOL/VOL
WILTING POINT	=	0.0330 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0830 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.310000009000E-02 CM/SEC

LAYER 4

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	=	1080.00 INCHES
POROSITY	=	0.6710 VOL/VOL
FIELD CAPACITY	=	0.2920 VOL/VOL
WILTING POINT	=	0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02 CM/SEC

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 3

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.0830 VOL/VOL
WILTING POINT	=	0.0330 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0830 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.310000009000E-02 CM/SEC

LAYER 6

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06 INCHES
POROSITY	=	0.0000 VOL/VOL
FIELD CAPACITY	=	0.0000 VOL/VOL
WILTING POINT	=	0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY	=	0.00 HOLES/ACRE
FML INSTALLATION DEFECTS	=	0.00 HOLES/ACRE
FML PLACEMENT QUALITY	=	1 - PERFECT

LAYER 7

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 17

THICKNESS	=	0.24 INCHES
POROSITY	=	0.7500 VOL/VOL
FIELD CAPACITY	=	0.7470 VOL/VOL
WILTING POINT	=	0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000003000E-08 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #10 WITH A POOR STAND OF GRASS, A SURFACE SLOPE OF 33.% AND A SLOPE LENGTH OF 158. FEET.

SCS RUNOFF CURVE NUMBER	=	91.00	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	4.269	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	4.776	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.632	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	322.797	INCHES
TOTAL INITIAL WATER	=	322.797	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM SAN FRANCISCO CALIFORNIA

STATION LATITUDE	=	36.90 DEGREES
MAXIMUM LEAF AREA INDEX	=	1.00

START OF GROWING SEASON (JULIAN DATE)	=	78
END OF GROWING SEASON (JULIAN DATE)	=	328
EVAPORATIVE ZONE DEPTH	=	12.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	10.50 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	75.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	71.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	73.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	74.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR SAN FRANCISCO CALIFORNIA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.15	3.43	3.60	1.83	0.26	0.12
0.09	0.07	0.30	1.13	3.20	3.55

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR SAN FRANCISCO CALIFORNIA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
49.40	51.80	53.00	55.30	57.60	60.50
61.80	62.50	62.60	59.90	54.30	49.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR SAN FRANCISCO CALIFORNIA AND STATION LATITUDE = 36.92 DEGREES

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.02	3.24	3.70	1.95	0.36	0.11
	0.06	0.08	0.25	0.92	3.06	4.16
STD. DEVIATIONS	1.77	2.17	1.82	1.32	0.38	0.13
	0.12	0.11	0.41	0.92	1.88	2.07
RUNOFF						
TOTALS	2.320	1.523	1.014	0.245	0.009	0.000
	0.000	0.000	0.009	0.048	0.759	2.053

STD. DEVIATIONS	1.702	1.739	1.168	0.419	0.039	0.000
	0.000	0.000	0.041	0.092	0.994	1.485
EVAPOTRANSPIRATION						
TOTALS	1.762	2.067	2.881	2.454	1.169	0.684
	0.070	0.075	0.106	0.329	0.857	1.482
STD. DEVIATIONS	0.084	0.293	0.632	1.194	0.440	0.389
	0.115	0.113	0.170	0.344	0.499	0.363
PERCOLATION/LEAKAGE THROUGH LAYER 2						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 7						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 2						
AVERAGES	9.9565	8.7632	7.7392	5.4783	3.0178	0.4950
	0.0000	0.0000	0.0000	0.2152	3.2496	8.6178
STD. DEVIATIONS	1.2231	1.4874	1.7769	1.3961	1.0546	0.6638
	0.0000	0.0000	0.0000	0.5770	2.5159	1.9615
DAILY AVERAGE HEAD ON TOP OF LAYER 6						
AVERAGES	0.0063	0.0064	0.0065	0.0066	0.0066	0.0066
	0.0066	0.0066	0.0066	0.0066	0.0066	0.0067
STD. DEVIATIONS	0.0038	0.0038	0.0038	0.0038	0.0038	0.0038
	0.0038	0.0038	0.0038	0.0038	0.0038	0.0038

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	21.91 (3.732)	79527.3	100.00
RUNOFF	7.981 (3.1086)	28970.00	36.428

EVAPOTRANSPIRATION	13.934 (1.8338)	50581.46	63.603
PERCOLATION/LEAKAGE THROUGH LAYER 2	0.00016 (0.00002)	0.593	0.00075
AVERAGE HEAD ON TOP OF LAYER 2	3.961 (0.432)		
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00000 (0.00000)	0.009	0.00001
AVERAGE HEAD ON TOP OF LAYER 6	0.007 (0.004)		
CHANGE IN WATER STORAGE	-0.007 (0.5932)	-24.22	-0.030

PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	3.36	12196.800
RUNOFF	3.353	12172.9912
PERCOLATION/LEAKAGE THROUGH LAYER 2	0.000001	0.00494
AVERAGE HEAD ON TOP OF LAYER 2	12.000	
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00002
AVERAGE HEAD ON TOP OF LAYER 6	0.013	
SNOW WATER	0.00	1.1433
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3980	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1360	

FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	4.0644	0.3387
2	0.0000	0.0000

3	1.9920	0.0830
4	315.3600	0.2920
5	1.0009	0.0834
6	0.0000	0.0000
7	0.1800	0.7500
SNOW WATER	0.000	

Geosyntec consultants

Written by: FWS Date: 14/07/08 (DD MM YY) Reviewed by: _____ Date: ___/___/___ (DD MM YY)

Client: Cosch Project: PPCMP Project/Proposal No. WG1019 Task No. 9

COMPARE INFILTRATION THROUGH FINAL COVER | TOP DECK

(1) Compare between prescriptive (SubD) and proposed alternative.

(2) Area where infiltration is expected to be the highest are the flatter areas of the top deck.

(3) Use HELP analysis to compare infiltration.

(4) SubD – 1' VEG layer ($k = 1.2\times10^{-4}$ cm/sec)
Geomembrane (1 hole/acre, good installation)
1' compacted clay liner ($k = 1\times10^{-7}$ cm/sec)
2' Foundation layer (same material as veg. layer).

ALT – 1' VEG layer ($k = 1.2\times10^{-4}$ cm/sec)
Geomembrane (1 hole/acre, good installation)
GCL
2' Foundation layer (same material as veg. layer).

(5) Use DEFAULT soils in HELP model. (Sandy soils)

(6) Use flattest area + longest drainage length
3%, 450' and for grass (i.e., immediately after closure)

(7) Since we are comparing relative performance conclusions would not vary by changing soil properties.

(8) ASSUME DOUBLE-SIDED TEXTURED HDPE GM.

Geosyntec consultants

Written by: FWS Date: 14/07/08 (DD MM YY) Reviewed by: _____ Date: ___/___/___ (DD MM YY)

Client: GCSC Project: PPCMP Project/Proposal No. WG1019 Task No. 01

Layer	SUB D Description		ALTERNATIVE	
#1	VEG.	VERT. PERC.	VEG.	VERT. PERC.
#2	GM	FML	GM	FML
→ #3	CCL	BARRIER	GCL	BARRIER
#4	FOUND.	VERT PERC	FOUND.	VERT. PERC.

	SUB D	ALTERNATIVE
PEAK DAILY PERC. / LEAK. LAYER 3	0.000011	0.000004
AVG ANNUAL TOT PERC. / LEAK LAYER 3	0.00131	0.00047

As can be observed the Alternative results in lower percolation ∴ better expected performance.

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 *******************************************************************************
 **                                                                           **
 **                                                                           **
 **              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                **
 **                   HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)              **
 **                   DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
 **                   USAE WATERWAYS EXPERIMENT STATION                       **
 **              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
 **                                                                           **
 **                                                                           **
 *******************************************************************************
 *******************************************************************************

 PRECIPITATION DATA FILE:    c:\help3\bvl2\BVL4.D4
 TEMPERATURE DATA FILE:      c:\help3\bvl2\BVL7.D7
 SOLAR RADIATION DATA FILE:  c:\help3\bvl2\BVL13.D13
 EVAPOTRANSPIRATION DATA:    c:\help3\bvl2\BVL11.D11
 SOIL AND DESIGN DATA FILE:  c:\help3\bvl2\BVLD~1.D10
 OUTPUT DATA FILE:           c:\help3\bvl2\BVLD 1.OUT

 TIME:  13:34     DATE:  7/17/2008

 *******************************************************************************

      TITLE:  BVL: final cover - Sub D

 *******************************************************************************


      NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
             COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                    LAYER  1
                                    --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER  10
     THICKNESS                     =     12.00   INCHES
     POROSITY                      =      0.3980 VOL/VOL
     FIELD CAPACITY                =      0.2440 VOL/VOL
     WILTING POINT                 =      0.1360 VOL/VOL
     INITIAL SOIL WATER CONTENT    =      0.3560 VOL/VOL
     EFFECTIVE SAT. HYD. COND.     =  0.119999997000E-03 CM/SEC
     NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
            FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                    LAYER  2
                                    --------
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                  TYPE 4 - FLEXIBLE MEMBRANE LINER
                       MATERIAL TEXTURE NUMBER  35
     THICKNESS                     =      0.06   INCHES
     POROSITY                      =      0.0000 VOL/VOL
     FIELD CAPACITY                =      0.0000 VOL/VOL
     WILTING POINT                 =      0.0000 VOL/VOL
     INITIAL SOIL WATER CONTENT    =      0.0000 VOL/VOL
     EFFECTIVE SAT. HYD. COND.     =  0.199999996000E-12 CM/SEC
     FML PINHOLE DENSITY           =      1.00   HOLES/ACRE
     FML INSTALLATION DEFECTS      =      1.00   HOLES/ACRE
     FML PLACEMENT QUALITY         =  3 - GOOD


                                    LAYER  3
                                    --------

                  TYPE 3 - BARRIER SOIL LINER
                       MATERIAL TEXTURE NUMBER  16
     THICKNESS                     =     12.00   INCHES
     POROSITY                      =      0.4270 VOL/VOL
     FIELD CAPACITY                =      0.4180 VOL/VOL
     WILTING POINT                 =      0.3670 VOL/VOL
     INITIAL SOIL WATER CONTENT    =      0.4270 VOL/VOL
     EFFECTIVE SAT. HYD. COND.     =  0.100000001000E-06 CM/SEC


                                    LAYER  4
                                    --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER  3
     THICKNESS                     =     24.00   INCHES
     POROSITY                      =      0.4570 VOL/VOL
     FIELD CAPACITY                =      0.0830 VOL/VOL
     WILTING POINT                 =      0.0330 VOL/VOL
     INITIAL SOIL WATER CONTENT    =      0.0830 VOL/VOL
     EFFECTIVE SAT. HYD. COND.     =  0.310000009000E-02 CM/SEC


                  GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                  ----------------------------------------

     NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
            SOIL DATA BASE USING SOIL TEXTURE #10 WITH A
            POOR STAND OF GRASS, A SURFACE SLOPE OF  3.%
            AND A SLOPE LENGTH OF  450. FEET.

     SCS RUNOFF CURVE NUMBER             =     89.90
     FRACTION OF AREA ALLOWING RUNOFF    =     100.0    PERCENT
     AREA PROJECTED ON HORIZONTAL PLANE  =      1.000   ACRES
     EVAPORATIVE ZONE DEPTH              =     12.0     INCHES
     INITIAL WATER IN EVAPORATIVE ZONE   =      4.272   INCHES
     UPPER LIMIT OF EVAPORATIVE STORAGE  =      4.776   INCHES
     LOWER LIMIT OF EVAPORATIVE STORAGE  =      1.632   INCHES
     INITIAL SNOW WATER                  =      0.000   INCHES
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     INITIAL WATER IN LAYER MATERIALS    =     11.388  INCHES
     TOTAL INITIAL WATER                 =     11.388  INCHES
     TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR


                  EVAPOTRANSPIRATION AND WEATHER DATA
                  -----------------------------------

     NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
            SAN FRANCISCO           CALIFORNIA

          STATION LATITUDE                      =  36.90 DEGREES
          MAXIMUM LEAF AREA INDEX               =   1.00
          START OF GROWING SEASON (JULIAN DATE) =     78
          END OF GROWING SEASON (JULIAN DATE)   =    328
          EVAPORATIVE ZONE DEPTH                =  12.0  INCHES
          AVERAGE ANNUAL WIND SPEED             =  10.50 MPH
          AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  75.00 %
          AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  71.00 %
          AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  73.00 %
          AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  74.00 %


     NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR     SAN FRANCISCO       CALIFORNIA

          NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

     JAN/JUL    FEB/AUG    MAR/SEP    APR/OCT    MAY/NOV    JUN/DEC
     -------    -------    -------    -------    -------    -------
      4.15       3.43       3.60       1.83       0.26       0.12
      0.09       0.07       0.30       1.13       3.20       3.55


     NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR     SAN FRANCISCO       CALIFORNIA

          NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

     JAN/JUL    FEB/AUG    MAR/SEP    APR/OCT    MAY/NOV    JUN/DEC
     -------    -------    -------    -------    -------    -------
     49.40      51.80      53.00      55.30      57.60      60.50
     61.80      62.50      62.60      59.90      54.30      49.30


     NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR     SAN FRANCISCO       CALIFORNIA
              AND STATION LATITUDE  =  36.92 DEGREES

 *******************************************************************************

      AVERAGE MONTHLY VALUES IN INCHES FOR YEARS     1 THROUGH    30
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                              JAN/JUL    FEB/AUG    MAR/SEP    APR/OCT    MAY/NOV    JUN/DEC
                              -------    -------    -------    -------    -------    -------
 PRECIPITATION
 -------------
   TOTALS                      4.02       3.24       3.70       1.95       0.36       0.11
                               0.06       0.08       0.25       0.92       3.06       4.16

   STD. DEVIATIONS             1.77       2.17       1.82       1.32       0.38       0.13
                               0.12       0.11       0.41       0.92       1.88       2.07

 RUNOFF
 ------
   TOTALS                      2.324      1.517      0.980      0.220      0.007      0.000
                               0.000      0.000      0.007      0.034      0.709      2.052

   STD. DEVIATIONS             1.707      1.740      1.166      0.417      0.030      0.000
                               0.000      0.000      0.032      0.070      0.997      1.524

 EVAPOTRANSPIRATION
 ------------------
   TOTALS                      1.762      2.081      2.903      2.485      1.175      0.675
                               0.071      0.074      0.107      0.331      0.905      1.495

   STD. DEVIATIONS             0.086      0.275      0.624      1.216      0.450      0.368
                               0.116      0.112      0.171      0.354      0.508      0.336

 PERCOLATION/LEAKAGE THROUGH LAYER  3
 -------------------------------------
   TOTALS                      0.0003     0.0002     0.0002     0.0002     0.0001     0.0000
                               0.0000     0.0000     0.0000     0.0000     0.0001     0.0002

   STD. DEVIATIONS             0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
                               0.0000     0.0000     0.0000     0.0000     0.0001     0.0001

 PERCOLATION/LEAKAGE THROUGH LAYER  4
 -------------------------------------
   TOTALS                      0.0004     0.0003     0.0003     0.0002     0.0001     0.0000
                               0.0000     0.0000     0.0000     0.0000     0.0001     0.0004

   STD. DEVIATIONS             0.0001     0.0001     0.0001     0.0001     0.0000     0.0000
                               0.0000     0.0000     0.0000     0.0000     0.0001     0.0001

 ------------------------------------------------------------------------------
          AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
 ------------------------------------------------------------------------------

 DAILY AVERAGE HEAD ON TOP OF LAYER  2
 -------------------------------------
   AVERAGES                    9.9813     8.7700     7.7556     5.4591     2.9665     0.4657
                               0.0000     0.0000     0.0000     0.2319     3.3801     8.6415

   STD. DEVIATIONS             1.2190     1.5035     1.8207     1.3816     0.9739     0.6097
                               0.0001     0.0000     0.0000     0.6010     2.5469     2.0366

 *******************************************************************************
```

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES		CU. FEET	PERCENT
PRECIPITATION	21.91	(3.732)	79527.3	100.00
RUNOFF	7.850	(3.0815)	28495.22	35.831
EVAPOTRANSPIRATION	14.064	(1.8195)	51052.54	64.195
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.00131	(0.00014)	4.757	0.00598
AVERAGE HEAD ON TOP OF LAYER 2	3.971	(0.431)		
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00185	(0.00023)	6.698	0.00842
CHANGE IN WATER STORAGE	-0.007	(0.6011)	-27.20	-0.034

****

****

PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	3.36	12196.800
RUNOFF	3.353	12172.8594
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.000011	0.03880
AVERAGE HEAD ON TOP OF LAYER 2	12.000	
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000031	0.11320
SNOW WATER	0.00	1.1433

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3980
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1360

****

****

FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	4.0637	0.3386
2	0.0000	0.0000
3	5.1240	0.4270
4	1.9757	0.0823
SNOW WATER	0.000	

****

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**
** HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
** HELP MODEL VERSION 3.07 (1 NOVEMBER 1997)
** DEVELOPED BY ENVIRONMENTAL LABORATORY
** USAE WATERWAYS EXPERIMENT STATION
** FOR USEPA RISK REDUCTION ENGINEERING LABORATORY
**
**
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****

PRECIPITATION DATA FILE: c:\help3\bvl2\BVL4.D4
TEMPERATURE DATA FILE: c:\help3\bvl2\BVL7.D7
SOLAR RADIATION DATA FILE: c:\help3\bvl2\BVL13.D13
EVAPOTRANSPIRATION DATA: c:\help3\bvl2\BVL11.D11
SOIL AND DESIGN DATA FILE: c:\help3\bvl2\BVL-AC2.D10
OUTPUT DATA FILE: c:\help3\bvl2\BVL-AC2.OUT

Alternative with GCL.

TIME: 13:38 DATE: 7/17/2008

****

TITLE: BVL: final cover - Alternative w. GCL

****

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 10

THICKNESS	=	12.00	INCHES
POROSITY	=	0.3980	VOL/VOL
FIELD CAPACITY	=	0.2440	VOL/VOL
WILTING POINT	=	0.1360	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3560	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.119999997000E-03	CM/SEC

12" Veg

NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 1.80 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	1.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	1.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 3

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 17

THICKNESS	=	0.24	INCHES
POROSITY	=	0.7500	VOL/VOL
FIELD CAPACITY	=	0.7470	VOL/VOL
WILTING POINT	=	0.4000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.7500	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000003000E-08	CM/SEC

GCL

LAYER 4

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 3

THICKNESS	=	24.00	INCHES
POROSITY	=	0.4570	VOL/VOL
FIELD CAPACITY	=	0.0830	VOL/VOL
WILTING POINT	=	0.0330	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0830	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.310000009000E-02	CM/SEC

24" Fundation

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #10 WITH A POOR STAND OF GRASS, A SURFACE SLOPE OF 3.% AND A SLOPE LENGTH OF 450. FEET.

SCS RUNOFF CURVE NUMBER	=	89.90	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	4.272	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	4.776	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.632	INCHES
INITIAL SNOW WATER	=	0.000	INCHES

INITIAL WATER IN LAYER MATERIALS	=	6.441	INCHES
TOTAL INITIAL WATER	=	6.441	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM SAN FRANCISCO CALIFORNIA

STATION LATITUDE	=	36.90	DEGREES
MAXIMUM LEAF AREA INDEX	=	1.00	
START OF GROWING SEASON (JULIAN DATE)	=	78	
END OF GROWING SEASON (JULIAN DATE)	=	328	
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	10.50	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	75.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	71.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	73.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	74.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR SAN FRANCISCO CALIFORNIA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.15	3.43	3.60	1.83	0.26	0.12
0.09	0.07	0.30	1.13	3.20	3.55

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR SAN FRANCISCO CALIFORNIA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
49.40	51.80	53.00	55.30	57.60	60.50
61.80	62.50	62.60	59.90	54.30	49.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR SAN FRANCISCO CALIFORNIA AND STATION LATITUDE = 36.92 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.02	3.24	3.70	1.95	0.36	0.11
	0.06	0.08	0.25	0.92	3.06	4.16
STD. DEVIATIONS	1.77	2.17	1.82	1.32	0.38	0.13
	0.12	0.11	0.41	0.92	1.88	2.07
RUNOFF						
TOTALS	2.324	1.517	0.980	0.221	0.007	0.000
	0.000	0.000	0.007	0.034	0.709	2.052
STD. DEVIATIONS	1.707	1.740	1.166	0.417	0.030	0.000
	0.000	0.000	0.032	0.070	0.997	1.524
EVAPOTRANSPIRATION						
TOTALS	1.762	2.081	2.903	2.469	1.197	0.668
	0.071	0.074	0.107	0.331	0.906	1.496
STD. DEVIATIONS	0.086	0.275	0.624	1.198	0.462	0.359
	0.116	0.112	0.171	0.354	0.509	0.336
PERCOLATION/LEAKAGE THROUGH LAYER 3						
TOTALS	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 2						
AVERAGES	9.9812	8.7700	7.7537	5.4647	2.9756	0.4553
	0.0000	0.0000	0.0000	0.2321	3.3801	8.6390
STD. DEVIATIONS	1.2197	1.5048	1.8251	1.3874	0.9750	0.5930
	0.0001	0.0000	0.0000	0.6015	2.5473	2.0352

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES		CU. FEET	PERCENT
PRECIPITATION	21.91	(3.732)	79527.3	100.00
RUNOFF	7.850	(3.0813)	28494.89	35.830
EVAPOTRANSPIRATION	14.066	(1.8211)	51058.86	64.203
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.00047	(0.00006)	1.693	0.00213
AVERAGE HEAD ON TOP OF LAYER 2	3.971	(0.431)		
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00053	(0.00007)	1.915	0.00241
CHANGE IN WATER STORAGE	-0.008	(0.6009)	-28.42	-0.036

****

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	3.36	12196.800
RUNOFF	3.353	12172.9482
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.000004	0.01620
AVERAGE HEAD ON TOP OF LAYER 2	12.000	
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000014	0.05154
SNOW WATER	0.00	1.1433

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3980

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1360

****

****

FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	4.0389	0.3366

2	0.0000	0.0000
3	0.1770	0.7500
4	1.9901	0.0829
SNOW WATER	0.000	

****

****

APPENDIX D
Final Cover Slope Stability Analyses and Related Calculations

Geosyntec consultants

Written by: FWS Date: 11/07/08 (DD MM YY) Reviewed by: _____ Date: ____/____/____ (DD MM YY)

Client: CoSA Project: PPCMP Project/Proposal No. WG019 Task No. 01

INFINITE SLOPE ANALYSIS

(1) Use methodology by Matasovic (1991).

(2) Flow is // to the slope.

(3) long-term static FS = 1.5 (no seepage, dry)

(4) short-term static FS = 1.3

(5) Seismic - need to meet 12" to 36" based on the WDRs.

(6) ASSUME DOUBLE-SIDED TEXTURED HDPE GM.

DISCUSSION / RESULTS

(a) Final cover will include geosynthetics.

(b) For 3:1 (H:V) slopes, we need approx. 26.3° to achieve long-term factor of safety = 1.5

(c) For 26.3° slopes and the selected we obtain a field acceleration = 0.13g

(d) Using the results from the seismic re-evaluation we obtain a deformation of 19 inches which is within the range discussed in the WDRs.

Cover Stability Analyses

The cover stability analyses is performed using the infinite slope approach. The expression for the factor of safety is provided by Matasovic [1991] as follows:

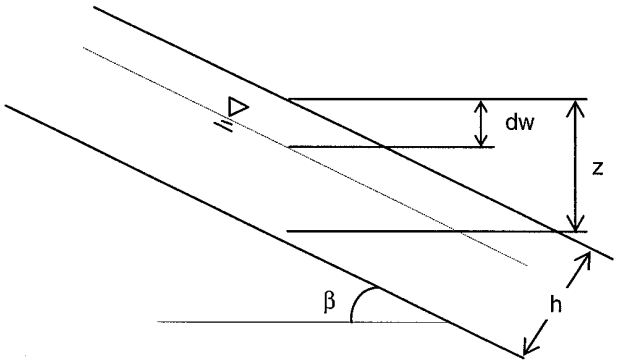
$$FS = \frac{\left(\frac{c}{\gamma\ z\cos^2\beta}\right) + \tan\phi\left[1 - \left(\frac{\gamma_w (z - d_w)}{\gamma\ z}\right)\right] - k_s \tan\beta\ \tan\phi}{k_s + \tan\beta}$$

Equation (1)

where:

c = cohesion / adhesion (psf)
γ = unit weight of cover soil (pcf)
γ_w = unit weight of water (pcf)
z = vertical thickness of the layer (ft)
β = slope angle (degrees)
ϕ = friction angle (degrees)
d_w = vertical depth to water table (ft)
k_s = seismic coefficient
FS = factor of safety

The expressions are explained in the figure.



And based on geometry:

$$z = \frac{h}{\cos\ \beta}$$

Equation (2)

Static Condition:

Under static conditions, the value of $k_s = 0$. Therefore, equation (1) can be modified to the following fo

$$FS = \frac{\left(\frac{c}{\gamma\ z\cos^2\beta}\right) + \tan\phi\ \left[1 - \left(\frac{\gamma_w (z - d_w)}{\gamma\ z}\right)\right]}{\tan\beta}$$ Equation (3)

Case A: No water table is present on the slope, i.e. dw = z. This is considered to be a long-term condition. Consequently, equation (3) is modified to the following form:

$$FS = \frac{\left(\frac{c}{\gamma\ z\cos^2\beta}\right) + \tan\phi}{\tan\beta}$$ Equation (4)

Case B: Water table is assumed to be at depth dw = 0.5 ft. This is considered to be a short-term condition, therefore, Equation (3) is used.

Seismic Condition:

The value of seismic coeffcient, k_s is estimated considering factor of safety, FS = 1. (Note: seismic coefficient = yield acceleration, i.e. $k_s = k_y$). The seismic coefficient is calculated only for the long-term condition, i.e. it has been assumed that seismicity and seepage will not occur simultaneously. Therefore, equation (1) can be modified to provide an expression for k_s, as follows:

$$k_s = \frac{\left(\frac{c}{\gamma\ z\cos^2\beta}\right) + \tan\phi - \tan\beta}{1 + \tan\phi\ \tan\beta}$$ Equation (5)

Reference:

Matasovic, N., "Selection of Method for Seismic Slope Stability Analyses", *Proceedings of Second International Conference on Recent Advances in Geotechnical Engineering and Soil Dynamics,* St. Louis, Missouri, Paper No. 7.20, 1991, pp. 1057-1062.

Calculations

The following values have been assumed in the analyses:

γ = 120 pcf
γ_w = 62.4 pcf
h = 1 ft
dw = 0 ft
c = 0 to 50 psf
ϕ = 20 to 30 degrees

Calculation of slope angle

Horizontal	Vertical	tanβ	Slope Angle (β)		z
			rad	degrees	ft
3	1	0.333	0.3218	18.435	1.054

Static Conditions:

Case A: No seepage (long-term condition). Equation (4) is used to calculate FS:

c		Factor of Safety					
(psf)	ϕ =	20	22	24	26	28	30
0		1.09	1.21	1.34	1.46	1.60	1.73
10		1.36	1.48	1.60	1.73	1.86	2.00
20		1.62	1.74	1.86	1.99	2.12	2.26
30		1.88	2.00	2.13	2.25	2.39	2.52
40		2.15	2.27	2.39	2.52	2.65	2.79
50		2.41	2.53	2.65	2.78	2.91	3.05

$\phi = 26°$
$c = 0$ psf
$FS_{ST} = 1.5$

Case B: Seepage (water at final cover surface) (short-term condition). Equation (3) is used to calculate FS:

c		Factor of Safety					
(psf)	ϕ =	20	22	24	26	28	30
0		0.52	0.58	0.64	0.70	0.77	0.83
10		0.79	0.85	0.90	0.97	1.03	1.09
20		1.05	1.11	1.17	1.23	1.29	1.36
30		1.31	1.37	1.43	1.49	1.56	1.62
40		1.58	1.64	1.70	1.76	1.82	1.89
50		1.84	1.90	1.96	2.02	2.08	2.15

Seismic Condition:

Only long-term condition is considered (it is assumed that seepage and seismicity do not occur simultaneously). Equation (5) is used to calculate ks:

c		k_s					
(psf)	ϕ =	20	22	24	26	28	30
0		0.03	0.06	0.10	0.13	0.17	0.20
10		0.11	0.14	0.17	0.21	0.24	0.28
20		0.18	0.22	0.25	0.28	0.32	0.35
30		0.26	0.29	0.33	0.36	0.39	0.43
40		0.34	0.37	0.40	0.44	0.47	0.50
50		0.42	0.45	0.48	0.51	0.54	0.57

$\phi = 26°$
$c = 0$ psf
$k_H = 0.13g$

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SEISMIC SITE RESPONSE AND DEFORMATION ANALYSIS
BUENA VISTA LANDFILL
WATSONVILLE, CALIFORNIA

INTRODUCTION

This analysis package presents the selection of ground motions, seismic site response and deformation potential analyses performed for Buena Vista Drive Sanitary landfill, (BVDSL) at Watsonville, California. The analyses are based upon the results of the seismic hazard performed by Geosyntec [2003]. Geosyntec [2003] identified that the Maximum Probable Earthquake (MPE) at the site is either a Moment Magnitude (M_w) 6.2 event on the Zayante-Vergales Fault or M_w 7.9 event on the San Andreas fault system.

Geosyntec estimated the seismic hazard at the site using the Next Generation Attenuation (NGA) Relationships, developed as part of a research project by the Pacific Earthquake Engineering Research Center. The NGA relationships are widely acknowledged as representing the earthquake profession's best scientific understanding of ground motion attenuation. They have been adopted by the U.S. Geologic Survey in its National Hazard Mapping Project, and on critical projects such as the BART Earthquake Safety Program. A total of 8 ground motions were selected and their intensity was appropriately scaled to fit the target response spectrum at the site. One-dimensional equivalent-linear site response analyses for two representative waste columns (100 ft and 160 ft high) were then performed. Based on the results of the seismic response analyses, Newmark-type seismic deformation analyses were performed. The results of the seismic deformation analyses are presented in the form of charts relating calculated permanent seismic displacement to yield acceleration. These charts were developed for the landfill waste mass and for the cover.

The BVDSL is approximately 2.5 miles (4 km) west of Watsonville, California. The approximate location of the BVDSL is shown on Figure 1. Geotechnical investigations indicate that the soil conditions below the landfill consist primarily of native soils composed of dense silty and clayey sands and gravel [County of Santa Cruz, 1999].

The report was prepared by Dimitrios Zekkos, Ph.D., P.E., and reviewed by Jonathan D. Bray, Ph.D., P.E., and Hari Sharma, Ph.D., P.E., G.E., in accordance with Geosyntec's review policy.

COVER SLIDING, 100-FT COLUMN

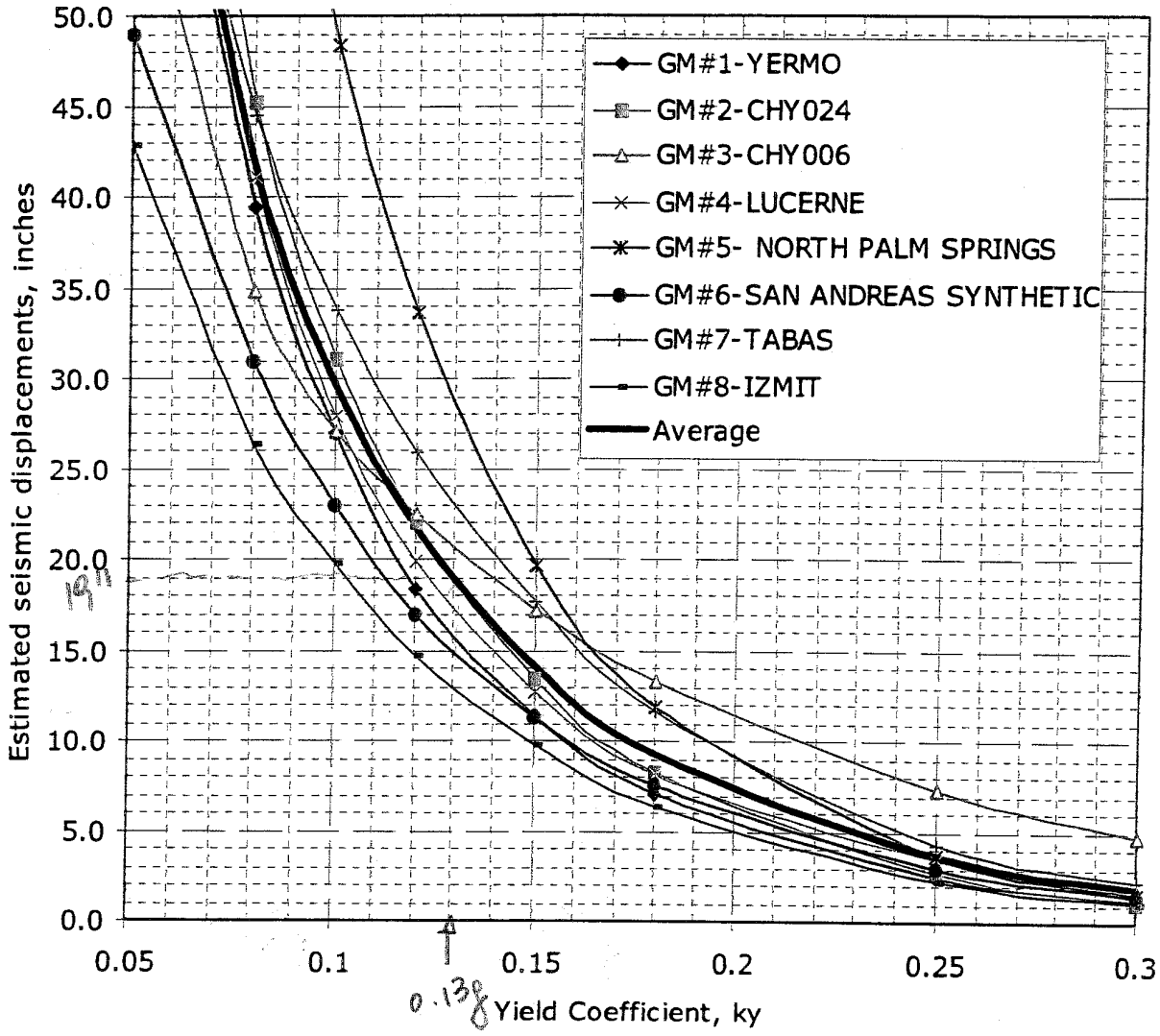


Figure 16: Seismic Displacements Estimates

December 2007	Buena Vista Landfill Santa Cruz, California	Geosyntec consultants

COVER SLIDING, 160-FT COLUMN

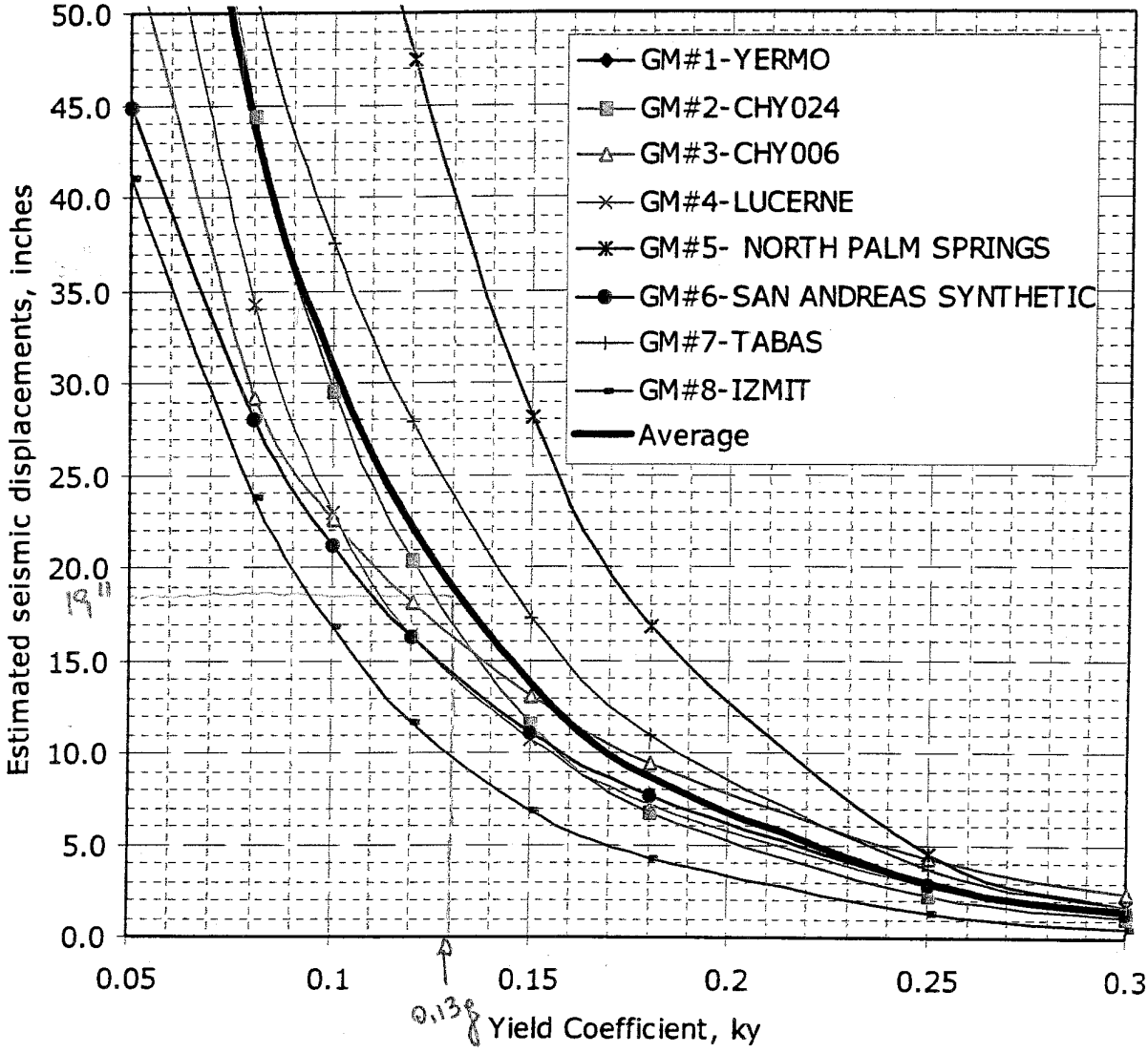


Figure 18: Seismic Displacements Estimates

December 2007	Buena Vista Landfill Santa Cruz, California	Geosyntec consultants

PERMEABILITY TEST

EMCON/OWT, Inc.
A Shaw Group Company

ASTM D5084

PROJECT NAME:	BUENA VISTA LF.- FINAL COVER	**LAB. NUMBER:**	03-085
SAMPLE NUMBER:	DP-1, 2, 3, 4 & 5	**PROJECT NUMBER:**	837998
DESCRIPTION:	CLAYEY SAND WITH GRAVEL, BROWN.	**SAMPLE DEPTH:**	REMOLDED
CHECKED BY:		**DATE:**	09/10/03
		TESTED BY:	DGC

Remolded to 85% of max. dry density at opt. + 7% water content.

SAMPLE DATA		BEFORE TEST	AFTER TEST	OVEN DRY		
DIAMETER	(cm)	7.28	7.04	TARE NUMBER		Q
HEIGHT	(cm)	6.40	6.32	WT. OF TARE+WET SOIL	(gm)	716.80
VOLUME	(cc)	266.264	245.885	WT. OF TARE+DRY SOIL	(gm)	640.50
WT. OF WET SOIL	(gm)	528.7	531.2	WT. OF TARE	(gm)	185.60
WT. OF DRY SOIL	(gm)	454.9	454.9	WT. OF WATER	(gm)	76.30
WT. OF WATER	(gm)	73.8	76.30	WT. OF DRY SOIL	(gm)	454.9
MOISTURE CONTENT	(%)	16.2	16.8	WATER CONTENT	(%)	16.8
DRY DENSITY	(pcf)	106.61	115.44	LAB. MAX. DRY DENSITY	(pcf)	125.5
VOID RATIO	(e)	0.58	0.46	OPT. WATER CONTENT	(%)	9.2
SATURATION	(s)	75.5	98.6	RELATIVE COMPACTION	(%)	85
POROSITY	(h)	0.3672	0.3148	SPECIFIC GRAVITY	(est.)	2.7

PRESSURE DATA DURING PERMEABILITY TEST:

"B" parameter	0.98	**Area of Burette:**	0.6 sq. cm.
CONFINING PRESS.	55 psi	**Temp. Correction:**	0.976 21 °C
BACK PRESS. (bot)	50 psi	**BACK PRESS. (top)**	50 psi.
AVERAGE CONSOL. PRESSURE:	5.0 psi		
PERMEANT:	*TAP WATER*		

DATE	TIME	ELAPSED TIME (sec)	STATUS RESET	BURETTE READING					
				TOP PRESS. (psi.)		BOTTOM PRESS. (psi.)		CHAMBER PRESS.,(psi.)	COMMENTS
SATURATION:									**Skempton's "B"**
9/10/2003	7:52			50.0		50.0		51.0	49.8
9/10/2003	13:12							61.0	59.6
CONSOLIDATION:				TOP (cm)	ΔT (cm.)	BOT. (cm)	ΔB (cm.)	CHAMBER (cm)	
PERMEABILITY:									
9/11/2003	5:29	RESET	R	9.7		35.2		14.0	PERM., (cm/sec.)
9/11/2003	5:35	360		16.6		28.1		13.9	1.1E-04
9/11/2003	5:36	RESET	R	9.8		35.1		13.9	PERM., (cm/sec.)
9/11/2003	5:42	360		16.8		28.0		13.9	1.1E-04
9/11/2003	5:43	RESET	R	9.8		35.2		13.9	PERM., (cm/sec.)
9/11/2003	5:49	360		16.8		28.2		13.9	1.1E-04
9/11/2003	5:50	RESET	R	9.7		35.1		13.9	PERM., (cm/sec.)
9/11/2003	5:56	360		16.7		28.1		13.9	1.1E-04
									δγχ93πμ

ATTERBERG LIMITS

ASTM D4318

Shaw EMCON/OWT, Inc.

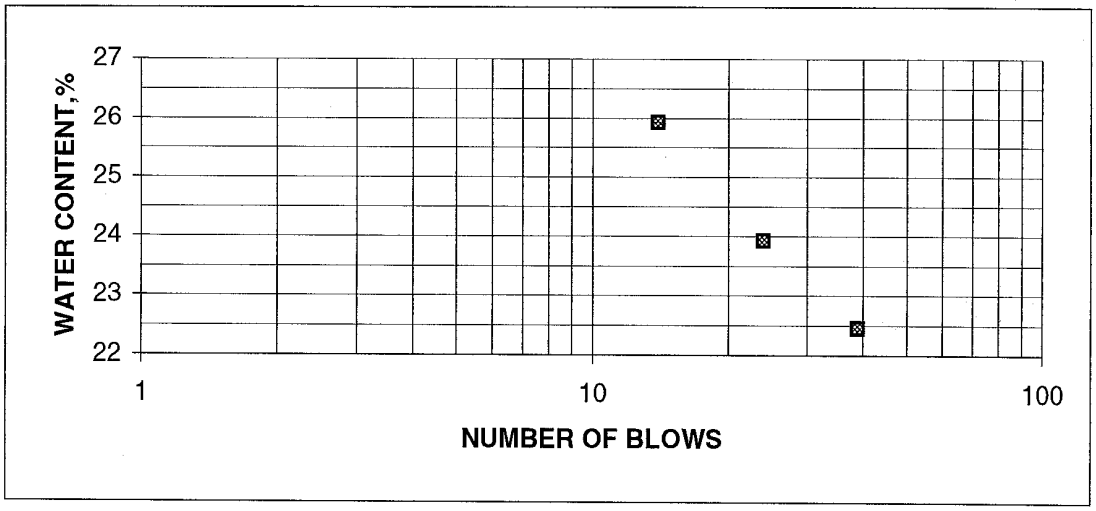
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WL0612-02

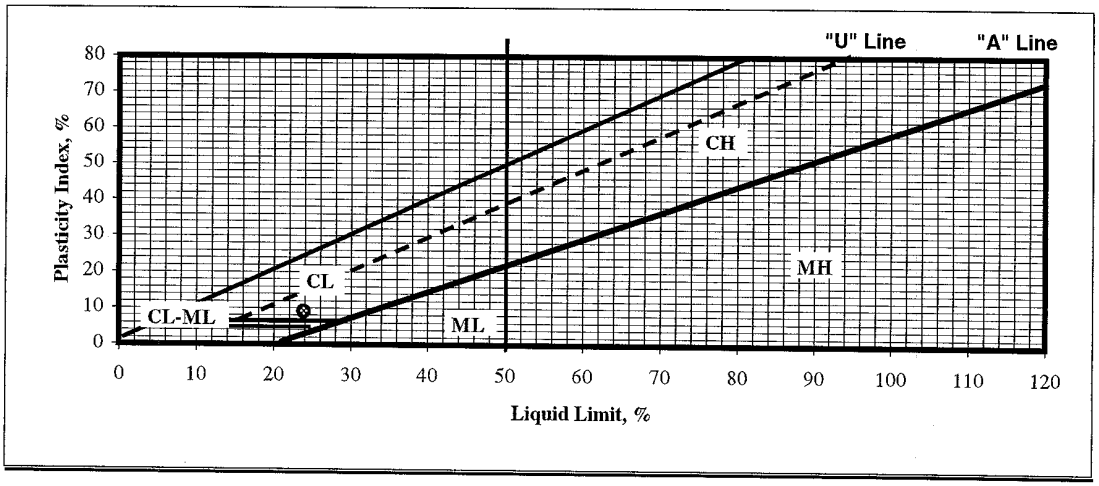
Project Name:	BV LF. FINAL COVER	**Lab. No.:**	03-081	**Proj. No.:**	837998
Sample No.:	DP-1,2,3,4 & 5	**Depth, ft.:**	COMB.	**Date:**	09/02/03
Description:	CLAYEY SAND WITH GRAVEL, BROWN.			**Tested By:**	DGC
				Checked By:	

*/	Liquid Limit			Plastic Limit		
Can Number	B-3	E-4	C-1	F-6	B-7	
Weight of Can + Wet Soil, gms.	68.49	65.37	67.01	47.17	46.54	
Weight of Can + Dry Soil, gms.	61.83	58.89	59.81	45.12	44.58	
Weight of Can, gms.	32.18	31.80	32.04	31.93	31.83	
Weight of Dry Soil, gms.	29.65	27.09	27.77	13.19	12.75	
Weight of Water, gms.	6.66	6.48	7.20	2.05	1.96	
Water Content, %	22.5	23.9	25.9	15.5	15.4	
Number of Blows	39	24	14			

Unified Soil Classification **SC**



LL=	24	PL=	15	PI=	9



δγχ93ατ

GRAIN SIZE DISTRIBUTION

ASTM D422

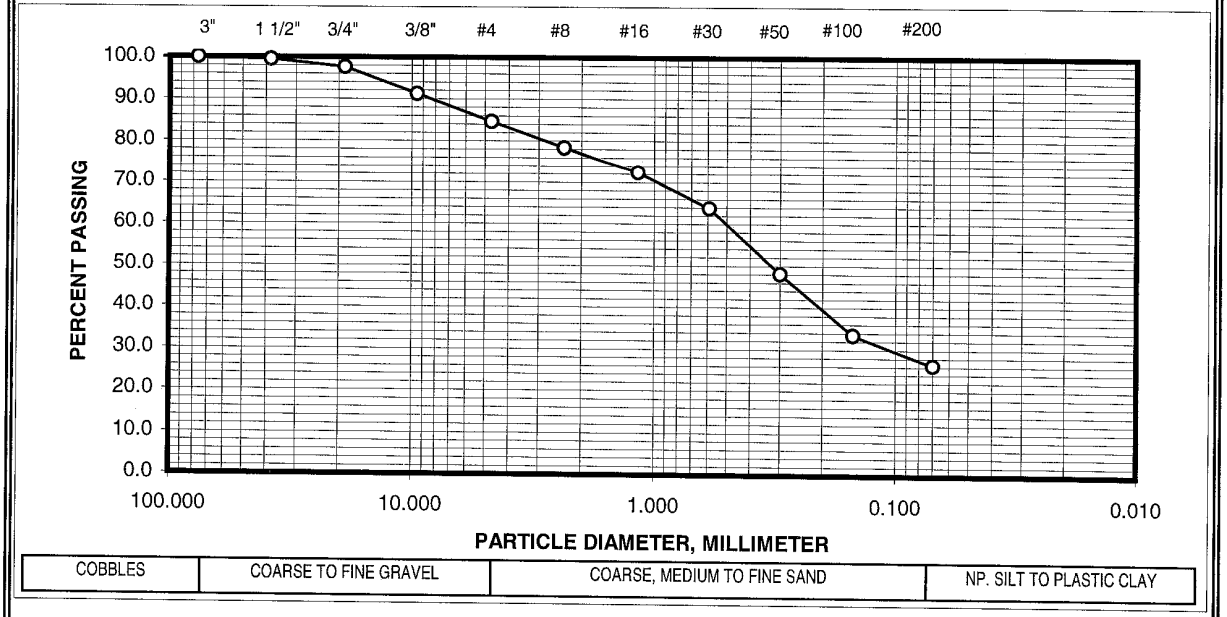
Shaw EMCON/OWT, Inc.
A Shaw Group Company

		LAB. NO.:	03-081
PROJECT NAME:	BUENA VISTA FINAL COVER	PROJECT NO.:	837998
SAMPLE NO.:	DP-1, 2, 3, 4 & 5 COMBINE	DATE:	09/02/03
DESCRIPTION:	CLAYEY SAND WITH GRAVEL, BROWN.	TECH.:	KJVC

UNIFIED SOIL CLASSIFICATION:	SC	CORRECTIONS:	
Moisture Content Determination:		1 1/2"	99.5
Pan Number:	#93	3/4"	97.6
Pan + Wet Soil, gms.	967.6	3/8"	91.2
Pan + Dry Soil, gms.	916.1	D_{60}	N/A
Wt. of Pan, gms.	176.2	D_{30}	N/A
Wt. of Dry Soil, gms.	739.9	D_{10}	0.000
Wt. of Water, gms.	51.5	C_U	N/A
Water content, %.	7.0	C_C	N/A

Liquid Limit:	24
Plasticity Index:	9
High; Mod.; Low; NP:	

SIEVE SIZE (U.S. STANDARD)	PARTICLE SIZE, (inches)	PARTICLES DIAMETER, (mm)	WEIGHT RETAINED (gms)	ACCUMULATED WEIGHT RETAINED (gms)	WEIGHT PASSING (gms)	PERCENT PASSING (%)
5"	5.000	127.00		0	739.9	100.0
3"	3.000	76.20		0	739.9	100.0
1 1/2"	1.500	38.10		0	739.9	99.5
3/4"	0.750	18.90		0	739.9	97.6
3/8"	0.375	9.52		0	739.9	91.2
#4	0.185	4.70	53.30	53.3	686.6	84.6
#8	0.093	2.36	51.20	104.5	635.4	78.3
#16	0.046	1.17	48.20	152.7	587.2	72.4
#30	0.023	0.59	69.60	222.3	517.6	63.8
#50	0.012	0.30	127.30	349.6	390.3	48.1
#100	0.006	0.15	119.20	468.8	271.1	33.4
#200	0.003	0.07	57.90	526.7	213.2	26.3



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COMPACTION TEST

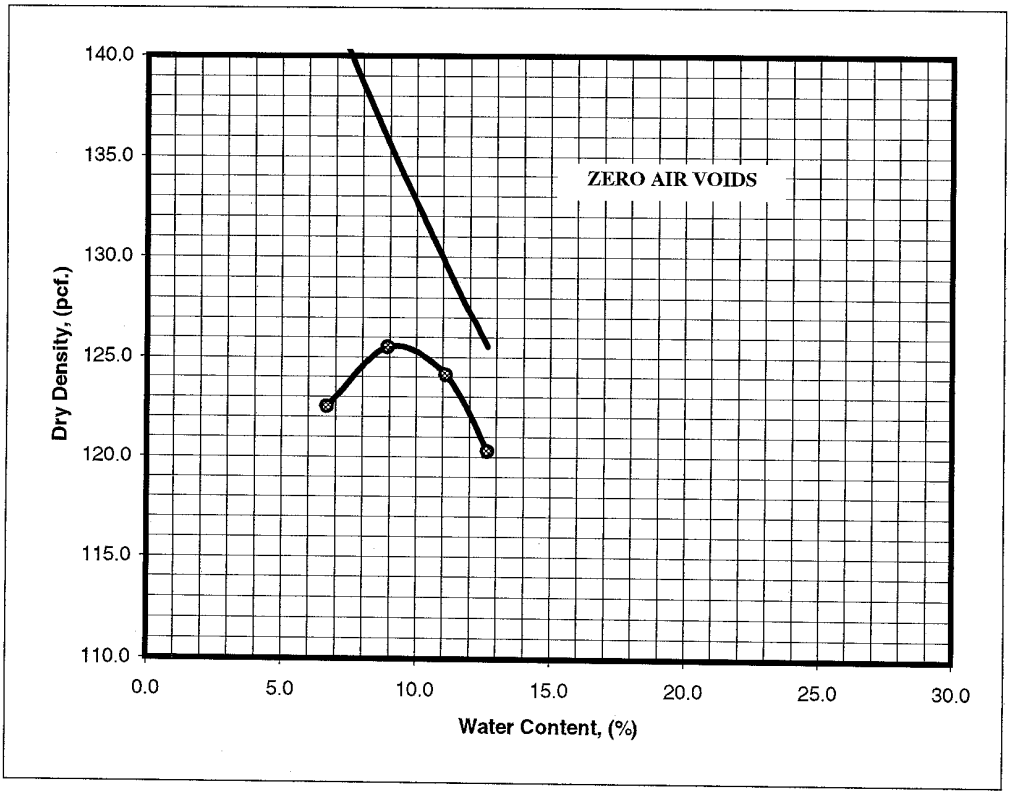
EMCON/OWT, Inc.
A Shaw Group Company

■ ASTM D1557
□ ASTM D698

Project Name:	BV LF. FINAL COVER	**Proj. No.:**	837998	**Checked By:**	DGC
Sample No.:	DP-1,2,3,4,&5	**Depth, ft.:**	BULK	**Lab. No.:**	03-081
Description:	CLAYEY SAND WITH GRAVEL, BROWN.			**Tested By:**	KJVC
				Date:	09/03/03
Vol., Mold, cf.:	0.03333	**Hammer Weight,:**	10 lbs.	**Hammer Drop:**	18"
No. of Layers:	5	**Blows/Layer:**	25	**ASTM Designation:**	
				Method:	"B"

Trial Number		Nat.	2	4	6	
Container Number		B	A	C	D	
Wet Soil + Container	(gms.)	756.80	748.30	820.70	888.60	
Dry Soil + Container	(gms.)	716.30	696.10	749.80	801.10	
Container Weight	(gms.)	110.40	111.50	111.50	111.00	
Weight of Water	(gms.)	40.50	52.20	70.90	87.50	
Weight of Dry Soil	(gms.)	605.90	584.60	638.30	690.10	
Moisture Content	(%)	6.7	8.9	11.1	12.7	
Wet Soil + Mold	(gms.)	3944	4035	4053	4017	
Weight of Mold	(gms.)	1968	1968	1968	1968	
Wet Weight of Soil	(lbs.)	4.36	4.56	4.60	4.52	
Wet Unit Weight	(pcf.)	130.7	136.7	137.9	135.5	
Dry Unit Weight	(pcf.)	122.5	125.5	124.1	120.3	

Maximum Dry Density, pcf.:	125.5
Opt. Moisture Content, %:	9.2
Est. Specific Gravity:	2.70



δγχ93χομπ

ATTERBERG LIMITS

ASTM D4318

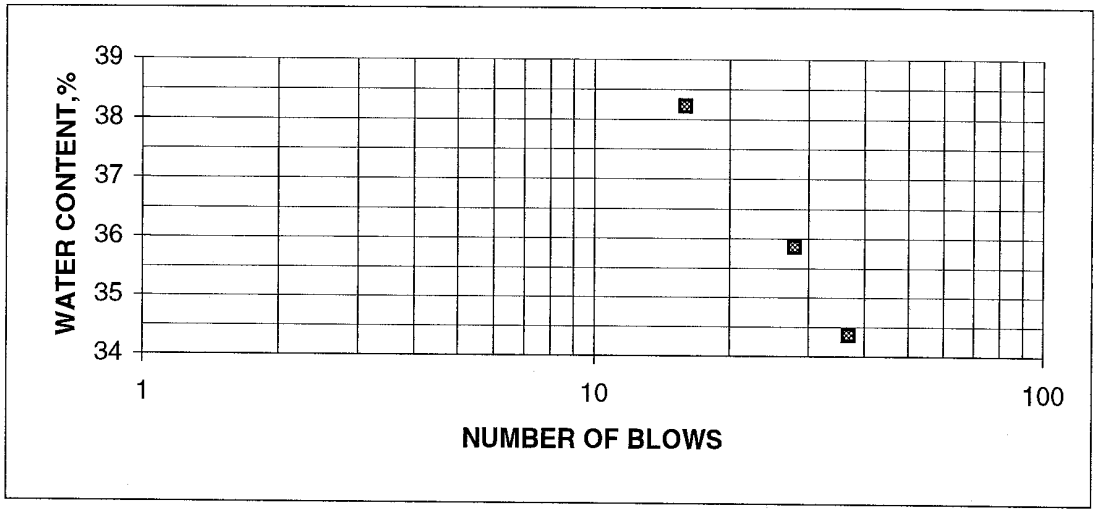
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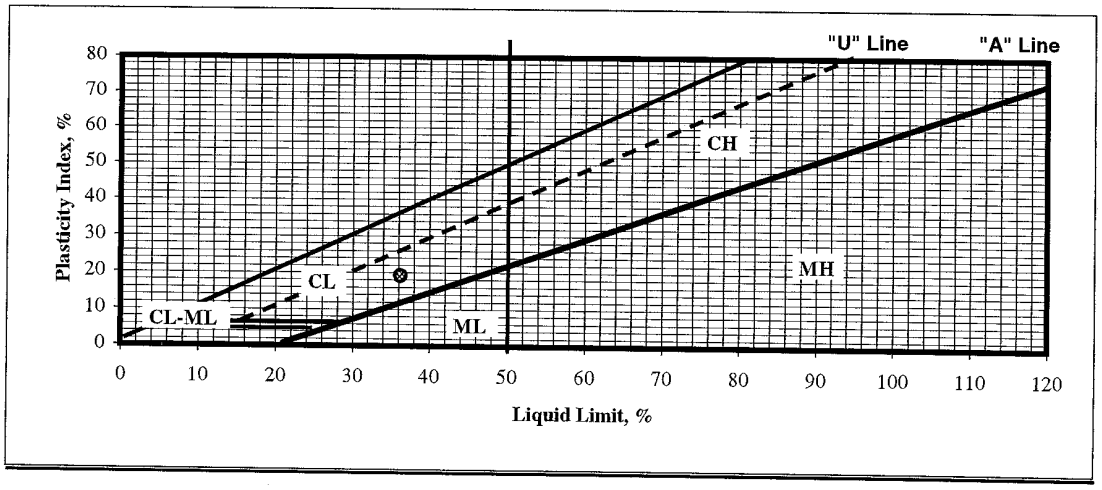
Project Name:	BV LF. FINAL COVER	**Lab. No.:**	03-081	**Proj. No.:**	WL0612-02 837998
Sample No.:	DP-6, 7	**Depth, ft.:**	BUCKET	**Date:**	09/05/03
Description:	CLAYEY SAND, BROWN.			**Tested By:**	DGC
				Checked By:	

*/	Liquid Limit			Plastic Limit		
Can Number	B-6	A-8	C-2	B-1	D-6	
Weight of Can + Wet Soil, gms.	64.07	66.28	67.50	43.87	43.94	
Weight of Can + Dry Soil, gms.	55.87	57.20	57.72	42.15	42.17	
Weight of Can, gms.	32.01	31.88	32.13	32.10	31.91	
Weight of Dry Soil, gms.	23.86	25.32	25.59	10.05	10.26	
Weight of Water, gms.	8.20	9.08	9.78	1.72	1.77	
Water Content, %	34.4	35.9	38.2	17.1	17.3	
Number of Blows	37	28	16			

Unified Soil Classification **SC**



LL=	36	PL=	17	PI=	19



δγχ93ατ

GRAIN SIZE DISTRIBUTION

ASTM D422

Shaw EMCON/OWT, Inc.

A Shaw Group Company

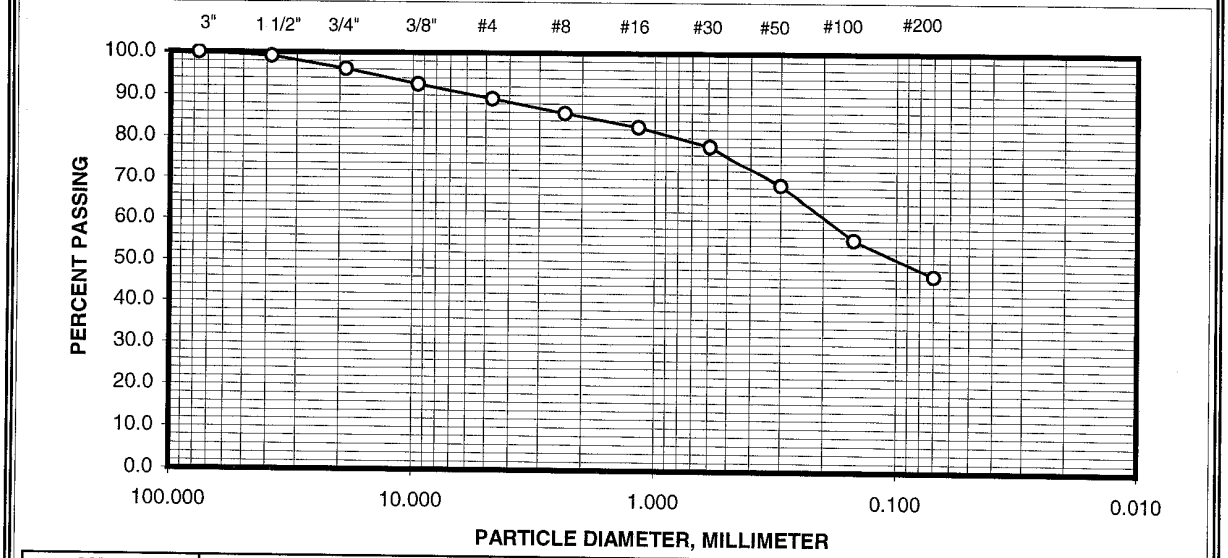
PROJECT NAME:	BUENA VISTA FINAL COVER	LAB. NO.:	03-081
SAMPLE NO.:	DP-6 & 7	PROJECT NO.:	837998
DESCRIPTION:	CLAYEY SAND, BROWN.	DATE:	09/02/03
		TECH.:	KJVC

UNIFIED SOIL CLASSIFICATION:	SC
Moisture Content Determination:	
Pan Number:	#94
Pan + Wet Soil, gms.	1044.5
Pan + Dry Soil, gms.	886.1
Wt. of Pan, gms.	176.3
Wt. of Dry Soil, gms.	709.8
Wt. of Water, gms.	158.4
Water content, %.	22.3

CORRECTIONS:	
1 1/2"	99.1
3/4"	96.1
3/8"	92.5
D_{60}	N/A
D_{30}	N/A
D_{10}	0.000
C_U	N/A
C_C	N/A

Liquid Limit:	36
Plasticity Index:	19
High; Mod.; Low; NP:	

SIEVE SIZE (U.S. STANDARD)	PARTICLE SIZE, (inches)	PARTICLES DIAMETER, (mm)	WEIGHT RETAINED (gms)	ACCUMULATED WEIGHT RETAINED (gms)	WEIGHT PASSING (gms)	PERCENT PASSING (%)
5"	5.000	127.00		0	709.8	100.0
3"	3.000	76.20		0	709.8	100.0
1 1/2"	1.500	38.10		0	709.8	99.1
3/4"	0.750	18.90		0	709.8	96.1
3/8"	0.375	9.52		0	709.8	92.5
#4	0.185	4.70	26.10	26.1	683.7	89.1
#8	0.093	2.36	25.90	52	657.8	85.7
#16	0.046	1.17	24.90	76.9	632.9	82.5
#30	0.023	0.59	34.90	111.8	598.0	77.9
#50	0.012	0.30	72.30	184.1	525.7	68.5
#100	0.006	0.15	101.00	285.1	424.7	55.3
#200	0.003	0.07	67.30	352.4	357.4	46.6



COBBLES	COARSE TO FINE GRAVEL	COARSE, MEDIUM TO FINE SAND	NP. SILT TO PLASTIC CLAY

δγχ93σϖ

COMPACTION TEST

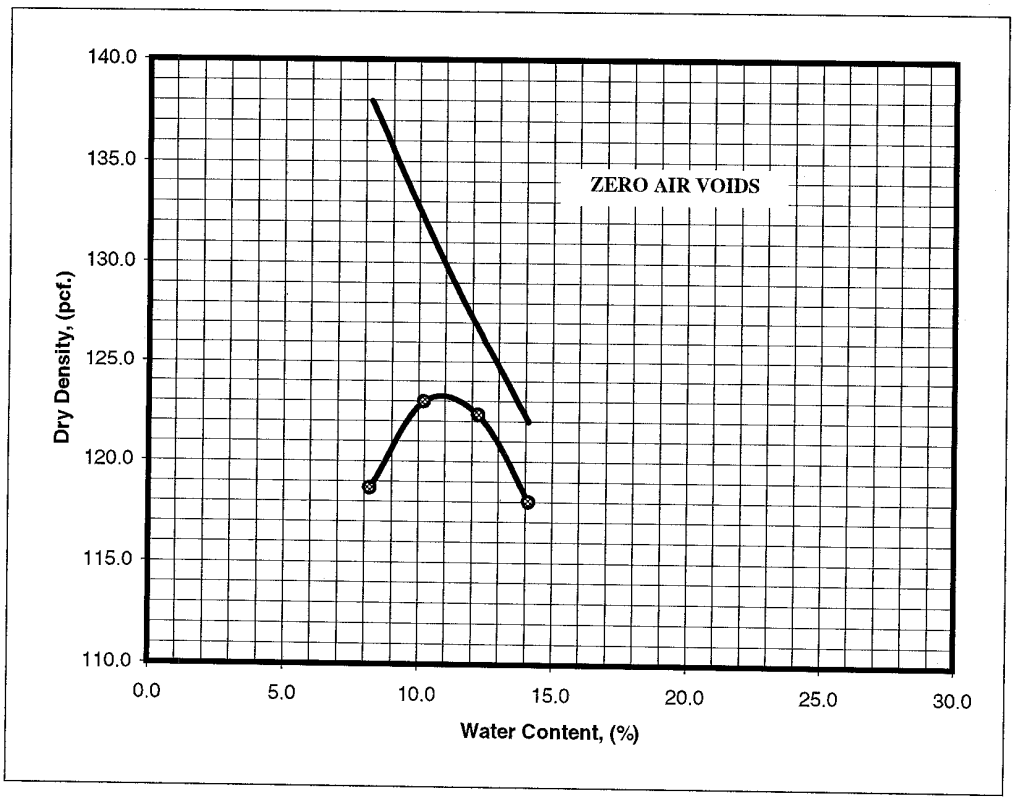
EMCON/OWT, Inc.
A Shaw Group Company

■ ASTM D1557
□ ASTM D698

Project Name:	BV LF. FINAL COVER	**Proj. No.:**	837998	**Checked By:**	
Sample No.:	DP-6, 7	**Depth, ft.:**	BULK	**Lab. No.:**	03-081
Description:	CLAYEY SAND, BROWN.			**Tested By:**	DGC
				Date:	09/08/03
Vol., Mold, cf.:	0.03333	**Hammer Weight,:**	10 lbs.	**Hammer Drop:**	18"
No. of Layers:	5	**Blows/Layer:**	25	**ASTM Designation:**	
				Method:	"B"

Trial Number		Air Dry	2	4	6	
Container Number		#6	Q	A-1	#43	
Wet Soil + Container	(gms.)	1149.20	1183.20	1146.80	1062.20	
Dry Soil + Container	(gms.)	1077.60	1090.80	1041.50	952.50	
Container Weight	(gms.)	204.20	185.60	180.90	175.70	
Weight of Water	(gms.)	71.60	92.40	105.30	109.70	
Weight of Dry Soil	(gms.)	873.40	905.20	860.60	776.80	
Moisture Content	(%)	8.2	10.2	12.2	14.1	
Wet Soil + Mold	(gms.)	3909	4017	4044	4004	
Weight of Mold	(gms.)	1968	1968	1968	1968	
Wet Weight of Soil	(lbs.)	4.28	4.52	4.58	4.49	
Wet Unit Weight	(pcf.)	128.4	135.5	137.3	134.7	
Dry Unit Weight	(pcf.)	118.6	123.0	122.3	118.0	

Maximum Dry Density, pcf.:	123.2
Opt. Moisture Content, %:	11.0
Est. Specific Gravity:	2.70



δγχ93χομπ

Geosyntec consultants

Written by: JAB Date: 16/7/08 Reviewed by: [illegible] Date: ___/___/___

Client: COSC Project: PPCMP Project/Proposal No. WG1019 Task No. 01

- The GSE method for designing geocomposites for final cover drainage was used to determine the appropriate pipe spacing on side slopes.
- Slope → 3:1 ✓
- On site materials are similar to HELP material #10 with a $K = 1.2 \times 10^{-4}$ cm/s. ✓ (check available site-specific soils)
- Transmissivity of GSE geocomposite (8 oz/yd²) was used to back calculate the drainage spacing.
  - $\Theta_{product}$ (m²/s) = 9.00×10^{-9}
- A factor of safety of 6.6 was used and is based on a combination of reduction factors (clogging, creep, etc.) (See attached GSE design procedures for more details)
  - $\Theta_{actual} = \Theta_{product} \cdot FS = 1.36 \times 10^{-9}$ m²/s.

Resulting estimated pipe spacing = 36 m ≈ 100 ft.

Buena Vista Drive Sanitary Landfill
Evaluate Drainage Geocomposite
WG1019- Final Cover Geocomposite Analysis Using GSE Drainage Manual design method

- Input variable is the geocomposite transmissivity to find length
with GSE geocomposite

HELP Default Soil #10

β (degrees)	18.43
t_{cover} (ft)	1
γ_{cover} (psf)	110
k_{cover} (cm/s)	1.20E-04
k_{cover} (m/s)	1.20E-06
FS	6.6
q_i (m/s)	1.20E-06
L (m)	36
$\Theta_{product}$ (m^2/s)	9.00E-04
Θ_{actual} (m^2/s)	1.36E-04

Reduction factors:

FSd	3	*(particulate clogging)*
RFcc	1	*(soil alkalinity)*
RFbc	2	*(root growth)*
RFcr	1.1	*(creep)*

FS	6.6

TABLE 4. DEFAULT SOIL, WASTE, AND GEOSYNTHETIC CHARACTERISTICS

Classification			Total Porosity	Field Capacity	Wilting Point	Saturated Hydraulic Conductivity
HELP	USDA	USCS	vol/vol	vol/vol	vol/vol	cm/sec
1	CoS	SP	0.417	0.045	0.018	1.0×10^{-2}
2	S	SW	0.437	0.062	0.024	5.8×10^{-3}
3	FS	SW	0.457	0.083	0.033	3.1×10^{-3}
4	LS	SM	0.437	0.105	0.047	1.7×10^{-3}
5	LFS	SM	0.457	0.131	0.058	1.0×10^{-3}
6	SL	SM	0.453	0.190	0.085	7.2×10^{-4}
7	FSL	SM	0.473	0.222	0.104	5.2×10^{-4}
8	L	ML	0.463	0.232	0.116	3.7×10^{-4}
9	SiL	ML	0.501	0.284	0.135	1.9×10^{-4}
10	SCL	SC	0.398	0.244	0.136	1.2×10^{-4}
11	CL	CL	0.464	0.310	0.187	6.4×10^{-5}
12	SiCL	CL	0.471	0.342	0.210	4.2×10^{-5}
13	SC	SC	0.430	0.321	0.221	3.3×10^{-5}
14	SiC	CH	0.479	0.371	0.251	2.5×10^{-5}
15	C	CH	0.475	0.378	0.265	1.7×10^{-5}
16	Barrier Soil		0.427	0.418	0.367	1.0×10^{-7}
17	Bentonite Mat (0.6 cm)		0.750	0.747	0.400	3.0×10^{-9}
18	Municipal Waste (900 lb/yd^3 or 312 kg/m^3)		0.671	0.292	0.077	1.0×10^{-3}
19	Municipal Waste (channeling and dead zones)		0.168	0.073	0.019	1.0×10^{-3}
20	Drainage Net (0.5 cm)		0.850	0.010	0.005	$1.0 \times 10^{+1}$
21	Gravel		0.397	0.032	0.013	3.0×10^{-1}
22	L*	ML	0.419	0.307	0.180	1.9×10^{-5}
23	SiL*	ML	0.461	0.360	0.203	9.0×10^{-6}
24	SCL*	SC	0.365	0.305	0.202	2.7×10^{-6}
25	CL*	CL	0.437	0.373	0.266	3.6×10^{-6}
26	SiCL*	CL	0.445	0.393	0.277	1.9×10^{-6}
27	SC*	SC	0.400	0.366	0.288	7.8×10^{-7}
28	SiC*	CH	0.452	0.411	0.311	1.2×10^{-6}
29	C*	CH	0.451	0.419	0.332	6.8×10^{-7}
30	Coal-Burning Electric Plant Fly Ash*		0.541	0.187	0.047	5.0×10^{-5}
31	Coal-Burning Electric Plant Bottom Ash*		0.578	0.076	0.025	4.1×10^{-3}
32	Municipal Incinerator Fly Ash*		0.450	0.116	0.049	1.0×10^{-2}
33	Fine Copper Slag*		0.375	0.055	0.020	4.1×10^{-2}
34	Drainage Net (0.6 cm)		0.850	0.010	0.005	$3.3 \times 10^{+1}$

* Moderately Compacted

(Continued)

GSE®

GSE STANDARD PRODUCTS

Product Data Sheet

GSE FabriNet UF Geocomposites

GSE FabriNet UF geocomposite consists of GSE HyperNet UF geonet heat-laminated on one or both sides with a GSE nonwoven needlepunched geotextile. GSE HyperNet UF is a 300 mil thick geonet manufactured from a premium grade high density polyethylene resin. For the purpose of lamination to geonets, GSE nonwoven needlepunched geotextiles are available in mass per unit area range of 6 oz/yd^2 (200 g/m^2) to 16 oz/yd^2 (540 g/m^2). GSE FabriNet UF geocomposites are designed and formulated to perform drainage function under a range of anticipated site loads, gradients and boundary conditions. Index properties for the product are provided in the table below. Please contact GSE for further information regarding performance under site-specific conditions.

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE ROLL VALUE[d]		
Geocomposite			**6 oz/yd^2**	**8 oz/yd^2**	**10 oz/yd^2**
Product Code:			F82060060T	F82080080T	F82100100T
Transmissivity[a], gal/min/ft (m^2/sec)	ASTM D 4716-00	1/540,000 ft^2	4.35 (9.0 x 10^{-4})	4.35 (9.0 x 10^{-4})	4.35 (9.0 x 10^{-4})
Ply Adhesion, lb/in (g/cm)	GRI GC-7	1/50,000 ft^2	1.0 (178)	1.0 (178)	1.0 (178)
Roll Width, ft (m)			15.0 (4.5)	15.0 (4.5)	15.0 (4.5)
Roll Length, ft (m)			160 (48)	150 (45)	140 (42)
Roll Area, ft^2 (m^2)			2,400 (223)	2,250 (209)	2,100 (195)
Geonet core[b]					
Transmissivity[a], gal/min/ft (m^2/sec)	ASTM D 4716-00		38.64 (8 x 10^{-3})	38.64 (8 x 10^{-3})	38.64 (8 x 10^{-3})
Thickness, mil (mm)	ASTM D 5199	1/50,000 ft^2	300 (7.6)	300 (7.6)	300 (7.6)
Density, g/cm^3	ASTM D 1505	1/50,000 ft^2	0.94	0.94	0.94
Tensile Strength (MD), lb/in (N/mm)	ASTM D 5035	1/50,000 ft^2	75 (13.3)	75 (13.3)	75 (13.3)
Carbon Black Content, %	ASTM D 1603	1/50,000 ft^2	2.0	2.0	2.0
Geotextile (prior to lamination)[b,c]					
Mass per Unit Area, oz/yd^2 (g/m^2)	ASTM D 5261	1/90,000 ft^2	6 (200)	8 (270)	10 (335)
Grab Tensile, lb (N)	ASTM D 4632	1/90,000 ft^2	170 (755)	220 (975)	260 (1,155)
Puncture Strength, lb (N)	ASTM D 4833	1/90,000 ft^2	90 (395)	120 (525)	165 (725)
AOS, US Sieve (mm)	ASTM D 4751	1/540,000 ft^2	70 (0.212)	80 (0.180)	100 (0.150)
Permittivity, (sec^{-1})	ASTM D 4491	1/540,000 ft^2	1.5	1.5	1.2
Flow Rate, gpm/ft^2 (l/min/m^2)	ASTM D 4491	1/540,000 ft^2	110 (4,480)	110 (4,480)	85 (3,460)
UV Resistance, % Retained	ASTM D 4355 (after 500 hours)	once per formulation	70	70	70

NOTES:

- [a]Gradient of 0.1, normal load of 10,000 psf, water at 70° F (20° C), between stainless steel plates for 15 minutes.
- [b]Component properties prior to lamination. Net thickness is a typical value.
- [c]Several geotextiles are available and may be supplied as determined by GSE.
- [d]These are MARV values and are based on the cumulative results of specimens tested by GSE. AOS in mm is a maximum average roll value.

DS066 R06/01/04

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CHAPTER 6
DESIGN EXAMPLES

6.1 Final Cover Drainage Geocomposite Design

The purpose of this design example is to show the process involved in designing and approving a geocomposite for use as the final cover drainage layer in a landfill cover system. The process is illustrated in Section 5.2 and typically involves the following steps:

1. Choose appropriate values for input parameters
2. Establish design input flow rate (i.e., impingement rate, q_i)
3. Solve for required transmissivity, θ_{req}
4. Establish allowable transmissivity, θ_{allow}
5. Select an appropriate product
6. Develop specifications
7. Obtain lab testing results
8. Determine product acceptability. If not acceptable, either redesign (return to Step 1) or select new product (return to Step 5).

Step 1 – Choose Input Parameter Values

Several of the input parameters are derived from the geometry of the design. For this example, Figure 6.1 shows a simplified design that will be used in selecting these geometric input parameters. Each of the input parameters is discussed below:

- Slope angle of side slope, $\beta = 18.43$ degrees (from design drawing Figure 6.1)
- Max. horizontal drainage length of side slope, L = 30m (from design drawings; distance between benches/ditches; make sure geocomposite "daylights" or drains into a pipe)
- Thickness of cover system, t_{cover} = 0.6 m (from design drawing Figure 6.1; regulations typically require cover thickness of at least 2 feet)
- Unit weight of cover soil, γ_{cover} = 17.3 kN/m^3 (typically ranges from 100 to 130 pcf; should correspond to soil type that will be used for protective soil)
- Permeability of cover protective soil, $k_{cover} = 1 \times 10^{-4}$ cm/s (should correspond to soil type that will be used for protective soil)

Step 2 – Establish Design Input Flow Rate (Impingement Rate, q_i)

Assume Unit Gradient Method for the design:

$q_i = k_{cover} = 1 \times 10^{-4}$ cm/s = 1×10^{-6} m/s

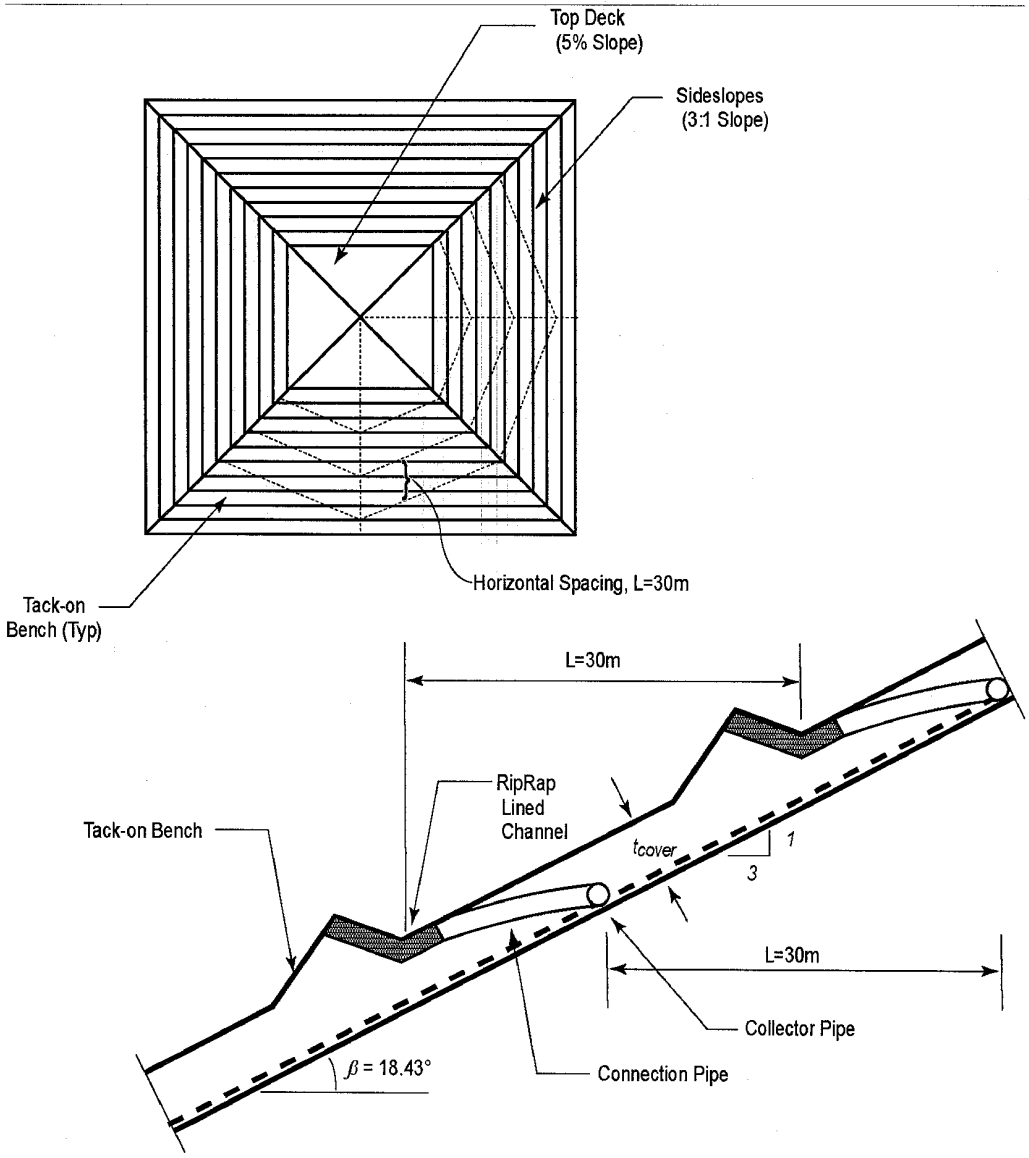


Figure 6.1 – Schematic showing design geometry of example problem.

Step 3 – Solve for Required Transmissivity

Use the following equation to solve for the required transmissivity (θ_{req}):

$$\theta_{req} = \frac{q_i \cdot L}{\sin\beta}$$

For the design example side slope,

$$\theta_{req} = \frac{k_{cover} \cdot L}{\sin\beta} = \frac{1\times10^{-6}\,m/s \cdot 30m}{0.3162} = 9.49\times10^{-5}\,m^2/s$$

Step 4 – Solve for Allowable Transmissivity

The required transmissivity, θ_{req}, as calculated above, is increased to account for uncertainties (in the form of an overall factor of safety) and the long-term reduction of the transmissivity of the geocomposite due to anticipated environmental factors (in the form of reduction factors).

$$\theta_{allow} = \theta_{req} * FS_D * RF_{CC} * RF_{BC} * RF_{CR}$$

For the design example:

- FS_D = 3.0 (accounts for uncertainty associated with inflow rate and the potential for particulate clogging)
- RF_{CC} = 1.0 (See Table 4.4 - ranges from 1.0 to 1.2 based on alkalinity of protective soil; if soil is not alkaline in nature, then this can be ignored and set equal to 1.0)
- RF_{BC} = 2.0 (See Table 4.4 - ranges from 1.2 to 3.5 based on anticipated biological growth environment; allow that potential root penetration could reduce transmissivity by half)
- RF_{CR} = 1.1 = see Table 4.5 = Contact manufacturers of products being considered

For side slope,

$$\theta_{allow} = 9.49 \times 10^{-5} \text{ m}^2/\text{sec} * 3.0 * 1.0 * 2.0 * 1.1$$
$$= 6.3 \times 10^{-4} \text{ m}^2/\text{sec}$$

Laboratory 100-hour transmissivity test value should be equal to or higher than the above allowable value.

For relatively mild slopes, such as the top deck, where the slope is stable even under saturated conditions, the drainage requirements are much less demanding. In such cases, the primary function of a drainage layer might be to allow the cover soils to drain after precipitation events so they will not remain saturated for prolonged periods of time. Saturated soils, even on relatively flat slopes, are more susceptible to erosion and localized bearing capacity failures (e.g. under a wheel load or a deer hoof). Even intermittent strip drains, similar in concept to agricultural drain tiles, can often be adequate for flatter 'top decks'. It is also a good practice to collect all surface and sub-surface drainage and keep it separate from the side-slope drainage, to avoid exceeding the sideslope drainage capacity and erosion resistance. A generic design concept is shown in the figure below (Figure 6.2). In this case the surface drainage ditch and subsurface drainage collector along the perimeter would be designed to function even in a severe storm event such as a 100-year storm event, because it is an element of protection for the side slopes. Because the slope stability of the top deck is not an issue in this case, the design storm event for the geocomposite drainage layer on the top deck might be similar to that typically used by State Departments of Transportation (e.g. a 10-year storm event). The sizing of the geocomposite lateral drainage media on the top deck could be based on the precipitation-runoff-infiltration method promoted by Soong and Koerner (1997) and explained in Chapter 4.

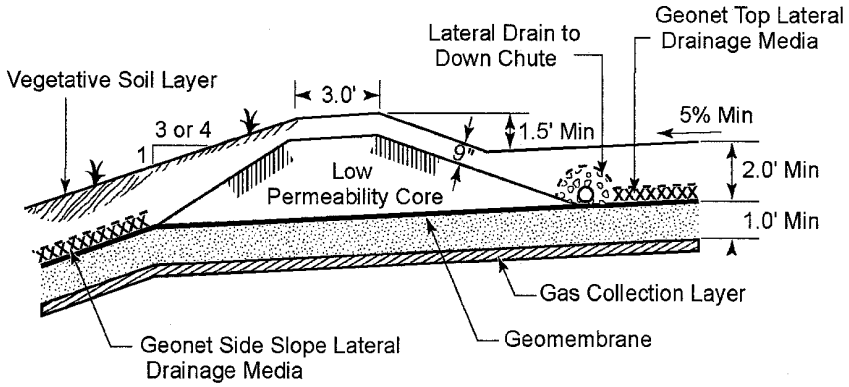


Figure 6.2 Example of drainage details for flat deck at the top of the slope.

Step 5 – Specification Development

The specifications should clearly define the conditions of the laboratory testing and the criteria that define the product's acceptability. These conditions should be specified for the unique case being analyzed (e.g., 3:1 slope with soil on one side).

Define Laboratory Testing Conditions

The required laboratory testing conditions include: (i) applied stress; (ii) hydraulic gradient; (iii) boundary conditions; and (iv) seating time.

Applied Stress – The applied stress used in testing should be equal to the maximum applied stress anticipated in field conditions.

For the design example,

$\sigma_{test} = t_{cover} * \gamma_{cover}$

t_{cover} = 0.6 m (from design drawings; cover soil thickness)

γ_{cover} = 17.3 kN/m^3 (typically ranges from 100 pcf to 130pcf; choose based on anticipated soil type for the cover soil)

σ_{test} = 0.6 m * 17.3 kN/m^3 = 10 kPa

Hydraulic Gradient – The hydraulic gradient is equal to the slope angle in units of length/length.

For the design example,

Side Slopes → Gradient = $sin\beta$=0.32

Boundary Conditions – The term "boundary conditions" refers to the makeup of the overlying and underlying materials during testing of the geocomposite. This design manual follows the guidelines of GRI-GC8 [1997], which requires that the boundary

conditions mimic field conditions. This means that site-specific materials shall be used wherever possible.

For the design example:

> Boundary conditions should mimic actual field conditions. The geocomposite will be used between the cover geomembrane and a layer of vegetative soil above the geocomposite. In laboratory testing, therefore, a textured geomembrane (GSE Type HDT) will be used below the geocomposite, and soil representative of the soil to be used for cover vegetative soil shall be used above the geocomposite. Both materials to be used for geocomposite testing should be provided to the laboratory by the contractor.

Seating Time – Seating time affects the amount of creep and intrusion that the geocomposite undergoes prior to transmissivity testing, which affects in turn the measured transmissivity of the product. The approach used in this design manual follows the guidelines of GRI-GC8 [1997], which requires a seating time of at least 100 hours for testing the transmissivity of the geocomposite. A greater seating time is acceptable; however, this may incur greater testing expense and is not strictly necessary.

For the design example:

> As required by GRI-GC8, a seating time of 100-hr will be used for the laboratory transmissivity testing.

Step 6 – Product Selection

Product selection is typically the responsibility of the contractor; however, in some cases the designer may be asked by the owner to select a product during the design phase. The designer should then consult with manufacturers to select a product that will meet project requirements at the least expensive cost.

For the design example,

> Based on the transmissivity data in Figure A-6, GSE double-sided FabriNet HF geocomposite (250mil geonet with geotextile on both sides) was selected for side slopes. The allowable transmissivity is 6.3×10^{-4} m^2/sec. The transmissivity shown on the manufacturer's chart for 1,000 psf loading at a gradient of 0.32 is only approximately 5×10^{-4} m^2/sec. At the design load of 240 psf, however, it is expected that the product would meet the specification requirements. This could be verified through testing. Alternately, the designer can specify a higher thickness geocomposite such as GSE FabriNet HS (275 mil thick net) or UF (300 mil thick net) to ensure that no issues arise during conformance testing.

Step 7 - Obtain Lab Testing Results and Creep Reduction Data for Product

Laboratory testing and creep reduction data may be required by the contractor as a part of his product approval submittal package, or as part of a construction quality assurance (CQA) program for conformance testing.

Laboratory Testing Results

Site-specific laboratory testing results for 100-hr transmissivity could be performed by a laboratory under the direction of the contractor or CQA firm (or designer in some cases). Testing should be performed for the conditions described in the specifications, which include: (i) applied stress; (ii) hydraulic gradient; (iii) boundary conditions; and (iv) seating time.

The designer should make sure that the testing procedures reflect the conditions detailed in the specifications. This permits then these results to be used to determine the product's acceptability.

For the design example a transmissivity value of 6.5×10^{-4} m^2/sec was obtained by an independent lab.

Creep Data

A creep value of 1.1 was provided by GSE for the 250 mil geonet.

Step 8 – Determine Product Acceptability

The above test data and the creep value indicate that the selected product meets the requirements of the design for the example problem presented here.

6.2 Landfill Gas Collection Geocomposite Design

The purpose of this design example is to show the process involved in designing and approving a geocomposite for use as the landfill gas (LFG) collection layer of a landfill. The process typically involves the following steps:

1. Choose appropriate values for input parameters
2. Establish design input flow rate (i.e., landfill gas flux, q_g)
3. Solve for required transmissivity, θ_{req}
4. Establish allowable trasmissivity, θ_{allow}
5. Develop specifications (lab testing conditions and acceptance criteria)
6. Select an appropriate product
7. Obtain lab testing results and creep reduction data for product
8. Determine product acceptability. If not acceptable, either redesign (return to Step 1) or select new product (return to Step 6)

Step 1 – Establish Input Parameters

- Factor of safety for slope failure, $FS_s = 1.5$ (based on standard practice)
- Interface shear strength, $\delta = 30^\circ$ (Also run 27°, 27.5° and 28.5°) (if testing is available, use test results; otherwise, consult with manufacturers to establish

APPENDIX E
Settlement Analyses

APPENDIX E
Settlement Analyses

Geosyntec
consultants

COMPUTATION COVER SHEET

Client: _____ Project: **Buena Vista Landfill** Project/ Proposal No.: **WG1019**

Task No. **01**

Title of Computations **Settlement and Strain Analyses**

Computations by:
Signature [signature] 7/17/08
Printed Name Jessica Bernardini Date
Title Staff Engineer

Assumptions and Procedures Checked by:
(peer reviewer)
Signature [signature] 18 Jul 08
Printed Name F. Settepani Date
Title

Computations Checked by:
Signature [signature] 18 Jul 08
Printed Name F. Settepani Date
Title

Computations backchecked by:
(originator)
Signature
Printed Name Date
Title

Approved by:
(pm or designate)
Signature
Printed Name Date
Title

Approval notes:

SETTLEMENT AND STRAIN ANALYSES

FINAL CLOSURE OF

MODULES 1, 2, 3, 4A, 4B, 5, AND 6 AT BUENA VISTA LANDFILL

PURPOSE

The analyses present settlements and strains in Modules 1, 2, 3, 4a, 4b, 5, and 6 at Buena Vista Drive Sanitary Landfill (BVL) after closure[1]. The analyses show that positive drainage will be maintained during the post-closure maintenance period; any ponding areas can be repaired as part of final cover maintenance after closure. Using the settlement estimates, strains of the final cover were also estimated and were found to be acceptable.

SETTLEMENT THEORY

Waste settlement has two components: primary settlement and secondary settlement. The procedures presented in Sharma and Lewis (1994) and Sharma and Reddy (2004) were used. Primary settlement was assumed to stop a few months after construction of the final cover has been finalized (0.4 year). Secondary settlement depends on time (i.e., consolidation under self-weight [sw] because of decomposition) and also on the effect, over time, of any external loads [el] such as construction of the final cover.

$S_{TOTAL} = S_{PRIMARY} + S_{SECONDARY}$

$S_{PRIMARY}$ = Settlement of waste layer under external loads

$$S_{PRIMARY} = H * \frac{C_c}{1+e_o} * \log\left(\frac{P_o + \Delta P}{P_o}\right)$$ where P_o = initial stress, ΔP = additional load

$S_{SECONDARY} = S_{SELF\ WEIGHT} + S_{EXTERNAL\ LOADS}$

[1] Portions of Modules 1 and 2 were closed in 1993.

$$S_{SELF\ WEIGHT} = H * C_{\alpha(sw)} * \log\left(\frac{t_{2(total)}}{t_{1(present)}}\right)$$

$$S_{EXTERNAL\ LOADS} = H * C_{\alpha(el)} * \log\left(\frac{t_{2(el)}}{t_1}\right)$$

Where settlements were estimated, the waste column was divided into two layers of equal thickness. The stress at the midpoint of each layer was calculated and used to estimate primary settlement. Because secondary settlement is independent of stress within the waste column, the waste was modeled as a single layer for estimating the secondary settlement.

Assumptions and Input Parameters

Figure 1 shows the final closure grading plan as well as the location of points used in the settlement analysis. Points were assumed across the site based on the locations of important drainage features such as benches and the top deck. The elevations at the point locations were estimated to the nearest foot. The maximum elevation of the proposed final cover is 200 ft mean sea level (msl). Geosyntec estimated the thicknesses of waste based on known base grades and additional fill (1.5 feet of final cover – 1 foot of vegetative layer plus 6 inches of foundation layer since we assumed that 18 inches are already in place as part of the interim cover) at each grid location to compute the existing and additional vertical stresses.

Figures 2a through 2g present the base grades of Modules 1, 2, 3, 4A, 4B, 5, and 6. The base grades of Modules 4A, 4B and 5 were obtained from computer-drafted contours. Modules 1 and 2 base grades were obtained from construction drawings prepared by others and available to Geosyntec. Modules 3 and 6 were obtained from as-built drawings.

Leachate levels were not considered in the settlement analysis calculations because the landfill has an active leachate collection and removal system that is expected to function after closure; therefore, the landfill operator will maintain the head of leachate to within 1 foot of the base as required by the regulations. Furthermore, leachate generation is expected to decrease after the final cover is constructed. For all Modules, the effect of leachate has been indirectly accounted in the coefficients assumed in the analyses and in the unit weights.

Modules 1 and 2 are not lined with composite liner systems. Modules 3, 4a, 4b, 5 and 6 are lined with a composite liner and have leachate collection and removal systems

The following unit weights were assumed:

- Waste = 65 pcf
- Cover or additional soil fill = 110 pcf

Waste filling began at different times depending on the Module. Table 1 presents the assumed filling history across the site. Waste decomposes after it has been placed and covered with interim cover; therefore, some of the total secondary settlement under self-weight in areas that may have been filled over time has already occurred before closure has begun. To account for the secondary settlement that has already occurred, Geosyntec assumed that waste has been settling under its own weight and averaged the beginning and ending of waste placement to be the

Settlement was determined for t = 30 years after closure (i.e., the end of postclosure maintenance period).

Table 1 – Assumed Fill Sequencing

Module	Start of Filling	Full By
1	1980	2023
2	1989	2023
3	1994	2023
4a	2004	2023
4b	2006	2023
5	2010	2023
6	2000	2023

The following coefficients were assumed for the calculations:

Primary Compression: $\frac{C_c}{1+e_o}(waste) = 0.2$

Sharma and Lewis (1994), p. 579
Based on NAVFAC 7.3 – range 0.1 to 0.4

Secondary Compression: $C_{\alpha(sw)}(waste) = 0.25$, $C_{a(el)}(waste) = 0.04$

Sharma and Reddy (2004), p. 907
$C_{\alpha(sw)}$ Ranges from 0.1 to 0.7
$C_{\alpha(el)}$ Ranges from 0.01 to 0.07

Time for secondary compression:

$t_{2(EL)}$ = time between end of cover construction and time of interest = 30 yrs

$t_{1(EL)}$= time until end of primary compression due to construction of final cover = 0.4 year

$t_{2(total\text{ - }SW)}$ = (End of Filling + 30 yrs) - average time during which waste has been settling under self weight [½(End of Filling - Beginning of Filling –)]

$t_{1(past\text{-}SW)}$ = average time during which waste has been settling under self weight = [½(End of Filling - Beginning of Filling)

STRAINS IN FINAL COVER GEOSYNTHETICS DUE TO SETTLEMENT

Strains between neighboring points were calculated to verify that the geosynthetic components of the final cover system could withstand the strains due to settlement.

The distance (in 3-D) between two grid points is calculated before and after settlement and the associated strain are calculated. The Δdist. is calculated using the coordinates of the two points. The Δelevation is calculated using the change in elevations resulting from the settlement analysis estimates.

$$L_2 - L_1 = \Delta L$$

where, $L_1 = \sqrt{\Delta dist.^2 + \Delta elevation\ initial^2}$

$$L_2 = \sqrt{\Delta dist.^2 + \Delta elevation\ final^2}$$

$$absoulte\left[\frac{\Delta L}{L_1} * 100\%\right] = strain\ (\%)$$

Geosyntec compared the strains estimated in the components of the final cover system to values in the literature; the final cover will consist of a geomembrane overlaying a foundation layer. LaGatta et al. (1997) shows that GCLs can accommodate high strains; Koerner (1999) shows typical stress-strain test results for machine and cross-machine direction tensile tests which show that geonets and geotextiles can withstand strains larger than 20%; geomembranes can withstand even higher strains.

Geosyntec compared the strain values reported in the literature with those calculated; settlement induced strains are not expected to affect the geosynthetic components with no strains reaching values greater or equal to 20%.

RESULTS

Results of the settlement calculations are summarized in Table 2 for the final closure grading plan shown on Figure 2. The calculated strains in the final cover geosynthetics are presented in Table 3. Areas of ponding will be repaired as part of the post-closure maintenance period.

REFERENCES

"*Construction Drawings, Buena Vista Drive Sanitary Landfill Expansion Site and Road Improvements,*" EMCON Associates, stamped as-built, June 24, 1986.

"*Construction Drawings, Module 2, Buena Vista Sanitary Landfill,*" Project 307-01.45, EMCON Associates, stamped as-built, April 1990.

"*Construction Quality Assurance Report, Module 3, Buena Vista Landfill,*" CH2MHill, November 1994.

"*Design Report Module 4a, Buena Vista Landfill,*" Geosyntec, May 2003.

"*Site Development Plan, Buena Vista Drive Sanitary Landfill*". Geosyntec Consultants, March 2005.

Sharma, H., and Lewis, S., *Waste Containment Systems, Waste Stabilization, and Landfills*, John Wiley & Sons, Inc., New York, 1994, pp. 578-581.

Sharma, H., and Reddy, K., *Geoenvironmental Engineering*, John Wiley & Sons, Inc., New Jersey, 2004, p. 907.

ATTACHMENTS

Table 2- Settlement Estimates for the Final Cover Grading Plan

Table 3- Strain Estimates of the Final Cover

Figures 1, 2a through 2g

Geosyntec Consultants, Inc.

TABLE 2
WASTE SETTLEMENT AT DISCRETE POINTS
PARTIAL FINAL CLOSURE OF Modules 1, 2, 3, 4a, 4b, 5 and 6
Buena Vista Landfill

WG10109- PCMP 2008
Settlement Calculations

INPUT PARAMETERS AND CONSTANTS

Unit Weight of Fill/Cover Soil =	110 pcf	$C_c/(1+e_o)$ =	0.2
Dry Unit Weight of Refuse =	65 pcf	$C_\alpha/(1+e_{o(SW)})$ =	0.2
Thickness of Final Cover Layer[1] =	1.5 ft	$C_\alpha/(1+e_{o(EL)})$ =	0.04

Point	Associated Module	Fill Placement Sequence: Begin Filling	End Filling	t_1 (total time)	t_2 (time elapsed)	Elevation (ft msl): Base Grade[2]	Final Grade[3]	Final Waste Thickness H (ft)	Elevation of Midpoint[4] (ft msl): Layer 1	Layer 2	Δp (psf)	Initial Stress at Midpoint P_o (psf): Layer 1	Layer 2	Primary Settlement S_p (ft)	Secondary Settlement S_s (ft): $S_{s(SW)}$ due to Self-weight	$S_{s(EL)}$ due to External Load	**Total Settlement S_{total} (ft)**
4165	4B	2006	2023	39	8.5	101	134	31.5	108.9	124.6	165	1,535.1	609.2	0.5	4.1	2.4	**7.0**
4166	4B	2006	2023	39	8.5	62	170	106.9	88.3	141.8	165	5,209.9	1,834.1	0.5	14.0	8.0	**22.6**
4167	4B	2006	2023	39	8.5	43	176	132.0	75.5	141.5	165	6,435.0	2,242.5	0.6	17.3	9.9	**27.8**
4168	4B	2006	2023	39	8.5	26	200	172.4	69.0	155.2	165	8,405.5	2,899.3	0.6	22.6	12.9	**36.1**
4169	4B	2006	2023	39	8.5	24	200	173.7	67.8	154.7	165	8,466.4	2,919.6	0.6	22.8	13.0	**36.4**
4170	5	2010	2023	37	6.5	19	168	147.7	55.7	129.6	165	7,201.8	2,498.1	0.6	22.1	11.1	**33.8**
4171	4B	2006	2023	39	8.5	51	134	81.2	71.6	112.2	165	3,957.5	1,416.7	0.5	10.7	6.1	**17.3**
4172	5	2010	2023	37	6.5	40	129	87.1	61.8	105.3	165	4,246.6	1,513.0	0.5	13.1	6.5	**20.1**
4173	5	2010	2023	37	6.5	21	176	153.2	59.6	136.2	165	7,470.0	2,587.5	0.6	23.0	11.5	**35.0**
4174	5	2010	2023	37	6.5	18	131	111.7	45.9	101.7	165	5,445.4	1,912.6	0.5	16.7	8.4	**25.7**
4175	5	2010	2023	37	6.5	24	126	100.0	49.5	99.5	165	4,876.5	1,723.0	0.5	15.0	7.5	**23.0**
4176	5	2010	2023	37	6.5	55	100	43.5	65.9	87.6	165	2,121.6	804.7	0.5	6.5	3.3	**10.3**
4177	4A	2004	2023	40	9.5	87	140	51.7	99.7	125.6	165	2,520.4	937.6	0.5	6.4	3.9	**10.8**
4178	3	1994	2023	45	14.5	105	126	19.5	109.9	119.6	165	950.6	414.4	0.4	1.9	1.5	**3.8**
4179	4A	2004	2023	40	9.5	53	172	117.4	82.5	141.2	165	5,723.3	2,005.3	0.5	14.5	8.8	**23.9**
4180	3	1994	2023	45	14.5	68	166	96.5	92.1	140.4	165	4,704.4	1,665.6	0.5	9.4	7.2	**17.2**
4181	4A	2004	2023	40	9.5	23	200	175.2	67.0	154.6	165	8,539.1	2,943.9	0.6	21.7	13.1	**35.4**
4182	4A	2004	2023	40	9.5	26	200	172.5	69.1	155.3	165	8,408.4	2,900.3	0.6	21.3	12.9	**34.8**
4183	3	1994	2023	45	14.5	26	200	172.1	69.0	155.1	165	8,390.4	2,894.3	0.6	16.8	12.9	**30.2**
4184	3	1994	2023	45	14.5	25	200	173.2	68.3	154.9	165	8,441.1	2,911.2	0.6	16.9	13.0	**30.4**
4185	3	1994	2023	45	14.5	30	200	168.5	72.1	156.4	165	8,214.4	2,835.6	0.6	16.4	12.6	**29.6**
4186	3	1994	2023	45	14.5	68	162	92.5	91.1	137.4	165	4,509.4	1,600.6	0.5	9.0	6.9	**16.5**
4187	2	1989	2023	47	17.0	68	168	98.5	92.6	141.9	165	4,801.9	1,698.1	0.5	8.7	7.4	**16.6**
4188	2	1989	2023	47	17.0	68	172	102.5	93.6	144.9	165	4,996.9	1,763.1	0.5	9.1	7.7	**17.3**
4189	2	1989	2023	47	17.0	73	172	97.5	97.4	146.1	165	4,753.1	1,681.9	0.5	8.6	7.3	**16.5**
4190	2	1989	2023	47	17.0	80	168	86.5	101.6	144.9	165	4,216.9	1,503.1	0.5	7.6	6.5	**14.7**
4191	2	1989	2023	47	17.0	25	186	159.5	64.9	144.6	165	7,775.6	2,689.4	0.6	14.1	12.0	**26.6**
4192	1	1980	2023	52	21.5	24	192	166.5	65.6	148.9	165	8,116.9	2,803.1	0.6	12.3	12.5	**25.3**
4193	6	2000	2023	42	11.5	24	76	50.5	36.6	61.9	165	2,461.9	918.1	0.5	5.6	3.8	**9.9**
4194	6	2000	2023	42	11.5	16	72	54.5	29.6	56.9	165	2,656.9	983.1	0.5	6.1	4.1	**10.7**
4195	6	2000	2023	42	11.5	18	73	53.9	31.5	58.4	165	2,629.1	973.9	0.5	6.0	4.0	**10.6**

TABLE 2
WASTE SETTLEMENT AT DISCRETE POINTS
PARTIAL FINAL CLOSURE OF Modules 1, 2, 3, 4a, 4b, 5 and 6
Buena Vista Landfill

Geosyntec Consultants, Inc.

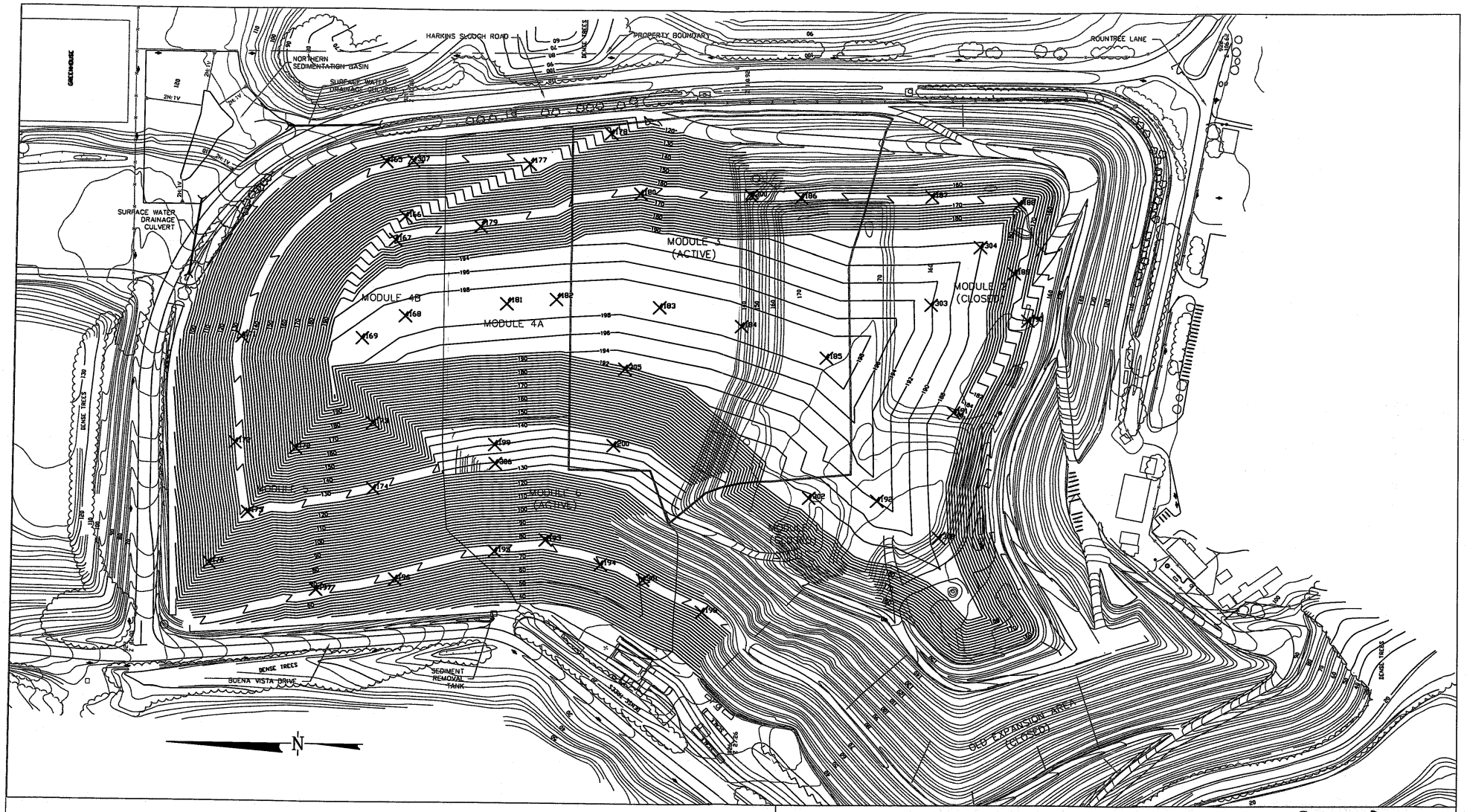
Point	Associated Module	Fill Placement Sequence				Elevation (ft msl)		Final Waste Thickness	Elevation of Midpoint[4] (ft msl)		Δp	Initial Stress at Midpoint P_o (psf)		Primary Settlement	Secondary Settlement S_s (ft)		**Total Settlement S_{total} (ft)**
		Begin Filling	End Filling	t_1 (total time)	t_2 (time elapsed)	Base Grade[2]	Final Grade[3]	H (ft)	Layer 1	Layer 2	(psf)	Layer 1	Layer 2	S_p (ft)	$S_{s(SW)}$ due to Self-weight	$S_{s(EL)}$ due to External Load	
4196	5	2010	2023	37	6.5	17	68	49.7	29.3	54.1	165	2,420.9	904.5	0.5	7.4	3.7	**11.7**
4197	5	2010	2023	37	6.5	26	66	38.3	35.8	54.9	165	1,866.6	719.7	0.5	5.7	2.9	**9.1**
4198	1	1980	2023	52	21.5	14	72	56.5	28.1	56.4	165	2,754.4	1,015.6	0.5	4.3	4.2	**9.0**
4199	6	2000	2023	42	11.5	18	136	116.5	47.1	105.4	165	5,679.4	1,990.6	0.5	12.5	8.7	**21.8**
4200	3	1994	2023	45	14.5	27	136	107.5	53.9	107.6	165	5,240.6	1,844.4	0.5	10.5	8.1	**19.1**
4300	3	1994	2023	45	14.5	68	160	90.4	90.6	135.8	165	4,405.1	1,565.9	0.5	8.8	6.8	**16.1**
4301	6	2000	2023	42	11.5	18	70	50.3	30.6	55.7	165	2,452.1	914.9	0.5	5.6	3.8	**9.9**
4302	1	1980	2023	52	21.5	24	187	162.0	64.5	145.5	165	7,896.5	2,729.7	0.6	12.0	12.1	**24.7**
4303	2	1989	2023	47	17.0	30	192	160.6	70.2	150.5	165	7,829.7	2,707.4	0.6	14.2	12.0	**26.8**
4304	2	1989	2023	47	17.0	40	188	146.6	76.7	150.0	165	7,148.2	2,480.2	0.6	13.0	11.0	**24.5**
4305	3	1994	2023	45	14.5	27	190	161.8	67.5	148.4	165	7,888.7	2,727.1	0.6	15.8	12.1	**28.5**
4306	5	2010	2023	37	6.5	19	131	110.7	46.7	102.0	165	5,396.6	1,896.4	0.5	16.6	8.3	**25.4**
4307	4B	2006	2023	39	8.5	100	134	32.3	108.1	124.2	165	1,574.6	622.4	0.5	4.2	2.4	**7.1**
4308	1	1980	2023	52	21.5	25	187	160.6	65.1	145.4	165	7,828.3	2,706.9	0.6	11.9	12.0	**24.5**

1 Assumed 1.5 ft for total final cover layer consisting of 1 ft vegetative layer and only 6" additional foundation layer.
2 Depending on the module, base grades were obtained from provided as-builts or grading plans (Modules 1, 2, 3, 4a, and 6), design reports (Modules 4b, 5)
3 Final closure grades shown on Figure 1.
4 Final waste thickness divided into 2 layers for primary settlement calculation.

TABLE 3
Strain Estimates of the
Final Cover of Modules 1, 2, 3, 4a, 4b, 5 and 6

Point	Northing	Easting	Final Grade	Elevation of Top of Final Cover (ft msl)
4165	11630.23	10810.59	134	127.0
4166	11586.64	10687.53	170	147.4
4167	11608.21	10634.16	176	148.2
4168	11584.22	10462.84	200	163.7
4169	11680.05	10412.15	200	163.2
4170	11824.89	10162.83	168	134.2
4171	11949.15	10413.00	134	116.7
4172	11960.55	10173.43	129	108.5
4173	11654.25	10220.40	176	141.0
4174	11652.27	10071.90	131	105.5
4175	11930.24	10015.95	126	103.0
4176	12016.02	9900.81	100	89.7
4177	11312.43	10807.14	140	129.2
4178	11132.15	10876.91	126	122.2
4179	11420.00	10665.89	172	148.1
4180	11066.81	10741.12	166	148.8
4181	11360.45	10491.74	200	164.5
4182	11250.79	10502.59	200	165.1
4183	11022.61	10485.44	200	169.4
4184	10841.46	10444.16	200	169.2
4185	10651.77	10374.06	200	170.4
4186	10710.03	10734.93	162	145.5
4187	10421.09	10739.01	168	151.4
4188	10228.56	10723.79	172	154.7
4189	10239.19	10567.38	172	155.5
4190	10208.03	10460.10	168	153.3
4191	10370.22	10252.35	186	159.4
4192	10538.35	10051.18	192	166.7
4193	11269.97	9958.23	76	66.1
4194	11147.35	9903.21	72	61.3
4195	11381.90	9931.87	73	62.9
4196	11601.11	9866.83	68	56.3
4197	11775.17	9841.91	66	56.9
4198	10924.53	9796.96	72	63.0
4199	11383.82	10173.43	136	114.2
4200	11121.40	10172.96	136	116.9
4300	10822.05	10738.91	160	143.7
4301	11054.29	9869.06	70	59.9
4302	10688.12	10057.16	187	162.8
4303	10421.52	10495.52	192	165.3
4304	10313.61	10625.76	188	163.6
4305	11097.54	10346.23	190	161.9
4306	11382.27	10130.47	131	105.8
4307	11570.51	10812.98	134	126.7
4308	10400.73	9967.87	187	162.6

To Point	From Point	D Distance (ft)	D Elevation Initial (ft)	D Elevation Final (ft)	L1 (initial)	L2 (final)	Strain (%)
4166	4165	130.6	36.0	20.4	135.4	132.1	2.43
4167	4165	177.8	42.0	21.2	182.7	179.1	1.99
4168	4166	224.7	29.8	16.3	226.7	225.3	0.61
4168	4167	173.0	23.8	15.5	174.6	173.7	0.54
4168	4169	108.4	0.2	0.5	108.4	108.4	0.00
4169	4167	233.3	23.6	15.0	234.5	233.8	0.30
4171	4172	239.8	5.4	8.2	239.9	240.0	0.03
4170	4175	180.8	42.0	31.3	185.6	183.4	1.15
4172	4175	160.4	2.6	5.5	160.4	160.5	0.05
4173	4174	148.5	44.9	35.5	155.1	152.7	1.57
4193	4194	134.4	4.0	4.8	134.5	134.5	0.02
4195	4196	228.7	5.4	6.5	228.7	228.7	0.01
4185	4192	342.2	8.0	3.7	342.3	342.2	0.02
4182	4181	110.2	0.0	0.6	110.2	110.2	0.00
4185	4184	202.2	0.3	1.2	202.2	202.2	0.00
4181	4179	184.1	27.9	16.4	186.2	184.8	0.74
4198	4194	246.9	0.0	1.6	246.9	246.9	0.00
4193	4194	134.4	4.0	4.8	134.5	134.5	0.02
4174	4175	283.5	5.1	2.5	283.6	283.6	0.01
4184	4183	185.8	0.0	-0.1	185.8	185.8	0.00
4192	4191	262.2	6.0	7.3	262.2	262.3	0.01
4191	4190	263.6	18.0	6.1	264.2	263.6	0.21
4189	4190	111.7	4.0	2.2	111.8	111.7	0.04
4188	4187	193.1	4.0	3.3	193.2	193.2	0.01
4187	4186	289.0	6.0	5.9	289.0	289.0	0.00
4183	4305	158.1	9.3	7.5	158.4	158.3	0.06
4199	4306	43.0	4.8	8.5	43.3	43.8	1.29
4192	4308	160.9	4.9	4.1	160.9	160.9	0.01
4303	4304	169.1	4.0	1.7	169.2	169.1	0.02
4180	4300	244.8	6.1	5.1	244.8	244.8	0.01
4186	4300	112.1	2.1	1.8	112.1	112.1	0.01
4177	4178	193.3	14.0	7.0	193.8	193.4	0.20
4165	4307	59.8	0.2	0.4	59.8	59.8	0.00
4193	4195	115.0	2.6	3.2	115.0	115.0	0.01
4177	4307	258.1	6.2	2.5	258.2	258.2	0.02
4175	4176	143.6	26.0	13.2	145.9	144.2	1.18
4196	4197	175.8	2.0	-0.6	175.8	175.8	0.01



TOPOGRAPHY (2004)

0 100 200

SCALE IN FEET

4123 POINTS USED IN SETTLEMENT ANALYSIS

FINAL FILL GRADES

Geosyntec consultants

FINAL FILL GRADING PLAN

BUENA VISTA LANDFILL
SANTA CRUZ, CA

FIGURE NO 1

WG1019

JULY 2008

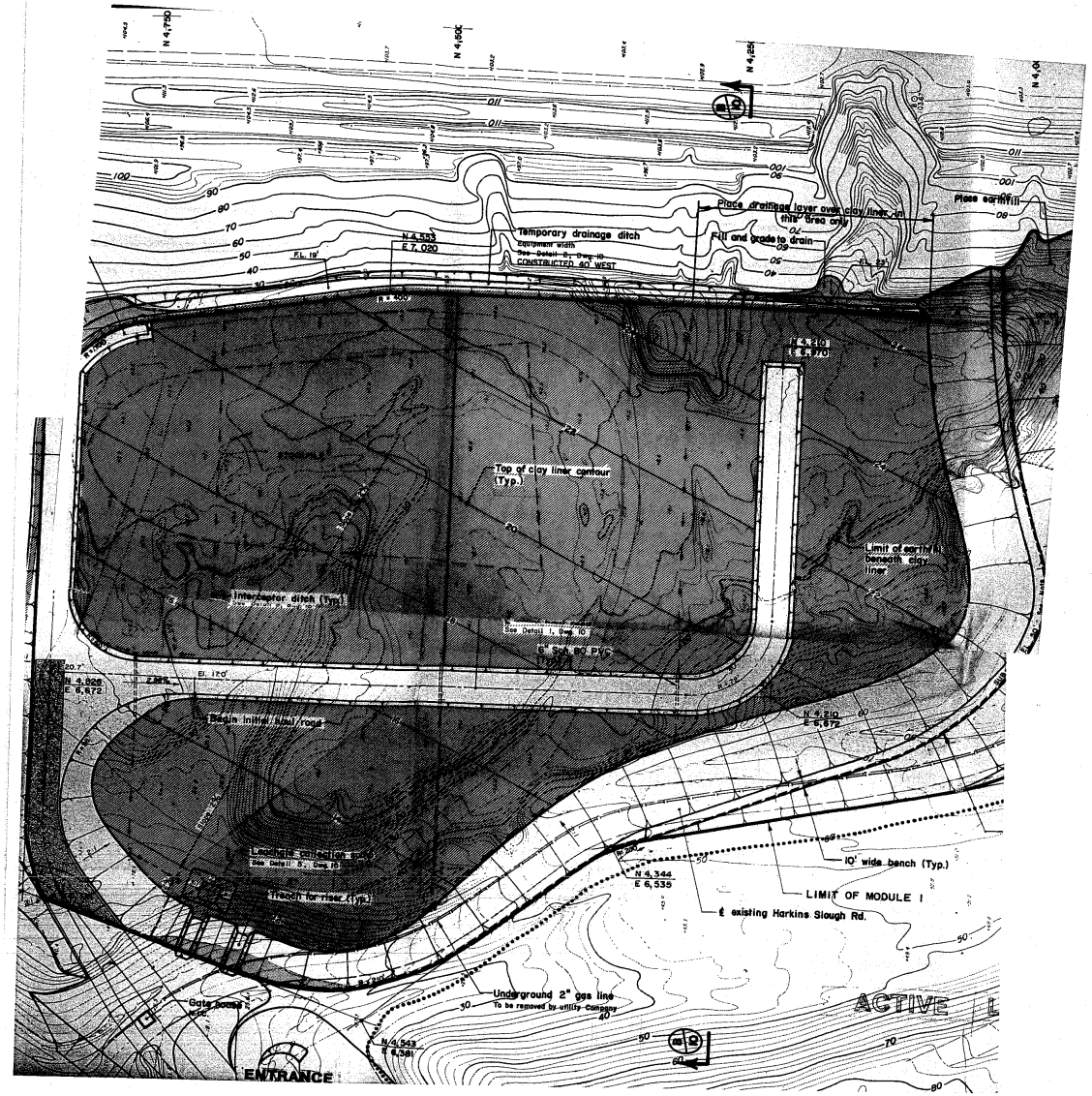
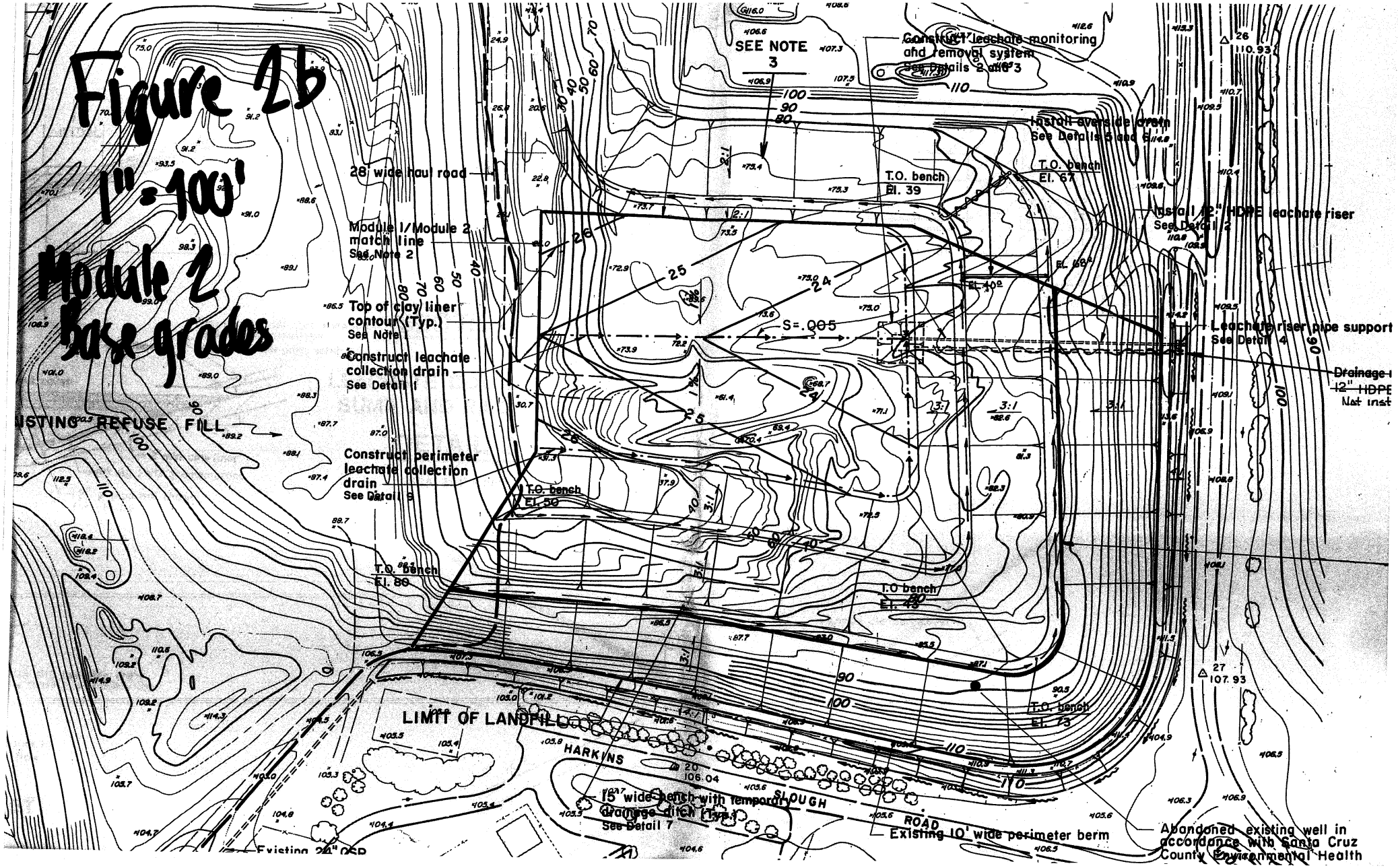


Figure 2a - Module 1 Basegrades

1" = 100'


Figure 2b
1"=100'
Module 2
base grades
SEE NOTE 3
Construct leachate monitoring and removal system See Details 2 and 3
Install overside drain See Details 5 and 6
T.O. bench El. 67
T.O. bench El. 39
28' wide haul road
Module 1/Module 2 match line See Note 2
Top of clay liner contour (Typ.) See Note 1
Construct leachate collection drain See Detail 1
Install 12" HDPE leachate riser See Detail 2
Leachate riser pipe support See Detail 4
Drainage
12" HDPE
Not inst
S=.005
EXISTING REFUSE FILL
Construct perimeter leachate collection drain See Detail 8
T.O. bench El. 50
T.O. bench El. 80
T.O bench El. 40
T.O. bench El. 73
LIMIT OF LANDFILL
HARKINS SLOUGH ROAD
15' wide bench with temporary drainage ditch (Typ.) See Detail 7
Existing 10' wide perimeter berm
Abandoned existing well in accordance with Santa Cruz County Environmental Health
Existing 24" CSP

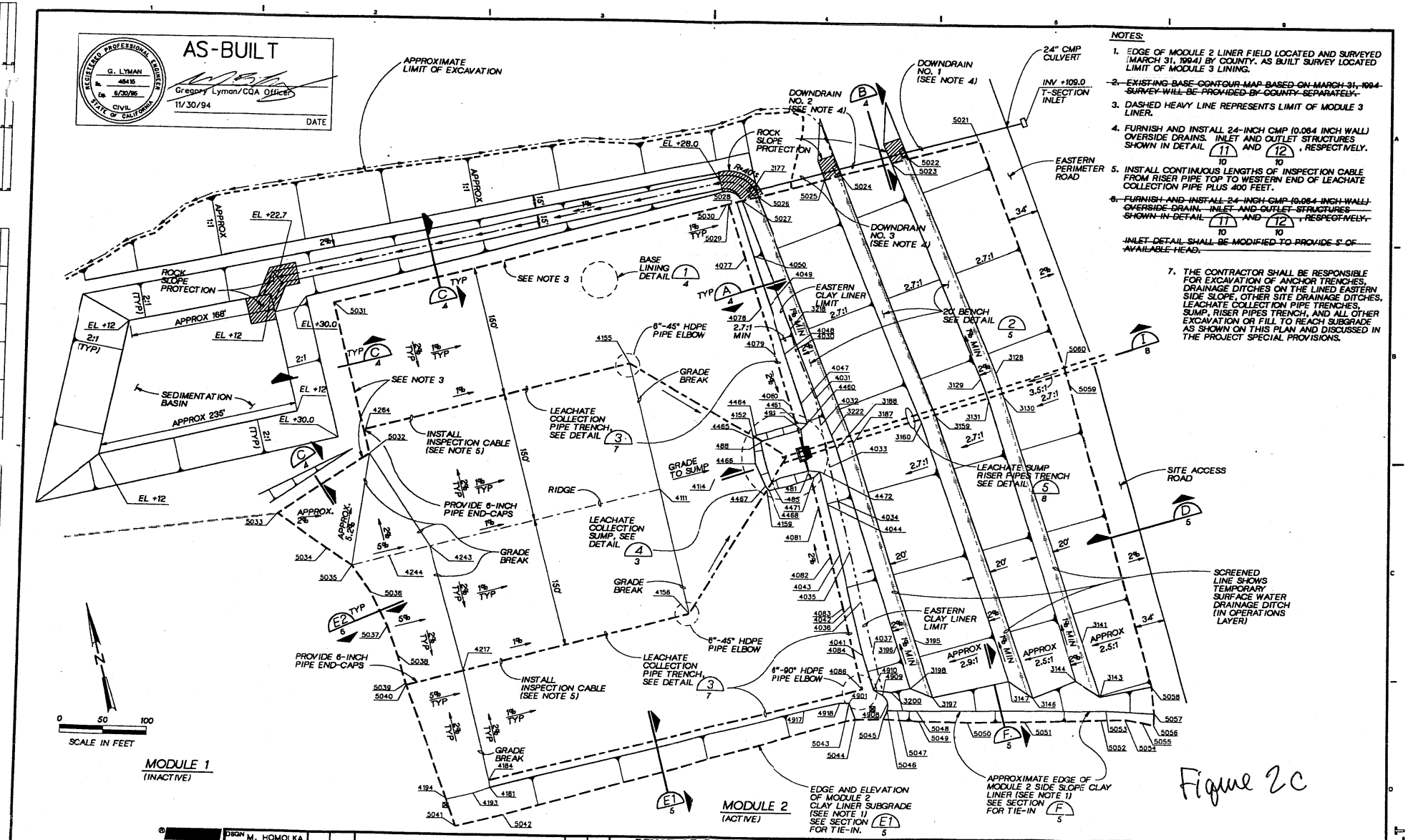


Figure 2C

DSGN	M. HOMOLKA				
DR	F. POON				
CHK	S. LEWIS				
APVD	G. LYMAN				
1	Nov 94	AS-BUILT REVISIONS	MH	GL	
NO.	DATE	REVISION	BY	APVD	

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CONSTRUCTION DRAWINGS
BUENA VISTA LANDFILL
COUNTY OF SANTA CRUZ, CALIFORNIA

MODULE 3 GEOMEMEBRANE LINING SUBGRADE PLAN

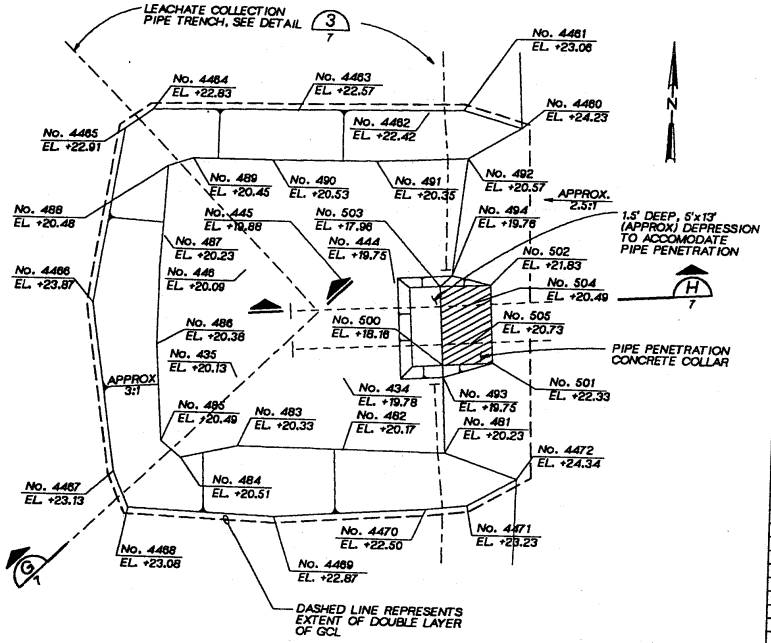
SHEET NO.	2
DWG NO.	
DATE	NOV 1994
PROJ NO.	BAE35903.CO

7-Dec-1994 35903W22.DLV

AS-BUILT

OVERLAY SCREEN

PROJECT FILE



SUMP DETAIL 4/2

1"=10'-0"

POINT NO	NORTHING	EASTING	ELEV	DESCRIPTION	POINT NO	NORTHING	EASTING	ELEV	DESCRIPTION
434	10907.85	10588.81	19.78	sump floor	4114	10913.89	10496.14	26.24	clay as-built feature
435	10907.59	10570.9	20.13	sump floor	4152	10951.57	10551.05	21.75	leachate collection pipe
444	10923.87	10596.51	19.75	sump floor	4155	11068.40	10432.47	25.36	leachate collection pipe
445	10923.97	10588.17	19.88	sump floor	4156	10769.37	10429.74	25.55	leachate collection pipe
446	10925.41	10571.6	20.09	sump floor	4159	10886.43	10550.94	21.97	leachate collection pipe
481	10895.92	10605.64	20.23	sump floor perimeter	4181	10629.73	10160.03	32.1	clay as-built feature
482	10895.96	10589.07	20.17	sump floor perimeter	4184	10636.2	10160.84	31.34	leachate collection pipe
483	10896.22	10571.23	20.33	sump floor perimeter	4193	10627.95	10139.58	32.61	clay as-built feature
484	10894.09	10561.86	20.51	sump floor perimeter	4194	10626.41	10109.27	34.73	clay as-built feature
485	10896.76	10558.29	20.49	sump floor perimeter	4217	10769.16	10161.93	28.41	leachate collection pipe
486	10912.75	10557.07	20.38	sump floor perimeter	4243	10919.06	10158.86	32.54	clay as-built feature
487	10930.7	10557.88	20.23	sump floor perimeter	4244	10919.15	10111.32	34.72	clay as-built feature
488	10942.19	10557.99	20.48	sump floor perimeter	4264	11068.67	10119.37	29.05	leachate collection pipe
489	10943.62	10562.25	20.45	sump floor perimeter	4460	10949.8	10616.61	24.23	sump rim as-built
490	10943.62	10575.7	20.53	sump floor perimeter	4461	10952.87	10606.94	23.06	sump rim as-built
491	10943.95	10592.97	20.35	sump floor perimeter	4462	10952.17	10601.27	22.42	sump rim as-built
492	10944.74	10607.87	20.57	sump floor perimeter	4463	10951.92	10579.71	22.57	sump rim as-built
493	10908.47	10604.94	19.75	sump floor perimeter	4464	10951.47	10555.06	22.83	sump rim as-built
494	10925.26	10605.93	19.76	sump floor perimeter	4465	10948.2	10550.81	22.91	sump rim as-built
500	10910.48	10604.89	18.18	penetration collar	4466	10919.29	10548.27	23.87	sump rim as-built
501	10910.93	10613.04	22.33	penetration collar	4467	10891.45	10550.73	23.13	sump rim as-built
502	10923.88	10612.27	21.83	penetration collar	4468	10885.52	10553.31	23.08	sump rim as-built
503	10923.52	10604.04	17.96	penetration collar	4469	10884.65	10577.74	22.87	sump rim as-built
504	10920.51	10608.84	20.49	top of pipe @ penetration	4470	10886.51	10602.88	22.5	sump rim as-built
505	10914.17	10609.36	20.73	top of pipe @ penetration	4471	10887.29	10609.57	23.23	sump rim as-built
3128	10952.353	10839.738	85.64	east slope as-built	4472	10891.83	10617.6	24.34	sump rim as-built
3129	10950.886	10821.302	85.30	east slope as-built	4901	10623.19	10585.36	28.07	as-built feature
3130	10923.719	10841.742	86.06	east slope as-built	4908	10612.22	10628.59	27.88	as-built feature
3131	10923.979	10823.898	85.88	east slope as-built	4909	10622.27	10624.92	27.77	as-built feature
3141	10624.738	10860.041	88.87	east slope as-built	4910	10630.64	10616.7	27.75	as-built feature
3143	10557.999	10864.223	89.64	east slope as-built	4917	10627.24	10532.73	28.05	as-built feature
3144	10583.229	10842.082	89.05	east slope as-built	4918	10625.91	10575.1	27.97	as-built feature
3146	10576.310	10788.589	87.51	east slope as-built	5021	11217.59	10887.31	113.79	as-built perimeter (east)
3147	10601.921	10766.346	86.84	east slope as-built	5022	11217.42	10805.44	83.15	as-built perimeter (north)
3159	10921.186	10761.486	84.03	east slope as-built	5023	11217.46	10785.42	82.53	as-built perimeter (north)
3160	10918.071	10744.375	83.58	east slope as-built	5024	11218.09	10724.54	61.06	as-built perimeter (north)
3177	11218.945	10611.962	30.70	east slope as-built	5025	11217.45	10704.43	60.66	as-built perimeter (north)
3187	10914.045	10663.030	34.39	east slope as-built	5026	11217.25	10623.4	31.11	as-built perimeter (north)
3188	10912.754	10642.933	33.55	east slope as-built	5027	11217.84	10604.51	30.6	as-built perimeter (north)
3195	10675.503	10675.204	36.39	east slope as-built	5028	11217.96	10591.78	28.33	as-built perimeter (north)
3196	10673.891	10654.985	35.99	east slope as-built	5029	11218.05	10588.69	27.09	as-built perimeter (north)
3197	10605.751	10678.314	36.87	east slope as-built	5030	11218.36	10585.98	26	as-built perimeter (north)
3198	10622.254	10622.254	36.54	east slope as-built	5031	11219.62	10118.03	33.09	as-built perimeter (north)
3200	10623.171	10635.552	31.15	east slope as-built	5032	11040.21	10117.23	30.5	as-built perimeter (west)
3218	11060.243	10623.899	31.73	east slope as-built	5033	10998.54	9996.947	39.29	as-built perimeter (west)
3222	10929.516	10641.107	32.15	east slope as-built	5034	10944.71	10044.11	37.84	as-built perimeter (west)
4030	11035.84	10624.03	30.56	east clay limit	5035	10916.62	10067.49	36.91	as-built perimeter (west)
4031	10975.65	10633.1	31.48	east clay limit	5036	10883.23	10080.85	35.57	as-built perimeter (west)
4032	10943.66	10631.77	29.61	east clay limit	5037	10840.55	10090.01	34.22	as-built perimeter (west)
4033	10893.98	10630.4	28.7	east clay limit	5038	10804.58	10093.77	33.22	as-built perimeter (west)
4034	10853.23	10629.76	28.72	east clay limit	5039	10770.7	10094.91	32.77	as-built perimeter (west)
4035	10793.42	10629.19	29.04	east clay limit	5040	10768.89	10095.03	31.97	as-built perimeter (west)
4036	10733.28	10627.49	29.45	east clay limit	5041	10596.1	10111.02	34.91	as-built perimeter (west)
4037	10673.09	10626.67	30.03	east clay limit	5042	10595.21	10167.58	26.52	as-built perimeter (south)
4041	10672.47	10614.38	27.82	east slope toe	5043	10603.69	10575.82	24.75	as-built feature
4042	10732.31	10614.9	26.64	east slope toe	5044	10602.72	10587.79	28.1	as-built perimeter (south)
4043	10792.64	10616.69	25.63	east slope toe	5045	10595.39	10618.58	28.84	as-built perimeter (south)
4044	10852.51	10617.21	24.72	east slope toe	5046	10604.01	10625.79	28.09	as-built feature
4047	10973.88	10615.12	24.33	east slope toe	5047	10600.89	10637.16	28.25	as-built feature
4048	11033.89	10610.28	25.25	east slope toe	5048	10595.02	10657.24	32.63	as-built feature
4049	11093.01	10606.37	26.62	east slope toe	5049	10582.85	10656.78	35.71	as-built perimeter (south)
4050	11153.07	10601.81	27.55	east slope toe	5050	10567.75	10708.96	46.72	as-built perimeter (south)
4077	11153.04	10592.02	25.51	leachate collection pipe	5051	10551.9	10772.25	62.37	as-built perimeter (south)
4078	11092.22	10595.53	24.32	leachate collection pipe	5052	10531.64	10858.26	86.14	as-built perimeter (south)
4079	11033.4	10599.34	23.09	leachate collection pipe	5053	10540.48	10866.41	87.55	as-built feature
4080	10973.09	10602.76	21.86	leachate collection pipe	5054	10524.9	10884.98	99.03	as-built perimeter (south)
4081	10851.93	10606	21.84	leachate collection pipe	5055	10516.69	10902.8	107.92	as-built perimeter (south)
4082	10792.83	10605.65	23.37	leachate collection pipe	5056	10510.19	10915.11	113.84	as-built perimeter (south)
4083	10731.22	10605.02	24.53	leachate collection pipe	5057	10523.24	10919.02	113.78	as-built perimeter (east)
4084	10672.28	10604.16	25.78	leachate collection pipe	5058	10554.74	10923.99	113.95	as-built perimeter (east)
4086	10635.21	10604.33	26.48	leachate collection pipe	5059	10918.29	10919.29	113.89	as-built perimeter (east)
4111	10918.13	10431.82	29.59	clay as-built feature	5060	10937.33	10918.39	114.02	as-built perimeter (east)

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AS-BUILT

Gregory Lyman/COA Officer

11/30/94 DATE

Fig 2c X

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DR F. POON
CHK S. LEWIS
APVD G. LYMAN

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BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"

IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

CONSTRUCTION DRAWINGS
BUENA VISTA LANDFILL
COUNTY OF SANTA CRUZ, CALIFORNIA

MODULE 3
GEOMEMBRANE LINING
SUBGRADE PLAN

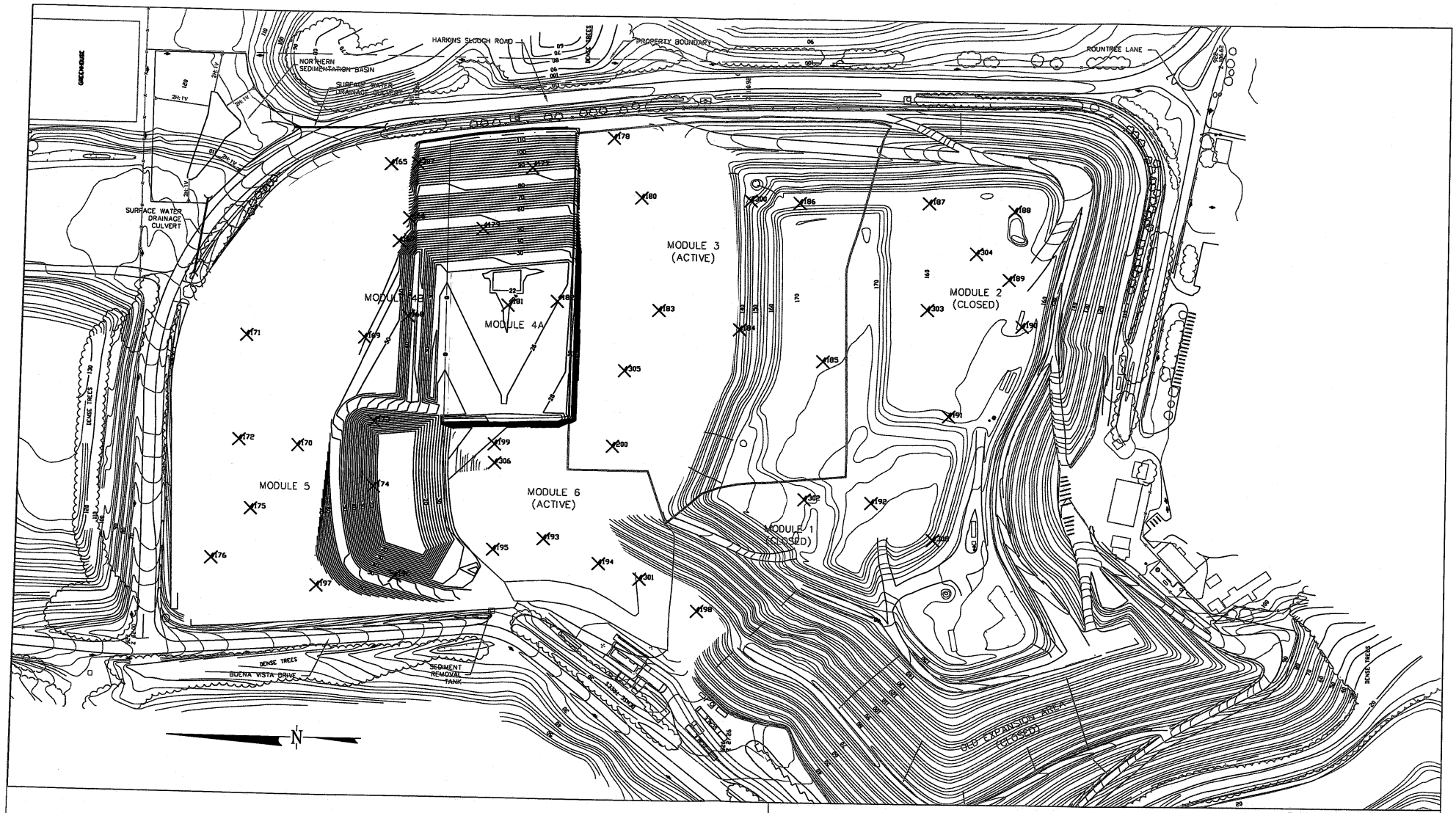
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DWG NO. 3
DATE NOV 1994
PROJ NO. BAE35903.CQ

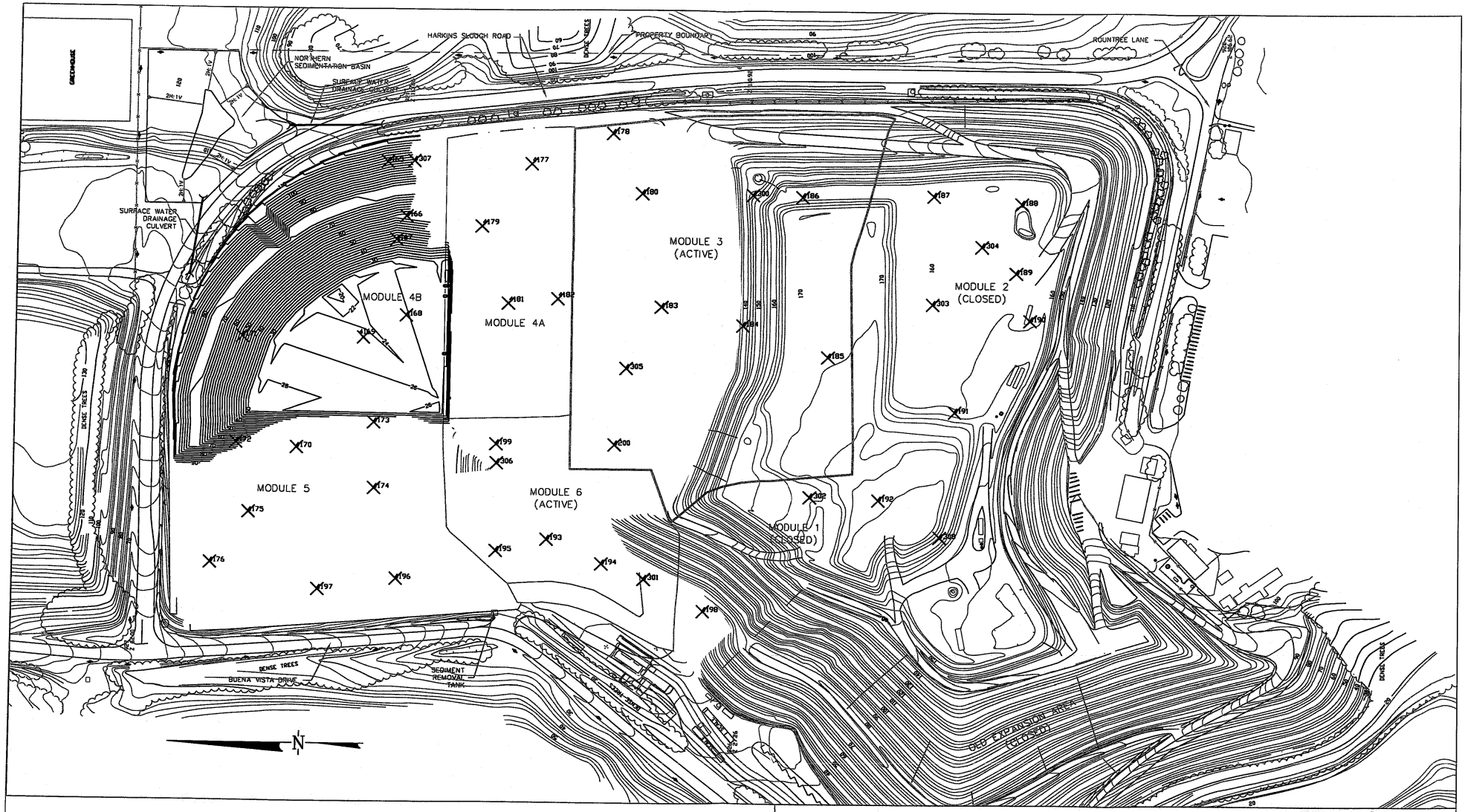
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AS-BUILT

OVERLAY BORDER

PROJD FILE


HARKINS SLOUGH ROAD
PROPERTY BOUNDARY
ROUNTREE LANE
NORTHERN SEDIMENTATION BASIN
SURFACE WATER DRAINAGE CULVERT
GREENHOUSE
DENSE TREES
MODULE 3 (ACTIVE)
MODULE 4B
MODULE 4A
MODULE 2 (CLOSED)
MODULE 5
MODULE 6 (ACTIVE)
MODULE 1 (CLOSED)
SEDIMENT REMOVAL TANK
BUENA VISTA DRIVE
OLD EXPANSION AREA (CLOSED)
N
TOPOGRAPHY (2004)
0 100 200
SCALE IN FEET
4123 POINTS USED IN SETTLEMENT ANALYSIS
BASE GRADES
Geosyntec consultants
BASE GRADING PLAN - MODULE 4A
BUENA VISTA LANDFILL
SANTA CRUZ, CA
FIGURE NO 2D
WG1019
JULY 2008

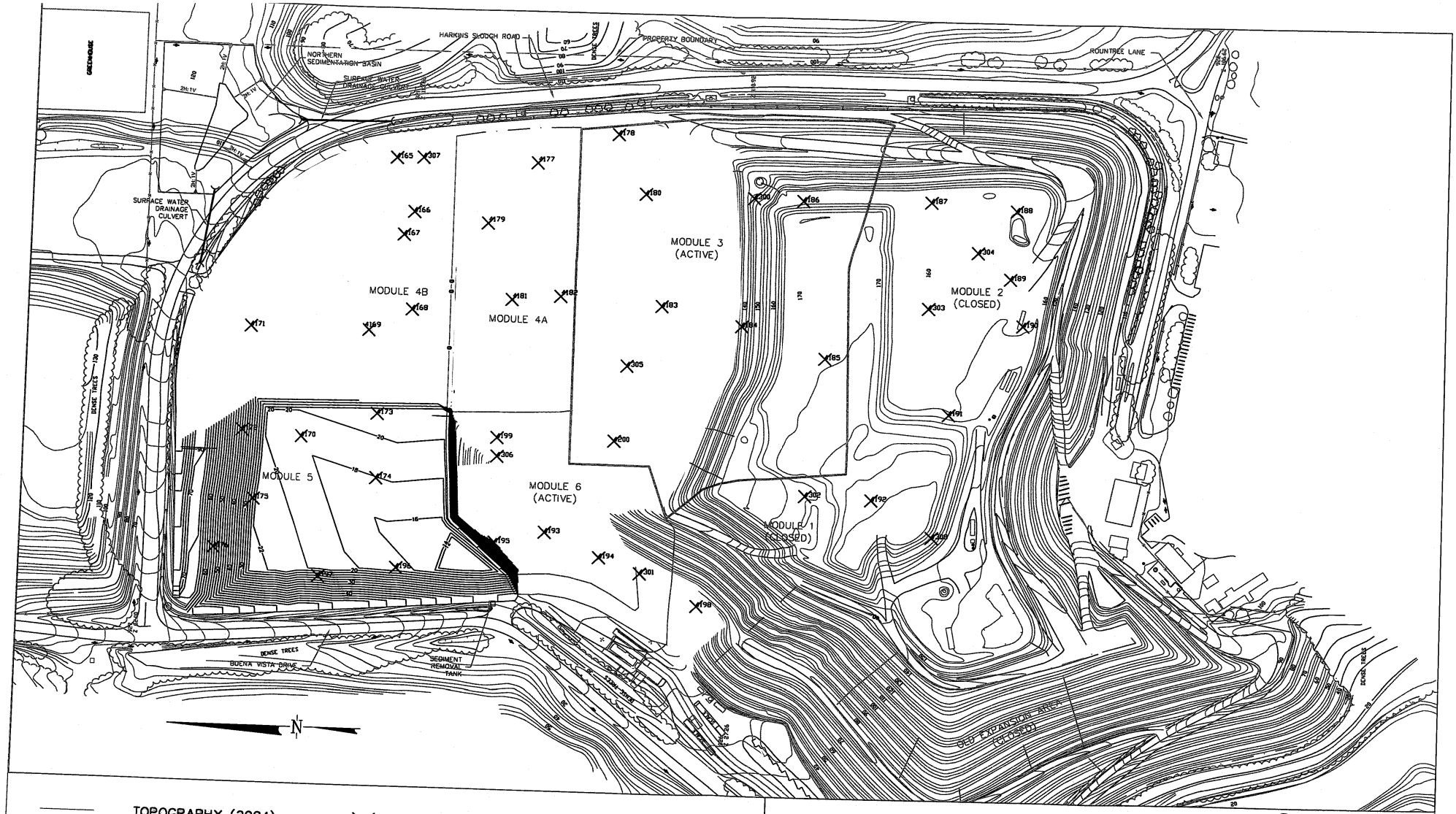


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BASE GRADING PLAN - MODULE 4B

BUENA VISTA LANDFILL
SANTA CRUZ, CA

FIGURE NO 28
WG1019
JULY 2008



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BASE GRADING PLAN - MODULE 5

BUENA VISTA LANDFILL
SANTA CRUZ, CA

FIGURE No. 2F

WG1019

JULY 2008



LEGEND

- 30 — MODULE 5 BASE GRADING CONTOUR
- 30 — MODULE 4A/4B BASE GRADING CONTOUR
- 30 — MODULE 6 BASE GRADING CONTOUR
- LINER LIMIT
- E — E' CROSS-SECTION LOCATION

NOTES:

1. EXISTING TOPOGRPAHY BASED AERIAL PHOTO FLOWN ON 21 JANUARY 2004.

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BASE GRADING PLAN
BUENA VISTA LANDFILL
SANTA CRUZ COUNTY, CALIFORNIA

FIGURE NO.	A26
PROJECT NO.	WL0658
DATE:	FEBRUARY 2005

P:\CAD\...\Buena Vista Site Development\dwg\SDP-APPENDIXFIGS.dwg 3-01-05 04:22:2... ERohmon

APPENDIX F
Seismic Hazard Evaluation and Seismic Deformation Analyses

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SEISMIC SITE RESPONSE AND DEFORMATION ANALYSIS
BUENA VISTA LANDFILL
WATSONVILLE, CALIFORNIA

INTRODUCTION

This analysis package presents the selection of ground motions, seismic site response and deformation potential analyses performed for Buena Vista Drive Sanitary landfill, (BVDSL) at Watsonville, California. The analyses are based upon the results of the seismic hazard performed by Geosyntec [2003]. Geosyntec [2003] identified that the Maximum Probable Earthquake (MPE) at the site is either a Moment Magnitude (M_w) 6.2 event on the Zayante-Vergales Fault or M_w 7.9 event on the San Andreas fault system.

Geosyntec estimated the seismic hazard at the site using the Next Generation Attenuation (NGA) Relationships, developed as part of a research project by the Pacific Earthquake Engineering Research Center. The NGA relationships are widely acknowledged as representing the earthquake profession's best scientific understanding of ground motion attenuation. They have been adopted by the U.S. Geologic Survey in its National Hazard Mapping Project, and on critical projects such as the BART Earthquake Safety Program. A total of 8 ground motions were selected and their intensity was appropriately scaled to fit the target response spectrum at the site. One-dimensional equivalent-linear site response analyses for two representative waste columns (100 ft and 160 ft high) were then performed. Based on the results of the seismic response analyses, Newmark-type seismic deformation analyses were performed. The results of the seismic deformation analyses are presented in the form of charts relating calculated permanent seismic displacement to yield acceleration. These charts were developed for the landfill waste mass and for the cover.

The BVDSL is approximately 2.5 miles (4 km) west of Watsonville, California. The approximate location of the BVDSL is shown on Figure 1. Geotechnical investigations indicate that the soil conditions below the landfill consist primarily of native soils composed of dense silty and clayey sands and gravel [County of Santa Cruz, 1999].

The report was prepared by Dimitrios Zekkos, Ph.D., P.E., and reviewed by Jonathan D. Bray, Ph.D., P.E., and Hari Sharma, Ph.D., P.E., G.E., in accordance with Geosyntec's review policy.

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SEISMIC HAZARD EVALUATION

Geosyntec [2003] identified the potentially governing faults and concluded that the Maximum Probable Earthquake (MPE) at the site is either a Moment Magnitude (M_w) 6.2 event on the Zayante-Vergales Fault located at a distance[1] of 3.4 miles (5.5 km) or a M_w 7.9 event on the San Andreas fault system located at a distance of 6.2 miles (9.9 km).

Due to its relatively large magnitude and its close proximity to the site, the M_w 7.9 event on the San Andreas fault governs the seismic performance evaluation of the BVDSL. The M_w 7.9 event is the largest historic event on the San Andreas fault as stipulated in the definition of the MPE. The M_w 7.9 event is also the maximum magnitude on the northern segment of the San Andreas fault according to the U.S. Geological Survey, and hence it can also be considered the Maximum Credible Earthquake (MCE).

Geosyntec estimated the ground motion intensity at the site from the two faults using the Next Generation Attenuation Relationships and found that the San Andreas Fault governs. All five NGA attenuation Relationships were used [Abrahamson, and Silva, 2007, Boore and Atkinson, 2007, Campbell and Bozorgnia, 2007, Chiou and Youngs, 2006, Idriss, 2007]. The input parameters used in the attenuation relationships for the governing San Andreas Fault event are shown in Table 1. For each attenuation relationship, the mean, mean+1σ and mean-1σ estimates are presented in Figure 2. The mean Peak Ground Acceleration at the site is listed in Table 2. According to the NGA relationships, the ground motion intensity at the site due to the MCE is lower than previously considered and this will impact the predicted seismic displacements. The average of the mean of the five response spectra was then calculated. The San Andreas fault event was found to govern and was considered in subsequent analyses.

Because the site is located only 9.9 km from the San Andreas fault, the average specturm was modified to capture the effects of forward-directivity for a rupture that would initiate well north of the site and propagate southward. Modifications were made per Somerville et al. [1997], and Abrahamson [2000]. The effect of directivity is shown in Figure 3. Directivity is caused by the constructive interference of seismic waves when fault rupture propagates towards the site. Directivity will affect the intensity of both horizontal components of the ground motion for spectral accelerations higher than periods of 0.6 sec. The fault normal component is also systematically higher than the fault parallel

[1] Shortest distance from the geometric center of the site to the inferred fault plane.

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component. Because the landfill slopes are oriented north-south and east-west, the ground motion perpendicular to the slopes is not the fault normal or the fault parallel component, but closer to the average of these two components. Thus, the average spectrum, as corrected for forward directivity, considering the average of the two components was used as the design spectrum.

EARTHQUAKE GROUND MOTIONS

A total of 8 acceleration-time histories were selected to represent the seismic hazard at the site in the context of calculating seismically induced permanent displacements. Seven ground motions were selected from the NGA database of recorded ground motions [PEER, 2005] based on tectonic environment, distance, magnitude, fault type, site conditions and other factors, including spectral shape and forward directivity. To supplement the lack of empirical data for Magnitude Mw 7.9 events at close distance to the ruptured fault, a synthetic "rock" ground motions developed by Dr. Silva that includes the effects of directivity, for a repeat of the 1906 Mw 8 event on the San Andreas Fault was also selected. Four of the eight ground motions were selected to have the pulse-like characteristics of forward directivity ground motions (i.e., GM#1, GM#4, GM#6, and GM#7). Selected ground motions were modified with amplitude scaling factors of 0.6 to 2.5 to better capture the target spectrum for the event.

As explained previously, the target spectrum for the controlling event is governed largely by forward-directivity near-fault ground motions. These motions contain high intensity pulses that are a particularly demanding characteristic of near-fault motions. Although these motions contain these intense pulses they are systematically relatively short in duration compared to "ordinary" ground motions, which however are less intense. Ground motions were selected to have durations appropriate for the scenario that they represent. Near-fault intense ground motions are systematically shorter in duration. Other "ordinary" or backward directivity motions were selected that were less intense but had longer durations that are more consistent with that expected for these scenarios. Arias Intensity values for each motion were used to check that each motion had an appropriate level of total energy overall for the controlling event.

The selected ground motions are:

- GM#1: The CDMG 22074 Yermo Fire Station, 260 component (NGA0900) recorded during the M_w 7.3 Landers earthquake on 6/28/2007. A scaling factor of 1.8 was used.

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- GM#2: The CWB 99999 CHY024, east component (NGA1193) recorded during the M_w 7.6 Chi-Chi, Taiwan earthquake on 9/20/2007. A scaling factor of 1.1 was used.

- GM#3: The CWB 99999 CHY006, west component (NGA1182) recorded during the M_w 7.6 Chi-Chi, Taiwan earthquake on 9/20/2007. A scaling factor of 0.8 was used.

- GM#4: The SCE 24 Lucerne, 260 component (NGA0879) recorded during the M_w 7.3 Landers earthquake on 6/28/2007. A scaling factor of 0.85 was used.

- GM#5: The USGS 5070 North Palm Springs, 090 component (NGA0882) recorded during the M_w 7.3 Landers earthquake on 6/28/2007. A scaling factor of 2.5 was used.

- GM#6: The synthetic 1906 M_w 8.0 San Andreas Event, developed by Walt Silva at a distance of 10 km that includes forward directivity. A scaling factor of 0.6 was used.

- GM#7: The 9101 Tabas station recording, Longitudinal component (NGA0143) recorded during the M_w 7.4 Tabas earthquake on 9/16/1978. A scaling factor of 0.45 was used.

- GM#8: The ERD 99999 Izmit recording, 090 component (NGA1165) recorded during the M_w 7.5 Kocaeli earthquake on 8/17/1999. A scaling factor of 1.3 was used.

The key characteristics of the selected ground motions are listed in Figures 4-11. Each figure includes the acceleration-time, velocity-time, and displacement–time history. It also includes the Arias Intensity-time history. The characteristics of the scaled ground motion, i.e., the Peak Ground Acceleration (PGA), the Peak Ground Velocity (PGV), the Mean Period T_m, the bracketed duration and significant duration are also presented. Relevant station information is also provided. Such information includes name and Magnitude of the event, rupture distance, and site conditions.

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Figure 12 illustrates the target spectrum along with the response spectra (5% damped) of the scaled ground motions. The average of the eight spectra "matches" or exceeds the target spectrum for periods between 0.1 sec to 2 sec.

SEISMIC SITE RESPONSE AND DEFORMATION ANALYSES

Method of Analysis

The seismic response and deformation analyses for BVDSL landfill were carried out following the methodology outlined below:

(i) select characteristic landfill cross sections based upon cell geometry;

(ii) assign material properties to the selected cross sections based upon available information, past experience, and engineering judgment;

(iii) select representative one-dimensional columns for seismic site response analysis;

(iv) perform one-dimensional equivalent-linear seismic site response analyses of the representative columns;

(v) perform Newmark-type [Newmark, 1965] seismic deformation analyses for the waste mass by processing the average acceleration time histories calculated in step (iv), expressing the results in terms of the calculated permanent seismic displacement versus yield acceleration.

The outlined methodology is essentially the *decoupled* approach to seismic deformation analyses. Lin and Whitman [1983] and Rathje and Bray [2000] demonstrated that this decoupled approach is generally reliable and is typically conservative when compared to more rigorous fully coupled seismic deformation analysis methods.

Two representative solid waste columns, 100 ft (30 m) thick, and 160 ft (48.8 m) thick, were analyzed.

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Material Properties

For the seismic site response analysis of the waste mass, Geosyntec divided the on-site materials into the following characteristic groups:

(i) MSW material;
(ii) Soil base and cover material; and
(iii) Dense to stiff soil underlying the site.

Material properties are summarized in Figure 13. Unit weights of soil materials (landfill cover and landfill subgrade) listed in Figure 13, are estimated based upon available data at the site [County of Santa Cruz, 1999]. Shear wave velocities assigned to the soil materials are estimated based upon Imai and Tonouchi [1982]. Shear modulus reduction and damping curves assigned to the landfill coover and base were selected based upon Vucetic and Dobry [1991] using Plasticity Index (PI) values reported in previous studies [County of Santa Cruz, 1999].

MSW materials disposed of at the site were characterized by the average Kavazanjian et al. [1996] recommended shear wave velocity profile and the Zekkos et al. [2006] unit weight profile. The Kavazanjian et al. [1996] shear wave velocity profiles are based on shear wave velocity measurements at ten southern California solid waste landfills. The Zekkos et al. [2006] is based on a model calibrated from field in-situ data from 6 landfills and large-scale laboratory tests. The Zekkos et al. [2008] shear modulus reduction and material damping curves for typical landfills were selected for the analyses. The shear modulus reduction and damping properties are based upon extensive, large-scale cyclic triaxial testing of municipal solid waste from the Tri-Cities landfill in the San Francisco Bay Area in northern California and are generally consistent with field and laboratory data from other landfills. MSW material properties are illustrated in Figure 14.

Seismic Site Response Analyses

One-dimensional equivalent-linear seismic response analyses of the characteristic columns through the landfill were conducted using the computer program SHAKE2000 [Ordonez, 2007]. SHAKE2000 computes the response of a system of homogeneous, visco-elastic layers of infinite horizontal extent subjected to vertically propagating shear waves. The program is based on the continuous solution to the wave equation adapted for use with transient motions through the Fast Fourier Transform Algorithm. The

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nonlinearity of the shear modulus and damping is accounted for by the use of equivalent linear soil properties [Idriss and Seed, 1968] using an iterative procedure to obtain values for modulus and damping compatible with the effective strains in each layer.

Seismic site response analysis computer outputs are enclosed in Appendix I. The equivalent acceleration time histories from the above described SHAKE2000 seismic site response analyses were used in the Newmark seismic deformation analyses as described below to estimate permanent seismic displacement for the waste mass and landfill cover. The results of the seismic site response analyses indicate that the largest seismic response is calculated for the 100 ft (30.4 m) high MSW Column.

Newmark Deformation Analyses

The results of the SHAKE2000 one-dimensional seismic site response analysis were used as input for Newmark [Newmark, 1965] seismic deformation analysis to evaluate the permanent seismic deformation potential of the landfill. The horizontal equivalent acceleration time history at the base of the landfill, which is equal to the shear stress time history at that elevation divided by the total vertical stress was estimated and was used as input in the analyses. The analyses were performed using the "Displacement Analyses" toolbox available in SHAKE2000. Since the seismic deformation calculated by this method is a function of yield acceleration, the analyses were repeated for several yield acceleration levels and presented in the form of seismically induced permanent displacement charts.

The results of the Newmark deformation analyses for the waste mass and the cover are presented in the form of charts relating calculated seismically induced permanent displacement to yield acceleration (permanent displacement charts) in Figures 15 through 18. The average calculated seismically induced permanent displacement curve should be used to evaluate the potential for seismic instability of the landfill.

Based on these calculations, the required minimum k_y for the average calculated seismically induced permanent base displacement to be less than or equal to 6 inches is 0.115. Additionally, the required minimum k_y for the average calculated seismically induced permanent displacement of the cover system to be less than or equal to 12 inches or 36 inches is 0.16 and 0.087 respectively.

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CONCLUSIONS

This calculation package presents the ground motion selection and the results of seismic site response and deformation potential analyses performed by GeoSyntec for BVDSL. The results of the seismic site response analysis of representative 100 ft (30.4 m), and 160 ft (48.8 m) high MSW columns are presented. The results of seismic deformation analysis are presented in a form of charts relating calculated permanent seismic deformation to yield acceleration (permanent displacement charts) in Figures 15 through 18. These permanent displacement charts can be used in conjunction with the yield accelerations of waste mass and final cover to evaluate the respective permanent seismic displacements.

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TABLES

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Table 1: NGA Attenuation Relationships Input Parameters

Source parameters	**Value**
Magnitude	7.9
Top of Rupture (km) [1]	0
Fault Type	Strike Slip
Dip (degrees)	90
Distance (location) Parameters[1]	
R_{rup} (km)	9.9
R_{jb}(km)	9.9
R_x (km)	9.9
Site Response Parameters	
V_{S30} (m/s)[2]	549
$Z_{1.0}$ (km)[3]	0.145/0.08
$Z_{2.5}$ (km)[4]	2.974

[1] Rupture assumed to extend to the surface.

[2] V_{s30} assumed to be 1800 fps (549 m/sec), which is a lower bound estimate of shear wave velocity of material. NGA predictions for a V_{s30}=2400 fps results in lower ground motion intensity at the site.

[3] Depth to layer with shear wave velocity of 1 km/sec is unknown. Based on recommendations, when the depth to the 1 km/sec is unknown a value of 0.145 km should be used for Abrahamson and Silva [2007] and a value of 0.08 km should be used for Chiou and Youngs [2006].

[4] Assumed value that has an effect on the Campbell and Bozorgnia [2007] attenuation relationship.

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Table 2: Peak Ground Acceleration (PGA) at the site predicted by the NGA relationships

Attenuation Relationship	**PGA, g**
Abrahamson and Silva [2007]	0.30
Boore and Atkinson [2007]	0.33
Campbell and Bozorgnia [2007]	0.29
Chiou and Youngs [2006]	0.39
Idriss [2007]	0.37

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FIGURES

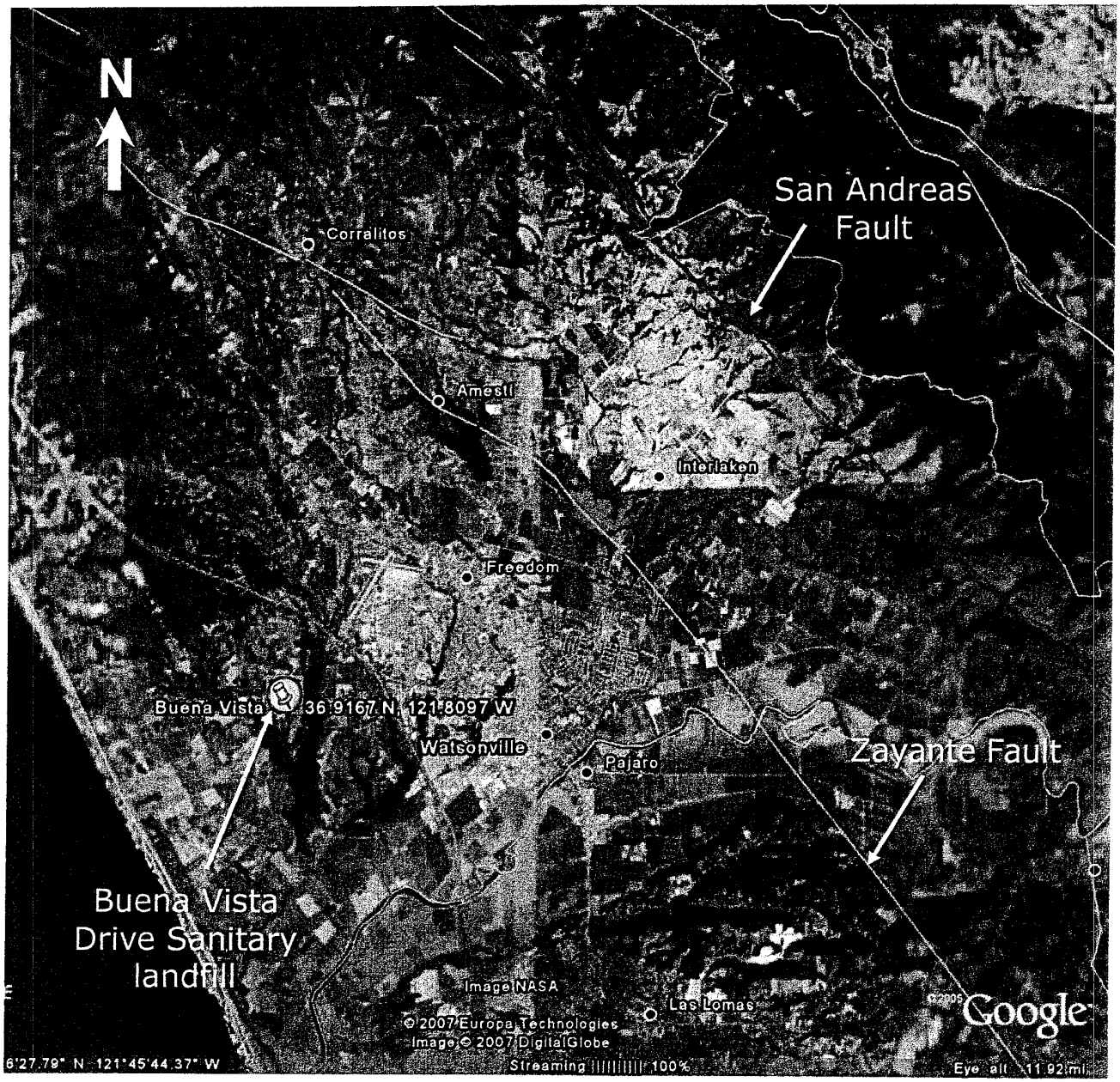
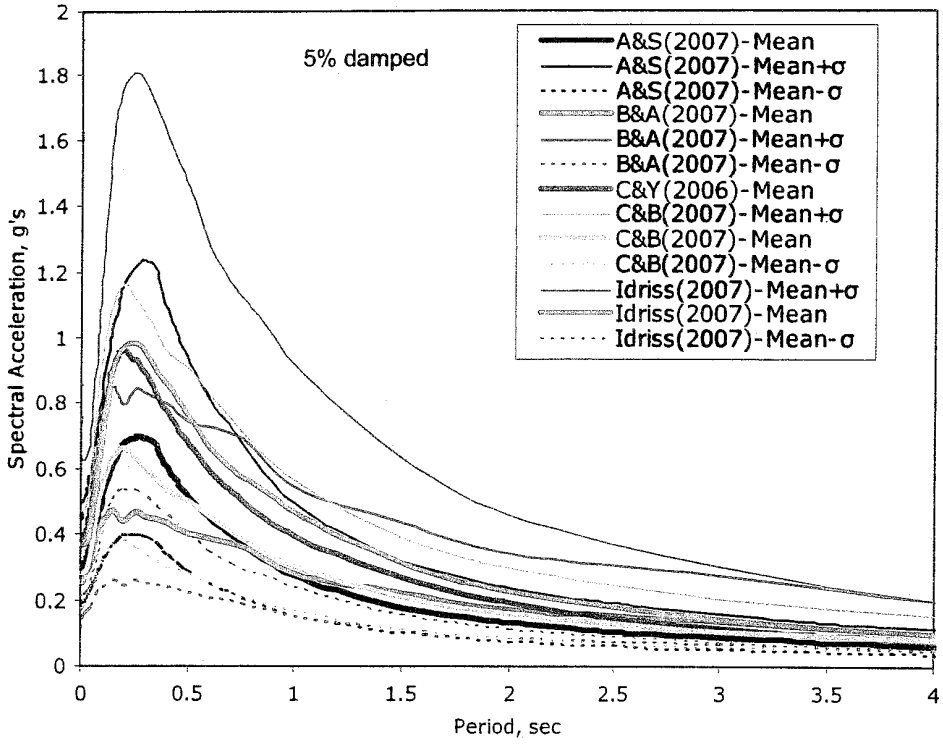
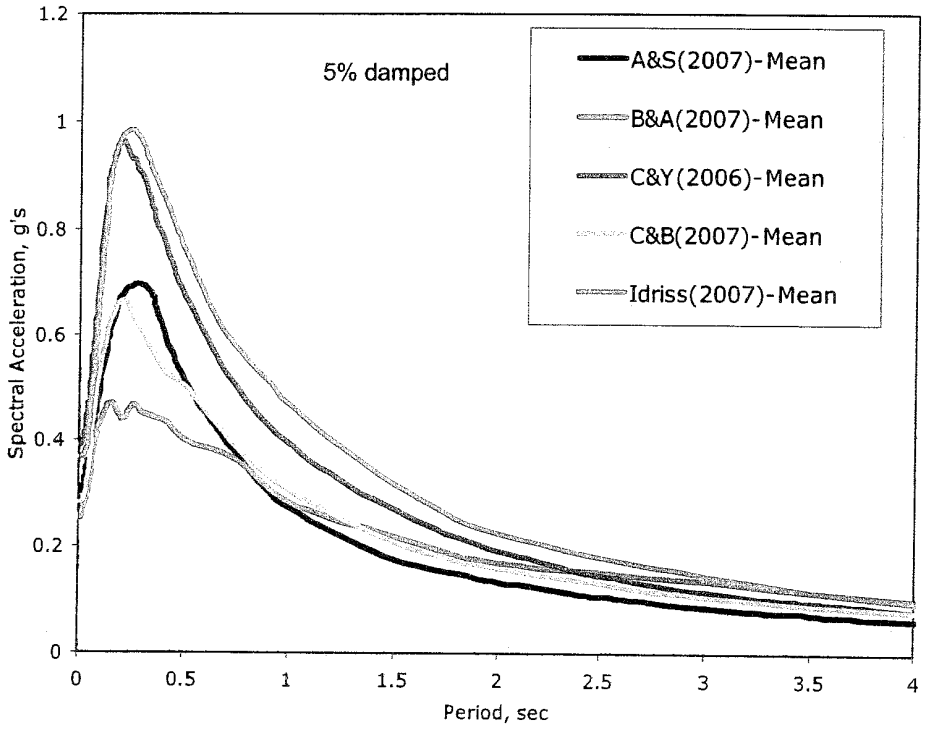


Figure 1: Landfill location and contributing faults

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Legend Explanation:

A&S(2007): Abrahamson, and Silva, 2007

B&A(2007): Boore and Atkinson, 2007

C&B(2007): Campbell and Bozorgnia, 2007

C&Y(2006): Chiou and Youngs, 2006

Figure 2: Mean, mean – σ and mean+σ estimate of intensity at the site from NGA relationships for the San Andreas Event

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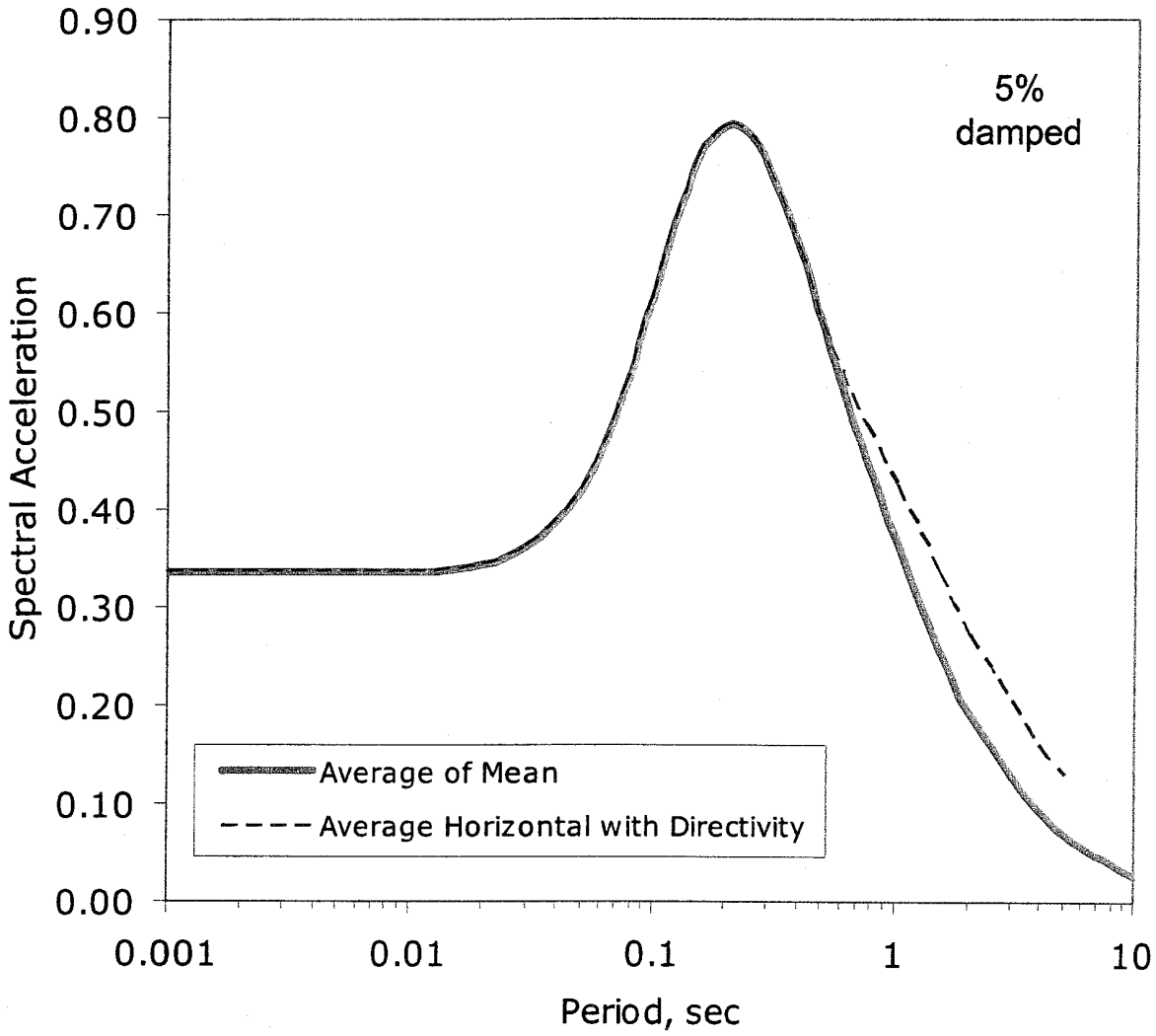
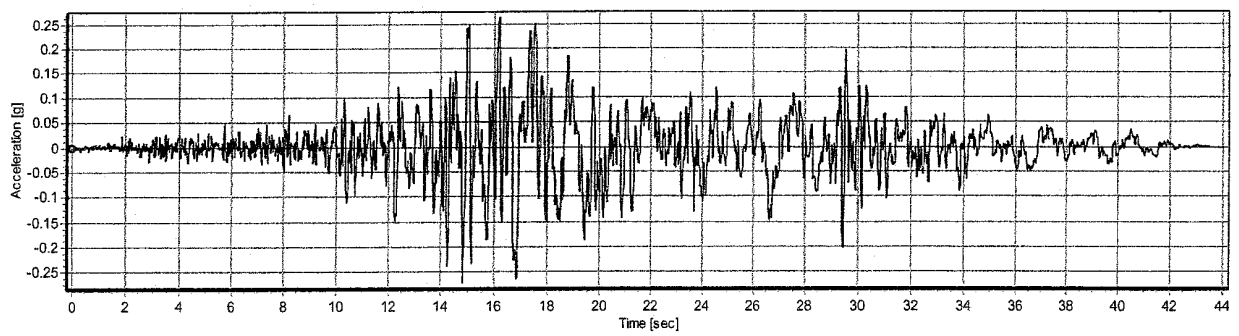
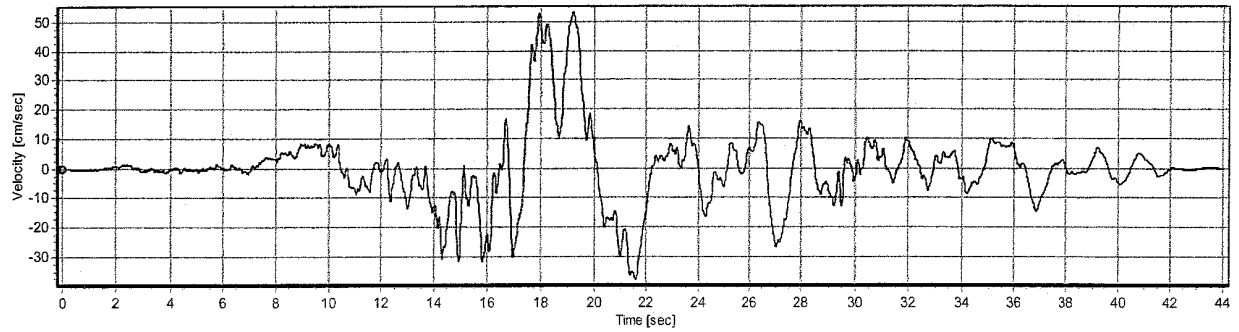
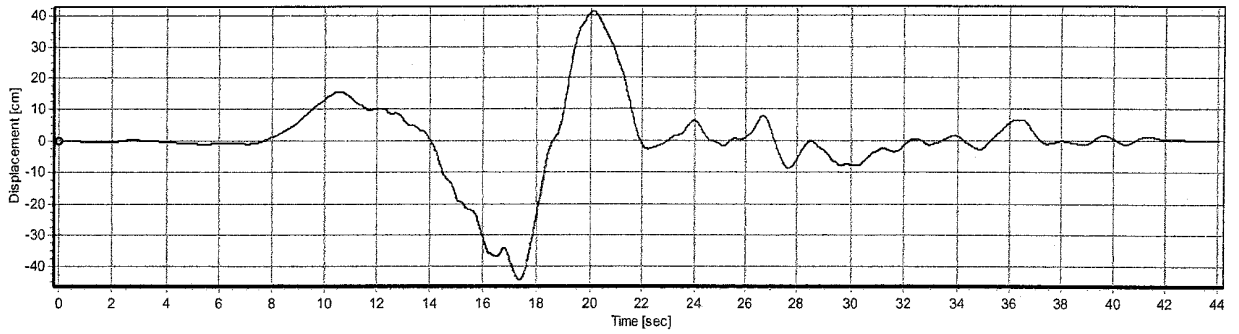


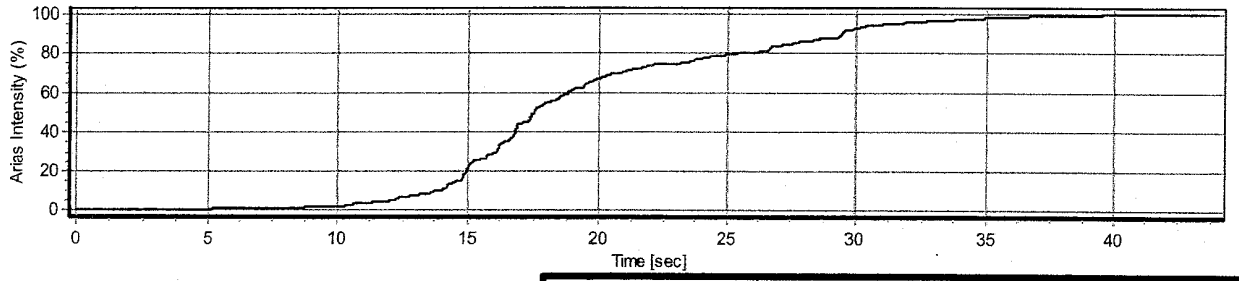
Figure 3: Target Spectrum corrected for directivity

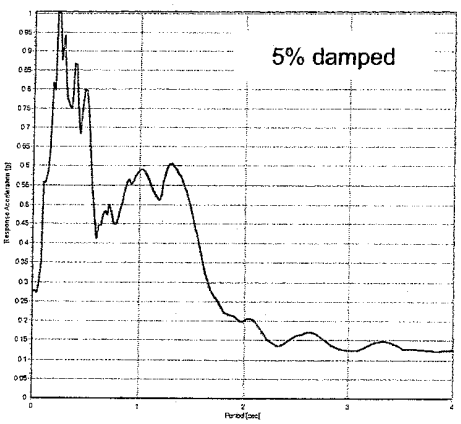
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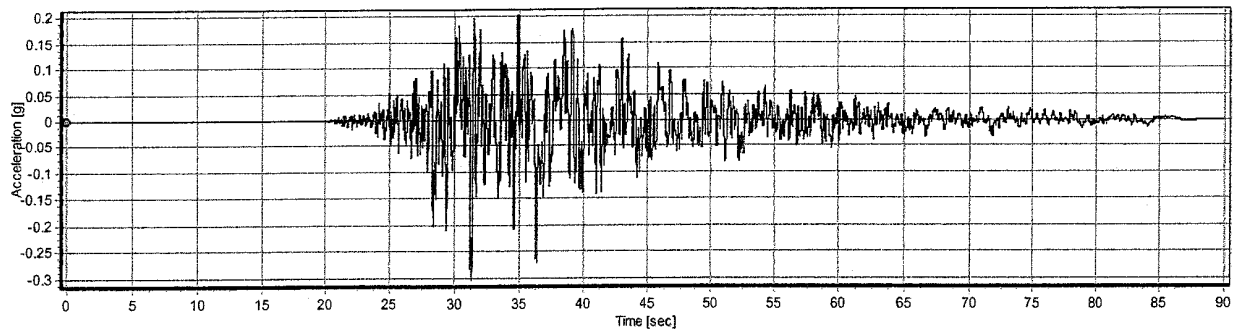


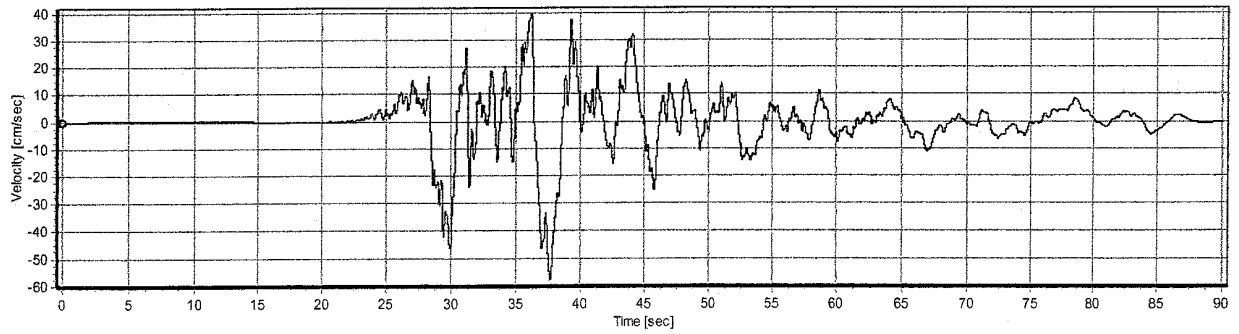
Note: Graphs representative of the scaled ground motion

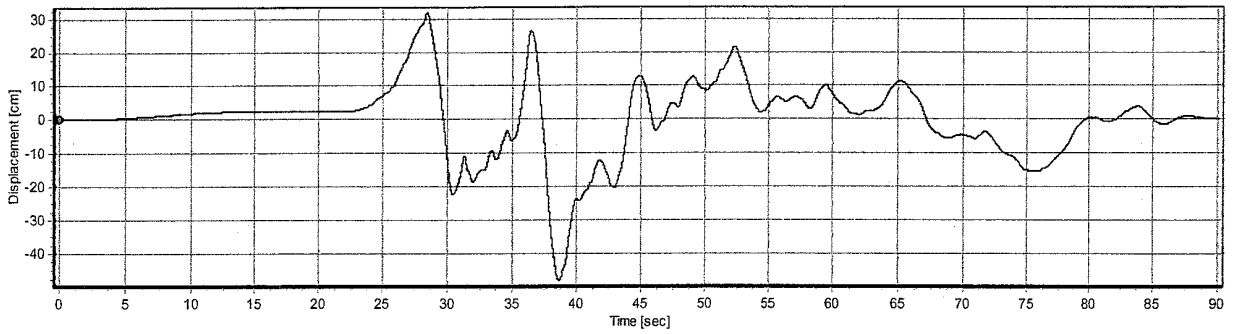
	Scaled Ground Motion		
PGA (g's)	0.27	Scale Factor	1.8
PGV (cm/sec)	53.5	M_w	7.28
Mean Period, T_m (sec)	0.65	Closest Distance (km)	23.6
Bracketed Duration (sec)	39.6	V_{s30} (m/sec)	354
Significant Duration (sec)	18.9		

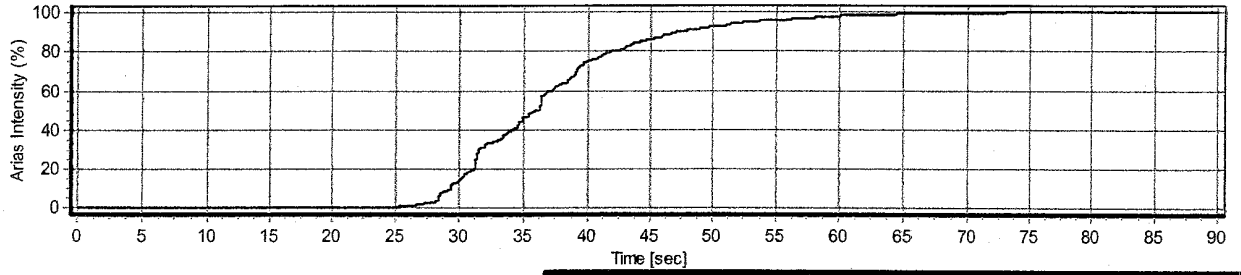
Figure 4: GM#1 – Landers Earthquake – Yermo Fire Station Record – 360 component

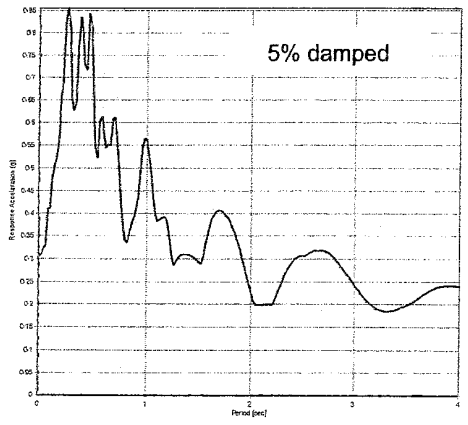
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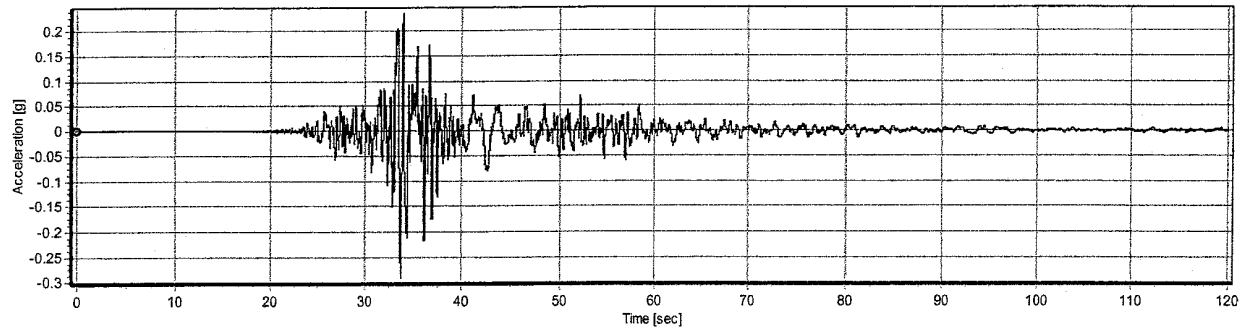


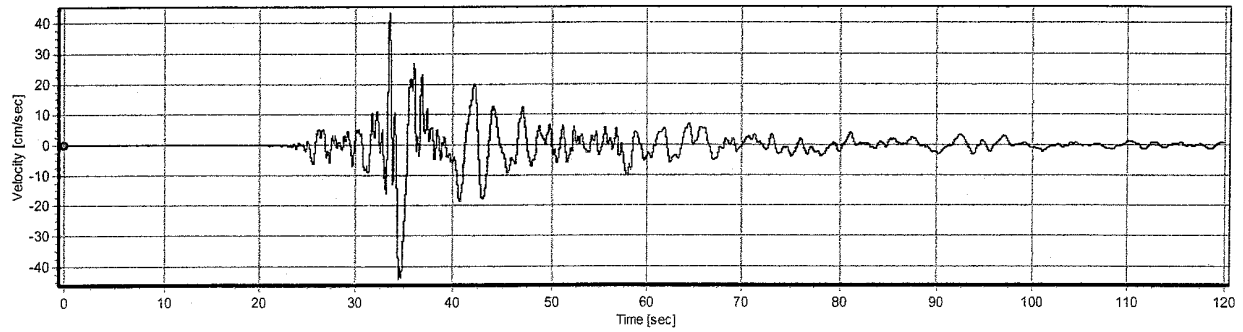
Note: Graphs representative of the scaled ground motion

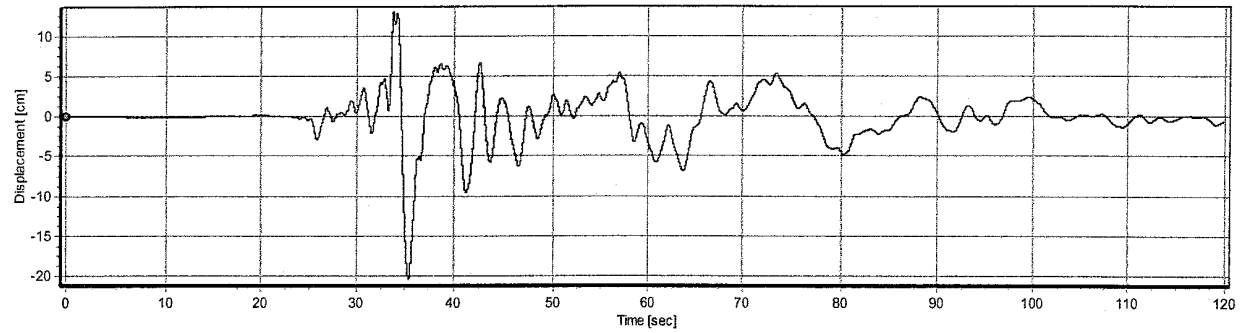
	Scaled Ground Motion		
PGA (g's)	0.31	Scale Factor	1.1
PGV (cm/sec)	58.2	M_w	7.62
Mean Period, T_m (sec)	0.87	Closest Distance (km)	9.6
Bracketed Duration (sec)	56.9	V_{s30} (m/sec)	428
Significant Duration (sec)	24.1		

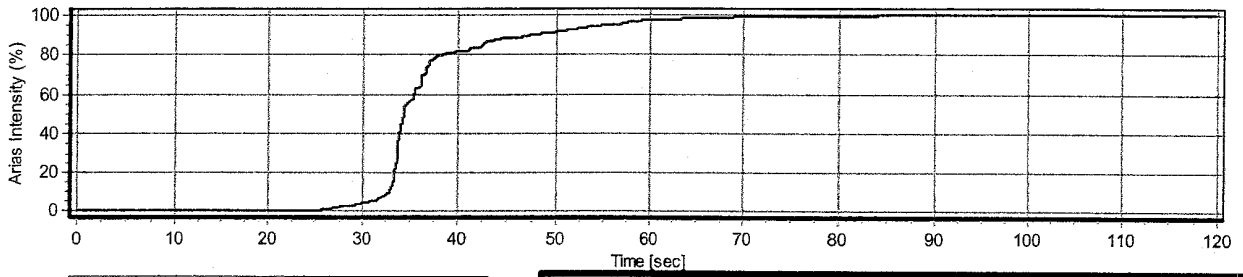
Figure 5: GM#2 – Chi-Chi earthquake – CHY024 station recording

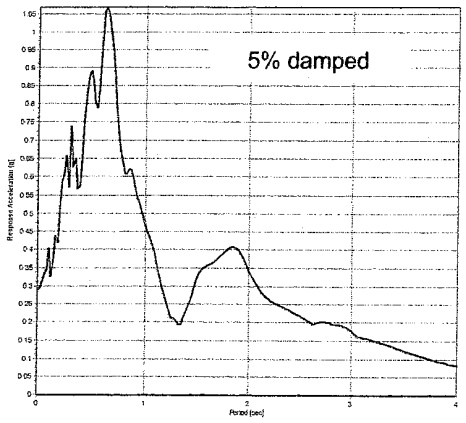
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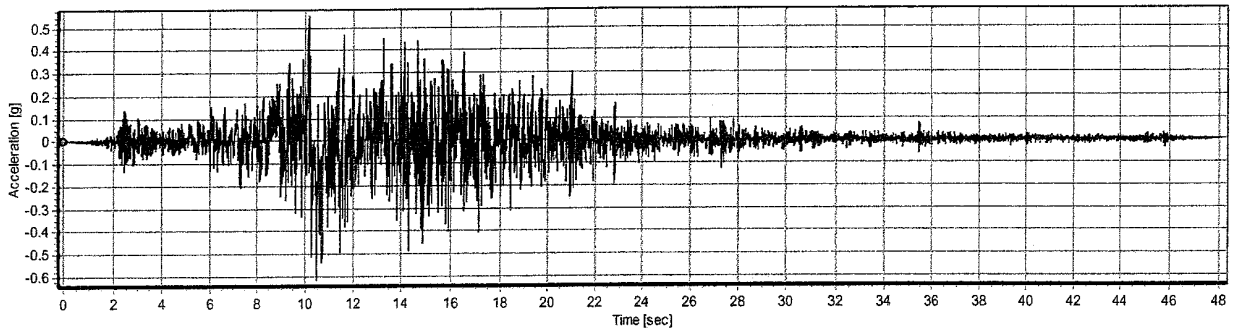


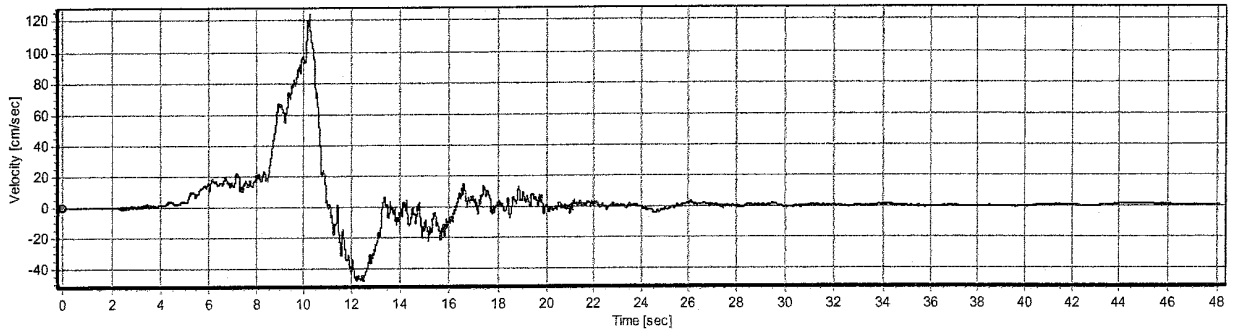
	Scaled Ground Motion		
PGA (g's)	0.29	Scale Factor	0.8
PGV (cm/sec)	44.4	M_w	7.62
Mean Period, T_m (sec)	0.92	Closest Distance (km)	9.8
Bracketed Duration (sec)	57.5	V_{s30} (m/sec)	438
Significant Duration (sec)	24.3		

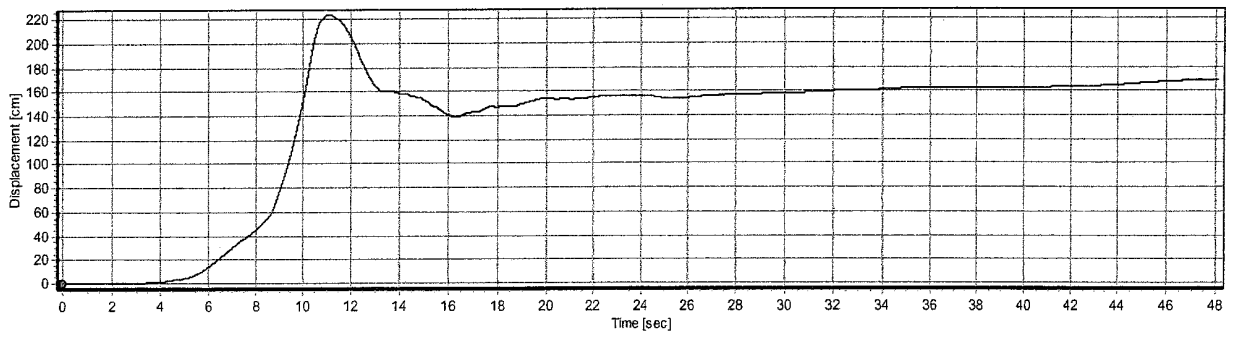
Note: Graphs representative of the scaled ground motion

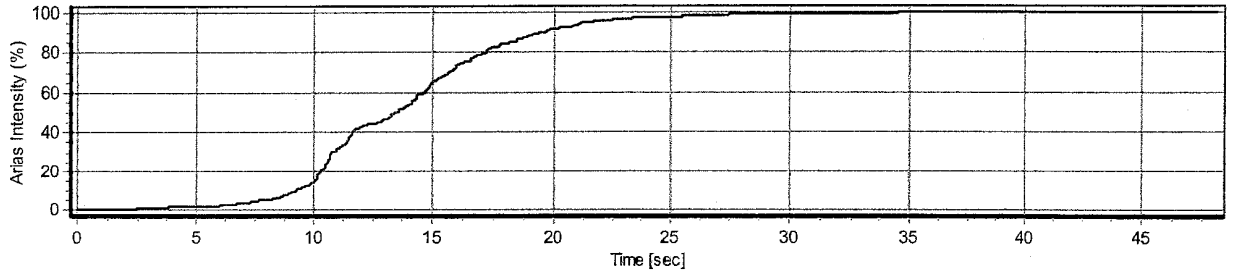
Figure 6: GM#3 – Chi-Chi earthquake – CWB 99999 station CHY006 recording

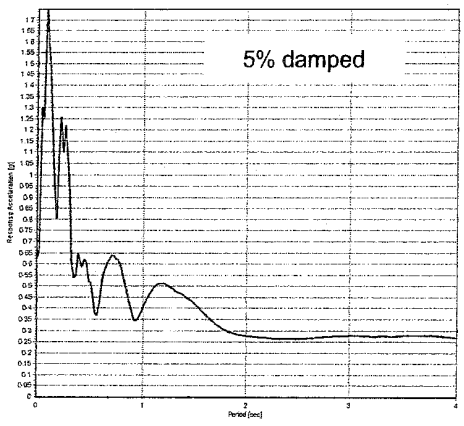
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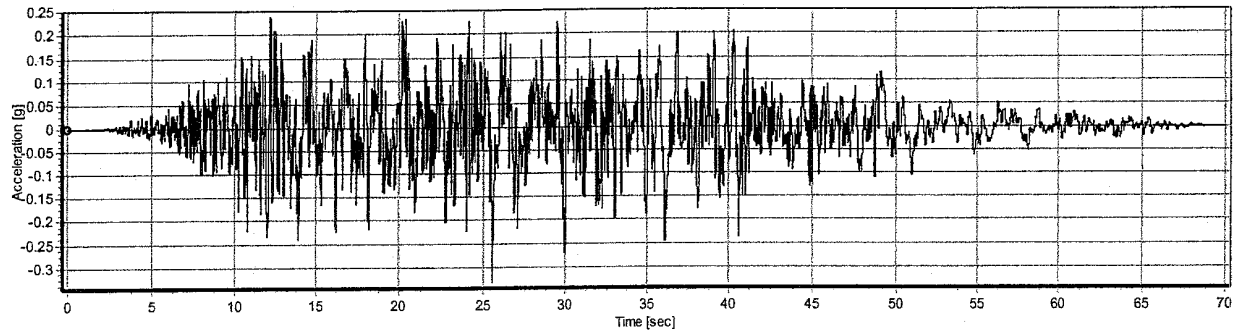


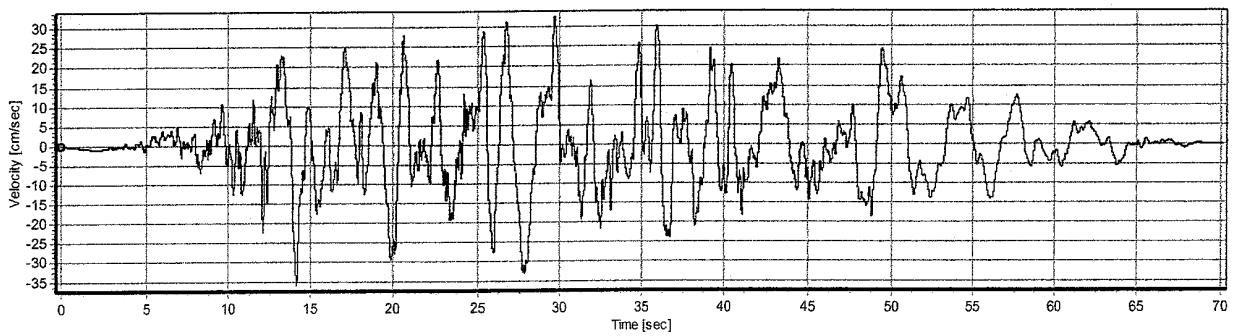


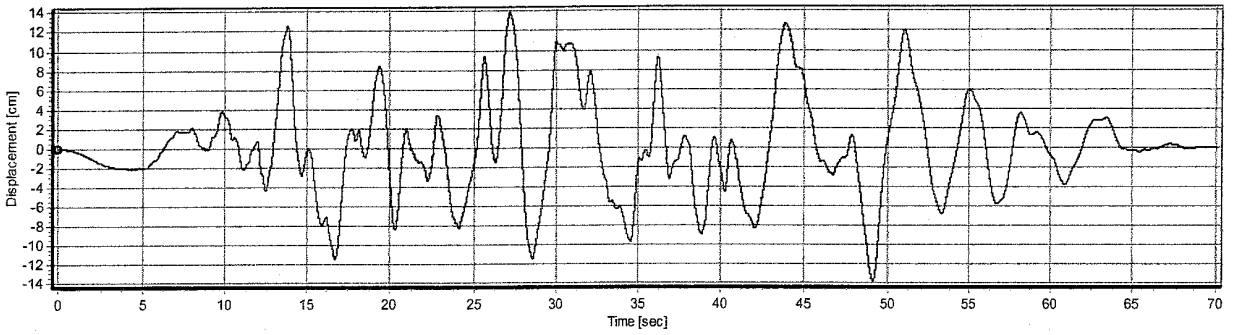
Note: Graphs representative of the scaled ground motion

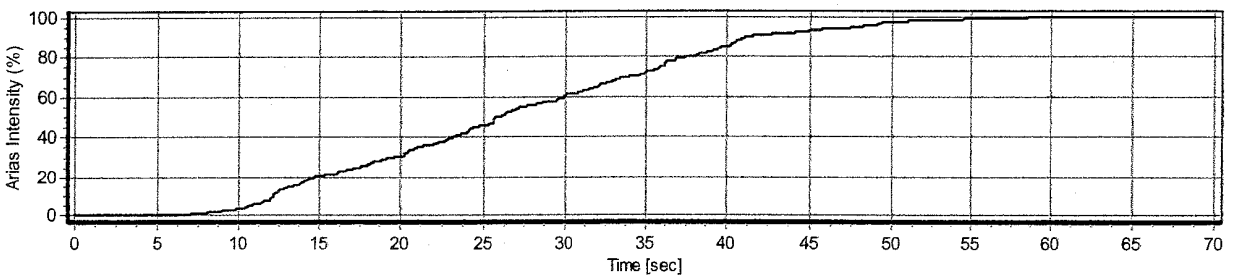
	Scaled Ground Motion		
PGA (g's)	0.62	Scale Factor	0.85
PGV (cm/sec)	124.6	M_w	7.28
Mean Period, T_m (sec)	0.33	Closest Distance (km)	2.2
Bracketed Duration (sec)	43.9	V_{s30} (m/sec)	685
Significant Duration (sec)	13.1		

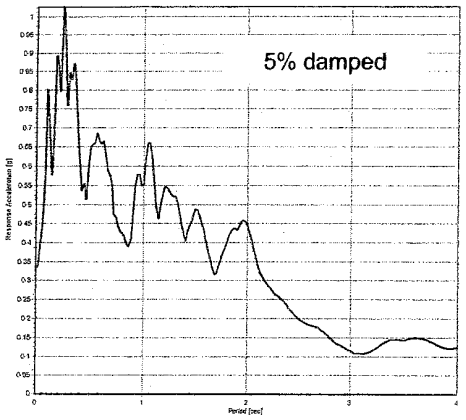
Figure 7: GM#4 – Landers earthquake – Lucerne station recording – 260 component









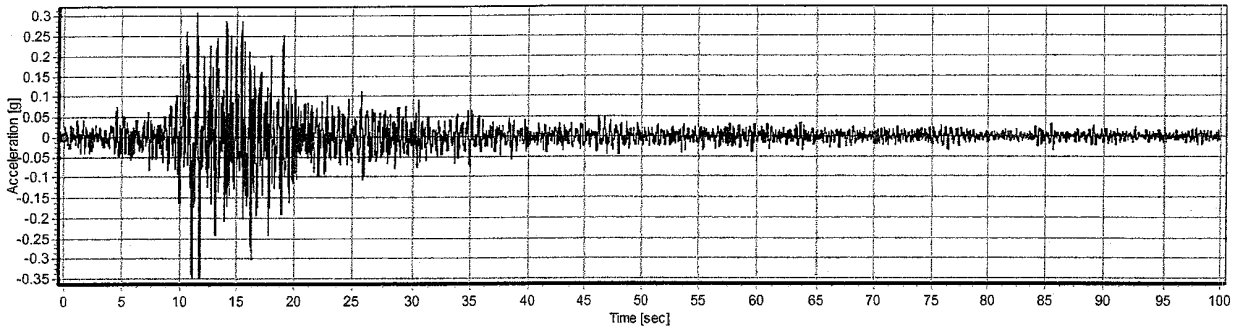


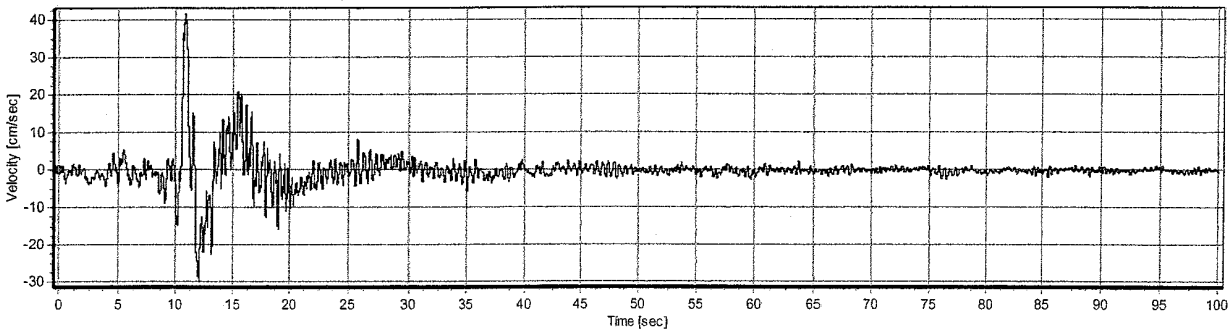
	Scaled Ground Motion		
PGA (g's)	0.33	Scale Factor	2.5
PGV (cm/sec)	36.2	M_w	7.28
Mean Period, T_m (sec)	0.68	Closest Distance (km)	26.8
Bracketed Duration (sec)	61.7	V_{s30} (m/sec)	345
Significant Duration (sec)	37.0		

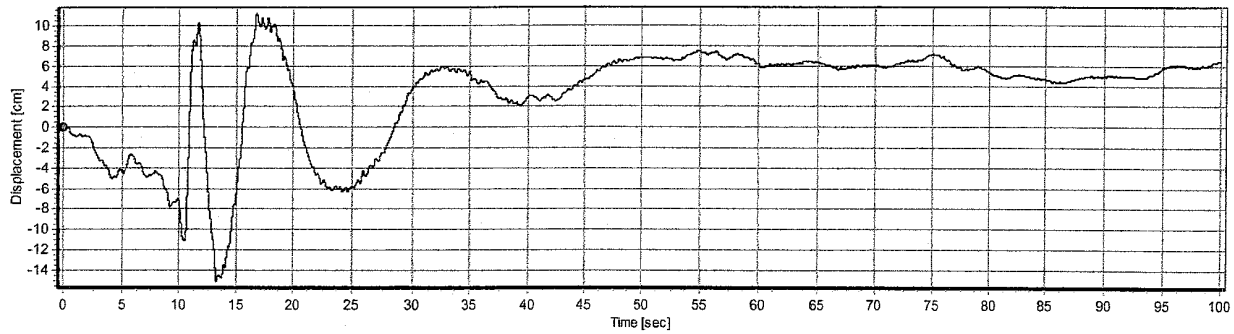
Note: Graphs representative of the scaled ground motion

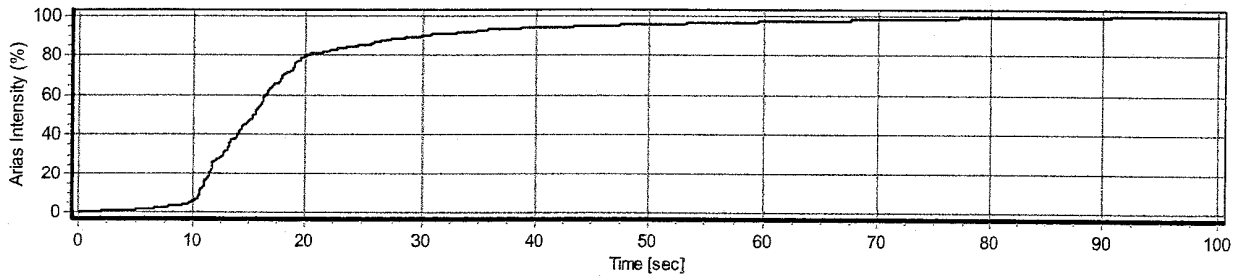
Figure 8: GM#5 – Landers earthquake – USGS 5070 North Palm Springs – NPS090 component

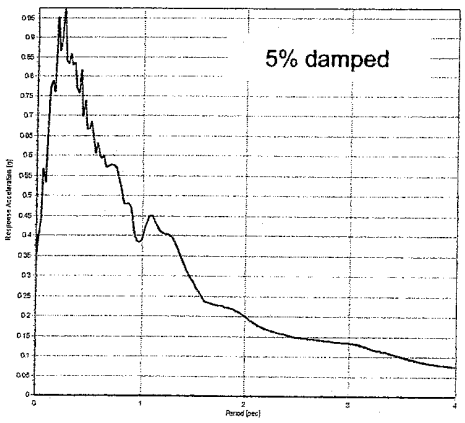
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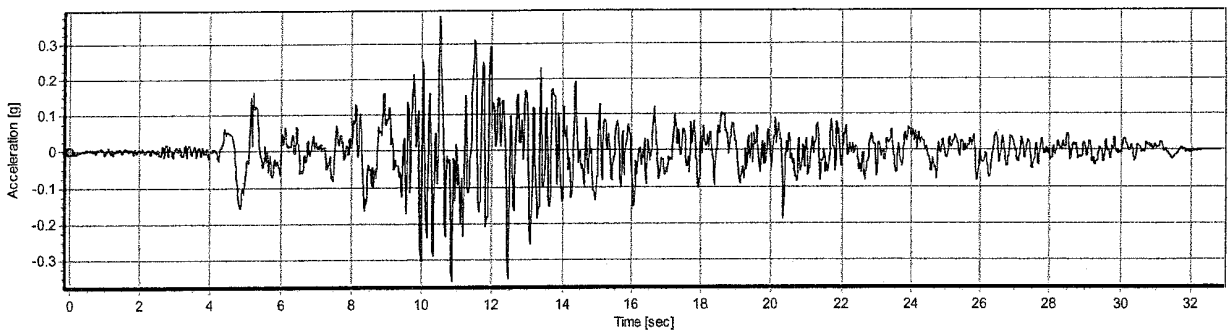


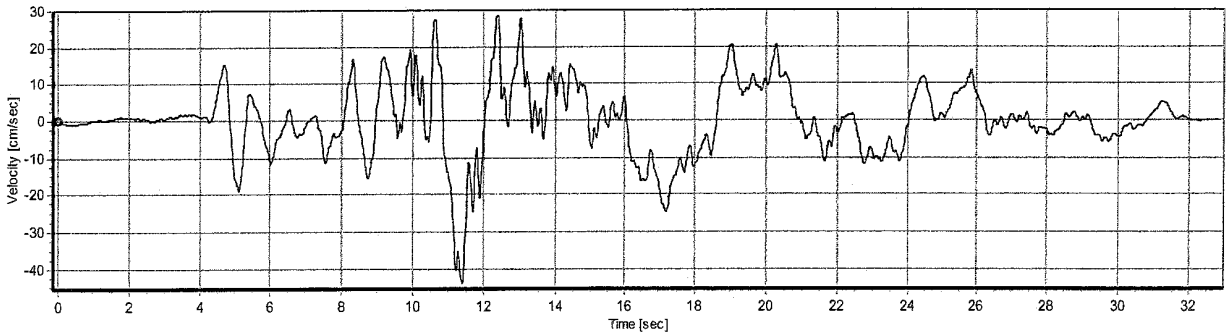
Note: Graphs representative of the scaled ground motion

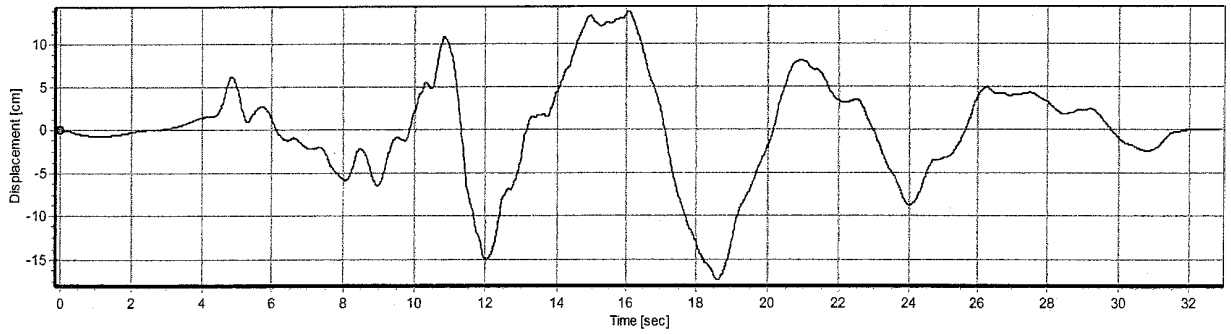
	Scaled Ground Motion		
PGA (g's)	0.35	Scale Factor	0.6
PGV (cm/sec)	41.9	M_w	8.0
Mean Period, T_m (sec)	0.41	Closest Distance (km)	10
Bracketed Duration (sec)	98.3	V_{s30} (m/sec)	rock
Significant Duration (sec)	35.1		

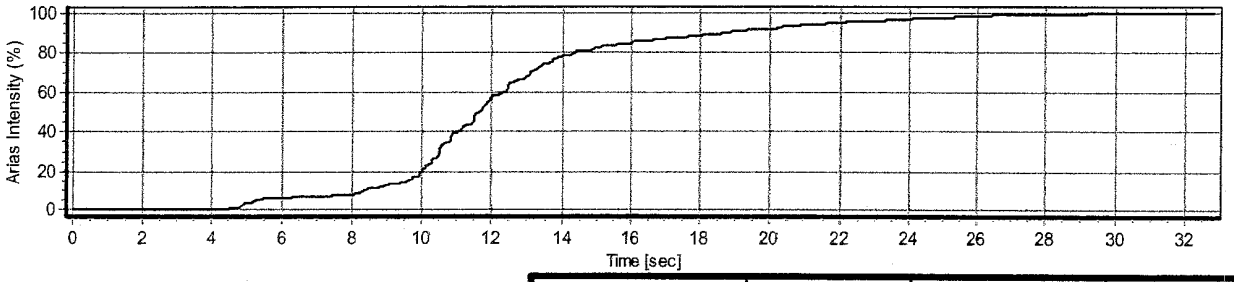
Figure 9: GM#6 – Mw=8.0 d=10 km, Synthetic San Andreas Event with forward directivity by Walt Silva

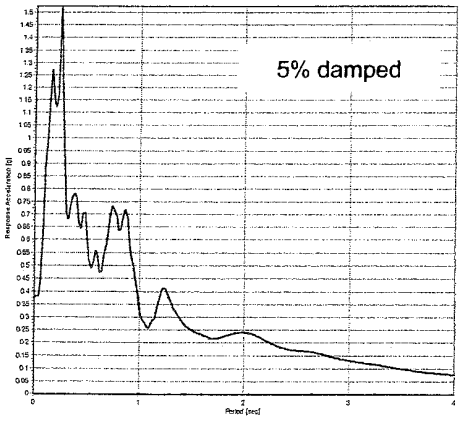
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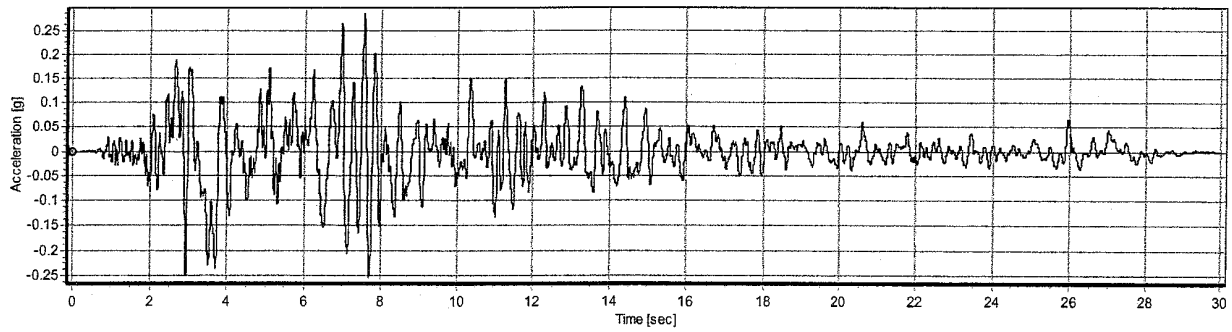


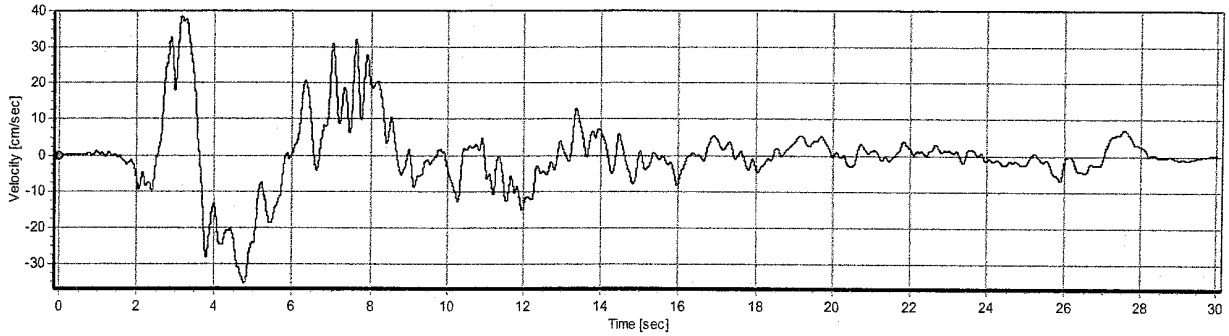
Note: Graphs representative of the scaled ground motion

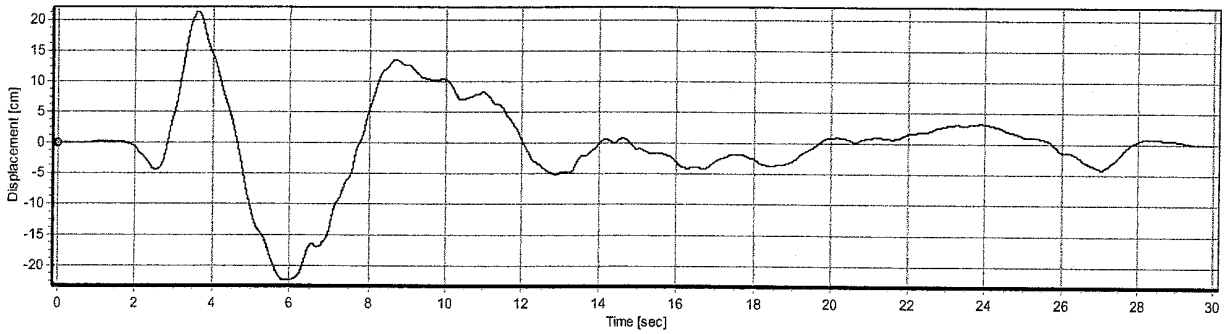
	Scaled Ground Motion		
PGA (g's)	0.38	Scale Factor	0.45
PGV (cm/sec)	44.0	M_w	7.35
Mean Period, T_m (sec)	0.24	Closest Distance (km)	2.1
Bracketed Duration (sec)	28.7	V_{s30} (m/sec)	767
Significant Duration (sec)	16.5		

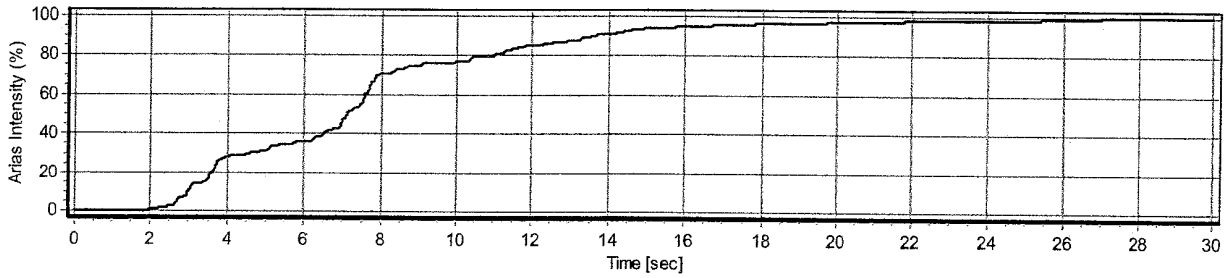
Figure 10: GM#7 – Tabas earthquake – Tabas station – Longitudinal component

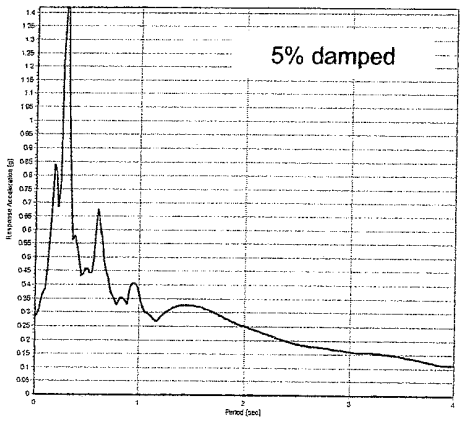
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Note: Graphs representative of the scaled ground motion

	Scaled Ground Motion		
PGA (g's)	0.29	Scale Factor	1.3
PGV (cm/sec)	38.7	M_w	7.5
Mean Period, T_m (sec)	0.58	Closest Distance (km)	7.2
Bracketed Duration (sec)	27.4	V_{s30} (m/sec)	811
Significant Duration (sec)	13.2		

Figure 11: GM#8 –Kocaeli earthquake – ERD 99999 Izmit recording – IZT090 component

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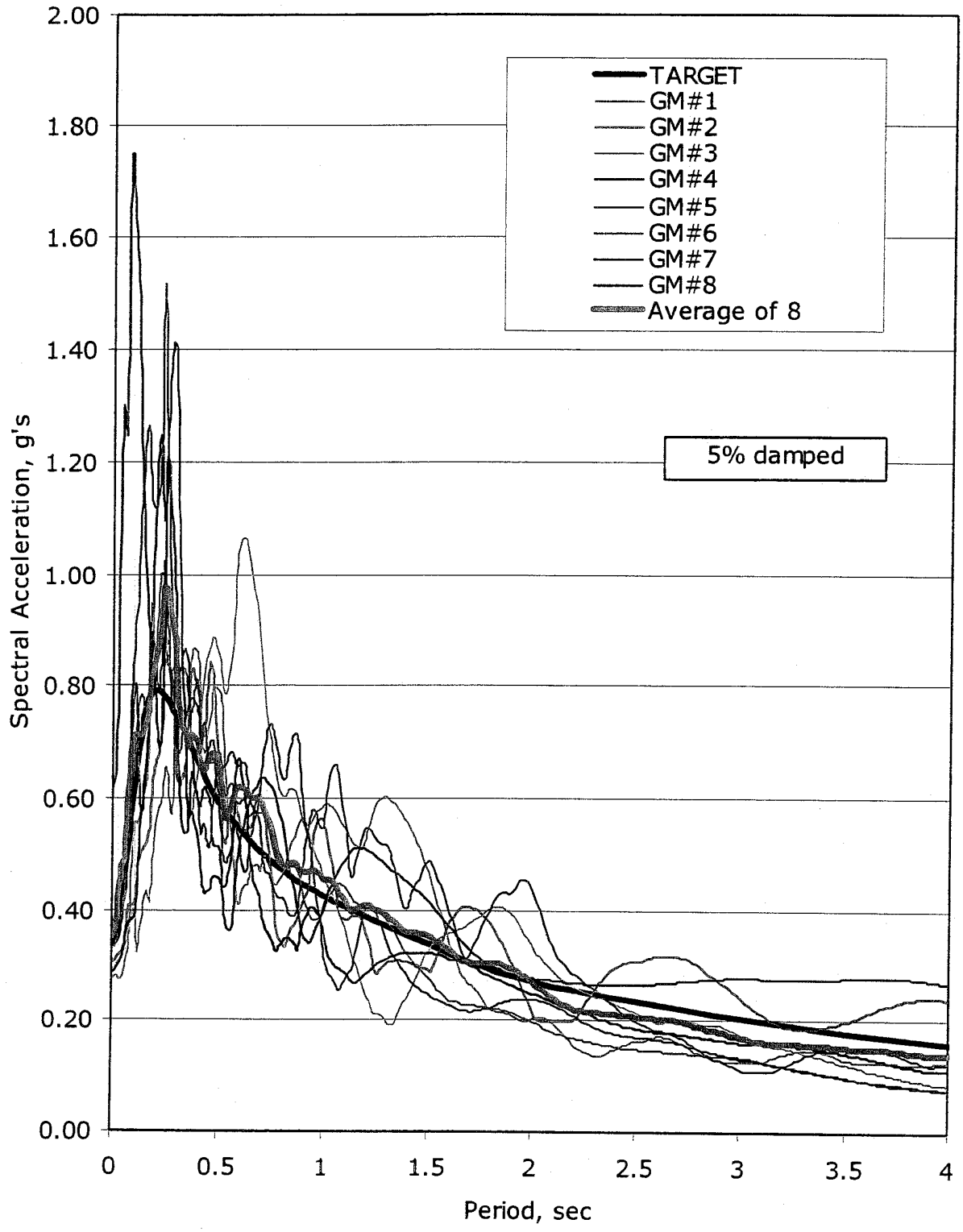


Figure 12: Target vs. scaled ground motion response spectra

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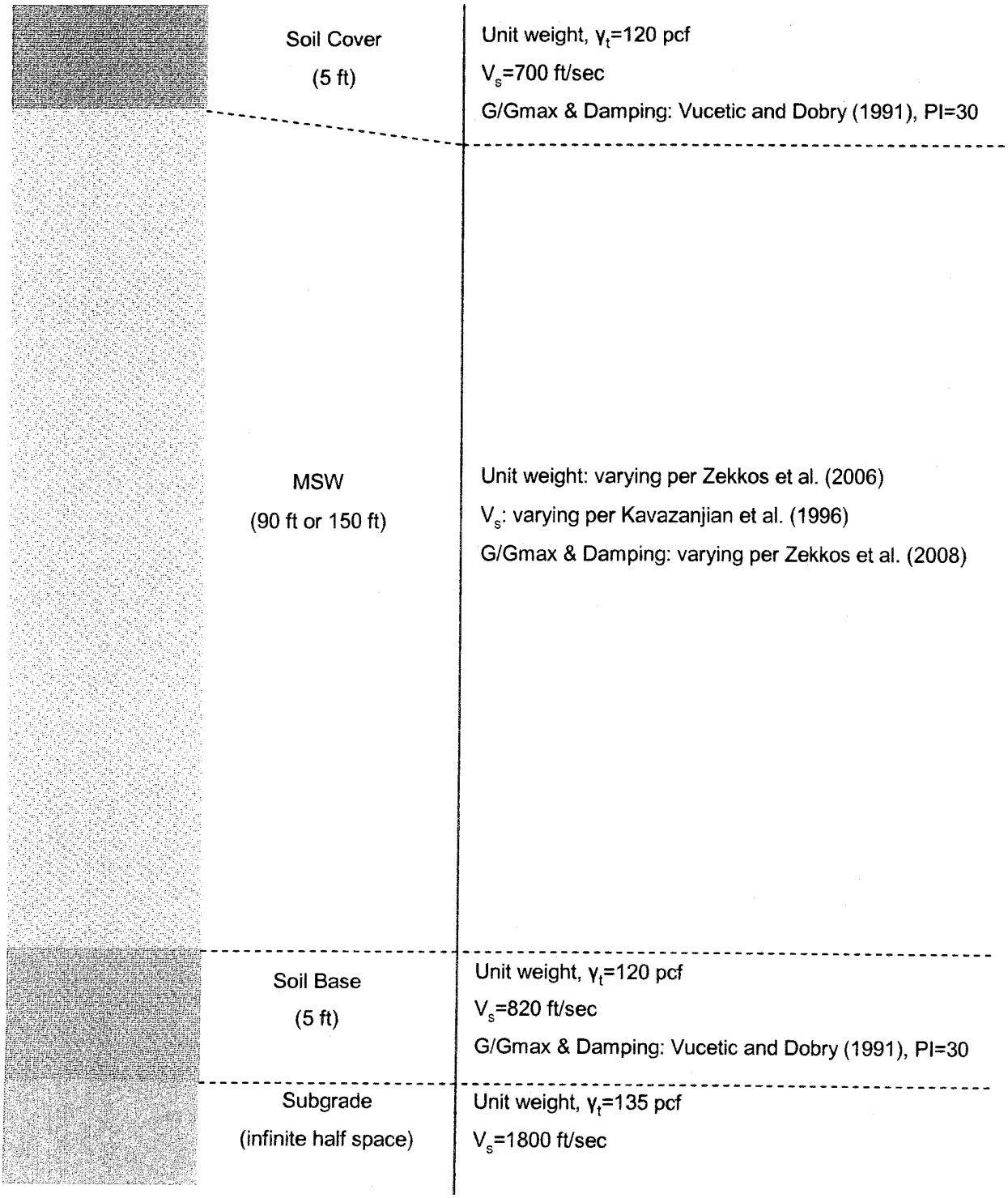
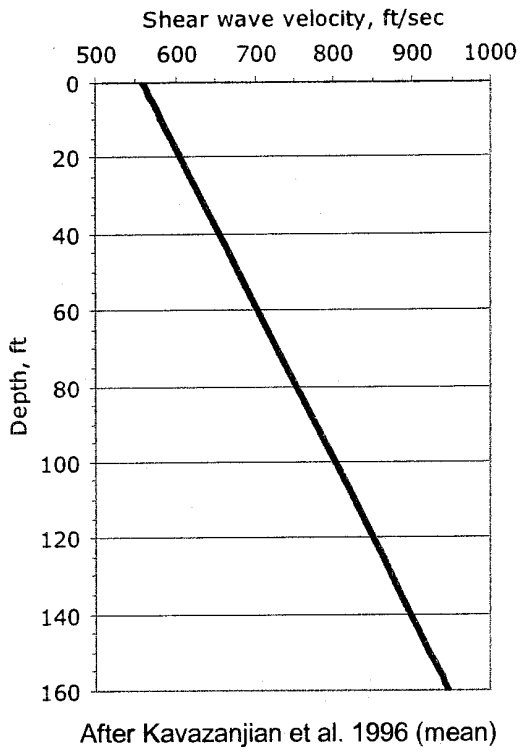
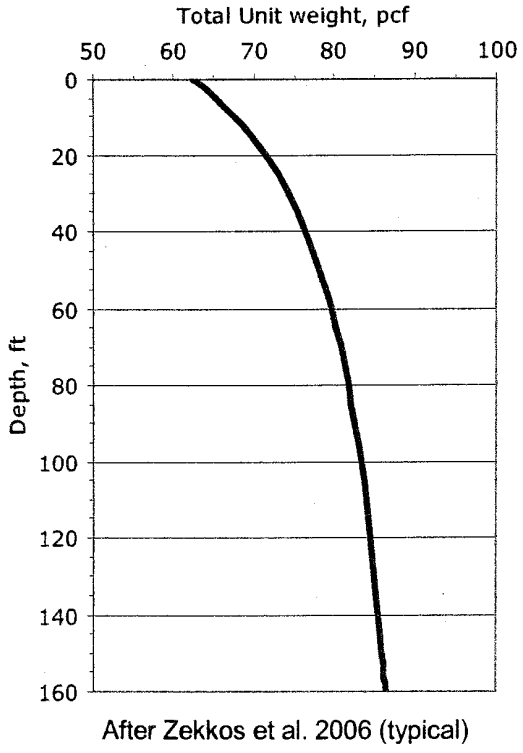


Figure 13: Soil profile for Site Response Analyses

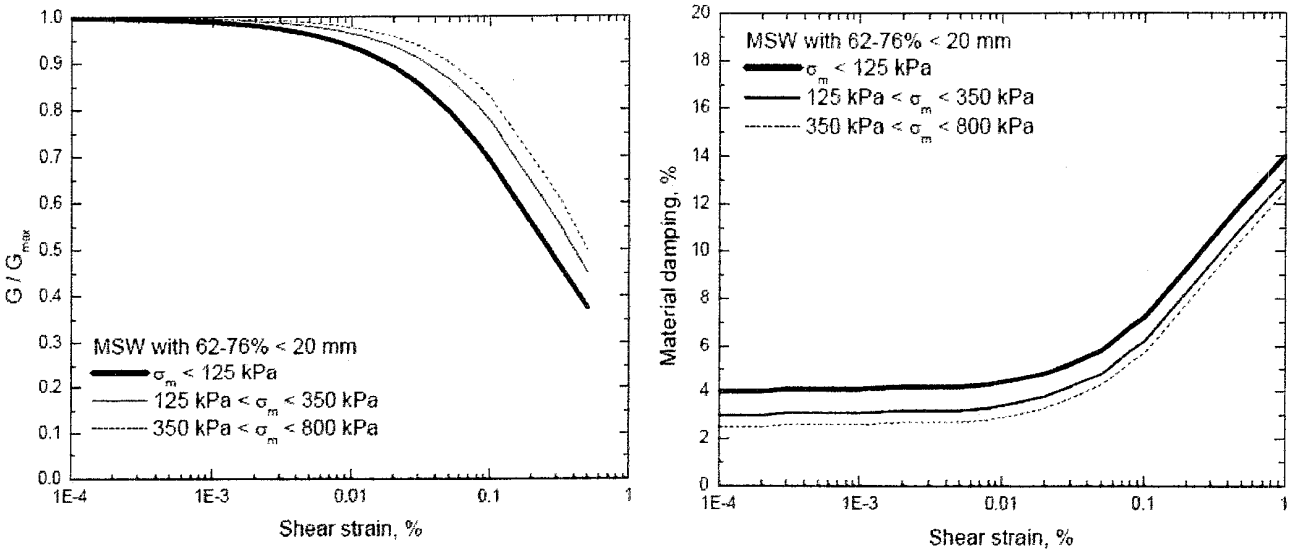
December 2007	Buena Vista Landfill Santa Cruz, California	Geosyntec consultants



After Kavazanjian et al. 1996 (mean)



After Zekkos et al. 2006 (typical)



After Zekkos et al. 2008 (typical)

Figure 14: MSW material Properties used in analyses

December 2007	Buena Vista Landfill Santa Cruz, California	Geosyntec consultants

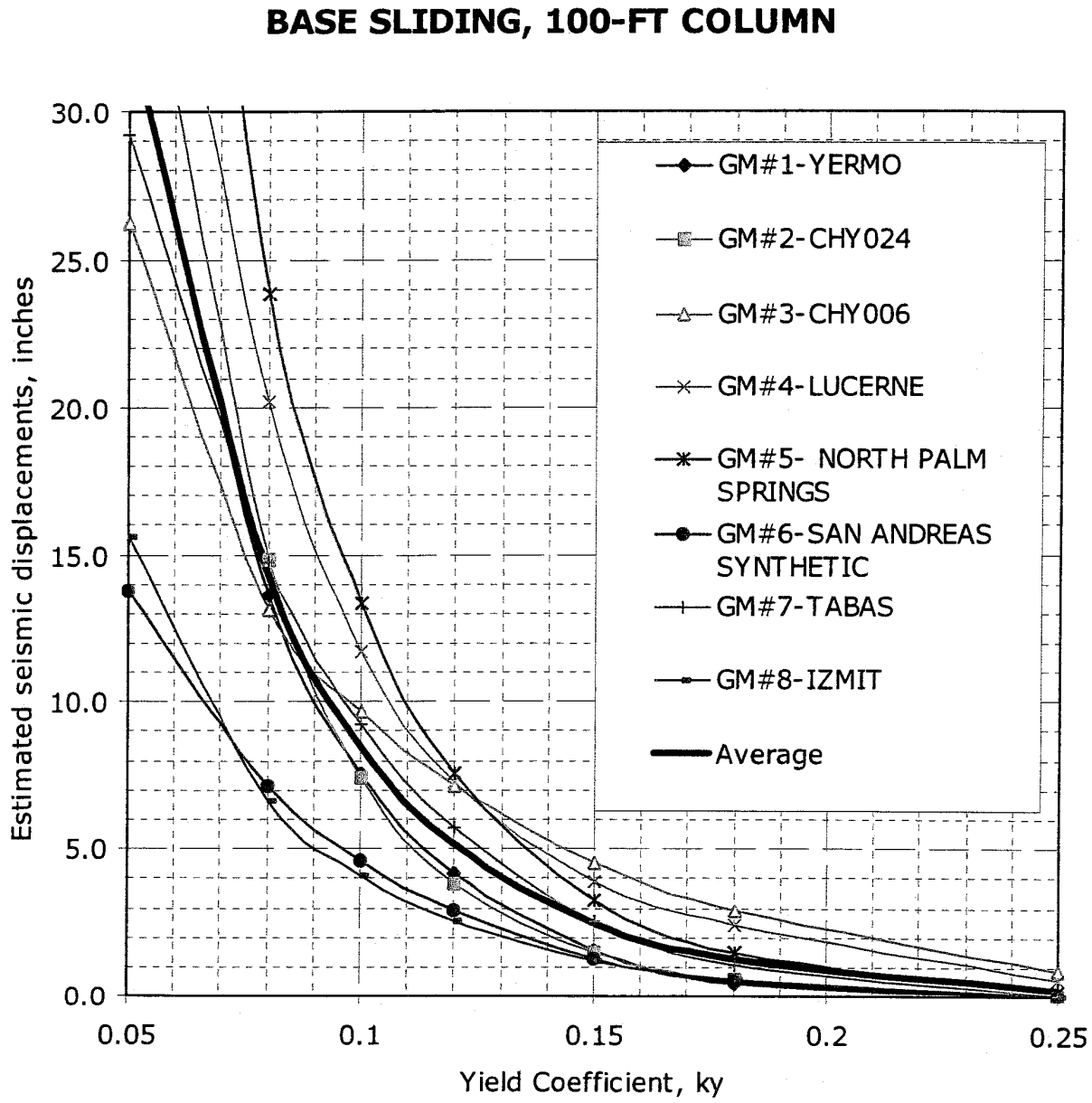


Figure 15: Seismic Displacements Estimates

December 2007	Buena Vista Landfill Santa Cruz, California	Geosyntec consultants

COVER SLIDING, 100-FT COLUMN

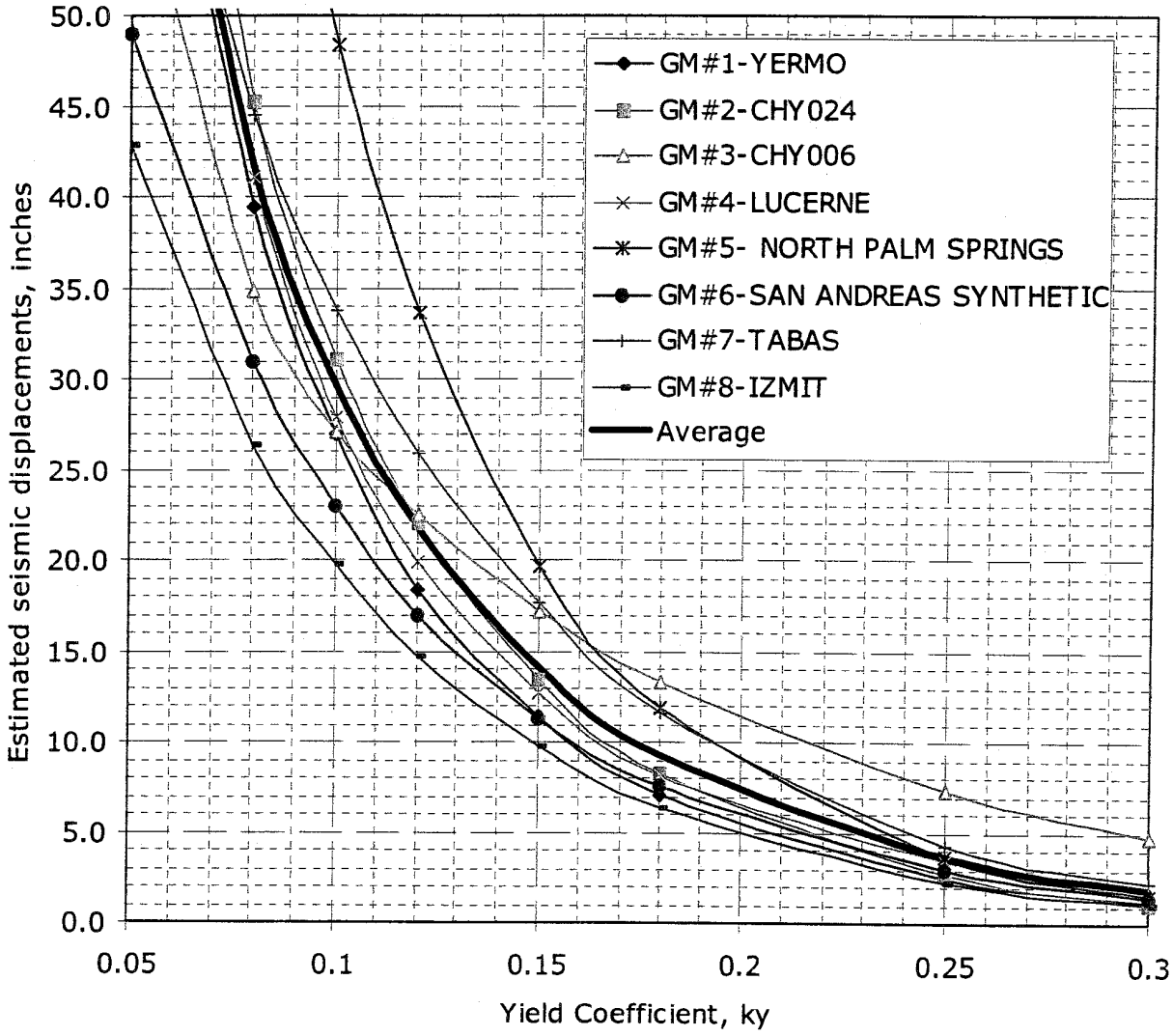


Figure 16: Seismic Displacements Estimates

December 2007	Buena Vista Landfill Santa Cruz, California	Geosyntec consultants

BASE SLIDING, 160-FT COLUMN

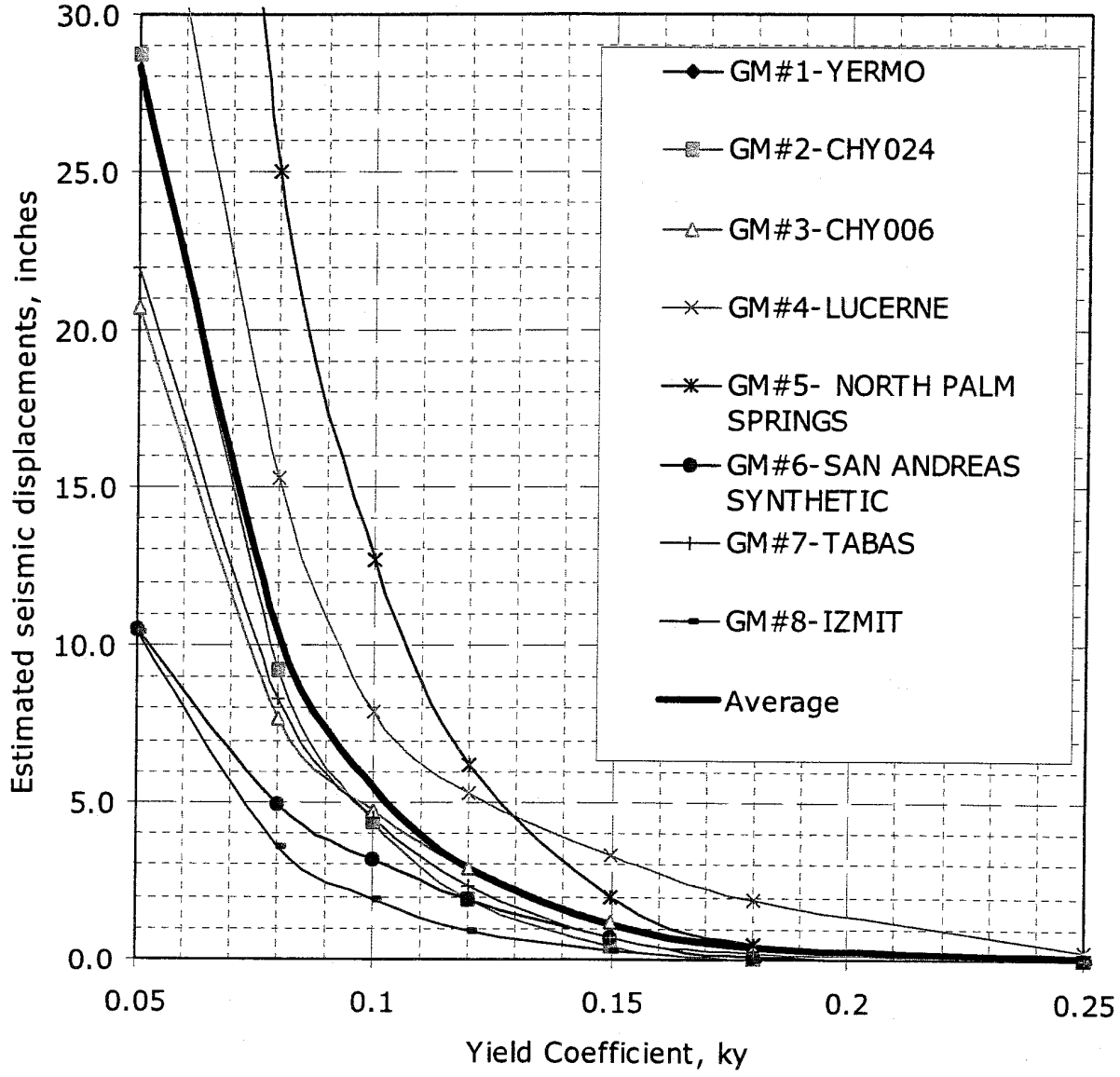


Figure 17: Seismic Displacements Estimates

December 2007	Buena Vista Landfill Santa Cruz, California	Geosyntec consultants

COVER SLIDING, 160-FT COLUMN

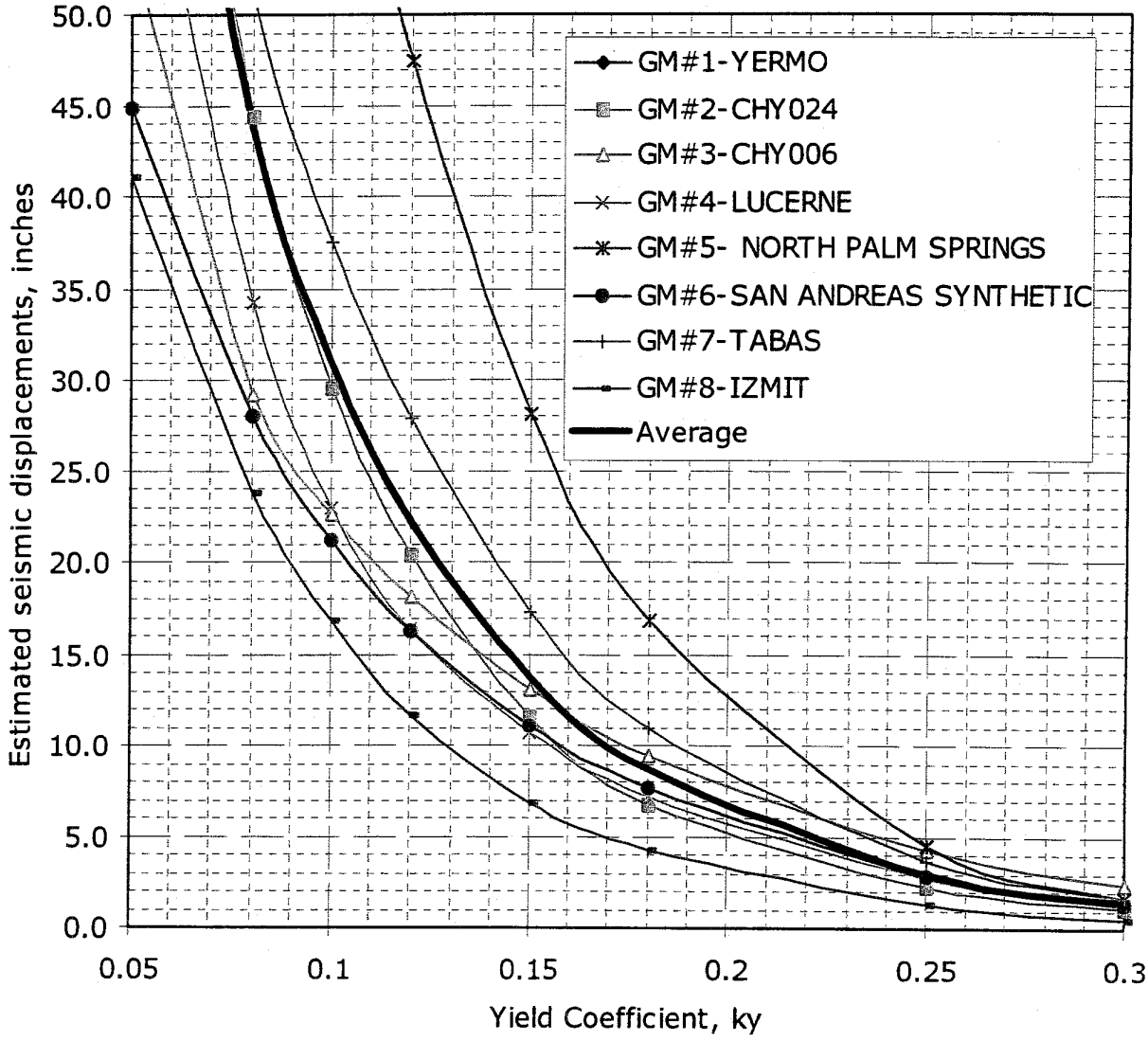


Figure 18: Seismic Displacements Estimates

December 2007	Buena Vista Landfill Santa Cruz, California	Geosyntec consultants

Geosyntec consultants

475 14th Street, Suite 400
Oakland, California 94612
PH 510.836.3034
FAX 510.836.3036
www.geosyntec.com

APPENDIX I

SHAKE2000 SITE RESPONSE ANALYSES OUTPUT

100 ft '-GM#1

```
*************************************************************
* SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL   *
*     LAYERED SITES by Per Schnable & John Lysmer - 1970    *
* --------------------------------------------------------- *
* SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985   *
* --------------------------------------------------------- *
* SHAKE88 :New modulus reduction curves for clays added     *
*       using results from Sun et al (1988) by J. I. Sun    *
*       & Ramin Golesorkhi February 26, 1988                *
* ----------------------------------------------------------*
* SHAKE90/91: Adjust last iteration; Input now is either    *
*       Gmax or max Vs; up to 13 materials can be specified*
*       by user; up to 50 Layers can be specified; object   *
*       motion can be read in from a separate file and can  *
*       user specified format; Different periods for res-   *
*       ponse spectral calculations;options are renumbered; *
*       and general cleanup by: J. I. Sun, I. M. Idriss &   *
*       P. Dirrim June 1990 - February 1991                 *
* --------------------------------------------------------- *
* SHAKE91: General cleanup and finalization of input out-   *
*       output format ... etc by: I. M. Idriss Dec. 1991    *
* --------------------------------------------------------- *
* SHAKE2000: Fix the incorrect output of Tot. Stress in     *
* Option 2. Changed path of ground motion file in           *
* SHAKE91.  Control file to input file names.  Modified     *
* by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003)   *
*          RUN DATE 12/05/2007                              *
*          RUN TIME 19:59                                   *
*************************************************************
 MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =     32768
 NECESSARY LENGTH OF BLANK COMMON X        =    204819

1******   OPTION  1  ***  READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

 **********************
  MATERIAL TYPE NO. 1
 **********************

 CURVE NO.  1:     MSW shallow MSW (SM<125) Zekkos, 2005
 CURVE NO.  2:     MSW shallow MSW (SM<125) Zekkos, 2005
```

CURVE NO. 1		CURVE NO. 2	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	4.00
0.0002	0.997	0.0002	4.00
0.0003	0.996	0.0003	4.10
0.0010	0.990	0.0010	4.10
0.0020	0.982	0.0020	4.20
0.0030	0.975	0.0030	4.20
0.0050	0.963	0.0050	4.20
0.0080	0.946	0.0080	4.30
0.0120	0.927	0.0120	4.50
0.0200	0.892	0.0200	4.80
0.0300	0.856	0.0300	5.20
0.0500	0.797	0.0500	5.80
0.0800	0.727	0.0800	6.80
0.1000	0.690	0.1000	7.20
0.3000	0.475	0.3000	10.50
0.5000	0.373	0.5000	12.00
1.0000	0.252	1.0000	14.00

```
 **********************
  MATERIAL TYPE NO. 2
 **********************

 CURVE NO.  3:     MSW deep    MSW (125<SM<350) Zekkos 2005
 CURVE NO.  4:     MSW deep    MSW (125<SM<350) Zekkos 2005
```

CURVE NO. 3		CURVE NO. 4	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	3.00
0.0002	0.999	0.0002	3.00
0.0003	0.998	0.0003	3.10
0.0010	0.995	0.0010	3.10
0.0020	0.992	0.0020	3.20
0.0030	0.988	0.0030	3.20
0.0050	0.981	0.0050	3.20
0.0080	0.971	0.0080	3.30
0.0120	0.959	0.0120	3.50
0.0200	0.937	0.0200	3.80
0.0300	0.911	0.0300	4.20
0.0500	0.867	0.0500	4.80
0.0800	0.810	0.0800	5.80
0.1000	0.777	0.1000	6.20
0.3000	0.564	0.3000	9.50
0.5000	0.450	0.5000	11.00
1.0000	0.305	1.0000	13.00

```
 **********************
  MATERIAL TYPE NO. 3
 **********************

 CURVE NO.  5:     Soil PI=100 G/Gmax - Soil with PI=100, OCR=1-15 (Vucetic
 CURVE NO.  6:     Soil PI=100 Damping - Soil with PI=100, OCR=1-8 (Vucetic
```

CURVE NO. 5		CURVE NO. 6	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0050	1.000	0.0010	1.20
0.0060	1.000	0.0030	1.50
0.0070	0.995	0.0050	1.70
0.0090	0.990	0.0070	1.90
0.0100	0.985	0.0090	2.00
0.0200	0.960	0.0100	2.05
0.0300	0.935	0.0200	2.50
0.0400	0.915	0.0300	2.90
0.0500	0.900	0.0400	3.10
0.0600	0.880	0.0500	3.30
0.0700	0.865	0.0600	3.50
0.0800	0.850	0.0800	3.80
0.0900	0.830	0.1000	4.00
0.1000	0.815	0.2000	5.20
0.2000	0.715	0.3000	6.10
0.3000	0.635	0.4000	6.80
0.5000	0.530	0.5000	7.40
0.6000	0.490	0.6000	8.00
0.9000	0.405	0.7000	8.60
1.0000	0.375	1.0000	9.70

```
 **********************
  MATERIAL TYPE NO. 4
 **********************

 CURVE NO.  7:     Soil PI=30  G/Gmax - Soil with PI=30, OCR=1-15 (Vucetic
 CURVE NO.  8:     Soil PI=30  Damping - Soil with PI=30, OCR=1-8 (Vucetic
```

CURVE NO. 7		CURVE NO. 8	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0010	1.000	0.0020	1.70
0.0020	0.995	0.0030	2.10
0.0030	0.985	0.0040	2.50
0.0040	0.970	0.0050	2.60
0.0050	0.960	0.0060	2.90
0.0060	0.950	0.0080	3.30
0.0080	0.925	0.0100	3.70
0.0090	0.910	0.0200	5.05
0.0100	0.900	0.0300	5.70
0.0200	0.820	0.0400	6.40
0.0300	0.745	0.0500	6.90
0.0400	0.700	0.0600	7.30
0.0700	0.600	0.0800	8.10
0.1000	0.530	0.1000	8.70
0.2000	0.420	0.2000	10.80
0.3000	0.350	0.3000	12.30
0.4000	0.305	0.4000	13.30
0.6000	0.240	0.5000	14.10
0.8000	0.205	0.7000	15.60
1.0000	0.165	1.0000	16.90

```
1******   OPTION  2  ***  READ SOIL PROFILE
 NEW SOIL PROFILE NO.      1       IDENTIFICATION  Soil Profile No.  1
 NUMBER OF LAYERS                    12          DEPTH TO BEDROCK         100.00
```

NO.	TYPE	THICKNESS (FT)	DEPTH (FT)	TOTAL PRESS. (KSF)	MODULUS (KSF)	DAMPING	UNIT WT. (KCF)	SHEAR VEL (FPS)
1	4	5.0000	2.5000	0.30	1826.	0.050	0.120	700.0
2	1	10.0000	10.0000	0.94	705.	0.050	0.067	582.0
3	1	10.0000	20.0000	1.62	810.	0.050	0.071	606.0
4	1	10.0000	30.0000	2.35	915.	0.050	0.074	631.0
5	1	10.0000	40.0000	3.10	1013.	0.050	0.076	655.0
6	2	10.0000	50.0000	3.87	1117.	0.050	0.078	679.0
7	2	10.0000	60.0000	4.66	1231.	0.050	0.080	704.0
8	2	10.0000	70.0000	5.46	1333.	0.050	0.081	728.0
9	2	10.0000	80.0000	6.28	1440.	0.050	0.082	752.0
10	2	10.0000	90.0000	7.10	1556.	0.050	0.083	777.0
11	4	5.0000	97.5000	7.82	2506.	0.050	0.120	820.0
12	BASE				13684.	0.050	0.136	1800.0

```
 PERIOD = 0.58 FROM AVERAGE SHEAR VEL. =     687.


  FREQUENCY     AMPLITUDE
 MAXIMUM AMPLIFICATION =  13.45
 FOR FREQUENCY         =   1.84 C/SEC.
    PERIOD             =   0.54 SEC.

1******   OPTION  3  ***  READ INPUT MOTION

  FILE NAME FOR INPUT MOTION = C:\Program Files\SHAKE2000\Quakes\YER360.eq
    NO. OF INPUT ACC. POINTS =  2200
   NO. OF POINTS USED IN FFT =  4096
       NO. OF HEADING LINES  =     4
     NO. OF POINTS PER LINE  =     4
  TIME STEP FOR INPUT MOTION = 0.0200
     FORMAT FOR TIME HISTORY =     (4E15.6)


 *****HEADER*****
Source File: C:\Program Files\SHAKE2000\Quakes\YER360.TXT
SHAKE2000 Conversion:    2200      .02       4         4         15        (4E15.
Acceleration Units: (g's) - No. Values: 2200 - Time Step: .02 (secs)
Data Format: (4E15.6) - No. Header Lines:  4
 **  FIRST AND LAST 5 LINES OF INPUT MOTION *****

     1  0.000703 0.002170 0.002317 0.000636
     2 -0.000536-0.002110-0.001705-0.000041
     3  0.000188 0.000083-0.001671-0.002653
     4 -0.001782-0.000915 0.000182-0.002068
     5 -0.004434-0.002657-0.000362 0.000010
  .....INPUT MOTION READ NOT ECHOED.....
   546 -0.000010 0.000013-0.000032-0.000082
   547 -0.000124-0.000160-0.000201-0.000206
   548 -0.000204-0.000234-0.000258-0.000267
   549 -0.000253-0.000231-0.000205-0.000171
   550 -0.000136-0.000100-0.000064-0.000029

 MAXIMUM ACCELERATION =  0.15153
 AT TIME              = 14.82 SEC
 THE VALUES WILL BE MULTIPLIED BY A FACTOR =  1.800
 TO GIVE NEW MAXIMUM ACCELERATION          =  0.27275
 MEAN SQUARE FREQUENCY =        3.16 C/SEC.
 MAX ACCELERATION =     0.27275 FOR FREQUENCIES REMOVED ABOVE      25.00 C/SEC.
1******   OPTION  4  ***  READ WHERE OBJECT MOTION IS GIVEN
  OBJECT MOTION IN LAYER NUMBER   12 OUTCROPPING

1******   OPTION  5  ***  OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
```

MAXIMUM NUMBER OF ITERATIONS = 5
FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN = 0.65

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\YER360.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 1

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ---> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00595	0.029	0.050	-73.2	1735.5	1826.1	-5.2	1.000
2	1	10.0	0.04739	0.057	0.050	12.8	566.1	704.8	-24.5	1.000
3	1	20.0	0.06945	0.065	0.050	23.1	605.7	809.7	-33.7	1.000
4	1	30.0	0.08622	0.069	0.050	27.9	653.9	915.0	-39.9	1.000
5	1	40.0	0.09664	0.071	0.050	30.0	704.4	1012.6	-43.7	1.000
6	2	50.0	0.09986	0.062	0.050	19.3	868.0	1116.8	-28.7	1.000
7	2	60.0	0.10570	0.064	0.050	21.5	943.5	1231.3	-30.5	1.000
8	2	70.0	0.10935	0.065	0.050	22.7	1012.8	1333.2	-31.6	1.000
9	2	80.0	0.10784	0.064	0.050	22.2	1097.9	1440.1	-31.2	1.000
10	2	90.0	0.10217	0.063	0.050	20.2	1202.7	1556.2	-29.4	1.000
11	4	97.5	0.06328	0.074	0.050	32.9	1548.7	2505.8	-61.8	1.000

1

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\YER360.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 2

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ---> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00575	0.028	0.039	-2.0	1739.0	1735.5	0.2	0.950
2	1	10.0	0.05428	0.060	0.057	4.0	553.1	566.1	-2.3	0.803
3	1	20.0	0.08464	0.069	0.065	5.8	581.1	605.7	-4.2	0.748
4	1	30.0	0.10477	0.073	0.069	5.5	623.0	653.9	-5.0	0.715
5	1	40.0	0.11437	0.076	0.071	6.1	672.1	704.4	-4.8	0.696
6	2	50.0	0.11053	0.065	0.062	4.7	846.1	868.0	-2.6	0.777
7	2	60.0	0.11326	0.066	0.064	3.2	927.0	943.5	-1.8	0.766
8	2	70.0	0.11084	0.065	0.065	0.6	1009.3	1012.8	-0.3	0.760
9	2	80.0	0.10417	0.063	0.064	-1.6	1107.5	1097.9	0.9	0.762
10	2	90.0	0.09540	0.061	0.063	-2.4	1220.0	1202.7	1.4	0.773
11	4	97.5	0.07941	0.081	0.074	7.8	1441.5	1548.7	-7.4	0.618

1

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\YER360.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 3

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ---> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00568	0.028	0.028	-0.8	1740.3	1739.0	0.1	0.952
2	1	10.0	0.05508	0.060	0.060	0.5	551.6	553.1	-0.3	0.785
3	1	20.0	0.08747	0.070	0.069	0.8	576.7	581.1	-0.8	0.718
4	1	30.0	0.10923	0.075	0.073	1.7	615.6	623.0	-1.2	0.681
5	1	40.0	0.12106	0.078	0.076	2.2	660.8	672.1	-1.7	0.664
6	2	50.0	0.11294	0.066	0.065	1.0	841.4	846.1	-0.6	0.758
7	2	60.0	0.11317	0.066	0.066	0.0	927.2	927.0	0.0	0.753
8	2	70.0	0.10829	0.064	0.065	-1.1	1015.3	1009.3	0.6	0.757
9	2	80.0	0.09936	0.062	0.063	-2.2	1120.3	1107.5	1.1	0.769
10	2	90.0	0.09252	0.061	0.061	-0.9	1227.1	1220.0	0.6	0.784
11	4	97.5	0.08573	0.083	0.081	2.5	1403.8	1441.5	-2.7	0.575

1

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\YER360.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 4

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ---> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00567	0.028	0.028	-0.1	1740.4	1740.3	0.0	0.953
2	1	10.0	0.05539	0.060	0.060	0.2	551.0	551.6	-0.1	0.783
3	1	20.0	0.08818	0.070	0.070	0.2	575.6	576.7	-0.2	0.712
4	1	30.0	0.11063	0.075	0.075	0.5	613.3	615.6	-0.4	0.673
5	1	40.0	0.12356	0.078	0.078	0.8	656.8	660.8	-0.6	0.653
6	2	50.0	0.11365	0.066	0.066	0.3	840.0	841.4	-0.2	0.753
7	2	60.0	0.11287	0.066	0.066	-0.1	927.8	927.2	0.1	0.753
8	2	70.0	0.10707	0.064	0.064	-0.5	1018.2	1015.3	0.3	0.762
9	2	80.0	0.09746	0.062	0.062	-0.6	1124.4	1120.3	0.4	0.778
10	2	90.0	0.09206	0.061	0.061	-0.1	1228.2	1227.1	0.1	0.789
11	4	97.5	0.08799	0.084	0.083	0.8	1391.0	1403.8	-0.9	0.560

1

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\YER360.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 5

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ---> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00567	0.028	0.028	0.0	1740.4	1740.4	0.0	0.953
2	1	10.0	0.05550	0.060	0.060	0.1	550.8	551.0	0.0	0.782
3	1	20.0	0.08835	0.070	0.070	0.1	575.3	575.6	0.0	0.711
4	1	30.0	0.11108	0.075	0.075	0.2	612.6	613.3	-0.1	0.670
5	1	40.0	0.12447	0.079	0.078	0.3	655.3	656.8	-0.2	0.649
6	2	50.0	0.11386	0.066	0.066	0.1	839.7	840.0	0.0	0.752
7	2	60.0	0.11270	0.066	0.066	-0.1	928.2	927.8	0.0	0.754
8	2	70.0	0.10657	0.064	0.064	-0.2	1019.4	1018.2	0.1	0.764
9	2	80.0	0.09686	0.061	0.062	-0.2	1125.8	1124.4	0.1	0.781
10	2	90.0	0.09199	0.061	0.061	0.0	1228.4	1228.2	0.0	0.789
11	4	97.5	0.08877	0.084	0.084	0.3	1386.7	1391.0	-0.3	0.555

VALUES IN TIME DOMAIN

LAYER	TYPE	THICKNESS FT	DEPTH FT	MAX STRAIN PRCNT	MAX STRESS PSF	TIME SEC
1	4	5.0000	2.5000	0.00872	151.85	15.20
2	1	10.0000	10.0000	0.08539	470.47	15.22
3	1	10.0000	20.0000	0.13593	782.42	15.20
4	1	10.0000	30.0000	0.17089	1048.00	15.20
5	1	10.0000	40.0000	0.19150	1257.71	16.98
6	2	10.0000	50.0000	0.17517	1471.52	16.98
7	2	10.0000	60.0000	0.17339	1608.78	16.98
8	2	10.0000	70.0000	0.16395	1669.39	16.98
9	2	10.0000	80.0000	0.14901	1675.56	16.98
10	2	10.0000	90.0000	0.14152	1738.13	17.38
11	4	5.0000	97.5000	0.13658	1899.80	17.38

PERIOD = 0.68 FROM AVERAGE SHEAR VEL. = 591.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 9.99
FOR FREQUENCY = 1.58 C/SEC.
PERIOD = 0.63 SEC.

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\Program Files\SHAKE2000\Quakes\YER360.eq
SOIL DEPOSIT - Soil Profile No. 1

LAYER		DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	ACC. RATIO	TH SAVED
OUTCR.		0.0000	0.50811	15.20	2.41	QUIET ZONE	ACC. RECORD
						0.000	512
WITHIN		5.0000	0.50592	15.20	2.36		
						0.000	0
WITHIN		15.0000	0.47109	15.18	1.90		
						0.000	0
WITHIN		25.0000	0.41718	16.98	1.95		
						0.000	0
WITHIN		35.0000	0.37380	16.96	2.14		
						0.000	0
WITHIN		45.0000	0.28809	16.96	2.42		
						0.000	0
WITHIN		55.0000	0.28707	16.22	2.67		
						0.000	0
WITHIN		65.0000	0.29454	17.40	2.79		
						0.000	0
WITHIN		75.0000	0.29310	17.40	2.88		
						0.000	0
WITHIN		85.0000	0.27301	17.38	2.90		
						0.000	0
WITHIN		95.0000	0.24279	16.18	2.89		
						0.000	512
WITHIN		100.0000	0.24073	17.52	2.88		
						0.000	512
OUTCR.		100.0000	0.27275	14.82	3.16		
						0.000	512

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - Stress History Layer No. 1

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - Strain History Layer No. 1

*** End of Output File No. 1 ***

100 ft - GM#2

```
 ************************************************************
 * SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL  *
 *     LAYERED SITES by Per Schnable & John Lysmer - 1970   *
 * -------------------------------------------------------- *
 * SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985  *
 * -------------------------------------------------------- *
 * SHAKE88 :New modulus reduction curves for clays added    *
 *       using results from Sun et al (1988) by J. I. Sun   *
 *       & Ramin Golesorkhi February 26, 1988               *
 * -------------------------------------------------------- *
 * SHAKE90/91: Adjust last iteration; Input now is either   *
 *       Gmax or max Vs; up to 13 materials can be specified*
 *       by user; up to 50 Layers can be specified; object  *
 *       motion can be read in from a separate file and can *
 *       user specified format; Different periods for res-  *
 *       ponse spectral calculations;options are renumbered;*
 *       and general cleanup by: J. I. Sun, I. M. Idriss &  *
 *       P. Dirrim June 1990 - February 1991                *
 * -------------------------------------------------------- *
 * SHAKE91: General cleanup and finalization of input out-  *
 *       output format ... etc by: I. M. Idriss Dec. 1991   *
 * -------------------------------------------------------- *
 * SHAKE2000: Fix the incorrect output of Tot. Stress in    *
 * Option 2. Changed path of ground motion file in          *
 * SHAKE91.  Control file to input file names.  Modified    *
 * by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003)  *
 *          RUN DATE 12/05/2007                             *
 *          RUN TIME 17:55                                  *
 ************************************************************
 MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =     32768
 NECESSARY LENGTH OF BLANK COMMON X        =    204819

1******   OPTION  1  ***  READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

 **********************
  MATERIAL TYPE NO. 1
 **********************

 CURVE NO.  1:     MSW shallow MSW (SM<125) Zekkos, 2005
 CURVE NO.  2:     MSW shallow MSW (SM<125) Zekkos, 2005

      CURVE NO. 1            CURVE NO. 2
 ====================   ====================
   STRAIN    G/GMAX       STRAIN    DAMPING
 --------   -------      --------   --------
   0.0001     1.000        0.0001      4.00
   0.0002     0.997        0.0002      4.00
   0.0003     0.996        0.0003      4.10
   0.0010     0.990        0.0010      4.10
   0.0020     0.982        0.0020      4.20
   0.0030     0.975        0.0030      4.20
   0.0050     0.963        0.0050      4.20
   0.0080     0.946        0.0080      4.30
   0.0120     0.927        0.0120      4.50
   0.0200     0.892        0.0200      4.80
   0.0300     0.856        0.0300      5.20
   0.0500     0.797        0.0500      5.80
   0.0800     0.727        0.0800      6.80
   0.1000     0.690        0.1000      7.20
   0.3000     0.475        0.3000     10.50
   0.5000     0.373        0.5000     12.00
   1.0000     0.252        1.0000     14.00

 **********************
  MATERIAL TYPE NO. 2
 **********************

 CURVE NO.  3:     MSW deep    MSW (125<SM<350) Zekkos 2005
 CURVE NO.  4:     MSW deep    MSW (125<SM<350) Zekkos 2005

      CURVE NO. 3            CURVE NO. 4
 ====================   ====================
   STRAIN    G/GMAX       STRAIN    DAMPING
 --------   -------      --------   --------
   0.0001     1.000        0.0001      3.00
   0.0002     0.999        0.0002      3.00
   0.0003     0.998        0.0003      3.10
   0.0010     0.995        0.0010      3.10
   0.0020     0.992        0.0020      3.20
   0.0030     0.988        0.0030      3.20
   0.0050     0.981        0.0050      3.20
   0.0080     0.971        0.0080      3.30
   0.0120     0.959        0.0120      3.50
   0.0200     0.937        0.0200      3.80
   0.0300     0.911        0.0300      4.20
   0.0500     0.867        0.0500      4.80
   0.0800     0.810        0.0800      5.80
   0.1000     0.777        0.1000      6.20
   0.3000     0.564        0.3000      9.50
   0.5000     0.450        0.5000     11.00
   1.0000     0.305        1.0000     13.00

 **********************
  MATERIAL TYPE NO. 3
 **********************

 CURVE NO.  5:     Soil PI=100 G/Gmax - Soil with PI=100, OCR=1-15 (Vucetic
 CURVE NO.  6:     Soil PI=100 Damping - Soil with PI=100, OCR=1-8 (Vucetic

      CURVE NO. 5            CURVE NO. 6
 ====================   ====================
   STRAIN    G/GMAX       STRAIN    DAMPING
 --------   -------      --------   --------
   0.0050     1.000        0.0010      1.20
   0.0060     1.000        0.0030      1.50
   0.0070     0.995        0.0050      1.70
   0.0090     0.990        0.0070      1.90
   0.0100     0.985        0.0090      2.00
   0.0200     0.960        0.0100      2.05
   0.0300     0.935        0.0200      2.50
   0.0400     0.915        0.0300      2.90
   0.0500     0.900        0.0400      3.10
   0.0600     0.880        0.0500      3.30
   0.0700     0.865        0.0600      3.50
   0.0800     0.850        0.0800      3.80
   0.0900     0.830        0.1000      4.00
   0.1000     0.815        0.2000      5.20
   0.2000     0.715        0.3000      6.10
   0.3000     0.635        0.4000      6.80
   0.5000     0.530        0.5000      7.40
   0.6000     0.490        0.6000      8.00
   0.9000     0.405        0.7000      8.60
   1.0000     0.375        1.0000      9.70

 **********************
  MATERIAL TYPE NO. 4
 **********************

 CURVE NO.  7:     Soil PI=30  G/Gmax - Soil with PI=30, OCR=1-15 (Vucetic
 CURVE NO.  8:     Soil PI=30  Damping - Soil with PI=30, OCR=1-8 (Vucetic

      CURVE NO. 7            CURVE NO. 8
 ====================   ====================
   STRAIN    G/GMAX       STRAIN    DAMPING
 --------   -------      --------   --------
   0.0010     1.000        0.0020      1.70
   0.0020     0.995        0.0030      2.10
   0.0030     0.985        0.0040      2.50
   0.0040     0.970        0.0050      2.60
   0.0050     0.960        0.0060      2.90
   0.0060     0.950        0.0080      3.30
   0.0080     0.925        0.0100      3.70
   0.0090     0.910        0.0200      5.05
   0.0100     0.900        0.0300      5.70
   0.0200     0.820        0.0400      6.40
   0.0300     0.745        0.0500      6.90
   0.0400     0.700        0.0600      7.30
   0.0700     0.600        0.0800      8.10
   0.1000     0.530        0.1000      8.70
   0.2000     0.420        0.2000     10.80
   0.3000     0.350        0.3000     12.30
   0.4000     0.305        0.4000     13.30
   0.6000     0.240        0.5000     14.10
   0.8000     0.205        0.7000     15.60
   1.0000     0.165        1.0000     16.90

1******   OPTION  2  ***  READ SOIL PROFILE
 NEW SOIL PROFILE NO.      1       IDENTIFICATION  Soil Profile No.  1
 NUMBER OF LAYERS                 12          DEPTH TO BEDROCK        100.00

  NO. TYPE  THICKNESS   DEPTH  TOTAL PRESS. MODULUS  DAMPING   UNIT WT.   SHEAR
VEL
             (FT)       (FT)       (KSF)       (KSF)                (KCF)     (FPS)
   1    4    5.0000     2.5000       0.30        1826.    0.050    0.120     700.0
   2    1   10.0000    10.0000       0.94         705.    0.050    0.067     582.0
   3    1   10.0000    20.0000       1.62         810.    0.050    0.071     606.0
   4    1   10.0000    30.0000       2.35         915.    0.050    0.074     631.0
   5    1   10.0000    40.0000       3.10        1013.    0.050    0.076     655.0
   6    2   10.0000    50.0000       3.87        1117.    0.050    0.078     679.0
   7    2   10.0000    60.0000       4.66        1231.    0.050    0.080     704.0
   8    2   10.0000    70.0000       5.46        1333.    0.050    0.081     728.0
   9    2   10.0000    80.0000       6.28        1440.    0.050    0.082     752.0
  10    2   10.0000    90.0000       7.10        1556.    0.050    0.083     777.0
  11    4    5.0000    97.5000       7.82        2506.    0.050    0.120     820.0
  12   BASE                                     13684.    0.050    0.136    1800.0

 PERIOD = 0.58 FROM AVERAGE SHEAR VEL. =     687.


  FREQUENCY    AMPLITUDE
 MAXIMUM AMPLIFICATION =  13.45
 FOR FREQUENCY         =   1.84 C/SEC.
    PERIOD             =   0.54 SEC.

1******   OPTION  3  ***  READ INPUT MOTION

  FILE NAME FOR INPUT MOTION = C:\Program Files\SHAKE2000\Quakes\GM#2-CHY024-
E.eq
    NO. OF INPUT ACC. POINTS = 18000
   NO. OF POINTS USED IN FFT = 32768
       NO. OF HEADING LINES =     4
      NO. OF POINTS PER LINE =     5
  TIME STEP FOR INPUT MOTION = 0.0050
     FORMAT FOR TIME HISTORY =     (5e15.6)


 *****HEADER*****
Source File: C:\Program Files\SHAKE2000\Quakes\GM#2-CHY024-E.AT2
SHAKE2000 Conversion:    18000     .005      4         5         15       (5e15.
Acceleration Units: (g's) - No. Values: 18000 - Time Step: .005 (secs)
Data Format: (5e15.6) - No. Header Lines:  4
 **  FIRST AND LAST 5 LINES OF INPUT MOTION *****

    1  0.000011 0.000011 0.000011 0.000011 0.000011
    2  0.000011 0.000011 0.000011 0.000011 0.000011
    3  0.000011 0.000012 0.000012 0.000012 0.000011
    4  0.000011 0.000012 0.000012 0.000012 0.000012
    5  0.000012 0.000012 0.000012 0.000012 0.000012
  ..........INPUT MOTION READ NOT ECHOED..........
 3596  0.000513 0.000513 0.000513 0.000514 0.000514
 3597  0.000514 0.000514 0.000514 0.000514 0.000515
 3598  0.000515 0.000515 0.000515 0.000515 0.000515
 3599  0.000515 0.000515 0.000515 0.000515 0.000516
 3600  0.000516 0.000516 0.000516 0.000516 0.000516

 MAXIMUM ACCELERATION =  0.27803
 AT TIME              = 37.58 SEC
 THE VALUES WILL BE MULTIPLIED BY A FACTOR =  1.100
 TO GIVE NEW MAXIMUM ACCELERATION          =  0.30583
 MEAN SQUARE FREQUENCY =       1.96 C/SEC.
 MAX ACCELERATION =     0.25592 FOR FREQUENCIES REMOVED ABOVE      25.00 C/SEC.
1******   OPTION  4  ***  READ WHERE OBJECT MOTION IS GIVEN
  OBJECT MOTION IN LAYER NUMBER   12 OUTCROPPING
```

1****** OPTION 5 *** OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
MAXIMUM NUMBER OF ITERATIONS = 5
FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN = 0.65

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\GM#2-CHY024-E.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 1

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00513	0.026	0.050	-89.2	1750.4	1826.1	-4.3	1.000
2	1	10.0	0.04125	0.056	0.050	10.3	577.4	704.8	-22.1	1.000
3	1	20.0	0.06138	0.062	0.050	19.8	620.6	809.7	-30.5	1.000
4	1	30.0	0.07590	0.067	0.050	25.2	672.4	915.0	-36.1	1.000
5	1	40.0	0.08608	0.069	0.050	27.9	723.9	1012.6	-39.9	1.000
6	2	50.0	0.09177	0.060	0.050	17.3	881.9	1116.8	-26.6	1.000
7	2	60.0	0.09375	0.061	0.050	17.8	968.5	1231.3	-27.1	1.000
8	2	70.0	0.09701	0.061	0.050	18.6	1041.9	1333.2	-28.0	1.000
9	2	80.0	0.09747	0.062	0.050	18.8	1124.4	1440.1	-28.1	1.000
10	2	90.0	0.09538	0.061	0.050	18.2	1220.0	1556.2	-27.6	1.000
11	4	97.5	0.06108	0.073	0.050	32.0	1564.5	2505.8	-60.2	1.000

1
EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\GM#2-CHY024-E.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 2

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00562	0.028	0.026	5.4	1741.3	1750.4	-0.5	0.959
2	1	10.0	0.05213	0.059	0.056	5.3	557.4	577.4	-3.6	0.819
3	1	20.0	0.08018	0.068	0.062	8.3	588.4	620.6	-5.5	0.766
4	1	30.0	0.10022	0.072	0.067	7.2	631.0	672.4	-6.6	0.735
5	1	40.0	0.11425	0.076	0.069	8.8	672.3	723.9	-7.7	0.715
6	2	50.0	0.11136	0.065	0.060	7.3	844.5	881.9	-4.4	0.790
7	2	60.0	0.11588	0.066	0.061	8.4	921.6	968.5	-5.1	0.787
8	2	70.0	0.11836	0.067	0.061	8.4	992.3	1041.9	-5.0	0.781
9	2	80.0	0.11667	0.067	0.062	7.6	1075.9	1124.4	-4.5	0.781
10	2	90.0	0.11144	0.065	0.061	6.3	1176.5	1220.0	-3.7	0.784
11	4	97.5	0.08865	0.084	0.073	12.3	1387.3	1564.5	-12.8	0.624

1
EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\GM#2-CHY024-E.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 3

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00554	0.028	0.028	-0.9	1742.8	1741.3	0.1	0.954
2	1	10.0	0.05287	0.059	0.059	0.5	555.9	557.4	-0.3	0.791
3	1	20.0	0.08249	0.069	0.068	0.7	584.6	588.4	-0.7	0.727
4	1	30.0	0.10380	0.073	0.072	1.4	624.7	631.0	-1.0	0.690
5	1	40.0	0.11928	0.077	0.076	1.7	663.8	672.3	-1.3	0.664
6	2	50.0	0.11449	0.066	0.065	1.3	838.5	844.5	-0.7	0.756
7	2	60.0	0.11954	0.067	0.066	1.4	914.2	921.6	-0.8	0.748
8	2	70.0	0.12165	0.068	0.067	1.2	985.2	992.3	-0.7	0.744
9	2	80.0	0.11897	0.067	0.067	0.9	1070.5	1075.9	-0.5	0.747
10	2	90.0	0.11238	0.066	0.065	0.4	1173.9	1176.5	-0.2	0.756
11	4	97.5	0.09718	0.086	0.084	2.9	1342.2	1387.3	-3.4	0.554

1
EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\GM#2-CHY024-E.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 4

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00551	0.028	0.028	-0.3	1743.3	1742.8	0.0	0.954
2	1	10.0	0.05279	0.059	0.059	-0.1	556.0	555.9	0.0	0.789
3	1	20.0	0.08266	0.069	0.069	0.1	584.3	584.6	0.0	0.722
4	1	30.0	0.10433	0.073	0.073	0.2	623.8	624.7	-0.1	0.683
5	1	40.0	0.12063	0.078	0.077	0.4	661.5	663.8	-0.3	0.655
6	2	50.0	0.11505	0.066	0.066	0.2	837.4	838.5	-0.1	0.751
7	2	60.0	0.12017	0.068	0.067	0.2	912.9	914.2	-0.1	0.742
8	2	70.0	0.12212	0.068	0.068	0.2	984.2	985.2	-0.1	0.739
9	2	80.0	0.11910	0.067	0.067	0.0	1070.2	1070.5	0.0	0.743
10	2	90.0	0.11211	0.065	0.066	-0.1	1174.7	1173.9	0.1	0.754
11	4	97.5	0.10004	0.087	0.086	0.9	1328.0	1342.2	-1.1	0.536

1
EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\GM#2-CHY024-E.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 5

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00551	0.028	0.028	-0.1	1743.4	1743.3	0.0	0.955
2	1	10.0	0.05272	0.059	0.059	0.0	556.2	556.0	0.0	0.789
3	1	20.0	0.08262	0.069	0.069	0.0	584.4	584.3	0.0	0.722
4	1	30.0	0.10440	0.073	0.073	0.0	623.7	623.8	0.0	0.682
5	1	40.0	0.12100	0.078	0.078	0.1	660.9	661.5	-0.1	0.653
6	2	50.0	0.11515	0.066	0.066	0.0	837.2	837.4	0.0	0.750
7	2	60.0	0.12028	0.068	0.068	0.0	912.7	912.9	0.0	0.741
8	2	70.0	0.12218	0.068	0.068	0.0	984.1	984.2	0.0	0.738
9	2	80.0	0.11904	0.067	0.067	0.0	1070.3	1070.2	0.0	0.743
10	2	90.0	0.11195	0.065	0.065	-0.1	1175.1	1174.7	0.0	0.755
11	4	97.5	0.10105	0.087	0.087	0.3	1323.9	1328.0	-0.3	0.530

VALUES IN TIME DOMAIN

LAYER	TYPE	THICKNESS FT	DEPTH FT	MAX STRAIN PRCNT	MAX STRESS PSF	TIME SEC
1	4	5.0000	2.5000	0.00847	147.65	37.99
2	1	10.0000	10.0000	0.08111	451.01	37.99
3	1	10.0000	20.0000	0.12711	742.70	37.99
4	1	10.0000	30.0000	0.16062	1001.91	37.99
5	1	10.0000	40.0000	0.18615	1231.47	37.71
6	2	10.0000	50.0000	0.17715	1483.45	37.70
7	2	10.0000	60.0000	0.18505	1689.27	37.70
8	2	10.0000	70.0000	0.18797	1850.01	37.70
9	2	10.0000	80.0000	0.18314	1959.92	37.70
10	2	10.0000	90.0000	0.17224	2023.20	37.69
11	4	5.0000	97.5000	0.15546	2064.41	37.69

PERIOD = 0.68 FROM AVERAGE SHEAR VEL. = 587.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 9.63
FOR FREQUENCY = 1.55 C/SEC.
PERIOD = 0.64 SEC.

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\Program Files\SHAKE2000\Quakes\GM#2-CHY024-E.eq
SOIL DEPOSIT - Soil Profile No. 1

LAYER		DEPTH	MAX. ACC.	TIME	MEAN SQ. FR.	ACC. RATIO	TH SAVED
		FT	G	SEC	C/SEC		
QUIET ZONE		ACC. RECORD					
	OUTCR.	0.0000	0.49518	37.99	1.84	0.000	4096
	WITHIN	5.0000	0.49171	37.99	1.82	0.000	0
	WITHIN	15.0000	0.43901	37.97	1.64	0.000	0
	WITHIN	25.0000	0.41182	37.70	1.52	0.000	0
	WITHIN	35.0000	0.39422	37.70	1.51	0.000	0
	WITHIN	45.0000	0.33124	37.69	1.62	0.000	0
	WITHIN	55.0000	0.26379	37.67	1.77	0.000	0
	WITHIN	65.0000	0.22759	34.33	1.87	0.000	0
	WITHIN	75.0000	0.21346	43.60	1.91	0.000	0
	WITHIN	85.0000	0.21160	43.59	1.88	0.000	0
	WITHIN	95.0000	0.20968	37.59	1.83	0.000	4096
	WITHIN	100.0000	0.20931	37.59	1.82	0.000	4096
	OUTCR.	100.0000	0.25592	37.59	1.96	0.000	4096

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - Stress History Layer No. 1

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - Strain History Layer No. 1

*** End of Output File No. 1 ***

100 ft - GM #3

```
 ***********************************************************
 * SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL *
 *     LAYERED SITES by Per Schnable & John Lysmer - 1970  *
 * ------------------------------------------------------- *
 * SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985 *
 * ------------------------------------------------------- *
 * SHAKE88 :New modulus reduction curves for clays added   *
 *       using results from Sun et al (1988) by J. I. Sun  *
 *       & Ramin Golesorkhi February 26, 1988              *
 * ------------------------------------------------------- *
 * SHAKE90/91: Adjust last iteration; Input now is either  *
 *       Gmax or max Vs; up to 13 materials can be specified*
 *       by user; up to 50 Layers can be specified; object *
 *       motion can be read in from a separate file and can *
 *       user specified format; Different periods for res- *
 *       ponse spectral calculations;options are renumbered;*
 *       and general cleanup by: J. I. Sun, I. M. Idriss & *
 *       P. Dirrim June 1990 - February 1991               *
 * ------------------------------------------------------- *
 * SHAKE91: General cleanup and finalization of input out- *
 *       output format ... etc by: I. M. Idriss Dec. 1991  *
 * ------------------------------------------------------- *
 * SHAKE2000: Fix the incorrect output of Tot. Stress in   *
 * Option 2. Changed path of ground motion file in         *
 * SHAKE91.  Control file to input file names.  Modified   *
 * by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003) *
 *          RUN DATE 12/05/2007                            *
 *          RUN TIME 20:17                                 *
 ***********************************************************
 MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =     32768
 NECESSARY LENGTH OF BLANK COMMON X        =    204819

1******   OPTION  1  ***  READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

 **********************
  MATERIAL TYPE NO. 1
 **********************

 CURVE NO.  1:     MSW shallow MSW (SM<125) Zekkos, 2005
 CURVE NO.  2:     MSW shallow MSW (SM<125) Zekkos, 2005
```

CURVE NO. 1		CURVE NO. 2	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	4.00
0.0002	0.997	0.0002	4.00
0.0003	0.996	0.0003	4.10
0.0010	0.990	0.0010	4.10
0.0020	0.982	0.0020	4.20
0.0030	0.975	0.0030	4.20
0.0050	0.963	0.0050	4.20
0.0080	0.946	0.0080	4.30
0.0120	0.927	0.0120	4.50
0.0200	0.892	0.0200	4.80
0.0300	0.856	0.0300	5.20
0.0400	0.823	0.0400	5.50
0.0500	0.797	0.0500	5.80
0.0800	0.727	0.0800	6.80
0.1000	0.690	0.1000	7.20
0.3000	0.475	0.3000	10.50
0.5000	0.373	0.5000	12.00
1.0000	0.252	1.0000	14.00

```
 **********************
  MATERIAL TYPE NO. 2
 **********************

 CURVE NO.  3:     MSW deep    MSW (125<SM<350) Zekkos 2005
 CURVE NO.  4:     MSW deep    MSW (125<SM<350) Zekkos 2005
```

CURVE NO. 3		CURVE NO. 4	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	3.00
0.0002	0.999	0.0002	3.00
0.0003	0.998	0.0003	3.10
0.0010	0.995	0.0010	3.10
0.0020	0.992	0.0020	3.20
0.0030	0.988	0.0030	3.20
0.0050	0.981	0.0050	3.20
0.0080	0.971	0.0080	3.30
0.0120	0.959	0.0120	3.50
0.0200	0.937	0.0200	3.80
0.0300	0.911	0.0300	4.20
0.0500	0.867	0.0500	4.80
0.0800	0.810	0.0800	5.80
0.1000	0.777	0.1000	6.20
0.3000	0.564	0.3000	9.50
0.5000	0.450	0.5000	11.00
1.0000	0.305	1.0000	13.00

```
 **********************
  MATERIAL TYPE NO. 3
 **********************

 CURVE NO.  5:     Soil PI=100 G/Gmax - Soil with PI=100, OCR=1-15 (Vucetic
 CURVE NO.  6:     Soil PI=100 Damping - Soil with PI=100, OCR=1-8 (Vucetic
```

CURVE NO. 5		CURVE NO. 6	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0050	1.000	0.0010	1.20
0.0060	1.000	0.0030	1.50
0.0070	0.995	0.0050	1.70
0.0090	0.990	0.0070	1.90
0.0100	0.985	0.0090	2.00
0.0200	0.960	0.0100	2.05
0.0300	0.935	0.0200	2.50
0.0400	0.915	0.0300	2.90
0.0500	0.900	0.0400	3.10
0.0600	0.880	0.0500	3.30
0.0700	0.865	0.0600	3.50
0.0800	0.850	0.0800	3.80
0.0900	0.830	0.1000	4.00
0.1000	0.815	0.2000	5.20
0.2000	0.715	0.3000	6.10
0.3000	0.635	0.4000	6.80
0.5000	0.530	0.5000	7.40
0.6000	0.490	0.6000	8.00
0.9000	0.405	0.7000	8.60
1.0000	0.375	1.0000	9.70

```
 **********************
  MATERIAL TYPE NO. 4
 **********************

 CURVE NO.  7:     Soil PI=30  G/Gmax - Soil with PI=30, OCR=1-15 (Vucetic
 CURVE NO.  8:     Soil PI=30  Damping - Soil with PI=30, OCR=1-8 (Vucetic
```

CURVE NO. 7		CURVE NO. 8	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0010	1.000	0.0020	1.70
0.0020	0.995	0.0030	2.10
0.0030	0.985	0.0040	2.50
0.0040	0.970	0.0050	2.60
0.0050	0.960	0.0060	2.90
0.0060	0.950	0.0080	3.30
0.0080	0.925	0.0100	3.70
0.0090	0.910	0.0200	5.05
0.0100	0.900	0.0300	5.70
0.0200	0.820	0.0400	6.40
0.0300	0.745	0.0500	6.90
0.0400	0.700	0.0600	7.30
0.0700	0.600	0.0800	8.10
0.1000	0.530	0.1000	8.70
0.2000	0.420	0.2000	10.80
0.3000	0.350	0.3000	12.30
0.4000	0.305	0.4000	13.30
0.6000	0.240	0.5000	14.10
0.8000	0.205	0.7000	15.60
1.0000	0.165	1.0000	16.90

```
1******   OPTION  2  ***  READ SOIL PROFILE
 NEW SOIL PROFILE NO.      1      IDENTIFICATION  Soil Profile No.  1
 NUMBER OF LAYERS                    12          DEPTH TO BEDROCK        100.00
```

NO.	TYPE	THICKNESS (FT)	DEPTH (FT)	TOTAL PRESS. (KSF)	MODULUS (KSF)	DAMPING	UNIT WT. (KCF)	SHEAR VEL (FPS)
1	4	5.0000	2.5000	0.30	1826.	0.050	0.120	700.0
2	1	10.0000	10.0000	0.94	705.	0.050	0.067	582.0
3	1	10.0000	20.0000	1.62	810.	0.050	0.071	606.0
4	1	10.0000	30.0000	2.35	915.	0.050	0.074	631.0
5	1	10.0000	40.0000	3.10	1013.	0.050	0.076	655.0
6	2	10.0000	50.0000	3.87	1117.	0.050	0.078	679.0
7	2	10.0000	60.0000	4.66	1231.	0.050	0.080	704.0
8	2	10.0000	70.0000	5.46	1333.	0.050	0.081	728.0
9	2	10.0000	80.0000	6.28	1440.	0.050	0.082	752.0
10	2	10.0000	90.0000	7.10	1556.	0.050	0.083	777.0
11	4	5.0000	97.5000	7.82	2506.	0.050	0.120	820.0
12	BASE				13684.	0.050	0.136	1800.0

```
 PERIOD = 0.58 FROM AVERAGE SHEAR VEL. =     687.


  FREQUENCY    AMPLITUDE
 MAXIMUM AMPLIFICATION =  13.45
 FOR FREQUENCY         =   1.84 C/SEC.
     PERIOD            =   0.54 SEC.

1******   OPTION  3  ***  READ INPUT MOTION

  FILE NAME FOR INPUT MOTION = C:\Program Files\SHAKE2000\Quakes\CHY006-W.eq
    NO. OF INPUT ACC. POINTS = 30000
   NO. OF POINTS USED IN FFT = 32768
        NO. OF HEADING LINES =     4
     NO. OF POINTS PER LINE  =     4
  TIME STEP FOR INPUT MOTION = 0.0040
     FORMAT FOR TIME HISTORY =     (4E15.6)


 *****HEADER*****
Source File: C:\Program Files\SHAKE2000\Quakes\CHY006-W.TXT
SHAKE2000 Conversion:    37500      .004      4          4          15        (4E15.
Acceleration Units: (g's) - No. Values: 37500 - Time Step: .004 (secs)
Data Format: (4E15.6) - No. Header Lines:  4
 **  FIRST AND LAST 5 LINES OF INPUT MOTION *****

     1 -0.000001-0.000001-0.000001-0.000001
     2 -0.000001-0.000001-0.000001-0.000001
     3 -0.000001-0.000001-0.000001-0.000001
     4 -0.000001-0.000001-0.000001-0.000001
     5 -0.000001-0.000001-0.000001-0.000001
  ............INPUT MOTION READ NOT ECHOED...........
  7496 -0.000215-0.000177-0.000169-0.000192
  7497 -0.000218-0.000226-0.000253-0.000324
  7498 -0.000435-0.000580-0.000751-0.000917
  7499 -0.001040-0.001061-0.000933-0.000646
  7500 -0.000248 0.000166 0.000470 0.000559

 MAXIMUM ACCELERATION =  0.36442
 AT TIME              = 33.75 SEC
 THE VALUES WILL BE MULTIPLIED BY A FACTOR =  0.800
 TO GIVE NEW MAXIMUM ACCELERATION          =  0.29154
 MEAN SQUARE FREQUENCY =        1.91 C/SEC.
 MAX ACCELERATION =      0.28959 FOR FREQUENCIES REMOVED ABOVE       25.00 C/SEC.
1******   OPTION  4  ***  READ WHERE OBJECT MOTION IS GIVEN
  OBJECT MOTION IN LAYER NUMBER   12 OUTCROPPING

1******   OPTION  5  ***  OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
```

```
 MAXIMUM NUMBER OF ITERATIONS                =      5
 FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN  =      0.65

    EARTHQUAKE    - C:\Program Files\SHAKE2000\Quakes\CHY006-W.eq
   SOIL PROFILE - Soil Profile No.  1

  ITERATION NUMBER  1

 VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ---->    <---- SHEAR MODULUS ----->
G/Go
          (FT)   STRAIN  NEW    USED   ERROR      NEW     USED    ERROR   RATIO
--- ---- ----  -------- -----  -----  ------  -------  ------  ------  -----
  1  4    2.5 0.00719 0.032  0.050   -58.7   1706.1   1826.1    -7.0  1.000
  2  1   10.0 0.05731 0.061  0.050    17.9    547.4    704.8   -28.8  1.000
  3  1   20.0 0.08339 0.069  0.050    27.3    583.1    809.7   -38.9  1.000
  4  1   30.0 0.10119 0.072  0.050    30.9    629.3    915.0   -45.4  1.000
  5  1   40.0 0.11227 0.075  0.050    33.8    675.8   1012.6   -49.8  1.000
  6  2   50.0 0.11661 0.067  0.050    24.9    834.5   1116.8   -33.8  1.000
  7  2   60.0 0.12079 0.068  0.050    26.1    911.7   1231.3   -35.1  1.000
  8  2   70.0 0.12497 0.069  0.050    27.2    978.3   1333.2   -36.3  1.000
  9  2   80.0 0.12698 0.069  0.050    27.7   1052.3   1440.1   -36.9  1.000
 10  2   90.0 0.12662 0.069  0.050    27.6   1138.0   1556.2   -36.8  1.000
 11  4   97.5 0.08252 0.082  0.050    38.9   1422.6   2505.8   -76.1  1.000
1
      EARTHQUAKE    - C:\Program Files\SHAKE2000\Quakes\CHY006-W.eq
     SOIL PROFILE - Soil Profile No.  1

   ITERATION NUMBER  2

  VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ---->    <---- SHEAR MODULUS ----->
G/Go
          (FT)   STRAIN  NEW    USED   ERROR      NEW     USED    ERROR   RATIO
--- ---- ----  -------- -----  -----  ------  -------  ------  ------  -----
  1  4    2.5 0.00797 0.033  0.032     4.3   1689.8   1706.1    -1.0  0.934
  2  1   10.0 0.07602 0.067  0.061     9.0    517.7    547.4    -5.7  0.777
  3  1   20.0 0.11674 0.077  0.069    10.3    534.2    583.1    -9.2  0.720
  4  1   30.0 0.14692 0.084  0.072    13.4    562.5    629.3   -11.9  0.688
  5  1   40.0 0.17580 0.089  0.075    15.1    586.9    675.8   -15.1  0.667
  6  2   50.0 0.17102 0.078  0.067    14.7    751.6    834.5   -11.0  0.747
  7  2   60.0 0.17951 0.080  0.068    15.0    817.1    911.7   -11.6  0.740
  8  2   70.0 0.18526 0.081  0.069    14.7    876.5    978.3   -11.6  0.734
  9  2   80.0 0.18487 0.080  0.069    14.0    947.4   1052.3   -11.1  0.731
 10  2   90.0 0.17822 0.079  0.069    12.9   1034.8   1138.0   -10.0  0.731
 11  4   97.5 0.14483 0.098  0.082    16.7   1180.8   1422.6   -20.5  0.568
1
      EARTHQUAKE    - C:\Program Files\SHAKE2000\Quakes\CHY006-W.eq
     SOIL PROFILE - Soil Profile No.  1

   ITERATION NUMBER  3

  VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ---->    <---- SHEAR MODULUS ----->
G/Go
          (FT)   STRAIN  NEW    USED   ERROR      NEW     USED    ERROR   RATIO
--- ---- ----  -------- -----  -----  ------  -------  ------  ------  -----
  1  4    2.5 0.00732 0.032  0.032    -0.3   1703.2   1702.1     0.1  0.932
  2  1   10.0 0.07455 0.066  0.066     0.1    519.8    520.0     0.0  0.738
  3  1   20.0 0.12716 0.079  0.079     0.9    520.7    524.3    -0.7  0.647
  4  1   30.0 0.17432 0.089  0.087     1.5    531.9    539.7    -1.5  0.590
  5  1   40.0 0.21385 0.095  0.093     1.6    548.1    557.9    -1.8  0.551
  6  2   50.0 0.19330 0.082  0.081     0.9    725.1    730.3    -0.7  0.654
  7  2   60.0 0.20025 0.083  0.082     0.7    791.0    795.4    -0.6  0.646
  8  2   70.0 0.20227 0.083  0.083     0.4    853.8    856.5    -0.3  0.642
  9  2   80.0 0.19607 0.082  0.082     0.0    931.0    931.2     0.0  0.647
 10  2   90.0 0.18331 0.080  0.080    -0.3   1026.3   1023.9     0.2  0.658
 11  4   97.5 0.16619 0.102  0.102     0.6   1126.1   1133.7    -0.7  0.452
1
      EARTHQUAKE    - C:\Program Files\SHAKE2000\Quakes\CHY006-W.eq
     SOIL PROFILE - Soil Profile No.  1

   ITERATION NUMBER  4

  VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ---->    <---- SHEAR MODULUS ----->
G/Go
          (FT)   STRAIN  NEW    USED   ERROR      NEW     USED    ERROR   RATIO
--- ---- ----  -------- -----  -----  ------  -------  ------  ------  -----
  1  4    2.5 0.00733 0.032  0.032     0.1   1703.0   1703.2     0.0  0.933
  2  1   10.0 0.07476 0.067  0.066     0.1    519.5    519.8    -0.1  0.738
  3  1   20.0 0.12831 0.079  0.079     0.3    519.2    520.7    -0.3  0.643
  4  1   30.0 0.17715 0.089  0.089     0.5    529.0    531.9    -0.5  0.581
  5  1   40.0 0.21777 0.095  0.095     0.6    544.5    548.1    -0.7  0.541
  6  2   50.0 0.19449 0.082  0.082     0.2    723.7    725.1    -0.2  0.649
  7  2   60.0 0.20091 0.083  0.083     0.1    790.2    791.0    -0.1  0.642
  8  2   70.0 0.20222 0.083  0.083     0.0    853.9    853.8     0.0  0.640
  9  2   80.0 0.19529 0.082  0.082    -0.1    932.1    931.0     0.1  0.646
 10  2   90.0 0.18193 0.080  0.080    -0.3   1028.6   1026.3     0.2  0.660
 11  4   97.5 0.16633 0.102  0.102     0.0   1125.8   1126.1     0.0  0.449

  VALUES IN TIME DOMAIN

  LAYER  TYPE      THICKNESS          DEPTH      MAX STRAIN      MAX STRESS
TIME
                       FT               FT          PRCNT             PSF
SEC

     1     4         5.0000          2.5000         0.01128          192.12
33.90
     2     1        10.0000         10.0000         0.11501          597.81
33.92
     3     1        10.0000         20.0000         0.19740         1027.75
33.92
     4     1        10.0000         30.0000         0.27254         1449.49
33.92
     5     1        10.0000         40.0000         0.33502         1836.18
33.92
     6     2        10.0000         50.0000         0.29922         2169.50
33.91
     7     2        10.0000         60.0000         0.30909         2444.87
33.90
     8     2        10.0000         70.0000         0.31110         2656.24
33.90
     9     2        10.0000         80.0000         0.30045         2797.09
33.90
    10     2        10.0000         90.0000         0.27990         2872.64
33.90
    11     4         5.0000         97.5000         0.25590         2881.64
33.90

  PERIOD = 0.73 FROM AVERAGE SHEAR VEL. =      549.


  FREQUENCY    AMPLITUDE
 MAXIMUM AMPLIFICATION =    7.87
 FOR FREQUENCY         =    1.44 C/SEC.
     PERIOD            =    0.69 SEC.

1******   OPTION  6  ***  COMPUTE MOTION IN NEW SUBLAYERS

   EARTHQUAKE -C:\Program Files\SHAKE2000\Quakes\CHY006-W.eq
  SOIL DEPOSIT - Soil Profile No.  1
    LAYER          DEPTH         MAX. ACC.          TIME      MEAN SQ. FR.
ACC. RATIO      TH SAVED
                     FT               G              SEC          C/SEC
QUIET ZONE       ACC. RECORD
     OUTCR.        0.0000         0.64220         33.89          1.63
0.014               4096
     WITHIN        5.0000         0.64095         33.89          1.62
0.014                  0
     WITHIN       15.0000         0.62075         33.90          1.52
0.014                  0
     WITHIN       25.0000         0.57812         33.90          1.45
0.014                  0
     WITHIN       35.0000         0.52117         33.90          1.44
0.014                  0
     WITHIN       45.0000         0.44320         33.88          1.53
0.014                  0
     WITHIN       55.0000         0.37213         33.88          1.63
0.016                  0
     WITHIN       65.0000         0.29542         33.55          1.73
0.020                  0
     WITHIN       75.0000         0.27161         33.54          1.78
0.022                  0
     WITHIN       85.0000         0.22458         33.78          1.78
0.026                  0
     WITHIN       95.0000         0.21602         33.76          1.78
0.026               4096
     WITHIN      100.0000         0.21014         33.76          1.79
0.026               4096
     OUTCR.      100.0000         0.28959         33.76          1.91
0.021               4096

1******   OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

  COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   11
  SCALE FOR PLOTTING      0.0000
 IDENTIFICATION - Stress History Layer No. 1

  COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   11
  SCALE FOR PLOTTING      0.0000
 IDENTIFICATION - Strain History Layer No. 1


 *** End of Output File No. 1 ***
```

100 ft - GM#4

```
 ***********************************************************
 * SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL *
 *     LAYERED SITES by Per Schnable & John Lysmer - 1970  *
 * ------------------------------------------------------- *
 * SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985 *
 * ------------------------------------------------------- *
 * SHAKE88 :New modulus reduction curves for clays added   *
 *      using results from Sun et al (1988) by J. I. Sun   *
 *      & Ramin Golesorkhi February 26, 1988               *
 * ------------------------------------------------------- *
 * SHAKE90/91: Adjust last iteration; Input now is either  *
 *      Gmax or max Vs; up to 13 materials can be specified*
 *      by user; up to 50 Layers can be specified; object  *
 *      motion can be read in from a separate file and can  *
 *      user specified format; Different periods for res-  *
 *      ponse spectral calculations;options are renumbered;*
 *      and general cleanup by: J. I. Sun, I. M. Idriss &  *
 *      P. Dirrim June 1990 - February 1991                *
 * ------------------------------------------------------- *
 * SHAKE91: General cleanup and finalization of input out- *
 *      output format ... etc by: I. M. Idriss Dec. 1991   *
 * ------------------------------------------------------- *
 * SHAKE2000: Fix the incorrect output of Tot. Stress in   *
 * Option 2. Changed path of ground motion file in         *
 * SHAKE91.  Control file to input file names.  Modified   *
 * by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003) *
 *          RUN DATE 12/05/2007                            *
 *          RUN TIME 17:09                                 *
 ***********************************************************
 MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =     32768
 NECESSARY LENGTH OF BLANK COMMON X        =    204819

1******   OPTION  1  ***  READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

 **********************
  MATERIAL TYPE NO. 1
 **********************

 CURVE NO.  1:     MSW shallow MSW (SM<125) Zekkos, 2005
 CURVE NO.  2:     MSW shallow MSW (SM<125) Zekkos, 2005

      CURVE NO. 1             CURVE NO. 2
   ==================      ==================
     STRAIN    G/GMAX        STRAIN    DAMPING
   --------   -------      --------  --------
     0.0001     1.000        0.0001      4.00
     0.0002     0.997        0.0002      4.00
     0.0003     0.996        0.0003      4.10
     0.0010     0.990        0.0010      4.10
     0.0020     0.982        0.0020      4.20
     0.0030     0.975        0.0030      4.20
     0.0050     0.963        0.0050      4.20
     0.0080     0.946        0.0080      4.30
     0.0120     0.927        0.0120      4.50
     0.0200     0.892        0.0200      4.80
     0.0300     0.856        0.0300      5.20
     0.0500     0.797        0.0500      5.80
     0.0800     0.727        0.0800      6.80
     0.1000     0.690        0.1000      7.20
     0.3000     0.475        0.3000     10.50
     0.5000     0.373        0.5000     12.00
     1.0000     0.252        1.0000     14.00

 **********************
  MATERIAL TYPE NO. 2
 **********************

 CURVE NO.  3:     MSW deep    MSW (125<SM<350) Zekkos 2005
 CURVE NO.  4:     MSW deep    MSW (125<SM<350) Zekkos 2005

      CURVE NO. 3             CURVE NO. 4
   ==================      ==================
     STRAIN    G/GMAX        STRAIN    DAMPING
   --------   -------      --------  --------
     0.0001     1.000        0.0001      3.00
     0.0002     0.999        0.0002      3.00
     0.0003     0.998        0.0003      3.10
     0.0010     0.995        0.0010      3.10
     0.0020     0.992        0.0020      3.20
     0.0030     0.988        0.0030      3.20
     0.0050     0.981        0.0050      3.20
     0.0080     0.971        0.0080      3.30
     0.0120     0.959        0.0120      3.50
     0.0200     0.937        0.0200      3.80
     0.0300     0.911        0.0300      4.20
     0.0500     0.867        0.0500      4.80
     0.0800     0.810        0.0800      5.80
     0.1000     0.777        0.1000      6.20
     0.3000     0.564        0.3000      9.50
     0.5000     0.450        0.5000     11.00
     1.0000     0.305        1.0000     13.00

 **********************
  MATERIAL TYPE NO. 3
 **********************

 CURVE NO.  5:     Soil PI=100 G/Gmax - Soil with PI=100, OCR=1-15 (Vucetic
 CURVE NO.  6:     Soil PI=100 Damping - Soil with PI=100, OCR=1-8 (Vucetic

      CURVE NO. 5             CURVE NO. 6
   ==================      ==================
     STRAIN    G/GMAX        STRAIN    DAMPING
   --------   -------      --------  --------
     0.0050     1.000        0.0010      1.20
     0.0060     1.000        0.0030      1.50
     0.0070     0.995        0.0050      1.70
     0.0090     0.990        0.0070      1.90
     0.0100     0.985        0.0090      2.00
     0.0200     0.960        0.0100      2.05
     0.0300     0.935        0.0200      2.50
     0.0400     0.915        0.0300      2.90
     0.0500     0.900        0.0400      3.10
     0.0600     0.880        0.0500      3.30
     0.0700     0.865        0.0600      3.50
     0.0800     0.850        0.0800      3.80
     0.0900     0.830        0.1000      4.00
     0.1000     0.815        0.2000      5.20
     0.2000     0.715        0.3000      6.10
     0.3000     0.635        0.4000      6.80
     0.5000     0.530        0.5000      7.40
     0.6000     0.490        0.6000      8.00
     0.9000     0.405        0.7000      8.60
     1.0000     0.375        1.0000      9.70

 **********************
  MATERIAL TYPE NO. 4
 **********************

 CURVE NO.  7:     Soil PI=30  G/Gmax - Soil with PI=30, OCR=1-15 (Vucetic
 CURVE NO.  8:     Soil PI=30  Damping - Soil with PI=30, OCR=1-8 (Vucetic

      CURVE NO. 7             CURVE NO. 8
   ==================      ==================
     STRAIN    G/GMAX        STRAIN    DAMPING
   --------   -------      --------  --------
     0.0010     1.000        0.0020      1.70
     0.0020     0.995        0.0030      2.10
     0.0030     0.985        0.0040      2.50
     0.0040     0.970        0.0050      2.60
     0.0050     0.960        0.0060      2.90
     0.0060     0.950        0.0080      3.30
     0.0080     0.925        0.0100      3.70
     0.0090     0.910        0.0200      5.05
     0.0100     0.900        0.0300      5.70
     0.0200     0.820        0.0400      6.40
     0.0300     0.745        0.0500      6.90
     0.0400     0.700        0.0600      7.30
     0.0700     0.600        0.0800      8.10
     0.1000     0.530        0.1000      8.70
     0.2000     0.420        0.2000     10.80
     0.3000     0.350        0.3000     12.30
     0.4000     0.305        0.4000     13.30
     0.6000     0.240        0.5000     14.10
     0.8000     0.205        0.7000     15.60
     1.0000     0.165        1.0000     16.90

1******   OPTION  2  ***  READ SOIL PROFILE
 NEW SOIL PROFILE NO.      1      IDENTIFICATION  Soil Profile No.  1
 NUMBER OF LAYERS                    12          DEPTH TO BEDROCK         100.00

  NO. TYPE  THICKNESS   DEPTH  TOTAL PRESS.  MODULUS  DAMPING   UNIT WT.   SHEAR
VEL
              (FT)       (FT)       (KSF)      (KSF)              (KCF)     (FPS)
   1    4    5.0000     2.5000      0.30       1826.   0.050     0.120      700.0
   2    1   10.0000    10.0000      0.94        705.   0.050     0.067      582.0
   3    1   10.0000    20.0000      1.62        810.   0.050     0.071      606.0
   4    1   10.0000    30.0000      2.35        915.   0.050     0.074      631.0
   5    1   10.0000    40.0000      3.10       1013.   0.050     0.076      655.0
   6    2   10.0000    50.0000      3.87       1117.   0.050     0.078      679.0
   7    2   10.0000    60.0000      4.66       1231.   0.050     0.080      704.0
   8    2   10.0000    70.0000      5.46       1333.   0.050     0.081      728.0
   9    2   10.0000    80.0000      6.28       1440.   0.050     0.082      752.0
  10    2   10.0000    90.0000      7.10       1556.   0.050     0.083      777.0
  11    4    5.0000    97.5000      7.82       2506.   0.050     0.120      820.0
  12   BASE                                   13684.   0.050     0.136     1800.0

 PERIOD = 0.58 FROM AVERAGE SHEAR VEL. =      687.


  FREQUENCY    AMPLITUDE
 MAXIMUM AMPLIFICATION =  13.45
 FOR FREQUENCY         =   1.84 C/SEC.
     PERIOD            =   0.54 SEC.

1******   OPTION  3  ***  READ INPUT MOTION

  FILE NAME FOR INPUT MOTION = C:\Program Files\SHAKE2000\Quakes\bydz\LCN260.eq
    NO. OF INPUT ACC. POINTS =   9624
  NO. OF POINTS USED IN FFT = 16384
       NO. OF HEADING LINES =     8
     NO. OF POINTS PER LINE =     4
  TIME STEP FOR INPUT MOTION = 0.0050
     FORMAT FOR TIME HISTORY =   (4E15.6E2)


 *****HEADER*****
Source File: C:\Program Files\SHAKE2000\Quakes\bydz\LCN260.AT2
SHAKE2000 Conversion:    9624      .005       8         4          15        (4E15.
Acceleration Units: (g's) - No. Values: 9624 - Time Step: .005 (secs)
Data Format: (4E15.6E2) - No. Header Lines:  8
PEER NGA STRONG MOTION DATABASE RECORD
LANDERS 6/28/92 11:58, LUCERNE, 260 (SCE STATION 24)
ACCELERATION TIME HISTORY IN UNITS OF G
9625    0.0050    NPTS, DT
 **  FIRST AND LAST 5 LINES OF INPUT MOTION *****

     1 -0.000006-0.000007-0.000005-0.000006
     2 -0.000005-0.000006-0.000005-0.000009
     3 -0.000011-0.000019-0.000023-0.000025
     4 -0.000019-0.000012-0.000001 0.000010
     5  0.000021 0.000020 0.000018 0.000016
  .............INPUT MOTION READ NOT ECHOED..........
  2402  0.000037 0.000027 0.000001-0.000012
  2403 -0.000009 0.000006 0.000014 0.000006
  2404 -0.000007-0.000014-0.000018-0.000017
  2405 -0.000010-0.000001 0.000000-0.000003
  2406 -0.000006-0.000006-0.000006-0.000005

 MAXIMUM ACCELERATION =  0.72684
 AT TIME              = 10.47 SEC
 THE VALUES WILL BE MULTIPLIED BY A FACTOR = 0.850
 TO GIVE NEW MAXIMUM ACCELERATION          = 0.61781
 MEAN SQUARE FREQUENCY =       9.50 C/SEC.
 MAX ACCELERATION =      0.58845 FOR FREQUENCIES REMOVED ABOVE      25.00 C/SEC.
```

```
1******   OPTION  4  ***  READ WHERE OBJECT MOTION IS GIVEN
  OBJECT MOTION IN LAYER NUMBER   12 OUTCROPPING

1******   OPTION  5  ***  OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
  MAXIMUM NUMBER OF ITERATIONS                =      5
  FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN  =      0.65

     EARTHQUAKE    - C:\Program Files\SHAKE2000\Quakes\bydz\LCN260.eq
    SOIL PROFILE - Soil Profile No.  1

   ITERATION NUMBER  1

  VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ---->    <---- SHEAR MODULUS ----->
G/Go
         (FT)   STRAIN  NEW    USED   ERROR      NEW     USED    ERROR   RATIO
--- ---- ----  -------- -----  -----  ------  -------  ------  ------  -----
  1  4    2.5 0.00791 0.033  0.050   -52.2   1690.9   1826.1    -8.0  1.000
  2  1   10.0 0.06040 0.062  0.050    19.4    541.9    704.8   -30.1  1.000
  3  1   20.0 0.08074 0.068  0.050    26.6    587.4    809.7   -37.8  1.000
  4  1   30.0 0.09026 0.070  0.050    28.7    646.9    915.0   -41.4  1.000
  5  1   40.0 0.09474 0.071  0.050    29.6    707.8   1012.6   -43.1  1.000
  6  2   50.0 0.09458 0.061  0.050    18.0    877.0   1116.8   -27.3  1.000
  7  2   60.0 0.09712 0.061  0.050    18.7    962.1   1231.3   -28.0  1.000
  8  2   70.0 0.10286 0.063  0.050    20.4   1028.6   1333.2   -29.6  1.000
  9  2   80.0 0.10866 0.064  0.050    22.5   1095.8   1440.1   -31.4  1.000
 10  2   90.0 0.10585 0.064  0.050    21.5   1192.0   1556.2   -30.6  1.000
 11  4   97.5 0.06587 0.076  0.050    33.9   1530.7   2505.8   -63.7  1.000
1
     EARTHQUAKE    - C:\Program Files\SHAKE2000\Quakes\bydz\LCN260.eq
    SOIL PROFILE - Soil Profile No.  1

   ITERATION NUMBER  2

  VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ---->    <---- SHEAR MODULUS ----->
G/Go
         (FT)   STRAIN  NEW    USED   ERROR      NEW     USED    ERROR   RATIO
--- ---- ----  -------- -----  -----  ------  -------  ------  ------  -----
  1  4    2.5 0.00951 0.036  0.033     9.0   1652.2   1690.9    -2.3  0.926
  2  1   10.0 0.08654 0.069  0.062    10.6    503.2    541.9    -7.7  0.769
  3  1   20.0 0.11121 0.075  0.068     9.3    541.9    587.4    -8.4  0.725
  4  1   30.0 0.11979 0.077  0.070     9.4    599.0    646.9    -8.0  0.707
  5  1   40.0 0.12637 0.079  0.071    10.1    652.3    707.8    -8.5  0.699
  6  2   50.0 0.12146 0.068  0.061    10.1    825.7    877.0    -6.2  0.785
  7  2   60.0 0.13320 0.071  0.061    12.9    888.3    962.1    -8.3  0.781
  8  2   70.0 0.14318 0.073  0.063    13.6    943.1   1028.6    -9.1  0.772
  9  2   80.0 0.13994 0.072  0.064    10.5   1025.1   1095.8    -6.9  0.761
 10  2   90.0 0.13012 0.070  0.064     8.9   1129.7   1192.0    -5.5  0.766
 11  4   97.5 0.10996 0.090  0.076    15.9   1290.3   1530.7   -18.6  0.611
1
     EARTHQUAKE    - C:\Program Files\SHAKE2000\Quakes\bydz\LCN260.eq
    SOIL PROFILE - Soil Profile No.  1

   ITERATION NUMBER  3

  VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ---->    <---- SHEAR MODULUS ----->
G/Go
         (FT)   STRAIN  NEW    USED   ERROR      NEW     USED    ERROR   RATIO
--- ---- ----  -------- -----  -----  ------  -------  ------  ------  -----
  1  4    2.5 0.00913 0.035  0.036     -2.1   1659.3   1652.2     0.4  0.905
  2  1   10.0 0.08774 0.070  0.069      0.4    501.6    503.2    -0.3  0.714
  3  1   20.0 0.11448 0.076  0.075      1.1    537.3    541.9    -0.9  0.669
  4  1   30.0 0.12445 0.079  0.077      1.5    592.2    599.0    -1.2  0.655
  5  1   40.0 0.13301 0.081  0.079      1.9    642.2    652.3    -1.6  0.644
  6  2   50.0 0.12681 0.069  0.068      1.9    816.3    825.7    -1.1  0.739
  7  2   60.0 0.14079 0.072  0.071      2.3    875.1    888.3    -1.5  0.721
  8  2   70.0 0.14853 0.074  0.073      1.5    933.6    943.1    -1.0  0.707
  9  2   80.0 0.13920 0.072  0.072     -0.2   1026.6   1025.1     0.1  0.712
 10  2   90.0 0.14116 0.072  0.070      3.4   1105.1   1129.7    -2.2  0.726
 11  4   97.5 0.13399 0.096  0.090      6.2   1211.7   1290.3    -6.5  0.515
1
     EARTHQUAKE    - C:\Program Files\SHAKE2000\Quakes\bydz\LCN260.eq
    SOIL PROFILE - Soil Profile No.  1

   ITERATION NUMBER  4

  VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ---->    <---- SHEAR MODULUS ----->
G/Go
         (FT)   STRAIN  NEW    USED   ERROR      NEW     USED    ERROR   RATIO
--- ---- ----  -------- -----  -----  ------  -------  ------  ------  -----
  1  4    2.5 0.00899 0.035  0.035     -0.8   1662.0   1659.3     0.2  0.909
  2  1   10.0 0.08711 0.070  0.070     -0.2    502.4    501.6     0.2  0.712
  3  1   20.0 0.11438 0.076  0.076      0.0    537.4    537.3     0.0  0.664
  4  1   30.0 0.12481 0.079  0.079      0.1    591.7    592.2    -0.1  0.647
  5  1   40.0 0.13403 0.081  0.081      0.3    640.7    642.2    -0.2  0.634
  6  2   50.0 0.12738 0.069  0.069      0.2    815.4    816.3    -0.1  0.731
  7  2   60.0 0.14157 0.072  0.072      0.2    873.8    875.1    -0.2  0.711
  8  2   70.0 0.14807 0.074  0.074     -0.1    934.4    933.6     0.1  0.700
  9  2   80.0 0.13994 0.072  0.072      0.2   1025.1   1026.6    -0.1  0.713
 10  2   90.0 0.14526 0.073  0.072      1.2   1096.5   1105.1    -0.8  0.710
 11  4   97.5 0.14351 0.098  0.096      2.1   1184.4   1211.7    -2.3  0.484
1
     EARTHQUAKE    - C:\Program Files\SHAKE2000\Quakes\bydz\LCN260.eq
    SOIL PROFILE - Soil Profile No.  1

   ITERATION NUMBER  5

  VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ---->    <---- SHEAR MODULUS ----->
G/Go
         (FT)   STRAIN  NEW    USED   ERROR      NEW     USED    ERROR   RATIO
--- ---- ----  -------- -----  -----  ------  -------  ------  ------  -----
  1  4    2.5 0.00895 0.035  0.035     -0.2   1663.0   1662.0     0.1  0.910
  2  1   10.0 0.08672 0.069  0.070     -0.1    503.0    502.4     0.1  0.713
  3  1   20.0 0.11412 0.076  0.076     -0.1    537.8    537.4     0.1  0.664
  4  1   30.0 0.12466 0.079  0.079      0.0    591.9    591.7     0.0  0.647
  5  1   40.0 0.13406 0.081  0.081      0.0    640.6    640.7     0.0  0.633
  6  2   50.0 0.12729 0.069  0.069      0.0    815.5    815.4     0.0  0.730
  7  2   60.0 0.14141 0.072  0.072      0.0    874.0    873.8     0.0  0.710
  8  2   70.0 0.14754 0.074  0.074     -0.1    935.4    934.4     0.1  0.701
  9  2   80.0 0.14035 0.072  0.072      0.1   1024.3   1025.1    -0.1  0.712
 10  2   90.0 0.14663 0.073  0.073      0.4   1093.7   1096.5    -0.3  0.705
 11  4   97.5 0.14700 0.099  0.098      0.7   1174.9   1184.4    -0.8  0.473

  VALUES IN TIME DOMAIN

  LAYER  TYPE       THICKNESS          DEPTH      MAX STRAIN     MAX STRESS
TIME
                        FT               FT          PRCNT          PSF
SEC

     1     4          5.0000          2.5000         0.01377         228.90
10.65
     2     1         10.0000         10.0000         0.13342         670.35
10.65
     3     1         10.0000         20.0000         0.17558         943.60
10.64
     4     1         10.0000         30.0000         0.19179        1134.77
10.62
     5     1         10.0000         40.0000         0.20625        1321.35
10.60
     6     2         10.0000         50.0000         0.19583        1596.75
10.58
     7     2         10.0000         60.0000         0.21756        1900.91
10.56
     8     2         10.0000         70.0000         0.22698        2120.98
10.55
     9     2         10.0000         80.0000         0.21592        2213.52
10.75
    10     2         10.0000         90.0000         0.22558        2473.53
10.74
    11     4          5.0000         97.5000         0.22615        2678.66
10.73

  PERIOD = 0.70 FROM AVERAGE SHEAR VEL. =      570.


  FREQUENCY    AMPLITUDE
 MAXIMUM AMPLIFICATION =    8.91
 FOR FREQUENCY         =    1.51 C/SEC.
     PERIOD            =    0.66 SEC.

1******   OPTION  6  ***  COMPUTE MOTION IN NEW SUBLAYERS

   EARTHQUAKE -C:\Program Files\SHAKE2000\Quakes\bydz\LCN260.eq
  SOIL DEPOSIT - Soil Profile No.  1
     LAYER           DEPTH         MAX. ACC.          TIME       MEAN SQ. FR.
ACC. RATIO       TH SAVED
                       FT               G              SEC           C/SEC
QUIET ZONE        ACC. RECORD
     OUTCR.          0.0000         0.76266          10.64           4.07
0.000                2048
     WITHIN          95.0000         0.47008          10.69           9.02
0.000                2048
     WITHIN         100.0000         0.48964          10.68           8.90
0.000                2048
     OUTCR.         100.0000         0.58845          10.47           9.50
0.000                   0

1******   OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

  COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   11
  SCALE FOR PLOTTING      0.0000
 IDENTIFICATION - Stress History Layer No. 1

  COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   11
  SCALE FOR PLOTTING      0.0000
 IDENTIFICATION - Strain History Layer No. 1


  *** End of Output File No. 1 ***
```

100 ft - GM# 5

```
 ************************************************************
 * SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL  *
 *      LAYERED SITES by Per Schnable & John Lysmer - 1970  *
 * ---------------------------------------------------------*
 * SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985  *
 * ---------------------------------------------------------*
 * SHAKE88 :New modulus reduction curves for clays added    *
 *      using results from Sun et al (1988) by J. I. Sun    *
 *      & Ramin Golesorkhi February 26, 1988                *
 * ---------------------------------------------------------*
 * SHAKE90/91: Adjust last iteration; Input now is either   *
 *      Gmax or max Vs; up to 13 materials can be specified *
 *      by user; up to 50 Layers can be specified; object   *
 *      motion can be read in from a separate file and can  *
 *      user specified format; Different periods for res-   *
 *      ponse spectral calculations;options are renumbered; *
 *      and general cleanup by: J. I. Sun, I. M. Idriss &   *
 *      P. Dirrim June 1990 - February 1991                 *
 * ---------------------------------------------------------*
 * SHAKE91: General cleanup and finalization of input out-  *
 *      output format ... etc by: I. M. Idriss Dec. 1991    *
 * ---------------------------------------------------------*
 * SHAKE2000: Fix the incorrect output of Tot. Stress in    *
 * Option 2. Changed path of ground motion file in          *
 * SHAKE91.  Control file to input file names.  Modified    *
 * by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003)  *
 *          RUN DATE 12/05/2007                             *
 *          RUN TIME 20:06                                  *
 ************************************************************
 MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =     32768
 NECESSARY LENGTH OF BLANK COMMON X        =    204819

1******   OPTION  1  ***  READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

 **********************
  MATERIAL TYPE NO. 1
 **********************

 CURVE NO.  1:     MSW shallow MSW (SM<125) Zekkos, 2005
 CURVE NO.  2:     MSW shallow MSW (SM<125) Zekkos, 2005

      CURVE NO. 1            CURVE NO. 2
 ====================   ====================
   STRAIN    G/GMAX       STRAIN    DAMPING
 --------   -------      --------  --------
   0.0001     1.000       0.0001      4.00
   0.0002     0.997       0.0002      4.00
   0.0003     0.996       0.0003      4.10
   0.0010     0.990       0.0010      4.10
   0.0020     0.982       0.0020      4.20
   0.0030     0.975       0.0030      4.20
   0.0050     0.963       0.0050      4.20
   0.0080     0.946       0.0080      4.30
   0.0120     0.927       0.0120      4.50
   0.0200     0.892       0.0200      4.80
   0.0300     0.856       0.0300      5.20
   0.0500     0.797       0.0500      5.80
   0.0800     0.727       0.0800      6.80
   0.1000     0.690       0.1000      7.20
   0.3000     0.475       0.3000     10.50
   0.5000     0.373       0.5000     12.00
   1.0000     0.252       1.0000     14.00

 **********************
  MATERIAL TYPE NO. 2
 **********************

 CURVE NO.  3:     MSW deep    MSW (125<SM<350) Zekkos 2005
 CURVE NO.  4:     MSW deep    MSW (125<SM<350) Zekkos 2005

      CURVE NO. 3            CURVE NO. 4
 ====================   ====================
   STRAIN    G/GMAX       STRAIN    DAMPING
 --------   -------      --------  --------
   0.0001     1.000       0.0001      3.00
   0.0002     0.999       0.0002      3.00
   0.0003     0.998       0.0003      3.10
   0.0010     0.995       0.0010      3.10
   0.0020     0.992       0.0020      3.20
   0.0030     0.988       0.0030      3.20
   0.0050     0.981       0.0050      3.20
   0.0080     0.971       0.0080      3.30
   0.0120     0.959       0.0120      3.50
   0.0200     0.937       0.0200      3.80
   0.0300     0.911       0.0300      4.20
   0.0500     0.867       0.0500      4.80
   0.0800     0.810       0.0800      5.80
   0.1000     0.777       0.1000      6.20
   0.3000     0.564       0.3000      9.50
   0.5000     0.450       0.5000     11.00
   1.0000     0.305       1.0000     13.00

 **********************
  MATERIAL TYPE NO. 3
 **********************

 CURVE NO.  5:     Soil PI=100 G/Gmax - Soil with PI=100, OCR=1-15 (Vucetic
 CURVE NO.  6:     Soil PI=100 Damping - Soil with PI=100, OCR=1-8 (Vucetic

      CURVE NO. 5            CURVE NO. 6
 ====================   ====================
   STRAIN    G/GMAX       STRAIN    DAMPING
 --------   -------      --------  --------
   0.0050     1.000       0.0010      1.20
   0.0060     1.000       0.0030      1.50
   0.0070     0.995       0.0050      1.70
   0.0090     0.990       0.0070      1.90
   0.0100     0.985       0.0090      2.00
   0.0200     0.960       0.0100      2.05
   0.0300     0.935       0.0200      2.50
   0.0400     0.915       0.0300      2.90
   0.0500     0.900       0.0400      3.10
   0.0600     0.880       0.0500      3.30
   0.0700     0.865       0.0600      3.50
   0.0800     0.850       0.0800      3.80
   0.0900     0.830       0.1000      4.00
   0.1000     0.815       0.2000      5.20
   0.2000     0.715       0.3000      6.10
   0.3000     0.635       0.4000      6.80
   0.5000     0.530       0.5000      7.40
   0.6000     0.490       0.6000      8.00
   0.9000     0.405       0.7000      8.60
   1.0000     0.375       1.0000      9.70

 **********************
  MATERIAL TYPE NO. 4
 **********************

 CURVE NO.  7:     Soil PI=30  G/Gmax - Soil with PI=30, OCR=1-15 (Vucetic
 CURVE NO.  8:     Soil PI=30  Damping - Soil with PI=30, OCR=1-8 (Vucetic

      CURVE NO. 7            CURVE NO. 8
 ====================   ====================
   STRAIN    G/GMAX       STRAIN    DAMPING
 --------   -------      --------  --------
   0.0010     1.000       0.0020      1.70
   0.0020     0.995       0.0030      2.10
   0.0030     0.985       0.0040      2.50
   0.0040     0.970       0.0050      2.60
   0.0050     0.960       0.0060      2.90
   0.0060     0.950       0.0080      3.30
   0.0080     0.925       0.0100      3.70
   0.0090     0.910       0.0200      5.05
   0.0100     0.900       0.0300      5.70
   0.0200     0.820       0.0400      6.40
   0.0300     0.745       0.0500      6.90
   0.0400     0.700       0.0600      7.30
   0.0700     0.600       0.0800      8.10
   0.1000     0.530       0.1000      8.70
   0.2000     0.420       0.2000     10.80
   0.3000     0.350       0.3000     12.30
   0.4000     0.305       0.4000     13.30
   0.6000     0.240       0.5000     14.10
   0.8000     0.205       0.7000     15.60
   1.0000     0.165       1.0000     16.90

1******   OPTION  2  ***  READ SOIL PROFILE
 NEW SOIL PROFILE NO.      1      IDENTIFICATION  Soil Profile No.  1
 NUMBER OF LAYERS                    12          DEPTH TO BEDROCK         100.00

  NO. TYPE  THICKNESS   DEPTH  TOTAL PRESS. MODULUS  DAMPING   UNIT WT.  SHEAR
VEL
            (FT)       (FT)      (KSF)       (KSF)              (KCF)     (FPS)
   1    4   5.0000     2.5000     0.30        1826.   0.050     0.120     700.0
   2    1  10.0000    10.0000     0.94         705.   0.050     0.067     582.0
   3    1  10.0000    20.0000     1.62         810.   0.050     0.071     606.0
   4    1  10.0000    30.0000     2.35         915.   0.050     0.074     631.0
   5    1  10.0000    40.0000     3.10        1013.   0.050     0.076     655.0
   6    2  10.0000    50.0000     3.87        1117.   0.050     0.078     679.0
   7    2  10.0000    60.0000     4.66        1231.   0.050     0.080     704.0
   8    2  10.0000    70.0000     5.46        1333.   0.050     0.081     728.0
   9    2  10.0000    80.0000     6.28        1440.   0.050     0.082     752.0
  10    2  10.0000    90.0000     7.10        1556.   0.050     0.083     777.0
  11    4   5.0000    97.5000     7.82        2506.   0.050     0.120     820.0
  12   BASE                                   13684.   0.050     0.136    1800.0

 PERIOD = 0.58 FROM AVERAGE SHEAR VEL. =     687.


  FREQUENCY    AMPLITUDE
 MAXIMUM AMPLIFICATION =  13.45
 FOR FREQUENCY         =   1.84 C/SEC.
    PERIOD             =   0.54 SEC.

1******   OPTION  3  ***  READ INPUT MOTION

  FILE NAME FOR INPUT MOTION = C:\Program Files\SHAKE2000\Quakes\NPS090.eq
    NO. OF INPUT ACC. POINTS = 14000
  NO. OF POINTS USED IN FFT = 32768
       NO. OF HEADING LINES =     4
     NO. OF POINTS PER LINE =     4
 TIME STEP FOR INPUT MOTION = 0.0050
    FORMAT FOR TIME HISTORY =     (4E15.6)


 *****HEADER*****
Source File: C:\Program Files\SHAKE2000\Quakes\NPS090.TXT
SHAKE2000 Conversion:    14000     .005      4          4          15        (4E15.
Acceleration Units: (g's) - No. Values: 14000 - Time Step: .005 (secs)
Data Format: (4E15.6) - No. Header Lines:  4
 **  FIRST AND LAST 5 LINES OF INPUT MOTION *****

    1 -0.000205-0.000266-0.000266-0.000205
    2 -0.000205-0.000266-0.000266-0.000204
    3 -0.000204-0.000204-0.000204-0.000204
    4 -0.000204-0.000204-0.000265-0.000204
    5 -0.000204-0.000204-0.000204-0.000204
  .............INPUT MOTION READ NOT ECHOED...........
 3496 -0.000038-0.000039-0.000039-0.000040
 3497 -0.000041-0.000042-0.000043-0.000044
 3498 -0.000045-0.000046-0.000047-0.000048
 3499 -0.000049-0.000050-0.000051-0.000051
 3500 -0.000052-0.000053-0.000053-0.000054

 MAXIMUM ACCELERATION =  0.13365
 AT TIME              = 25.55 SEC
 THE VALUES WILL BE MULTIPLIED BY A FACTOR =  2.500
 TO GIVE NEW MAXIMUM ACCELERATION          =  0.33414
 MEAN SQUARE FREQUENCY =       3.54 C/SEC.
 MAX ACCELERATION =     0.33630 FOR FREQUENCIES REMOVED ABOVE      25.00 C/SEC.
1******   OPTION  4  ***  READ WHERE OBJECT MOTION IS GIVEN
  OBJECT MOTION IN LAYER NUMBER   12 OUTCROPPING

1******   OPTION  5  ***  OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
```

```
 MAXIMUM NUMBER OF ITERATIONS                =     5
 FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN =     0.65

     EARTHQUAKE    - C:\Program Files\SHAKE2000\Quakes\NPS090.eq
     SOIL PROFILE - Soil Profile No.  1

  ITERATION NUMBER  1

  VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ---->    <---- SHEAR MODULUS ----->
G/Go
          (FT)    STRAIN  NEW     USED   ERROR       NEW     USED     ERROR    RATIO
--- ---- ----  -------- -----  ------  ------  -------  ------   ------  -----
  1  4    2.5 0.00597 0.029  0.050   -72.8    1735.2   1826.1     -5.2  1.000
  2  1   10.0 0.04695 0.057  0.050    12.7     566.8    704.8    -24.3  1.000
  3  1   20.0 0.06412 0.063  0.050    21.0     615.4    809.7    -31.6  1.000
  4  1   30.0 0.07266 0.066  0.050    24.2     678.3    915.0    -34.9  1.000
  5  1   40.0 0.07713 0.067  0.050    25.6     741.7   1012.6    -36.5  1.000
  6  2   50.0 0.08005 0.058  0.050    13.8     904.5   1116.8    -23.5  1.000
  7  2   60.0 0.08523 0.059  0.050    15.4     985.9   1231.3    -24.9  1.000
  8  2   70.0 0.08812 0.060  0.050    16.3    1060.8   1333.2    -25.7  1.000
  9  2   80.0 0.08963 0.060  0.050    16.7    1142.3   1440.1    -26.1  1.000
 10  2   90.0 0.08912 0.060  0.050    16.6    1235.7   1556.2    -25.9  1.000
 11  4   97.5 0.05858 0.072  0.050    31.0    1583.2   2505.8    -58.3  1.000
1
      EARTHQUAKE    - C:\Program Files\SHAKE2000\Quakes\NPS090.eq
      SOIL PROFILE - Soil Profile No.  1

   ITERATION NUMBER  2

   VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ---->    <---- SHEAR MODULUS ----->
G/Go
          (FT)    STRAIN  NEW     USED   ERROR       NEW     USED     ERROR    RATIO
--- ---- ----  -------- -----  ------  ------  -------  ------   ------  -----
  1  4    2.5 0.00613 0.029  0.029     1.2    1731.5   1735.2     -0.2  0.950
  2  1   10.0 0.05730 0.061  0.057     6.0     547.4    566.8     -3.5  0.804
  3  1   20.0 0.08360 0.069  0.063     8.0     582.8    615.4     -5.6  0.760
  4  1   30.0 0.09976 0.072  0.066     8.3     631.7    678.3     -7.4  0.741
  5  1   40.0 0.11356 0.076  0.067    11.3     673.5    741.7    -10.1  0.732
  6  2   50.0 0.11033 0.065  0.058    10.7     846.5    904.5     -6.9  0.810
  7  2   60.0 0.11570 0.066  0.059    10.9     921.9    985.9     -6.9  0.801
  8  2   70.0 0.11997 0.067  0.060    11.5     988.8   1060.8     -7.3  0.796
  9  2   80.0 0.12188 0.068  0.060    11.6    1063.7   1142.3     -7.4  0.793
 10  2   90.0 0.12099 0.068  0.060    11.5    1151.7   1235.7     -7.3  0.794
 11  4   97.5 0.09887 0.087  0.072    16.4    1333.7   1583.2    -18.7  0.632
1
      EARTHQUAKE    - C:\Program Files\SHAKE2000\Quakes\NPS090.eq
      SOIL PROFILE - Soil Profile No.  1

   ITERATION NUMBER  3

   VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ---->    <---- SHEAR MODULUS ----->
G/Go
          (FT)    STRAIN  NEW     USED   ERROR       NEW     USED     ERROR    RATIO
--- ---- ----  -------- -----  ------  ------  -------  ------   ------  -----
  1  4    2.5 0.00596 0.029  0.029     -1.4    1735.5   1731.5      0.2  0.948
  2  1   10.0 0.05766 0.061  0.061      0.2     546.8    547.4     -0.1  0.777
  3  1   20.0 0.08600 0.069  0.069      0.7     579.0    582.8     -0.7  0.720
  4  1   30.0 0.10617 0.074  0.072      2.5     620.7    631.7     -1.8  0.690
  5  1   40.0 0.12455 0.079  0.076      3.5     655.2    673.5     -2.8  0.665
  6  2   50.0 0.11686 0.067  0.065      2.6     834.0    846.5     -1.5  0.758
  7  2   60.0 0.12220 0.068  0.066      2.4     908.9    921.9     -1.4  0.749
  8  2   70.0 0.12645 0.069  0.067      2.3     975.2    988.8     -1.4  0.742
  9  2   80.0 0.12806 0.069  0.068      2.1    1049.9   1063.7     -1.3  0.739
 10  2   90.0 0.12667 0.069  0.068      2.0    1137.8   1151.7     -1.2  0.740
 11  4   97.5 0.11392 0.091  0.087      4.7    1276.3   1333.7     -4.5  0.532
1
      EARTHQUAKE    - C:\Program Files\SHAKE2000\Quakes\NPS090.eq
      SOIL PROFILE - Soil Profile No.  1

   ITERATION NUMBER  4

   VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ---->    <---- SHEAR MODULUS ----->
G/Go
          (FT)    STRAIN  NEW     USED   ERROR       NEW     USED     ERROR    RATIO
--- ---- ----  -------- -----  ------  ------  -------  ------   ------  -----
  1  4    2.5 0.00591 0.029  0.029     -0.5    1736.3   1735.5      0.0  0.950
  2  1   10.0 0.05749 0.061  0.061     -0.1     547.1    546.8      0.1  0.776
  3  1   20.0 0.08621 0.069  0.069      0.1     578.7    579.0     -0.1  0.715
  4  1   30.0 0.10764 0.074  0.074      0.6     618.2    620.7     -0.4  0.678
  5  1   40.0 0.12764 0.079  0.079      0.9     650.3    655.2     -0.7  0.647
  6  2   50.0 0.11811 0.067  0.067      0.5     831.7    834.0     -0.3  0.747
  7  2   60.0 0.12337 0.068  0.068      0.4     906.6    908.9     -0.3  0.738
  8  2   70.0 0.12748 0.069  0.069      0.4     973.1    975.2     -0.2  0.732
  9  2   80.0 0.12889 0.070  0.069      0.3    1048.1   1049.9     -0.2  0.729
 10  2   90.0 0.12725 0.069  0.069      0.2    1136.4   1137.8     -0.1  0.731
 11  4   97.5 0.11793 0.092  0.091      1.1    1262.5   1276.3     -1.1  0.509
1
      EARTHQUAKE    - C:\Program Files\SHAKE2000\Quakes\NPS090.eq
      SOIL PROFILE - Soil Profile No.  1

   ITERATION NUMBER  5

   VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ---->    <---- SHEAR MODULUS ----->
G/Go
          (FT)    STRAIN  NEW     USED   ERROR       NEW     USED     ERROR    RATIO
--- ---- ----  -------- -----  ------  ------  -------  ------   ------  -----
  1  4    2.5 0.00590 0.029  0.029     -0.1    1736.4   1736.3      0.0  0.951
  2  1   10.0 0.05742 0.061  0.061      0.0     547.2    547.1      0.0  0.776
  3  1   20.0 0.08620 0.069  0.069      0.0     578.7    578.7      0.0  0.715
  4  1   30.0 0.10798 0.074  0.074      0.1     617.6    618.2     -0.1  0.676
  5  1   40.0 0.12849 0.080  0.079      0.3     649.0    650.3     -0.2  0.642
  6  2   50.0 0.11833 0.067  0.067      0.1     831.3    831.7      0.0  0.745
  7  2   60.0 0.12355 0.068  0.068      0.1     906.3    906.6      0.0  0.736
  8  2   70.0 0.12761 0.069  0.069      0.0     972.9    973.1      0.0  0.730
  9  2   80.0 0.12893 0.070  0.070      0.0    1048.0   1048.1      0.0  0.728
 10  2   90.0 0.12722 0.069  0.069      0.0    1136.5   1136.4      0.0  0.730
 11  4   97.5 0.11899 0.092  0.092      0.3    1258.9   1262.5     -0.3  0.504

  VALUES IN TIME DOMAIN

  LAYER  TYPE      THICKNESS          DEPTH      MAX STRAIN     MAX STRESS
TIME
                       FT              FT          PRCNT           PSF
SEC

     1     4         5.0000          2.5000        0.00908         157.66
25.73
     2     1        10.0000         10.0000        0.08834         483.26
25.73
     3     1        10.0000         20.0000        0.13261         767.36
25.73
     4     1        10.0000         30.0000        0.16612        1026.91
36.33
     5     1        10.0000         40.0000        0.19768        1285.60
36.32
     6     2        10.0000         50.0000        0.18204        1514.07
36.31
     7     2        10.0000         60.0000        0.19007        1723.21
36.31
     8     2        10.0000         70.0000        0.19633        1910.51
36.30
     9     2        10.0000         80.0000        0.19835        2078.88
36.29
    10     2        10.0000         90.0000        0.19572        2224.22
36.28
    11     4         5.0000         97.5000        0.18307        2311.24
36.28

  PERIOD = 0.69 FROM AVERAGE SHEAR VEL. =      582.


  FREQUENCY    AMPLITUDE
 MAXIMUM AMPLIFICATION =    9.36
 FOR FREQUENCY         =    1.54 C/SEC.
    PERIOD             =    0.65 SEC.

1******   OPTION  6  ***  COMPUTE MOTION IN NEW SUBLAYERS

   EARTHQUAKE -C:\Program Files\SHAKE2000\Quakes\NPS090.eq
  SOIL DEPOSIT - Soil Profile No.  1
    LAYER          DEPTH          MAX. ACC.          TIME       MEAN SQ. FR.
ACC. RATIO      TH SAVED
                     FT                G              SEC          C/SEC
QUIET ZONE       ACC. RECORD
    OUTCR.          0.0000         0.52357          25.72          2.40
0.000              4096
    WITHIN          5.0000         0.51653          25.72          2.34
0.000                 0
    WITHIN         15.0000         0.43324          36.28          1.86
0.000                 0
    WITHIN         25.0000         0.40241          36.26          1.99
0.000                 0
    WITHIN         35.0000         0.41829          25.66          2.17
0.000                 0
    WITHIN         45.0000         0.35194          36.22          2.52
0.000                 0
    WITHIN         55.0000         0.37698          12.45          2.72
0.000                 0
    WITHIN         65.0000         0.35424          12.44          2.81
0.000                 0
    WITHIN         75.0000         0.28054          12.49          2.96
0.000                 0
    WITHIN         85.0000         0.27359          12.48          3.13
0.000                 0
    WITHIN         95.0000         0.27091          25.56          3.24
0.000              4096
    WITHIN        100.0000         0.26598          25.55          3.24
0.000              4096
    OUTCR.        100.0000         0.33630          25.55          3.54
0.000              4096

1******   OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

  COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   11
  SCALE FOR PLOTTING      0.0000
 IDENTIFICATION - Stress History Layer No. 1

  COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   11
  SCALE FOR PLOTTING      0.0000
 IDENTIFICATION - Strain History Layer No. 1


 *** End of Output File No. 1 ***
```

100 ft - GM#6

```
**********************************************************
* SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL *
*     LAYERED SITES by Per Schnable & John Lysmer - 1970  *
* ---------------------------------------------------------*
* SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985 *
* ---------------------------------------------------------*
* SHAKE88 :New modulus reduction curves for clays added    *
*      using results from Sun et al (1988) by J. I. Sun    *
*      & Ramin Golesorkhi February 26, 1988                *
* ---------------------------------------------------------*
* SHAKE90/91: Adjust last iteration; Input now is either   *
*      Gmax or max Vs; up to 13 materials can be specified*
*      by user; up to 50 Layers can be specified; object   *
*      motion can be read in from a separate file and can  *
*      user specified format; Different periods for res-   *
*      ponse spectral calculations;options are renumbered; *
*      and general cleanup by: J. I. Sun, I. M. Idriss &   *
*      P. Dirrim June 1990 - February 1991                 *
* ---------------------------------------------------------*
* SHAKE91: General cleanup and finalization of input out-  *
*      output format ... etc by: I. M. Idriss Dec. 1991    *
* ---------------------------------------------------------*
* SHAKE2000: Fix the incorrect output of Tot. Stress in    *
* Option 2. Changed path of ground motion file in          *
* SHAKE91.  Control file to input file names.  Modified    *
* by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003)  *
*          RUN DATE 12/05/2007                             *
*          RUN TIME 19:30                                  *
**********************************************************
 MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =     32768
 NECESSARY LENGTH OF BLANK COMMON X        =    204819

1******   OPTION  1  ***  READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

 **********************
 MATERIAL TYPE NO. 1
 **********************

 CURVE NO.  1:     MSW shallow MSW (SM<125) Zekkos, 2005
 CURVE NO.  2:     MSW shallow MSW (SM<125) Zekkos, 2005
```

CURVE NO. 1		CURVE NO. 2	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	4.00
0.0002	0.997	0.0002	4.00
0.0003	0.996	0.0003	4.10
0.0010	0.990	0.0010	4.10
0.0020	0.982	0.0020	4.20
0.0030	0.975	0.0030	4.20
0.0050	0.963	0.0050	4.20
0.0080	0.946	0.0080	4.30
0.0120	0.927	0.0120	4.50
0.0200	0.892	0.0200	4.80
0.0300	0.856	0.0300	5.20
0.0500	0.797	0.0500	5.80
0.0800	0.727	0.0800	6.80
0.1000	0.690	0.1000	7.20
0.3000	0.475	0.3000	10.50
0.5000	0.373	0.5000	12.00
1.0000	0.252	1.0000	14.00

```
 **********************
 MATERIAL TYPE NO. 2
 **********************

 CURVE NO.  3:     MSW deep    MSW (125<SM<350) Zekkos 2005
 CURVE NO.  4:     MSW deep    MSW (125<SM<350) Zekkos 2005
```

CURVE NO. 3		CURVE NO. 4	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	3.00
0.0002	0.999	0.0002	3.00
0.0003	0.998	0.0003	3.10
0.0010	0.995	0.0010	3.10
0.0020	0.992	0.0020	3.20
0.0030	0.988	0.0030	3.20
0.0050	0.981	0.0050	3.20
0.0080	0.971	0.0080	3.30
0.0120	0.959	0.0120	3.50
0.0200	0.937	0.0200	3.80
0.0300	0.911	0.0300	4.20
0.0500	0.867	0.0500	4.80
0.0800	0.810	0.0800	5.80
0.1000	0.777	0.1000	6.20
0.3000	0.564	0.3000	9.50
0.5000	0.450	0.5000	11.00
1.0000	0.305	1.0000	13.00

```
 **********************
 MATERIAL TYPE NO. 3
 **********************

 CURVE NO.  5:     Soil PI=100 G/Gmax - Soil with PI=100, OCR=1-15 (Vucetic
 CURVE NO.  6:     Soil PI=100 Damping - Soil with PI=100, OCR=1-8 (Vucetic
```

CURVE NO. 5		CURVE NO. 6	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0050	1.000	0.0010	1.20
0.0060	1.000	0.0030	1.50
0.0070	0.995	0.0050	1.70
0.0090	0.990	0.0070	1.90
0.0100	0.985	0.0090	2.00
0.0200	0.960	0.0100	2.05
0.0300	0.935	0.0200	2.50
0.0400	0.915	0.0300	2.90
0.0500	0.900	0.0400	3.10
0.0600	0.880	0.0500	3.30
0.0700	0.865	0.0600	3.50
0.0800	0.850	0.0800	3.80
0.0900	0.830	0.1000	4.00
0.1000	0.815	0.2000	5.20
0.2000	0.715	0.3000	6.10
0.3000	0.635	0.4000	6.80
0.5000	0.530	0.5000	7.40
0.6000	0.490	0.6000	8.00
0.9000	0.405	0.7000	8.60
1.0000	0.375	1.0000	9.70

```
 **********************
 MATERIAL TYPE NO. 4
 **********************

 CURVE NO.  7:     Soil PI=30  G/Gmax - Soil with PI=30, OCR=1-15 (Vucetic
 CURVE NO.  8:     Soil PI=30  Damping - Soil with PI=30, OCR=1-8 (Vucetic
```

CURVE NO. 7		CURVE NO. 8	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0010	1.000	0.0020	1.70
0.0020	0.995	0.0030	2.10
0.0030	0.985	0.0040	2.50
0.0040	0.970	0.0050	2.60
0.0050	0.960	0.0060	2.90
0.0060	0.950	0.0080	3.30
0.0080	0.925	0.0100	3.70
0.0090	0.910	0.0200	5.05
0.0100	0.900	0.0300	5.70
0.0200	0.820	0.0400	6.40
0.0300	0.745	0.0500	6.90
0.0400	0.700	0.0600	7.30
0.0700	0.600	0.0800	8.10
0.1000	0.530	0.1000	8.70
0.2000	0.420	0.2000	10.80
0.3000	0.350	0.3000	12.30
0.4000	0.305	0.4000	13.30
0.6000	0.240	0.5000	14.10
0.8000	0.205	0.7000	15.60
1.0000	0.165	1.0000	16.90

```
1******   OPTION  2  ***  READ SOIL PROFILE
 NEW SOIL PROFILE NO.      1       IDENTIFICATION  Soil Profile No.  1
 NUMBER OF LAYERS                    12           DEPTH TO BEDROCK          100.00
```

NO.	TYPE	THICKNESS (FT)	DEPTH (FT)	TOTAL PRESS. (KSF)	MODULUS (KSF)	DAMPING	UNIT WT. (KCF)	SHEAR VEL (FPS)
1	4	5.0000	2.5000	0.30	1826.	0.050	0.120	700.0
2	1	10.0000	10.0000	0.94	705.	0.050	0.067	582.0
3	1	10.0000	20.0000	1.62	810.	0.050	0.071	606.0
4	1	10.0000	30.0000	2.35	915.	0.050	0.074	631.0
5	1	10.0000	40.0000	3.10	1013.	0.050	0.076	655.0
6	2	10.0000	50.0000	3.87	1117.	0.050	0.078	679.0
7	2	10.0000	60.0000	4.66	1231.	0.050	0.080	704.0
8	2	10.0000	70.0000	5.46	1333.	0.050	0.081	728.0
9	2	10.0000	80.0000	6.28	1440.	0.050	0.082	752.0
10	2	10.0000	90.0000	7.10	1556.	0.050	0.083	777.0
11	4	5.0000	97.5000	7.82	2506.	0.050	0.120	820.0
12	BASE				13684.	0.050	0.136	1800.0

```
 PERIOD = 0.58 FROM AVERAGE SHEAR VEL. =     687.


  FREQUENCY    AMPLITUDE
 MAXIMUM AMPLIFICATION =  13.45
 FOR FREQUENCY         =   1.84 C/SEC.
     PERIOD            =   0.54 SEC.

1******   OPTION  3  ***  READ INPUT MOTION

  FILE NAME FOR INPUT MOTION = C:\Program Files\SHAKE2000\Quakes\ForwardM8R10.eq
    NO. OF INPUT ACC. POINTS = 19986
   NO. OF POINTS USED IN FFT = 32768
       NO. OF HEADING LINES =     4
     NO. OF POINTS PER LINE =     6
  TIME STEP FOR INPUT MOTION = 0.0050
     FORMAT FOR TIME HISTORY =     (6E12.5)


 *****HEADER*****
Source File: C:\Program Files\SHAKE2000\Quakes\GM#6-ForwardM8R10.ath
SHAKE2000 Conversion:    19986     .005       4         6         12        (6E12.
Acceleration Units: (g's) - No. Values: 19986 - Time Step: .005 (secs)
Data Format: (6E12.5) - No. Header Lines:  4
 **  FIRST AND LAST 5 LINES OF INPUT MOTION *****

    1 -0.031260-0.024950-0.017550-0.008760 0.002590 0.013150
    2  0.025550 0.035160 0.042180 0.045610 0.045720 0.043760
    3  0.040350 0.036100 0.031190 0.024810 0.017610 0.010380
    4  0.005050 0.001470 0.000720 0.003880 0.006070 0.008230
    5  0.007970 0.006090 0.003310-0.000030-0.001290-0.001830
  ............INPUT MOTION READ NOT ECHOED..........
 3327 -0.003420-0.008770-0.012800-0.015380-0.016460-0.016590
 3328 -0.015860-0.015170-0.014670-0.014300-0.013770-0.013720
 3329 -0.013400-0.013020-0.012610-0.012040-0.010780-0.009150
 3330 -0.006510-0.003910-0.001660-0.000810 0.000150 0.000220
 3331 -0.000090-0.000160-0.000810-0.001770-0.002300-0.002590

 MAXIMUM ACCELERATION =  0.58301
 AT TIME              = 11.65 SEC
 THE VALUES WILL BE MULTIPLIED BY A FACTOR =  0.600
 TO GIVE NEW MAXIMUM ACCELERATION          =  0.34981
 MEAN SQUARE FREQUENCY =       4.04 C/SEC.
 MAX ACCELERATION =     0.35354 FOR FREQUENCIES REMOVED ABOVE      25.00 C/SEC.
1******   OPTION  4  ***  READ WHERE OBJECT MOTION IS GIVEN
  OBJECT MOTION IN LAYER NUMBER   12 OUTCROPPING

1******   OPTION  5  ***  OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
```

```
 MAXIMUM NUMBER OF ITERATIONS                =     5
 FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN  =     0.65

     EARTHQUAKE    - C:\Program Files\SHAKE2000\Quakes\ForwardM8R10.eq
     SOIL PROFILE - Soil Profile No.  1

  ITERATION NUMBER  1

 VALUES IN TIME DOMAIN
```

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ---- NEW	USED	ERROR	<---- SHEAR MODULUS ----- NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00686	0.031	0.050	-62.1	1713.6	1826.1	-6.6	1.000
2	1	10.0	0.05392	0.060	0.050	16.1	553.8	704.8	-27.3	1.000
3	1	20.0	0.07543	0.067	0.050	25.1	595.8	809.7	-35.9	1.000
4	1	30.0	0.09049	0.070	0.050	28.8	646.5	915.0	-41.5	1.000
5	1	40.0	0.10010	0.072	0.050	30.6	698.5	1012.6	-45.0	1.000
6	2	50.0	0.10358	0.063	0.050	20.7	860.1	1116.8	-29.8	1.000
7	2	60.0	0.10282	0.063	0.050	20.4	950.1	1231.3	-29.6	1.000
8	2	70.0	0.10187	0.063	0.050	20.1	1031.1	1333.2	-29.3	1.000
9	2	80.0	0.09900	0.062	0.050	19.1	1121.1	1440.1	-28.5	1.000
10	2	90.0	0.09384	0.061	0.050	17.8	1223.8	1556.2	-27.2	1.000
11	4	97.5	0.05854	0.072	0.050	31.0	1583.5	2505.8	-58.2	1.000

```
1
      EARTHQUAKE    - C:\Program Files\SHAKE2000\Quakes\ForwardM8R10.eq
      SOIL PROFILE - Soil Profile No.  1

   ITERATION NUMBER  2

  VALUES IN TIME DOMAIN
```

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ---- NEW	USED	ERROR	<---- SHEAR MODULUS ----- NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00717	0.031	0.031	2.0	1706.6	1713.6	-0.4	0.938
2	1	10.0	0.06764	0.064	0.060	7.5	530.0	553.8	-4.5	0.786
3	1	20.0	0.10076	0.072	0.067	7.6	557.5	595.8	-6.9	0.736
4	1	30.0	0.12276	0.078	0.070	10.2	594.7	646.5	-8.7	0.707
5	1	40.0	0.13472	0.081	0.072	11.0	639.6	698.5	-9.2	0.690
6	2	50.0	0.12179	0.068	0.063	7.2	825.1	860.1	-4.3	0.770
7	2	60.0	0.11923	0.067	0.063	6.6	914.8	950.1	-3.9	0.772
8	2	70.0	0.11730	0.067	0.063	6.3	994.6	1031.1	-3.7	0.773
9	2	80.0	0.11506	0.066	0.062	6.6	1079.8	1121.1	-3.8	0.778
10	2	90.0	0.11067	0.065	0.061	6.4	1178.6	1223.8	-3.8	0.786
11	4	97.5	0.08833	0.084	0.072	13.4	1389.1	1583.5	-14.0	0.632

```
1
      EARTHQUAKE    - C:\Program Files\SHAKE2000\Quakes\ForwardM8R10.eq
      SOIL PROFILE - Soil Profile No.  1

   ITERATION NUMBER  3

  VALUES IN TIME DOMAIN
```

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ---- NEW	USED	ERROR	<---- SHEAR MODULUS ----- NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00712	0.031	0.031	1.4	1706.9	1707.4	-0.0	0.935
2	1	10.0	0.06992	0.065	0.064	1.1	526.5	530.0	-0.7	0.752
3	1	20.0	0.10592	0.074	0.072	2.0	549.6	557.5	-1.4	0.689
4	1	30.0	0.13022	0.080	0.078	2.2	584.1	594.7	-1.8	0.650
5	1	40.0	0.14239	0.083	0.081	2.0	628.7	639.6	-1.7	0.632
6	2	50.0	0.12241	0.068	0.068	0.2	824.0	825.1	-0.1	0.739
7	2	60.0	0.11891	0.067	0.067	-0.1	915.4	914.8	0.1	0.743
8	2	70.0	0.11845	0.067	0.067	0.4	992.1	994.6	-0.3	0.746
9	2	80.0	0.11661	0.067	0.066	0.6	1076.1	1079.8	-0.3	0.750
10	2	90.0	0.11249	0.066	0.065	0.7	1173.7	1178.6	-0.4	0.757
11	4	97.5	0.09900	0.087	0.084	3.5	1333.0	1389.1	-4.2	0.554

```
1
      EARTHQUAKE    - C:\Program Files\SHAKE2000\Quakes\ForwardM8R10.eq
      SOIL PROFILE - Soil Profile No.  1

   ITERATION NUMBER  4

  VALUES IN TIME DOMAIN
```

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ---- NEW	USED	ERROR	<---- SHEAR MODULUS ----- NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00713	0.031	0.031	0.0	1707.4	1707.2	0.0	0.935
2	1	10.0	0.07028	0.065	0.065	0.2	526.0	526.5	-0.1	0.747
3	1	20.0	0.10727	0.074	0.074	0.5	547.6	549.6	-0.4	0.679
4	1	30.0	0.13214	0.080	0.080	0.5	581.5	584.1	-0.5	0.638
5	1	40.0	0.14421	0.083	0.083	0.5	626.1	628.7	-0.4	0.621
6	2	50.0	0.12188	0.068	0.068	-0.2	824.9	824.0	0.1	0.738
7	2	60.0	0.11807	0.067	0.067	-0.3	917.1	915.4	0.2	0.743
8	2	70.0	0.11824	0.067	0.067	-0.1	992.6	992.1	0.0	0.744
9	2	80.0	0.11656	0.067	0.067	0.0	1076.2	1076.1	0.0	0.747
10	2	90.0	0.11262	0.066	0.066	0.1	1173.3	1173.7	0.0	0.754
11	4	97.5	0.10281	0.088	0.087	1.3	1317.1	1333.0	-1.2	0.532

```
1
      EARTHQUAKE    - C:\Program Files\SHAKE2000\Quakes\ForwardM8R10.eq
      SOIL PROFILE - Soil Profile No.  1

   ITERATION NUMBER  5

  VALUES IN TIME DOMAIN
```

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ---- NEW	USED	ERROR	<---- SHEAR MODULUS ----- NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00713	0.031	0.031	0.0	1707.4	1707.4	0.0	0.935
2	1	10.0	0.07034	0.065	0.065	0.0	525.9	526.0	0.0	0.746
3	1	20.0	0.10766	0.074	0.074	0.1	547.0	547.6	-0.1	0.676
4	1	30.0	0.13268	0.080	0.080	0.2	580.7	581.5	-0.1	0.635
5	1	40.0	0.14469	0.083	0.083	0.1	625.5	626.1	-0.1	0.618
6	2	50.0	0.12163	0.068	0.068	-0.1	825.4	824.9	0.1	0.739
7	2	60.0	0.11773	0.067	0.067	-0.1	917.8	917.1	0.1	0.745
8	2	70.0	0.11810	0.067	0.067	-0.1	992.9	992.6	0.0	0.745
9	2	80.0	0.11646	0.067	0.067	0.0	1076.4	1076.2	0.0	0.747
10	2	90.0	0.11258	0.066	0.066	0.0	1173.4	1173.3	0.0	0.754
11	4	97.5	0.10398	0.088	0.088	0.4	1312.6	1317.1	-0.3	0.526

```
  VALUES IN TIME DOMAIN
```

LAYER	TYPE	THICKNESS FT	DEPTH FT	MAX STRAIN PRCNT	MAX STRESS PSF	TIME SEC
1	4	5.0000	2.5000	0.01097	187.29	11.82
2	1	10.0000	10.0000	0.10822	569.23	11.82
3	1	10.0000	20.0000	0.16564	907.02	11.82
4	1	10.0000	30.0000	0.20413	1186.93	11.82
5	1	10.0000	40.0000	0.22261	1393.84	11.82
6	2	10.0000	50.0000	0.18713	1543.64	11.81
7	2	10.0000	60.0000	0.18112	1661.03	11.82
8	2	10.0000	70.0000	0.18169	1803.37	11.85
9	2	10.0000	80.0000	0.17916	1928.11	11.84
10	2	10.0000	90.0000	0.17321	2032.25	11.85
11	4	5.0000	97.5000	0.15997	2106.95	11.84

```
  PERIOD = 0.69 FROM AVERAGE SHEAR VEL. =     580.


  FREQUENCY     AMPLITUDE
  MAXIMUM AMPLIFICATION =    9.47
  FOR FREQUENCY         =    1.55 C/SEC.
      PERIOD            =    0.64 SEC.

1******   OPTION  6  ***  COMPUTE MOTION IN NEW SUBLAYERS

    EARTHQUAKE -C:\Program Files\SHAKE2000\Quakes\ForwardM8R10.eq
   SOIL DEPOSIT - Soil Profile No.  1
```

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	ACC. RATIO	TH SAVED	QUIET ZONE	ACC. RECORD
OUTCR.	0.0000	0.62280	11.82	2.77	0.000	4096		
WITHIN	5.0000	0.61401	11.82	2.72	0.000	0		
WITHIN	15.0000	0.53170	11.80	2.27	0.000	0		
WITHIN	25.0000	0.43933	11.78	2.40	0.000	0		
WITHIN	35.0000	0.39751	11.76	2.94	0.000	0		
WITHIN	45.0000	0.34424	11.09	3.32	0.000	0		
WITHIN	55.0000	0.30427	16.47	3.50	0.000	0		
WITHIN	65.0000	0.28876	14.06	3.68	0.000	0		
WITHIN	75.0000	0.28992	15.63	3.88	0.000	0		
WITHIN	85.0000	0.29761	11.03	4.02	0.000	0		
WITHIN	95.0000	0.30930	11.01	3.98	0.000	4096		
WITHIN	100.0000	0.30251	11.01	3.90	0.000	4096		
OUTCR.	100.0000	0.35354	11.01	4.04	0.000	4096		

```
1******   OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

  COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   11
  SCALE FOR PLOTTING      0.0000
 IDENTIFICATION - Stress History Layer No. 1

  COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   11
  SCALE FOR PLOTTING      0.0000
 IDENTIFICATION - Strain History Layer No. 1


 *** End of Output File No. 1 ***
```

100ft - GM#7

```
*********************************************************
* SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL *
*     LAYERED SITES by Per Schnable & John Lysmer - 1970  *
* ----------------------------------------------------- *
* SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985 *
* ----------------------------------------------------- *
* SHAKE88 :New modulus reduction curves for clays added   *
*      using results from Sun et al (1988) by J. I. Sun   *
*      & Ramin Golesorkhi February 26, 1988               *
*  ---------------------------------------------------*
* SHAKE90/91: Adjust last iteration; Input now is either  *
*      Gmax or max Vs; up to 13 materials can be specified*
*      by user; up to 50 Layers can be specified; object  *
*      motion can be read in from a separate file and can *
*      user specified format; Different periods for res-  *
*      ponse spectral calculations;options are renumbered;*
*      and general cleanup by: J. I. Sun, I. M. Idriss &  *
*      P. Dirrim June 1990 - February 1991                *
*  ---------------------------------------------------- *
* SHAKE91: General cleanup and finalization of input out- *
*      output format ... etc by: I. M. Idriss Dec. 1991   *
*  ---------------------------------------------------- *
* SHAKE2000: Fix the incorrect output of Tot. Stress in   *
* Option 2. Changed path of ground motion file in         *
* SHAKE91.  Control file to input file names.  Modified   *
* by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003) *
*          RUN DATE 12/05/2007                            *
*          RUN TIME 19:44                                 *
*********************************************************
 MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =     32768
 NECESSARY LENGTH OF BLANK COMMON X        =    204819

1******   OPTION  1  ***  READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

 **********************
  MATERIAL TYPE NO. 1
 **********************

 CURVE NO.  1:     MSW shallow MSW (SM<125) Zekkos, 2005
 CURVE NO.  2:     MSW shallow MSW (SM<125) Zekkos, 2005
```

CURVE NO. 1		CURVE NO. 2	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	4.00
0.0002	0.997	0.0002	4.00
0.0003	0.996	0.0003	4.10
0.0010	0.990	0.0010	4.10
0.0020	0.982	0.0020	4.20
0.0030	0.975	0.0030	4.20
0.0050	0.963	0.0050	4.20
0.0080	0.946	0.0080	4.30
0.0120	0.927	0.0120	4.50
0.0200	0.892	0.0200	4.80
0.0300	0.856	0.0300	5.20
0.0500	0.797	0.0500	5.80
0.0800	0.727	0.0800	6.80
0.1000	0.690	0.1000	7.20
0.3000	0.475	0.3000	10.50
0.5000	0.373	0.5000	12.00
1.0000	0.252	1.0000	14.00

```
 **********************
  MATERIAL TYPE NO. 2
 **********************

 CURVE NO.  3:     MSW deep    MSW (125<SM<350) Zekkos 2005
 CURVE NO.  4:     MSW deep    MSW (125<SM<350) Zekkos 2005
```

CURVE NO. 3		CURVE NO. 4	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	3.00
0.0002	0.999	0.0002	3.00
0.0003	0.998	0.0003	3.10
0.0010	0.995	0.0010	3.10
0.0020	0.992	0.0020	3.20
0.0030	0.988	0.0030	3.20
0.0050	0.981	0.0050	3.20
0.0080	0.971	0.0080	3.30
0.0120	0.959	0.0120	3.50
0.0200	0.937	0.0200	3.80
0.0300	0.911	0.0300	4.20
0.0500	0.867	0.0500	4.80
0.0800	0.810	0.0800	5.80
0.1000	0.777	0.1000	6.20
0.3000	0.564	0.3000	9.50
0.5000	0.450	0.5000	11.00
1.0000	0.305	1.0000	13.00

```
 **********************
  MATERIAL TYPE NO. 3
 **********************

 CURVE NO.  5:     Soil PI=100 G/Gmax - Soil with PI=100, OCR=1-15 (Vucetic
 CURVE NO.  6:     Soil PI=100 Damping - Soil with PI=100, OCR=1-8 (Vucetic
```

CURVE NO. 5		CURVE NO. 6	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0050	1.000	0.0010	1.20
0.0060	1.000	0.0030	1.50
0.0070	0.995	0.0050	1.70
0.0090	0.990	0.0070	1.90
0.0100	0.985	0.0090	2.00
0.0200	0.960	0.0100	2.05
0.0300	0.935	0.0200	2.50
0.0400	0.915	0.0300	2.90
0.0500	0.900	0.0400	3.10
0.0600	0.880	0.0500	3.30
0.0700	0.865	0.0600	3.50
0.0800	0.850	0.0800	3.80
0.0900	0.830	0.1000	4.00
0.1000	0.815	0.2000	5.20
0.2000	0.715	0.3000	6.10
0.3000	0.635	0.4000	6.80
0.5000	0.530	0.5000	7.40
0.6000	0.490	0.6000	8.00
0.9000	0.405	0.7000	8.60
1.0000	0.375	1.0000	9.70

```
 **********************
  MATERIAL TYPE NO. 4
 **********************

 CURVE NO.  7:     Soil PI=30  G/Gmax - Soil with PI=30, OCR=1-15 (Vucetic
 CURVE NO.  8:     Soil PI=30  Damping - Soil with PI=30, OCR=1-8 (Vucetic
```

CURVE NO. 7		CURVE NO. 8	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0010	1.000	0.0020	1.70
0.0020	0.995	0.0030	2.10
0.0030	0.985	0.0040	2.50
0.0040	0.970	0.0050	2.60
0.0050	0.960	0.0060	2.90
0.0060	0.950	0.0080	3.30
0.0080	0.925	0.0100	3.70
0.0090	0.910	0.0200	5.05
0.0100	0.900	0.0300	5.70
0.0200	0.820	0.0400	6.40
0.0300	0.745	0.0500	6.90
0.0400	0.700	0.0600	7.30
0.0700	0.600	0.0800	8.10
0.1000	0.530	0.1000	8.70
0.2000	0.420	0.2000	10.80
0.3000	0.350	0.3000	12.30
0.4000	0.305	0.4000	13.30
0.6000	0.240	0.5000	14.10
0.8000	0.205	0.7000	15.60
1.0000	0.165	1.0000	16.90

```
1******   OPTION  2  ***  READ SOIL PROFILE
 NEW SOIL PROFILE NO.      1      IDENTIFICATION  Soil Profile No.  1
 NUMBER OF LAYERS                    12          DEPTH TO BEDROCK        100.00
```

NO.	TYPE	THICKNESS (FT)	DEPTH (FT)	TOTAL PRESS. (KSF)	MODULUS (KSF)	DAMPING	UNIT WT. (KCF)	SHEAR VEL (FPS)
1	4	5.0000	2.5000	0.30	1826.	0.050	0.120	700.0
2	1	10.0000	10.0000	0.94	705.	0.050	0.067	582.0
3	1	10.0000	20.0000	1.62	810.	0.050	0.071	606.0
4	1	10.0000	30.0000	2.35	915.	0.050	0.074	631.0
5	1	10.0000	40.0000	3.10	1013.	0.050	0.076	655.0
6	2	10.0000	50.0000	3.87	1117.	0.050	0.078	679.0
7	2	10.0000	60.0000	4.66	1231.	0.050	0.080	704.0
8	2	10.0000	70.0000	5.46	1333.	0.050	0.081	728.0
9	2	10.0000	80.0000	6.28	1440.	0.050	0.082	752.0
10	2	10.0000	90.0000	7.10	1556.	0.050	0.083	777.0
11	4	5.0000	97.5000	7.82	2506.	0.050	0.120	820.0
12	BASE				13684.	0.050	0.136	1800.0

```
 PERIOD = 0.58 FROM AVERAGE SHEAR VEL. =     687.

  FREQUENCY    AMPLITUDE
 MAXIMUM AMPLIFICATION =  13.45
 FOR FREQUENCY         =   1.84 C/SEC.
     PERIOD            =   0.54 SEC.

1******   OPTION  3  ***  READ INPUT MOTION

  FILE NAME FOR INPUT MOTION = C:\Program Files\SHAKE2000\Quakes\TAB-LN.eq
    NO. OF INPUT ACC. POINTS =  1640
  NO. OF POINTS USED IN FFT  =  2048
       NO. OF HEADING LINES  =     4
     NO. OF POINTS PER LINE  =     4
 TIME STEP FOR INPUT MOTION = 0.0200
    FORMAT FOR TIME HISTORY =     (4e15.6)


 *****HEADER*****
Source File: C:\Program Files\SHAKE2000\Quakes\TAB-LN.TXT
SHAKE2000 Conversion:    1640      .02       4         4          15        (4e15.
Acceleration Units: (g's) - No. Values: 1640 - Time Step: .02 (secs)
Data Format: (4e15.6) - No. Header Lines:  4
 **  FIRST AND LAST 5 LINES OF INPUT MOTION *****

    1 -0.009931-0.012427-0.010033-0.000049
    2 -0.007329-0.017854-0.005761 0.004277
    3 -0.011388-0.020884-0.006605 0.001884
    4 -0.009621-0.015898-0.008119-0.004092
    5 -0.004034-0.000578 0.003463 0.003607
  .............INPUT MOTION READ NOT ECHOED...........
  406  0.001287 0.000331-0.000240-0.000475
  407 -0.000435 0.000193 0.001144 0.001872
  408  0.001892 0.001463 0.001215 0.000922
  409  0.000673 0.000502 0.000252 0.000030
  410 -0.000151-0.000303-0.000478-0.000687

 MAXIMUM ACCELERATION =  0.83581
 AT TIME              = 10.50 SEC
 THE VALUES WILL BE MULTIPLIED BY A FACTOR =  0.450
 TO GIVE NEW MAXIMUM ACCELERATION          =  0.37611
 MEAN SQUARE FREQUENCY =       4.03 C/SEC.
 MAX ACCELERATION =     0.37611 FOR FREQUENCIES REMOVED ABOVE      25.00 C/SEC.
1******   OPTION  4  ***  READ WHERE OBJECT MOTION IS GIVEN
  OBJECT MOTION IN LAYER NUMBER   12 OUTCROPPING

1******   OPTION  5  ***  OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
```

MAXIMUM NUMBER OF ITERATIONS = 5
FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN = 0.65

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\TAB-LN.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 1

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	NEW	<---- DAMPING ----> USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00744	0.032	0.050	-56.3	1700.6	1826.1	-7.4	1.000
2	1	10.0	0.05877	0.061	0.050	18.6	544.8	704.8	-29.4	1.000
3	1	20.0	0.07980	0.068	0.050	26.4	589.0	809.7	-37.5	1.000
4	1	30.0	0.08609	0.069	0.050	27.9	654.1	915.0	-39.9	1.000
5	1	40.0	0.09097	0.070	0.050	28.9	714.6	1012.6	-41.7	1.000
6	2	50.0	0.09333	0.061	0.050	17.7	879.2	1116.8	-27.0	1.000
7	2	60.0	0.09848	0.062	0.050	19.0	959.5	1231.3	-28.3	1.000
8	2	70.0	0.10466	0.063	0.050	21.1	1024.1	1333.2	-30.2	1.000
9	2	80.0	0.10627	0.064	0.050	21.7	1102.0	1440.1	-30.7	1.000
10	2	90.0	0.10096	0.062	0.050	19.7	1206.3	1556.2	-29.0	1.000
11	4	97.5	0.06467	0.075	0.050	33.4	1539.0	2505.8	-62.8	1.000

1

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\TAB-LN.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 2

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	NEW	<---- DAMPING ----> USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00837	0.034	0.032	5.4	1678.6	1700.6	-1.3	0.931
2	1	10.0	0.07938	0.068	0.061	9.4	513.2	544.8	-6.1	0.773
3	1	20.0	0.11186	0.075	0.068	9.8	541.0	589.0	-8.9	0.727
4	1	30.0	0.12089	0.078	0.069	10.8	597.4	654.1	-9.5	0.715
5	1	40.0	0.12424	0.079	0.070	10.5	655.7	714.6	-9.0	0.706
6	2	50.0	0.11358	0.066	0.061	7.7	840.2	879.2	-4.6	0.787
7	2	60.0	0.12112	0.068	0.062	8.9	911.0	959.5	-5.3	0.779
8	2	70.0	0.12508	0.069	0.063	7.8	978.0	1024.1	-4.7	0.768
9	2	80.0	0.12553	0.069	0.064	7.3	1055.5	1102.0	-4.4	0.765
10	2	90.0	0.12193	0.068	0.062	8.3	1149.3	1206.3	-5.0	0.775
11	4	97.5	0.09842	0.087	0.075	13.3	1335.9	1539.0	-15.2	0.614

1

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\TAB-LN.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 3

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	NEW	<---- DAMPING ----> USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00835	0.034	0.034	-0.1	1679.1	1678.6	0.0	0.919
2	1	10.0	0.08252	0.069	0.068	1.1	508.8	513.2	-0.9	0.728
3	1	20.0	0.11705	0.077	0.075	1.8	533.8	541.0	-1.3	0.668
4	1	30.0	0.12722	0.079	0.078	1.9	588.3	597.4	-1.6	0.653
5	1	40.0	0.13295	0.081	0.079	2.5	642.3	655.7	-2.1	0.648
6	2	50.0	0.11555	0.066	0.066	0.8	836.5	840.2	-0.4	0.752
7	2	60.0	0.12394	0.068	0.068	1.0	905.5	911.0	-0.6	0.740
8	2	70.0	0.12814	0.069	0.069	1.0	971.8	978.0	-0.6	0.734
9	2	80.0	0.13160	0.070	0.069	2.0	1042.3	1055.5	-1.3	0.733
10	2	90.0	0.12829	0.069	0.068	2.2	1134.0	1149.3	-1.4	0.739
11	4	97.5	0.11123	0.090	0.087	4.0	1285.8	1335.9	-3.9	0.533

1

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\TAB-LN.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 4

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	NEW	<---- DAMPING ----> USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00824	0.034	0.034	-0.7	1682.3	1679.1	0.2	0.920
2	1	10.0	0.08204	0.068	0.069	-0.2	509.4	508.8	0.1	0.722
3	1	20.0	0.11723	0.077	0.077	0.1	533.5	533.8	0.0	0.659
4	1	30.0	0.12810	0.079	0.079	0.3	587.0	588.3	-0.2	0.643
5	1	40.0	0.13512	0.081	0.081	0.6	639.0	642.3	-0.5	0.634
6	2	50.0	0.11563	0.066	0.066	0.0	836.3	836.5	0.0	0.749
7	2	60.0	0.12362	0.068	0.068	-0.1	906.1	905.5	0.1	0.735
8	2	70.0	0.12849	0.070	0.069	0.1	971.1	971.8	-0.1	0.729
9	2	80.0	0.13301	0.071	0.070	0.5	1039.3	1042.3	-0.3	0.724
10	2	90.0	0.12984	0.070	0.069	0.5	1130.4	1134.0	-0.3	0.729
11	4	97.5	0.11517	0.091	0.090	1.2	1271.9	1285.8	-1.1	0.513

1

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\TAB-LN.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 5

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	NEW	<---- DAMPING ----> USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00820	0.033	0.034	-0.3	1683.4	1682.3	0.1	0.921
2	1	10.0	0.08169	0.068	0.068	-0.1	509.9	509.4	0.1	0.723
3	1	20.0	0.11704	0.077	0.077	-0.1	533.8	533.5	0.0	0.659
4	1	30.0	0.12835	0.079	0.079	0.1	586.7	587.0	-0.1	0.642
5	1	40.0	0.13586	0.081	0.081	0.2	638.0	639.0	-0.2	0.631
6	2	50.0	0.11565	0.066	0.066	0.0	836.3	836.3	0.0	0.749
7	2	60.0	0.12332	0.068	0.068	-0.1	906.7	906.1	0.1	0.736
8	2	70.0	0.12850	0.070	0.070	0.0	971.1	971.1	0.0	0.728
9	2	80.0	0.13333	0.071	0.071	0.1	1038.7	1039.3	-0.1	0.722
10	2	90.0	0.13021	0.070	0.070	0.1	1129.5	1130.4	-0.1	0.726
11	4	97.5	0.11633	0.092	0.091	0.3	1267.9	1271.9	-0.3	0.508

VALUES IN TIME DOMAIN

LAYER	TYPE	THICKNESS FT	DEPTH FT	MAX STRAIN PRCNT	MAX STRESS PSF	TIME SEC
1	4	5.0000	2.5000	0.01262	212.22	11.02
2	1	10.0000	10.0000	0.12568	640.28	11.02
3	1	10.0000	20.0000	0.18006	960.66	11.02
4	1	10.0000	30.0000	0.19746	1159.10	11.04
5	1	10.0000	40.0000	0.20901	1335.67	11.04
6	2	10.0000	50.0000	0.17792	1487.93	11.02
7	2	10.0000	60.0000	0.18973	1719.22	10.94
8	2	10.0000	70.0000	0.19769	1919.72	10.96
9	2	10.0000	80.0000	0.20512	2131.79	10.96
10	2	10.0000	90.0000	0.20032	2264.42	10.96
11	4	5.0000	97.5000	0.17897	2276.34	10.96

PERIOD = 0.70 FROM AVERAGE SHEAR VEL. = 575.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 9.26
FOR FREQUENCY = 1.54 C/SEC.
PERIOD = 0.65 SEC.

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\Program Files\SHAKE2000\Quakes\TAB-LN.eq
SOIL DEPOSIT - Soil Profile No. 1

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	ACC. RATIO	TH SAVED
OUTCR.	0.0000	0.70452	11.02	2.56	0.012	256
WITHIN	5.0000	0.69148	11.02	2.51	0.013	0
WITHIN	15.0000	0.49201	11.00	1.95	0.018	0
WITHIN	25.0000	0.48979	10.96	2.05	0.018	0
WITHIN	35.0000	0.52690	10.94	2.45	0.015	0
WITHIN	45.0000	0.54780	10.92	2.82	0.013	0
WITHIN	55.0000	0.49408	10.92	2.96	0.012	0
WITHIN	65.0000	0.40754	10.90	3.12	0.012	0
WITHIN	75.0000	0.40987	10.54	3.38	0.009	0
WITHIN	85.0000	0.38341	10.52	3.67	0.007	0
WITHIN	95.0000	0.30321	10.30	3.88	0.007	256
WITHIN	100.0000	0.29327	10.30	3.92	0.006	256
OUTCR.	100.0000	0.37611	10.50	4.03	0.001	256

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - Stress History Layer No. 1

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - Strain History Layer No. 1

*** End of Output File No. 1 ***

100 ft - GM #8

```
 ************************************************************
 * SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL  *
 *      LAYERED SITES by Per Schnable & John Lysmer - 1970  *
 * ---------------------------------------------------------*
 * SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985  *
 * ---------------------------------------------------------*
 * SHAKE88 :New modulus reduction curves for clays added    *
 *      using results from Sun et al (1988) by J. I. Sun    *
 *      & Ramin Golesorkhi February 26, 1988                *
 *  --------------------------------------------------------*
 * SHAKE90/91: Adjust last iteration; Input now is either   *
 *      Gmax or max Vs; up to 13 materials can be specified *
 *      by user; up to 50 Layers can be specified; object   *
 *      motion can be read in from a separate file and can  *
 *      user specified format; Different periods for res-   *
 *      ponse spectral calculations;options are renumbered; *
 *      and general cleanup by: J. I. Sun, I. M. Idriss &   *
 *      P. Dirrim June 1990 - February 1991                 *
 *  --------------------------------------------------------*
 * SHAKE91: General cleanup and finalization of input out-  *
 *      output format ... etc by: I. M. Idriss Dec. 1991    *
 *  --------------------------------------------------------*
 * SHAKE2000: Fix the incorrect output of Tot. Stress in    *
 * Option 2. Changed path of ground motion file in          *
 * SHAKE91.  Control file to input file names.  Modified    *
 * by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003)  *
 *          RUN DATE 12/05/2007                             *
 *          RUN TIME 19:49                                  *
 ************************************************************
 MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =     32768
 NECESSARY LENGTH OF BLANK COMMON X        =    204819

1******   OPTION  1  ***  READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

 **********************
  MATERIAL TYPE NO. 1
 **********************

 CURVE NO.  1:     MSW shallow MSW (SM<125) Zekkos, 2005
 CURVE NO.  2:     MSW shallow MSW (SM<125) Zekkos, 2005
```

CURVE NO. 1		CURVE NO. 2	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	4.00
0.0002	0.997	0.0002	4.00
0.0003	0.996	0.0003	4.10
0.0010	0.990	0.0010	4.10
0.0020	0.982	0.0020	4.20
0.0030	0.975	0.0030	4.20
0.0050	0.963	0.0050	4.20
0.0080	0.946	0.0080	4.30
0.0120	0.927	0.0120	4.50
0.0200	0.892	0.0200	4.80
0.0300	0.856	0.0300	5.20
0.0500	0.797	0.0500	5.80
0.0800	0.727	0.0800	6.80
0.1000	0.690	0.1000	7.20
0.3000	0.475	0.3000	10.50
0.5000	0.373	0.5000	12.00
1.0000	0.252	1.0000	14.00

```
 **********************
  MATERIAL TYPE NO. 2
 **********************

 CURVE NO.  3:     MSW deep    MSW (125<SM<350) Zekkos 2005
 CURVE NO.  4:     MSW deep    MSW (125<SM<350) Zekkos 2005
```

CURVE NO. 3		CURVE NO. 4	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	3.00
0.0002	0.999	0.0002	3.00
0.0003	0.998	0.0003	3.10
0.0010	0.995	0.0010	3.10
0.0020	0.992	0.0020	3.20
0.0030	0.988	0.0030	3.20
0.0050	0.981	0.0050	3.20
0.0080	0.971	0.0080	3.30
0.0120	0.959	0.0120	3.50
0.0200	0.937	0.0200	3.80
0.0300	0.911	0.0300	4.20
0.0500	0.867	0.0500	4.80
0.0800	0.810	0.0800	5.80
0.1000	0.777	0.1000	6.20
0.3000	0.564	0.3000	9.50
0.5000	0.450	0.5000	11.00
1.0000	0.305	1.0000	13.00

```
 **********************
  MATERIAL TYPE NO. 3
 **********************

 CURVE NO.  5:     Soil PI=100 G/Gmax - Soil with PI=100, OCR=1-15 (Vucetic
 CURVE NO.  6:     Soil PI=100 Damping - Soil with PI=100, OCR=1-8 (Vucetic
```

CURVE NO. 5		CURVE NO. 6	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0050	1.000	0.0010	1.20
0.0060	1.000	0.0030	1.50
0.0070	0.995	0.0050	1.70
0.0090	0.990	0.0070	1.90
0.0100	0.985	0.0090	2.00
0.0200	0.960	0.0100	2.05
0.0300	0.935	0.0200	2.50
0.0400	0.915	0.0300	2.90
0.0500	0.900	0.0400	3.10
0.0600	0.880	0.0500	3.30
0.0700	0.865	0.0600	3.50
0.0800	0.850	0.0800	3.80
0.0900	0.830	0.1000	4.00
0.1000	0.815	0.2000	5.20
0.2000	0.715	0.3000	6.10
0.3000	0.635	0.4000	6.80
0.5000	0.530	0.5000	7.40
0.6000	0.490	0.6000	8.00
0.9000	0.405	0.7000	8.60
1.0000	0.375	1.0000	9.70

```
 **********************
  MATERIAL TYPE NO. 4
 **********************

 CURVE NO.  7:     Soil PI=30  G/Gmax - Soil with PI=30, OCR=1-15 (Vucetic
 CURVE NO.  8:     Soil PI=30  Damping - Soil with PI=30, OCR=1-8 (Vucetic
```

CURVE NO. 7		CURVE NO. 8	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0010	1.000	0.0020	1.70
0.0020	0.995	0.0030	2.10
0.0030	0.985	0.0040	2.50
0.0040	0.970	0.0050	2.60
0.0050	0.960	0.0060	2.90
0.0060	0.950	0.0080	3.30
0.0080	0.925	0.0100	3.70
0.0090	0.910	0.0200	5.05
0.0100	0.900	0.0300	5.70
0.0200	0.820	0.0400	6.40
0.0300	0.745	0.0500	6.90
0.0400	0.700	0.0600	7.30
0.0700	0.600	0.0800	8.10
0.1000	0.530	0.1000	8.70
0.2000	0.420	0.2000	10.80
0.3000	0.350	0.3000	12.30
0.4000	0.305	0.4000	13.30
0.6000	0.240	0.5000	14.10
0.8000	0.205	0.7000	15.60
1.0000	0.165	1.0000	16.90

```
1******   OPTION  2  ***  READ SOIL PROFILE
 NEW SOIL PROFILE NO.      1      IDENTIFICATION  Soil Profile No.  1
 NUMBER OF LAYERS                    12          DEPTH TO BEDROCK          100.00
```

NO.	TYPE	THICKNESS (FT)	DEPTH (FT)	TOTAL PRESS. (KSF)	MODULUS (KSF)	DAMPING	UNIT WT. (KCF)	SHEAR VEL (FPS)
1	4	5.0000	2.5000	0.30	1826.	0.050	0.120	700.0
2	1	10.0000	10.0000	0.94	705.	0.050	0.067	582.0
3	1	10.0000	20.0000	1.62	810.	0.050	0.071	606.0
4	1	10.0000	30.0000	2.35	915.	0.050	0.074	631.0
5	1	10.0000	40.0000	3.10	1013.	0.050	0.076	655.0
6	2	10.0000	50.0000	3.87	1117.	0.050	0.078	679.0
7	2	10.0000	60.0000	4.66	1231.	0.050	0.080	704.0
8	2	10.0000	70.0000	5.46	1333.	0.050	0.081	728.0
9	2	10.0000	80.0000	6.28	1440.	0.050	0.082	752.0
10	2	10.0000	90.0000	7.10	1556.	0.050	0.083	777.0
11	4	5.0000	97.5000	7.82	2506.	0.050	0.120	820.0
12	BASE				13684.	0.050	0.136	1800.0

```
 PERIOD = 0.58 FROM AVERAGE SHEAR VEL. =     687.


  PREQUENCY    AMPLITUDE
 MAXIMUM AMPLIFICATION =  13.45
 FOR FREQUENCY         =   1.84 C/SEC.
    PERIOD             =   0.54 SEC.

1******   OPTION  3  ***  READ INPUT MOTION

  FILE NAME FOR INPUT MOTION = C:\Program Files\SHAKE2000\Quakes\IZT090.eq
    NO. OF INPUT ACC. POINTS =  6000
  NO. OF POINTS USED IN FFT  =  8192
       NO. OF HEADING LINES  =     4
     NO. OF POINTS PER LINE  =     4
  TIME STEP FOR INPUT MOTION = 0.0050
     FORMAT FOR TIME HISTORY =     (4e15.6)


 *****HEADER*****
Source File: C:\Program Files\SHAKE2000\Quakes\IZT090.TXT
SHAKE2000 Conversion:    6000      .005      4         4         15        (4e15.
Acceleration Units: (g's) - No. Values: 6000 - Time Step: .005 (secs)
Data Format: (4e15.6) - No. Header Lines:  4
 **  FIRST AND LAST 5 LINES OF INPUT MOTION *****

    1  0.000151 0.000150 0.000149 0.000148
    2  0.000147 0.000144 0.000142 0.000140
    3  0.000140 0.000141 0.000145 0.000150
    4  0.000156 0.000165 0.000172 0.000176
    5  0.000178 0.000177 0.000171 0.000167
  ............INPUT MOTION READ NOT ECHOED...........
 1496 -0.000065-0.000111-0.000157-0.000203
 1497 -0.000250-0.000297-0.000344-0.000392
 1498 -0.000439-0.000487-0.000535-0.000584
 1499 -0.000632-0.000681-0.000730-0.000779
 1500 -0.000828-0.000878-0.000927-0.000977

 MAXIMUM ACCELERATION =  0.21954
 AT TIME              =  7.55 SEC
 THE VALUES WILL BE MULTIPLIED BY A FACTOR =  1.300
 TO GIVE NEW MAXIMUM ACCELERATION          =  0.28540
 MEAN SQUARE FREQUENCY =          3.03 C/SEC.
 MAX ACCELERATION =     0.28530 FOR FREQUENCIES REMOVED ABOVE       25.00 C/SEC.
1******   OPTION  4  ***  READ WHERE OBJECT MOTION IS GIVEN
  OBJECT MOTION IN LAYER NUMBER   12 OUTCROPPING

1******   OPTION  5  ***  OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
```

MAXIMUM NUMBER OF ITERATIONS = 5
FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN = 0.65

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\IZT090.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 1

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00534	0.027	0.050	-84.6	1746.5	1826.1	-4.6	1.000
2	1	10.0	0.04134	0.056	0.050	10.3	577.2	704.8	-22.1	1.000
3	1	20.0	0.05485	0.060	0.050	16.6	634.2	809.7	-27.7	1.000
4	1	30.0	0.06619	0.064	0.050	21.8	691.1	915.0	-32.4	1.000
5	1	40.0	0.07162	0.066	0.050	23.8	752.8	1012.6	-34.5	1.000
6	2	50.0	0.07180	0.056	0.050	10.2	919.3	1116.8	-21.5	1.000
7	2	60.0	0.06877	0.055	0.050	8.7	1020.0	1231.3	-20.7	1.000
8	2	70.0	0.07452	0.056	0.050	11.5	1091.4	1333.2	-22.2	1.000
9	2	80.0	0.07817	0.058	0.050	13.1	1170.5	1440.1	-23.0	1.000
10	2	90.0	0.07891	0.058	0.050	13.4	1263.1	1556.2	-23.2	1.000
11	4	97.5	0.05137	0.070	0.050	28.2	1642.1	2505.8	-52.6	1.000

1
EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\IZT090.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 2

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00574	0.028	0.027	4.2	1739.2	1746.5	-0.4	0.956
2	1	10.0	0.05321	0.059	0.056	6.0	555.2	577.2	-4.0	0.819
3	1	20.0	0.07977	0.068	0.060	11.7	589.0	634.2	-7.7	0.783
4	1	30.0	0.09736	0.072	0.064	10.6	635.4	691.1	-8.8	0.755
5	1	40.0	0.10469	0.073	0.066	10.5	689.6	752.8	-9.2	0.743
6	2	50.0	0.09315	0.061	0.056	8.3	879.5	919.3	-4.5	0.823
7	2	60.0	0.08534	0.059	0.055	7.4	985.6	1020.0	-3.5	0.828
8	2	70.0	0.08772	0.060	0.056	5.3	1061.7	1091.4	-2.8	0.819
9	2	80.0	0.09127	0.060	0.058	4.7	1138.4	1170.5	-2.8	0.813
10	2	90.0	0.09527	0.061	0.058	5.6	1220.3	1263.1	-3.5	0.812
11	4	97.5	0.07942	0.081	0.070	13.9	1441.4	1642.1	-13.9	0.655

1
EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\IZT090.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 3

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00581	0.028	0.028	0.0	1738.1	1738.1	0.0	0.952
2	1	10.0	0.05589	0.060	0.060	0.3	550.0	550.9	-0.2	0.782
3	1	20.0	0.08659	0.069	0.069	0.4	578.1	579.9	-0.3	0.716
4	1	30.0	0.10586	0.074	0.073	0.6	621.2	623.8	-0.4	0.682
5	1	40.0	0.11310	0.076	0.075	0.5	674.3	676.8	-0.4	0.668
6	2	50.0	0.09337	0.061	0.061	-0.2	879.1	877.9	0.1	0.786
7	2	60.0	0.08442	0.059	0.059	-0.2	987.6	986.4	0.1	0.801
8	2	70.0	0.09053	0.060	0.060	0.3	1055.5	1057.2	-0.2	0.793
9	2	80.0	0.09745	0.062	0.061	0.4	1124.5	1127.2	-0.2	0.783
10	2	90.0	0.10086	0.062	0.062	0.4	1206.6	1209.3	-0.2	0.777
11	4	97.5	0.09658	0.086	0.085	1.7	1345.2	1372.0	-2.0	0.548

1
EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\IZT090.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 4

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00580	0.028	0.028	0.6	1738.1	1739.2	-0.1	0.952
2	1	10.0	0.05544	0.060	0.059	1.5	550.9	555.2	-0.8	0.788
3	1	20.0	0.08541	0.069	0.068	1.8	579.9	589.0	-1.6	0.727
4	1	30.0	0.10430	0.073	0.072	2.4	623.8	635.4	-1.9	0.694
5	1	40.0	0.11167	0.075	0.073	2.6	676.8	689.6	-1.9	0.681
6	2	50.0	0.09404	0.061	0.061	0.3	877.9	879.5	-0.2	0.787
7	2	60.0	0.08497	0.059	0.059	-0.1	986.4	985.6	0.1	0.800
8	2	70.0	0.08974	0.060	0.060	0.7	1057.2	1061.7	-0.4	0.796
9	2	80.0	0.09620	0.061	0.060	1.5	1127.2	1138.4	-1.0	0.791
10	2	90.0	0.09993	0.062	0.061	1.4	1209.3	1220.3	-0.9	0.784
11	4	97.5	0.09146	0.085	0.081	4.5	1372.0	1441.4	-5.1	0.575

1
EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\IZT090.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 5

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00580	0.028	0.028	0.0	1738.1	1738.1	0.0	0.952
2	1	10.0	0.05597	0.060	0.060	0.0	549.9	550.0	0.0	0.780
3	1	20.0	0.08679	0.069	0.069	0.1	577.7	578.1	-0.1	0.714
4	1	30.0	0.10618	0.074	0.074	0.1	620.6	621.2	-0.1	0.679
5	1	40.0	0.11335	0.076	0.076	0.1	673.9	674.3	-0.1	0.666
6	2	50.0	0.09303	0.061	0.061	-0.1	879.7	879.1	0.1	0.787
7	2	60.0	0.08419	0.059	0.059	-0.1	988.1	987.6	0.0	0.802
8	2	70.0	0.09074	0.060	0.060	0.1	1055.1	1055.5	0.0	0.792
9	2	80.0	0.09772	0.062	0.062	0.1	1123.9	1124.5	-0.1	0.781
10	2	90.0	0.10106	0.062	0.062	0.1	1206.0	1206.6	0.0	0.775
11	4	97.5	0.09865	0.087	0.086	0.7	1334.8	1345.2	-0.8	0.537

VALUES IN TIME DOMAIN

LAYER	TYPE	THICKNESS FT	DEPTH FT	MAX STRAIN PRCNT	MAX STRESS PSF	TIME SEC
1	4	5.0000	2.5000	0.00893	155.21	7.28
2	1	10.0000	10.0000	0.08610	473.59	7.29
3	1	10.0000	20.0000	0.13353	771.86	7.28
4	1	10.0000	30.0000	0.16335	1014.67	7.28
5	1	10.0000	40.0000	0.17438	1175.88	7.29
6	2	10.0000	50.0000	0.14312	1258.14	7.29
7	2	10.0000	60.0000	0.12953	1279.23	3.64
8	2	10.0000	70.0000	0.13959	1473.42	7.03
9	2	10.0000	80.0000	0.15033	1690.42	7.02
10	2	10.0000	90.0000	0.15547	1875.88	7.01
11	4	5.0000	97.5000	0.15177	2041.58	3.73

PERIOD = 0.67 FROM AVERAGE SHEAR VEL. = 595.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 10.33
FOR FREQUENCY = 1.59 C/SEC.
PERIOD = 0.63 SEC.

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\Program Files\SHAKE2000\Quakes\IZT090.eq
SOIL DEPOSIT - Soil Profile No. 1

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	ACC. RATIO	TH SAVED	QUIET ZONE	ACC. RECORD
OUTCR.	0.0000	0.52080	7.28	2.37	0.000	1024		
WITHIN	5.0000	0.51680	7.28	2.35	0.000	0		
WITHIN	15.0000	0.45901	7.27	2.05	0.000	0		
WITHIN	25.0000	0.35493	7.27	1.81	0.000	0		
WITHIN	35.0000	0.30223	3.62	1.95	0.000	0		
WITHIN	45.0000	0.32779	7.04	2.40	0.000	0		
WITHIN	55.0000	0.33666	7.02	2.69	0.000	0		
WITHIN	65.0000	0.33396	7.01	2.85	0.000	0		
WITHIN	75.0000	0.31587	7.58	2.90	0.000	0		
WITHIN	85.0000	0.29476	7.57	2.95	0.000	0		
WITHIN	95.0000	0.24603	7.56	2.97	0.000	1024		
WITHIN	100.0000	0.22984	3.71	2.95	0.000	1024		
OUTCR.	100.0000	0.28530	7.55	3.03	0.000	1024		

1****** OPTION 7 *** COMPUTE STRESS/STRAIN HISTORY

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - Stress History Layer No. 1

COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF LAYER 11
SCALE FOR PLOTTING 0.0000
IDENTIFICATION - Strain History Layer No. 1

*** End of Output File No. 1 ***

160 ft - GM#1

```
*********************************************************
* SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL *
*     LAYERED SITES by Per Schnable & John Lysmer - 1970  *
* ----------------------------------------------------- *
* SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985 *
* ----------------------------------------------------- *
* SHAKE88 :New modulus reduction curves for clays added  *
*      using results from Sun et al (1988) by J. I. Sun  *
*      & Ramin Golesorkhi February 26, 1988              *
*  ---------------------------------------------------- *
* SHAKE90/91: Adjust last iteration; Input now is either *
*      Gmax or max Vs; up to 13 materials can be specified*
*      by user; up to 50 Layers can be specified; object *
*      motion can be read in from a separate file and can *
*      user specified format; Different periods for res- *
*      ponse spectral calculations;options are renumbered;*
*      and general cleanup by: J. I. Sun, I. M. Idriss & *
*      P. Dirrim June 1990 - February 1991               *
*  ---------------------------------------------------- *
* SHAKE91: General cleanup and finalization of input out- *
*      output format ... etc by: I. M. Idriss Dec. 1991  *
*  ---------------------------------------------------- *
* SHAKE2000: Fix the incorrect output of Tot. Stress in  *
* Option 2. Changed path of ground motion file in        *
* SHAKE91.  Control file to input file names.  Modified  *
* by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003) *
*          RUN DATE 12/10/2007                          *
*          RUN TIME 15:47                               *
*********************************************************
 MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =     32768
 NECESSARY LENGTH OF BLANK COMMON X        =    204819

1******   OPTION  1  ***  READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

 **********************
  MATERIAL TYPE NO. 1
 **********************

 CURVE NO.  1:     MSW shallow MSW (SM<125) Zekkos, 2005
 CURVE NO.  2:     MSW shallow MSW (SM<125) Zekkos, 2005
```

CURVE NO. 1		CURVE NO. 2	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	4.00
0.0002	0.997	0.0002	4.00
0.0003	0.996	0.0003	4.10
0.0010	0.990	0.0010	4.10
0.0020	0.982	0.0020	4.20
0.0030	0.975	0.0030	4.20
0.0050	0.963	0.0050	4.20
0.0080	0.946	0.0080	4.30
0.0120	0.927	0.0120	4.50
0.0200	0.892	0.0200	4.80
0.0300	0.856	0.0300	5.20
0.0500	0.797	0.0500	5.80
0.0800	0.727	0.0800	6.80
0.1000	0.690	0.1000	7.20
0.3000	0.475	0.3000	10.50
0.5000	0.373	0.5000	12.00
1.0000	0.252	1.0000	14.00

```
 **********************
  MATERIAL TYPE NO. 2
 **********************

 CURVE NO.  3:     MSW deep    MSW (125<SM<350) Zekkos 2005
 CURVE NO.  4:     MSW deep    MSW (125<SM<350) Zekkos 2005
```

CURVE NO. 3		CURVE NO. 4	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	3.00
0.0002	0.999	0.0002	3.00
0.0003	0.998	0.0003	3.10
0.0010	0.995	0.0010	3.10
0.0020	0.992	0.0020	3.20
0.0030	0.988	0.0030	3.20
0.0050	0.981	0.0050	3.20
0.0080	0.971	0.0080	3.30
0.0120	0.959	0.0120	3.50
0.0200	0.937	0.0200	3.80
0.0300	0.911	0.0300	4.20
0.0500	0.867	0.0500	4.80
0.0800	0.810	0.0800	5.80
0.1000	0.777	0.1000	6.20
0.3000	0.564	0.3000	9.50
0.5000	0.450	0.5000	11.00
1.0000	0.305	1.0000	13.00

```
 **********************
  MATERIAL TYPE NO. 3
 **********************

 CURVE NO.  5:     Soil PI=100 G/Gmax - Soil with PI=100, OCR=1-15 (Vucetic
 CURVE NO.  6:     Soil PI=100 Damping - Soil with PI=100, OCR=1-8 (Vucetic
```

CURVE NO. 5		CURVE NO. 6	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0050	1.000	0.0010	1.20
0.0060	1.000	0.0030	1.50
0.0070	0.995	0.0050	1.70
0.0090	0.990	0.0070	1.90
0.0100	0.985	0.0090	2.00
0.0200	0.960	0.0100	2.05
0.0300	0.935	0.0200	2.50
0.0400	0.915	0.0300	2.90
0.0500	0.900	0.0400	3.10
0.0600	0.880	0.0500	3.30
0.0700	0.865	0.0600	3.50
0.0800	0.850	0.0800	3.80
0.0900	0.830	0.1000	4.00
0.1000	0.815	0.2000	5.20
0.2000	0.715	0.3000	6.10
0.3000	0.635	0.4000	6.80
0.5000	0.530	0.5000	7.40
0.6000	0.490	0.6000	8.00
0.9000	0.405	0.7000	8.60
1.0000	0.375	1.0000	9.70

```
 **********************
  MATERIAL TYPE NO. 4
 **********************

 CURVE NO.  7:     Soil PI=30  G/Gmax - Soil with PI=30, OCR=1-15 (Vucetic
 CURVE NO.  8:     Soil PI=30  Damping - Soil with PI=30, OCR=1-8 (Vucetic
```

CURVE NO. 7		CURVE NO. 8	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0010	1.000	0.0020	1.70
0.0020	0.995	0.0030	2.10
0.0030	0.985	0.0040	2.50
0.0040	0.970	0.0050	2.60
0.0050	0.960	0.0060	2.90
0.0060	0.950	0.0080	3.30
0.0080	0.925	0.0100	3.70
0.0090	0.910	0.0200	5.05
0.0100	0.900	0.0300	5.70
0.0200	0.820	0.0400	6.40
0.0300	0.745	0.0500	6.90
0.0400	0.700	0.0600	7.30
0.0700	0.600	0.0800	8.10
0.1000	0.530	0.1000	8.70
0.2000	0.420	0.2000	10.80
0.3000	0.350	0.3000	12.30
0.4000	0.305	0.4000	13.30
0.6000	0.240	0.5000	14.10
0.8000	0.205	0.7000	15.60
1.0000	0.165	1.0000	16.90

```
1******   OPTION  2  ***  READ SOIL PROFILE
 NEW SOIL PROFILE NO.      1      IDENTIFICATION  Soil Profile No.  1
 NUMBER OF LAYERS                    18          DEPTH TO BEDROCK         160.00
```

NO.	TYPE	THICKNESS (FT)	DEPTH (FT)	TOTAL PRESS. (KSF)	MODULUS (KSF)	DAMPING	UNIT WT. (KCF)	SHEAR VEL (FPS)
1	4	5.0000	2.5000	0.30	1826.	0.050	0.120	700.0
2	1	10.0000	10.0000	0.94	705.	0.050	0.067	582.0
3	1	10.0000	20.0000	1.62	810.	0.050	0.071	606.0
4	1	10.0000	30.0000	2.35	915.	0.050	0.074	631.0
5	1	10.0000	40.0000	3.10	1013.	0.050	0.076	655.0
6	2	10.0000	50.0000	3.87	1117.	0.050	0.078	679.0
7	2	10.0000	60.0000	4.66	1231.	0.050	0.080	704.0
8	2	10.0000	70.0000	5.46	1333.	0.050	0.081	728.0
9	2	10.0000	80.0000	6.28	1440.	0.050	0.082	752.0
10	2	10.0000	90.0000	7.10	1556.	0.050	0.083	777.0
11	2	10.0000	100.0000	7.93	1654.	0.050	0.083	801.0
12	2	10.0000	110.0000	8.77	1776.	0.050	0.084	825.0
13	5	10.0000	120.0000	9.61	1907.	0.050	0.085	850.0
14	5	10.0000	130.0000	10.47	2016.	0.050	0.085	874.0
15	5	10.0000	140.0000	11.32	2129.	0.050	0.085	898.0
16	5	10.0000	150.0000	12.17	2270.	0.050	0.086	922.0
17	4	5.0000	157.5000	12.90	2506.	0.050	0.120	820.0
18	BASE				13684.	0.050	0.136	1800.0

```
 PERIOD = 0.85 FROM AVERAGE SHEAR VEL. =     753.

  FREQUENCY    AMPLITUDE
 MAXIMUM AMPLIFICATION =  13.77
 FOR FREQUENCY         =   1.31 C/SEC.
     PERIOD            =   0.77 SEC.

1******   OPTION  3  ***  READ INPUT MOTION

  FILE NAME FOR INPUT MOTION = C:\Program Files\SHAKE2000\Quakes\GM#1-YER360.eq
    NO. OF INPUT ACC. POINTS =  2200
   NO. OF POINTS USED IN FFT =  4096
        NO. OF HEADING LINES =     8
     NO. OF POINTS PER LINE  =     4
  TIME STEP FOR INPUT MOTION = 0.0200
     FORMAT FOR TIME HISTORY =   (4E15.6E2)


 *****HEADER*****
Source File: C:\Program Files\SHAKE2000\Quakes\GM#1-YER360.AT2
SHAKE2000 Conversion:    2200      .02       8         4         15        (4E15.
Acceleration Units: (g's) - No. Values: 2200 - Time Step: .02 (secs)
Data Format: (4E15.6E2) - No. Header Lines:  8
PSER NGA STRONG MOTION DATABASE RECORD
LANDERS 06/28/92 1158, YERMO FIRE STATION, 360 (CDMG STATION 22074)
ACCELERATION TIME HISTORY IN UNITS OF G
2200     0.0200     NPTS, DT
 **  FIRST AND LAST 5 LINES OF INPUT MOTION *****

    1  0.000704 0.002171 0.002317 0.000637
    2 -0.000536-0.002109-0.001705-0.000041
    3  0.000188 0.000084-0.001670-0.002652
    4 -0.001782-0.000914 0.000183-0.002068
    5 -0.004434-0.002657-0.000361 0.000010
 ............INPUT MOTION READ NOT ECHOED............
  546 -0.000010 0.000014-0.000032-0.000082
  547 -0.000123-0.000160-0.000201-0.000205
  548 -0.000203-0.000233-0.000258-0.000266
  549 -0.000253-0.000230-0.000205-0.000171
  550 -0.000135-0.000099-0.000063-0.000029
```

MAXIMUM ACCELERATION = 0.15153
AT TIME = 14.82 SEC
THE VALUES WILL BE MULTIPLIED BY A FACTOR = 1.800
TO GIVE NEW MAXIMUM ACCELERATION = 0.27275
MEAN SQUARE FREQUENCY = 3.16 C/SEC.
MAX ACCELERATION = 0.27275 FOR FREQUENCIES REMOVED ABOVE 25.00 C/SEC.
1****** OPTION 4 *** READ WHERE OBJECT MOTION IS GIVEN
OBJECT MOTION IN LAYER NUMBER 18 OUTCROPPING

1****** OPTION 5 *** OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
MAXIMUM NUMBER OF ITERATIONS = 5
FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN = 0.65

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\GM#1-YER360.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 1

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ---> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00547	0.027	0.050	-82.0	1744.1	1826.1	-4.7	1.000
2	1	10.0	0.04373	0.056	0.050	11.4	572.6	704.8	-23.1	1.000
3	1	20.0	0.06300	0.063	0.050	20.5	617.5	809.7	-31.1	1.000
4	1	30.0	0.07344	0.066	0.050	24.4	676.9	915.0	-35.2	1.000
5	1	40.0	0.07809	0.067	0.050	25.9	739.8	1012.6	-36.9	1.000
6	2	50.0	0.08472	0.059	0.050	15.3	895.2	1116.8	-24.8	1.000
7	2	60.0	0.08658	0.059	0.050	15.8	983.0	1231.3	-25.3	1.000
8	2	70.0	0.08722	0.060	0.050	16.0	1062.8	1333.2	-25.4	1.000
9	2	80.0	0.08514	0.059	0.050	15.4	1153.2	1440.1	-24.9	1.000
10	2	90.0	0.08052	0.058	0.050	14.0	1259.0	1556.2	-23.6	1.000
11	2	100.0	0.08325	0.059	0.050	14.8	1329.9	1653.8	-24.4	1.000
12	2	110.0	0.08351	0.059	0.050	14.9	1426.9	1775.5	-24.4	1.000
13	5	120.0	0.08301	0.054	0.050	6.8	1621.8	1907.2	-17.6	1.000
14	5	130.0	0.08322	0.054	0.050	6.9	1714.1	2016.4	-17.6	1.000
15	5	140.0	0.08327	0.054	0.050	6.9	1809.3	2128.7	-17.7	1.000
16	5	150.0	0.08210	0.053	0.050	6.5	1933.8	2270.4	-17.4	1.000
17	4	157.5	0.07762	0.080	0.050	37.6	1452.7	2505.8	-72.5	1.000

1

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\GM#1-YER360.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 2

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ---> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00530	0.027	0.027	-1.9	1747.3	1744.1	0.2	0.955
2	1	10.0	0.05020	0.058	0.056	2.9	561.3	572.6	-2.0	0.812
3	1	20.0	0.07603	0.067	0.063	6.0	594.8	617.5	-3.8	0.763
4	1	30.0	0.09269	0.071	0.066	6.3	642.9	676.9	-5.3	0.740
5	1	40.0	0.10927	0.075	0.067	9.6	681.1	739.8	-8.6	0.731
6	2	50.0	0.10958	0.065	0.059	8.8	847.9	895.2	-5.6	0.802
7	2	60.0	0.11383	0.066	0.059	9.8	925.8	983.0	-6.2	0.798
8	2	70.0	0.11455	0.066	0.060	9.9	1000.8	1062.8	-6.2	0.797
9	2	80.0	0.10955	0.065	0.059	8.7	1093.5	1153.2	-5.5	0.801
10	2	90.0	0.10834	0.064	0.058	9.8	1185.0	1259.0	-6.2	0.809
11	2	100.0	0.11223	0.065	0.059	10.3	1248.0	1329.9	-6.6	0.804
12	2	110.0	0.11287	0.066	0.059	10.5	1337.9	1426.9	-6.7	0.804
13	5	120.0	0.10618	0.059	0.054	8.7	1555.8	1621.8	-4.2	0.850
14	5	130.0	0.10770	0.059	0.054	9.3	1639.6	1714.1	-4.5	0.850
15	5	140.0	0.10773	0.059	0.054	9.3	1730.7	1809.3	-4.5	0.850
16	5	150.0	0.10602	0.059	0.053	9.0	1852.7	1933.8	-4.4	0.852
17	4	157.5	0.14197	0.098	0.080	17.9	1188.7	1452.7	-22.2	0.580

1

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\GM#1-YER360.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 3

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ---> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00526	0.027	0.027	-0.4	1747.9	1747.3	0.0	0.957
2	1	10.0	0.05092	0.058	0.058	0.5	559.8	561.3	-0.3	0.796
3	1	20.0	0.07856	0.068	0.067	1.0	590.9	594.8	-0.7	0.735
4	1	30.0	0.10088	0.072	0.071	2.2	629.8	642.9	-2.1	0.703
5	1	40.0	0.12312	0.078	0.075	4.6	657.5	681.1	-3.6	0.673
6	2	50.0	0.11961	0.067	0.065	3.9	829.0	847.9	-2.3	0.759
7	2	60.0	0.12409	0.068	0.066	3.8	905.2	925.8	-2.3	0.752
8	2	70.0	0.12272	0.068	0.066	3.0	983.0	1000.8	-1.8	0.751
9	2	80.0	0.11642	0.067	0.065	2.7	1076.5	1093.5	-1.6	0.759
10	2	90.0	0.11697	0.067	0.064	3.5	1161.9	1185.0	-2.0	0.761
11	2	100.0	0.12103	0.068	0.065	3.3	1223.8	1248.0	-2.0	0.755
12	2	110.0	0.12141	0.068	0.066	3.2	1312.8	1337.9	-1.9	0.754
13	5	120.0	0.11274	0.061	0.059	3.0	1534.4	1555.8	-1.4	0.816
14	5	130.0	0.11368	0.061	0.059	2.7	1619.1	1639.6	-1.3	0.813
15	5	140.0	0.11360	0.061	0.059	2.6	1709.6	1730.7	-1.2	0.813
16	5	150.0	0.10983	0.060	0.059	1.8	1837.7	1852.7	-0.8	0.816
17	4	157.5	0.16923	0.103	0.098	5.2	1118.9	1188.7	-6.2	0.474

1

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\GM#1-YER360.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 4

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ---> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00526	0.027	0.027	0.0	1748.0	1747.9	0.0	0.957
2	1	10.0	0.05097	0.058	0.058	0.0	559.7	559.8	0.0	0.794
3	1	20.0	0.07956	0.068	0.068	0.4	589.3	590.9	-0.3	0.730
4	1	30.0	0.10368	0.073	0.072	1.1	624.9	629.8	-0.8	0.688
5	1	40.0	0.12906	0.080	0.078	1.8	648.1	657.5	-1.4	0.649
6	2	50.0	0.12343	0.068	0.067	1.4	822.2	829.0	-0.8	0.742
7	2	60.0	0.12780	0.069	0.068	1.3	898.2	905.2	-0.8	0.735
8	2	70.0	0.12569	0.069	0.068	1.0	976.8	983.0	-0.6	0.737
9	2	80.0	0.11812	0.067	0.067	0.6	1072.5	1076.5	-0.4	0.748
10	2	90.0	0.11964	0.067	0.067	1.0	1155.1	1161.9	-0.6	0.747
11	2	100.0	0.12368	0.068	0.068	1.0	1216.9	1223.8	-0.6	0.740
12	2	110.0	0.12438	0.069	0.068	1.1	1304.5	1312.8	-0.6	0.739
13	5	120.0	0.11469	0.061	0.061	0.8	1528.3	1534.4	-0.4	0.805
14	5	130.0	0.11504	0.061	0.061	0.6	1614.6	1619.1	-0.3	0.803
15	5	140.0	0.11499	0.061	0.061	0.6	1704.7	1709.6	-0.3	0.803
16	5	150.0	0.11077	0.060	0.060	0.4	1834.1	1837.7	-0.2	0.809
17	4	157.5	0.18132	0.105	0.103	2.0	1091.4	1118.9	-2.5	0.447

1

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\GM#1-YER360.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 5

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ---> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00526	0.027	0.027	0.0	1748.0	1748.0	0.0	0.957
2	1	10.0	0.05095	0.058	0.058	0.0	559.7	559.7	0.0	0.794
3	1	20.0	0.08007	0.068	0.068	0.2	588.6	589.3	-0.1	0.728
4	1	30.0	0.10466	0.073	0.073	0.4	623.2	624.9	-0.3	0.683
5	1	40.0	0.13145	0.080	0.080	0.7	644.5	648.1	-0.6	0.640
6	2	50.0	0.12481	0.069	0.068	0.5	819.8	822.2	-0.3	0.736
7	2	60.0	0.12905	0.070	0.069	0.4	895.9	898.2	-0.3	0.729
8	2	70.0	0.12669	0.069	0.069	0.3	974.7	976.8	-0.2	0.733
9	2	80.0	0.11845	0.067	0.067	0.1	1071.7	1072.5	-0.1	0.745
10	2	90.0	0.12043	0.068	0.067	0.3	1153.1	1155.1	-0.2	0.742
11	2	100.0	0.12447	0.069	0.068	0.3	1214.8	1216.9	-0.2	0.736
12	2	110.0	0.12538	0.069	0.069	0.3	1301.7	1304.5	-0.2	0.735
13	5	120.0	0.11526	0.061	0.061	0.2	1526.5	1528.3	-0.1	0.801
14	5	130.0	0.11531	0.061	0.061	0.1	1613.7	1614.6	-0.1	0.801
15	5	140.0	0.11528	0.061	0.061	0.1	1703.7	1704.7	-0.1	0.801
16	5	150.0	0.11097	0.060	0.060	0.1	1833.3	1834.1	0.0	0.808
17	4	157.5	0.18674	0.106	0.105	0.8	1079.7	1091.4	-1.1	0.436

VALUES IN TIME DOMAIN

LAYER	TYPE	THICKNESS FT	DEPTH FT	MAX STRAIN PRCNT	MAX STRESS PSF	TIME SEC
1	4	5.0000	2.5000	0.00809	141.34	16.42
2	1	10.0000	10.0000	0.07838	438.71	16.42
3	1	10.0000	20.0000	0.12319	726.01	17.60
4	1	10.0000	30.0000	0.16102	1006.20	17.58
5	1	10.0000	40.0000	0.20224	1310.78	17.04
6	2	10.0000	50.0000	0.19201	1578.65	17.04
7	2	10.0000	60.0000	0.19854	1783.29	17.04
8	2	10.0000	70.0000	0.19490	1903.76	17.04
9	2	10.0000	80.0000	0.18222	1954.30	17.02
10	2	10.0000	90.0000	0.18527	2140.05	17.50
11	2	10.0000	100.0000	0.19149	2330.22	17.48
12	2	10.0000	110.0000	0.19289	2516.22	17.48
13	5	10.0000	120.0000	0.17732	2709.96	17.46
14	5	10.0000	130.0000	0.17740	2864.41	17.44
15	5	10.0000	140.0000	0.17736	3023.44	17.44
16	5	10.0000	150.0000	0.17072	3131.22	17.44
17	4	5.0000	157.5000	0.28729	3135.55	17.58

PERIOD = 0.99 FROM AVERAGE SHEAR VEL. = 649.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 10.07
FOR FREQUENCY = 1.12 C/SEC.
PERIOD = 0.90 SEC.

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\Program Files\SHAKE2000\Quakes\GM#1-YER360.eq
SOIL DEPOSIT - Soil Profile No. 1

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	ACC. RATIO	TH SAVED QUIET ZONE	ACC. RECORD
OUTCR.	0.0000	0.46681	16.42	1.99	0.000	512	
WITHIN	5.0000	0.46348	16.42	1.96	0.000	0	
WITHIN	15.0000	0.42873	17.58	1.59	0.000	0	
WITHIN	35.0000	0.40727	17.04	1.58	0.000	0	
WITHIN	55.0000	0.32664	17.46	1.87	0.000	0	
WITHIN	75.0000	0.34462	17.46	2.01	0.000	0	

```
     WITHIN         85.0000          0.34431          17.46            2.11
0.000                    0
     WITHIN        105.0000          0.32761          17.44            2.34
0.000                    0
     WITHIN        125.0000          0.29393          17.42            2.57
0.000                    0
     WITHIN        135.0000          0.25378          17.40            2.65
0.000                    0
     WITHIN        155.0000          0.24502          17.54            2.80
0.000                  512
     WITHIN        160.0000          0.24160          17.52            3.00
0.000                  512
     OUTCR.        160.0000          0.27275          14.82            3.16
0.000                  512

1******   OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

  COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   17
  SCALE FOR PLOTTING      0.0000
 IDENTIFICATION - Stress History Layer No. 1

  COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   17
  SCALE FOR PLOTTING      0.0000
 IDENTIFICATION - Strain History Layer No. 1


  *** End of Output File No. 1 ***
```

160 ft - GM#2

```
*********************************************************
* SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL *
*     LAYERED SITES by Per Schnable & John Lysmer - 1970  *
* ------------------------------------------------------- *
* SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985 *
* ------------------------------------------------------- *
* SHAKE88 :New modulus reduction curves for clays added   *
*      using results from Sun et al (1988) by J. I. Sun   *
*      & Ramin Golesorkhi February 26, 1988               *
*  -----------------------------------------------------  *
* SHAKE90/91: Adjust last iteration; Input now is either  *
*      Gmax or max Vs; up to 13 materials can be specified*
*      by user; up to 50 Layers can be specified; object  *
*      motion can be read in from a separate file and can  *
*      user specified format; Different periods for res-  *
*      ponse spectral calculations;options are renumbered;*
*      and general cleanup by: J. I. Sun, I. M. Idriss &  *
*      P. Dirrim June 1990 - February 1991                *
*  -----------------------------------------------------  *
* SHAKE91: General cleanup and finalization of input out- *
*      output format ... etc by: I. M. Idriss Dec. 1991   *
*  -----------------------------------------------------  *
* SHAKE2000: Fix the incorrect output of Tot. Stress in   *
* Option 2. Changed path of ground motion file in         *
* SHAKE91.  Control file to input file names.  Modified   *
* by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003) *
*          RUN DATE 12/10/2007                            *
*          RUN TIME 15:53                                 *
*********************************************************
 MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =     32768
 NECESSARY LENGTH OF BLANK COMMON X        =    204819

1******   OPTION  1  ***  READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

 **********************
  MATERIAL TYPE NO. 1
 **********************

 CURVE NO.  1:     MSW shallow MSW (SM<125) Zekkos, 2005
 CURVE NO.  2:     MSW shallow MSW (SM<125) Zekkos, 2005
```

CURVE NO. 1		CURVE NO. 2	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	4.00
0.0002	0.997	0.0002	4.00
0.0003	0.996	0.0003	4.10
0.0010	0.990	0.0010	4.10
0.0020	0.982	0.0020	4.20
0.0030	0.975	0.0030	4.20
0.0050	0.963	0.0050	4.20
0.0080	0.946	0.0080	4.30
0.0120	0.927	0.0120	4.50
0.0200	0.892	0.0200	4.80
0.0300	0.856	0.0300	5.20
0.0500	0.797	0.0500	5.80
0.0800	0.727	0.0800	6.80
0.1000	0.690	0.1000	7.20
0.3000	0.475	0.3000	10.50
0.5000	0.373	0.5000	12.00
1.0000	0.252	1.0000	14.00

```
 **********************
  MATERIAL TYPE NO. 2
 **********************

 CURVE NO.  3:     MSW deep    MSW (125<SM<350) Zekkos 2005
 CURVE NO.  4:     MSW deep    MSW (125<SM<350) Zekkos 2005
```

CURVE NO. 3		CURVE NO. 4	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	3.00
0.0002	0.999	0.0002	3.00
0.0003	0.998	0.0003	3.10
0.0010	0.995	0.0010	3.10
0.0020	0.992	0.0020	3.20
0.0030	0.988	0.0030	3.20
0.0050	0.981	0.0050	3.20
0.0080	0.971	0.0080	3.30
0.0120	0.959	0.0120	3.50
0.0200	0.937	0.0200	3.80
0.0300	0.911	0.0300	4.20
0.0500	0.867	0.0500	4.80
0.0800	0.810	0.0800	5.80
0.1000	0.777	0.1000	6.20
0.3000	0.564	0.3000	9.50
0.5000	0.450	0.5000	11.00
1.0000	0.305	1.0000	13.00

```
 **********************
  MATERIAL TYPE NO. 3
 **********************

 CURVE NO.  5:     Soil PI=100 G/Gmax - Soil with PI=100, OCR=1-15 (Vucetic
 CURVE NO.  6:     Soil PI=100 Damping - Soil with PI=100, OCR=1-8 (Vucetic
```

CURVE NO. 5		CURVE NO. 6	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0050	1.000	0.0010	1.20
0.0060	1.000	0.0030	1.50
0.0070	0.995	0.0050	1.70
0.0090	0.990	0.0070	1.90
0.0100	0.985	0.0090	2.00
0.0200	0.960	0.0100	2.05
0.0300	0.935	0.0200	2.50
0.0400	0.915	0.0300	2.90
0.0500	0.900	0.0400	3.10
0.0600	0.880	0.0500	3.30
0.0700	0.865	0.0600	3.50
0.0800	0.850	0.0800	3.80
0.0900	0.830	0.1000	4.00
0.1000	0.815	0.2000	5.20
0.2000	0.715	0.3000	6.10
0.3000	0.635	0.4000	6.80
0.5000	0.530	0.5000	7.40
0.6000	0.490	0.6000	8.00
0.9000	0.405	0.7000	8.60
1.0000	0.375	1.0000	9.70

```
 **********************
  MATERIAL TYPE NO. 4
 **********************

 CURVE NO.  7:     Soil PI=30  G/Gmax - Soil with PI=30, OCR=1-15 (Vucetic
 CURVE NO.  8:     Soil PI=30  Damping - Soil with PI=30, OCR=1-8 (Vucetic
```

CURVE NO. 7		CURVE NO. 8	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0010	1.000	0.0020	1.70
0.0020	0.995	0.0030	2.10
0.0030	0.985	0.0040	2.50
0.0040	0.970	0.0050	2.60
0.0050	0.960	0.0060	2.90
0.0060	0.950	0.0080	3.30
0.0080	0.925	0.0100	3.70
0.0090	0.910	0.0200	5.05
0.0100	0.900	0.0300	5.70
0.0200	0.820	0.0400	6.40
0.0300	0.745	0.0500	6.90
0.0400	0.700	0.0600	7.30
0.0700	0.600	0.0800	8.10
0.1000	0.530	0.1000	8.70
0.2000	0.420	0.2000	10.80
0.3000	0.350	0.3000	12.30
0.4000	0.305	0.4000	13.30
0.6000	0.240	0.5000	14.10
0.8000	0.205	0.7000	15.60
1.0000	0.165	1.0000	16.90

```
1******   OPTION  2  ***  READ SOIL PROFILE
 NEW SOIL PROFILE NO.      1       IDENTIFICATION  Soil Profile No.  1
 NUMBER OF LAYERS                      18          DEPTH TO BEDROCK        160.00
```

NO.	TYPE	THICKNESS (FT)	DEPTH (FT)	TOTAL PRESS. (KSF)	MODULUS (KSF)	DAMPING	UNIT WT. (KCF)	SHEAR VEL (FPS)
1	4	5.0000	2.5000	0.30	1826.	0.050	0.120	700.0
2	1	10.0000	10.0000	0.94	705.	0.050	0.067	582.0
3	1	10.0000	20.0000	1.62	810.	0.050	0.071	606.0
4	1	10.0000	30.0000	2.35	915.	0.050	0.074	631.0
5	1	10.0000	40.0000	3.10	1013.	0.050	0.076	655.0
6	2	10.0000	50.0000	3.87	1117.	0.050	0.078	679.0
7	2	10.0000	60.0000	4.66	1231.	0.050	0.080	704.0
8	2	10.0000	70.0000	5.46	1333.	0.050	0.081	728.0
9	2	10.0000	80.0000	6.28	1440.	0.050	0.082	752.0
10	2	10.0000	90.0000	7.10	1556.	0.050	0.083	777.0
11	2	10.0000	100.0000	7.93	1654.	0.050	0.083	801.0
12	2	10.0000	110.0000	8.77	1776.	0.050	0.084	825.0
13	5	10.0000	120.0000	9.61	1907.	0.050	0.085	850.0
14	5	10.0000	130.0000	10.47	2016.	0.050	0.085	874.0
15	5	10.0000	140.0000	11.32	2129.	0.050	0.085	898.0
16	5	10.0000	150.0000	12.17	2270.	0.050	0.086	922.0
17	4	5.0000	157.5000	12.90	2506.	0.050	0.120	820.0
18	BASE				13684.	0.050	0.136	1800.0

```
 PERIOD = 0.85 FROM AVERAGE SHEAR VEL. =     753.

  FREQUENCY    AMPLITUDE
 MAXIMUM AMPLIFICATION =  13.77
 FOR FREQUENCY         =   1.31 C/SEC.
     PERIOD            =   0.77 SEC.

1******   OPTION  3  ***  READ INPUT MOTION

  FILE NAME FOR INPUT MOTION = C:\Program Files\SHAKE2000\Quakes\GM#2-CHY024-
E.eq
    NO. OF INPUT ACC. POINTS = 18000
   NO. OF POINTS USED IN FFT = 32768
       NO. OF HEADING LINES =     4
     NO. OF POINTS PER LINE =     5
  TIME STEP FOR INPUT MOTION = 0.0050
     FORMAT FOR TIME HISTORY =     (5e15.6)


 *****HEADER*****
Source File: C:\Program Files\SHAKE2000\Quakes\GM#2-CHY024-E.AT2
SHAKE2000 Conversion:    18000     .005      4        5          15        (5e15.
Acceleration Units: (g's) - No. Values: 18000 - Time Step: .005 (secs)
Data Format: (5e15.6) - No. Header Lines:  4
 **  FIRST AND LAST 5 LINES OF INPUT MOTION *****

     1  0.000011 0.000011 0.000011 0.000011 0.000011
     2  0.000011 0.000011 0.000011 0.000011 0.000011
     3  0.000011 0.000012 0.000012 0.000012 0.000011
     4  0.000011 0.000012 0.000012 0.000012 0.000012
     5  0.000012 0.000012 0.000012 0.000012 0.000012
  ............INPUT MOTION READ NOT ECHOED...........
  3596  0.000513 0.000513 0.000513 0.000514 0.000514
  3597  0.000514 0.000514 0.000514 0.000514 0.000515
  3598  0.000515 0.000515 0.000515 0.000515 0.000515
  3599  0.000515 0.000515 0.000515 0.000515 0.000516
  3600  0.000516 0.000516 0.000516 0.000516 0.000516

 MAXIMUM ACCELERATION =  0.27803
 AT TIME              = 37.58 SEC
 THE VALUES WILL BE MULTIPLIED BY A FACTOR =  1.100
```

```
 TO GIVE NEW MAXIMUM ACCELERATION          =  0.30583
 MEAN SQUARE FREQUENCY =        1.96 C/SEC.
 MAX ACCELERATION =      0.25592 FOR FREQUENCIES REMOVED ABOVE       25.00 C/SEC.
1******   OPTION  4  ***  READ WHERE OBJECT MOTION IS GIVEN
  OBJECT MOTION IN LAYER NUMBER   18 OUTCROPPING

1******   OPTION  5  ***  OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
  MAXIMUM NUMBER OF ITERATIONS                =     5
  FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN  =     0.65

     EARTHQUAKE   - C:\Program Files\SHAKE2000\Quakes\GM#2-CHY024-E.eq
    SOIL PROFILE - Soil Profile No.  1

   ITERATION NUMBER  1

  VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ---->    <---- SHEAR MODULUS ----->
G/Go
          (FT)   STRAIN  NEW    USED   ERROR      NEW     USED    ERROR    RATIO
--- ---- ----  -------- ----- ------ ------  -------  ------  ------  -----
  1  4    2.5 0.00502 0.026  0.050  -91.8   1752.6   1826.1    -4.2  1.000
  2  1   10.0 0.04004 0.055  0.050    9.7    579.8    704.8   -21.6  1.000
  3  1   20.0 0.05790 0.061  0.050   18.2    627.7    809.7   -29.0  1.000
  4  1   30.0 0.07232 0.066  0.050   24.1    679.0    915.0   -34.8  1.000
  5  1   40.0 0.08555 0.069  0.050   27.7    724.9   1012.6   -39.7  1.000
  6  2   50.0 0.09535 0.061  0.050   18.2    875.6   1116.8   -27.5  1.000
  7  2   60.0 0.10059 0.062  0.050   19.6    955.4   1231.3   -28.9  1.000
  8  2   70.0 0.10336 0.063  0.050   20.6   1027.4   1333.2   -29.8  1.000
  9  2   80.0 0.10319 0.063  0.050   20.6   1110.2   1440.1   -29.7  1.000
 10  2   90.0 0.10071 0.062  0.050   19.6   1207.0   1556.2   -28.9  1.000
 11  2  100.0 0.09784 0.062  0.050   18.8   1290.4   1653.8   -28.2  1.000
 12  2  110.0 0.09249 0.061  0.050   17.5   1400.1   1775.5   -26.8  1.000
 13  5  120.0 0.08628 0.054  0.050    8.0   1612.6   1907.2   -18.3  1.000
 14  5  130.0 0.08117 0.053  0.050    6.1   1720.4   2016.4   -17.2  1.000
 15  5  140.0 0.07651 0.052  0.050    3.9   1829.7   2128.7   -16.3  1.000
 16  5  150.0 0.07206 0.051  0.050    1.5   1965.4   2270.4   -15.5  1.000
 17  4  157.5 0.06592 0.076  0.050   33.9   1530.4   2505.8   -63.7  1.000
1
     EARTHQUAKE   - C:\Program Files\SHAKE2000\Quakes\GM#2-CHY024-E.eq
    SOIL PROFILE - Soil Profile No.  1

   ITERATION NUMBER  2

  VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ---->    <---- SHEAR MODULUS ----->
G/Go
          (FT)   STRAIN  NEW    USED   ERROR      NEW     USED    ERROR    RATIO
--- ---- ----  -------- ----- ------ ------  -------  ------  ------  -----
  1  4    2.5 0.00525 0.027  0.026    2.7   1748.2   1752.6    -0.3  0.960
  2  1   10.0 0.05016 0.058  0.055    4.6    561.4    579.8    -3.3  0.823
  3  1   20.0 0.07923 0.068  0.061    9.8    589.9    627.7    -6.4  0.775
  4  1   30.0 0.10416 0.073  0.066   10.1    624.1    679.0    -8.8  0.742
  5  1   40.0 0.12606 0.079  0.069   12.4    652.8    724.9   -11.0  0.716
  6  2   50.0 0.12445 0.069  0.061   10.8    820.4    875.6    -6.7  0.784
  7  2   60.0 0.12875 0.070  0.062   10.7    896.4    955.4    -6.6  0.776
  8  2   70.0 0.12982 0.070  0.063    9.8    968.4   1027.4    -6.1  0.771
  9  2   80.0 0.12608 0.069  0.063    8.7   1054.2   1110.2    -5.3  0.771
 10  2   90.0 0.11871 0.067  0.062    7.4   1157.4   1207.0    -4.3  0.776
 11  2  100.0 0.11164 0.065  0.062    5.7   1249.7   1290.4    -3.3  0.780
 12  2  110.0 0.10257 0.063  0.061    3.4   1370.9   1400.1    -2.1  0.789
 13  5  120.0 0.08941 0.055  0.054    1.2   1604.1   1612.6    -0.5  0.846
 14  5  130.0 0.08525 0.054  0.053    1.6   1708.0   1720.4    -0.7  0.853
 15  5  140.0 0.08176 0.053  0.052    2.5   1814.2   1829.7    -0.9  0.860
 16  5  150.0 0.07764 0.052  0.051    3.0   1948.1   1965.4    -0.9  0.866
 17  4  157.5 0.10057 0.087  0.076   13.3   1325.8   1530.4   -15.4  0.611
1
     EARTHQUAKE   - C:\Program Files\SHAKE2000\Quakes\GM#2-CHY024-E.eq
    SOIL PROFILE - Soil Profile No.  1

   ITERATION NUMBER  3

  VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ---->    <---- SHEAR MODULUS ----->
G/Go
          (FT)   STRAIN  NEW    USED   ERROR      NEW     USED    ERROR    RATIO
--- ---- ----  -------- ----- ------ ------  -------  ------  ------  -----
  1  4    2.5 0.00525 0.027  0.027    0.0   1748.2   1748.2     0.0  0.957
  2  1   10.0 0.05163 0.059  0.058    1.0    558.4    561.4    -0.5  0.797
  3  1   20.0 0.08382 0.069  0.068    1.5    582.4    589.9    -1.3  0.728
  4  1   30.0 0.11165 0.075  0.073    2.8    611.6    624.1    -2.0  0.682
  5  1   40.0 0.13674 0.081  0.079    3.0    636.7    652.8    -2.5  0.645
  6  2   50.0 0.12897 0.070  0.069    1.5    812.7    820.4    -1.0  0.735
  7  2   60.0 0.13280 0.071  0.070    1.3    889.0    896.4    -0.8  0.728
  8  2   70.0 0.13281 0.071  0.070    1.0    962.5    968.4    -0.6  0.726
  9  2   80.0 0.12761 0.069  0.069    0.5   1050.9   1054.2    -0.3  0.732
 10  2   90.0 0.11863 0.067  0.067    0.0   1157.6   1157.4     0.0  0.744
 11  2  100.0 0.11046 0.065  0.065   -0.5   1253.1   1249.7     0.3  0.756
 12  2  110.0 0.10093 0.062  0.063   -0.8   1376.4   1370.9     0.4  0.772
 13  5  120.0 0.08748 0.055  0.055   -0.7   1609.3   1604.1     0.3  0.841
 14  5  130.0 0.08389 0.054  0.054   -0.5   1712.0   1708.0     0.2  0.847
 15  5  140.0 0.08061 0.053  0.053   -0.5   1818.0   1814.2     0.2  0.852
 16  5  150.0 0.07649 0.052  0.052   -0.6   1951.6   1948.1     0.2  0.858
 17  4  157.5 0.11283 0.091  0.087    3.8   1280.1   1325.8    -3.6  0.529
1
     EARTHQUAKE   - C:\Program Files\SHAKE2000\Quakes\GM#2-CHY024-E.eq
    SOIL PROFILE - Soil Profile No.  1

   ITERATION NUMBER  4

  VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ---->    <---- SHEAR MODULUS ----->
G/Go
          (FT)   STRAIN  NEW    USED   ERROR      NEW     USED    ERROR    RATIO
--- ---- ----  -------- ----- ------ ------  -------  ------  ------  -----
  1  4    2.5 0.00525 0.027  0.027    0.0   1748.2   1748.2     0.0  0.957
  2  1   10.0 0.05193 0.059  0.059    0.2    557.8    558.4    -0.1  0.792
  3  1   20.0 0.08491 0.069  0.069    0.3    580.7    582.4    -0.3  0.719
  4  1   30.0 0.11378 0.076  0.075    0.7    608.3    611.6    -0.6  0.668
  5  1   40.0 0.13979 0.082  0.081    0.8    632.3    636.7    -0.7  0.629
  6  2   50.0 0.12964 0.070  0.070    0.2    811.6    812.7    -0.1  0.728
  7  2   60.0 0.13326 0.071  0.071    0.1    888.2    889.0    -0.1  0.722
  8  2   70.0 0.13293 0.071  0.071    0.0    962.3    962.5     0.0  0.722
  9  2   80.0 0.12727 0.069  0.069   -0.1   1051.6   1050.9     0.1  0.730
 10  2   90.0 0.11791 0.067  0.067   -0.3   1159.5   1157.6     0.2  0.744
 11  2  100.0 0.10957 0.065  0.065   -0.4   1255.7   1253.1     0.2  0.758
 12  2  110.0 0.10017 0.062  0.062   -0.4   1379.0   1376.4     0.2  0.775
 13  5  120.0 0.08706 0.055  0.055   -0.2   1610.4   1609.3     0.1  0.844
 14  5  130.0 0.08361 0.054  0.054   -0.1   1712.9   1712.0     0.1  0.849
 15  5  140.0 0.08036 0.053  0.053   -0.1   1818.8   1818.0     0.0  0.854
 16  5  150.0 0.07627 0.052  0.052   -0.1   1952.3   1951.6     0.0  0.860
 17  4  157.5 0.11656 0.092  0.091    1.1   1267.2   1280.1    -1.0  0.511
1
     EARTHQUAKE   - C:\Program Files\SHAKE2000\Quakes\GM#2-CHY024-E.eq
    SOIL PROFILE - Soil Profile No.  1

   ITERATION NUMBER  5

  VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ---->    <---- SHEAR MODULUS ----->
G/Go
          (FT)   STRAIN  NEW    USED   ERROR      NEW     USED    ERROR    RATIO
--- ---- ----  -------- ----- ------ ------  -------  ------  ------  -----
  1  4    2.5 0.00525 0.027  0.027    0.0   1748.2   1748.2     0.0  0.957
  2  1   10.0 0.05200 0.059  0.059    0.1    557.6    557.8     0.0  0.791
  3  1   20.0 0.08519 0.069  0.069    0.1    580.2    580.7    -0.1  0.717
  4  1   30.0 0.11441 0.076  0.076    0.2    607.3    608.3    -0.2  0.665
  5  1   40.0 0.14072 0.082  0.082    0.2    631.0    632.3    -0.2  0.624
  6  2   50.0 0.12972 0.070  0.070    0.0    811.4    811.6     0.0  0.727
  7  2   60.0 0.13326 0.071  0.071    0.0    888.2    888.2     0.0  0.721
  8  2   70.0 0.13282 0.071  0.071    0.0    962.5    962.3     0.0  0.722
  9  2   80.0 0.12704 0.069  0.069   -0.1   1052.1   1051.6     0.0  0.730
 10  2   90.0 0.11759 0.067  0.067   -0.1   1160.3   1159.5     0.1  0.745
 11  2  100.0 0.10926 0.065  0.065   -0.1   1256.6   1255.7     0.1  0.759
 12  2  110.0 0.09996 0.062  0.062   -0.1   1379.7   1379.0     0.1  0.777
 13  5  120.0 0.08701 0.055  0.055    0.0   1610.6   1610.4     0.0  0.844
 14  5  130.0 0.08359 0.054  0.054    0.0   1712.9   1712.9     0.0  0.849
 15  5  140.0 0.08036 0.053  0.053    0.0   1818.9   1818.8     0.0  0.854
 16  5  150.0 0.07627 0.052  0.052    0.0   1952.3   1952.3     0.0  0.860
 17  4  157.5 0.11774 0.092  0.092    0.3   1263.1   1267.2    -0.3  0.506

  VALUES IN TIME DOMAIN

  LAYER  TYPE      THICKNESS          DEPTH      MAX STRAIN     MAX STRESS
TIME
                       FT               FT          PRCNT           PSF
SEC

     1     4         5.0000          2.5000         0.00808         141.19
37.83
     2     1        10.0000         10.0000         0.08001         446.24
37.83
     3     1        10.0000         20.0000         0.13106         761.06
37.82
     4     1        10.0000         30.0000         0.17601        1070.60
37.81
     5     1        10.0000         40.0000         0.21650        1368.95
37.80
     6     2        10.0000         50.0000         0.19957        1619.60
37.79
     7     2        10.0000         60.0000         0.20501        1820.90
37.79
     8     2        10.0000         70.0000         0.20434        1966.42
37.79
     9     2        10.0000         80.0000         0.19544        2055.32
37.78
    10     2        10.0000         90.0000         0.18091        2097.63
37.78
    11     2        10.0000        100.0000         0.16809        2110.71
37.77
    12     2        10.0000        110.0000         0.15378        2120.70
37.75
    13     5        10.0000        120.0000         0.13387        2155.83
37.73
    14     5        10.0000        130.0000         0.12861        2202.90
37.72
    15     5        10.0000        140.0000         0.12363        2248.57
37.70
    16     5        10.0000        150.0000         0.11734        2290.72
37.69
    17     4         5.0000        157.5000         0.18115        2295.42
37.69

  PERIOD = 0.98 FROM AVERAGE SHEAR VEL. =     656.


  FREQUENCY    AMPLITUDE
 MAXIMUM AMPLIFICATION =  10.69
 FOR FREQUENCY         =   1.14 C/SEC.
     PERIOD            =   0.88 SEC.

1******   OPTION  6  ***  COMPUTE MOTION IN NEW SUBLAYERS

   EARTHQUAKE -C:\Program Files\SHAKE2000\Quakes\GM#2-CHY024-E.eq
  SOIL DEPOSIT - Soil Profile No.  1
    LAYER          DEPTH          MAX. ACC.          TIME        MEAN SQ. FR.
ACC. RATIO       TH SAVED
                     FT               G              SEC            C/SEC
QUIET ZONE       ACC. RECORD
     OUTCR.        0.0000         0.46267           37.82           1.74
0.000              4096
     WITHIN        5.0000         0.46142           37.81           1.73
0.000                 0
     WITHIN       15.0000         0.44878           37.78           1.53
0.000                 0
     WITHIN       35.0000         0.40782           37.78           1.27
0.000                 0
     WITHIN       55.0000         0.25981           37.75           1.45
0.000                 0
     WITHIN       75.0000         0.23031           43.62           1.67
0.000                 0
     WITHIN       85.0000         0.23726           37.68           1.75
0.000                 0
```

```
     WITHIN        105.0000         0.23319          43.65           1.81
0.000                   0
     WITHIN        125.0000         0.21927          37.63           1.79
0.000                   0
     WITHIN        135.0000         0.20744          37.62           1.76
0.000                   0
     WITHIN        155.0000         0.18531          37.60           1.74
0.000                4096
     WITHIN        160.0000         0.18659          37.59           1.78
0.000                4096
     OUTCR.        160.0000         0.25592          37.59           1.96
0.000                4096

1******   OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

  COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   17
  SCALE FOR PLOTTING      0.0000
 IDENTIFICATION - Stress History Layer No. 1

  COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   17
  SCALE FOR PLOTTING      0.0000
 IDENTIFICATION - Strain History Layer No. 1


  *** End of Output File No. 1 ***
```

160 ft - GM#3

```
*********************************************************
* SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL *
*     LAYERED SITES by Per Schnable & John Lysmer - 1970  *
* ------------------------------------------------------- *
* SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985 *
* ------------------------------------------------------- *
* SHAKE88 :New modulus reduction curves for clays added   *
*      using results from Sun et al (1988) by J. I. Sun   *
*      & Ramin Golesorkhi February 26, 1988               *
* ------------------------------------------------------- *
* SHAKE90/91: Adjust last iteration; Input now is either  *
*      Gmax or max Vs; up to 13 materials can be specified*
*      by user; up to 50 Layers can be specified; object  *
*      motion can be read in from a separate file and can *
*      user specified format; Different periods for res-  *
*      ponse spectral calculations;options are renumbered;*
*      and general cleanup by: J. I. Sun, I. M. Idriss &  *
*      P. Dirrim June 1990 - February 1991                *
* ------------------------------------------------------- *
* SHAKE91: General cleanup and finalization of input out- *
*      output format ... etc by: I. M. Idriss Dec. 1991   *
* ------------------------------------------------------- *
* SHAKE2000: Fix the incorrect output of Tot. Stress in   *
* Option 2. Changed path of ground motion file in         *
* SHAKE91.  Control file to input file names.  Modified   *
* by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003) *
*          RUN DATE 12/10/2007                            *
*          RUN TIME 16:41                                 *
*********************************************************
 MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =     32768
 NECESSARY LENGTH OF BLANK COMMON X        =    204819

1******   OPTION  1  ***  READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

 **********************
  MATERIAL TYPE NO. 1
 **********************

 CURVE NO.  1:     MSW shallow MSW (SM<125) Zekkos, 2005
 CURVE NO.  2:     MSW shallow MSW (SM<125) Zekkos, 2005
```

CURVE NO. 1		CURVE NO. 2	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	4.00
0.0002	0.997	0.0002	4.00
0.0003	0.996	0.0003	4.10
0.0010	0.990	0.0010	4.10
0.0020	0.982	0.0020	4.20
0.0030	0.975	0.0030	4.20
0.0050	0.963	0.0050	4.20
0.0080	0.946	0.0080	4.30
0.0120	0.927	0.0120	4.50
0.0200	0.892	0.0200	4.80
0.0300	0.856	0.0300	5.20
0.0500	0.797	0.0500	5.80
0.0800	0.727	0.0800	6.80
0.1000	0.690	0.1000	7.20
0.3000	0.475	0.3000	10.50
0.5000	0.373	0.5000	12.00
1.0000	0.252	1.0000	14.00

```
 **********************
  MATERIAL TYPE NO. 2
 **********************

 CURVE NO.  3:     MSW deep    MSW (125<SM<350) Zekkos 2005
 CURVE NO.  4:     MSW deep    MSW (125<SM<350) Zekkos 2005
```

CURVE NO. 3		CURVE NO. 4	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	3.00
0.0002	0.999	0.0002	3.00
0.0003	0.998	0.0003	3.10
0.0010	0.995	0.0010	3.10
0.0020	0.992	0.0020	3.20
0.0030	0.988	0.0030	3.20
0.0050	0.981	0.0050	3.20
0.0080	0.971	0.0080	3.30
0.0120	0.959	0.0120	3.50
0.0200	0.937	0.0200	3.80
0.0300	0.911	0.0300	4.20
0.0500	0.867	0.0500	4.80
0.0800	0.810	0.0800	5.80
0.1000	0.777	0.1000	6.20
0.3000	0.564	0.3000	9.50
0.5000	0.450	0.5000	11.00
1.0000	0.305	1.0000	13.00

```
 **********************
  MATERIAL TYPE NO. 3
 **********************

 CURVE NO.  5:     Soil PI=100 G/Gmax - Soil with PI=100, OCR=1-15 (Vucetic
 CURVE NO.  6:     Soil PI=100 Damping - Soil with PI=100, OCR=1-8 (Vucetic
```

CURVE NO. 5		CURVE NO. 6	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0050	1.000	0.0010	1.20
0.0060	1.000	0.0030	1.50
0.0070	0.995	0.0050	1.70
0.0090	0.990	0.0070	1.90
0.0100	0.985	0.0090	2.00
0.0200	0.960	0.0100	2.05
0.0300	0.935	0.0200	2.50
0.0400	0.915	0.0300	2.90
0.0500	0.900	0.0400	3.10
0.0600	0.880	0.0500	3.30
0.0700	0.865	0.0600	3.50
0.0800	0.850	0.0800	3.80
0.0900	0.830	0.1000	4.00
0.1000	0.815	0.2000	5.20
0.2000	0.715	0.3000	6.10
0.3000	0.635	0.4000	6.80
0.5000	0.530	0.5000	7.40
0.6000	0.490	0.6000	8.00
0.9000	0.405	0.7000	8.60
1.0000	0.375	1.0000	9.70

```
 **********************
  MATERIAL TYPE NO. 4
 **********************

 CURVE NO.  7:     Soil PI=30  G/Gmax - Soil with PI=30, OCR=1-15 (Vucetic
 CURVE NO.  8:     Soil PI=30  Damping - Soil with PI=30, OCR=1-8 (Vucetic
```

CURVE NO. 7		CURVE NO. 8	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0010	1.000	0.0020	1.70
0.0020	0.995	0.0030	2.10
0.0030	0.985	0.0040	2.50
0.0040	0.970	0.0050	2.60
0.0050	0.960	0.0060	2.90
0.0060	0.950	0.0080	3.30
0.0080	0.925	0.0100	3.70
0.0090	0.910	0.0200	5.05
0.0100	0.900	0.0300	5.70
0.0200	0.820	0.0400	6.40
0.0300	0.745	0.0500	6.90
0.0400	0.700	0.0600	7.30
0.0700	0.600	0.0800	8.10
0.1000	0.530	0.1000	8.70
0.2000	0.420	0.2000	10.80
0.3000	0.350	0.3000	12.30
0.4000	0.305	0.4000	13.30
0.6000	0.240	0.5000	14.10
0.8000	0.205	0.7000	15.60
1.0000	0.165	1.0000	16.90

```
1******   OPTION  2  ***  READ SOIL PROFILE
 NEW SOIL PROFILE NO.      1       IDENTIFICATION  Soil Profile No.  1
 NUMBER OF LAYERS                 18          DEPTH TO BEDROCK        160.00
```

NO.	TYPE	THICKNESS (FT)	DEPTH (FT)	TOTAL PRESS. (KSF)	MODULUS (KSF)	DAMPING	UNIT WT. (KCF)	SHEAR VEL (FPS)
1	4	5.0000	2.5000	0.30	1826.	0.050	0.120	700.0
2	1	10.0000	10.0000	0.94	705.	0.050	0.067	582.0
3	1	10.0000	20.0000	1.62	810.	0.050	0.071	606.0
4	1	10.0000	30.0000	2.35	915.	0.050	0.074	631.0
5	1	10.0000	40.0000	3.10	1013.	0.050	0.076	655.0
6	2	10.0000	50.0000	3.87	1117.	0.050	0.078	679.0
7	2	10.0000	60.0000	4.66	1231.	0.050	0.080	704.0
8	2	10.0000	70.0000	5.46	1333.	0.050	0.081	728.0
9	2	10.0000	80.0000	6.28	1440.	0.050	0.082	752.0
10	2	10.0000	90.0000	7.10	1556.	0.050	0.083	777.0
11	2	10.0000	100.0000	7.93	1654.	0.050	0.083	801.0
12	2	10.0000	110.0000	8.77	1776.	0.050	0.084	825.0
13	5	10.0000	120.0000	9.61	1907.	0.050	0.085	850.0
14	5	10.0000	130.0000	10.47	2016.	0.050	0.085	874.0
15	5	10.0000	140.0000	11.32	2129.	0.050	0.085	898.0
16	5	10.0000	150.0000	12.17	2270.	0.050	0.086	922.0
17	4	5.0000	157.5000	12.90	2506.	0.050	0.120	820.0
18	BASE				13684.	0.050	0.136	1800.0

```
 PERIOD = 0.85 FROM AVERAGE SHEAR VEL. =     753.

  FREQUENCY    AMPLITUDE
 MAXIMUM AMPLIFICATION =  13.77
 FOR FREQUENCY         =   1.31 C/SEC.
     PERIOD            =   0.77 SEC.

1******   OPTION  3  ***  READ INPUT MOTION

  FILE NAME FOR INPUT MOTION = C:\Program Files\SHAKE2000\Quakes\GM#3-CHY006-
W.eq
    NO. OF INPUT ACC. POINTS = 30000
   NO. OF POINTS USED IN FFT = 32768
        NO. OF HEADING LINES =     4
     NO. OF POINTS PER LINE  =     5
  TIME STEP FOR INPUT MOTION = 0.0040
     FORMAT FOR TIME HISTORY =     (5E15.6)


 *****HEADER*****
Source File: C:\Program Files\SHAKE2000\Quakes\GM#3-CHY006-W.AT2
SHAKE2000 Conversion:    37495     .004      4         5          15       (5E15.
Acceleration Units: (g's) - No. Values: 37495 - Time Step: .004 (secs)
Data Format: (5E15.6) - No. Header Lines:  4
 **  FIRST AND LAST 5 LINES OF INPUT MOTION *****

     1 -0.000001-0.000001-0.000001-0.000001-0.000001
     2 -0.000001-0.000001-0.000001-0.000001-0.000001
     3 -0.000001-0.000001-0.000001-0.000001-0.000001
     4 -0.000001-0.000001-0.000001-0.000001-0.000001
     5 -0.000001-0.000001-0.000001-0.000001-0.000001
  .............INPUT MOTION READ NOT ECHOED.............
 5996  0.000339 0.000069-0.000158-0.000274-0.000271
 5997 -0.000215-0.000177-0.000169-0.000192-0.000218
 5998 -0.000226-0.000253-0.000324-0.000435-0.000580
 5999 -0.000751-0.000917-0.001040-0.001061-0.000933
 6000 -0.000646-0.000248 0.000166 0.000470 0.000559

 MAXIMUM ACCELERATION =  0.36442
 AT TIME              = 40.50 SEC
 THE VALUES WILL BE MULTIPLIED BY A FACTOR =  0.800
```

TO GIVE NEW MAXIMUM ACCELERATION = 0.29154
MEAN SQUARE FREQUENCY = 1.60 C/SEC.
MAX ACCELERATION = 0.24174 FOR FREQUENCIES REMOVED ABOVE 25.00 C/SEC.

1****** OPTION 4 *** READ WHERE OBJECT MOTION IS GIVEN
OBJECT MOTION IN LAYER NUMBER 18 OUTCROPPING

1****** OPTION 5 *** OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
MAXIMUM NUMBER OF ITERATIONS = 5
FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN = 0.65

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\GM#3-CHY006-W.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 1

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00614	0.029	0.050	-70.6	1731.2	1826.1	-5.5	1.000
2	1	10.0	0.04906	0.058	0.050	13.5	563.3	704.8	-25.1	1.000
3	1	20.0	0.07168	0.066	0.050	23.9	601.9	809.7	-34.5	1.000
4	1	30.0	0.08785	0.070	0.050	28.2	651.0	915.0	-40.6	1.000
5	1	40.0	0.09917	0.072	0.050	30.4	700.1	1012.6	-44.6	1.000
6	2	50.0	0.10651	0.064	0.050	21.7	854.1	1116.8	-30.8	1.000
7	2	60.0	0.11445	0.066	0.050	24.3	924.5	1231.3	-33.2	1.000
8	2	70.0	0.12138	0.068	0.050	26.3	985.8	1333.2	-35.2	1.000
9	2	80.0	0.12587	0.069	0.050	27.4	1054.7	1440.1	-36.5	1.000
10	2	90.0	0.12807	0.069	0.050	28.0	1134.5	1556.2	-37.2	1.000
11	2	100.0	0.13034	0.070	0.050	28.5	1200.1	1653.8	-37.8	1.000
12	2	110.0	0.12926	0.070	0.050	28.3	1291.3	1775.5	-37.5	1.000
13	5	120.0	0.12631	0.064	0.050	21.9	1493.7	1907.2	-27.7	1.000
14	5	130.0	0.12371	0.063	0.050	21.1	1587.2	2016.4	-27.0	1.000
15	5	140.0	0.11992	0.062	0.050	19.9	1687.9	2128.7	-26.1	1.000
16	5	150.0	0.11396	0.061	0.050	17.9	1822.0	2270.4	-24.6	1.000
17	4	157.5	0.10381	0.088	0.050	43.3	1313.2	2505.8	-90.8	1.000

1

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\GM#3-CHY006-W.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 2

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00616	0.029	0.029	0.2	1730.7	1731.2	0.0	0.948
2	1	10.0	0.05922	0.062	0.058	6.2	544.0	563.3	-3.6	0.799
3	1	20.0	0.09565	0.071	0.066	7.8	564.7	601.9	-6.6	0.743
4	1	30.0	0.12605	0.079	0.070	11.7	589.9	651.0	-10.4	0.711
5	1	40.0	0.15114	0.084	0.072	14.9	616.8	700.1	-13.5	0.691
6	2	50.0	0.15007	0.074	0.064	13.9	779.9	854.1	-9.5	0.765
7	2	60.0	0.16097	0.076	0.066	13.4	843.1	924.5	-9.7	0.751
8	2	70.0	0.16946	0.078	0.068	12.9	899.6	985.8	-9.6	0.739
9	2	80.0	0.17299	0.078	0.069	12.2	965.9	1054.7	-9.2	0.732
10	2	90.0	0.17189	0.078	0.069	11.3	1045.7	1134.5	-8.5	0.729
11	2	100.0	0.17054	0.078	0.070	10.3	1113.9	1200.1	-7.7	0.726
12	2	110.0	0.16383	0.077	0.070	9.3	1209.7	1291.3	-6.7	0.727
13	5	120.0	0.14465	0.068	0.064	6.0	1445.3	1493.7	-3.4	0.783
14	5	130.0	0.13752	0.067	0.063	4.8	1547.1	1587.2	-2.6	0.787
15	5	140.0	0.12948	0.065	0.062	3.6	1657.3	1687.9	-1.8	0.793
16	5	150.0	0.11938	0.062	0.061	2.2	1802.2	1822.0	-1.1	0.802
17	4	157.5	0.16309	0.102	0.088	13.4	1133.6	1313.2	-15.8	0.524

1

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\GM#3-CHY006-W.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 3

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00614	0.029	0.029	-0.1	1731.1	1730.7	0.0	0.948
2	1	10.0	0.06115	0.062	0.062	1.1	540.6	544.0	-0.6	0.772
3	1	20.0	0.10146	0.072	0.071	1.7	556.4	564.7	-1.5	0.697
4	1	30.0	0.13820	0.082	0.079	3.4	573.4	589.9	-2.9	0.645
5	1	40.0	0.16986	0.088	0.084	4.0	593.7	616.8	-3.9	0.609
6	2	50.0	0.16185	0.076	0.074	3.0	763.5	779.9	-2.1	0.698
7	2	60.0	0.17274	0.078	0.076	2.7	826.3	843.1	-2.0	0.685
8	2	70.0	0.18055	0.080	0.078	2.4	883.2	899.6	-1.9	0.675
9	2	80.0	0.18248	0.080	0.078	2.0	951.0	965.9	-1.6	0.671
10	2	90.0	0.17909	0.080	0.078	1.5	1033.4	1045.7	-1.2	0.672
11	2	100.0	0.17549	0.079	0.078	1.1	1104.7	1113.9	-0.8	0.674
12	2	110.0	0.16623	0.077	0.077	0.6	1204.6	1209.7	-0.4	0.681
13	5	120.0	0.14152	0.067	0.068	-1.0	1453.1	1445.3	0.5	0.758
14	5	130.0	0.13298	0.066	0.067	-1.5	1559.8	1547.1	0.8	0.767
15	5	140.0	0.12399	0.063	0.065	-2.1	1674.6	1657.3	1.0	0.779
16	5	150.0	0.11345	0.061	0.062	-2.5	1823.9	1802.2	1.2	0.794
17	4	157.5	0.17615	0.104	0.102	2.2	1102.9	1133.6	-2.8	0.452

1

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\GM#3-CHY006-W.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 4

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00615	0.029	0.029	0.1	1730.8	1731.1	0.0	0.948
2	1	10.0	0.06166	0.062	0.062	0.3	539.7	540.6	-0.2	0.767
3	1	20.0	0.10317	0.073	0.072	0.7	553.8	556.4	-0.5	0.687
4	1	30.0	0.14237	0.083	0.082	1.1	568.1	573.4	-0.9	0.627
5	1	40.0	0.17659	0.089	0.088	1.3	586.0	593.7	-1.3	0.586
6	2	50.0	0.16518	0.077	0.076	0.8	759.1	763.5	-0.6	0.684
7	2	60.0	0.17586	0.079	0.078	0.7	822.0	826.3	-0.5	0.671
8	2	70.0	0.18321	0.080	0.080	0.5	879.4	883.2	-0.4	0.662
9	2	80.0	0.18437	0.080	0.080	0.4	948.1	951.0	-0.3	0.660
10	2	90.0	0.18005	0.080	0.080	0.2	1031.7	1033.4	-0.2	0.664
11	2	100.0	0.17564	0.079	0.079	0.0	1104.4	1104.7	0.0	0.668
12	2	110.0	0.16551	0.077	0.077	-0.2	1206.1	1204.6	0.1	0.678
13	5	120.0	0.13948	0.067	0.067	-0.6	1458.3	1453.1	0.4	0.762
14	5	130.0	0.13065	0.065	0.066	-0.8	1566.5	1559.8	0.4	0.774
15	5	140.0	0.12159	0.063	0.063	-0.9	1682.4	1674.6	0.5	0.787
16	5	150.0	0.11116	0.060	0.061	-1.0	1832.6	1823.9	0.5	0.803
17	4	157.5	0.17920	0.105	0.104	0.5	1096.1	1102.9	-0.6	0.440

1

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\GM#3-CHY006-W.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 5

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00616	0.029	0.029	0.1	1730.6	1730.8	0.0	0.948
2	1	10.0	0.06184	0.063	0.062	0.1	539.4	539.7	-0.1	0.766
3	1	20.0	0.10379	0.073	0.073	0.2	552.8	553.8	-0.2	0.684
4	1	30.0	0.14388	0.083	0.083	0.4	566.2	568.1	-0.3	0.621
5	1	40.0	0.17906	0.089	0.089	0.5	583.2	586.0	-0.5	0.579
6	2	50.0	0.16620	0.077	0.077	0.2	757.8	759.1	-0.2	0.680
7	2	60.0	0.17676	0.079	0.079	0.2	820.8	822.0	-0.1	0.668
8	2	70.0	0.18390	0.080	0.080	0.1	878.4	879.4	-0.1	0.660
9	2	80.0	0.18476	0.080	0.080	0.1	947.6	948.1	-0.1	0.658
10	2	90.0	0.18011	0.080	0.080	0.0	1031.6	1031.7	0.0	0.663
11	2	100.0	0.17542	0.079	0.079	0.0	1104.8	1104.4	0.0	0.668
12	2	110.0	0.16503	0.077	0.077	-0.1	1207.2	1206.1	0.1	0.679
13	5	120.0	0.13873	0.067	0.067	-0.2	1460.2	1458.3	0.1	0.765
14	5	130.0	0.12986	0.065	0.065	-0.3	1568.8	1566.5	0.1	0.777
15	5	140.0	0.12083	0.063	0.063	-0.3	1684.9	1682.4	0.1	0.790
16	5	150.0	0.11048	0.060	0.060	-0.3	1835.2	1832.6	0.1	0.807
17	4	157.5	0.18002	0.105	0.105	0.1	1094.3	1096.1	-0.2	0.437

VALUES IN TIME DOMAIN

LAYER	TYPE	THICKNESS FT	DEPTH FT	MAX STRAIN PRCNT	MAX STRESS PSF	TIME SEC
1	4	5.0000	2.5000	0.00948	164.04	40.75
2	1	10.0000	10.0000	0.09514	513.48	40.76
3	1	10.0000	20.0000	0.15968	884.25	40.75
4	1	10.0000	30.0000	0.22136	1257.56	40.75
5	1	10.0000	40.0000	0.27548	1614.36	40.75
6	2	10.0000	50.0000	0.25570	1940.97	40.74
7	2	10.0000	60.0000	0.27194	2235.27	40.74
8	2	10.0000	70.0000	0.28292	2487.93	40.73
9	2	10.0000	80.0000	0.28425	2695.13	40.73
10	2	10.0000	90.0000	0.27709	2858.86	40.72
11	2	10.0000	100.0000	0.26987	2980.50	40.72
12	2	10.0000	110.0000	0.25389	3062.21	40.72
13	5	10.0000	120.0000	0.21343	3112.43	40.71
14	5	10.0000	130.0000	0.19979	3129.67	40.70
15	5	10.0000	140.0000	0.18589	3127.41	40.70
16	5	10.0000	150.0000	0.16997	3114.90	40.69
17	4	5.0000	157.5000	0.27695	3035.73	40.69

PERIOD = 1.02 FROM AVERAGE SHEAR VEL. = 629.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 9.09
FOR FREQUENCY = 1.08 C/SEC.
PERIOD = 0.93 SEC.

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\Program Files\SHAKE2000\Quakes\GM#3-CHY006-W.eq
SOIL DEPOSIT - Soil Profile No. 1

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	ACC. RATIO	TH SAVED ACC. RECORD	QUIET ZONE
OUTCR.	0.0000	0.54395	40.74	1.37	0.025	4096	
WITHIN	5.0000	0.54370	40.73	1.36	0.025	0	
WITHIN	15.0000	0.53669	40.73	1.28	0.025	0	
WITHIN	35.0000	0.47939	40.72	1.14	0.026	0	
WITHIN	55.0000	0.38506	40.70	1.17	0.029	0	
WITHIN	75.0000	0.28974	40.68	1.28	0.034	0	
WITHIN	85.0000	0.24037	40.66	1.34	0.039	0	

```
     WITHIN        105.0000         0.20808          40.59            1.42
0.042                    0
     WITHIN        125.0000         0.18295          40.58            1.44
0.043                    0
     WITHIN        135.0000         0.17059          40.57            1.43
0.045                    0
     WITHIN        155.0000         0.15451          43.42            1.43
0.049                 4096
     WITHIN        160.0000         0.15398          43.42            1.48
0.051                 4096
     OUTCR.        160.0000         0.24174          40.50            1.60
0.032                 4096

1******   OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

  COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   17
  SCALE FOR PLOTTING      0.0000
 IDENTIFICATION - Stress History Layer No. 1

  COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   17
  SCALE FOR PLOTTING      0.0000
 IDENTIFICATION - Strain History Layer No. 1


  *** End of Output File No. 1 ***
```

160 FT - GM#4

```
 ************************************************************
 * SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL  *
 *     LAYERED SITES by Per Schnable & John Lysmer - 1970   *
 * -------------------------------------------------------- *
 * SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985  *
 * -------------------------------------------------------- *
 * SHAKE88 :New modulus reduction curves for clays added    *
 *      using results from Sun et al (1988) by J. I. Sun    *
 *      & Ramin Golesorkhi February 26, 1988                *
 * -------------------------------------------------------- *
 * SHAKE90/91: Adjust last iteration; Input now is either   *
 *      Gmax or max Vs; up to 13 materials can be specified *
 *      by user; up to 50 Layers can be specified; object   *
 *      motion can be read in from a separate file and can  *
 *      user specified format; Different periods for res-   *
 *      ponse spectral calculations;options are renumbered; *
 *      and general cleanup by: J. I. Sun, I. M. Idriss &   *
 *      P. Dirrim June 1990 - February 1991                 *
 * -------------------------------------------------------- *
 * SHAKE91: General cleanup and finalization of input out-  *
 *      output format ... etc by: I. M. Idriss Dec. 1991    *
 * -------------------------------------------------------- *
 * SHAKE2000: Fix the incorrect output of Tot. Stress in    *
 * Option 2. Changed path of ground motion file in          *
 * SHAKE91.  Control file to input file names.  Modified    *
 * by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003)  *
 *          RUN DATE 12/10/2007                             *
 *          RUN TIME 16:46                                  *
 ************************************************************
 MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =     32768
 NECESSARY LENGTH OF BLANK COMMON X        =    204819

1******   OPTION  1  ***  READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

 **********************
 MATERIAL TYPE NO. 1
 **********************

 CURVE NO.  1:     MSW shallow MSW (SM<125) Zekkos, 2005
 CURVE NO.  2:     MSW shallow MSW (SM<125) Zekkos, 2005
```

CURVE NO. 1		CURVE NO. 2	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	4.00
0.0002	0.997	0.0002	4.00
0.0003	0.996	0.0003	4.10
0.0010	0.990	0.0010	4.10
0.0020	0.982	0.0020	4.20
0.0030	0.975	0.0030	4.20
0.0050	0.963	0.0050	4.20
0.0080	0.946	0.0080	4.30
0.0120	0.927	0.0120	4.50
0.0200	0.892	0.0200	4.80
0.0300	0.856	0.0300	5.20
0.0500	0.797	0.0500	5.80
0.0800	0.727	0.0800	6.80
0.1000	0.690	0.1000	7.20
0.3000	0.475	0.3000	10.50
0.5000	0.373	0.5000	12.00
1.0000	0.252	1.0000	14.00

```
 **********************
 MATERIAL TYPE NO. 2
 **********************

 CURVE NO.  3:     MSW deep    MSW (125<SM<350) Zekkos 2005
 CURVE NO.  4:     MSW deep    MSW (125<SM<350) Zekkos 2005
```

CURVE NO. 3		CURVE NO. 4	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	3.00
0.0002	0.999	0.0002	3.00
0.0003	0.998	0.0003	3.10
0.0010	0.995	0.0010	3.10
0.0020	0.992	0.0020	3.20
0.0030	0.988	0.0030	3.20
0.0050	0.981	0.0050	3.20
0.0080	0.971	0.0080	3.30
0.0120	0.959	0.0120	3.50
0.0200	0.937	0.0200	3.80
0.0300	0.911	0.0300	4.20
0.0500	0.867	0.0500	4.80
0.0800	0.810	0.0800	5.80
0.1000	0.777	0.1000	6.20
0.3000	0.564	0.3000	9.50
0.5000	0.450	0.5000	11.00
1.0000	0.305	1.0000	13.00

```
 **********************
 MATERIAL TYPE NO. 3
 **********************

 CURVE NO.  5:     Soil PI=100 G/Gmax - Soil with PI=100, OCR=1-15 (Vucetic
 CURVE NO.  6:     Soil PI=100 Damping - Soil with PI=100, OCR=1-8 (Vucetic
```

CURVE NO. 5		CURVE NO. 6	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0050	1.000	0.0010	1.20
0.0060	1.000	0.0030	1.50
0.0070	0.995	0.0050	1.70
0.0090	0.990	0.0070	1.90
0.0100	0.985	0.0090	2.00
0.0200	0.960	0.0100	2.05
0.0300	0.935	0.0200	2.50
0.0400	0.915	0.0300	2.90
0.0500	0.900	0.0400	3.10
0.0600	0.880	0.0500	3.30
0.0700	0.865	0.0600	3.50
0.0800	0.850	0.0800	3.80
0.0900	0.830	0.1000	4.00
0.1000	0.815	0.2000	5.20
0.2000	0.715	0.3000	6.10
0.3000	0.635	0.4000	6.80
0.5000	0.530	0.5000	7.40
0.6000	0.490	0.6000	8.00
0.9000	0.405	0.7000	8.60
1.0000	0.375	1.0000	9.70

```
 **********************
 MATERIAL TYPE NO. 4
 **********************

 CURVE NO.  7:     Soil PI=30  G/Gmax - Soil with PI=30, OCR=1-15 (Vucetic
 CURVE NO.  8:     Soil PI=30  Damping - Soil with PI=30, OCR=1-8 (Vucetic
```

CURVE NO. 7		CURVE NO. 8	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0010	1.000	0.0020	1.70
0.0020	0.995	0.0030	2.10
0.0030	0.985	0.0040	2.50
0.0040	0.970	0.0050	2.60
0.0050	0.960	0.0060	2.90
0.0060	0.950	0.0080	3.30
0.0080	0.925	0.0100	3.70
0.0090	0.910	0.0200	5.05
0.0100	0.900	0.0300	5.70
0.0200	0.820	0.0400	6.40
0.0300	0.745	0.0500	6.90
0.0400	0.700	0.0600	7.30
0.0700	0.600	0.0800	8.10
0.1000	0.530	0.1000	8.70
0.2000	0.420	0.2000	10.80
0.3000	0.350	0.3000	12.30
0.4000	0.305	0.4000	13.30
0.6000	0.240	0.5000	14.10
0.8000	0.205	0.7000	15.60
1.0000	0.165	1.0000	16.90

```
1******   OPTION  2  ***  READ SOIL PROFILE
 NEW SOIL PROFILE NO.      1      IDENTIFICATION  Soil Profile No.  1
 NUMBER OF LAYERS                    18          DEPTH TO BEDROCK        160.00
```

NO.	TYPE	THICKNESS (FT)	DEPTH (FT)	TOTAL PRESS. (KSF)	MODULUS (KSF)	DAMPING	UNIT WT. (KCF)	SHEAR VEL (FPS)
1	4	5.0000	2.5000	0.30	1826.	0.050	0.120	700.0
2	1	10.0000	10.0000	0.94	705.	0.050	0.067	582.0
3	1	10.0000	20.0000	1.62	810.	0.050	0.071	606.0
4	1	10.0000	30.0000	2.35	915.	0.050	0.074	631.0
5	1	10.0000	40.0000	3.10	1013.	0.050	0.076	655.0
6	2	10.0000	50.0000	3.87	1117.	0.050	0.078	679.0
7	2	10.0000	60.0000	4.66	1231.	0.050	0.080	704.0
8	2	10.0000	70.0000	5.46	1333.	0.050	0.081	728.0
9	2	10.0000	80.0000	6.28	1440.	0.050	0.082	752.0
10	2	10.0000	90.0000	7.10	1556.	0.050	0.083	777.0
11	2	10.0000	100.0000	7.93	1654.	0.050	0.083	801.0
12	2	10.0000	110.0000	8.77	1776.	0.050	0.084	825.0
13	5	10.0000	120.0000	9.61	1907.	0.050	0.085	850.0
14	5	10.0000	130.0000	10.47	2016.	0.050	0.085	874.0
15	5	10.0000	140.0000	11.32	2129.	0.050	0.085	898.0
16	5	10.0000	150.0000	12.17	2270.	0.050	0.086	922.0
17	4	5.0000	157.5000	12.90	2506.	0.050	0.120	820.0
18	BASE				13684.	0.050	0.136	1800.0

```
 PERIOD = 0.85 FROM AVERAGE SHEAR VEL. =     753.


  FREQUENCY    AMPLITUDE
 MAXIMUM AMPLIFICATION =  13.77
 FOR FREQUENCY         =   1.31 C/SEC.
     PERIOD            =   0.77 SEC.

1******   OPTION  3  ***  READ INPUT MOTION

  FILE NAME FOR INPUT MOTION = C:\Program Files\SHAKE2000\Quakes\LCN260.eq
    NO. OF INPUT ACC. POINTS =  9624
  NO. OF POINTS USED IN FFT = 16384
       NO. OF HEADING LINES =     8
     NO. OF POINTS PER LINE =     4
  TIME STEP FOR INPUT MOTION = 0.0050
     FORMAT FOR TIME HISTORY =   (4E15.6E2)


 *****HEADER*****
Source File: C:\Program Files\SHAKE2000\Quakes\bydz\LCN260.AT2
SHAKE2000 Conversion:    9624      .005       8         4         15        (4E15.
Acceleration Units: (g's) - No. Values: 9624 - Time Step: .005 (secs)
Data Format: (4E15.6E2) - No. Header Lines:  8
PEER NGA STRONG MOTION DATABASE RECORD
LANDERS 6/28/92 11:58, LUCERNE, 260 (SCE STATION 24)
ACCELERATION TIME HISTORY IN UNITS OF G
9625     0.0050     NPTS, DT
 **  FIRST AND LAST 5 LINES OF INPUT MOTION *****

     1 -0.000006-0.000007-0.000005-0.000006
     2 -0.000005-0.000006-0.000005-0.000009
     3 -0.000011-0.000019-0.000023-0.000025
     4 -0.000019-0.000012-0.000001 0.000010
     5  0.000021 0.000020 0.000018 0.000016
  ............INPUT MOTION READ NOT ECHOED...........
  2402  0.000037 0.000027 0.000001-0.000012
  2403 -0.000009 0.000006 0.000014 0.000006
  2404 -0.000007-0.000014-0.000018-0.000017
  2405 -0.000010-0.000001 0.000000-0.000003
  2406 -0.000006-0.000006-0.000006-0.000005
```

MAXIMUM ACCELERATION = 0.72684
AT TIME = 10.47 SEC
THE VALUES WILL BE MULTIPLIED BY A FACTOR = 0.850
TO GIVE NEW MAXIMUM ACCELERATION = 0.61781
MEAN SQUARE FREQUENCY = 9.50 C/SEC.
MAX ACCELERATION = 0.58845 FOR FREQUENCIES REMOVED ABOVE 25.00 C/SEC.

1****** OPTION 4 *** READ WHERE OBJECT MOTION IS GIVEN
OBJECT MOTION IN LAYER NUMBER 18 OUTCROPPING

1****** OPTION 5 *** OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
MAXIMUM NUMBER OF ITERATIONS = 5
FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN = 0.65

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\LCN260.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 1

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	NEW	<---- DAMPING ----> USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00772	0.033	0.050	-53.8	1694.8	1826.1	-7.7	1.000
2	1	10.0	0.05868	0.061	0.050	18.6	544.9	704.8	-29.3	1.000
3	1	20.0	0.07245	0.066	0.050	24.1	600.6	809.7	-34.8	1.000
4	1	30.0	0.07861	0.068	0.050	26.1	667.6	915.0	-37.1	1.000
5	1	40.0	0.08258	0.069	0.050	27.1	730.8	1012.6	-38.6	1.000
6	2	50.0	0.09513	0.061	0.050	18.2	876.0	1116.8	-27.5	1.000
7	2	60.0	0.10054	0.062	0.050	19.6	955.5	1231.3	-28.9	1.000
8	2	70.0	0.10395	0.063	0.050	20.8	1025.9	1333.2	-30.0	1.000
9	2	80.0	0.11314	0.066	0.050	23.9	1084.5	1440.1	-32.8	1.000
10	2	90.0	0.11995	0.067	0.050	25.9	1154.3	1556.2	-34.8	1.000
11	2	100.0	0.12415	0.068	0.050	27.0	1215.7	1653.8	-36.0	1.000
12	2	110.0	0.12471	0.069	0.050	27.1	1303.6	1775.5	-36.2	1.000
13	5	120.0	0.12377	0.063	0.050	21.1	1501.0	1907.2	-27.1	1.000
14	5	130.0	0.12450	0.064	0.050	21.4	1584.8	2016.4	-27.2	1.000
15	5	140.0	0.12525	0.064	0.050	21.6	1670.6	2128.7	-27.4	1.000
16	5	150.0	0.12500	0.064	0.050	21.5	1782.6	2270.4	-27.4	1.000
17	4	157.5	0.11931	0.092	0.050	45.9	1257.9	2505.8	-99.2	1.000

1

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\LCN260.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 2

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	NEW	<---- DAMPING ----> USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00713	0.031	0.033	-3.5	1707.3	1694.8	0.7	0.928
2	1	10.0	0.06508	0.064	0.061	3.5	534.0	544.9	-2.0	0.773
3	1	20.0	0.09011	0.070	0.066	6.0	572.7	600.6	-4.9	0.742
4	1	30.0	0.11376	0.076	0.068	10.9	608.3	667.6	-9.8	0.730
5	1	40.0	0.13174	0.080	0.069	14.6	644.1	730.8	-13.5	0.722
6	2	50.0	0.12372	0.068	0.061	10.7	821.7	876.0	-6.6	0.784
7	2	60.0	0.12590	0.069	0.062	9.8	901.8	955.5	-6.0	0.776
8	2	70.0	0.14469	0.073	0.063	13.6	940.4	1025.9	-9.1	0.769
9	2	80.0	0.15926	0.076	0.066	13.5	989.0	1084.5	-9.7	0.753
10	2	90.0	0.16608	0.077	0.067	12.7	1056.1	1154.3	-9.3	0.742
11	2	100.0	0.17028	0.078	0.068	12.2	1114.4	1215.7	-9.1	0.735
12	2	110.0	0.16914	0.078	0.069	11.8	1198.7	1303.6	-8.8	0.734
13	5	120.0	0.15637	0.070	0.063	10.0	1417.4	1501.0	-5.9	0.787
14	5	130.0	0.15888	0.071	0.064	10.3	1492.6	1584.8	-6.2	0.786
15	5	140.0	0.16134	0.071	0.064	10.7	1569.5	1670.6	-6.4	0.785
16	5	150.0	0.16028	0.071	0.064	10.5	1676.8	1782.6	-6.3	0.785
17	4	157.5	0.23204	0.113	0.092	18.6	988.2	1257.9	-27.3	0.502

1

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\LCN260.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 3

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	NEW	<---- DAMPING ----> USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00671	0.031	0.031	-2.8	1717.0	1707.3	0.6	0.935
2	1	10.0	0.06526	0.064	0.064	0.1	533.8	534.0	-0.1	0.758
3	1	20.0	0.09409	0.071	0.070	1.1	566.9	572.7	-1.0	0.707
4	1	30.0	0.12132	0.078	0.076	2.5	596.8	608.3	-1.9	0.665
5	1	40.0	0.14399	0.083	0.080	3.2	626.5	644.1	-2.8	0.636
6	2	50.0	0.12703	0.069	0.068	1.1	816.0	821.7	-0.7	0.736
7	2	60.0	0.13357	0.071	0.069	2.5	887.6	901.8	-1.6	0.732
8	2	70.0	0.15695	0.076	0.073	3.2	919.4	940.4	-2.3	0.705
9	2	80.0	0.17164	0.078	0.076	2.9	968.1	989.0	-2.2	0.687
10	2	90.0	0.17701	0.079	0.077	2.4	1036.9	1056.1	-1.9	0.679
11	2	100.0	0.18058	0.080	0.078	2.2	1095.5	1114.4	-1.7	0.674
12	2	110.0	0.17912	0.080	0.078	2.2	1178.9	1198.7	-1.7	0.675
13	5	120.0	0.16279	0.072	0.070	1.7	1403.0	1417.4	-1.0	0.743
14	5	130.0	0.16679	0.072	0.071	2.0	1474.2	1492.6	-1.2	0.740
15	5	140.0	0.16972	0.073	0.071	2.1	1549.3	1569.5	-1.3	0.737
16	5	150.0	0.16669	0.072	0.071	1.6	1660.1	1676.8	-1.0	0.739
17	4	157.5	0.28303	0.121	0.113	6.1	902.2	988.2	-9.5	0.394

1

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\LCN260.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 4

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	NEW	<---- DAMPING ----> USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00657	0.030	0.031	-1.0	1720.3	1717.0	0.2	0.940
2	1	10.0	0.06497	0.064	0.064	-0.2	534.2	533.8	0.1	0.757
3	1	20.0	0.09461	0.071	0.071	0.1	566.2	566.9	-0.1	0.700
4	1	30.0	0.12240	0.078	0.078	0.3	595.2	596.8	-0.3	0.652
5	1	40.0	0.14648	0.083	0.083	0.6	623.1	626.5	-0.5	0.619
6	2	50.0	0.12688	0.069	0.069	-0.1	816.2	816.0	0.0	0.731
7	2	60.0	0.13558	0.071	0.071	0.6	884.1	887.6	-0.4	0.721
8	2	70.0	0.16011	0.076	0.076	0.8	914.2	919.4	-0.6	0.690
9	2	80.0	0.17436	0.079	0.078	0.6	963.7	968.1	-0.5	0.672
10	2	90.0	0.17919	0.080	0.079	0.5	1033.2	1036.9	-0.4	0.666
11	2	100.0	0.18251	0.080	0.080	0.4	1092.1	1095.5	-0.3	0.662
12	2	110.0	0.18124	0.080	0.080	0.4	1174.9	1178.9	-0.3	0.664
13	5	120.0	0.16398	0.072	0.072	0.3	1400.4	1403.0	-0.2	0.736
14	5	130.0	0.16859	0.073	0.072	0.4	1470.1	1474.2	-0.3	0.731
15	5	140.0	0.17134	0.073	0.073	0.4	1545.5	1549.3	-0.2	0.728
16	5	150.0	0.16751	0.072	0.072	0.2	1658.0	1660.1	-0.1	0.731
17	4	157.5	0.30634	0.124	0.121	2.3	868.8	902.2	-3.8	0.360

1

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\LCN260.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 5

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	NEW	<---- DAMPING ----> USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00653	0.030	0.030	-0.3	1721.4	1720.3	0.1	0.942
2	1	10.0	0.06479	0.064	0.064	-0.1	534.5	534.2	0.1	0.758
3	1	20.0	0.09453	0.071	0.071	0.0	566.3	566.2	0.0	0.699
4	1	30.0	0.12241	0.078	0.078	0.0	595.2	595.2	0.0	0.650
5	1	40.0	0.14688	0.084	0.083	0.1	622.5	623.1	-0.1	0.615
6	2	50.0	0.12658	0.069	0.069	-0.1	816.7	816.2	0.1	0.731
7	2	60.0	0.13603	0.071	0.071	0.1	883.3	884.1	-0.1	0.718
8	2	70.0	0.16078	0.076	0.076	0.2	913.2	914.2	-0.1	0.686
9	2	80.0	0.17481	0.079	0.079	0.1	963.0	963.7	-0.1	0.669
10	2	90.0	0.17949	0.080	0.080	0.1	1032.7	1033.2	0.0	0.664
11	2	100.0	0.18275	0.080	0.080	0.1	1091.7	1092.1	0.0	0.660
12	2	110.0	0.18162	0.080	0.080	0.1	1174.2	1174.9	-0.1	0.662
13	5	120.0	0.16414	0.072	0.072	0.0	1400.1	1400.4	0.0	0.734
14	5	130.0	0.16897	0.073	0.073	0.1	1469.3	1470.1	-0.1	0.729
15	5	140.0	0.17164	0.073	0.073	0.1	1544.8	1545.5	0.0	0.726
16	5	150.0	0.16751	0.072	0.072	0.0	1658.0	1658.0	0.0	0.730
17	4	157.5	0.31689	0.125	0.124	0.9	855.6	868.8	-1.6	0.347

VALUES IN TIME DOMAIN

LAYER	TYPE	THICKNESS FT	DEPTH FT	MAX STRAIN PRCNT	MAX STRESS PSF	TIME SEC
1	4	5.0000	2.5000	0.01004	172.73	10.73
2	1	10.0000	10.0000	0.09967	532.49	10.95
3	1	10.0000	20.0000	0.14544	823.42	10.94
4	1	10.0000	30.0000	0.18833	1120.86	10.93
5	1	10.0000	40.0000	0.22597	1407.90	10.91
6	2	10.0000	50.0000	0.19473	1589.45	10.90
7	2	10.0000	60.0000	0.20928	1850.25	10.86
8	2	10.0000	70.0000	0.24735	2261.33	10.85
9	2	10.0000	80.0000	0.26893	2591.80	10.84
10	2	10.0000	90.0000	0.27614	2853.05	10.83
11	2	10.0000	100.0000	0.28116	3070.58	10.81
12	2	10.0000	110.0000	0.27941	3282.81	10.80
13	5	10.0000	120.0000	0.25252	3536.22	10.78
14	5	10.0000	130.0000	0.25995	3821.53	10.77
15	5	10.0000	140.0000	0.26406	4081.01	10.76
16	5	10.0000	150.0000	0.25770	4272.74	10.75
17	4	5.0000	157.5000	0.48753	4235.85	10.74

PERIOD = 1.02 FROM AVERAGE SHEAR VEL. = 625.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 8.65
FOR FREQUENCY = 1.06 C/SEC.
PERIOD = 0.94 SEC.

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\Program Files\SHAKE2000\Quakes\LCN260.eq
SOIL DEPOSIT - Soil Profile No. 1

LAYER	DEPTH TH SAVED FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	ACC. RATIO QUIET ZONE ACC. RECORD
OUTCR.	0.0000	0.58051	10.73	3.08	0.000
	2048				
WITHIN	5.0000	0.56594	10.73	2.91	0.000
	0				
WITHIN	15.0000	0.49437	10.91	2.62	0.000
	0				
WITHIN	35.0000	0.49171	10.80	3.10	0.000
	0				
WITHIN	55.0000	0.59141	10.84	3.73	0.000
	0				
WITHIN	75.0000	0.49582	10.81	4.21	0.000
	0				

```
     WITHIN         85.0000          0.47813          10.80            4.73
0.000                    0
     WITHIN        105.0000          0.52560          10.76            5.53
0.000                    0
     WITHIN        125.0000          0.51991          10.74            6.32
0.000                    0
     WITHIN        135.0000          0.46418          10.72            6.87
0.000                    0
     WITHIN        155.0000          0.43258          10.47            7.96
0.000                 2048
     WITHIN        160.0000          0.46737          10.47            9.32
0.000                 2048
     OUTCR.        160.0000          0.58845          10.47            9.50
0.000                 2048

1******   OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

  COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   17
  SCALE FOR PLOTTING      0.0000
 IDENTIFICATION - Stress History Layer No. 1

  COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   17
  SCALE FOR PLOTTING      0.0000
 IDENTIFICATION - Strain History Layer No. 1


  *** End of Output File No. 1 ***
```

160 FT - GM#5

```
 ***********************************************************
 * SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL *
 *     LAYERED SITES by Per Schnable & John Lysmer - 1970  *
 * ------------------------------------------------------- *
 * SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985 *
 * ------------------------------------------------------- *
 * SHAKE88 :New modulus reduction curves for clays added   *
 *      using results from Sun et al (1988) by J. I. Sun   *
 *      & Ramin Golesorkhi February 26, 1988               *
 * ------------------------------------------------------- *
 * SHAKE90/91: Adjust last iteration; Input now is either  *
 *      Gmax or max Vs; up to 13 materials can be specified*
 *      by user; up to 50 Layers can be specified; object  *
 *      motion can be read in from a separate file and can *
 *      user specified format; Different periods for res-  *
 *      ponse spectral calculations;options are renumbered;*
 *      and general cleanup by: J. I. Sun, I. M. Idriss &  *
 *      P. Dirrim June 1990 - February 1991                *
 * ------------------------------------------------------- *
 * SHAKE91: General cleanup and finalization of input out- *
 *      output format ... etc by: I. M. Idriss Dec. 1991   *
 * ------------------------------------------------------- *
 * SHAKE2000: Fix the incorrect output of Tot. Stress in   *
 * Option 2. Changed path of ground motion file in         *
 * SHAKE91.  Control file to input file names.  Modified   *
 * by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003) *
 *          RUN DATE 12/10/2007                            *
 *          RUN TIME 16:51                                 *
 ***********************************************************
 MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =      32768
 NECESSARY LENGTH OF BLANK COMMON X        =     204819

1******   OPTION  1  ***  READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

 **********************
 MATERIAL TYPE NO. 1
 **********************

 CURVE NO.  1:     MSW shallow MSW (SM<125) Zekkos, 2005
 CURVE NO.  2:     MSW shallow MSW (SM<125) Zekkos, 2005
```

CURVE NO. 1		CURVE NO. 2	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	4.00
0.0002	0.997	0.0002	4.00
0.0003	0.996	0.0003	4.10
0.0010	0.990	0.0010	4.10
0.0020	0.982	0.0020	4.20
0.0030	0.975	0.0030	4.20
0.0050	0.963	0.0050	4.20
0.0080	0.946	0.0080	4.30
0.0120	0.927	0.0120	4.50
0.0200	0.892	0.0200	4.80
0.0300	0.856	0.0300	5.20
0.0500	0.797	0.0500	5.80
0.0800	0.727	0.0800	6.80
0.1000	0.690	0.1000	7.20
0.3000	0.475	0.3000	10.50
0.5000	0.373	0.5000	12.00
1.0000	0.252	1.0000	14.00

```
 **********************
 MATERIAL TYPE NO. 2
 **********************

 CURVE NO.  3:     MSW deep    MSW (125<SM<350) Zekkos 2005
 CURVE NO.  4:     MSW deep    MSW (125<SM<350) Zekkos 2005
```

CURVE NO. 3		CURVE NO. 4	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	3.00
0.0002	0.999	0.0002	3.00
0.0003	0.998	0.0003	3.10
0.0010	0.995	0.0010	3.10
0.0020	0.992	0.0020	3.20
0.0030	0.988	0.0030	3.20
0.0050	0.981	0.0050	3.20
0.0080	0.971	0.0080	3.30
0.0120	0.959	0.0120	3.50
0.0200	0.937	0.0200	3.80
0.0300	0.911	0.0300	4.20
0.0500	0.867	0.0500	4.80
0.0800	0.810	0.0800	5.80
0.1000	0.777	0.1000	6.20
0.3000	0.564	0.3000	9.50
0.5000	0.450	0.5000	11.00
1.0000	0.305	1.0000	13.00

```
 **********************
 MATERIAL TYPE NO. 3
 **********************

 CURVE NO.  5:     Soil PI=100 G/Gmax - Soil with PI=100, OCR=1-15 (Vucetic
 CURVE NO.  6:     Soil PI=100 Damping - Soil with PI=100, OCR=1-8 (Vucetic
```

CURVE NO. 5		CURVE NO. 6	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0050	1.000	0.0010	1.20
0.0060	1.000	0.0030	1.50
0.0070	0.995	0.0050	1.70
0.0090	0.990	0.0070	1.90
0.0100	0.985	0.0090	2.00
0.0200	0.960	0.0100	2.05
0.0300	0.935	0.0200	2.50
0.0400	0.915	0.0300	2.90
0.0500	0.900	0.0400	3.10
0.0600	0.880	0.0500	3.30
0.0700	0.865	0.0600	3.50
0.0800	0.850	0.0800	3.80
0.0900	0.830	0.1000	4.00
0.1000	0.815	0.2000	5.20
0.2000	0.715	0.3000	6.10
0.3000	0.635	0.4000	6.80
0.5000	0.530	0.5000	7.40
0.6000	0.490	0.6000	8.00
0.9000	0.405	0.7000	8.60
1.0000	0.375	1.0000	9.70

```
 **********************
 MATERIAL TYPE NO. 4
 **********************

 CURVE NO.  7:     Soil PI=30  G/Gmax - Soil with PI=30, OCR=1-15 (Vucetic
 CURVE NO.  8:     Soil PI=30  Damping - Soil with PI=30, OCR=1-8 (Vucetic
```

CURVE NO. 7		CURVE NO. 8	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0010	1.000	0.0020	1.70
0.0020	0.995	0.0030	2.10
0.0030	0.985	0.0040	2.50
0.0040	0.970	0.0050	2.60
0.0050	0.960	0.0060	2.90
0.0060	0.950	0.0080	3.30
0.0080	0.925	0.0100	3.70
0.0090	0.910	0.0200	5.05
0.0100	0.900	0.0300	5.70
0.0200	0.820	0.0400	6.40
0.0300	0.745	0.0500	6.90
0.0400	0.700	0.0600	7.30
0.0700	0.600	0.0800	8.10
0.1000	0.530	0.1000	8.70
0.2000	0.420	0.2000	10.80
0.3000	0.350	0.3000	12.30
0.4000	0.305	0.4000	13.30
0.5000	0.240	0.5000	14.10
0.8000	0.205	0.7000	15.60
1.0000	0.165	1.0000	16.90

```
1******   OPTION  2  ***  READ SOIL PROFILE
 NEW SOIL PROFILE NO.      1      IDENTIFICATION  Soil Profile No.  1
 NUMBER OF LAYERS                    18          DEPTH TO BEDROCK        160.00
```

NO.	TYPE	THICKNESS (FT)	DEPTH (FT)	TOTAL PRESS. (KSF)	MODULUS (KSF)	DAMPING	UNIT WT. (KCF)	SHEAR VEL (FPS)
1	4	5.0000	2.5000	0.30	1826.	0.050	0.120	700.0
2	1	10.0000	10.0000	0.94	705.	0.050	0.067	582.0
3	1	10.0000	20.0000	1.62	810.	0.050	0.071	606.0
4	1	10.0000	30.0000	2.35	915.	0.050	0.074	631.0
5	1	10.0000	40.0000	3.10	1013.	0.050	0.076	655.0
6	2	10.0000	50.0000	3.87	1117.	0.050	0.078	679.0
7	2	10.0000	60.0000	4.66	1231.	0.050	0.080	704.0
8	2	10.0000	70.0000	5.46	1333.	0.050	0.081	728.0
9	2	10.0000	80.0000	6.28	1440.	0.050	0.082	752.0
10	2	10.0000	90.0000	7.10	1556.	0.050	0.083	777.0
11	2	10.0000	100.0000	7.93	1654.	0.050	0.083	801.0
12	2	10.0000	110.0000	8.77	1776.	0.050	0.084	825.0
13	5	10.0000	120.0000	9.61	1907.	0.050	0.085	850.0
14	5	10.0000	130.0000	10.47	2016.	0.050	0.085	874.0
15	5	10.0000	140.0000	11.32	2129.	0.050	0.085	898.0
16	5	10.0000	150.0000	12.17	2270.	0.050	0.086	922.0
17	4	5.0000	157.5000	12.90	2506.	0.050	0.120	820.0
18	BASE				13684.	0.050	0.136	1800.0

```
 PERIOD = 0.85 FROM AVERAGE SHEAR VEL. =      753.

  FREQUENCY    AMPLITUDE
 MAXIMUM AMPLIFICATION =  13.77
 FOR FREQUENCY         =   1.31 C/SEC.
     PERIOD            =   0.77 SEC.

1******   OPTION  3  ***  READ INPUT MOTION

  FILE NAME FOR INPUT MOTION = C:\Program Files\SHAKE2000\Quakes\NPS090.eq
    NO. OF INPUT ACC. POINTS = 14000
  NO. OF POINTS USED IN FFT = 32768
       NO. OF HEADING LINES =     4
     NO. OF POINTS PER LINE =     4
 TIME STEP FOR INPUT MOTION = 0.0050
    FORMAT FOR TIME HISTORY =     (4E15.6)


 *****HEADER*****
Source File: C:\Program Files\SHAKE2000\Quakes\NPS090.TXT
SHAKE2000 Conversion:    14000      .005       4         4         15        (4E15.
Acceleration Units: (g's) - No. Values: 14000 - Time Step: .005 (secs)
Data Format: (4E15.6) - No. Header Lines:  4
 **  FIRST AND LAST 5 LINES OF INPUT MOTION *****

     1 -0.000205-0.000266-0.000266-0.000205
     2 -0.000205-0.000266-0.000266-0.000204
     3 -0.000204-0.000204-0.000204-0.000204
     4 -0.000204-0.000204-0.000265-0.000204
     5 -0.000204-0.000204-0.000204-0.000204
  ............INPUT MOTION READ NOT ECHOED...........
 3496 -0.000038-0.000039-0.000039-0.000040
 3497 -0.000041-0.000042-0.000043-0.000044
 3498 -0.000045-0.000046-0.000047-0.000048
 3499 -0.000049-0.000050-0.000051-0.000051
 3500 -0.000052-0.000053-0.000053-0.000054

 MAXIMUM ACCELERATION =  0.13365
 AT TIME              = 25.55 SEC
 THE VALUES WILL BE MULTIPLIED BY A FACTOR =  2.500
 TO GIVE NEW MAXIMUM ACCELERATION          =  0.33414
```

```
 MEAN SQUARE FREQUENCY =        3.54 C/SEC.
 MAX ACCELERATION =      0.33630 FOR FREQUENCIES REMOVED ABOVE      25.00 C/SEC.
1******   OPTION  4  ***  READ WHERE OBJECT MOTION IS GIVEN
  OBJECT MOTION IN LAYER NUMBER   18 OUTCROPPING

1******   OPTION  5  ***  OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
  MAXIMUM NUMBER OF ITERATIONS                =     5
  FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN  =     0.65

     EARTHQUAKE    - C:\Program Files\SHAKE2000\Quakes\NPS090.eq
    SOIL PROFILE - Soil Profile No.  1

   ITERATION NUMBER  1

  VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ---->    <---- SHEAR MODULUS ----->
G/Go
          (FT)   STRAIN  NEW    USED   ERROR      NEW     USED    ERROR   RATIO
--- ---- ----  -------- ----- ------ ------  -------  ------  ------  -----
  1  4    2.5 0.00628 0.030  0.050   -68.7   1727.6   1826.1    -5.7   1.000
  2  1   10.0 0.04960 0.058  0.050    13.7    562.4    704.8   -25.3   1.000
  3  1   20.0 0.06890 0.065  0.050    22.9    606.7    809.7   -33.5   1.000
  4  1   30.0 0.07935 0.068  0.050    26.3    666.3    915.0   -37.3   1.000
  5  1   40.0 0.08590 0.069  0.050    27.8    724.2   1012.6   -39.8   1.000
  6  2   50.0 0.08891 0.060  0.050    16.5    887.2   1116.8   -25.9   1.000
  7  2   60.0 0.08906 0.060  0.050    16.6    977.9   1231.3   -25.9   1.000
  8  2   70.0 0.09183 0.060  0.050    17.3   1052.7   1333.2   -26.6   1.000
  9  2   80.0 0.09404 0.061  0.050    17.9   1132.1   1440.1   -27.2   1.000
 10  2   90.0 0.09439 0.061  0.050    18.0   1222.4   1556.2   -27.3   1.000
 11  2  100.0 0.09515 0.061  0.050    18.2   1297.2   1653.8   -27.5   1.000
 12  2  110.0 0.09384 0.061  0.050    17.8   1396.3   1775.5   -27.2   1.000
 13  5  120.0 0.09154 0.055  0.050     9.8   1598.4   1907.2   -19.3   1.000
 14  5  130.0 0.09000 0.055  0.050     9.3   1694.2   2016.4   -19.0   1.000
 15  5  140.0 0.08824 0.055  0.050     8.7   1793.9   2128.7   -18.7   1.000
 16  5  150.0 0.08519 0.054  0.050     7.6   1923.3   2270.4   -18.0   1.000
 17  4  157.5 0.07879 0.081  0.050    37.9   1445.3   2505.8   -73.4   1.000
1
     EARTHQUAKE    - C:\Program Files\SHAKE2000\Quakes\NPS090.eq
    SOIL PROFILE - Soil Profile No.  1

   ITERATION NUMBER  2

  VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ---->    <---- SHEAR MODULUS ----->
G/Go
          (FT)   STRAIN  NEW    USED   ERROR      NEW     USED    ERROR   RATIO
--- ---- ----  -------- ----- ------ ------  -------  ------  ------  -----
  1  4    2.5 0.00601 0.029  0.030    -2.1   1734.5   1727.6     0.4   0.946
  2  1   10.0 0.05649 0.061  0.058     4.4    548.9    562.4    -2.5   0.798
  3  1   20.0 0.08404 0.069  0.065     5.9    582.1    606.7    -4.2   0.749
  4  1   30.0 0.10096 0.072  0.068     6.2    629.7    666.3    -5.8   0.728
  5  1   40.0 0.11246 0.076  0.069     8.3    675.4    724.2    -7.2   0.715
  6  2   50.0 0.10441 0.063  0.060     5.4    858.4    887.2    -3.4   0.794
  7  2   60.0 0.10615 0.064  0.060     6.1    942.5    977.9    -3.8   0.794
  8  2   70.0 0.11118 0.065  0.060     7.2   1008.5   1052.7    -4.4   0.790
  9  2   80.0 0.11321 0.066  0.061     7.3   1084.3   1132.1    -4.4   0.786
 10  2   90.0 0.11208 0.065  0.061     6.8   1174.7   1222.4    -4.1   0.786
 11  2  100.0 0.11292 0.066  0.061     6.9   1246.0   1297.2    -4.1   0.784
 12  2  110.0 0.11138 0.065  0.061     6.7   1342.5   1396.3    -4.0   0.786
 13  5  120.0 0.10258 0.058  0.055     4.1   1568.1   1598.4    -1.9   0.838
 14  5  130.0 0.10120 0.057  0.055     3.9   1663.1   1694.2    -1.9   0.840
 15  5  140.0 0.09905 0.057  0.055     3.6   1763.0   1793.9    -1.8   0.843
 16  5  150.0 0.09499 0.056  0.054     3.5   1892.3   1923.3    -1.6   0.847
 17  4  157.5 0.12954 0.095  0.081    15.0   1225.2   1445.3   -18.0   0.577
1
     EARTHQUAKE    - C:\Program Files\SHAKE2000\Quakes\NPS090.eq
    SOIL PROFILE - Soil Profile No.  1

   ITERATION NUMBER  3

  VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ---->    <---- SHEAR MODULUS ----->
G/Go
          (FT)   STRAIN  NEW    USED   ERROR      NEW     USED    ERROR   RATIO
--- ---- ----  -------- ----- ------ ------  -------  ------  ------  -----
  1  4    2.5 0.00581 0.028  0.029    -1.9   1737.9   1734.5     0.2   0.950
  2  1   10.0 0.05625 0.061  0.061    -0.1    549.4    548.9     0.1   0.779
  3  1   20.0 0.08538 0.069  0.069     0.4    579.9    582.1    -0.4   0.719
  4  1   30.0 0.10448 0.073  0.072     1.4    623.5    629.7    -1.0   0.688
  5  1   40.0 0.11804 0.077  0.076     1.9    665.8    675.4    -1.4   0.667
  6  2   50.0 0.10571 0.064  0.063     0.6    855.7    858.4    -0.3   0.769
  7  2   60.0 0.10960 0.065  0.064     1.5    934.9    942.5    -0.8   0.765
  8  2   70.0 0.11454 0.066  0.065     1.4   1000.8   1008.5    -0.8   0.756
  9  2   80.0 0.11647 0.067  0.066     1.3   1076.4   1084.3    -0.7   0.753
 10  2   90.0 0.11590 0.066  0.065     1.5   1164.6   1174.7    -0.9   0.755
 11  2  100.0 0.11680 0.067  0.066     1.5   1235.2   1246.0    -0.9   0.753
 12  2  110.0 0.11508 0.066  0.065     1.5   1331.2   1342.5    -0.8   0.756
 13  5  120.0 0.10379 0.058  0.058     0.6   1564.0   1568.1    -0.3   0.822
 14  5  130.0 0.10217 0.058  0.057     0.5   1659.5   1663.1    -0.2   0.825
 15  5  140.0 0.09975 0.057  0.057     0.2   1761.1   1763.0    -0.1   0.828
 16  5  150.0 0.09568 0.056  0.056     0.2   1890.2   1892.3    -0.1   0.833
 17  4  157.5 0.15187 0.100  0.095     4.8   1161.9   1225.2    -5.4   0.489
1
     EARTHQUAKE    - C:\Program Files\SHAKE2000\Quakes\NPS090.eq
    SOIL PROFILE - Soil Profile No.  1

   ITERATION NUMBER  4

  VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ---->    <---- SHEAR MODULUS ----->
G/Go
          (FT)   STRAIN  NEW    USED   ERROR      NEW     USED    ERROR   RATIO
--- ---- ----  -------- ----- ------ ------  -------  ------  ------  -----
  1  4    2.5 0.00577 0.028  0.028    -0.5   1738.7   1737.9     0.0   0.952
  2  1   10.0 0.05582 0.060  0.061    -0.3    550.2    549.4     0.1   0.779
  3  1   20.0 0.08521 0.069  0.069    -0.1    580.2    579.9     0.0   0.716
  4  1   30.0 0.10504 0.073  0.073     0.2    622.6    623.5    -0.2   0.681
  5  1   40.0 0.11925 0.077  0.077     0.4    663.8    665.8    -0.3   0.658
  6  2   50.0 0.10565 0.064  0.064     0.0    855.9    855.7     0.0   0.766
  7  2   60.0 0.11050 0.065  0.065     0.4    932.9    934.9    -0.2   0.759
  8  2   70.0 0.11524 0.066  0.066     0.3    999.2   1000.8    -0.2   0.751
  9  2   80.0 0.11715 0.067  0.067     0.3   1074.8   1076.4    -0.2   0.747
 10  2   90.0 0.11682 0.067  0.066     0.4   1162.2   1164.6    -0.2   0.748
 11  2  100.0 0.11773 0.067  0.067     0.4   1232.7   1235.2    -0.2   0.747
 12  2  110.0 0.11595 0.066  0.066     0.3   1328.7   1331.2    -0.2   0.750
 13  5  120.0 0.10394 0.058  0.058     0.1   1563.5   1564.0     0.0   0.820
 14  5  130.0 0.10226 0.058  0.058     0.0   1659.2   1659.5     0.0   0.823
 15  5  140.0 0.09970 0.057  0.057     0.0   1761.2   1761.1     0.0   0.827
 16  5  150.0 0.09566 0.056  0.056     0.0   1890.3   1890.2     0.0   0.833
 17  4  157.5 0.15998 0.101  0.100     1.6   1141.2   1161.9    -1.8   0.464
1
     EARTHQUAKE    - C:\Program Files\SHAKE2000\Quakes\NPS090.eq
    SOIL PROFILE - Soil Profile No.  1

   ITERATION NUMBER  5

  VALUES IN TIME DOMAIN

 NO TYPE DEPTH  UNIFRM. <---- DAMPING ---->    <---- SHEAR MODULUS ----->
G/Go
          (FT)   STRAIN  NEW    USED   ERROR      NEW     USED    ERROR   RATIO
--- ---- ----  -------- ----- ------ ------  -------  ------  ------  -----
  1  4    2.5 0.00576 0.028  0.028    -0.1   1738.9   1738.7     0.0   0.952
  2  1   10.0 0.05564 0.060  0.060    -0.1    550.5    550.2     0.1   0.781
  3  1   20.0 0.08505 0.069  0.069     0.0    580.5    580.2     0.0   0.717
  4  1   30.0 0.10509 0.073  0.073     0.0    622.5    622.6     0.0   0.680
  5  1   40.0 0.11952 0.077  0.077     0.1    663.4    663.8    -0.1   0.656
  6  2   50.0 0.10555 0.064  0.064     0.0    856.1    855.9     0.0   0.766
  7  2   60.0 0.11074 0.065  0.065     0.1    932.4    932.9    -0.1   0.758
  8  2   70.0 0.11542 0.066  0.066     0.1    998.8    999.2     0.0   0.749
  9  2   80.0 0.11731 0.067  0.067     0.1   1074.4   1074.8     0.0   0.746
 10  2   90.0 0.11705 0.067  0.067     0.1   1161.7   1162.2    -0.1   0.747
 11  2  100.0 0.11795 0.067  0.067     0.1   1232.1   1232.7    -0.1   0.745
 12  2  110.0 0.11616 0.066  0.066     0.1   1328.0   1328.7     0.0   0.748
 13  5  120.0 0.10395 0.058  0.058     0.0   1563.4   1563.5     0.0   0.820
 14  5  130.0 0.10225 0.058  0.058     0.0   1659.2   1659.2     0.0   0.823
 15  5  140.0 0.09966 0.057  0.057     0.0   1761.3   1761.2     0.0   0.827
 16  5  150.0 0.09565 0.056  0.056     0.0   1890.3   1890.3     0.0   0.833
 17  4  157.5 0.16288 0.102  0.101     0.5   1134.1   1141.2    -0.6   0.455

  VALUES IN TIME DOMAIN

  LAYER  TYPE       THICKNESS           DEPTH      MAX STRAIN     MAX STRESS
TIME
                        FT                FT          PRCNT           PSF
SEC

     1     4          5.0000          2.5000         0.00886         153.98
25.81
     2     1         10.0000         10.0000         0.08560         470.95
25.81
     3     1         10.0000         20.0000         0.13085         759.19
25.81
     4     1         10.0000         30.0000         0.16168        1006.55
25.82
     5     1         10.0000         40.0000         0.18387        1220.57
25.83
     6     2         10.0000         50.0000         0.16238        1389.76
25.82
     7     2         10.0000         60.0000         0.17036        1589.37
36.41
     8     2         10.0000         70.0000         0.17756        1774.26
36.40
     9     2         10.0000         80.0000         0.18048        1939.75
36.40
    10     2         10.0000         90.0000         0.18008        2092.94
36.39
    11     2         10.0000        100.0000         0.18147        2236.93
36.39
    12     2         10.0000        110.0000         0.17870        2374.33
36.40
    13     5         10.0000        120.0000         0.15993        2500.39
36.39
    14     5         10.0000        130.0000         0.15731        2609.98
36.39
    15     5         10.0000        140.0000         0.15333        2700.53
36.39
    16     5         10.0000        150.0000         0.14715        2781.45
36.40
    17     4          5.0000        157.5000         0.25059        2859.81
36.41

  PERIOD = 0.98 FROM AVERAGE SHEAR VEL. =     655.


  FREQUENCY    AMPLITUDE
 MAXIMUM AMPLIFICATION =  10.47
 FOR FREQUENCY         =   1.13 C/SEC.
     PERIOD            =   0.89 SEC.

1******   OPTION  6  ***  COMPUTE MOTION IN NEW SUBLAYERS

   EARTHQUAKE -C:\Program Files\SHAKE2000\Quakes\NPS090.eq
  SOIL DEPOSIT - Soil Profile No.  1
    LAYER          DEPTH          MAX. ACC.          TIME       MEAN SQ. FR.
ACC. RATIO       TH SAVED
                     FT                G              SEC             C/SEC
QUIET ZONE       ACC. RECORD
     OUTCR.        0.0000          0.51155         25.81            2.01
0.000              4096
     WITHIN        5.0000          0.50594         25.81            1.96
0.000                 0
     WITHIN       15.0000          0.41610         25.83            1.55
0.000                 0
     WITHIN       35.0000          0.40603         25.74            1.64
0.000                 0
     WITHIN       55.0000          0.33451         25.70            1.93
0.000                 0
     WITHIN       75.0000          0.31471         12.57            1.99
0.000                 0
     WITHIN       85.0000          0.33290         12.57            2.14
0.000                 0
     WITHIN      105.0000          0.26958         12.55            2.49
0.000                 0
```

```
     WITHIN        125.0000         0.26859          12.05           2.74
0.000                    0
     WITHIN        135.0000         0.26438          12.03           2.86
0.000                    0
     WITHIN        155.0000         0.24355          25.56           3.07
0.000                 4096
     WITHIN        160.0000         0.25805          25.55           3.37
0.000                 4096
     OUTCR.        160.0000         0.33630          25.55           3.54
0.000                 4096

1******   OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

  COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   17
  SCALE FOR PLOTTING      0.0000
 IDENTIFICATION - Stress History Layer No. 1

  COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   17
  SCALE FOR PLOTTING      0.0000
 IDENTIFICATION - Strain History Layer No. 1


  *** End of Output File No. 1 ***
```

160 FT - GM#6

```
 ***********************************************************
 * SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL *
 *     LAYERED SITES by Per Schnable & John Lysmer - 1970  *
 * ------------------------------------------------------- *
 * SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985 *
 * ------------------------------------------------------- *
 * SHAKE88 :New modulus reduction curves for clays added   *
 *      using results from Sun et al (1988) by J. I. Sun   *
 *      & Ramin Golesorkhi February 26, 1988               *
 * ------------------------------------------------------- *
 * SHAKE90/91: Adjust last iteration; Input now is either  *
 *      Gmax or max Vs; up to 13 materials can be specified*
 *      by user; up to 50 Layers can be specified; object  *
 *      motion can be read in from a separate file and can *
 *      user specified format; Different periods for res-  *
 *      ponse spectral calculations;options are renumbered;*
 *      and general cleanup by: J. I. Sun, I. M. Idriss &  *
 *      P. Dirrim June 1990 - February 1991                *
 * ------------------------------------------------------- *
 * SHAKE91: General cleanup and finalization of input out- *
 *      output format ... etc by: I. M. Idriss Dec. 1991   *
 * ------------------------------------------------------- *
 * SHAKE2000: Fix the incorrect output of Tot. Stress in   *
 * Option 2. Changed path of ground motion file in         *
 * SHAKE91.  Control file to input file names.  Modified   *
 * by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003) *
 *          RUN DATE 12/10/2007                            *
 *          RUN TIME 16:56                                 *
 ***********************************************************
 MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =     32768
 NECESSARY LENGTH OF BLANK COMMON X        =    204819

1******   OPTION  1  ***  READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

 **********************
  MATERIAL TYPE NO. 1
 **********************

 CURVE NO.  1:     MSW shallow MSW (SM<125) Zekkos, 2005
 CURVE NO.  2:     MSW shallow MSW (SM<125) Zekkos, 2005
```

CURVE NO. 1		CURVE NO. 2	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	4.00
0.0002	0.997	0.0002	4.00
0.0003	0.996	0.0003	4.10
0.0010	0.990	0.0010	4.10
0.0020	0.982	0.0020	4.20
0.0030	0.975	0.0030	4.20
0.0050	0.963	0.0050	4.20
0.0080	0.946	0.0080	4.30
0.0120	0.927	0.0120	4.50
0.0200	0.892	0.0200	4.80
0.0300	0.856	0.0300	5.20
0.0500	0.797	0.0500	5.80
0.0800	0.727	0.0800	6.80
0.1000	0.690	0.1000	7.20
0.3000	0.475	0.3000	10.50
0.5000	0.373	0.5000	12.00
1.0000	0.252	1.0000	14.00

```
 **********************
  MATERIAL TYPE NO. 2
 **********************

 CURVE NO.  3:     MSW deep    MSW (125<SM<350) Zekkos 2005
 CURVE NO.  4:     MSW deep    MSW (125<SM<350) Zekkos 2005
```

CURVE NO. 3		CURVE NO. 4	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	3.00
0.0002	0.999	0.0002	3.00
0.0003	0.998	0.0003	3.10
0.0010	0.995	0.0010	3.10
0.0020	0.992	0.0020	3.20
0.0030	0.988	0.0030	3.20
0.0050	0.981	0.0050	3.20
0.0080	0.971	0.0080	3.30
0.0120	0.959	0.0120	3.50
0.0200	0.937	0.0200	3.80
0.0300	0.911	0.0300	4.20
0.0500	0.867	0.0500	4.80
0.0800	0.810	0.0800	5.80
0.1000	0.777	0.1000	6.20
0.3000	0.564	0.3000	9.50
0.5000	0.450	0.5000	11.00
1.0000	0.305	1.0000	13.00

```
 **********************
  MATERIAL TYPE NO. 3
 **********************

 CURVE NO.  5:     Soil PI=100 G/Gmax - Soil with PI=100, OCR=1-15 (Vucetic
 CURVE NO.  6:     Soil PI=100 Damping - Soil with PI=100, OCR=1-8 (Vucetic
```

CURVE NO. 5		CURVE NO. 6	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0050	1.000	0.0010	1.20
0.0060	1.000	0.0030	1.50
0.0070	0.995	0.0050	1.70
0.0090	0.990	0.0070	1.90
0.0100	0.985	0.0090	2.00
0.0200	0.960	0.0100	2.05
0.0300	0.935	0.0200	2.50
0.0400	0.915	0.0300	2.90
0.0500	0.900	0.0400	3.10
0.0600	0.880	0.0500	3.30
0.0700	0.865	0.0600	3.50
0.0800	0.850	0.0800	3.80
0.0900	0.830	0.1000	4.00
0.1000	0.815	0.2000	5.20
0.2000	0.715	0.3000	6.10
0.3000	0.635	0.4000	6.80
0.5000	0.530	0.5000	7.40
0.6000	0.490	0.6000	8.00
0.9000	0.405	0.7000	8.60
1.0000	0.375	1.0000	9.70

```
 **********************
  MATERIAL TYPE NO. 4
 **********************

 CURVE NO.  7:     Soil PI=30  G/Gmax - Soil with PI=30, OCR=1-15 (Vucetic
 CURVE NO.  8:     Soil PI=30  Damping - Soil with PI=30, OCR=1-8 (Vucetic
```

CURVE NO. 7		CURVE NO. 8	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0010	1.000	0.0020	1.70
0.0020	0.995	0.0030	2.10
0.0030	0.985	0.0040	2.50
0.0040	0.970	0.0050	2.60
0.0050	0.960	0.0060	2.90
0.0060	0.950	0.0080	3.30
0.0080	0.925	0.0100	3.70
0.0090	0.910	0.0200	5.05
0.0100	0.900	0.0300	5.70
0.0200	0.820	0.0400	6.40
0.0300	0.745	0.0500	6.90
0.0400	0.700	0.0600	7.30
0.0700	0.600	0.0800	8.10
0.1000	0.530	0.1000	8.70
0.2000	0.420	0.2000	10.80
0.3000	0.350	0.3000	12.30
0.4000	0.305	0.4000	13.30
0.6000	0.240	0.5000	14.10
0.8000	0.205	0.7000	15.60
1.0000	0.165	1.0000	16.90

```
1******   OPTION  2  ***  READ SOIL PROFILE
 NEW SOIL PROFILE NO.      1      IDENTIFICATION  Soil Profile No.  1
 NUMBER OF LAYERS                    18          DEPTH TO BEDROCK        160.00
```

NO.	TYPE	THICKNESS (FT)	DEPTH (FT)	TOTAL PRESS. (KSF)	MODULUS (KSF)	DAMPING	UNIT WT. (KCF)	SHEAR VEL (FPS)
1	4	5.0000	2.5000	0.30	1826.	0.050	0.120	700.0
2	1	10.0000	10.0000	0.94	705.	0.050	0.067	582.0
3	1	10.0000	20.0000	1.62	810.	0.050	0.071	606.0
4	1	10.0000	30.0000	2.35	915.	0.050	0.074	631.0
5	1	10.0000	40.0000	3.10	1013.	0.050	0.076	655.0
6	2	10.0000	50.0000	3.87	1117.	0.050	0.078	679.0
7	2	10.0000	60.0000	4.66	1231.	0.050	0.080	704.0
8	2	10.0000	70.0000	5.46	1333.	0.050	0.081	728.0
9	2	10.0000	80.0000	6.28	1440.	0.050	0.082	752.0
10	2	10.0000	90.0000	7.10	1556.	0.050	0.083	777.0
11	2	10.0000	100.0000	7.93	1654.	0.050	0.083	801.0
12	2	10.0000	110.0000	8.77	1776.	0.050	0.084	825.0
13	5	10.0000	120.0000	9.61	1907.	0.050	0.085	850.0
14	5	10.0000	130.0000	10.47	2016.	0.050	0.085	874.0
15	5	10.0000	140.0000	11.32	2129.	0.050	0.085	898.0
16	5	10.0000	150.0000	12.17	2270.	0.050	0.086	922.0
17	4	5.0000	157.5000	12.90	2506.	0.050	0.120	820.0
18	BASE				13684.	0.050	0.136	1800.0

```
 PERIOD = 0.85 FROM AVERAGE SHEAR VEL. =     753.


  FREQUENCY    AMPLITUDE
 MAXIMUM AMPLIFICATION =  13.77
 FOR FREQUENCY         =   1.31 C/SEC.
     PERIOD            =   0.77 SEC.

1******   OPTION  3  ***  READ INPUT MOTION

  FILE NAME FOR INPUT MOTION = C:\Program Files\SHAKE2000\Quakes\GM#6-
ForwardM8R10.acc
     NO. OF INPUT ACC. POINTS = 19986
   NO. OF POINTS USED IN FFT = 32768
        NO. OF HEADING LINES =     4
     NO. OF POINTS PER LINE =     6
  TIME STEP FOR INPUT MOTION = 0.0050
     FORMAT FOR TIME HISTORY =     (6E12.5)


 *****HEADER*****
Source File: C:\Program Files\SHAKE2000\Quakes\GM#6-ForwardM8R10.ath
SHAKE2000 Conversion:    19986     .005       4         6         12        (6E12.
Acceleration Units: (g's) - No. Values: 19986 - Time Step: .005 (secs)
Data Format: (6E12.5) - No. Header Lines:  4
 **  FIRST AND LAST 5 LINES OF INPUT MOTION *****

     1 -0.031260-0.024950-0.017550-0.008760 0.002590 0.013150
     2  0.025550 0.035160 0.042180 0.045610 0.045720 0.043760
     3  0.040350 0.036100 0.031190 0.024810 0.017610 0.010380
     4  0.005050 0.001470 0.000720 0.003880 0.006070 0.008230
     5  0.007970 0.006090 0.003310-0.000030-0.001290-0.001830
  ............INPUT MOTION READ NOT ECHOED............
  3327 -0.003420-0.008770-0.012800-0.015380-0.016460-0.016590
  3328 -0.015860-0.015170-0.014670-0.014300-0.013770-0.013720
  3329 -0.013400-0.013020-0.012610-0.012040-0.010760-0.009150
  3330 -0.006510-0.003910-0.001660-0.000810 0.000150 0.000220
  3331 -0.000090-0.000160-0.000810-0.001770-0.002300-0.002590

 MAXIMUM ACCELERATION =  0.58301
 AT TIME              = 11.65 SEC
 THE VALUES WILL BE MULTIPLIED BY A FACTOR =  0.600
```

TO GIVE NEW MAXIMUM ACCELERATION = 0.34981
MEAN SQUARE FREQUENCY = 4.04 C/SEC.
MAX ACCELERATION = 0.35354 FOR FREQUENCIES REMOVED ABOVE 25.00 C/SEC.

1****** OPTION 4 *** READ WHERE OBJECT MOTION IS GIVEN
OBJECT MOTION IN LAYER NUMBER 18 OUTCROPPING

1****** OPTION 5 *** OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
MAXIMUM NUMBER OF ITERATIONS = 5
FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN = 0.65

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\GM#6-ForwardM8R10.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 1

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00653	0.030	0.050	-65.7	1721.4	1826.1	-6.1	1.000
2	1	10.0	0.05122	0.059	0.050	14.6	559.2	704.8	-26.0	1.000
3	1	20.0	0.06999	0.065	0.050	23.3	604.8	809.7	-33.9	1.000
4	1	30.0	0.07990	0.068	0.050	26.4	665.4	915.0	-37.5	1.000
5	1	40.0	0.08820	0.070	0.050	28.3	719.8	1012.6	-40.7	1.000
6	2	50.0	0.09168	0.060	0.050	17.3	882.1	1116.8	-26.6	1.000
7	2	60.0	0.09126	0.060	0.050	17.2	973.4	1231.3	-26.5	1.000
8	2	70.0	0.08977	0.060	0.050	16.8	1057.2	1333.2	-26.1	1.000
9	2	80.0	0.08636	0.059	0.050	15.8	1150.2	1440.1	-25.2	1.000
10	2	90.0	0.08555	0.059	0.050	15.5	1245.1	1556.2	-25.0	1.000
11	2	100.0	0.08809	0.060	0.050	16.3	1316.0	1653.8	-25.7	1.000
12	2	110.0	0.08778	0.060	0.050	16.2	1413.8	1775.5	-25.6	1.000
13	5	120.0	0.08579	0.054	0.050	7.8	1614.0	1907.2	-18.2	1.000
14	5	130.0	0.08603	0.054	0.050	7.9	1705.7	2016.4	-18.2	1.000
15	5	140.0	0.08530	0.054	0.050	7.7	1802.9	2128.7	-18.1	1.000
16	5	150.0	0.08272	0.054	0.050	6.7	1931.7	2270.4	-17.5	1.000
17	4	157.5	0.07673	0.080	0.050	37.4	1458.4	2505.8	-71.8	1.000

1
EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\GM#6-ForwardM8R10.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 2

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00642	0.030	0.030	-0.8	1724.0	1721.4	0.2	0.943
2	1	10.0	0.05974	0.062	0.059	5.3	543.0	559.2	-3.0	0.793
3	1	20.0	0.08685	0.069	0.065	6.2	577.7	604.8	-4.7	0.747
4	1	30.0	0.10199	0.073	0.068	6.4	627.8	665.4	-6.0	0.727
5	1	40.0	0.10975	0.075	0.070	6.7	680.3	719.8	-5.8	0.711
6	2	50.0	0.10327	0.063	0.060	4.0	860.8	882.1	-2.5	0.790
7	2	60.0	0.10308	0.063	0.060	4.1	949.5	973.4	-2.5	0.791
8	2	70.0	0.10257	0.063	0.060	4.3	1029.3	1057.2	-2.7	0.793
9	2	80.0	0.10244	0.063	0.059	5.3	1112.2	1150.2	-3.4	0.799
10	2	90.0	0.10054	0.062	0.059	4.8	1207.5	1245.1	-3.1	0.800
11	2	100.0	0.09895	0.062	0.060	3.4	1287.6	1316.0	-2.2	0.796
12	2	110.0	0.09803	0.062	0.060	3.2	1384.8	1413.8	-2.1	0.796
13	5	120.0	0.09156	0.055	0.054	2.1	1598.4	1614.0	-1.0	0.846
14	5	130.0	0.09045	0.055	0.054	1.6	1693.0	1705.7	-0.7	0.846
15	5	140.0	0.08773	0.055	0.054	0.9	1795.4	1802.9	-0.4	0.847
16	5	150.0	0.08453	0.054	0.054	0.7	1925.5	1931.7	-0.3	0.851
17	4	157.5	0.11481	0.091	0.080	12.4	1273.2	1458.4	-14.5	0.582

1
EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\GM#6-ForwardM8R10.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 3

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00630	0.030	0.030	-0.9	1727.2	1724.0	0.2	0.944
2	1	10.0	0.06039	0.062	0.062	0.4	541.9	543.0	-0.2	0.770
3	1	20.0	0.08838	0.070	0.069	0.4	575.3	577.7	-0.4	0.713
4	1	30.0	0.10397	0.073	0.073	0.8	624.4	627.8	-0.6	0.686
5	1	40.0	0.11437	0.076	0.075	1.6	672.1	680.3	-1.2	0.672
6	2	50.0	0.10414	0.063	0.063	0.4	859.0	860.8	-0.2	0.771
7	2	60.0	0.10401	0.063	0.063	0.4	947.4	949.5	-0.2	0.771
8	2	70.0	0.10431	0.063	0.063	0.8	1025.0	1029.3	-0.4	0.772
9	2	80.0	0.10513	0.064	0.063	1.2	1105.0	1112.2	-0.7	0.772
10	2	90.0	0.10297	0.063	0.062	1.1	1200.3	1207.5	-0.6	0.776
11	2	100.0	0.10096	0.062	0.062	0.8	1282.0	1287.6	-0.4	0.779
12	2	110.0	0.09929	0.062	0.062	0.4	1381.5	1384.8	-0.2	0.780
13	5	120.0	0.08969	0.055	0.055	-0.7	1603.3	1598.4	0.3	0.838
14	5	130.0	0.08978	0.055	0.055	-0.2	1694.9	1693.0	0.1	0.840
15	5	140.0	0.08856	0.055	0.055	0.3	1792.9	1795.4	-0.1	0.843
16	5	150.0	0.08551	0.054	0.054	0.4	1922.2	1925.5	-0.2	0.848
17	4	157.5	0.13258	0.096	0.091	4.6	1215.9	1273.2	-4.7	0.508

1
EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\GM#6-ForwardM8R10.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 4

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00625	0.030	0.030	-0.4	1728.4	1727.2	0.1	0.946
2	1	10.0	0.06027	0.062	0.062	-0.1	542.1	541.9	0.0	0.769
3	1	20.0	0.08835	0.070	0.070	0.0	575.4	575.3	0.0	0.710
4	1	30.0	0.10366	0.073	0.073	-0.1	624.9	624.4	0.1	0.682
5	1	40.0	0.11539	0.076	0.076	0.3	670.3	672.1	-0.3	0.664
6	2	50.0	0.10405	0.063	0.063	0.0	859.2	859.0	0.0	0.769
7	2	60.0	0.10397	0.063	0.063	0.0	947.5	947.4	0.0	0.769
8	2	70.0	0.10455	0.063	0.063	0.1	1024.4	1025.0	-0.1	0.769
9	2	80.0	0.10563	0.064	0.064	0.2	1103.7	1105.0	-0.1	0.767
10	2	90.0	0.10344	0.063	0.063	0.2	1199.0	1200.3	-0.1	0.771
11	2	100.0	0.10155	0.062	0.062	0.3	1280.1	1282.0	-0.1	0.775
12	2	110.0	0.09969	0.062	0.062	0.1	1380.4	1381.5	-0.1	0.778
13	5	120.0	0.08960	0.055	0.055	0.0	1603.5	1603.3	0.0	0.841
14	5	130.0	0.08989	0.055	0.055	0.0	1694.6	1694.9	0.0	0.841
15	5	140.0	0.08887	0.055	0.055	0.1	1792.0	1792.9	-0.1	0.842
16	5	150.0	0.08583	0.054	0.054	0.1	1921.2	1922.2	-0.1	0.847
17	4	157.5	0.13903	0.097	0.096	1.5	1197.1	1215.9	-1.6	0.485

1
EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\GM#6-ForwardM8R10.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 5

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ----> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00623	0.030	0.030	-0.1	1728.7	1728.4	0.0	0.946
2	1	10.0	0.06018	0.062	0.062	-0.1	542.3	542.1	0.0	0.769
3	1	20.0	0.08823	0.070	0.070	0.0	575.5	575.4	0.0	0.711
4	1	30.0	0.10334	0.073	0.073	-0.1	625.5	624.9	0.1	0.683
5	1	40.0	0.11562	0.076	0.076	0.1	669.9	670.3	-0.1	0.662
6	2	50.0	0.10397	0.063	0.063	0.0	859.3	859.2	0.0	0.769
7	2	60.0	0.10391	0.063	0.063	0.0	947.6	947.5	0.0	0.769
8	2	70.0	0.10457	0.063	0.063	0.0	1024.3	1024.4	0.0	0.768
9	2	80.0	0.10573	0.064	0.064	0.0	1103.4	1103.7	0.0	0.766
10	2	90.0	0.10355	0.063	0.063	0.0	1198.7	1199.0	0.0	0.770
11	2	100.0	0.10175	0.063	0.062	0.1	1279.5	1280.1	0.0	0.774
12	2	110.0	0.09981	0.062	0.062	0.0	1380.1	1380.4	0.0	0.777
13	5	120.0	0.08964	0.055	0.055	0.0	1603.4	1603.5	0.0	0.841
14	5	130.0	0.08997	0.055	0.055	0.0	1694.3	1694.6	0.0	0.840
15	5	140.0	0.08897	0.055	0.055	0.0	1791.7	1792.0	0.0	0.842
16	5	150.0	0.08593	0.054	0.054	0.0	1920.8	1921.2	0.0	0.846
17	4	157.5	0.14127	0.097	0.097	0.5	1190.7	1197.1	-0.5	0.478

VALUES IN TIME DOMAIN

LAYER	TYPE	THICKNESS FT	DEPTH FT	MAX STRAIN PRCNT	MAX STRESS PSF	TIME SEC
1	4	5.0000	2.5000	0.00959	165.73	11.26
2	1	10.0000	10.0000	0.09258	501.92	11.26
3	1	10.0000	20.0000	0.13574	781.00	11.67
4	1	10.0000	30.0000	0.15899	993.54	11.66
5	1	10.0000	40.0000	0.17787	1192.32	11.24
6	2	10.0000	50.0000	0.15996	1374.29	11.24
7	2	10.0000	60.0000	0.15987	1514.67	11.23
8	2	10.0000	70.0000	0.16087	1647.98	11.21
9	2	10.0000	80.0000	0.16265	1795.14	11.20
10	2	10.0000	90.0000	0.15930	1909.95	11.20
11	2	10.0000	100.0000	0.15653	2003.74	11.23
12	2	10.0000	110.0000	0.15356	2119.77	11.22
13	5	10.0000	120.0000	0.13791	2211.41	11.22
14	5	10.0000	130.0000	0.13841	2345.51	11.26
15	5	10.0000	140.0000	0.13688	2452.80	11.26
16	5	10.0000	150.0000	0.13220	2539.78	11.25
17	4	5.0000	157.5000	0.21734	2601.74	11.24

PERIOD = 0.97 FROM AVERAGE SHEAR VEL. = 661.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 10.99
FOR FREQUENCY = 1.15 C/SEC.
PERIOD = 0.87 SEC.

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\Program Files\SHAKE2000\Quakes\GM#6-ForwardM8R10.eq
SOIL DEPOSIT - Soil Profile No. 1

LAYER	DEPTH FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	ACC. RATIO	TH SAVED QUIET ZONE	ACC. RECORD
OUTCR.	0.0000	0.55198	11.26	2.77	0.000	4096	
WITHIN	5.0000	0.54194	11.26	2.73	0.000	0	
WITHIN	15.0000	0.44504	11.88	2.26	0.000	0	
WITHIN	35.0000	0.37919	11.19	2.67	0.000	0	
WITHIN	55.0000	0.38350	11.16	3.08	0.000	0	
WITHIN	75.0000	0.35281	11.12	3.13	0.000	0	
WITHIN	85.0000	0.37888	11.11	3.22	0.000	0	

```
     WITHIN        105.0000          0.35443           11.09            3.37
0.000                   0
     WITHIN        125.0000          0.28736           16.23            3.54
0.000                   0
     WITHIN        135.0000          0.27290           16.22            3.61
0.000                   0
     WITHIN        155.0000          0.26105           11.65            3.73
0.000                4096
     WITHIN        160.0000          0.27553           11.64            3.90
0.000                4096
     OUTCR.        160.0000          0.35354           11.01            4.04
0.000                4096

1******   OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

  COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   17
  SCALE FOR PLOTTING      0.0000
 IDENTIFICATION - Stress History Layer No. 1

  COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   17
  SCALE FOR PLOTTING      0.0000
 IDENTIFICATION - Strain History Layer No. 1


  *** End of Output File No. 1 ***
```

160 ft - GM#7

```
*************************************************************
* SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL   *
*     LAYERED SITES by Per Schnable & John Lysmer - 1970    *
* --------------------------------------------------------- *
* SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985   *
* --------------------------------------------------------- *
* SHAKE88 :New modulus reduction curves for clays added     *
*      using results from Sun et al (1988) by J. I. Sun     *
*      & Ramin Golesorkhi February 26, 1988                 *
* ----------------------------------------------------------*
* SHAKE90/91: Adjust last iteration; Input now is either    *
*      Gmax or max Vs; up to 13 materials can be specified  *
*      by user; up to 50 Layers can be specified; object    *
*      motion can be read in from a separate file and can   *
*      user specified format; Different periods for res-    *
*      ponse spectral calculations;options are renumbered;  *
*      and general cleanup by: J. I. Sun, I. M. Idriss &    *
*      P. Dirrim June 1990 - February 1991                  *
* --------------------------------------------------------- *
* SHAKE91: General cleanup and finalization of input out-   *
*      output format ... etc by: I. M. Idriss Dec. 1991     *
* --------------------------------------------------------- *
* SHAKE2000: Fix the incorrect output of Tot. Stress in     *
* Option 2. Changed path of ground motion file in           *
* SHAKE91.  Control file to input file names.  Modified     *
* by Jerald M. LaVassar & Gustavo A. Ordonez (March 2003)   *
*          RUN DATE 12/10/2007                              *
*          RUN TIME 17:00                                   *
*************************************************************
 MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =     32768
 NECESSARY LENGTH OF BLANK COMMON X        =    204819

1******   OPTION  1  ***  READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

 **********************
  MATERIAL TYPE NO. 1
 **********************

 CURVE NO.  1:     MSW shallow MSW (SM<125) Zekkos, 2005
 CURVE NO.  2:     MSW shallow MSW (SM<125) Zekkos, 2005
```

CURVE NO. 1		CURVE NO. 2	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	4.00
0.0002	0.997	0.0002	4.00
0.0003	0.996	0.0003	4.10
0.0010	0.990	0.0010	4.10
0.0020	0.982	0.0020	4.20
0.0030	0.975	0.0030	4.20
0.0050	0.963	0.0050	4.20
0.0080	0.946	0.0080	4.30
0.0120	0.927	0.0120	4.50
0.0200	0.892	0.0200	4.80
0.0300	0.856	0.0300	5.20
0.0500	0.797	0.0500	5.80
0.0800	0.727	0.0800	6.80
0.1000	0.690	0.1000	7.20
0.3000	0.475	0.3000	10.50
0.5000	0.373	0.5000	12.00
1.0000	0.252	1.0000	14.00

```
 **********************
  MATERIAL TYPE NO. 2
 **********************

 CURVE NO.  3:     MSW deep    MSW (125<SM<350) Zekkos 2005
 CURVE NO.  4:     MSW deep    MSW (125<SM<350) Zekkos 2005
```

CURVE NO. 3		CURVE NO. 4	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0001	1.000	0.0001	3.00
0.0002	0.999	0.0002	3.00
0.0003	0.998	0.0003	3.10
0.0010	0.995	0.0010	3.10
0.0020	0.992	0.0020	3.20
0.0030	0.988	0.0030	3.20
0.0050	0.981	0.0050	3.20
0.0080	0.971	0.0080	3.30
0.0120	0.959	0.0120	3.50
0.0200	0.937	0.0200	3.80
0.0300	0.911	0.0300	4.20
0.0500	0.867	0.0500	4.80
0.0800	0.810	0.0800	5.80
0.1000	0.777	0.1000	6.20
0.3000	0.564	0.3000	9.50
0.5000	0.450	0.5000	11.00
1.0000	0.305	1.0000	13.00

```
 **********************
  MATERIAL TYPE NO. 3
 **********************

 CURVE NO.  5:     Soil PI=100 G/Gmax - Soil with PI=100, OCR=1-15 (Vucetic
 CURVE NO.  6:     Soil PI=100 Damping - Soil with PI=100, OCR=1-8 (Vucetic
```

CURVE NO. 5		CURVE NO. 6	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0050	1.000	0.0010	1.20
0.0060	1.000	0.0030	1.50
0.0070	0.995	0.0050	1.70
0.0090	0.990	0.0070	1.90
0.0100	0.985	0.0090	2.00
0.0200	0.960	0.0100	2.05
0.0300	0.935	0.0200	2.50
0.0400	0.915	0.0300	2.90
0.0500	0.900	0.0400	3.10
0.0600	0.880	0.0500	3.30
0.0700	0.865	0.0600	3.50
0.0800	0.850	0.0800	3.80
0.0900	0.830	0.1000	4.00
0.1000	0.815	0.2000	5.20
0.2000	0.715	0.3000	6.10
0.3000	0.635	0.4000	6.80
0.5000	0.530	0.5000	7.40
0.6000	0.490	0.6000	8.00
0.9000	0.405	0.7000	8.60
1.0000	0.375	1.0000	9.70

```
 **********************
  MATERIAL TYPE NO. 4
 **********************

 CURVE NO.  7:     Soil PI=30  G/Gmax - Soil with PI=30, OCR=1-15 (Vucetic
 CURVE NO.  8:     Soil PI=30  Damping - Soil with PI=30, OCR=1-8 (Vucetic
```

CURVE NO. 7		CURVE NO. 8	
STRAIN	G/GMAX	STRAIN	DAMPING
0.0010	1.000	0.0020	1.70
0.0020	0.995	0.0030	2.10
0.0030	0.985	0.0040	2.50
0.0040	0.970	0.0050	2.60
0.0050	0.960	0.0060	2.90
0.0060	0.950	0.0080	3.30
0.0080	0.925	0.0100	3.70
0.0090	0.910	0.0200	5.05
0.0100	0.900	0.0300	5.70
0.0200	0.820	0.0400	6.40
0.0300	0.745	0.0500	6.90
0.0400	0.700	0.0600	7.30
0.0700	0.600	0.0800	8.10
0.1000	0.530	0.1000	8.70
0.2000	0.420	0.2000	10.80
0.3000	0.350	0.3000	12.30
0.4000	0.305	0.4000	13.30
0.6000	0.240	0.5000	14.10
0.8000	0.205	0.7000	15.60
1.0000	0.165	1.0000	16.90

```
1******   OPTION  2  ***  READ SOIL PROFILE
 NEW SOIL PROFILE NO.      1      IDENTIFICATION  Soil Profile No.  1
 NUMBER OF LAYERS                    18          DEPTH TO BEDROCK          160.00
```

NO.	TYPE	THICKNESS (FT)	DEPTH (FT)	TOTAL PRESS. (KSF)	MODULUS (KSF)	DAMPING	UNIT WT. (KCF)	SHEAR VEL (FPS)
1	4	5.0000	2.5000	0.30	1826.	0.050	0.120	700.0
2	1	10.0000	10.0000	0.94	705.	0.050	0.067	582.0
3	1	10.0000	20.0000	1.62	810.	0.050	0.071	606.0
4	1	10.0000	30.0000	2.35	915.	0.050	0.074	631.0
5	1	10.0000	40.0000	3.10	1013.	0.050	0.076	655.0
6	2	10.0000	50.0000	3.87	1117.	0.050	0.078	679.0
7	2	10.0000	60.0000	4.66	1231.	0.050	0.080	704.0
8	2	10.0000	70.0000	5.46	1333.	0.050	0.081	728.0
9	2	10.0000	80.0000	6.28	1440.	0.050	0.082	752.0
10	2	10.0000	90.0000	7.10	1556.	0.050	0.083	777.0
11	2	10.0000	100.0000	7.93	1654.	0.050	0.083	801.0
12	2	10.0000	110.0000	8.77	1776.	0.050	0.084	825.0
13	5	10.0000	120.0000	9.61	1907.	0.050	0.085	850.0
14	5	10.0000	130.0000	10.47	2016.	0.050	0.085	874.0
15	5	10.0000	140.0000	11.32	2129.	0.050	0.085	898.0
16	5	10.0000	150.0000	12.17	2270.	0.050	0.086	922.0
17	4	5.0000	157.5000	12.90	2506.	0.050	0.120	820.0
18	BASE				13684.	0.050	0.136	1800.0

```
 PERIOD = 0.85 FROM AVERAGE SHEAR VEL. =     753.


  FREQUENCY    AMPLITUDE
 MAXIMUM AMPLIFICATION =  13.77
 FOR FREQUENCY         =   1.31 C/SEC.
     PERIOD            =   0.77 SEC.

1******   OPTION  3  ***  READ INPUT MOTION

  FILE NAME FOR INPUT MOTION = C:\Program Files\SHAKE2000\Quakes\TAB-LN.eq
    NO. OF INPUT ACC. POINTS =  1640
  NO. OF POINTS USED IN FFT  =  2048
       NO. OF HEADING LINES  =     4
     NO. OF POINTS PER LINE  =     4
  TIME STEP FOR INPUT MOTION = 0.0200
     FORMAT FOR TIME HISTORY =     (4e15.6)


 *****HEADER*****
Source File: C:\Program Files\SHAKE2000\Quakes\TAB-LN.TXT
SHAKE2000 Conversion:    1640      .02       4          4          15          (4e15.
Acceleration Units: (g's) - No. Values: 1640 - Time Step: .02 (secs)
Data Format: (4e15.6) - No. Header Lines:  4
 **  FIRST AND LAST 5 LINES OF INPUT MOTION *****

    1 -0.009931-0.012427-0.010033-0.000049
    2 -0.007329-0.017854-0.005761 0.004277
    3 -0.011388-0.020884-0.006605 0.001884
    4 -0.009621-0.015898-0.008119-0.004092
    5 -0.004034-0.000578 0.003463 0.003607
 ............INPUT MOTION READ NOT ECHOED...........
  406  0.001287 0.000331-0.000240-0.000475
  407 -0.000435 0.000193 0.001144 0.001872
  408  0.001892 0.001463 0.001215 0.000922
  409  0.000673 0.000502 0.000252 0.000030
  410 -0.000151-0.000303-0.000478-0.000687

 MAXIMUM ACCELERATION =  0.83581
 AT TIME              = 10.50 SEC
 THE VALUES WILL BE MULTIPLIED BY A FACTOR =  0.450
 TO GIVE NEW MAXIMUM ACCELERATION          =  0.37611
```

MEAN SQUARE FREQUENCY = 4.03 C/SEC.
MAX ACCELERATION = 0.37611 FOR FREQUENCIES REMOVED ABOVE 25.00 C/SEC.
1****** OPTION 4 *** READ WHERE OBJECT MOTION IS GIVEN
OBJECT MOTION IN LAYER NUMBER 18 OUTCROPPING

1****** OPTION 5 *** OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
MAXIMUM NUMBER OF ITERATIONS = 5
FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN = 0.65

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\TAB-LN.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 1

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ---- NEW	USED	ERROR	<---- SHEAR MODULUS ----- NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00735	0.032	0.050	-57.1	1702.6	1826.1	-7.3	1.000
2	1	10.0	0.05794	0.061	0.050	18.2	546.2	704.8	-29.0	1.000
3	1	20.0	0.08228	0.069	0.050	27.0	584.9	809.7	-38.4	1.000
4	1	30.0	0.09536	0.071	0.050	29.7	638.6	915.0	-43.3	1.000
5	1	40.0	0.09997	0.072	0.050	30.6	698.7	1012.6	-44.9	1.000
6	2	50.0	0.09814	0.062	0.050	18.9	870.9	1116.8	-28.2	1.000
7	2	60.0	0.09628	0.061	0.050	18.5	963.7	1231.3	-27.8	1.000
8	2	70.0	0.09750	0.062	0.050	18.8	1040.9	1333.2	-28.1	1.000
9	2	80.0	0.09556	0.061	0.050	18.3	1128.6	1440.1	-27.6	1.000
10	2	90.0	0.09016	0.060	0.050	16.9	1233.0	1556.2	-26.2	1.000
11	2	100.0	0.09319	0.061	0.050	17.7	1302.3	1653.8	-27.0	1.000
12	2	110.0	0.09387	0.061	0.050	17.9	1396.2	1775.5	-27.2	1.000
13	5	120.0	0.09251	0.056	0.050	10.1	1595.9	1907.2	-19.5	1.000
14	5	130.0	0.09332	0.056	0.050	10.3	1685.1	2016.4	-19.7	1.000
15	5	140.0	0.09343	0.056	0.050	10.4	1778.6	2128.7	-19.7	1.000
16	5	150.0	0.09071	0.055	0.050	9.5	1905.4	2270.4	-19.2	1.000
17	4	157.5	0.08335	0.082	0.050	39.1	1417.6	2505.8	-76.8	1.000

1
EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\TAB-LN.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 2

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ---- NEW	USED	ERROR	<---- SHEAR MODULUS ----- NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00708	0.031	0.032	-1.7	1708.6	1702.6	0.4	0.932
2	1	10.0	0.06797	0.065	0.061	5.3	529.5	546.2	-3.2	0.775
3	1	20.0	0.10262	0.073	0.069	5.9	554.6	584.9	-5.5	0.722
4	1	30.0	0.12087	0.078	0.071	8.4	597.4	638.6	-6.9	0.698
5	1	40.0	0.12880	0.080	0.072	9.6	648.5	698.7	-7.7	0.690
6	2	50.0	0.11485	0.066	0.062	6.8	837.8	870.9	-3.9	0.780
7	2	60.0	0.11351	0.066	0.061	6.8	926.5	963.7	-4.0	0.783
8	2	70.0	0.11204	0.065	0.062	5.9	1006.5	1040.9	-3.4	0.781
9	2	80.0	0.11153	0.065	0.061	6.3	1088.5	1128.6	-3.7	0.784
10	2	90.0	0.11290	0.066	0.060	8.4	1172.5	1233.0	-5.2	0.792
11	2	100.0	0.11527	0.066	0.061	8.3	1239.5	1302.3	-5.1	0.787
12	2	110.0	0.11105	0.065	0.061	6.6	1343.5	1396.2	-3.9	0.786
13	5	120.0	0.10070	0.057	0.056	2.8	1574.8	1595.9	-1.3	0.837
14	5	130.0	0.10027	0.057	0.056	2.3	1666.6	1685.1	-1.1	0.836
15	5	140.0	0.10048	0.057	0.056	2.4	1758.5	1778.6	-1.1	0.836
16	5	150.0	0.09843	0.057	0.055	2.6	1882.1	1905.4	-1.2	0.839
17	4	157.5	0.14018	0.097	0.082	15.6	1193.8	1417.6	-18.8	0.566

1
EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\TAB-LN.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 3

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ---- NEW	USED	ERROR	<---- SHEAR MODULUS ----- NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00715	0.031	0.031	0.4	1707.1	1708.6	-0.1	0.936
2	1	10.0	0.07024	0.065	0.065	1.1	526.0	529.5	-0.7	0.751
3	1	20.0	0.10640	0.074	0.073	1.5	548.9	554.6	-1.0	0.685
4	1	30.0	0.12546	0.079	0.078	1.4	590.7	597.4	-1.1	0.653
5	1	40.0	0.13589	0.081	0.080	2.0	637.9	648.5	-1.7	0.640
6	2	50.0	0.11808	0.067	0.066	1.2	831.8	837.8	-0.7	0.750
7	2	60.0	0.11543	0.066	0.066	0.8	922.5	926.5	-0.4	0.752
8	2	70.0	0.11310	0.066	0.065	0.4	1004.1	1006.5	-0.2	0.755
9	2	80.0	0.11391	0.066	0.065	1.0	1082.6	1088.5	-0.5	0.756
10	2	90.0	0.11569	0.066	0.066	1.1	1165.2	1172.5	-0.6	0.753
11	2	100.0	0.11760	0.067	0.066	0.9	1233.0	1239.5	-0.5	0.749
12	2	110.0	0.11148	0.065	0.065	0.2	1342.2	1343.5	-0.1	0.757
13	5	120.0	0.10080	0.057	0.057	0.1	1574.4	1574.8	0.0	0.826
14	5	130.0	0.10002	0.057	0.057	-0.1	1667.5	1666.6	0.1	0.826
15	5	140.0	0.10055	0.057	0.057	0.0	1758.3	1758.5	0.0	0.826
16	5	150.0	0.09855	0.057	0.057	0.0	1881.8	1882.1	0.0	0.829
17	4	157.5	0.16529	0.102	0.097	4.9	1128.3	1193.8	-5.8	0.476

1
EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\TAB-LN.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 4

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ---- NEW	USED	ERROR	<---- SHEAR MODULUS ----- NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00716	0.031	0.031	0.1	1706.7	1707.1	0.0	0.935
2	1	10.0	0.07062	0.065	0.065	0.2	525.5	526.0	-0.1	0.746
3	1	20.0	0.10701	0.074	0.074	0.2	548.0	548.9	-0.2	0.678
4	1	30.0	0.12629	0.079	0.079	0.3	589.6	590.7	-0.2	0.646
5	1	40.0	0.13777	0.082	0.081	0.5	635.2	637.9	-0.4	0.630
6	2	50.0	0.11840	0.067	0.067	0.1	831.2	831.8	-0.1	0.745
7	2	60.0	0.11523	0.066	0.066	-0.1	922.9	922.5	0.0	0.749
8	2	70.0	0.11280	0.066	0.066	-0.1	1004.8	1004.1	0.1	0.753
9	2	80.0	0.11414	0.066	0.066	0.1	1082.0	1082.6	-0.1	0.752
10	2	90.0	0.11585	0.066	0.066	0.1	1164.8	1165.2	0.0	0.749
11	2	100.0	0.11741	0.067	0.067	-0.1	1233.5	1233.0	0.0	0.746
12	2	110.0	0.11078	0.065	0.065	-0.3	1344.4	1342.2	0.2	0.756
13	5	120.0	0.10052	0.057	0.057	-0.1	1575.4	1574.4	0.1	0.826
14	5	130.0	0.09975	0.057	0.057	-0.1	1668.2	1667.5	0.0	0.827
15	5	140.0	0.10035	0.057	0.057	-0.1	1759.0	1758.3	0.0	0.826
16	5	150.0	0.09834	0.057	0.057	-0.1	1882.4	1881.8	0.0	0.829
17	4	157.5	0.17470	0.104	0.102	1.6	1106.2	1128.3	-2.0	0.450

1
EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\TAB-LN.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 5

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ---- NEW	USED	ERROR	<---- SHEAR MODULUS ----- NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00716	0.031	0.031	0.0	1706.6	1706.7	0.0	0.935
2	1	10.0	0.07069	0.065	0.065	0.0	525.4	525.5	0.0	0.746
3	1	20.0	0.10711	0.074	0.074	0.0	547.8	548.0	0.0	0.677
4	1	30.0	0.12639	0.079	0.079	0.0	589.4	589.6	0.0	0.644
5	1	40.0	0.13824	0.082	0.082	0.1	634.5	635.2	-0.1	0.627
6	2	50.0	0.11835	0.067	0.067	0.0	831.3	831.2	0.0	0.744
7	2	60.0	0.11503	0.066	0.066	-0.1	923.3	922.9	0.0	0.750
8	2	70.0	0.11261	0.066	0.066	-0.1	1005.2	1004.8	0.0	0.754
9	2	80.0	0.11412	0.066	0.066	0.0	1082.1	1082.0	0.0	0.751
10	2	90.0	0.11584	0.066	0.066	0.0	1164.8	1164.8	0.0	0.748
11	2	100.0	0.11722	0.067	0.067	-0.1	1234.1	1233.5	0.0	0.746
12	2	110.0	0.11048	0.065	0.065	-0.1	1345.3	1344.4	0.1	0.757
13	5	120.0	0.10039	0.057	0.057	-0.1	1575.9	1575.4	0.0	0.826
14	5	130.0	0.09967	0.057	0.057	0.0	1668.4	1668.2	0.0	0.827
15	5	140.0	0.10028	0.057	0.057	0.0	1759.3	1759.0	0.0	0.826
16	5	150.0	0.09827	0.057	0.057	0.0	1882.6	1882.4	0.0	0.829
17	4	157.5	0.17819	0.105	0.104	0.6	1098.4	1106.2	-0.7	0.441

VALUES IN TIME DOMAIN

LAYER	TYPE	THICKNESS FT	DEPTH FT	MAX STRAIN PRCNT	MAX STRESS PSF	TIME SEC
1	4	5.0000	2.5000	0.01102	188.12	10.76
2	1	10.0000	10.0000	0.10875	571.47	10.76
3	1	10.0000	20.0000	0.16479	903.01	10.76
4	1	10.0000	30.0000	0.19445	1146.42	11.74
5	1	10.0000	40.0000	0.21268	1350.98	11.74
6	2	10.0000	50.0000	0.18208	1513.45	11.72
7	2	10.0000	60.0000	0.17697	1633.29	11.70
8	2	10.0000	70.0000	0.17324	1740.66	11.68
9	2	10.0000	80.0000	0.17556	1899.68	11.66
10	2	10.0000	90.0000	0.17821	2075.79	11.66
11	2	10.0000	100.0000	0.18035	2224.66	11.64
12	2	10.0000	110.0000	0.16997	2285.01	11.64
13	5	10.0000	120.0000	0.15445	2433.23	11.24
14	5	10.0000	130.0000	0.15334	2558.06	11.24
15	5	10.0000	140.0000	0.15427	2713.71	11.22
16	5	10.0000	150.0000	0.15119	2845.95	11.20
17	4	5.0000	157.5000	0.27414	3032.65	11.20

PERIOD = 0.98 FROM AVERAGE SHEAR VEL. = 651.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 10.44
FOR FREQUENCY = 1.13 C/SEC.
PERIOD = 0.89 SEC.

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

EARTHQUAKE -C:\Program Files\SHAKE2000\Quakes\TAB-LN.eq
SOIL DEPOSIT - Soil Profile No. 1

LAYER	DEPTH TH SAVED FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	ACC. RATIO
QUIET ZONE	ACC. RECORD				
OUTCR.	0.0000	0.62758	10.76	2.16	
	256				0.010
WITHIN	5.0000	0.62072	10.76	2.12	
	0				0.010
WITHIN	15.0000	0.49988	11.74	1.64	
	0				0.012
WITHIN	35.0000	0.40300	10.46	1.98	
	0				0.016
WITHIN	55.0000	0.37116	11.62	2.30	
	0				0.016
WITHIN	75.0000	0.38634	11.64	2.44	
	0				0.013
WITHIN	85.0000	0.33165	11.62	2.67	
	0				0.013
WITHIN	105.0000	0.33640	10.36	3.21	
	0				0.010

```
     WITHIN        125.0000         0.29031          11.98           3.58
0.008                   0
     WITHIN        135.0000         0.31311          11.98           3.69
0.006                   0
     WITHIN        155.0000         0.30806          10.50           3.93
0.006                 256
     WITHIN        160.0000         0.30831          10.84           4.12
0.006                 256
     OUTCR.        160.0000         0.37611          10.50           4.03
0.001                 256

1******   OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

  COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   17
  SCALE FOR PLOTTING      0.0000
 IDENTIFICATION - Stress History Layer No. 1

  COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   17
  SCALE FOR PLOTTING      0.0000
 IDENTIFICATION - Strain History Layer No. 1


  *** End of Output File No. 1 ***
```

160ft - GM #8

```
 ***********************************************************
 * SHAKE: PROGRAM FOR EARTHQUAKE RESPONSE ANAL. HORIZONTAL *
 *     LAYERED SITES by Per Schnable & John Lysmer - 1970  *
 * ------------------------------------------------------- *
 * SHAKE85: IBM PC SHAKE VERSION S.S.(Willie) Lai,Jan 1985 *
 * ------------------------------------------------------- *
 * SHAKE88 :New modulus reduction curves for clays added   *
 *      using results from Sun et al (1988) by J. I. Sun   *
 *      & Ramin Golesorkhi February 26, 1988               *
 *  -----------------------------------------------------  *
 * SHAKE90/91: Adjust last iteration; Input now is either  *
 *      Gmax or max Vs; up to 13 materials can be specified*
 *      by user; up to 50 Layers can be specified; object  *
 *      motion can be read in from a separate file and can *
 *      user specified format; Different periods for res-  *
 *      ponse spectral calculations;options are renumbered;*
 *      and general cleanup by: J. I. Sun, I. M. Idriss &  *
 *      P. Dirrim June 1990 - February 1991                *
 *  ------------------------------------------------------ *
 * SHAKE91: General cleanup and finalization of input out- *
 *      output format ... etc by: I. M. Idriss Dec. 1991   *
 *  ------------------------------------------------------ *
 * SHAKE2000: Fix the incorrect output of Tot. Stress in   *
 * Option 2. Changed path of ground motion file in         *
 * SHAKE91.  Control file to input file names.  Modified   *
 * by Jerald M. LaVaesar & Gustavo A. Ordonez (March 2003) *
 *          RUN DATE 12/10/2007                            *
 *          RUN TIME 17:04                                 *
 ***********************************************************
 MAX. NUMBER OF TERMS IN FOURIER TRANSFORM =      32768
 NECESSARY LENGTH OF BLANK COMMON X        =     204819

1******   OPTION  1  ***  READ RELATION BETWEEN SOIL PROPERTIES AND STRAIN

 **********************
  MATERIAL TYPE NO. 1
 **********************

 CURVE NO.  1:     MSW shallow MSW (SM<125) Zekkos, 2005
 CURVE NO.  2:     MSW shallow MSW (SM<125) Zekkos, 2005

      CURVE NO. 1            CURVE NO. 2
   ==================     ==================
     STRAIN    G/GMAX       STRAIN    DAMPING
   --------   -------     --------  --------
     0.0001     1.000       0.0001      4.00
     0.0002     0.997       0.0002      4.00
     0.0003     0.996       0.0003      4.10
     0.0010     0.990       0.0010      4.10
     0.0020     0.982       0.0020      4.20
     0.0030     0.975       0.0030      4.20
     0.0050     0.963       0.0050      4.20
     0.0080     0.946       0.0080      4.30
     0.0120     0.927       0.0120      4.50
     0.0200     0.892       0.0200      4.80
     0.0300     0.856       0.0300      5.20
     0.0500     0.797       0.0500      5.80
     0.0800     0.727       0.0800      6.80
     0.1000     0.690       0.1000      7.20
     0.3000     0.475       0.3000     10.50
     0.5000     0.373       0.5000     12.00
     1.0000     0.252       1.0000     14.00

 **********************
  MATERIAL TYPE NO. 2
 **********************

 CURVE NO.  3:     MSW deep    MSW (125<SM<350) Zekkos 2005
 CURVE NO.  4:     MSW deep    MSW (125<SM<350) Zekkos 2005

      CURVE NO. 3            CURVE NO. 4
   ==================     ==================
     STRAIN    G/GMAX       STRAIN    DAMPING
   --------   -------     --------  --------
     0.0001     1.000       0.0001      3.00
     0.0002     0.999       0.0002      3.00
     0.0003     0.998       0.0003      3.10
     0.0010     0.995       0.0010      3.10
     0.0020     0.992       0.0020      3.20
     0.0030     0.988       0.0030      3.20
     0.0050     0.981       0.0050      3.20
     0.0080     0.971       0.0080      3.30
     0.0120     0.959       0.0120      3.50
     0.0200     0.937       0.0200      3.80
     0.0300     0.911       0.0300      4.20
     0.0500     0.867       0.0500      4.80
     0.0800     0.810       0.0800      5.80
     0.1000     0.777       0.1000      6.20
     0.3000     0.564       0.3000      9.50
     0.5000     0.450       0.5000     11.00
     1.0000     0.305       1.0000     13.00

 **********************
  MATERIAL TYPE NO. 3
 **********************

 CURVE NO.  5:     Soil PI=100 G/Gmax - Soil with PI=100, OCR=1-15 (Vucetic
 CURVE NO.  6:     Soil PI=100 Damping - Soil with PI=100, OCR=1-8 (Vucetic

      CURVE NO. 5            CURVE NO. 6
   ==================     ==================
     STRAIN    G/GMAX       STRAIN    DAMPING
   --------   -------     --------  --------
     0.0050     1.000       0.0010      1.20
     0.0060     1.000       0.0030      1.50
     0.0070     0.995       0.0050      1.70
     0.0090     0.990       0.0070      1.90
     0.0100     0.985       0.0090      2.00
     0.0200     0.960       0.0100      2.05
     0.0300     0.935       0.0200      2.50
     0.0400     0.915       0.0300      2.90
     0.0500     0.900       0.0400      3.10
     0.0600     0.880       0.0500      3.30
     0.0700     0.865       0.0600      3.50
     0.0800     0.850       0.0800      3.80
     0.0900     0.830       0.1000      4.00
     0.1000     0.815       0.2000      5.20
     0.2000     0.715       0.3000      6.10
     0.3000     0.635       0.4000      6.80
     0.5000     0.530       0.5000      7.40
     0.6000     0.490       0.6000      8.00
     0.9000     0.405       0.7000      8.60
     1.0000     0.375       1.0000      9.70

 **********************
  MATERIAL TYPE NO. 4
 **********************

 CURVE NO.  7:     Soil PI=30  G/Gmax - Soil with PI=30, OCR=1-15 (Vucetic
 CURVE NO.  8:     Soil PI=30  Damping - Soil with PI=30, OCR=1-8 (Vucetic

      CURVE NO. 7            CURVE NO. 8
   ==================     ==================
     STRAIN    G/GMAX       STRAIN    DAMPING
   --------   -------     --------  --------
     0.0010     1.000       0.0020      1.70
     0.0020     0.995       0.0030      2.10
     0.0030     0.985       0.0040      2.50
     0.0040     0.970       0.0050      2.60
     0.0050     0.960       0.0060      2.90
     0.0060     0.950       0.0080      3.30
     0.0080     0.925       0.0100      3.70
     0.0090     0.910       0.0200      5.05
     0.0100     0.900       0.0300      5.70
     0.0200     0.820       0.0400      6.40
     0.0300     0.745       0.0500      6.90
     0.0400     0.700       0.0600      7.30
     0.0700     0.600       0.0800      8.10
     0.1000     0.530       0.1000      8.70
     0.2000     0.420       0.2000     10.80
     0.3000     0.350       0.3000     12.30
     0.4000     0.305       0.4000     13.30
     0.6000     0.240       0.5000     14.10
     0.8000     0.205       0.7000     15.60
     1.0000     0.165       1.0000     16.90

1******   OPTION  2  ***  READ SOIL PROFILE
 NEW SOIL PROFILE NO.      1      IDENTIFICATION  Soil Profile No.  1
 NUMBER OF LAYERS                    18          DEPTH TO BEDROCK        160.00

  NO. TYPE  THICKNESS   DEPTH  TOTAL PRESS. MODULUS  DAMPING   UNIT WT.  SHEAR
VEL
              (FT)      (FT)      (KSF)      (KSF)              (KCF)    (FPS)
   1    4   5.0000    2.5000      0.30       1826.   0.050     0.120    700.0
   2    1  10.0000   10.0000      0.94        705.   0.050     0.067    582.0
   3    1  10.0000   20.0000      1.62        810.   0.050     0.071    606.0
   4    1  10.0000   30.0000      2.35        915.   0.050     0.074    631.0
   5    1  10.0000   40.0000      3.10       1013.   0.050     0.076    655.0
   6    2  10.0000   50.0000      3.87       1117.   0.050     0.078    679.0
   7    2  10.0000   60.0000      4.66       1231.   0.050     0.080    704.0
   8    2  10.0000   70.0000      5.46       1333.   0.050     0.081    728.0
   9    2  10.0000   80.0000      6.28       1440.   0.050     0.082    752.0
  10    2  10.0000   90.0000      7.10       1556.   0.050     0.083    777.0
  11    2  10.0000  100.0000      7.93       1654.   0.050     0.083    801.0
  12    2  10.0000  110.0000      8.77       1776.   0.050     0.084    825.0
  13    5  10.0000  120.0000      9.61       1907.   0.050     0.085    850.0
  14    5  10.0000  130.0000     10.47       2016.   0.050     0.085    874.0
  15    5  10.0000  140.0000     11.32       2129.   0.050     0.085    898.0
  16    5  10.0000  150.0000     12.17       2270.   0.050     0.086    922.0
  17    4   5.0000  157.5000     12.90       2506.   0.050     0.120    820.0
  18   BASE                                 13684.   0.050     0.136   1800.0

 PERIOD = 0.85 FROM AVERAGE SHEAR VEL. =     753.

  FREQUENCY    AMPLITUDE
 MAXIMUM AMPLIFICATION =  13.77
 FOR FREQUENCY         =   1.31 C/SEC.
     PERIOD            =   0.77 SEC.

1******   OPTION  3  ***  READ INPUT MOTION

  FILE NAME FOR INPUT MOTION = C:\Program Files\SHAKE2000\Quakes\IZT090.eq
    NO. OF INPUT ACC. POINTS =    6000
   NO. OF POINTS USED IN FFT =    8192
        NO. OF HEADING LINES =       4
     NO. OF POINTS PER LINE  =       4
  TIME STEP FOR INPUT MOTION = 0.0050
     FORMAT FOR TIME HISTORY =      (4e15.6)


 *****HEADER*****
Source File: C:\Program Files\SHAKE2000\Quakes\IZT090.TXT
SHAKE2000 Conversion:    6000        .005        4          4          15        (4e15.
Acceleration Units: (g's) - No. Values: 6000 - Time Step: .005 (secs)
Data Format: (4e15.6) - No. Header Lines:  4
 **  FIRST AND LAST 5 LINES OF INPUT MOTION *****

     1  0.000151 0.000150 0.000149 0.000148
     2  0.000147 0.000144 0.000142 0.000140
     3  0.000140 0.000141 0.000145 0.000150
     4  0.000156 0.000165 0.000172 0.000176
     5  0.000178 0.000177 0.000171 0.000167
  ............INPUT MOTION READ NOT ECHOED...........
 1496 -0.000065-0.000111-0.000157-0.000203
 1497 -0.000250-0.000297-0.000344-0.000392
 1498 -0.000439-0.000487-0.000535-0.000584
 1499 -0.000632-0.000681-0.000730-0.000779
 1500 -0.000828-0.000878-0.000927-0.000977

 MAXIMUM ACCELERATION =  0.21954
 AT TIME              =  7.55 SEC
 THE VALUES WILL BE MULTIPLIED BY A FACTOR = 1.300
 TO GIVE NEW MAXIMUM ACCELERATION          =  0.28540
```

```
     WITHIN        125.0000         0.21386           3.75           2.74
0.000                   0
     WITHIN        135.0000         0.20393           3.74           2.73
0.000                   0
     WITHIN        155.0000         0.20559           3.71           2.74
0.000                1024
     WITHIN        160.0000         0.23105           7.67           2.88
0.000                1024
     OUTCR.        160.0000         0.28530           7.55           3.03
0.000                1024

1******   OPTION  7  ***  COMPUTE STRESS/STRAIN HISTORY

  COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   17
  SCALE FOR PLOTTING     0.0000
 IDENTIFICATION - Stress History Layer No. 1

  COMPUTE STRESS OR STRAIN HISTORY AT THE TOP OF  LAYER   17
  SCALE FOR PLOTTING     0.0000
 IDENTIFICATION - Strain History Layer No. 1


  *** End of Output File No. 1 ***
```

MEAN SQUARE FREQUENCY = 3.03 C/SEC.
MAX ACCELERATION = 0.28530 FOR FREQUENCIES REMOVED ABOVE 25.00 C/SEC.

1****** OPTION 4 *** READ WHERE OBJECT MOTION IS GIVEN
OBJECT MOTION IN LAYER NUMBER 18 OUTCROPPING

1****** OPTION 5 *** OBTAIN STRAIN COMPATIBLE SOIL PROPERTIES
MAXIMUM NUMBER OF ITERATIONS = 5
FACTOR FOR UNIFORM STRAIN IN TIME DOMAIN = 0.65

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\IZT090.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 1

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ---> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00690	0.031	0.050	-61.6	1712.7	1826.1	-6.6	1.000
2	1	10.0	0.05461	0.060	0.050	16.5	552.5	704.8	-27.6	1.000
3	1	20.0	0.07678	0.067	0.050	25.5	593.6	809.7	-36.4	1.000
4	1	30.0	0.08895	0.070	0.050	28.5	649.1	915.0	-41.0	1.000
5	1	40.0	0.09357	0.071	0.050	29.4	709.8	1012.6	-42.7	1.000
6	2	50.0	0.09058	0.060	0.050	17.0	884.1	1116.8	-26.3	1.000
7	2	60.0	0.08168	0.058	0.050	14.3	993.6	1231.3	-23.9	1.000
8	2	70.0	0.07417	0.056	0.050	11.3	1092.1	1333.2	-22.1	1.000
9	2	80.0	0.08009	0.058	0.050	13.8	1166.2	1440.1	-23.5	1.000
10	2	90.0	0.08347	0.059	0.050	14.9	1250.7	1556.2	-24.4	1.000
11	2	100.0	0.08596	0.059	0.050	15.7	1322.0	1653.8	-25.1	1.000
12	2	110.0	0.08564	0.059	0.050	15.6	1420.3	1775.5	-25.0	1.000
13	5	120.0	0.08399	0.054	0.050	7.2	1619.0	1907.2	-17.8	1.000
14	5	130.0	0.08291	0.054	0.050	6.8	1715.0	2016.4	-17.6	1.000
15	5	140.0	0.08163	0.053	0.050	6.3	1814.7	2128.7	-17.3	1.000
16	5	150.0	0.07953	0.053	0.050	5.4	1942.6	2270.4	-16.9	1.000
17	4	157.5	0.07454	0.079	0.050	36.7	1472.6	2505.8	-70.2	1.000

1

EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\IZT090.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 2

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ---> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00600	0.029	0.031	-6.6	1734.7	1712.7	1.3	0.938
2	1	10.0	0.05667	0.061	0.060	1.3	548.6	552.5	-0.7	0.784
3	1	20.0	0.08335	0.069	0.067	2.3	583.2	593.6	-1.8	0.733
4	1	30.0	0.09574	0.071	0.070	1.9	638.0	649.1	-1.8	0.709
5	1	40.0	0.09592	0.071	0.071	0.6	705.7	709.8	-0.6	0.701
6	2	50.0	0.08304	0.059	0.060	-2.7	898.4	884.1	1.6	0.792
7	2	60.0	0.08921	0.060	0.058	2.6	977.6	993.6	-1.6	0.807
8	2	70.0	0.09323	0.061	0.056	7.2	1049.7	1092.1	-4.0	0.819
9	2	80.0	0.09618	0.061	0.058	5.4	1127.3	1166.2	-3.5	0.810
10	2	90.0	0.09599	0.061	0.059	4.1	1218.6	1250.7	-2.6	0.804
11	2	100.0	0.09619	0.061	0.059	3.3	1294.5	1322.0	-2.1	0.799
12	2	110.0	0.09528	0.061	0.059	3.1	1392.3	1420.3	-2.0	0.800
13	5	120.0	0.08918	0.055	0.054	2.0	1604.7	1619.0	-0.9	0.849
14	5	130.0	0.08985	0.055	0.054	2.6	1694.7	1715.0	-1.2	0.851
15	5	140.0	0.08991	0.055	0.053	3.1	1788.8	1814.7	-1.4	0.852
16	5	150.0	0.08802	0.055	0.053	3.4	1914.0	1942.6	-1.5	0.856
17	4	157.5	0.12081	0.093	0.079	14.8	1252.9	1472.6	-17.5	0.588

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EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\IZT090.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 3

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ---> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00568	0.028	0.029	-3.3	1740.3	1734.7	0.3	0.950
2	1	10.0	0.05457	0.060	0.061	-1.3	552.5	548.6	0.7	0.778
3	1	20.0	0.08117	0.068	0.069	-0.7	586.7	583.2	0.6	0.720
4	1	30.0	0.09283	0.071	0.071	-0.8	642.7	638.0	0.7	0.697
5	1	40.0	0.09161	0.070	0.071	-1.2	713.4	705.7	1.1	0.697
6	2	50.0	0.08106	0.058	0.059	-0.7	902.4	898.4	0.4	0.804
7	2	60.0	0.08984	0.060	0.060	0.2	976.3	977.6	-0.1	0.794
8	2	70.0	0.09592	0.061	0.061	0.8	1044.1	1049.7	-0.5	0.787
9	2	80.0	0.09811	0.062	0.061	0.6	1123.0	1127.3	-0.4	0.783
10	2	90.0	0.09714	0.061	0.061	0.3	1215.8	1218.6	-0.2	0.783
11	2	100.0	0.09725	0.062	0.061	0.3	1291.8	1294.5	-0.2	0.783
12	2	110.0	0.09666	0.061	0.061	0.4	1388.5	1392.3	-0.3	0.784
13	5	120.0	0.08958	0.055	0.055	0.1	1603.6	1604.7	-0.1	0.841
14	5	130.0	0.09050	0.055	0.055	0.2	1692.9	1694.7	-0.1	0.840
15	5	140.0	0.09064	0.055	0.055	0.3	1786.7	1788.8	-0.1	0.840
16	5	150.0	0.08871	0.055	0.055	0.3	1911.8	1914.0	-0.1	0.843
17	4	157.5	0.14133	0.097	0.093	4.9	1190.5	1252.9	-5.2	0.500

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EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\IZT090.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 4

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ---> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00563	0.028	0.028	-0.5	1741.2	1740.3	0.1	0.953
2	1	10.0	0.05389	0.060	0.060	-0.4	553.9	552.5	0.2	0.784
3	1	20.0	0.08027	0.068	0.068	-0.3	588.2	586.7	0.3	0.725
4	1	30.0	0.09174	0.070	0.071	-0.3	644.5	642.7	0.3	0.702
5	1	40.0	0.09029	0.070	0.070	-0.4	715.8	713.4	0.3	0.705
6	2	50.0	0.08050	0.058	0.058	-0.2	903.6	902.4	0.1	0.808
7	2	60.0	0.08976	0.060	0.060	0.0	976.4	976.3	0.0	0.793
8	2	70.0	0.09630	0.061	0.061	0.1	1043.3	1044.1	-0.1	0.783
9	2	80.0	0.09838	0.062	0.062	0.1	1122.4	1123.0	-0.1	0.780
10	2	90.0	0.09728	0.062	0.061	0.0	1215.5	1215.8	0.0	0.781
11	2	100.0	0.09739	0.062	0.062	0.0	1291.5	1291.8	0.0	0.781
12	2	110.0	0.09684	0.061	0.061	0.1	1388.0	1388.5	0.0	0.782
13	5	120.0	0.08954	0.055	0.055	0.0	1603.7	1603.6	0.0	0.841
14	5	130.0	0.09047	0.055	0.055	0.0	1692.9	1692.9	0.0	0.840
15	5	140.0	0.09061	0.055	0.055	0.0	1786.8	1786.7	0.0	0.839
16	5	150.0	0.08868	0.055	0.055	0.0	1911.8	1911.8	0.0	0.842
17	4	157.5	0.14862	0.099	0.097	1.5	1170.5	1190.5	-1.7	0.475

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EARTHQUAKE - C:\Program Files\SHAKE2000\Quakes\IZT090.eq
SOIL PROFILE - Soil Profile No. 1

ITERATION NUMBER 5

VALUES IN TIME DOMAIN

NO	TYPE	DEPTH (FT)	UNIFRM. STRAIN	<---- DAMPING ---> NEW	USED	ERROR	<---- SHEAR MODULUS -----> NEW	USED	ERROR	RATIO G/Go
1	4	2.5	0.00562	0.028	0.028	-0.1	1741.4	1741.2	0.0	0.954
2	1	10.0	0.05369	0.060	0.060	-0.1	554.2	553.9	0.1	0.786
3	1	20.0	0.07998	0.068	0.068	-0.1	588.7	588.2	0.1	0.726
4	1	30.0	0.09140	0.070	0.070	-0.1	645.0	644.5	0.1	0.704
5	1	40.0	0.08993	0.070	0.070	-0.1	716.5	715.8	0.1	0.707
6	2	50.0	0.08034	0.058	0.058	-0.1	903.9	903.6	0.0	0.809
7	2	60.0	0.08969	0.060	0.060	0.0	976.6	976.4	0.0	0.793
8	2	70.0	0.09634	0.061	0.061	0.0	1043.2	1043.3	0.0	0.783
9	2	80.0	0.09841	0.062	0.062	0.0	1122.4	1122.4	0.0	0.779
10	2	90.0	0.09729	0.062	0.062	0.0	1215.5	1215.5	0.0	0.781
11	2	100.0	0.09740	0.062	0.062	0.0	1291.4	1291.5	0.0	0.781
12	2	110.0	0.09686	0.061	0.061	0.0	1388.0	1388.0	0.0	0.782
13	5	120.0	0.08950	0.055	0.055	0.0	1603.8	1603.7	0.0	0.841
14	5	130.0	0.09044	0.055	0.055	0.0	1693.0	1692.9	0.0	0.840
15	5	140.0	0.09057	0.055	0.055	0.0	1786.9	1786.8	0.0	0.839
16	5	150.0	0.08865	0.055	0.055	0.0	1911.9	1911.8	0.0	0.842
17	4	157.5	0.15114	0.100	0.099	0.5	1163.8	1170.5	-0.6	0.467

VALUES IN TIME DOMAIN

LAYER	TYPE	THICKNESS FT	DEPTH FT	MAX STRAIN PRCNT	MAX STRESS PSF	TIME SEC
1	4	5.0000	2.5000	0.00864	150.49	7.81
2	1	10.0000	10.0000	0.08260	457.51	7.82
3	1	10.0000	20.0000	0.12304	723.77	7.82
4	1	10.0000	30.0000	0.14061	906.17	7.82
5	1	10.0000	40.0000	0.13836	990.44	7.81
6	2	10.0000	50.0000	0.12360	1116.82	3.86
7	2	10.0000	60.0000	0.13799	1347.38	3.86
8	2	10.0000	70.0000	0.14822	1546.36	3.86
9	2	10.0000	80.0000	0.15140	1699.37	3.86
10	2	10.0000	90.0000	0.14968	1819.42	3.85
11	2	10.0000	100.0000	0.14985	1935.33	3.83
12	2	10.0000	110.0000	0.14901	2068.35	3.81
13	5	10.0000	120.0000	0.13770	2208.31	3.79
14	5	10.0000	130.0000	0.13913	2355.45	3.78
15	5	10.0000	140.0000	0.13934	2489.74	3.77
16	5	10.0000	150.0000	0.13639	2607.50	3.77
17	4	5.0000	157.5000	0.23252	2721.74	3.76

PERIOD = 0.96 FROM AVERAGE SHEAR VEL. = 666.

FREQUENCY AMPLITUDE
MAXIMUM AMPLIFICATION = 11.12
FOR FREQUENCY = 1.14 C/SEC.
PERIOD = 0.87 SEC.

1****** OPTION 6 *** COMPUTE MOTION IN NEW SUBLAYERS

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SOIL DEPOSIT - Soil Profile No. 1

LAYER	DEPTH TH SAVED FT	MAX. ACC. G	TIME SEC	MEAN SQ. FR. C/SEC	ACC. RATIO QUIET ZONE
OUTCR.	0.0000	0.50168	7.80	2.40	0.000
	1024				
WITHIN	5.0000	0.49524	7.81	2.38	0.000
	0				
WITHIN	15.0000	0.38415	7.81	2.04	0.000
	0				
WITHIN	35.0000	0.29492	3.87	1.71	0.000
	0				
WITHIN	55.0000	0.31929	7.11	2.27	0.000
	0				
WITHIN	75.0000	0.32122	7.94	2.46	0.000
	0				
WITHIN	85.0000	0.30305	7.07	2.55	0.000
	0				
WITHIN	105.0000	0.25071	7.05	2.71	0.000
	0				

APPENDIX G
Landfill Slope Stability Analyses

APPENDIX G
Landfill Slope Stability Analyses

BUENA VISTA DRIVE SANITARY LANDFILL
WG1019-01
Appendix F - Preliminary Closure and Postclosure Maintenance Plan (PCPMP) –

PREFACE/CLARIFICATION/BACKGROUND

Appendix F of the PCPMP includes two Appendices labeled Appendix A and Appendix B which are excerpted from the *Site Development Plan, Buena Vista Drive Sanitary Landfill, Watsonville, California* prepared by Geosyntec and dated 4 March 2005.

The reader is referred to the text and explanation in the *Site Development Plan* for a thorough explanation.

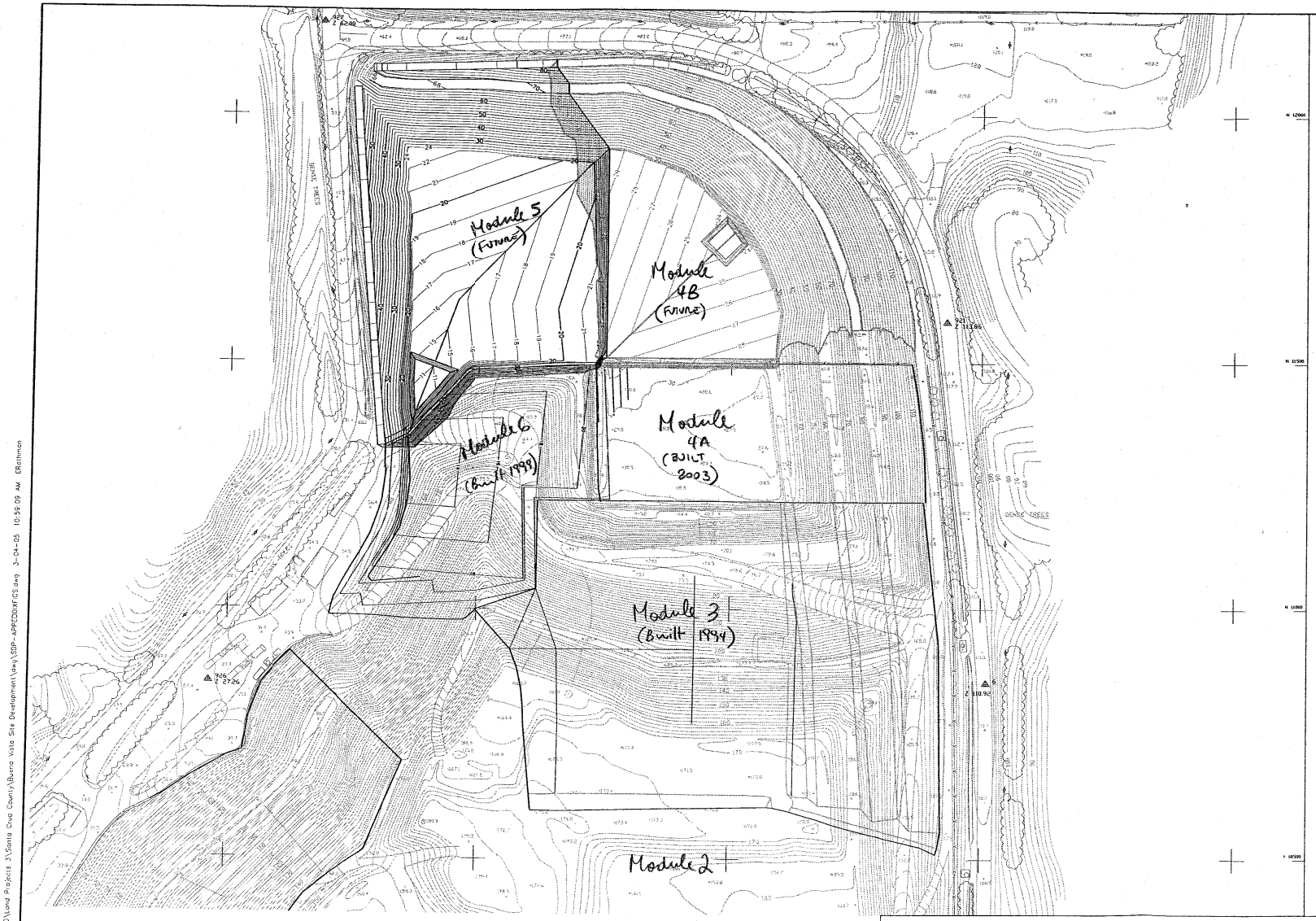
As part of PCPMP, Geosyntec updated the seismicity for the site based on updated regional seismic information and new generation attenuation (NGA) relationships. Appendix E of the PCPMP presents the updated seismic hazard evaluation and seismic deformation analyses. The updated re-evaluation does not change the static slope stability analyses; however, new results for the estimated seismic deformations were obtained. These results were used in Appendix D of the PCPMP and in Appendix F.

Geosyntec updated Appendix F by striking the portions that were superseded and adding a clarifying sheet following the stricken text.

Reference: *Site Development Plan, Buena Vista Drive Sanitary Landfill, Watsonville, California* prepared by Geosyntec and dated 4 March 2005.

APPENDIX A

INTERFACE STRENGTH DATA



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SCALE IN FEET

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LEGEND

30 — MODULE 5 BASE GRADING CONTOUR

30 — MODULE 4A/4B BASE GRADING CONTOUR

30 — MODULE 6 BASE GRADING CONTOUR

LINER LIMIT

NOTES:

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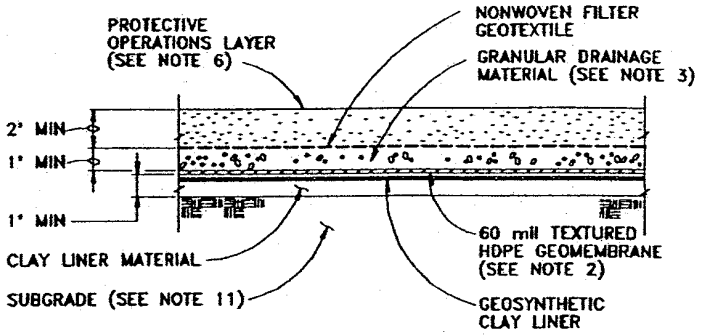
GeoSyntec Consultants

BASE ~~AND FINAL~~ GRADING PLAN
BUENA VISTA LANDFILL
SANTA CRUZ COUNTY, CALIFORNIA

FIGURE NO.	
PROJECT NO.	WL0658
DATE:	FEBRUARY 2005

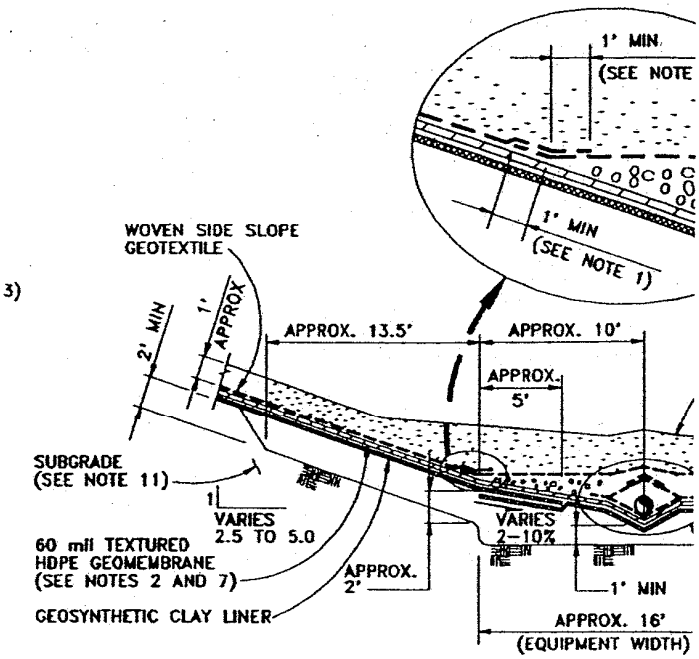
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AS-BUILT COMPOSITE LINER SYSTEMS
MODULES 3, 6, 4A

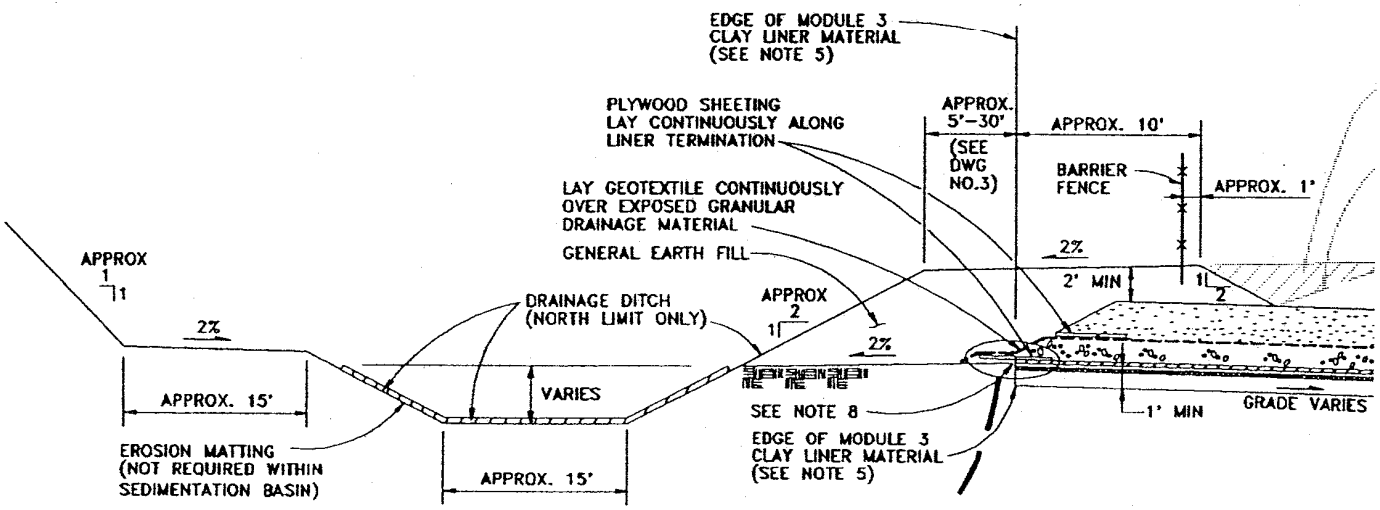


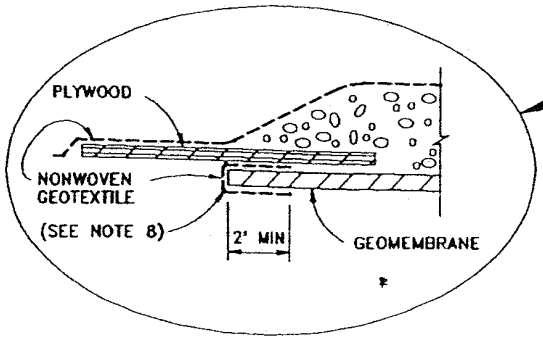
DETAIL 1
BASE LINING DETAIL 2
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Basa Liner : Module 3



SECTION
SIDE SLOPE LINING – BASE LINING
NTS





SECTION C
BASE LINING TERMINATION 2
(SEE NOTE 4)
NTS

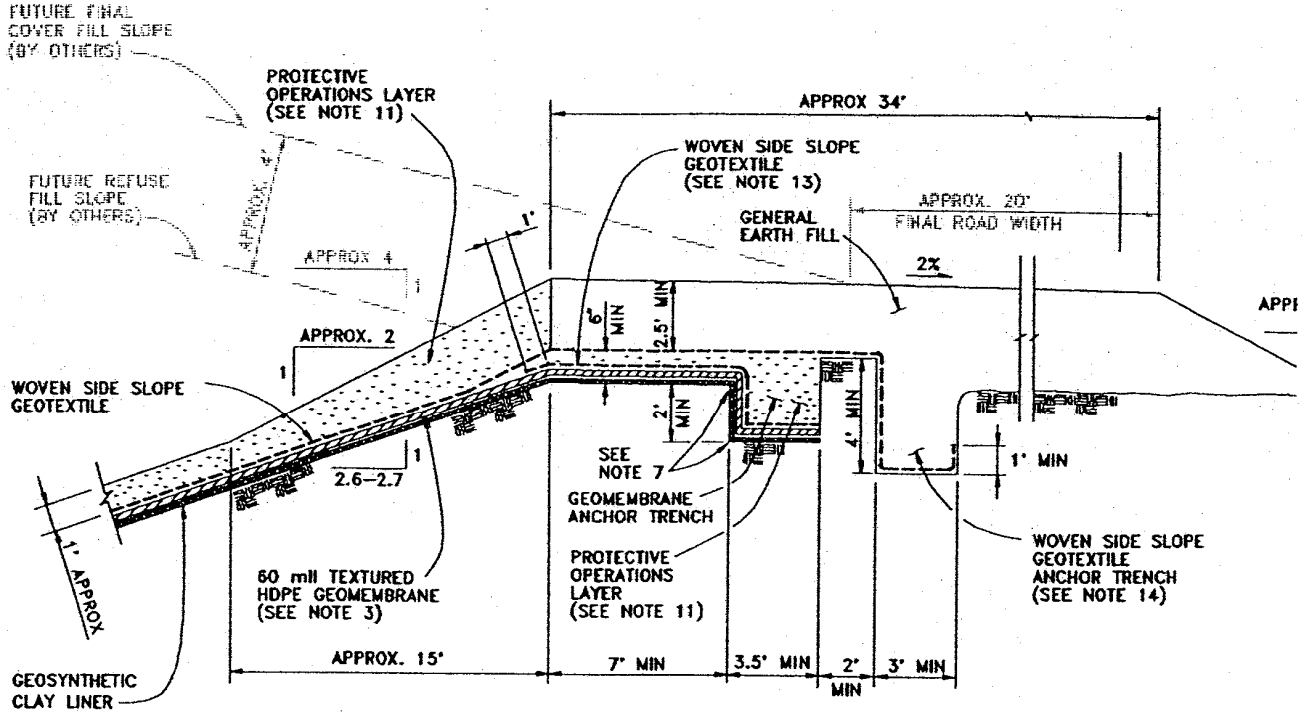
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DR	T. OCAMPO						
CHK	S. LEWIS	1	Nov 94	AS-BUILT REVISIONS	MH	GL	
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CH2M HILL

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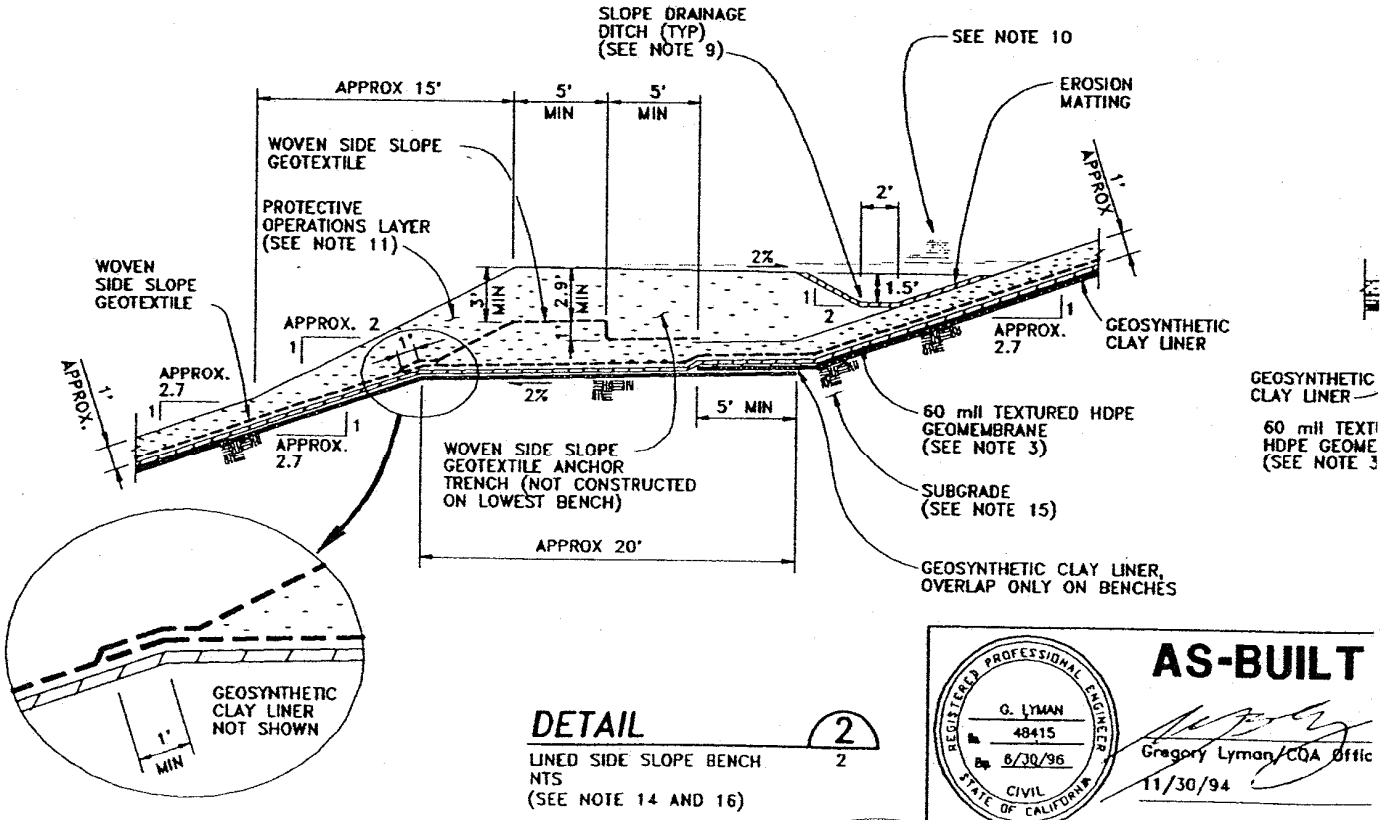
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SECTION D 2

EAST SIDE SLOPE LINING –
TOP SLOPE TERMINATION AND DRAINAGE
(SEE NOTES 5 AND 6)
NTS

Side-slope Liner : Module 3



DETAIL 2 2

LINED SIDE SLOPE BENCH
NTS
(SEE NOTE 14 AND 16)

REGISTERED PROFESSIONAL ENGINEER
G. LYMAN
No. 48415
Exp. 6/30/96
CIVIL
STATE OF CALIFORNIA

AS-BUILT

Gregory Lyman/COA Offic
11/30/94

Built 1994

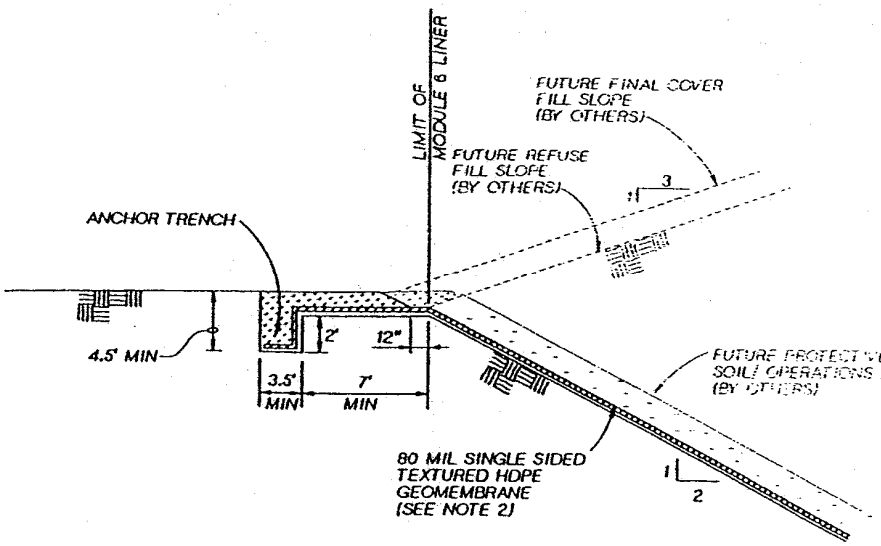
CH2M HILL

DSGN	M. HOMOLKA
DR	T. OCAMPO
CHK	S. LEWIS
APVD	G. LYMAN

Module 3

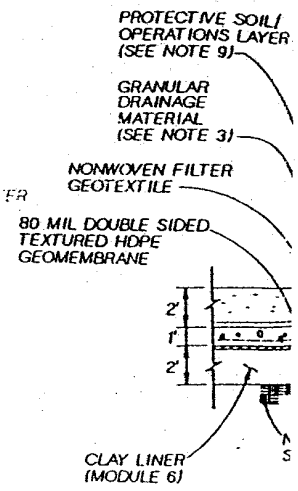
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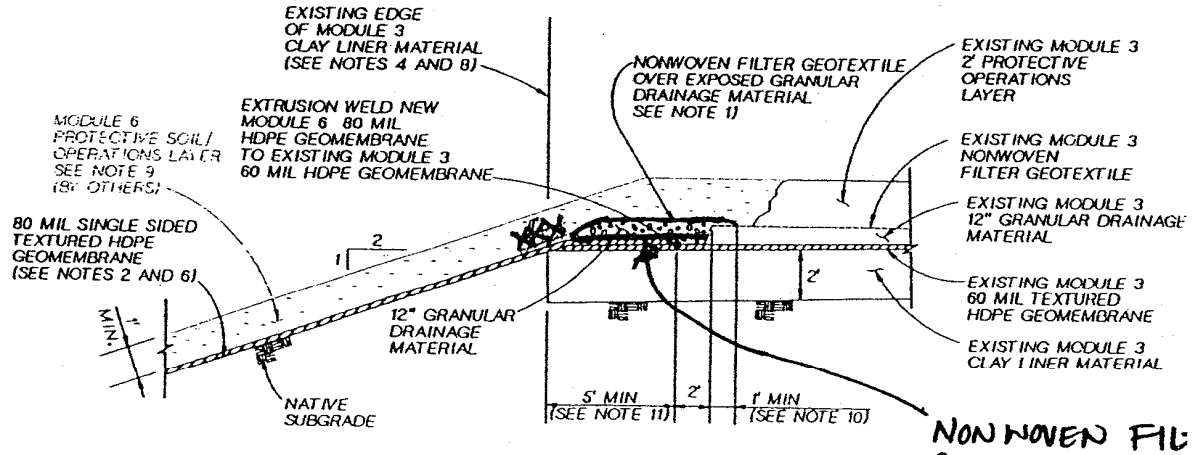
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SECTION E
3

EAST SIDE SLOPE LINING - TOP SLOPE TERMINATION (SEE NOTES 5 AND 6) NTS





SECTION G
3

SIDE SLOPE LINING TIE-IN MODULE 6 / MODULE 3 (SEE NOTES 5 AND 6) NTS

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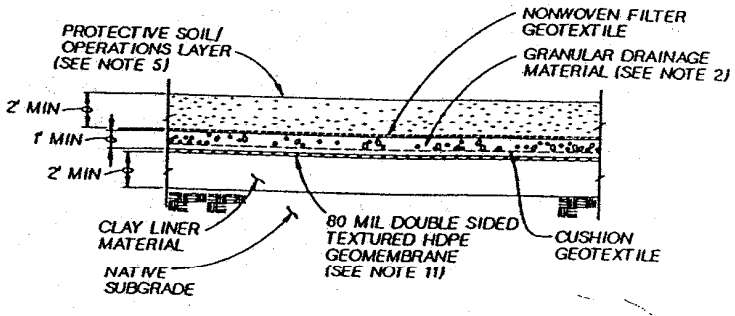
Side-Slope Liner: Module 6

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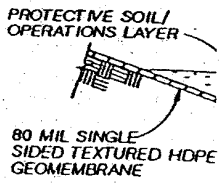
CH2MHILL

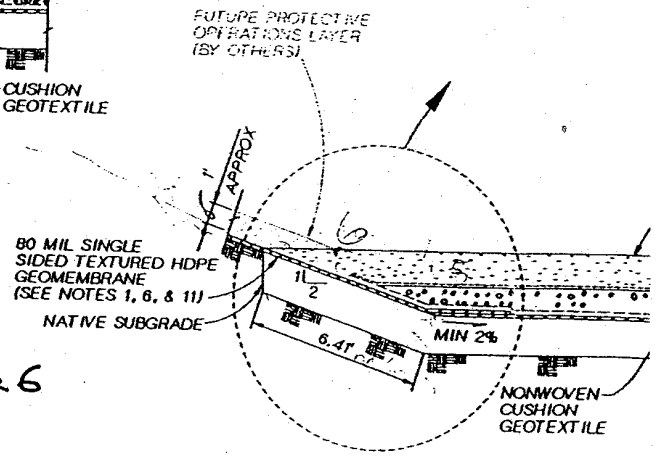
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DR	A. WONG						
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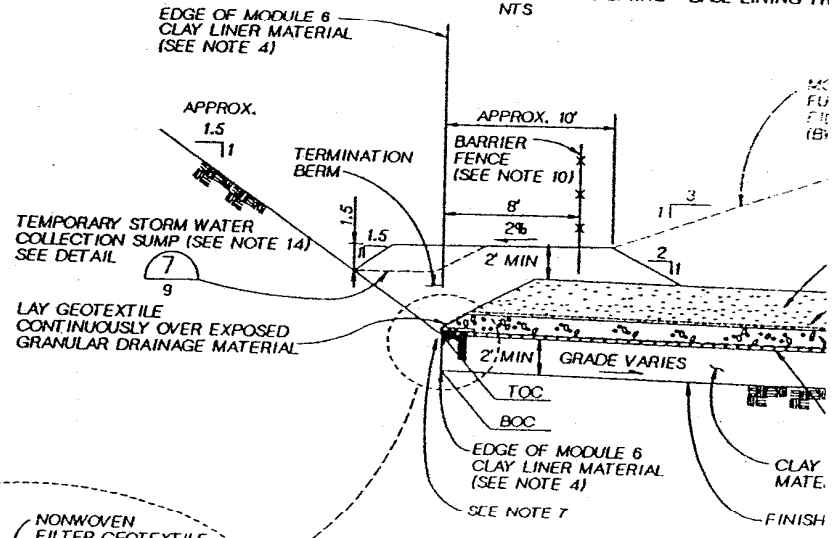
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BASE LINING DETAIL 3
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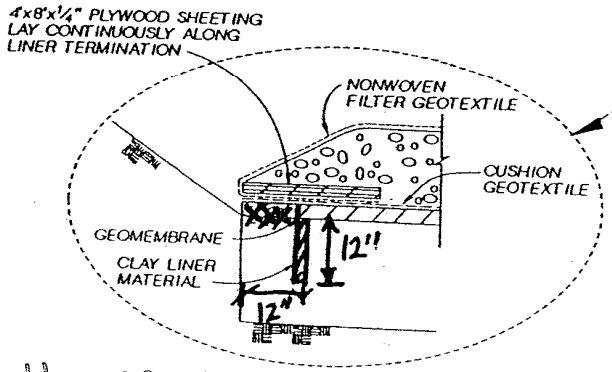




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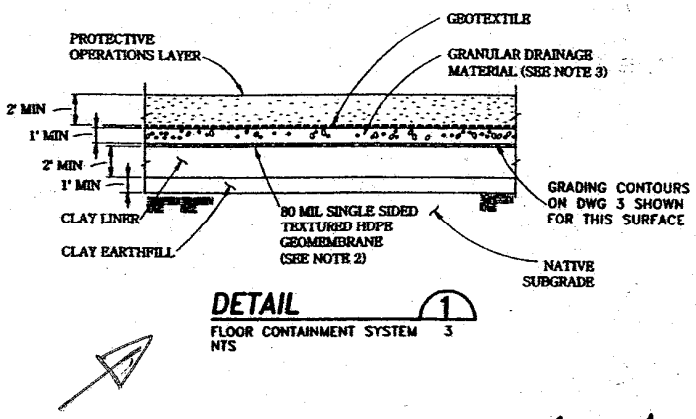


SECTION D
BASE LINING TERMINATION 3
(SEE NOTE 3)
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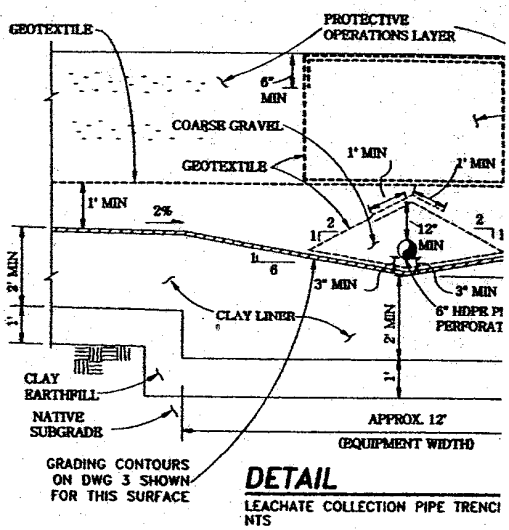
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CH2MHILL

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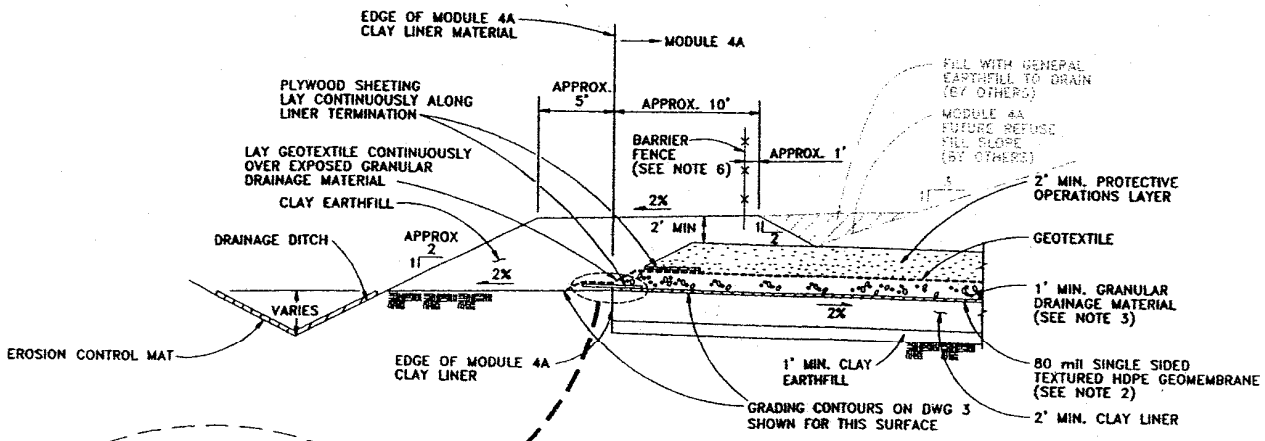


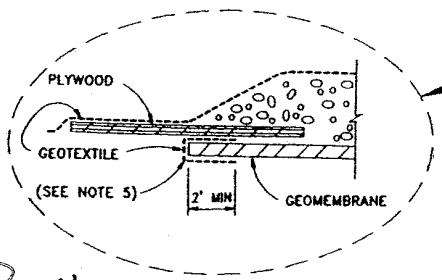
DETAIL 1
FLOOR CONTAINMENT SYSTEM 3
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DETAIL
LEACHATE COLLECTION PIPE TRENCH
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Base - Liner : Module 4A





SECTION B
FLOOR CONTAINMENT SYSTEM TERMINATION 3
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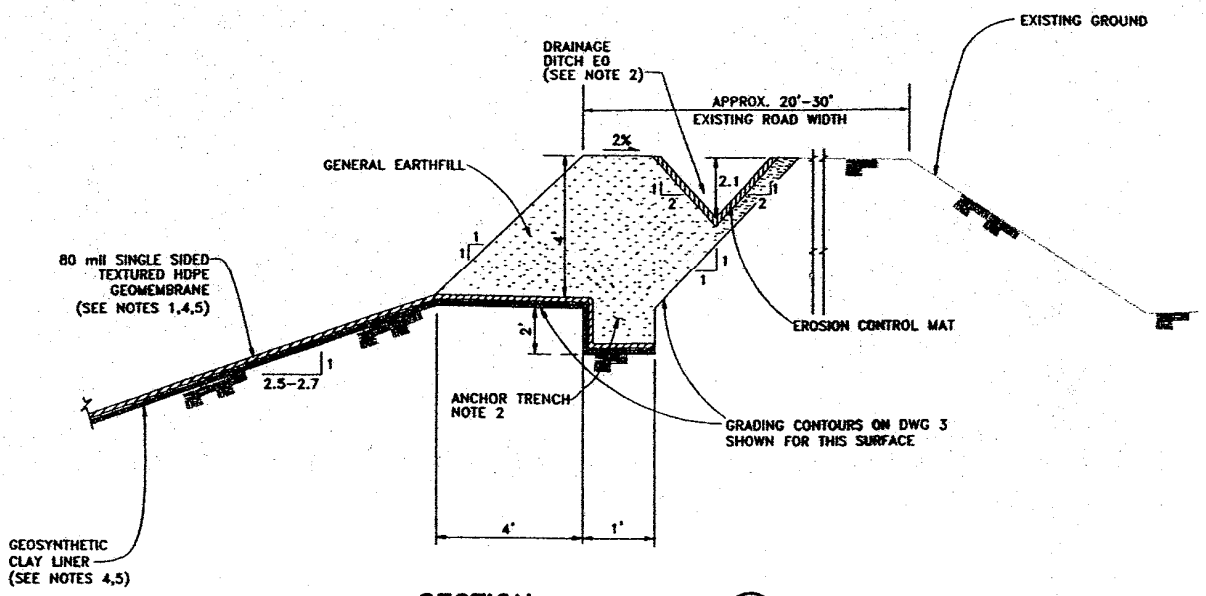
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Module 4A

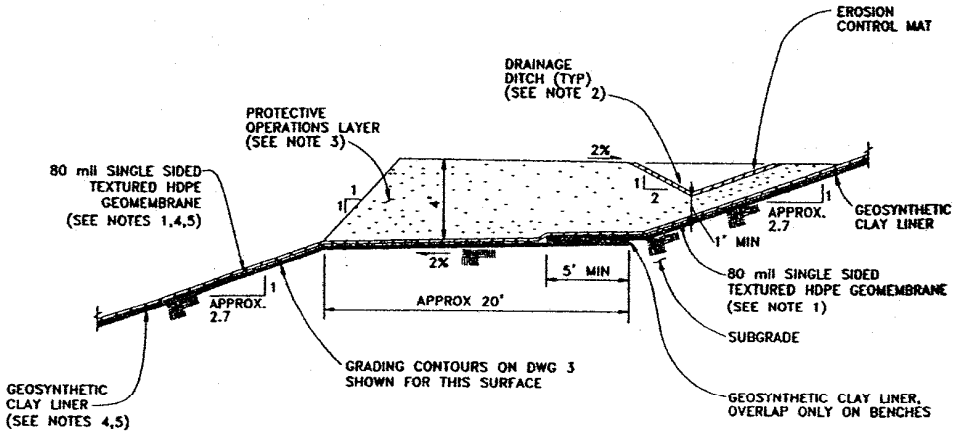
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SOLID WASTE AND RECYCLING SERVICES DIVISION
DEPARTMENT OF PUBLIC WORKS
COUNTY OF SANTA CRUZ, CALIFORNIA



SECTION H 3
EAST SIDE SLOPE CONTAINMENT SYSTEM TERMINATION AND DRAINAGE (SEE NOTE 6)
NTS

Side-Slope Liner: Module 4A



SECTION 1
LINED SIDE SLOPE BENCH (TYP.) 3
NTS

Built 2003

Module 4A

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SOLID WASTE AND RECYCLING SERVICES DIVISION
DEPARTMENT OF PUBLIC WORKS
COUNTY OF SANTA CRUZ, CALIFORNIA

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INTERFACE STRENGTH TESTS
MODULE 3

Construction Quality Assurance Report
Module 3, Buena Vista Landfill
County of Santa Cruz, California

Prepared for

The County of Santa Cruz, California

This document has been prepared under the direction
of a California Registered Professional Engineer

Prepared by

CH2MHILL

1111 Broadway, Suite 1200
Oakland, California 94607

November 1994
BAE35903.CQ.RP

Appendix 8-A
Modified Base Lining Equivalency Technical Memorandum

Module 3
Buena Vista Landfill
Modified Base Lining Equivalency
Technical Memorandum



Prepared for
County of Santa Cruz

Prepared by

CH2M HILL

November 1994

GEOSYNTEC CONSULTANTS

Geomechanics and Environmental Laboratory
5775 Peachtree Dunwoody Road • Suite 10D
Atlanta, Georgia 30342 • USA
Tel. (404) 705-9500 • Fax (404) 705-9300

5 October 1994

Mr. B. Tom Boardman
Geotechnical Department
CH2M Hill
1111 Broadway, P.O. Box 12681
Oakland, California 94604-2681

Subject: Final Report
Direct Shear Testing
Buena Vista Landfill, Module 3
Santa Cruz County, California
CH2M Hill Project No. BAE 35903.CQ.LT

Dear Mr. Boardman:

GeoSyntec Consultants (GeoSyntec) is pleased to present the final report for the direct shear testing program performed for CH2M Hill for Module 3 of the Buena Vista Landfill project located in Santa Cruz County, California, CH2M Hill Project No. BAE 35903.CQ.LT. The work was performed in general accordance with CH2M Hill's Standard Agreement for Subconsultant Services, issued to GeoSyntec on 12 July 1994. All of the laboratory testing was conducted at GeoSyntec's Geomechanics and Environmental Laboratory located in Atlanta, Georgia.

GeoSyntec appreciates the opportunity to provide laboratory testing services to CH2M Hill. Should you have any questions regarding the enclosed report, please do not hesitate to contact any of the undersigned.

Sincerely,

Zehong Yuan, Ph.D.
Assistant Department Manager
Soil-Geosynthetic Interaction Testing

Robert H. Swan, Jr.
Department Manager
Soil-Geosynthetic Interaction Testing

Gary R. Schmertmann, Ph.D., P.E. (Georgia)
Project Engineer

Enclosure

GLI3642/GEL94386

Prepared for

CH2M-Hill
111 Broadway, P.O. Box 12681
Oakland, California 94604-2681

FINAL REPORT
DIRECT SHEAR TESTING

BUENA VISTA LANDFILL, MODULE 3
SANTA CRUZ COUNTY, CALIFORNIA
CH2M HILL PROJECT NO:
BAE 35903.CQ.LT

Prepared by

GeoSyntec Consultants
Geomechanics and Environmental Laboratory
5775 Peachtree Dunwoody Road, Suite 10D
Atlanta, Georgia 30342

Project Number GLI3642

5 October 1994

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1.2 Organization 2

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2.1 Overview 2
2.2 Direct Shear Tests 2

3. TESTING PROGRAM 3

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3.2 Geosynthetic and Soil Materials 3

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3.2.2 Soil Material 4

3.3 Direct Shear Tests 4

3.3.1 Configuration of the Test Specimens 4
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APPENDIX A: DIRECT SHEAR TEST DATA
APPENDIX B: DIRECT SHEAR TEST DATA FOR SIMILAR TEST SERIES

1. INTRODUCTION

1.1 Terms of Reference

This report was prepared by Mr. Robert H. Swan, Jr. and Dr. Zehong Yuan, both of GeoSyntec Consultants (GeoSyntec), Atlanta, Georgia. The report was reviewed by Dr. Gary R. Schmertmann, P.E. (Georgia) also of GeoSyntec, in accordance with the internal peer review policy of the firm. The laboratory testing program described in this report was performed at the request of Mr. B. Tom Boardman of CH2M Hill, Oakland, California.

CH2M Hill authorized GeoSyntec to undertake a laboratory testing program to evaluate: (i) the interface shearing resistance between geosynthetic clay liner (GCL) and geomembrane and (ii) the internal shearing resistance of the GCL for Module 3 of the Buena Vista Landfill project located in Santa Cruz County, California, CH2M Hill Project No. BAE 35903.CQ.LT. The materials used in the testing program included two different samples of Claymax 500SP GCL and two different samples of 60-mil (1.5-mm) thick Gundle Lining Systems, Inc. (Gundle) smooth-textured high density polyethylene (HDPE) geomembrane. All of the materials used in the testing program were provided to GeoSyntec by CH2M Hill.

The tests were conducted in accordance with the procedures defined in the 14 July 1994, 10 August 1994, and 14 August 1994 letters prepared by Mr. Tom Boardman of CH2M Hill and CH2M Hill's Standard Agreement for Subconsultant Services, issued to GeoSyntec on 12 July 1994. GeoSyntec understands that the sample preparation procedures and testing conditions used in the testing program were selected by CH2M Hill to simulate anticipated field conditions. All of the tests were conducted at GeoSyntec's Geomechanics and Environmental Laboratory located in Atlanta, Georgia.

1.2 Organization

The remainder of the report is organized as follows:

- background information regarding the laboratory testing program is presented in Section 2;
- details of the laboratory testing program are described in Section 3; and
- results of the laboratory testing program are presented in Section 4.

2. BACKGROUND

2.1 Overview

The laboratory testing program consisted of four direct shear test series. Two test series were performed to determine the interface shear strength between the GCL and geomembrane and two test series were performed to determine the internal shear strength of the GCL. Each direct shear test series consisted of two to three direct shear tests with each test conducted at a different level of normal stress ranging from 10 to 100 psi (70 to 700 kPa). A general description of the test method used during this testing program is given in the following section.

2.2 Direct Shear Tests

The direct shear tests were performed in general accordance with ASTM Standard Test Method D 5321, "*Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method*". The tests were conducted in a large direct shear device containing an upper and lower shear box. The upper shear box measures 12 in. by 12 in. (300 mm by 300 mm) in plan and 3 in. (75 mm) in depth. The lower shear box measures 12 in. by 14 in. (300 mm by 350 mm) in plan and 3 in. (75 mm) in depth.

3. TESTING PROGRAM

3.1 Overview

The testing program consisted of four direct shear test series. The materials used in the testing program are summarized in Section 3.2. Details of each test series and specific testing procedures are presented Section 3.3.

3.2 Geosynthetic and Soil Materials

3.2.1 Geosynthetic Materials

Four geosynthetic materials were used in the testing program. These materials are referenced by name in this report, and include:

- Two samples of Claymax 500SP GCL, manufactured by the James Clem Corporation, consisting of a primary woven geotextile on one side of a bentonite component and a secondary woven geotextile on the other side of the bentonite component, referred to as Claymax 500SP GCL. The components of the GCL were stitch-bonded together with lines of stitches on 4-in. (100-mm) centers in the direction of manufacture (machine direction); and

- Two samples of 60-mil (1.5-mm) thick Gundle smooth-textured HDPE geomembrane, referred to as 60-mil Gundle smooth-textured HDPE geomembrane. One side of the geomembrane had a smooth surface and the other side had a textured surface.

Bulk samples of the GCL and geomembrane materials used in the testing program were provided to GeoSyntec by CH2M Hill from the project site. Each bulk sample was identified with a roll number assigned by the manufacturer.

3.2.2 Soil Material

A concrete sand was provided by GeoSyntec to fill the lower shear box and serve as a bedding layer below each test interface in Test Series 1 and 4.

3.3 Direct Shear Tests

3.3.1 Configuration of the Test Specimens

The configurations of the test specimens used in the four direct shear test series were as follows:

- *Test Series Numbers 1 and 4:* interface between soaked Claymax 500SP GCL (primary woven geotextile in contact with geomembrane) and 60-mil Gundle smooth-textured HDPE geomembrane (textured side against GCL). From top to bottom, each test specimen consisted of:
  - rigid substrate with textured steel gripping surfaces;
  - Claymax 500SP GCL (primary woven geotextile in contact with geomembrane);
  - 60-mil Gundle smooth-textured HDPE geomembrane (textured side against GCL); and
  - concrete sand.

- *Test Series Numbers 2 and 3:* internal strength of soaked Claymax 500SP GCL with three lines of stitches. From top to bottom, each test specimen consisted of:
  - rigid substrate with textured steel gripping surface;
  - Claymax 500SP GCL; and
  - rigid substrate with textured steel gripping surface.

For each test series, the geosynthetic specimens were trimmed from the bulk samples provided by CH2M Hill. As previously noted, each bulk sample of geosynthetic had a roll number assigned by its manufacturer. The roll numbers for each of the geosynthetic specimens used in each test series of the testing program are presented in Table 1.

3.3.2 Test Procedure

A summary of the test equipment and conditions used to conduct the direct shear tests is presented in Table 2. This table indicates the size of the shear box, initial moisture content of GCL specimens, normal stress applied during soaking, time for soaking, the moisture content of the GCL specimens at the completion of testing, the normal stress applied to rigid substrate in the upper shear box during shearing, and the horizontal displacement rate for each test.

For each direct shear test series, fresh geosynthetic specimens were prepared for each normal stress condition. For each test, the test specimens were set up and tested as described below to achieve the desired moisture conditions and to cause shearing to occur at the desired test interface or within the GCL specimen.

- *Test Series Numbers 1 and 4:* fresh specimens of GCL and the smooth-textured geomembrane were trimmed from each bulk sample of material provided by CH2M Hill and attached to the upper and lower shear boxes, respectively, with mechanical compression clamps. The smooth-textured geomembrane specimen was oriented so that the textured side faced upward. The GCL specimen was trimmed so that it contained three lines of stitches. The GCL specimen was oriented so that the primary woven geotextile of the GCL faced downward (i.e., in contact with the textured side of the geomembrane specimen). This set-up caused shearing to occur at the interface between the primary woven geotextile component of the GCL and the textured side of the geomembrane specimen. A rigid substrate with a textured steel gripping surface was placed above the GCL specimen. The textured steel gripping surface was employed to minimize slippage between the upper geotextile component of the GCL and rigid wooden substrate and therefore provide more uniform transfer of shear load onto the test interface. Inspection of the GCL specimens after testing indicated that the textured steel gripping surface did not appear to damage the geotextile components during each test.

For each test in Test Series 1, the entire test specimen (including the rigid substrate with the textured steel gripping surface) was soaked in tap water for 24 hours under each applied normal stress prior to being sheared. The normal stress during soaking was applied to the test specimen prior to submerging it in the tap water. After the 24-hour soaking period, each test specimen was immediately sheared without disruption of the normal stress.

For each test in Test Series 4, the entire test specimen (excluding the rigid substrate with the textured steel gripping surface) was soaked in tap water for 24 hours under each applied normal stress prior to being sheared. The normal stress during soaking was applied to the test specimen prior to submerging it in the tap water. After the 24-hour soaking period, the test specimen was placed and secured in the shear box for testing. The rigid wooden substrate with the textured steel gripping surface was placed on top of the GCL specimen prior to application of the test normal stress. The normal stress used for shearing was applied to the test specimen within approximately five minutes of the removal of the normal stress used for soaking, and shearing of the test specimen followed immediately.

- *Test Series Numbers 2 and 3*: fresh specimens of the GCL were trimmed from the bulk samples of the GCL provided by CH2M Hill. The GCL specimen was trimmed so that it contained three lines of stitches. Each test was conducted specifically to evaluate the internal strength of the GCL specimen. This was achieved by constraining the GCL specimen such that shearing could only occur through the bentonite component of the GCL specimen. Specimen constraint was accomplished by completely bonding the geotextile component on each side of the GCL specimen to the rigid wooden substrate with the use of textured steel gripping surfaces. The ends of each geotextile were then sandwiched between a second rigid wooden substrate prior to testing as shown in Figure 1. The entire test specimen was then placed in the direct shear box to provide confinement for the exposed bentonite component. It is noted that the textured gripping surface was employed to minimize slippage between each geotextile component of the GCL specimen and rigid wooden substrate and therefore to provide more

uniform transfer of shear load to the GCL specimen. Inspection of the GCL specimens after testing indicated that the textured steel gripping surface did not appear to damage the geotextile components during each test.

For each test in Test Series 2, the entire test specimen (including the rigid substrates with the textured steel gripping surfaces) was soaked in tap water for 24 hours under each applied normal stress prior to being sheared. The normal stress during soaking was applied to the test specimen prior to submerging it in the tap water. After the 24-hour soaking period, each test specimen was immediately sheared without disruption of the normal stress.

For each test in Test Series 3, the entire test specimen (excluding the rigid substrates with the textured steel gripping surfaces) was soaked in tap water for 24 hours under each applied normal stress prior to being sheared. The normal stress during soaking was applied to the test specimen prior to submerging it in the tap water. After the 24-hour soaking period, the test specimen was placed and secured in the shear box for testing. The rigid wooden substrates with the textured steel gripping surfaces were placed on the GCL specimen prior to application of the test normal stress. The normal stress used for shearing was applied to the test specimen within approximately five minutes of the removal of the normal stress used for soaking, and shearing of the test specimen followed immediately.

Other features of the testing procedure included the following:

- a freshly remolded 3-in. (75-mm) thick layer of concrete sand was used as a bedding layer below the geomembrane specimen in each interface direct shear test (Test Series 1 and 4); the concrete sand was compacted by hand tamping to a relatively dense state under dry conditions;

- each specimen was soaked in tap water for 24 hours under each applied normal stress prior to being sheared;

- the direction of shear for each test was in the direction of manufacture (machine direction) of the geosynthetic samples;

- all of the interface direct shear tests (Test Series 1 and 4) were performed using a constant effective sample area (i.e., the plan area of the geosynthetic specimens were larger than that of the upper shear box), therefore, no area correction was required when computing normal and shear stresses;

- for the internal direct shear tests on the GCL (Test Series 2 and 3), a constant area of 1 ft^2 (0.1 m^2) was assumed in computing normal and shear stresses; and

- all of the tests were sheared until a constant, residual shear load was recorded.

4. TEST RESULTS

4.1 Overview

The data reduction procedures and test results are summarized below. The direct shear test data and comprehensive summary plots for each test series are presented in Appendix A. The direct shear test data and comprehensive summary plots for similar test series (i.e., Test Series 1 and 4 and Test Series 2 and 3) are presented in Appendix B in order to facilitate comparison.

4.2 Direct Shear Tests

For each test in Test Series 1 and 4 sliding (i.e., shear failure) occurred at the intended interface. For Test Series 2 and 3, the mode of failure was evaluated after each test. In each test failure was observed to occur due to rupture and unravelling of the three lines of stitches within the test specimen and the separation of the secondary geotextile from the bentonite component of the GCL.

The total-stress shearing resistance was evaluated for each applied normal stress. The test data were plotted on a graph of shear force versus horizontal displacement. The resulting plots are presented in Appendix A. The peak value of shear force was used to calculate the peak shear strength. For this report, the residual shear strength was assumed to be equal to the stabilized post-peak shear force measured at the end of each test.

The total-stress peak and residual shear strengths derived from the plotted test results are summarized in Table 3. These strengths were plotted on a graph of shear stress versus normal stress and the results were used to evaluate total-stress peak or residual strength envelopes. A best fit straight line was drawn through the two or three data points from each test series to obtain total-stress peak and residual friction angles and adhesions. The coefficient of correlation (R^2), a standard statistical indicator of how well the best-fit line matches the test data, was obtained for each best-fit line. The summary plots of shear stress versus normal stress for each test series are also presented in Appendix A. The friction angles, adhesions, and R^2 values derived from the plotted test results are summarized in Table 4.

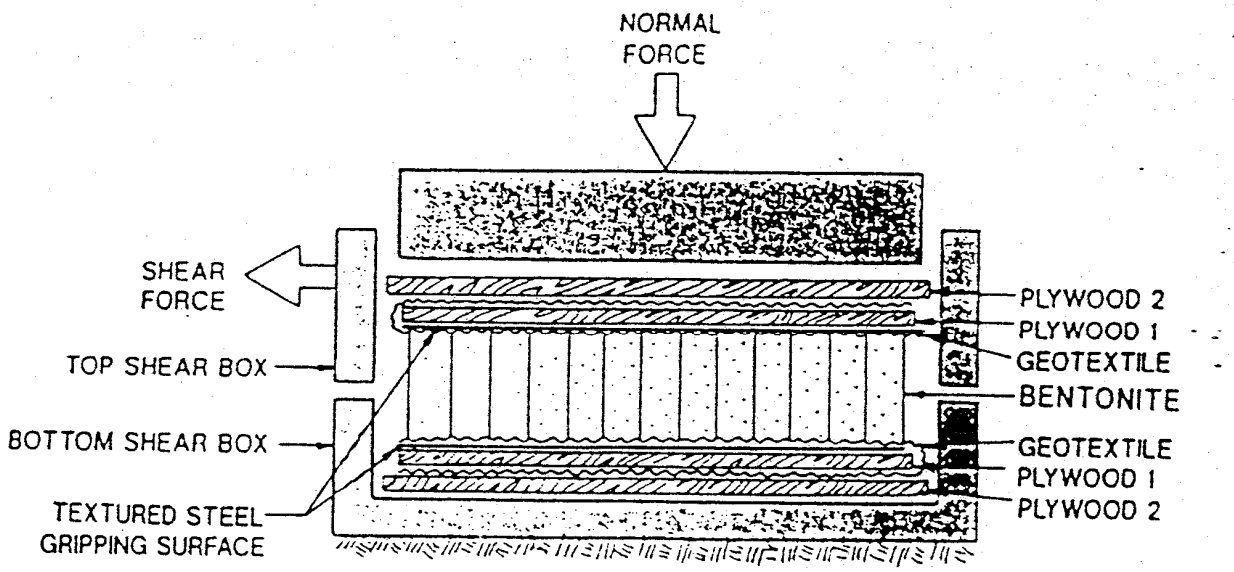
Shear stress versus normal stress plots reported in Appendix A include a best-fit straight line through all of the data points for each test series. CH2M Hill requested that additional plots be prepared for Test Series 1 and 4 and Test Series 2 and 3. For these test series, a best-fit straight line was drawn through all of the data points from each of the two test series to develop shear strength envelopes for: (i) the soaked Claymax 500SP GCL-geomembrane interfaces for the range of normal stresses from 10 to 100 psi (70 to 700 kPa) and (ii) the internal strength of the soaked Claymax 500SP GCL for the range of normal stresses ranging from 20 to 100 psi (140 to 700 kPa). The coefficient of correlation (R^2), a standard statistical indicator of how well the best-fit line matches the test data, was obtained for each best-fit line. The friction angles, adhesions, and R^2 values derived from the plotted test results are summarized in Table 5. The summary plots of shear force versus displacement and shear stress versus normal stress for the Test Series 1 and 4 and Test Series 2 and 3 are presented in Appendix B.

For each test series, it is noted that the reported adhesion is the shear stress axis intercept of the best-fit straight line drawn through the test data on a plot of shear stress versus normal stress. This value may not be the "true adhesion" of the interface or GCL specimen and caution should be exercised in using this adhesion value for applications involving normal stresses outside the range of stresses covered by the test series.

4.3 Closure

The reported results apply only to the materials and test conditions used during the testing program. The results do not necessarily apply to other materials or test conditions. The results should not be used in engineering analyses unless the test conditions model anticipated field conditions. The testing was performed in accordance with general engineering testing standards and requirements. This testing report is submitted for the exclusive use of CH2M Hill.

GCL TEST SPECIMEN CONFIGURATION



GeoSyntec Consultants
GEOMECHANICS AND ENVIRONMENTAL LABORATORY

FIGURE NO.	1
PROJECT NO.	GLI3642
DOCUMENT NO.	GEL94386
PAGE NO	

TABLE 1

DIRECT SHEAR TESTING
GCL AND GEOMEMBRANE ROLL NUMBERS
CH2M HILL
BUENA VISTA LANDFILL, MODULE 3

Test Series Number	Roll Numbers Claymax 500SP GCL	Roll Numbers[1] 60-mil Gundle Smooth-Textured HDPE Geomembrane
1	0137797	7015132
2	0137797	N/A
3	0146424	N/A
4	0146424	7015116

Note: (1) N/A refers to the fact that the geomembrane specimen was not used in the specific test series.

TABLE 2

SUMMARY OF DIRECT SHEAR TEST EQUIPMENT AND CONDITIONS
DIRECT SHEAR TESTING
CH2M HILL
BUENA VISTA LANDFILL, MODULE 3

Test Series Number	Shear Box Size	TEST CONDITIONS[1]				Normal Stress During Shearing (psi)	Displacement Rate (in./min)
		ω_{ci} (%)	Soaking Stress (psi)	Time of Soaking (Hours)	ω_{cf} (%)		
1	12" x 12"	32.5	60	24	116.1	60	0.04
		32.5	80	24	105.3	80	0.04
		32.5	100	24	95.4	100	0.04
2	12" x 12"	32.5	60	24	120.9	60	0.04
		32.5	80	24	108.2	80	0.04
		32.5	100	24	100.1	100	0.04
3	12" x 12"	26.5	20	24	151.4	20	0.04
		26.5	40	24	138.2	40	0.04
4-	12" x 12"	26.5	10	24	163.2	10	0.04
		26.5	20	24	154.6	20	0.04
		26.5	40	24	140.1	40	0.04

Note: (1) ω_{ci} refers to initial moisture content of GCL specimen.
ω_{cf} refers to final moisture content of GCL specimen.

TABLE 3

DIRECT SHEAR TEST RESULTS
MEASURED PEAK AND RESIDUAL TOTAL SHEAR STRENGTHS
CH2M HILL
BUENA VISTA LANDFILL, MODULE 3

Test Series Number[1]	Normal Stress[2] (psi)	Measured Peak Shear Strength (psi)	Measured Residual Shear Strength (psi)	Reference Appendix Figure Number
1	60.0 80.0 100.0	11.9 15.7 19.3	8.2 12.1 13.9	A-1 and A-2
2	60.0 80.0 100.0	13.3 19.1 21.4	6.1 8.4 9.8	A-3 and A-4
3	20.0 40.0	6.3 13.1	3.1 5.8	A-5 and A-6
4	10.0 20.0 40.0	2.2 3.8 7.9	1.7 2.7 6.2	A-7 and A-8

Notes: (1) For each test series, the Claymax 500SP GCL specimen contained three lines of stitches at the central portion of the test specimen.

(2) Test specimens were soaked in tap water for 24 hours under each applied normal stress prior to being sheared.

TABLE 4

DIRECT SHEAR TEST RESULTS
MEASURED TOTAL STRESS SHEAR STRENGTH PARAMETERS
CH2M HILL
BUENA VISTA LANDFILL, MODULE 3

Test Series Number	Interface or GCL Specimen Tested[1]	Normal[2] Stress Range (psi)	Peak Strength[3]			Residual Strength[3]		
			Friction Angle	Adhesion (psf)	R^2	Friction Angle	Adhesion (psf)	R^2
1	Soaked Claymax 500SP GCL (Clem Roll No. 0137797, Primary Woven Geotextile in Contact With Geomembrane)/60-mil Gundle Smooth-Textured HDPE Geomembrane (Gundle Roll No. 7015132, Textured Side Against GCL)	60 to 100	10°	115	1.000	8°	0	0.952
2	Internal Strength of Soaked Claymax 500SP GCL (Clem Roll No. 0137797) With Three Lines of Stitches	60 to 100	12°	240	0.940	5°	100	0.980
3	Internal Strength of Soaked Claymax 500SP GCL (Clem Roll No. 0146424) With Three Lines of Stitches	20 to 40	19°	- 65	1.000	8°	60	1.000
4	Soaked Claymax 500SP GCL (Clem Roll No. 0146424, Primary Woven Geotextile in Contact With Geomembrane)/60-mil Gundle Smooth-Textured HDPE Geomembrane (Gundle Roll No. 7015116, Textured Side Against GCL)	10 to 40	11°	15	0.997	9°	5	0.986

Notes: (1) For each test series, the Claymax 500SP GCL specimen contained three lines of stitches at the central portion of the specimen; the entire test specimen was soaked in tap water for 24 hours under each applied normal stress prior to placement in the shear box for testing.

(2) Test specimens were sheared immediately after application of the normal stress used for shearing.

(3) The reported value of adhesion may not be the "true adhesion" of the interface or GCL specimen and caution should be exercised in using this adhesion value for applications involving normal stresses outside the range of stresses covered by the test. The value of R^2, the coefficient of correlation, provides an indication of how well the best-fit shear strength parameters match the test data.

TABLE 5

DIRECT SHEAR TEST RESULTS
MEASURED TOTAL STRESS SHEAR STRENGTH PARAMETERS
FOR SIMILAR TEST SERIES
CH2M HILL
BUENA VISTA LANDFILL, MODULE 3

Test Series Number	Interface or GCL Specimen Tested[1]	Normal[2] Stress (psi)	Peak Strength[3]			Residual Strength[3]		
			Friction Angle	Adhesion (psf)	R^2	Friction Angle	Adhesion (psf)	R^2
1 and 4	Soaked Claymax 500SP GCL (Primary Woven Geotextile in Contact With Geomembrane)/60-mil Gundle Smooth-Textured HDPE Geomembrane (Textured Side Against GCL)	10 to 100	11°	25	0.990	8°	35	0.989
2 and 3	Internal Strength of Soaked Claymax 500SP GCL With Three Lines of Stitches	20 to 100	10°	540	0.941	5°	260	0.962

Notes: (1) For each test series, the Claymax 500SP GCL specimen contained three lines of stitches at the central portion of the specimen; the entire test specimen was soaked in tap water for 24 hours under each applied normal stress prior to placement in the shear box for testing.

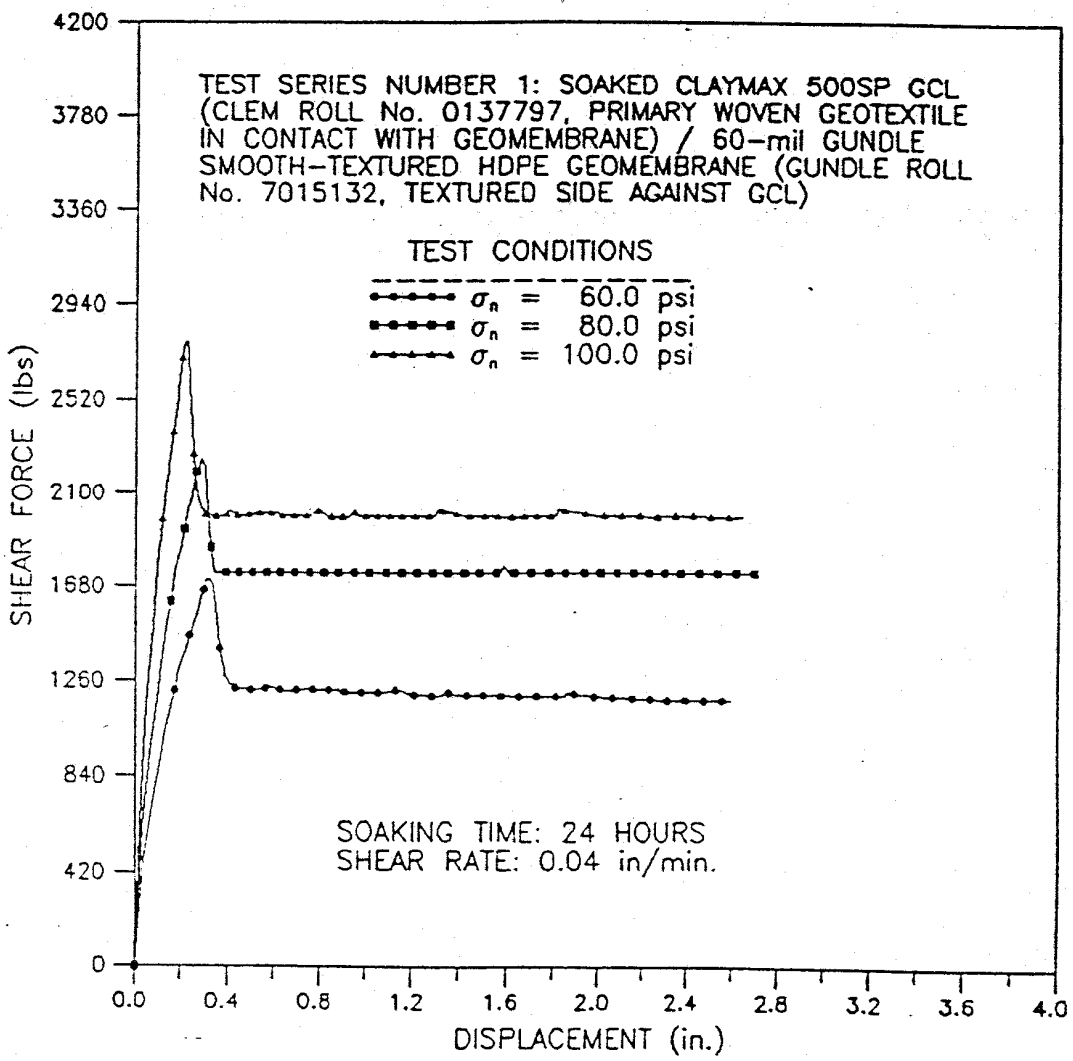
(2) Test specimens were sheared immediately after application of the normal stress used for shearing.

(3) The reported value of adhesion may not be the "true adhesion" of the interface or GCL specimen and caution should be exercised in using this adhesion value for applications involving normal stresses outside the range of stresses covered by the test. The value of R^2, the coefficient of correlation, provides an indication of how well the best-fit shear strength parameters match the test data.

APPENDIX A

DIRECT SHEAR TEST DATA

CH2M HILL
BUENA VISTA LANDFILL, MODULE 3
INTERFACE DIRECT SHEAR TESTING



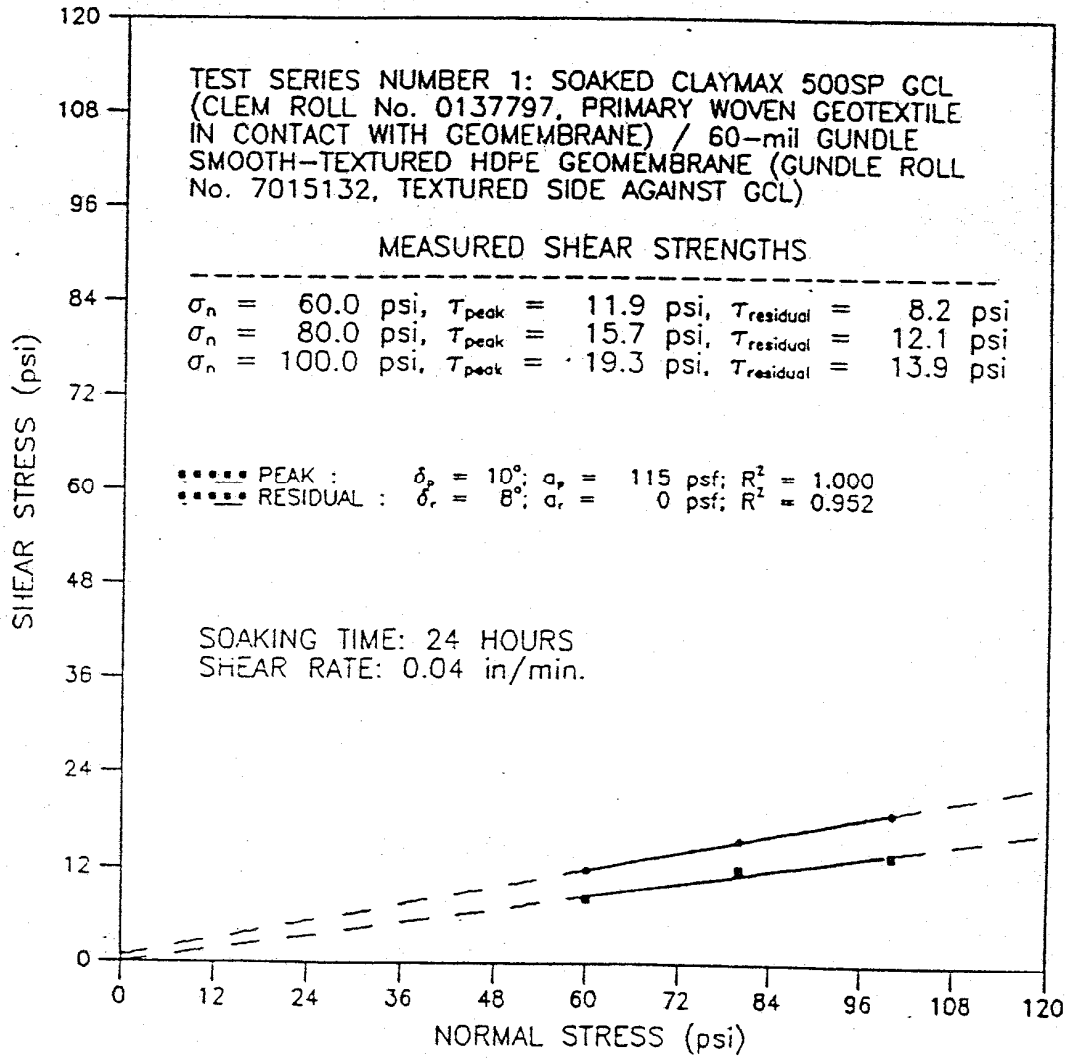
NOTE: The shear box size was 12 in, by 12 in.(300 mm by 300 mm), and the contact area remained constant throughout the entire test.

DATE TESTED: 23 THRU 26 JULY 1994

GeoSyntec Consultants
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FIGURE NO.	A-1
PROJECT NO.	GI13642
DOCUMENT NO.	GEI94386
PAGE NO.	

CH2M HILL
BUENA VISTA LANDFILL, MODULE 3
INTERFACE DIRECT SHEAR TESTING



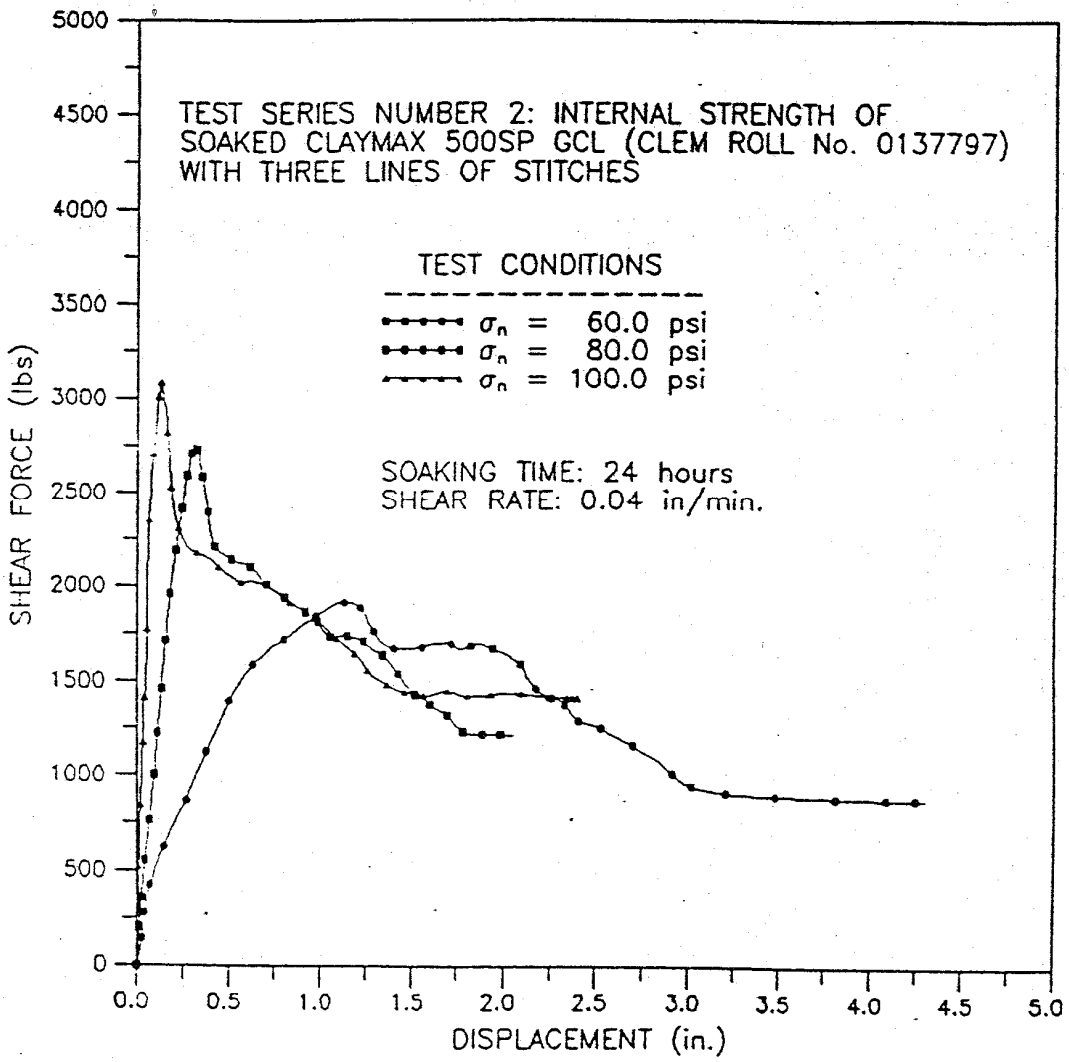
NOTE: The reported value of adhesion may not be the true adhesion of the interface, and caution should be exercised in using this adhesion value for applications involving normal stresses outside the range of stresses covered by the test.

DATE TESTED: 23 THRU 26 JULY 1994

GeoSyntec Consultants
GEOMECHANICS AND ENVIRONMENTAL LABORATORY

FIGURE NO.	A-2
PROJECT NO.	GLI3642
DOCUMENT NO.	GEL94386
PAGE NO.	

CH2M HILL
BUENA VISTA LANDFILL, MODULE 3
DIRECT SHEAR TESTING



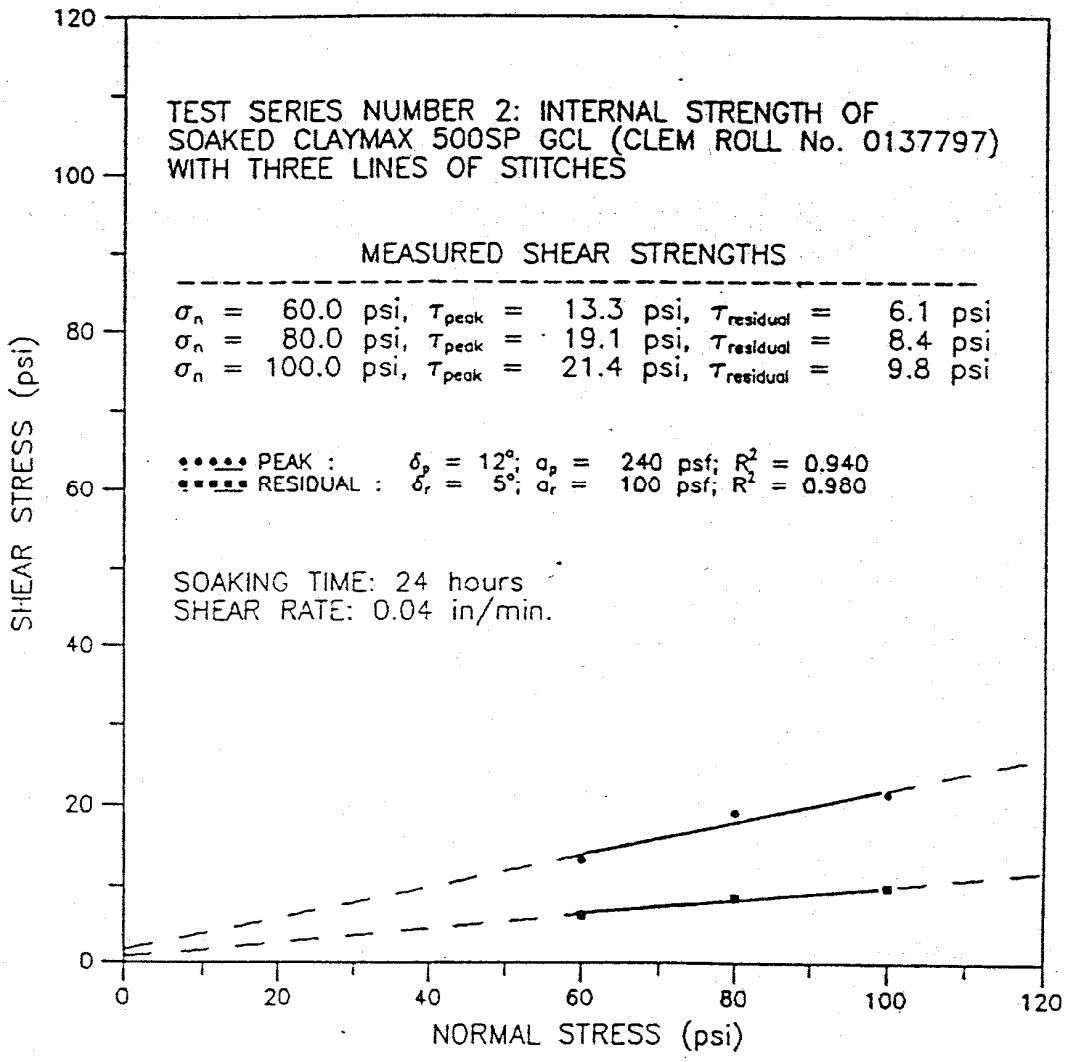
NOTE: The shear box size was 12 in. by 12 in.(300 mm by 300 mm).

DATE TESTED: 27 THRU 30 JULY 1994

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FIGURE NO.	A-3
PROJECT NO.	GLI3642
DOCUMENT NO.	GEL94386
PAGE NO.	

CH2M HILL
BUENA VISTA LANDFILL, MODULE 3
DIRECT SHEAR TESTING



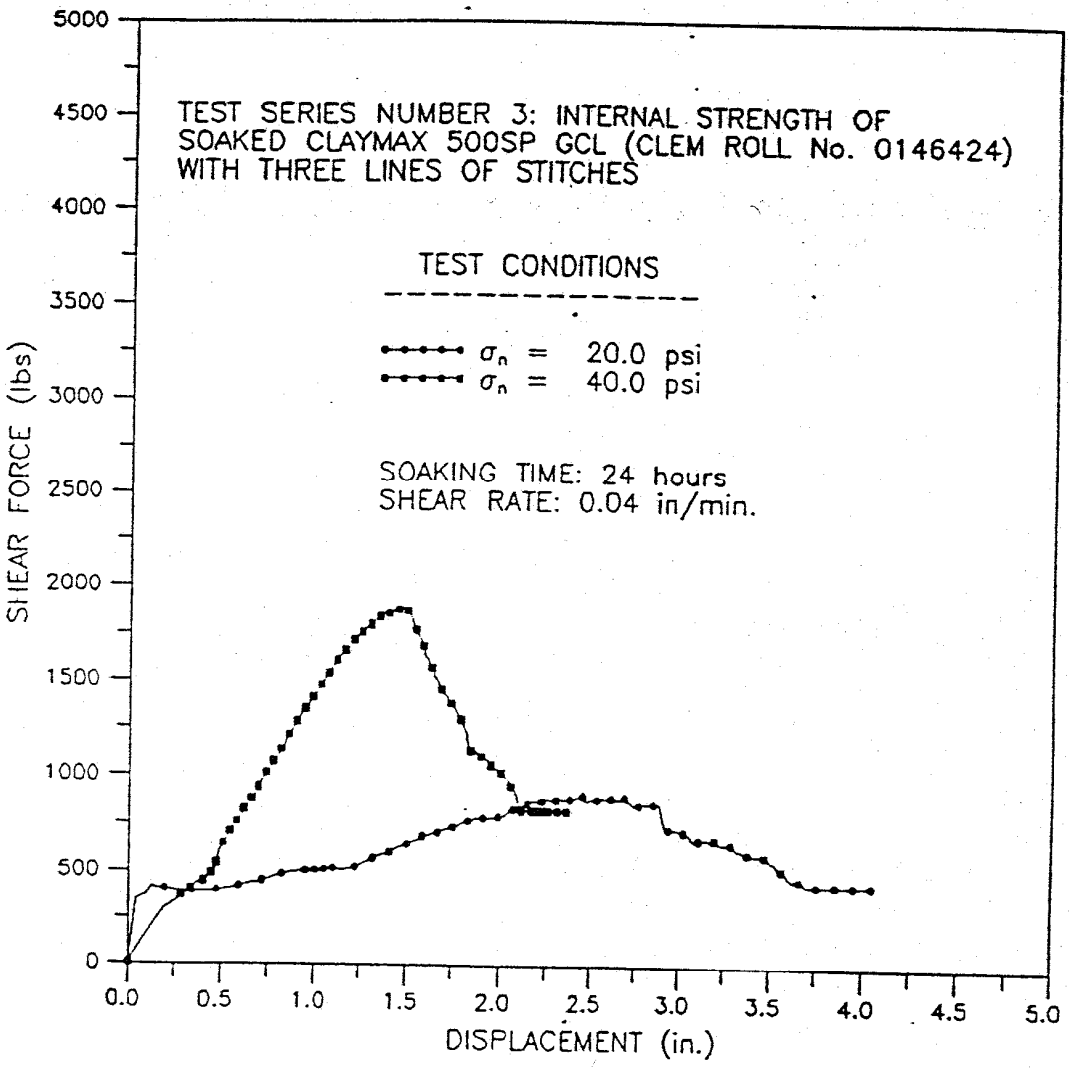
NOTES: (1) The reported value of adhesion may not be the true adhesion of the GCL specimen, and caution should be exercised in using this adhesion value for applications involving normal stresses outside the range of stresses covered by the test.
(2) Shear stress calculated assuming a constant shear area of 1 ft^2.

DATE TESTED: 27 THRU 30 JULY 1994

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FIGURE NO.	A-4
PROJECT NO.	GLI3642
DOCUMENT NO.	GEL94386
PAGE NO.	

CH2M HILL
BUENA VISTA LANDFILL, MODULE 3
DIRECT SHEAR TESTING



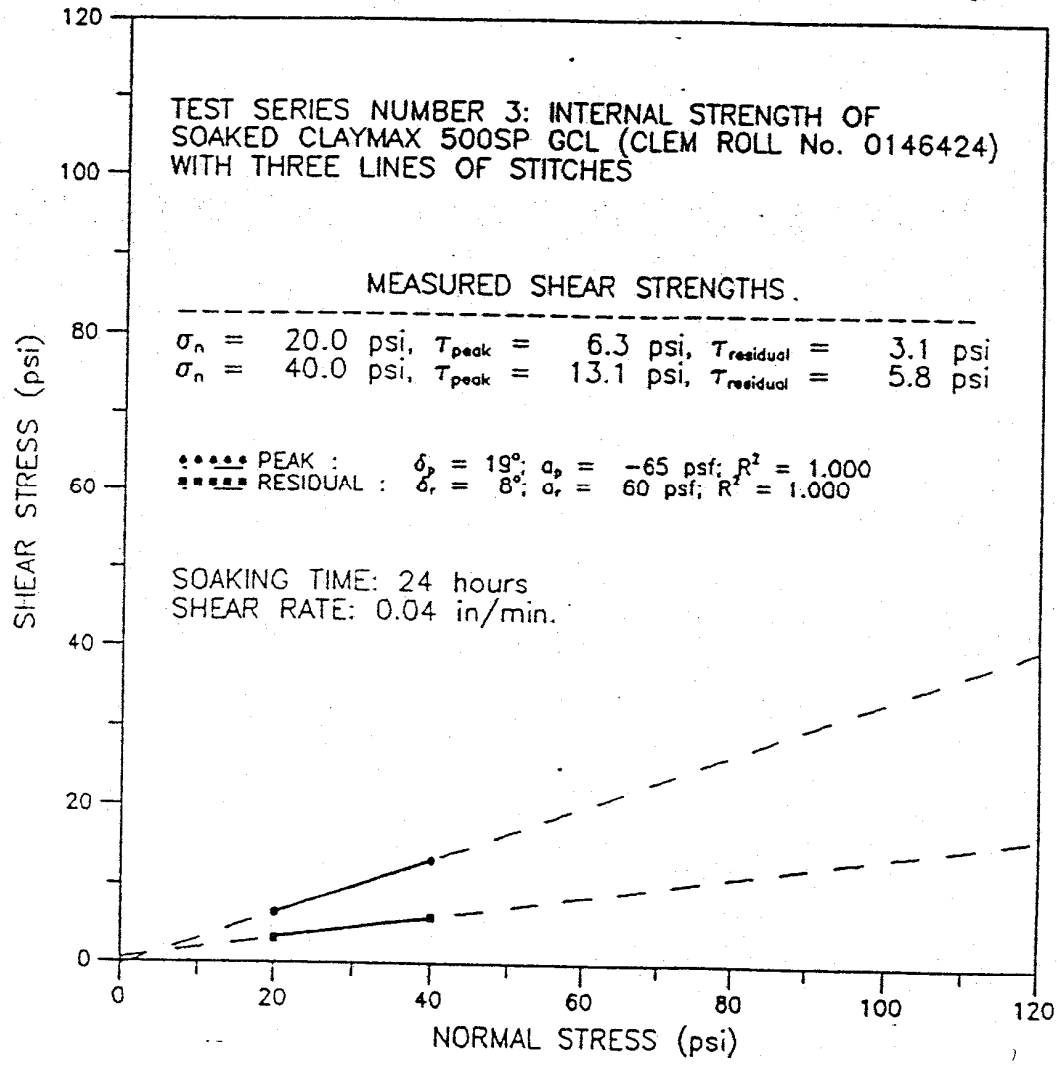
NOTE: The shear box size was 12 in. by 12 in.(300 mm by 300 mm).

DATE TESTED: 12 THRU 17 AUGUST 1994

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FIGURE NO.	A-5
PROJECT NO.	GLI3642
DOCUMENT NO.	GEL94386
PAGE NO.	

CH2M HILL
BUENA VISTA LANDFILL, MODULE 3
DIRECT SHEAR TESTING



NOTES: (1) The reported value of adhesion may not be the true adhesion of the GCL specimen, and caution should be exercised in using this adhesion value for applications involving normal stresses outside the range of stresses covered by the test.

(2) Shear stress calculated assuming a constant shear area of 1 ft^2.

DATE TESTED: 12 THRU 17 AUGUST 1994

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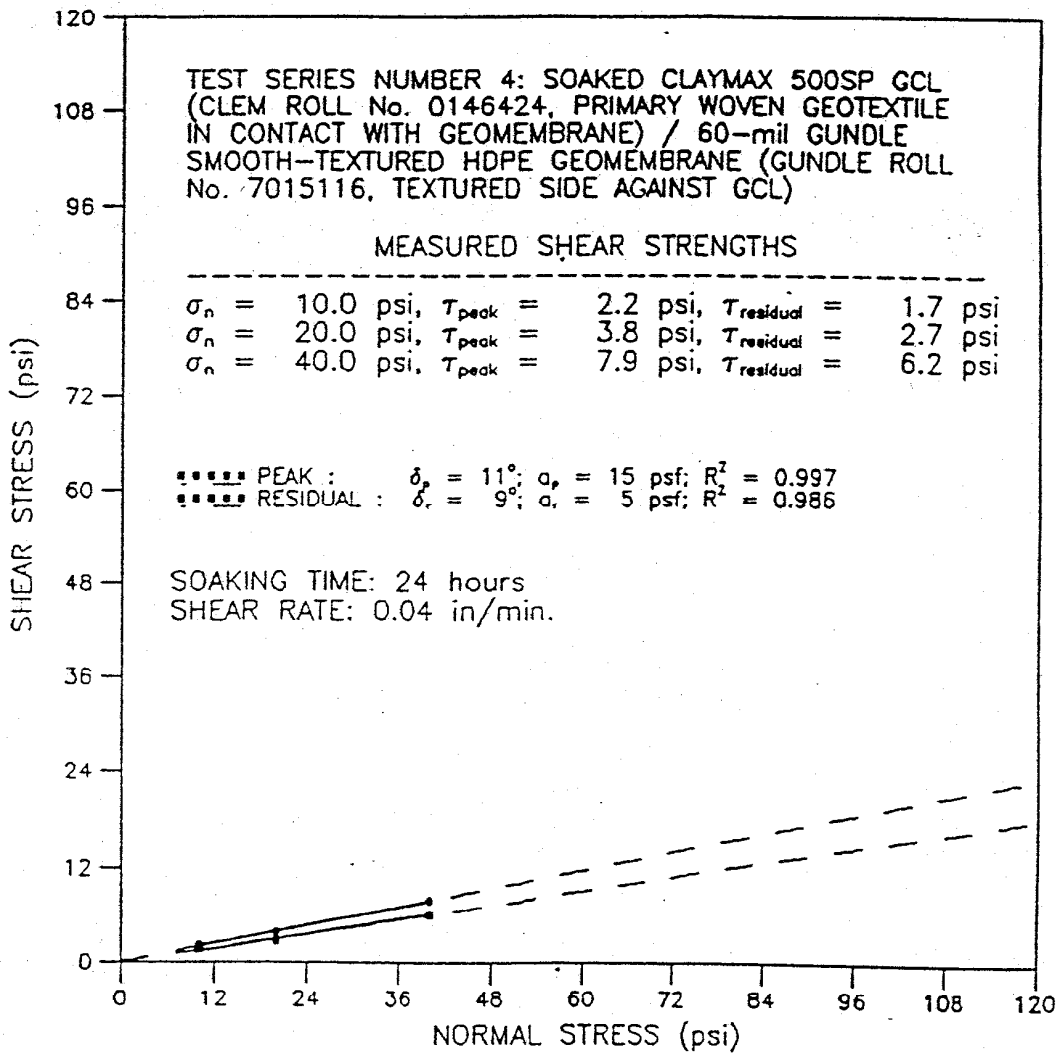
GEOMECHANICS AND ENVIRONMENTAL LABORATORY

FIGURE NO.	A–6
PROJECT NO.	GLI3642
DOCUMENT NO.	GEL94386
PAGE NO.	

APPENDIX B

DIRECT SHEAR TEST DATA FOR SIMILAR TEST SERIES

CH2M HILL
BUENA VISTA LANDFILL, MODULE 3
INTERFACE DIRECT SHEAR TESTING



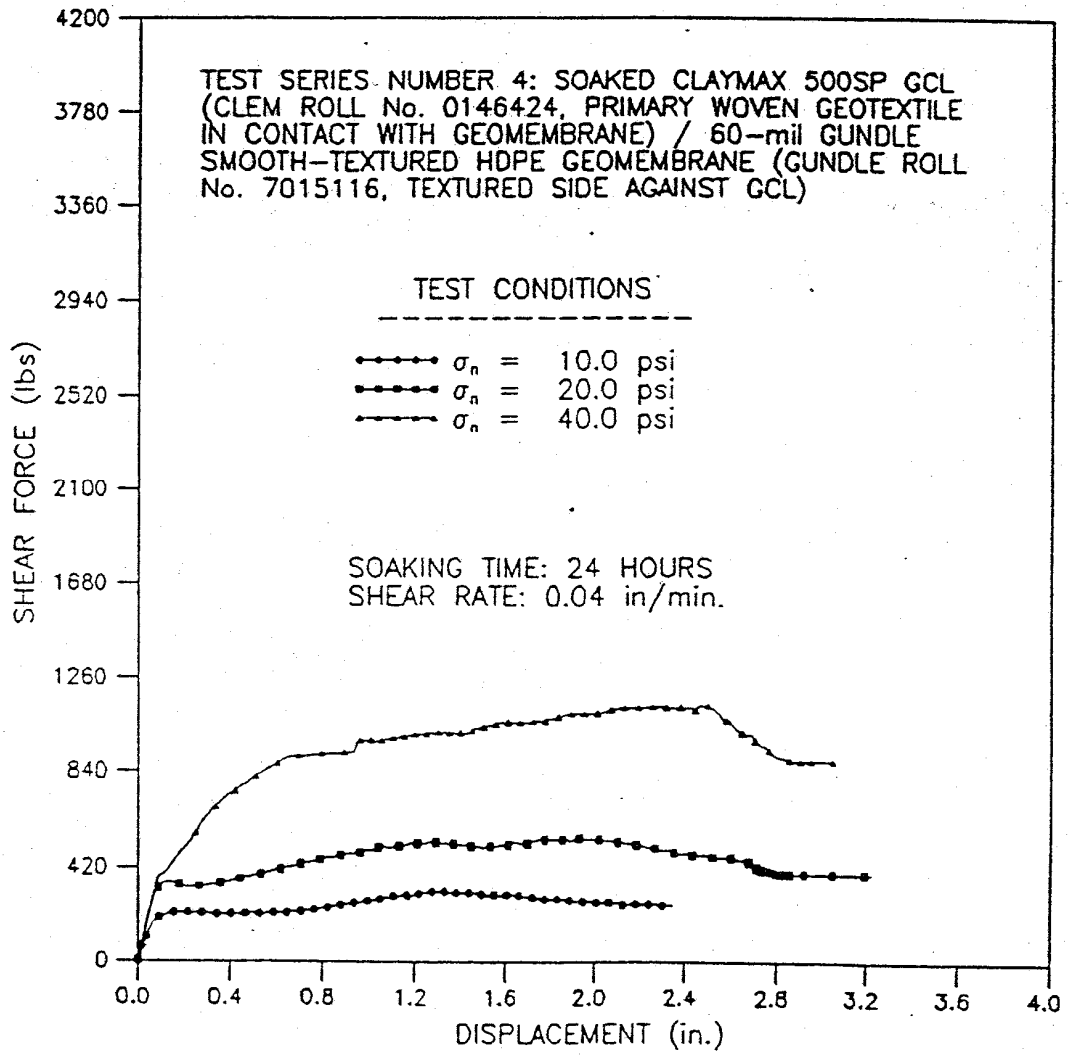
NOTE: The reported value of adhesion may not be the true adhesion of the interface, and caution should be exercised in using this adhesion value for applications involving normal stresses outside the range of stresses covered by the test.

DATE TESTED: 11 THRU 23 AUGUST 1994

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FIGURE NO.	A-8
PROJECT NO.	GL13642
DOCUMENT NO.	GEL94386
PAGE NO.	

CH2M HILL
BUENA VISTA LANDFILL, MODULE 3
INTERFACE DIRECT SHEAR TESTING



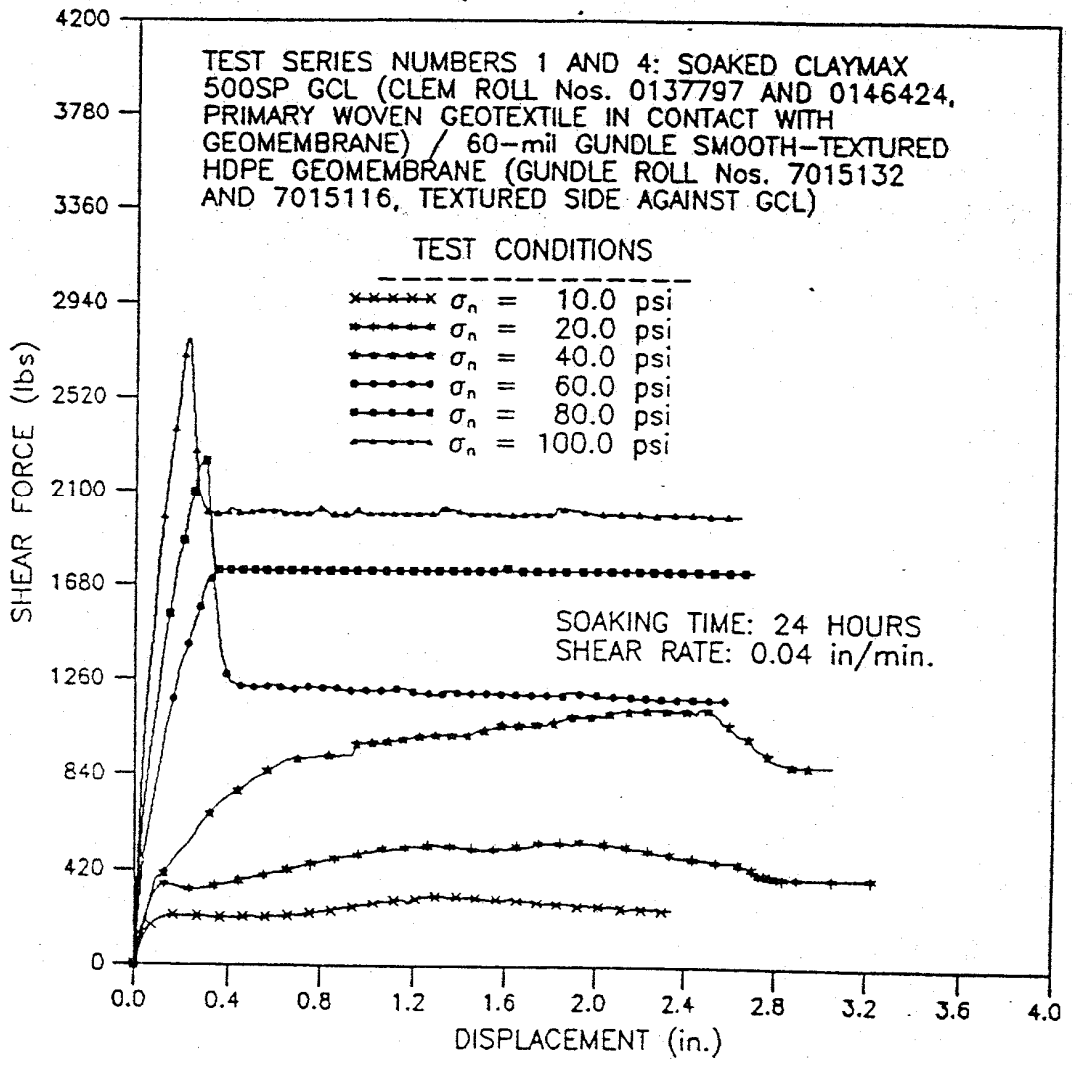
NOTE: The shear box size was 12 in. by 12 in.(300 mm by 300 mm), and the contact area remained constant throughout the entire test.

DATE TESTED: 11 THRU 23 AUGUST 1994

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FIGURE NO.	A-7
PROJECT NO.	GLI3642
DOCUMENT NO.	GEL94386
PAGE NO.	

CH2M HILL
BUENA VISTA LANDFILL, MODULE 3
INTERFACE DIRECT SHEAR TESTING



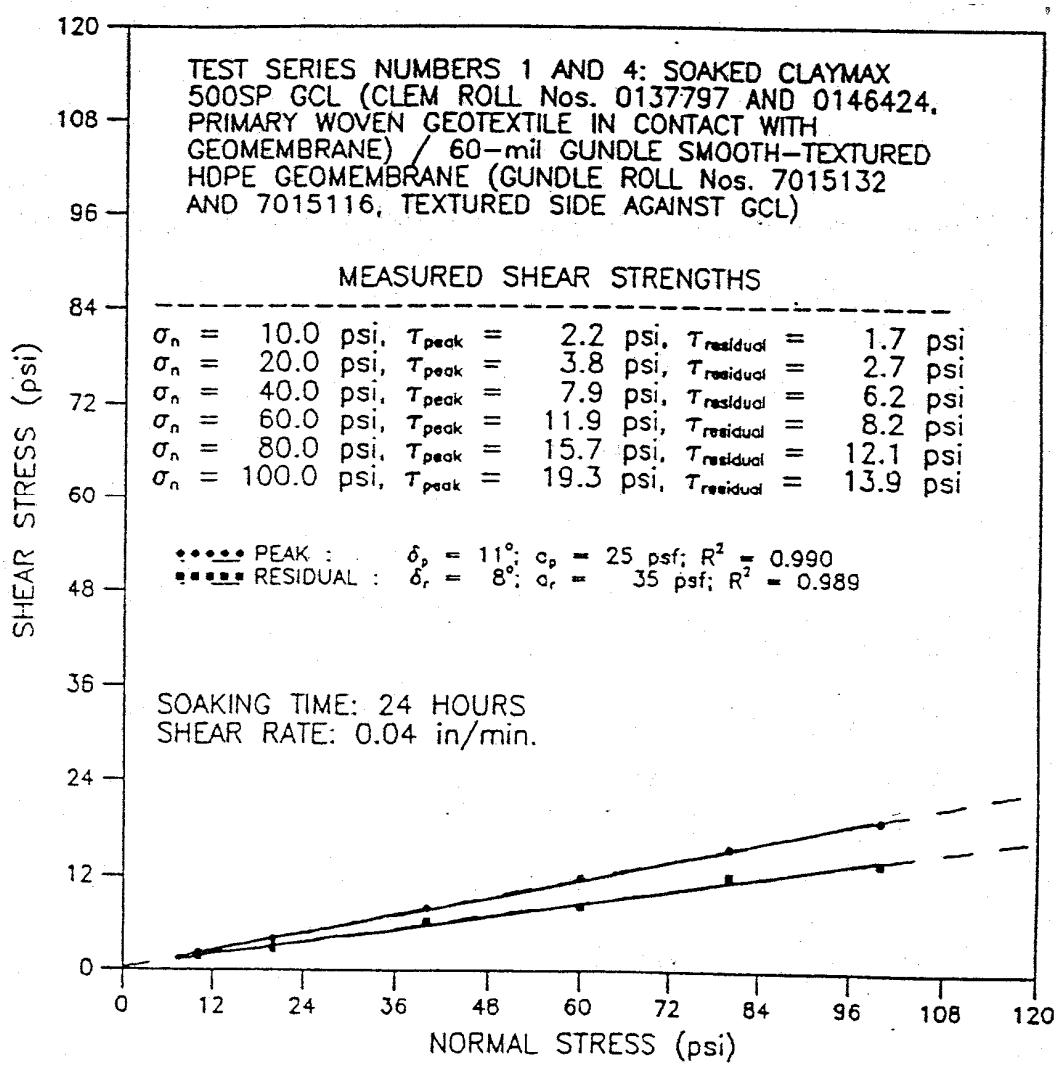
NOTE: The shear box size was 12 in. by 12 in.(300 mm by 300 mm), and the contact area remained constant throughout the entire test.

DATE TESTED: 23 JULY THRU 23 AUGUST 1994

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FIGURE NO.	B-1
PROJECT NO.	GLI3642
DOCUMENT NO.	GEL94386
PAGE NO.	

CH2M HILL
BUENA VISTA LANDFILL, MODULE 3
INTERFACE DIRECT SHEAR TESTING



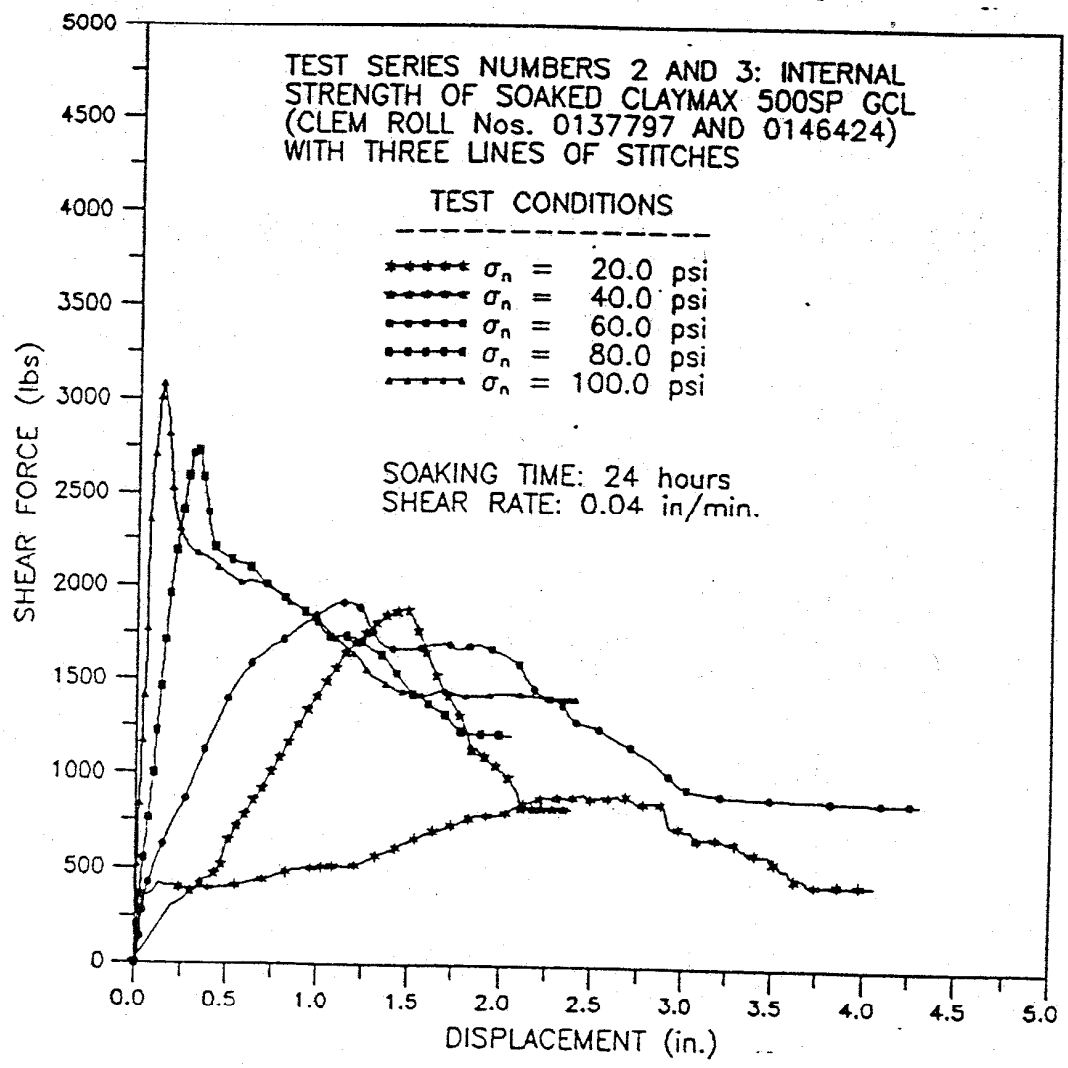
NOTE: The reported value of adhesion may not be the true adhesion of the interface, and caution should be exercised in using this adhesion value for applications involving normal stresses outside the range of stresses covered by the test.

DATE TESTED: 23 JULY THRU 23 AUGUST 1994

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FIGURE NO.	B-2
PROJECT NO.	GLI3642
DOCUMENT NO.	GEL94386
PAGE NO.	

CH2M HILL
BUENA VISTA LANDFILL, MODULE 3
DIRECT SHEAR TESTING



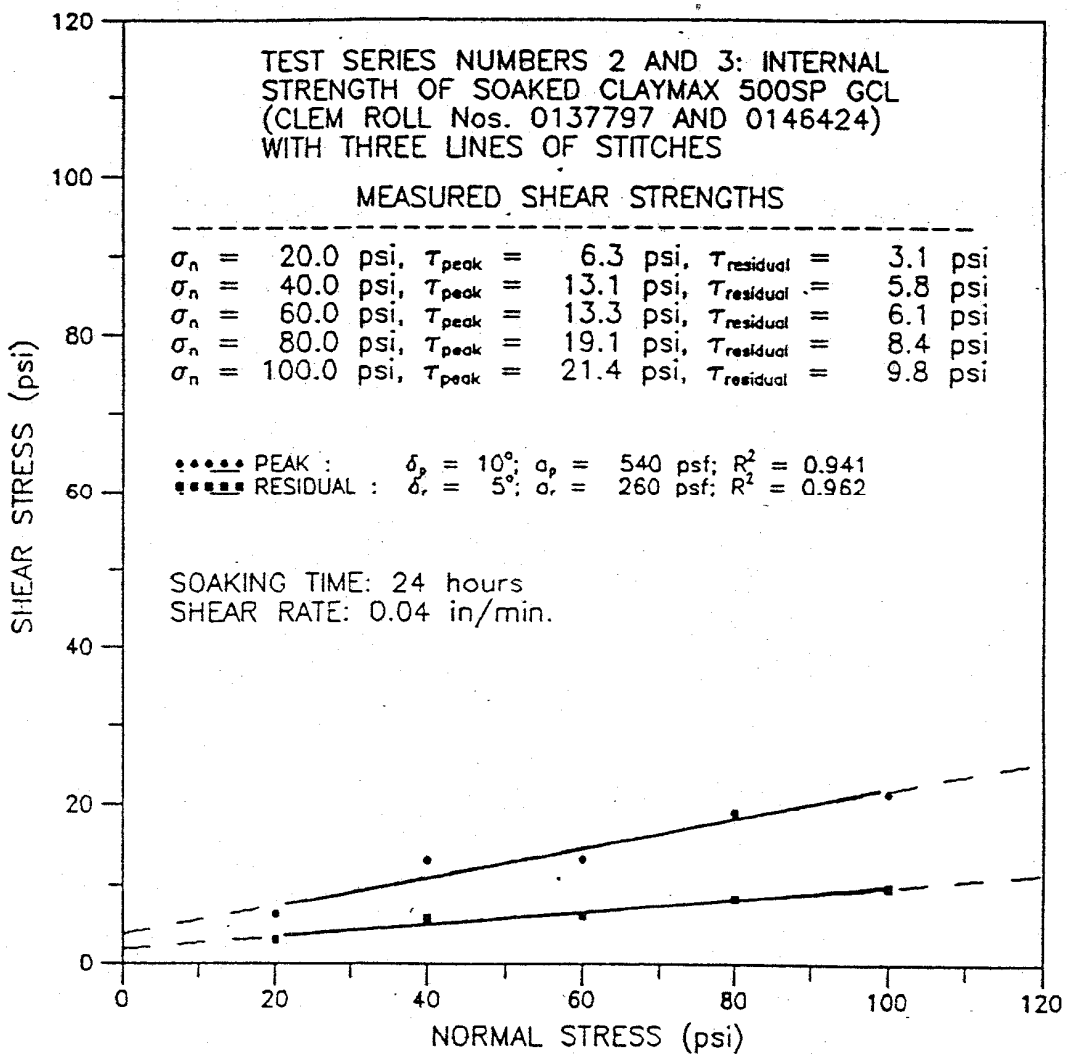
NOTE: The shear box size was 12 in. by 12 in.(300 mm by 300 mm).

DATE TESTED: 30 JULY TO 17 AUGUST 1994

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FIGURE NO.	B-3
PROJECT NO.	GLI3642
DOCUMENT NO.	GEL94386
PAGE NO.	

CH2M HILL
BUENA VISTA LANDFILL, MODULE 3
DIRECT SHEAR TESTING



NOTES: (1) The reported value of adhesion may not be the true adhesion of the GCL specimen, and caution should be exercised in using this adhesion value for applications involving normal stresses outside the range of stresses covered by the test.
(2) Shear stress calculated assuming a constant shear area of 1 ft^2.

DATE TESTED: 30 JULY TO 17 AUGUST 1994

GeoSyntec Consultants
GEOMECHANICS AND ENVIRONMENTAL LABORATORY

FIGURE NO.	B-4
PROJECT NO.	GLI3642
DOCUMENT NO.	GEL94386
PAGE NO.	

INTERFACE STRENGTH RETESTS
MODULE 6

Buena Vista Drive Sanitary Landfill
Site Development Plans – 2005 Update
Interface Strengths for Module 6

In 2003, as part of the construction for Module 4A, samples of the Module 6 base liner system (i.e., clay, geomembrane, nonwoven geotextile) were collected by GeoSyntec. In 2004, GeoSyntec performed compaction (ASTM D1557) and Atterberg limits (ASTM D4318) on the clay sample. Interface shear testing was performed in general accordance with ASTM D5321 using the site-specific materials collected at the site for:

- textured HDPE/nonwoven geotextile
- textured HDPE/compacted clay liner

To fabricate the clay samples for the interface tests, GeoSyntec reviewed the Construction Quality Assurance (CQA) Report prepared by CH2MHill (2000) to obtain the relative compaction at placement for the fourth lift (i.e., the lift nearest to the textured geomembrane) of the clay liner. Based on reviewing the compaction data collected during CQA for the fourth lift, the average relative compaction for the fourth clay lift was approximately 95 percent; therefore, the clay liner samples for interface testing were fabricated at 95 percent and 3 percent above optimum.

Construction Quality Assurance
Daily Field Inspection Logs
Module 6
Buena Vista Sanitary Landfill
Santa Cruz County, California

Prepared for

County of Santa Cruz

This document has been prepared under the direction
of a California registered professional engineer

Prepared by



CH2MHILL

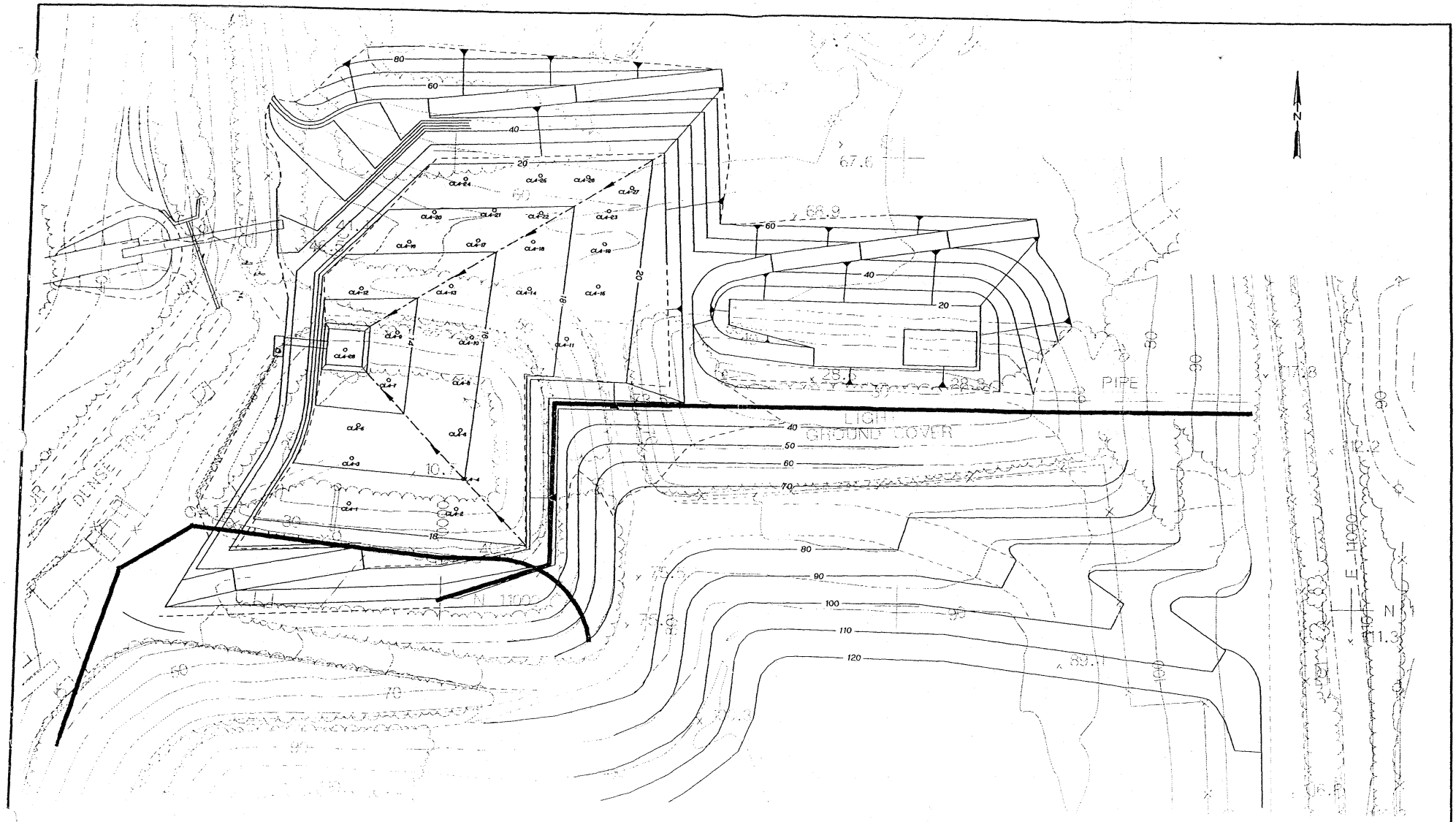
1111 Broadway, Suite 1200
Oakland, California 94607

May 2000

TABLE 3-3
Compaction Test Results
Module 6
Buena Vista Sanitary Landfill

Sample Number	Material Description	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
CL-1	sandy clay	111	14.5
CL-2	sandy clay	111	16.5
CL-3	sandy clay	111	17.0
CL-4	Clay w/sand	109	16.0

[1]All sand cone density tests were performed in general accordance with ASTM D1557, Method A



NOTE: CL4 INDICATES FOURTH LIFT (18-24 INCHES) OF CLAY LINER

FIGURE 3-4

LIFT 4
NUCLEAR GAGE DENSITY TEST LOCATIONS
MODULE 6

BUENA VISTA SANITARY LANDFILL
SANTA CRUZ, CALIFORNIA

INTERFACE DIRECT SHEAR SUMMARY

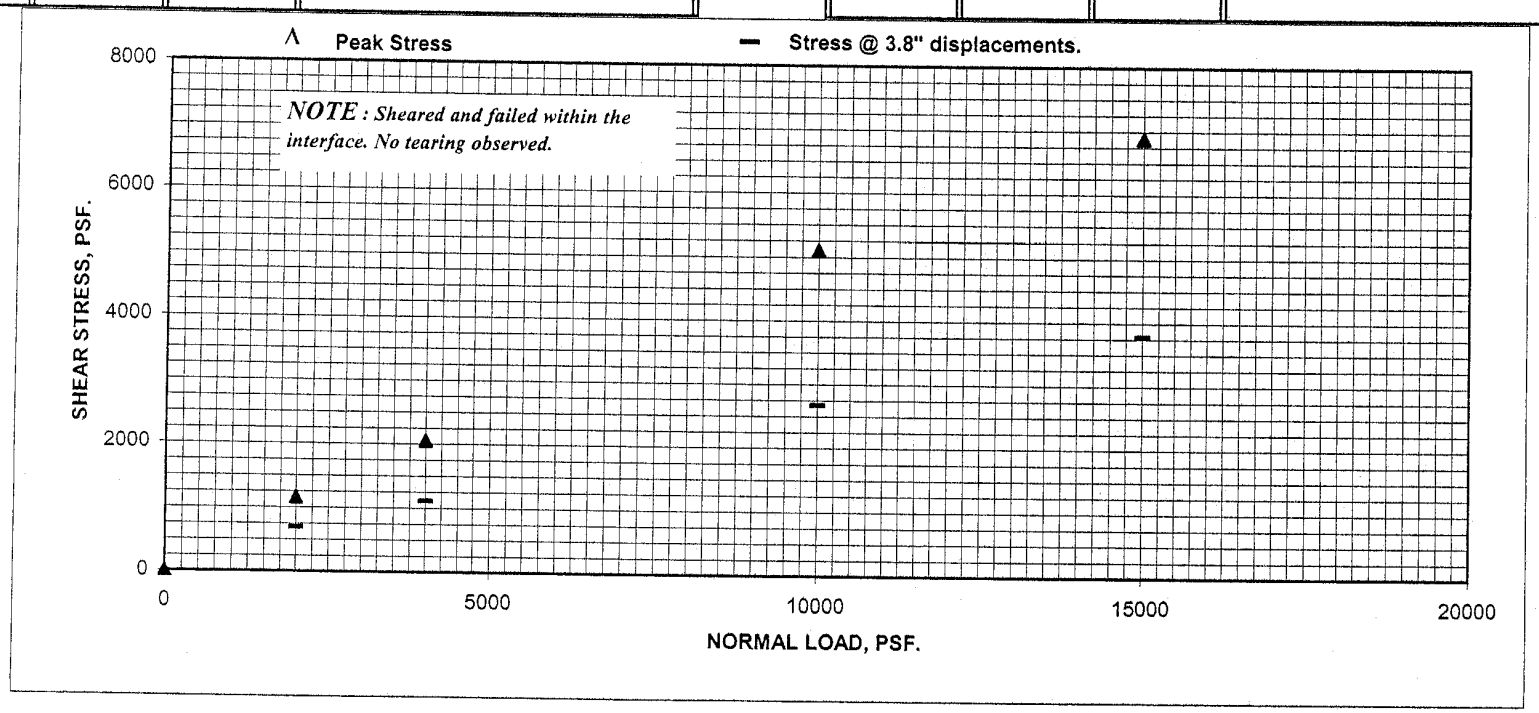
Shaw™ EMCON/OWT, Inc.
A Shaw Group Company

PROJECT NAME: BUENA VISTA LANDFILL
DESCRIPTION: 80mil DS TEXTURED HDPE / NWGT.

PROJECT NUMBER: 837998
DATE: 04/30/04

Load, psf.	Peak	Residual Strength	
2,000	1161	691	
4,000	2055	1114	
10,000	5104	2676	
15,000	6889	3783	

Load, psf.	Peak	Residual Strength	



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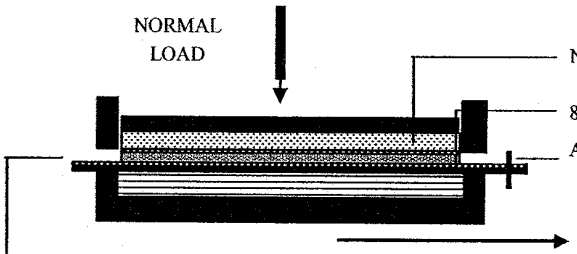
INTERFACE DIRECT SHEAR

Shaw EMCON/OWT, Inc.
A Shaw Group Company

ASTM D5321

Checked By:

Project Name: BUENA VISTA LF. **Proj. No.:** 837998 **Date:** 4/28/2004
Sample Number: HDPE / NWGT **Load, psf.:** 2,000 **Tested By:** DGC
SampleDescription: 80mil DS TEXTURED HDPE / NWGT.



All components of the liner system were exposed + 1/4" on soil.

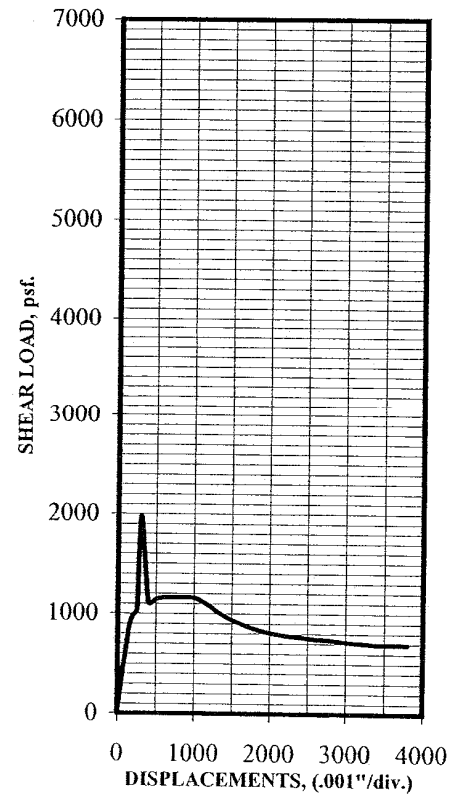
Max. Dry Density, pcf.	
Opt. Water Content,%	
Soil Initial w/c., %	
Initial Density, pcf.	
Soil Final w/c., %	
Asperity, inch.	0.029

DISPLACEMENTS, .001"/div.	SHEAR, psf.
0	11.0
50	320.0
100	614.0
150	878.0
200	988.0
250	1049.0
300	1983.0
400	1121.0
500	1152.0
600	1172.0
800	1172.0
1000	1169.0
1200	1092.0
1400	985.0
1600	916.0
1800	858.0
2000	820.0
2200	795.0
2400	779.0
2600	760.0
2800	749.0
3000	732.0
3200	719.0
3400	706.0
3600	702.0
3800	702.0

TEST CONDITIONS

1. Anchor the 80 mil DS textured HDPE onto the bottom box and spray with water.
2. Nailed down the geotextile onto a plywood, sprayed with water and placed on top of the textured HDPE.
3.Apply full normal load and flooded with water.
4. Wait for approximately 10-15 min. before shearing.
5. Sheared at 0.2 inches / minute.
6. Failure occured within the interface. The geotextile stretched for about 1/4". No tearing observed.

SHEAR LOAD VS. DISPLACEMENTS



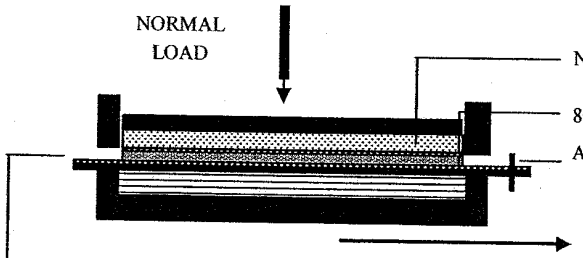
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INTERFACE DIRECT SHEAR

Shaw EMCON/OWT, Inc.
A Shaw Group Company

ASTM D5321

Project Name:	BUENA VISTA LF.	**Proj. No.:**	837998	**Checked By:**	
Sample Number:	HDPE / NWGT	**Load, psf.:**	4,000	**Date:**	4/28/2004
SampleDescription:	80mil DS TEXTURED HDPE / NWGT.			**Tested By:**	DGC



All components of the liner system were exposed + 1/4" on soil.

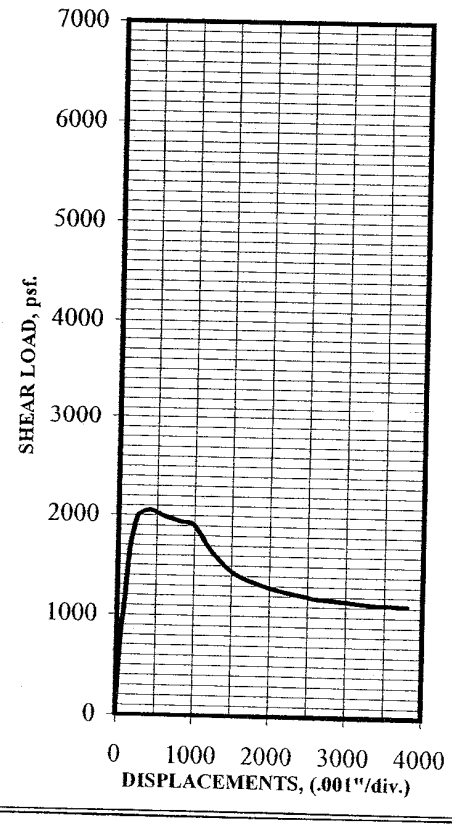
Max. Dry Density, pcf.	
Opt. Water Content,%	
Soil Initial w/c., %	
Initial Density, pcf.	
Soil Final w/c., %	
Asperity, inch.	0.033

DISPLACEMENTS, .001"/div.	SHEAR, psf.
0	11.0
50	731.0
100	1171.0
150	1639.0
200	1843.0
250	2002.0
300	2036.0
400	2066.0
500	2039.0
600	2003.0
800	1955.0
1000	1913.0
1200	1689.0
1400	1518.0
1600	1405.0
1800	1346.0
2000	1292.0
2200	1258.0
2400	1226.0
2600	1194.0
2800	1179.0
3000	1166.0
3200	1148.0
3400	1135.0
3600	1131.0
3800	1125.0

TEST CONDITIONS

1. Anchor the 80 mil DS textured HDPE onto the bottom box and spray with water.
2. Nailed down the geotextile onto a plywood, sprayed with water and placed on top of the textured HDPE.
3.Apply full normal load and flooded with water.
4. Wait for approximately 10-15 min. before shearing.
5. Sheared at 0.2 inches / minute.
6. Failure occured within the interface. The geotextile stretched for about 1/4". No tearing observed.

SHEAR LOAD VS. DISPLACEMENTS



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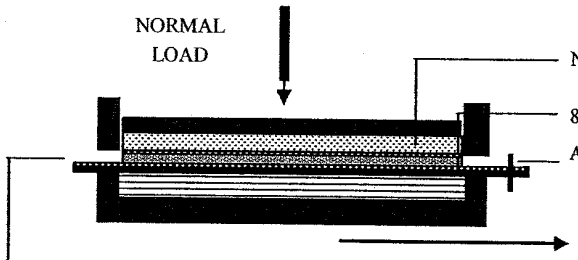
INTERFACE DIRECT SHEAR

Shaw EMCON/OWT, Inc.
A Shaw Group Company

ASTM D5321

Checked By:

Project Name: BUENA VISTA LF. **Proj. No.:** 837998 **Date:** 4/29/2004
Sample Number: HDPE / NWGT **Load, psf.:** 10,000 **Tested By:** DGC
SampleDescription: 80mil DS TEXTURED HDPE / NWGT.



All components of the liner system were exposed + 1/4" on soil.

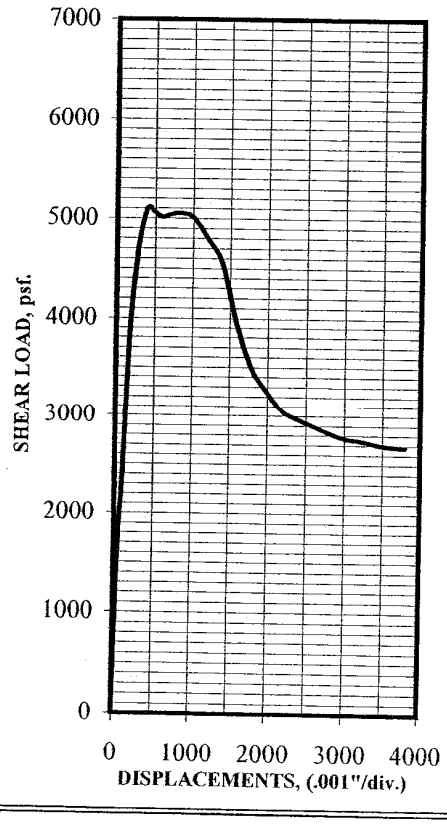
Max. Dry Density, pcf.	
Opt. Water Content,%	
Soil Initial w/c., %	
Initial Density, pcf.	
Soil Final w/c., %	
Asperity, inch.	0.031

DISPLACEMENTS, .001"/div.	SHEAR, psf.
0	11.0
50	1607.0
100	2349.0
150	3283.0
200	4042.0
250	4471.0
300	4801.0
400	5115.0
500	5069.0
600	5027.0
800	5063.0
1000	5022.0
1200	4809.0
1400	4564.0
1600	3939.0
1800	3487.0
2000	3250.0
2200	3057.0
2400	2973.0
2600	2905.0
2800	2838.0
3000	2780.0
3200	2758.0
3400	2724.0
3600	2700.0
3800	2687.0

TEST CONDITIONS

1. Anchor the 80 mil DS textured HDPE onto the bottom box and spray with water.
2. Nailed down the geotextile onto a plywood, sprayed with water and placed on top of the textured HDPE.
3.Apply full normal load and flooded with water.
4. Wait for approximately 10-15 min. before shearing.
5. Sheared at 0.2 inches / minute.
6. Failure occured within the interface. The geotextile stretched for about 1/2". No tearing observed.

SHEAR LOAD VS. DISPLACEMENTS



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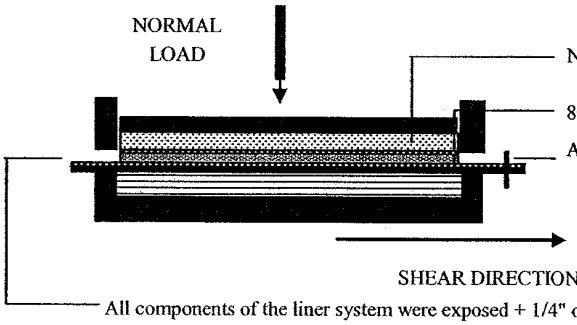
INTERFACE DIRECT SHEAR

Shaw EMCON/OWT, Inc.
A Shaw Group Company

ASTM D5321

Checked By:

Project Name: BUENA VISTA LF. **Proj. No.:** 837998 **Date:** 4/29/2004
Sample Number: HDPE / NWGT **Load, psf.:** 15,000 **Tested By:** DGC
SampleDescription: 80mil DS TEXTURED HDPE / NWGT.



All components of the liner system were exposed + 1/4" on soil.

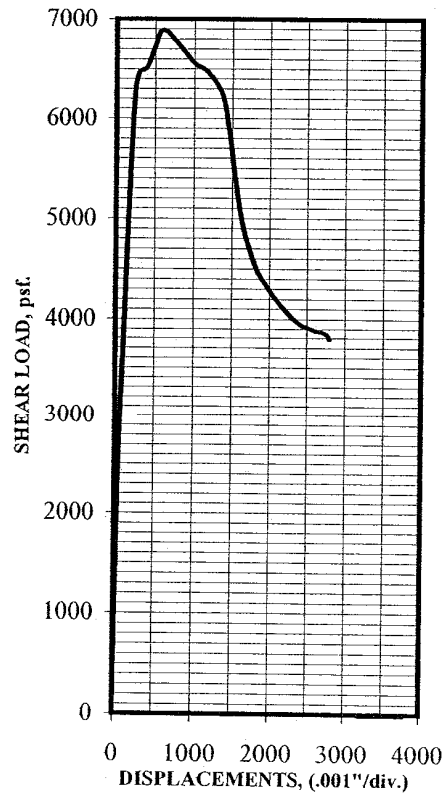
Max. Dry Density, pcf.	
Opt. Water Content,%	
Soil Initial w/c., %	
Initial Density, pcf.	
Soil Final w/c., %	
Asperity, inch.	0.029

DISPLACEMENTS, .001"/div.	SHEAR, psf.
0	11.0
50	2432.0
100	3653.0
150	4679.0
200	5604.0
250	6306.0
300	6471.0
400	6530.0
500	6727.0
600	6900.0
800	6761.0
1000	6571.0
1200	6457.0
1400	6185.0
1600	5116.0
1800	4567.0
2000	4299.0
2200	4108.0
2400	3964.0
2600	3893.0
2800	3794.0
3000	
3200	
3400	
3600	
3800	

TEST CONDITIONS

1. Anchor the 80 mil DS textured HDPE onto the bottom box and spray with water.
2. Nailed down the geotextile onto a plywood, sprayed with water and placed on top of the textured HDPE.
3.Apply full normal load and flooded with water.
4. Wait for approximately 10-15 min. before shearing.
5. Sheared at 0.2 inches / minute.
6. Failure occured within the interface. The geotextile stretched for about 1/2". No tearing observed.

SHEAR LOAD VS. DISPLACEMENTS



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ATTERBERG LIMITS

ASTM D4318

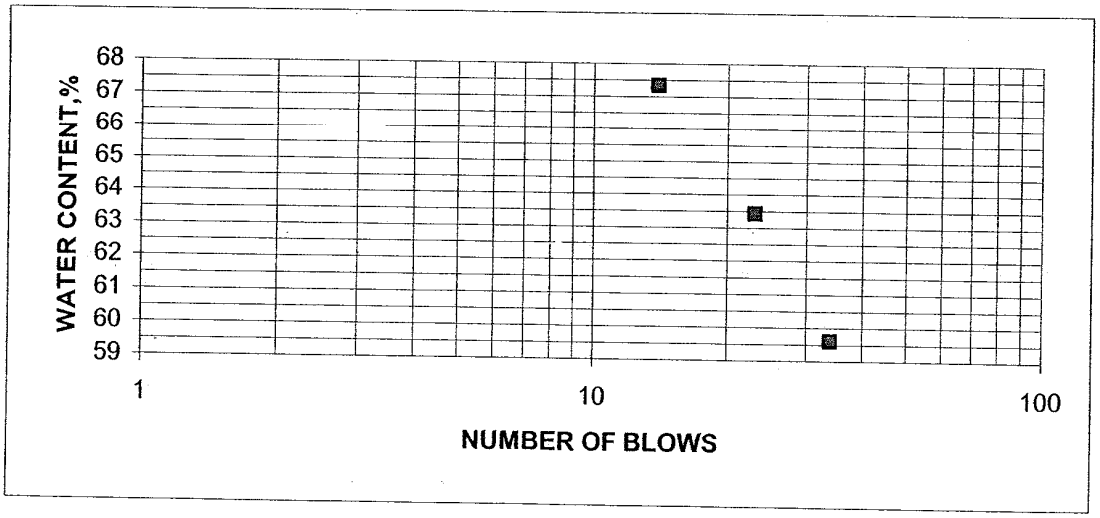
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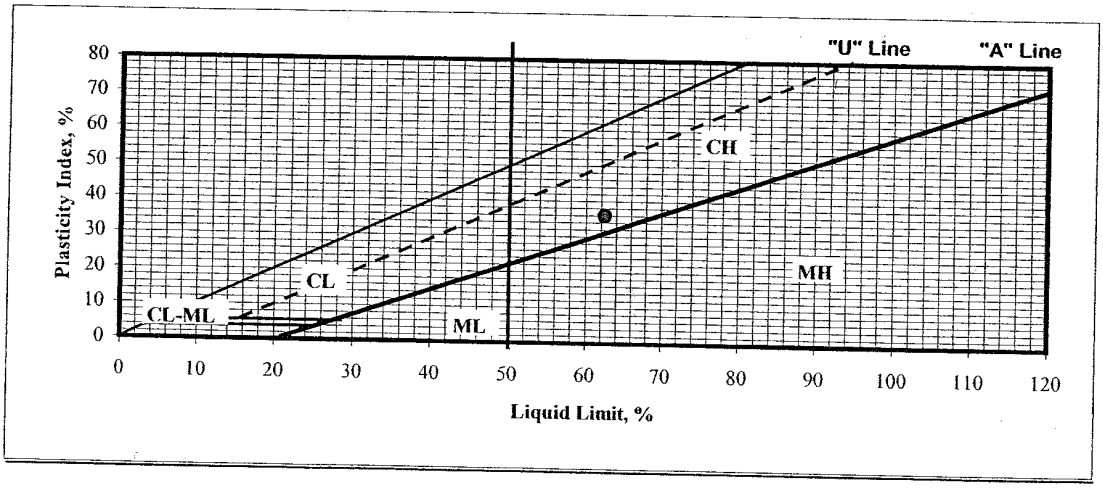
Project Name:	BUENA VISTA LANDFILL	**Lab. No.:**	04-013	**Proj. No.:**	837998
Sample No.:	MOD.6 CLAY LINER	**Depth, ft.:**	BULK	**Date:**	04/28/04
Description:	FAT CLAY, BROWN.			**Tested By:**	DGC
				Checked By:	

*/	Liquid Limit			Plastic Limit		
Can Number	A-5	M-4	G-6	B-8	J-6	
Weight of Can + Wet Soil, gms.	70.48	70.04	68.70	47.65	44.98	
Weight of Can + Dry Soil, gms.	56.12	55.23	53.94	44.40	42.24	
Weight of Can, gms.	32.03	31.88	32.02	32.12	31.96	
Weight of Dry Soil, gms.	24.09	23.35	21.92	12.28	10.28	
Weight of Water, gms.	14.36	14.81	14.76	3.25	2.74	
Water Content, %	59.6	63.4	67.3	26.5	26.7	
Number of Blows	34	23	14			

Unified Soil Classification **CH**



LL=	63	PL=	27	PI=	36



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COMPACTION TEST

Shaw™ EMCON/OWT, Inc.
A Shaw Group Company

■ ASTM D1557
□ ASTM D698

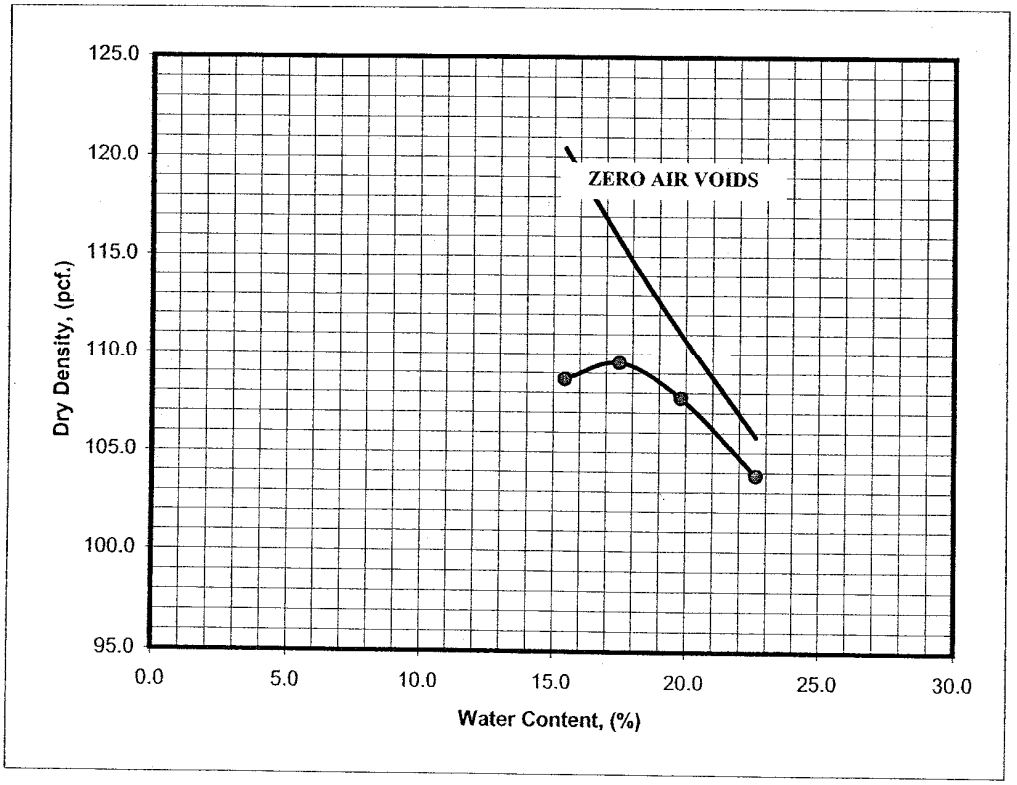
Checked By:

Project Name:	BUENA VISTA LF.	**Proj. No.:**	837998	**Lab. No.:**	04-013
Sample No.:	MOD.-6 CLAY LINER	**Depth, ft.:**	BULK	**Tested By:**	KJVC
Description:	FAT CLAY, BROWN.			**Date:**	04/27/04

Vol., Mold, cf.:	0.03333	**Hammer Weight,:**	10 lbs.	**Hammer Drop:**	18"
No. of Layers:	5	**Blows/Layer:**	25	**ASTM Designation:**	
				Method:	"A"

Trial Number		-6	-4	-2	Nat.	
Container Number		B	C	D	A	
Wet Soil + Container	(gms.)	868.40	737.40	872.50	823.40	
Dry Soil + Container	(gms.)	767.00	644.20	746.50	692.00	
Container Weight	(gms.)	110.60	111.80	111.20	111.40	
Weight of Water	(gms.)	101.40	93.20	126.00	131.40	
Weight of Dry Soil	(gms.)	656.40	532.40	635.30	580.60	
Moisture Content	(%)	15.4	17.5	19.8	22.6	
Wet Soil + Mold	(gms.)	3865	3914	3920	3893	
Weight of Mold	(gms.)	1968	1968	1968	1968	
Wet Weight of Soil	(lbs.)	4.18	4.29	4.30	4.24	
Wet Unit Weight	(pcf.)	125.5	128.7	129.1	127.3	
Dry Unit Weight	(pcf.)	108.7	109.5	107.7	103.8	

Maximum Dry Density, pcf.:	109.5
Opt. Moisture Content, %:	17.5
Est. Specific Gravity:	2.75



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TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

July 22, 2004

Mail To:

Mr. Fabrizio Settepani
Geosyntec Consultants
475 14th Street, Ste. 450
Oakland, CA 94612

Email: fsettepani@geosytnec.com

Bill To:

<= Same

Dear Mr. Settepani:

Thank you for consulting TRI/Environmental, Inc. (TRI) for your geosynthetics testing needs. TRI is pleased to submit this final report for laboratory testing.

Project:	BVL, Project #WL0658-02
TRI Job Reference Number:	E2201-09-03
Material(s) Tested:	Two 80 mil Textured HDPE Geomembrane(s)
Test(s) Requested:	Asperity Height (GRI GM12)

If you have any questions or require any additional information, please call us at 1-800-880-8378.

Sincerely,

Mark E Sebesta

Mark Sebesta, P.E.
Soils-Geosynthetics Interaction Laboratory Director
Geosynthetic Services Division

TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

GEOMEMBRANE TEST RESULTS

TRI Client: Geosyntec Consultants
Project: BVL

Material: 80 mil HDPE Textured Geomembrane
Sample Identification: 6000 psf specimen
TRI Log #: E2201-09-03

PARAMETER	TEST REPLICATE NUMBER										MEAN	STD. DEV.
	1	2	3	4	5	6	7	8	9	10		
Asperity Height (GRI GM12)												
Asperity Height (mils) - Side A	25	24	22	28	26	25	31	23	27	32	26	3

MD Machine Direction
TD Transverse Direction

The testing is based upon accepted industry practice as well as the test method listed. Test results reported herein do not apply to samples other than those tested. TRI neither accepts responsibility for nor makes claim as to the final use and purpose of the material. TRI observes and maintains client confidentiality. TRI limits reproduction of this report, except in full, without prior approval of TRI.

TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

GEOMEMBRANE TEST RESULTS

TRI Client: Geosyntec Consultants
Project: BVL

Material: 80 mil HDPE Textured Geomembrane
Sample Identification: 10000 psf specimen
TRI Log #: E2201-09-03

PARAMETER	TEST REPLICATE NUMBER										MEAN	STD. DEV.
	1	2	3	4	5	6	7	8	9	10		
Asperity Height (GRI GM12)												
Asperity Height (mils) - Side A	21	34	32	23	31	29	24	27	25	34	28	4

MD Machine Direction
TD Transverse Direction

The testing is based upon accepted industry practice as well as the test method listed. Test results reported herein do not apply to samples other than those tested. TRI neither accepts responsibility for nor makes claim as to the final use and purpose of the material. TRI observes and maintains client confidentiality. TRI limits reproduction of this report, except in full, without prior approval of TRI.

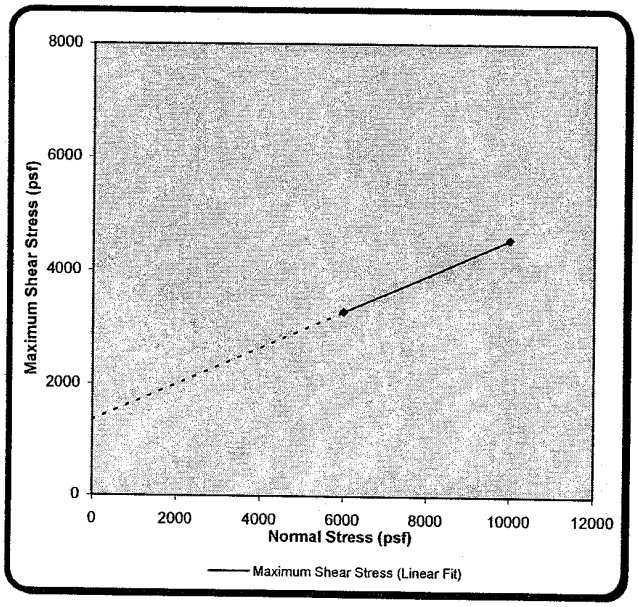
TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

INTERFACE FRICTION TEST REPORT

Client: **Geosyntec**
Project: BVL Project no.WL0658-02
Test Date: 6/30-7/1/04

TRI Log#: E2201-09-03
Test Method: ASTM D 5321

Tested Interface: Textured 80 mil HDPE Geomembrane vs. Module 6 Compacted Clay Liner (CH) LL=63, PI=36



Upper Box:	Module 6 Clay Liner compacted to 104.0 pcf at 20.5 % moisture content (95 % maximum dry density at +3 optimum moisture content as determined by a modified Proctor test). (CH) LL=63, PI=36
Lower Box:	80 mil textured HDPE geomembrane
Interface Conditioning:	Interface soaked and loading applied for a minimum of 24 hours prior to shear
Gap:	6 mm
Box Dimension:	12"x12"x4"
Test Condition:	Wet
Shearing Rate:	0.04 inches/minute

Trial Number	1	2
Bearing Slide Resistance (lbs)	65	103
Normal Stress (psf)	6000	10000
Maximum Shear Stress (psf)	3341	4654
Corrected Shear Stress (psf)	3276	4551
Secant Angle (degrees)	28.6	24.5
Post Test Moisture Content	22.2%	18.9%

RESULTS: Maximum Friction Angle and Y-intercept

Regression Friction Angle (degrees):		**17.7**		
Y-intercept or Regression Adhesion (psf):		**1364**		
Regression Line:	Y=	0.319	* X +	1364
Regression Coefficient (r squared):		1.000		

MES 7/22/04
Quality Review/Date

Note: Shearing occurred in the soil, 4 to 5 mm above the geomembrane, for both points.

The testing herein is based upon accepted industry practice as well as the test method listed. Test results reported herein do not apply to samples other than those tested. TRI neither accepts responsibility for nor makes claim as to the final use and purpose of the material. TRI observes and maintains client confidentiality. TRI limits reproduction of this report, except in full, without prior approval of TRI.

9063 Bee Caves Road □ Austin, TX 78733-6201 □ (512) 263-2101 □ (512) 263-2558 □ 1-800-880-TEST

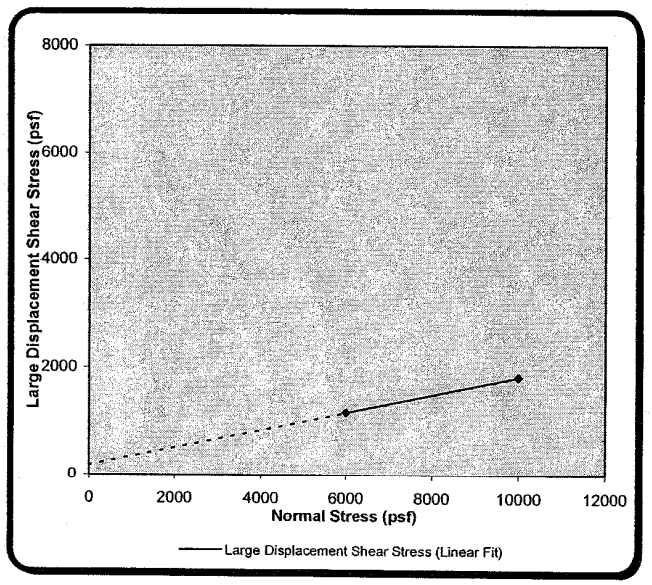
TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

INTERFACE FRICTION TEST REPORT

Client: **Geosyntec**
Project: BVL Project no.WL0658-02
Test Date: 6/30-7/1/04

TRI Log#: E2201-09-03
Test Method: ASTM D 5321

Tested Interface: Textured 80 mil HDPE Geomembrane vs. Module 6 Compacted Clay Liner (CH) LL=63, PI=36.



Upper Box:	Module 6 Clay Liner compacted to 104.0 pcf at 20.5 % moisture content (95 % maximum dry density at +3 optimum moisture content as determined by a modified Proctor test). (CH) LL=63, PI=36
Lower Box:	(CH) LL=63, PI=36 80 mil textured HDPE geomembrane
Interface Conditioning:	Interface soaked and loading applied for a minimum of 24 hours prior to shear
Gap:	6 mm
Box Dimension:	12"x12"x4"
Test Condition:	Wet
Shearing Rate:	0.04 inches/minute

Trial Number	1	2
Bearing Slide Resistance (lbs)	65	103
Normal Stress (psf)	6000	10000
Large Displacment Shear Stress (psf)	1232	1928
Corrected Shear Stress (psf)	1167	1825
Secant Angle (degrees)	11.0	10.3
Post Test Moisture Content	22.2%	18.9%

RESULTS: Large Displacement Friction Angle and Y-intercept at 3.3-in. of Displacement

Regression Friction Angle (degrees):		**9.3**		
Y-intercept or Regression Adhesion (psf):		**180**		
Regression Line:	Y=	0.165	* X +	180
Regression Coefficient (r squared):		1.000		

MES 7/22/04
Quality Review/Date

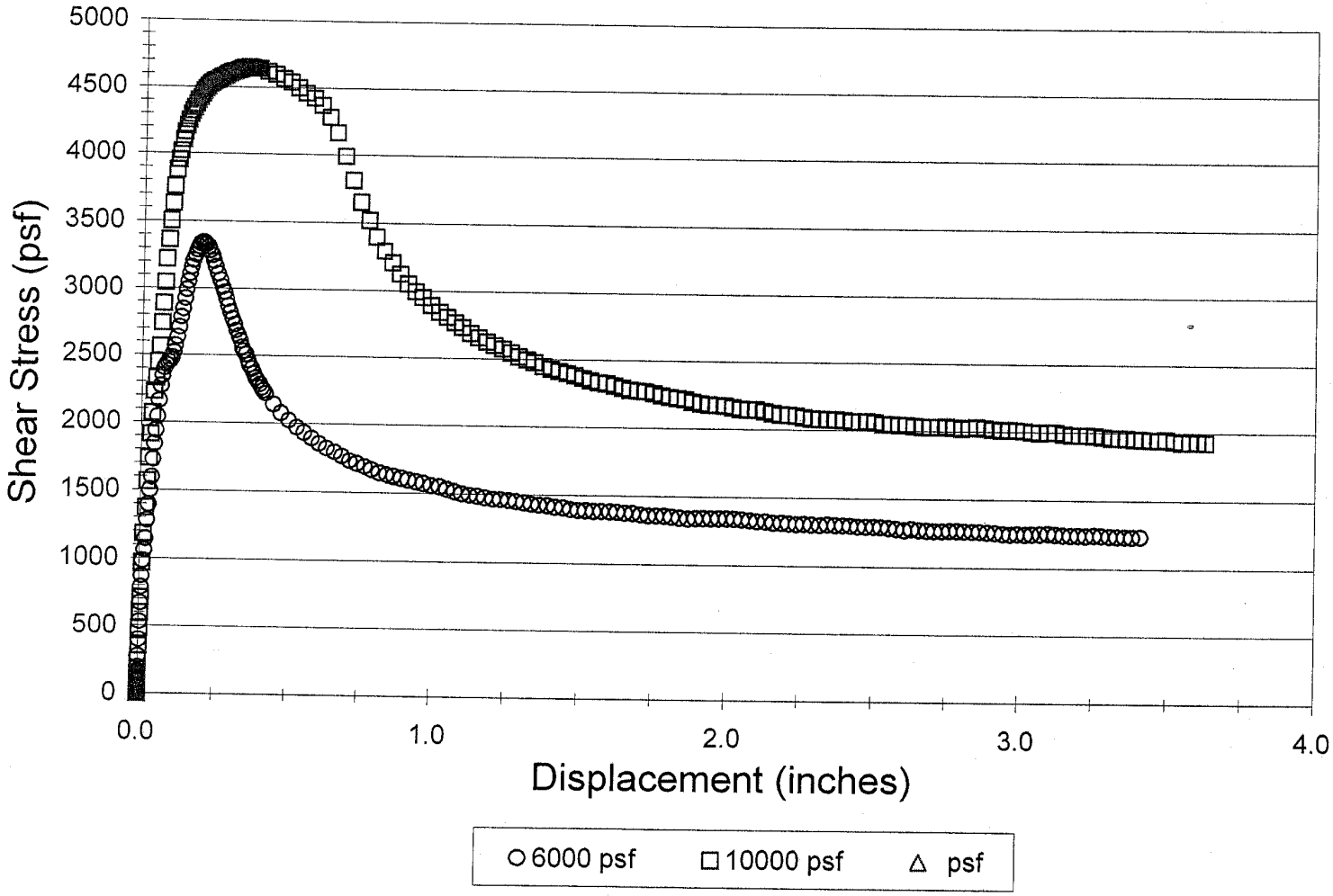
Note: Shearing occurred in the soil, 4 to 5 mm above the geomembrane, for both points.

The testing herein is based upon accepted industry practice as well as the test method listed. Test results reported herein do not apply to samples other than those tested. TRI neither accepts responsibility for nor makes claim as to the final use and purpose of the material. TRI observes and maintains client confidentiality. TRI limits reproduction of this report, except in full, without prior approval of TRI.

9063 Bee Caves Road □ Austin, TX 78733-6201 □ (512) 263-2101 □ (512) 263-2558 □ 1-800-880-TEST

TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

GEOSYNTEC INTERFACE FRICTION TEST
Module 6 Compacted Clay Liner vs.
80 mil Textured HDPE Geomembrane



9063 Bee Caves Road □ Austin, TX 78733-6201 □ (512) 263-2101 □ FAX (512) 263-2558 □ 1-800-880-TEST

TRI Log No. E2201-09-03

TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

September 17, 2004

Mail To:

Mr. Fabrizio Settepani
Geosyntec Consultants
475 14th Street, Ste. 450
Oakland, CA 94612

Email: fsettepani@geosytnec.com

Bill To:

<= Same

Dear Mr. Settepani:

Thank you for consulting TRI/Environmental, Inc. (TRI) for your geosynthetics testing needs. TRI is pleased to submit this final report for laboratory testing.

Project:	BVL, Project #WL0658-02
TRI Job Reference Number:	E2201-09-03
Material(s) Tested:	80 mil Textured HDPE Geomembrane(s) Sample # 3
Test(s) Requested:	Asperity Height (GRI GM12)

If you have any questions or require any additional information, please call us at 1-800-880-8378.

Sincerely,

Sam R. Allen

Sam Allen
Vice President and Division Manager
Geosynthetic Services Division

TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

GEOMEMBRANE TEST RESULTS

TRI Client: Geosyntec Consultants
Project: BVL

Material: 80 mil HDPE Textured Geomembrane
Asperity Height (GRI GM12)
TRI Log #: E2201-09-03

PARAMETER	TEST REPLICATE NUMBER										MEAN	STD. DEV.
	1	2	3	4	5	6	7	8	9	10		
Sample Identification: 6000 psf specimen												
Asperity Height (mils) - Baseline	25	24	22	28	26	25	31	23	27	32	26	3
Asperity Height (mils) - Post Test	19	22	21	18	22	22	21	24	22	24	22	2
Sample Identification: 10000 psf specimen												
Asperity Height (mils) - Baseline	21	34	32	23	31	29	24	27	25	34	28	4
Asperity Height (mils) - Post Test	25	22	22	21	20	22	22	25	21	25	23	2
Sample Identification: 2000 psf specimen												
Asperity Height (mils) - Baseline	25	28	22	28	23	22	26	24	25	27	25	2
Asperity Height (mils) - Post Test	25	23	28	23	27						25	2
Sample Identification: 4000 psf specimen												
Asperity Height (mils) - Baseline	22	28	28	29	24	27	22	23	26	28	26	3
Asperity Height (mils) - Post Test	21	24	20	24	25						23	2
Sample Identification: 15000 psf specimen												
Asperity Height (mils) - Baseline	35	33	32	27	27	31	30	26	28	28	30	3
Asperity Height (mils) - Post Test	18	21	19	21	26						21	3

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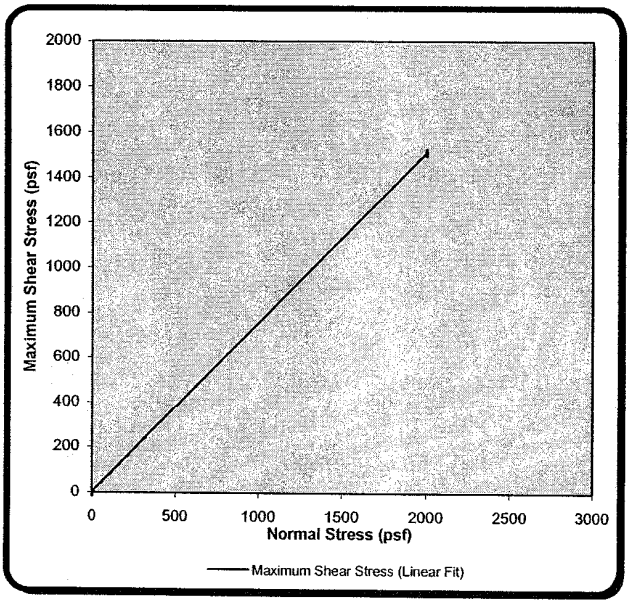
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INTERFACE FRICTION TEST REPORT

Client: **Geosyntec**
Project: BVL Project no.WL0658-02
Test Date: 8/26-8/27/04

TRI Log#: E2201-09-03
Test Method: ASTM D 5321

Tested Interface: Textured 80 mil HDPE Geomembrane vs. Module 6 Compacted Clay Liner (CH) LL=63, PI=36



Upper Box: Module 6 Clay Liner compacted to 104.0 pcf at 20.5 % moisture content (95 % maximum dry density at +3 optimum moisture content as determined by a modified Proctor test). (CH) LL=63, PI=36

Lower Box: 80 mil textured HDPE geomembrane

Interface Conditioning: Interface soaked and loading applied for a minimum of 24 hours prior to shear

Gap: 6 mm

Box Dimension: 12"x12"x4"

Test Condition: Wet

Shearing Rate: 0.04 inches/minute

Trial Number	1
Bearing Slide Resistance (lbs)	27
Normal Stress (psf)	2000
Maximum Shear Stress (psf)	1538
Corrected Shear Stress (psf)	1511
Secant Angle (degrees)	37.1

RESULTS: Maximum Friction Angle using the test point and the origin.

Friction Angle with origin (degrees): 37.1

SRA 8-31-04
Quality Review/Date

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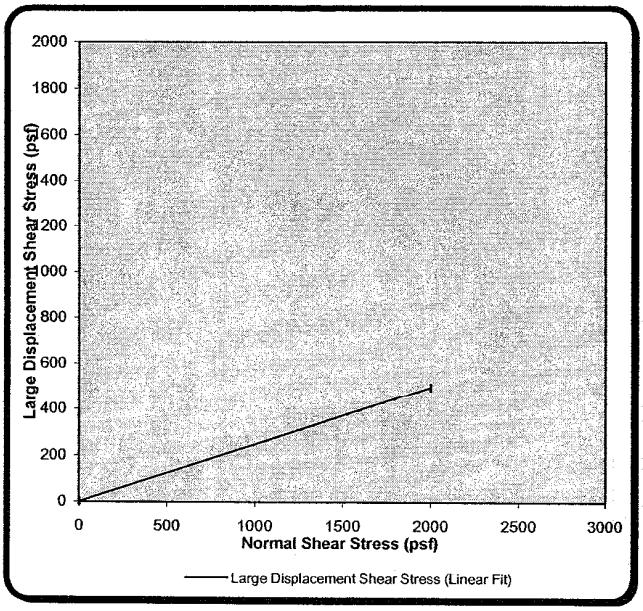
TRI/ENVIRONMENTAL, INC.
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INTERFACE FRICTION TEST REPORT

Client: **Geosyntec**
Project: BVL Project no.WL0658-02
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Upper Box: Module 6 Clay Liner compacted to 104.0 pcf at 20.5 % moisture content (95 % maximum dry density at +3 optimum moisture content as determined by a modified Proctor test). (CH) LL=63, PI=36

Lower Box: 80 mil textured HDPE geomembrane

Interface Conditioning: Interface soaked and loading applied for a minimum of 24 hours prior to shear

Gap: 6 mm

Box Dimension: 12"x12"x4"

Test Condition: Wet

Shearing Rate: 0.04 inches/minute

Trial Number	1
Bearing Slide Resistance (lbs)	27
Normal Stress (psf)	2000
Large Displacment Shear Stress (psf)	524
Corrected Shear Stress (psf)	497
Secant Angle (degrees)	14.0

RESULTS: Large Displacement Friction Angle and Y-intercept at 3.0-in. of Displacement

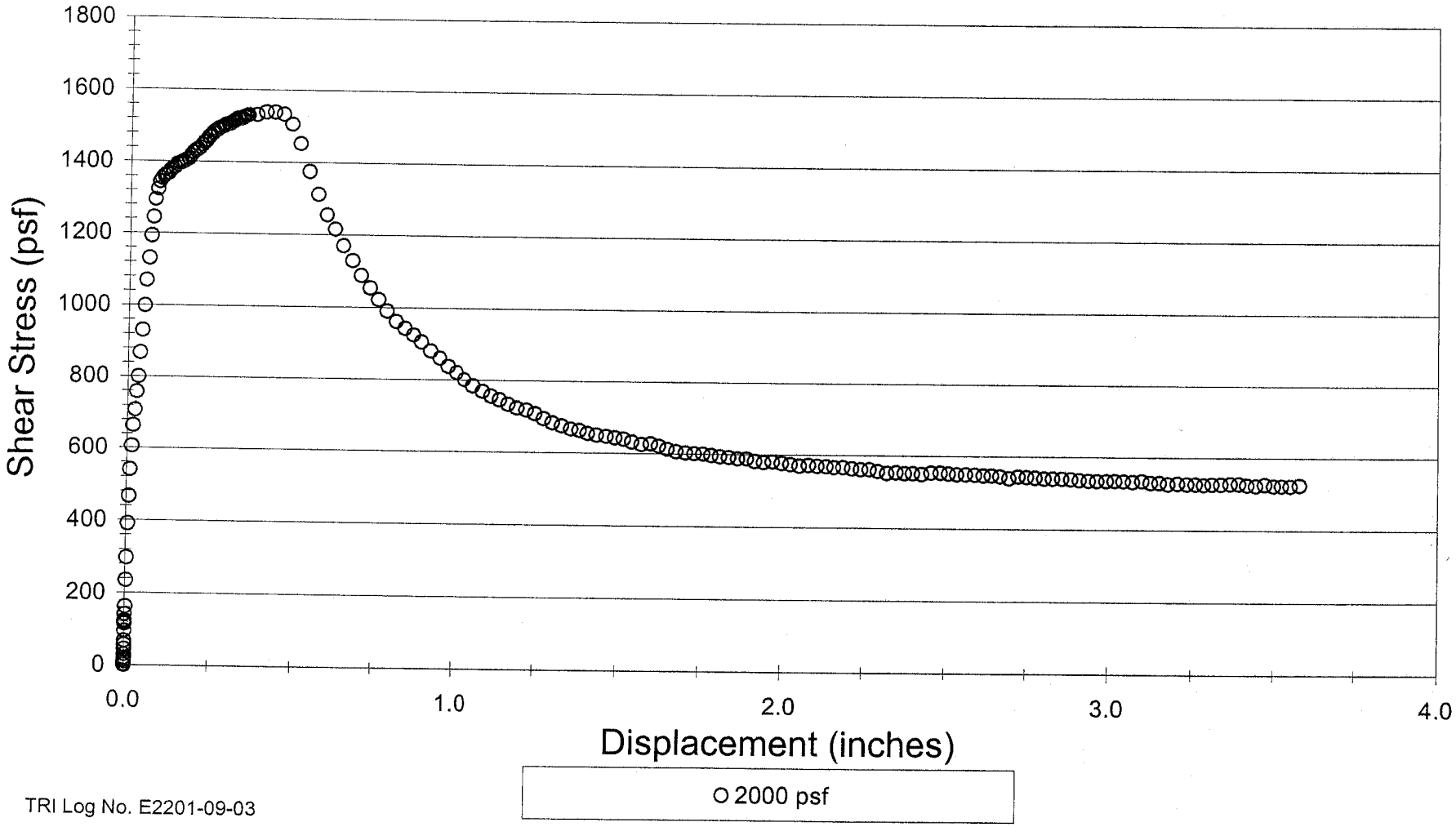
Regression Friction Angle (degrees): 14.0

SRA 8-31-04
Quality Review/Date

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GEOSYNTEC INTERFACE FRICTION TEST
Module 6 Compacted Clay Liner vs.
80 mil Textured HDPE Geomembrane



TRI Log No. E2201-09-03

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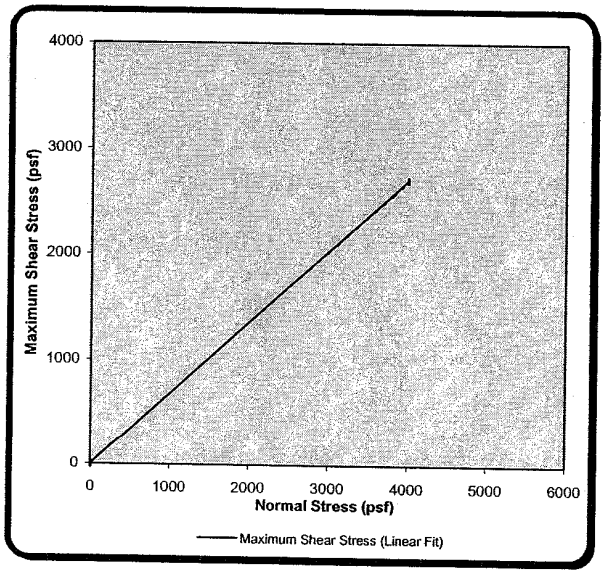
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INTERFACE FRICTION TEST REPORT

Client: **Geosyntec**
Project: BVL Project no.WL0658-02
Test Date: 8/26-8/27/04

TRI Log#: E2201-09-03
Test Method: ASTM D 5321

Tested Interface: Textured 80 mil HDPE Geomembrane vs. Module 6 Compacted Clay Liner (CH) LL=63, PI=36



Upper Box:	Module 6 Clay Liner compacted to 104.0 pcf at 20.5 % moisture content (95 % maximum dry density at +3 optimum moisture content as determined by a modified Proctor test). (CH) LL=63, PI=36
Lower Box:	80 mil textured HDPE geomembrane
Interface Conditioning:	Interface soaked and loading applied for a minimum of 24 hours prior to shear
Gap:	6 mm
Box Dimension:	12"x12"x4"
Test Condition:	Wet
Shearing Rate:	0.04 inches/minute

Trial Number	1
Bearing Slide Resistance (lbs)	46
Normal Stress (psf)	4000
Maximum Shear Stress (psf)	2750
Corrected Shear Stress (psf)	2704
Secant Angle (degrees)	34.1

RESULTS: Maximum Friction Angle using the test point and the origin.

Friction Angle with origin (degrees): 34.1

SRA 8-31-04
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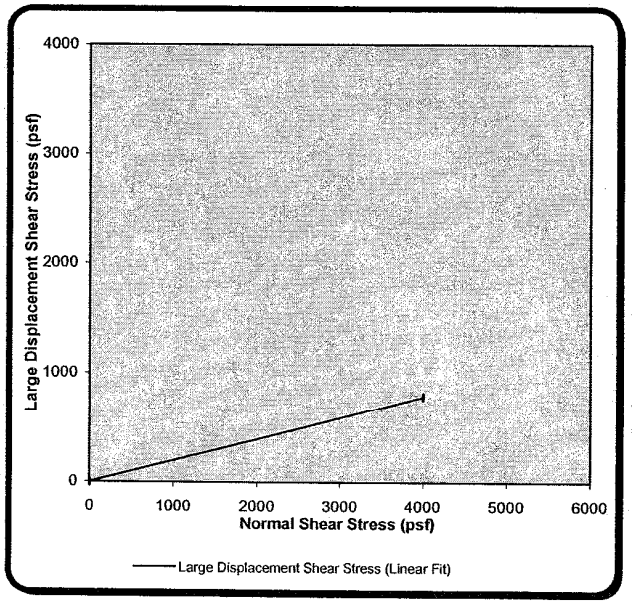
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INTERFACE FRICTION TEST REPORT

Client: **Geosyntec**
Project: BVL Project no.WL0658-02
Test Date: 8/26-8/27/04

TRI Log#: E2201-09-03
Test Method: ASTM D 5321

Tested Interface: Textured 80 mil HDPE Geomembrane vs. Module 6 Compacted Clay Liner (CH) LL=63, PI=36



Upper Box: Module 6 Clay Liner compacted to 104.0 pcf at 20.5 % moisture content (95 % maximum dry density at +3 optimum moisture content as determined by a modified Proctor test). (CH) LL=63, PI=36

Lower Box: 80 mil textured HDPE geomembrane

Interface Conditioning: Interface soaked and loading applied for a minimum of 24 hours prior to shear

Gap: 6 mm

Box Dimension: 12"x12"x4"

Test Condition: Wet

Shearing Rate: 0.04 inches/minute

Trial Number	1
Bearing Slide Resistance (lbs)	46
Normal Stress (psf)	4000
Large Displacment Shear Stress (psf)	832
Corrected Shear Stress (psf)	786
Secant Angle (degrees)	11.1

RESULTS: Large Displacement Friction Angle and Y-intercept at 3.0-in. of Displacement

Regression Friction Angle (degrees): 11.1

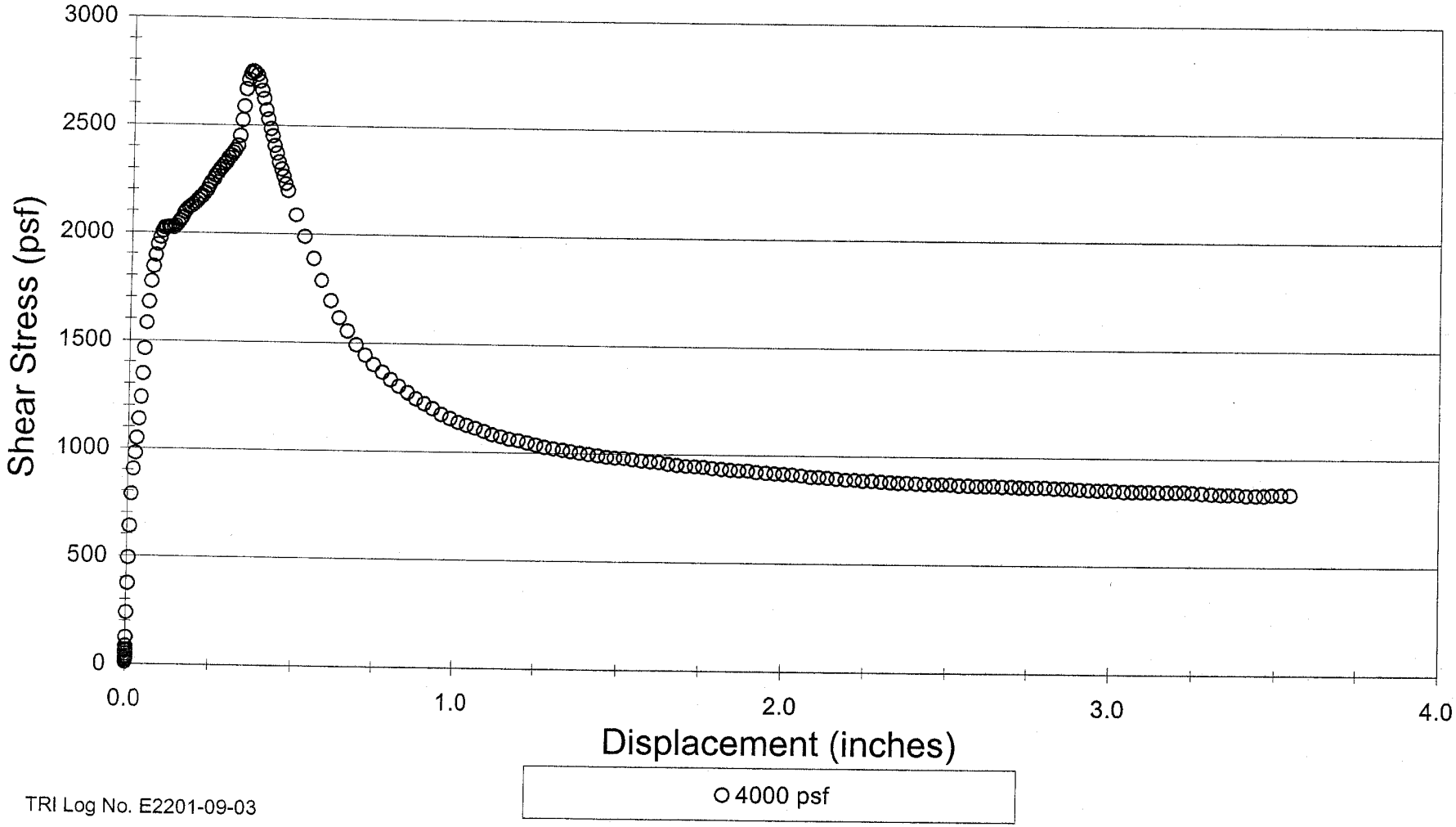
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GEOSYNTEC INTERFACE FRICTION TEST
Module 6 Compacted Clay Liner vs.
80 mil Textured HDPE Geomembrane



TRI Log No. E2201-09-03

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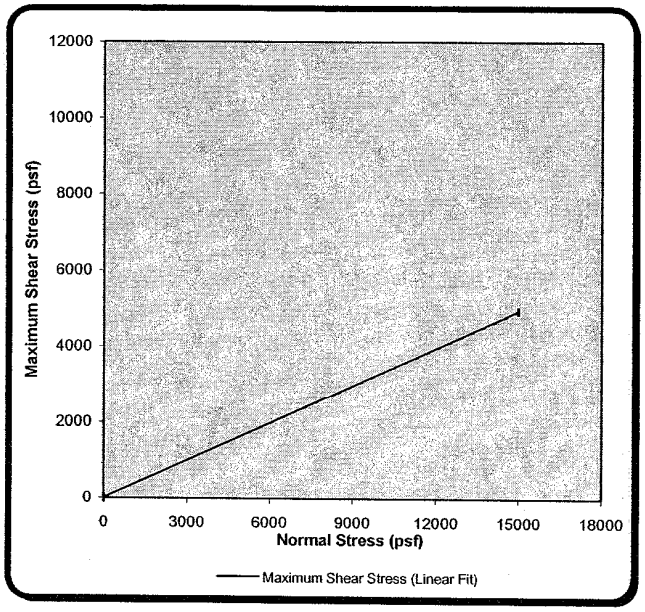
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INTERFACE FRICTION TEST REPORT

Client: **Geosyntec**
Project: BVL Project no.WL0658-02
Test Date: 8/26-8/27/04

TRI Log#: E2201-09-03
Test Method: ASTM D 5321

Tested Interface: Textured 80 mil HDPE Geomembrane vs. Module 6 Compacted Clay Liner (CH) LL=63, PI=36



Upper Box: Module 6 Clay Liner compacted to 104.0 p
20.5 % moisture content (95 % maximum dry density at +3 optimum moisture conter as determined by a modified Proctor test). (CH) LL=63, PI=36

Lower Box: 80 mil textured HDPE geomembrane

Interface Conditioning: Interface soaked and loading applied for a minimum of 24 hours prior to shear

Gap: 6 mm

Box Dimension: 12"x12"x4"

Test Condition: Wet

Shearing Rate: 0.04 inches/minute

Trial Number	1
Bearing Slide Resistance (lbs)	151
Normal Stress (psf)	15000
Maximum Shear Stress (psf)	5096
Corrected Shear Stress (psf)	4946
Secant Angle (degrees)	18.2

RESULTS: Maximum Friction Angle using the test point and the origin.

Friction Angle with origin (degrees): 18.2

SRA 8-31-04
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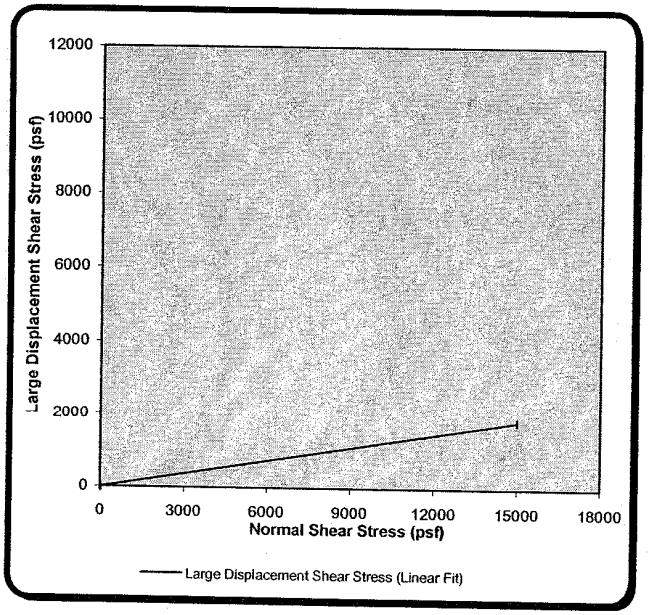
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INTERFACE FRICTION TEST REPORT

Client: **Geosyntec**
Project: BVL Project no.WL0658-02
Test Date: 8/26-8/27/04

TRI Log#: E2201-09-03
Test Method: ASTM D 5321

Tested Interface: Textured 80 mil HDPE Geomembrane vs. Module 6 Compacted Clay Liner (CH) LL=63, PI=36



Upper Box: Module 6 Clay Liner compacted to 104.0 p
20.5 % moisture content (95 % maximum
dry density at +3 optimum moisture conter
as determined by a modified Proctor test).
(CH) LL=63, PI=36

Lower Box: 80 mil textured HDPE geomembrane

Interface Conditioning: Interface soaked and loading applied for a minimum of 24 hours prior to shear

Gap: 6 mm

Box Dimension: 12"x12"x4"

Test Condition: Wet

Shearing Rate: 0.04 inches/minute

Trial Number	1
Bearing Slide Resistance (lbs)	151
Normal Stress (psf)	15000
Large Displacment Shear Stress (psf)	1973
Corrected Shear Stress (psf)	1823
Secant Angle (degrees)	6.9

RESULTS: Large Displacement Friction Angle and Y-intercept at 3.0-in. of Displacement

Regression Friction Angle (degrees): 6.9

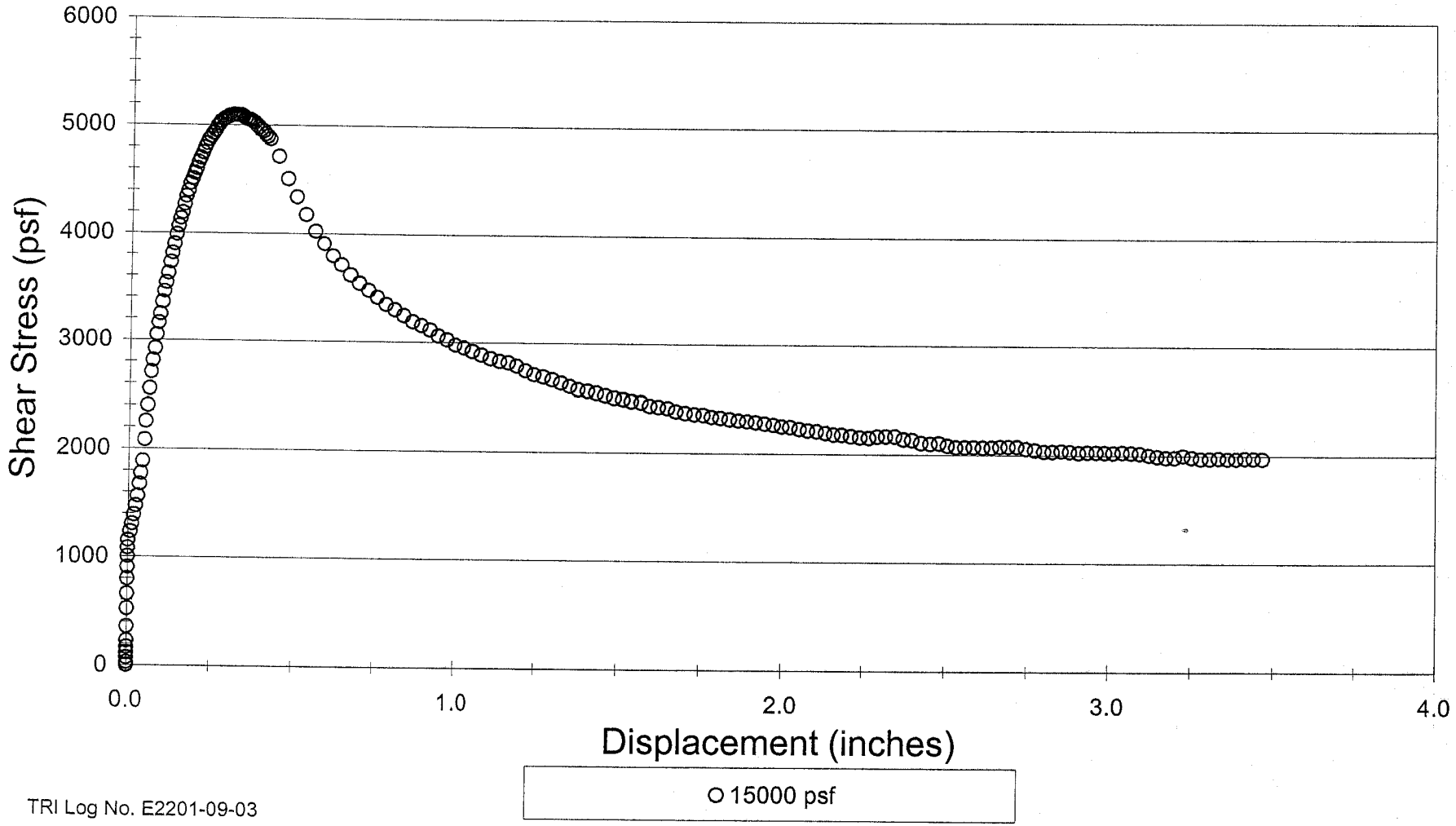
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GEOSYNTEC INTERFACE FRICTION TEST
Module 6 Compacted Clay Liner vs.
80 mil Textured HDPE Geomembrane



TRI Log No. E2201-09-03

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INTERFACE STRENGTH TESTS
MODULE 4A

Prepared for:

County of Santa Cruz
Department of Public Works
701 Ocean Street, Room 410
Santa Cruz, California 95060-4070
(831) 454-2160

REPORT OF CONSTRUCTION QUALITY ASSURANCE

MODULE 4A CONSTRUCTION

Buena Vista Drive Sanitary Landfill
1231 Buena Vista Drive
Watsonville, California 95076

Prepared by:



GeoSyntec Consultants
475 14th Avenue, Suite 450
Oakland, California 94612
(510) 836-3034

Project Number: WL0612
8 March 2004

APPENDIX H

INTERFACE SHEAR STRENGTH TESTS AND INTERIM SLOPE STABILITY

APPENDIX H-1

INTERFACE SHEAR STRENGTH TESTS

Fabrizio Settepani

Fr lewisengineering@mindspring.com
Se. Thursday, March 04, 2004 10:52 AM
To: Fabrizio Settepani
Subject: BVL Module 4A - Slope Stability Review

Fabrizio,

Lewis Engineering has reviewed the test results submitted by GeoSyntec Consultants for the Module 4A project with respect to the static slope stability analyses of the interim slopes. Since the static factors of safety for the interim slopes are above 1.5, the interface strength test results are acceptable. Additional stability analyses will be performed as part of updating the site development plans.

Sangeeta Lewis, P.E.
Principal
Lewis Engineering
510-601-7223
510-601-7206 (fax)

Written by: FWS Date: 03/09/15 (YY/MM/DD) Reviewed by: _____ Date: ___/___/___

Client: GSCmy Project: Mod 4A Project/Proposal No.: WL0612 Task No.: _____

Re: Interface Strength CCL/HDPE (test) for slope stab.

(1) Test completed by Precision geosynthetics labs following proj. specs. for Mod 4A construction.

(2) Based on plotting of data, observed bi-linear envelope

(3) Consisting of:

σ_N	ϕ	c
0 - 4000 psf	19°	0 psf
> 4000 psf	9.4°	700 psf

See Figure A for graph.

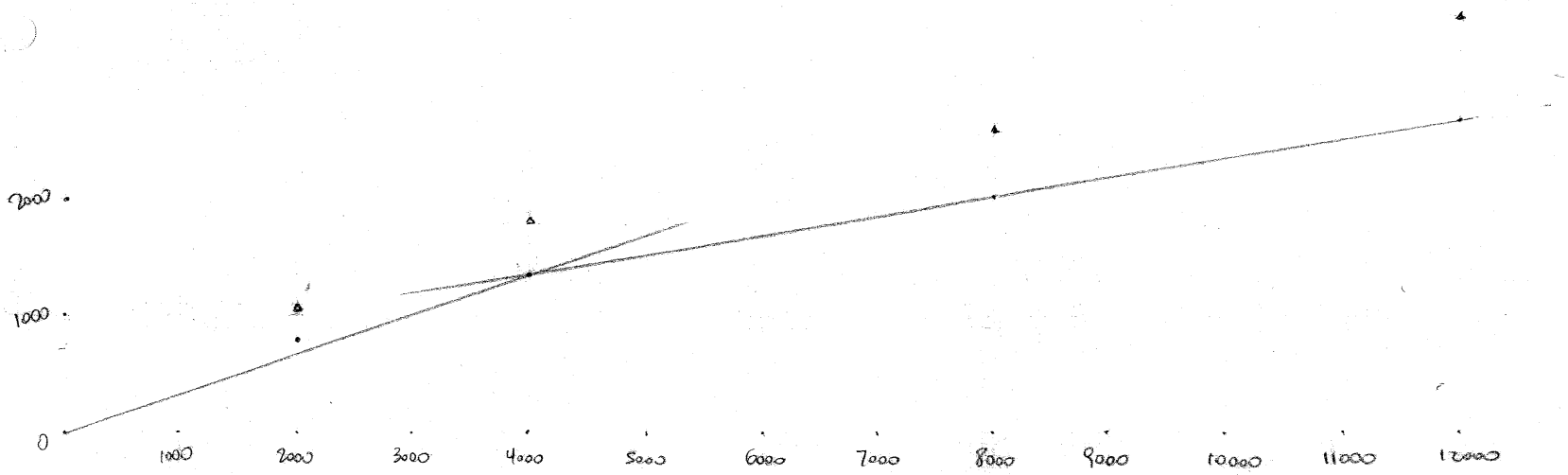
Re: Interface Strength GCL/HDPE (test) for slope stab. re-evaluation

(1) Test completed by Precision geosynthetics labs following proj. specs except that material (GCL) hydrated under no load (specs called for 125 psf) for 20 hrs.

(2) Two tests were ran because GCLs from different prod. lots were used for Mod 4A. For strength envelope, plotted the data and drew strength envelope consists of:

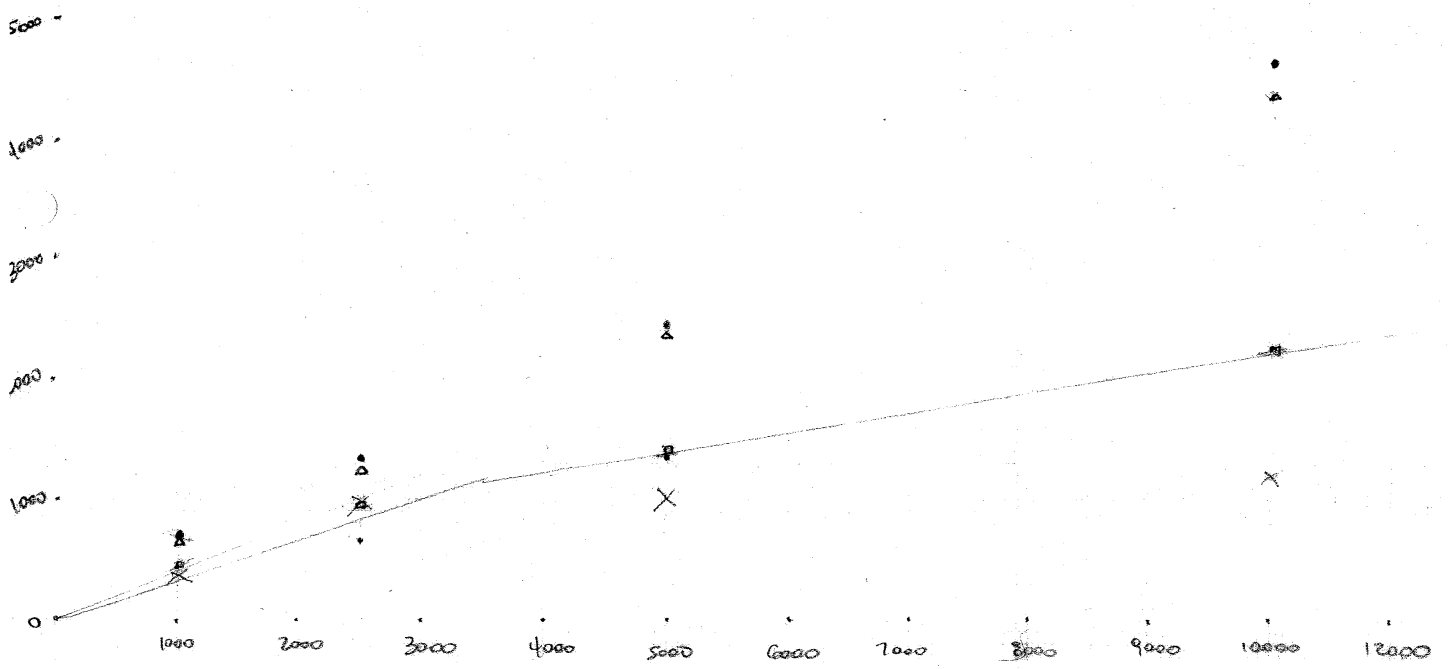
σ_N	$\tau_{\#1}$	$\tau_{\#2}$	τ_{AVE}
0 psf			0 psf
1000	413	442	428
2500	762	924	843
5000	1322	1401	1362
10000	2272	2278	2276

See Figure B for plot.



• 3" displacement
△ peak

Figure A
Co. Sump
Mod 4A
CQA TEST
CCL/HDPE (Text)



. 3" displacement
Δ peak
□ 3" displacement
• peak
× Spec

TEST #1
TEST #2

Figure B
Co. SCurve
Mod 4A
CQA Test
GCL/HDPE (test)

Precision Geosynthetic Laboratories

November 5, 2003

Mr. Fabrizio Settapani
Geosyntec
1500 Newell Avenue, Suite 800
Walnut Street, CA. 94596

Dear Mr. Settapani: **RE: Buena Vista Landfill**

Thank you for consulting Precision Geosynthetic Laboratories for your material testing needs.

It should be noted that the test specimen and test sample used for this report was believed to be representative of the material produced under the designation herein stated. However, these results are indicative of only the specimens that were actually tested. The testing herein is based upon accepted industry practice as well as the test method listed. Precision Geosynthetic Laboratories neither accepts responsibility for nor makes claims to the final use and purpose of the material.

By accepting the data and results represented on this report, Client agrees to limit the liability of Precision Geosynthetic Laboratories from Client and all other parties for claims arising out of the use of this data to the cost for the respective test(s) represented in this report, and Client agrees to indemnify and hold harmless Precision Geosynthetic Laboratories from and against all liability in excess of the aforementioned limit.

The test data and all associated project information provided shall be held in confidence and disclosed to other parties only with the authorization of Client or Precision Geosynthetic Laboratories.

It is a company policy to keep the physical records of each job for 2 years since the receipt of the samples and keep the electronic file for 7 years. We will dispose the samples two weeks after the final report is faxed to you. Should you want us to keep them for some period of time, please advise us immediately.

If you have any questions or if we may be of further service, please do not hesitate to call at 800-522-4599.

Sincerely,

PRECISION GEOSYNTHETIC LABORATORIES

Cora B. Queja
Vice President

Enclosure: (Job No.G030747)

Precision Geosynthetic Laboratories

CLIENT: GEOSYNTEC
PROJECT: Buena Vista Landfill

INTERFACE SHEAR TEST RESULTS
(PGL Job No. G030747)

AMPLE IDENTIFICATIONS:

AMPLE ID	PRECISION CONTROL NUMBER	DATE RECEIVED	ORIGIN OF MATERIAL
ndy Lean Clay	88901	8/20/03	Geosyntec
)PE R#103122284	90805	8/11/03	Geosyntec
)PE R#103122298	90836	8/11/03	Geosyntec
:L R# 5830 L#200335LO	89021	N/A	Geosyntec

STS REQUIRED:

TEST METHOD	DESCRIPTION
ASTM D5321/ D6243	Interface Shear

ST NDITIONS: The samples were conditioned for a minimum one hour in the laboratory at 22 ± 2°C (71.6 ± 3.6°F) l at 60 ± 10% relative humidity prior to test.

ST RESULTS:

e test results are summarized in Tables 1 & 2 . The units in which the data are reported are included these tables.

ECISION GEOSYNTHETIC LABORATORIES

a B. Queja
e President

1160 North Gilbert Street, Anaheim, CA. 92801, Tel# 714-520-9631, Fax#714-520-9637

PGL Job Number: Job No G0 Config.# Config # 1a
Project Name: Buena Vista Landfill
Sandy Lean Clay C#88901/ HDPE R#103122284 C# 90805 (Textured side)
QC'd By:

Figure #1
Normal Stress/ Interface Stress

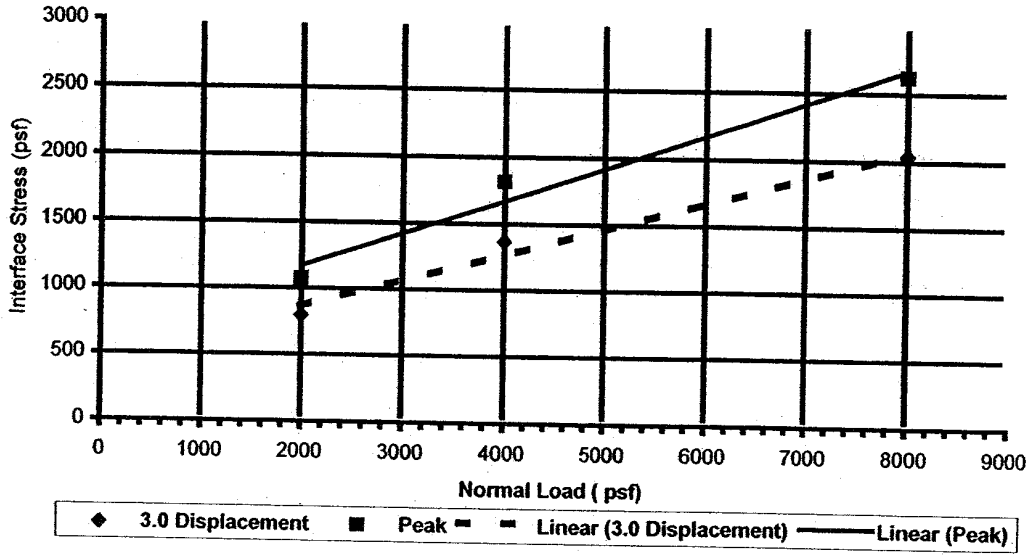


Figure #2
Shear Stress/ Displacement Curve

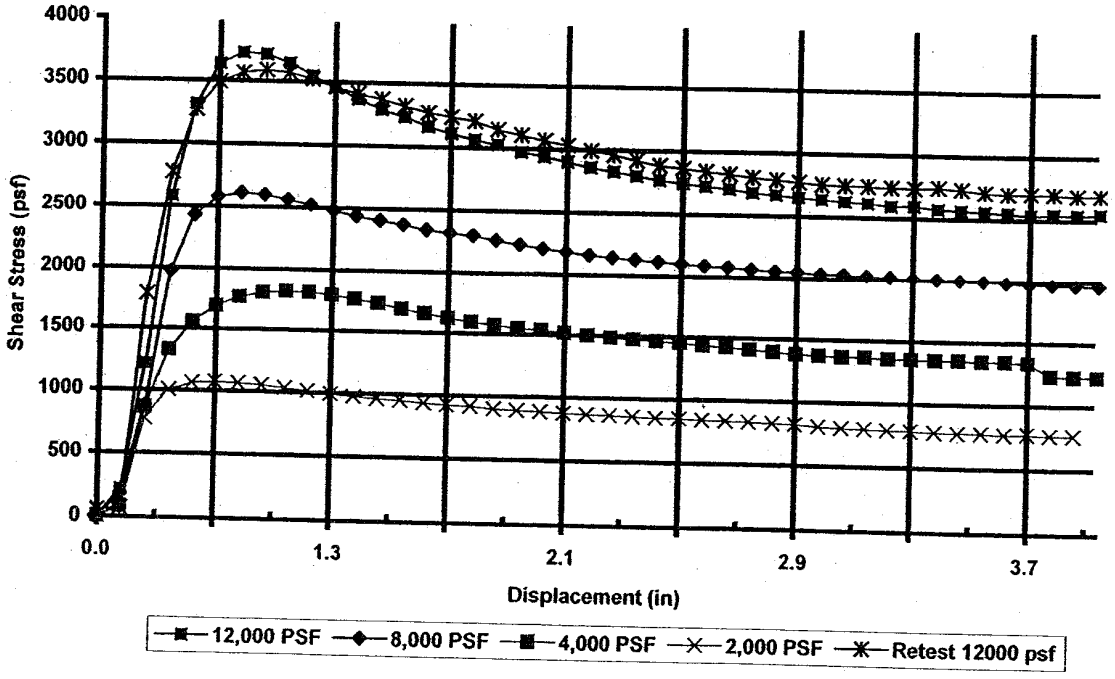
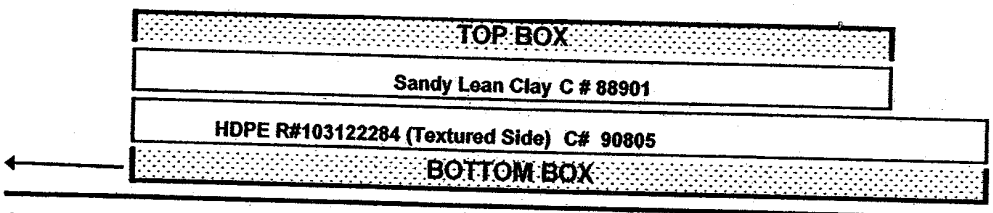


TABLE Config # 1a
CLIENT: GEOSYNTEC
PROJECT: Buena Vista Landfill

INTERFACE SHEAR TEST RESULT (ASTM D 6243)
PGL Job No. Job No G030747

QC'd by: _____
Date: 11/5/03

TEST CONFIGURATION # Config # 1a



TEST CONDITIONS:

SAMPLE PREPARATION:

1. The TOP box contained the soil .
   Specimens were cut along machine direction to 14" x 17" for the BOTTOM box, with effective test area of 12" x 12".
2. Soil was compacted to **105.6** pcf @ **21.00%** moisture content, forming 2 inch layer in the TOP box.

CONSOLIDATION:

1. Each set of specimen was consolidated under **soaked** condition for **24 hrs** @ normal load before shearing.
2. Normal loads were applied using **Bladder** for the highest load, **Bladder** for the medium load and **Bladder** for the lowest load.

SHEAR TEST:

1. Shear test was conducted @ **0.040** in/ min.
2. Sheared @ minimum **3.0** inch horizontal displacement.
3. The test specimens were sheared in **soaked** condition
4. Test were performed in general accordance with ASTM D6243-98 / ASTM D5321-92 using Brainard-Kilman LG-112 Direct Shear machine with effective test area of 12 in X 12 in.

TEST RESULTS:

Normal Stress (psi)	Normal Stress (psf)	FINAL MC (Soil) (%)	Asperity Heights Initial (Average in mils)	Asperity Heights Final (Average in mils)	PEAK STRENGTH SHEAR STRESS (psf)	PEAK STRENGTH PEAK SECANT ANGLE (degrees)	3.0 " DISPLACEMENT STRENGTH SHEAR STRESS (psf)	3.0 " DISPLACEMENT STRENGTH 3.0 " DISPLACEMENT SECANT ANGLE (degrees)
13.89	2000	22.81	17.6	17.6	1077	28	798	22
27.78	4000	22.33	20.25	19.75	1813	24	1366	19
55.56	8000	21.97	19.5	19	2616	18	2034	14
83.33	12000	21.77	17.5	17.5	3729	17	2625	12
RETEST	**12000**	**20.5**	**20.5**	**19.5**	**3587**	**17**	**2756**	**12**
		COHESION (psf):			**650**		**551**	
		COEFFICIENT OF FRICTION:			**0.26**		**0.18**	
		FRICTION ANGLE(degrees):			**14.3**		**10.1**	

NOTE: The friction angles and cohesion results given here are based on mathematically determined best fit line.

OBSERVATIONS:

See Figure #1 and #2

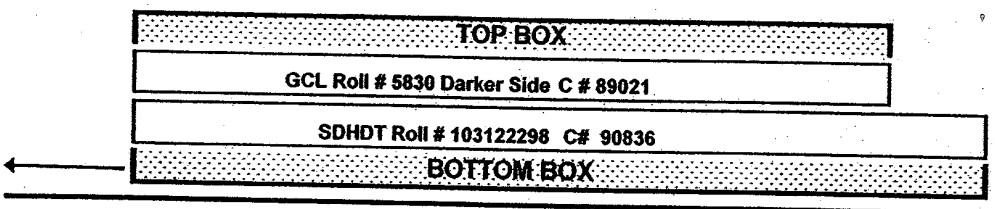
Failure occurred on the clay Soil is too wet

TABLE Config # 2
CLIENT: GEOSYNTEC
PROJECT: Buena Vista Landfill

INTERFACE SHEAR TEST RESULT (ASTM D 6243)
PGL Job No. Job No G030747

QC'd by:
Date: 11/5/03

TEST CONFIGURATION Config # 2



TEST CONDITIONS:

SAMPLE PREPARATION:

1. Specimens were cut along machine direction to 14" x 19" for the upper box, and 14" x 17" for the lower box, with an effective test area of 12" x 12".
2. Initial moisture content of the GCL was 17.25%.

HYDRATION:

1. The GCL specimens were hydrated for 20 hrs with distilled water

CONSOLIDATION:

1. Each set of specimen was consolidated under wet/spray drained for 16 HRS @ normal load before shearing.
2. Normal loads were applied using Bladder for the highest load, Bladder for the 2 medium loads and Bladder for the lowest load.

SHEAR TEST:

1. Shear test was conducted @ 0.040 in/ min.
2. Sheared @ minimum 3.0 inch horizontal displacement.
3. The test specimens were sheared in wet/spray drained condition
4. Test were performed in general accordance with ASTM D6243-98 / ASTM D5321-92 using Brainard-Kilman LG-112 Direct Shear machine with effective test area of 12 in X 12 in.

TEST RESULTS:

Normal Stress (psi)	Normal Stress (psf)	FINAL MC (GCL) (%)	Asperity Heights Initial (Average in mils)	Asperity Heights Final (Average in mils)	PEAK STRENGTH SHEAR STRESS (psf)	PEAK STRENGTH PEAK SECANT ANGLE (degrees)	3.0 " DISPLACEMENT STRENGTH SHEAR STRESS (psf)	3.0 " DISPLACEMENT STRENGTH 3.0 " DISPLACEMENT SECANT ANGLE (degrees)
6.94	1000	125.1	20	20	691	35	442	24
17.36	2500	118.26	22	21	1314	28	924	20
34.72	5000	114.12	22	21	2493	27	1401	16
69.44	10000	102.8	23	19	4589	25	2278	13
					COHESION (psf):	**260.41**	**349.49**	
					COEFFICIENT OF FRICTION:	**0.43**	**0.20**	
					FRICTION ANGLE(degrees):	**23.5**	**11.2**	

TEST #2

NOTE: The friction angles and cohesion results given here are based on mathematically determined best fit line.

OBSERVATIONS:

See Figure #1 and #2
Failure occurred internal of the GCL under 10,000 psf,
Failre occurred between the interface under 1000, 2500, 5000 psf

PGL Job Number: Job No G030747 **Config # 2**
Project Name: Buena Vista Landfill
GCL R# 5830 (Darker Side) C#89021 / HDPE R#103122298 C# 90836
QC'd By:

Figure #1
Normal Stress/ Interface Stress

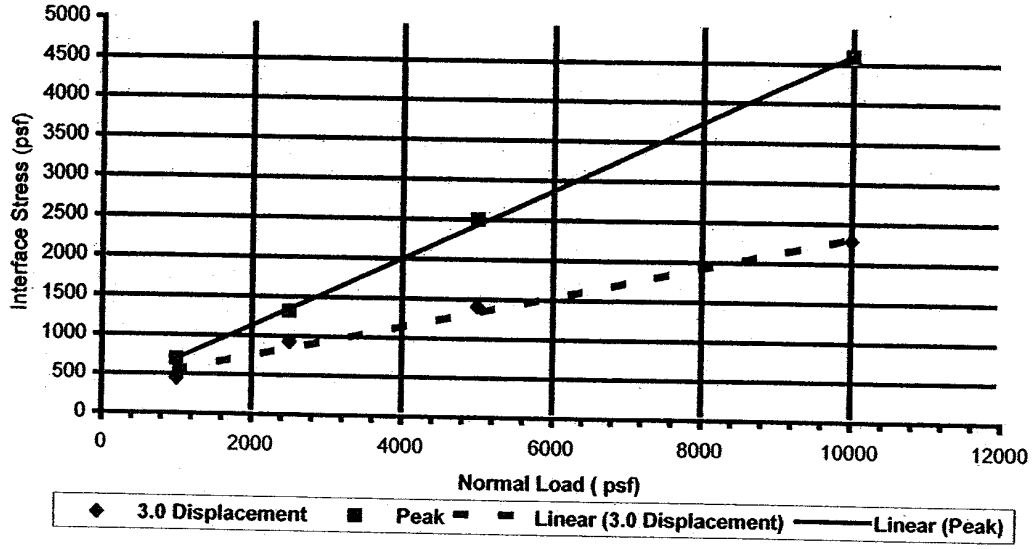
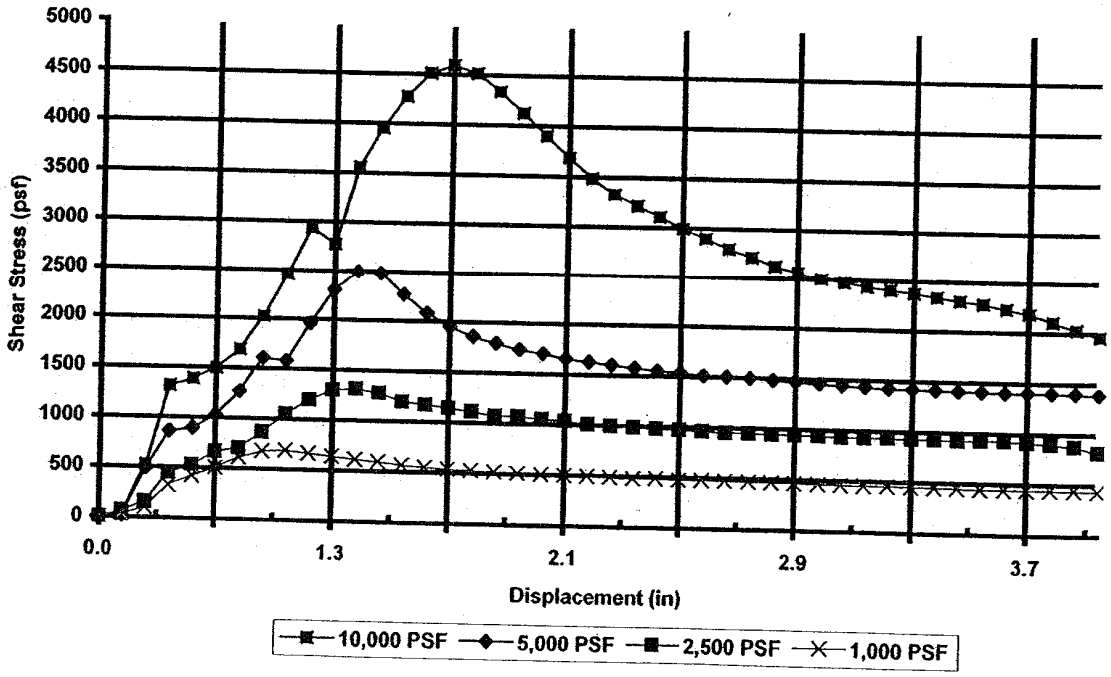


Figure #2
Shear Stress/ Displacement Curve



Precision Geosynthetic Laboratories

November 11, 2003

Mr. Fabrizio Settapani
Geosyntec
1500 Newell Avenue, Suite 800
Walnut Street, CA. 94596

Dear Mr. Settapani: **RE: Buena Vista Landfill**

Thank you for consulting Precision Geosynthetic Laboratories for your material testing needs.

It should be noted that the test specimen and test sample used for this report was believed to be representative of the material produced under the designation herein stated. However, these results are indicative of only the specimens that were actually tested. The testing herein is based upon accepted industry practice as well as the test method listed. Precision Geosynthetic Laboratories neither accepts responsibility for nor makes claims to the final use and purpose of the material.

By accepting the data and results represented on this report, Client agrees to limit the liability of Precision Geosynthetic Laboratories from Client and all other parties for claims arising out of the use of this data to the cost for the respective test(s) represented in this report, and Client agrees to indemnify and hold harmless Precision Geosynthetic Laboratories from and against all liability in excess of the aforementioned limit.

The test data and all associated project information provided shall be held in confidence and disclosed to other parties only with the authorization of Client or Precision Geosynthetic Laboratories.

It is a company policy to keep the physical records of each job for 2 years since the receipt of the samples and keep the electronic file for 7 years. We will dispose the samples two weeks after the final report is faxed to you. Should you want us to keep them for some period of time, please advise us immediately.

If you have any questions or if we may be of further service, please do not hesitate to call at 800-522-4599.

Sincerely,

PRECISION GEOSYNTHETIC LABORATORIES

Cora B. Queja
Vice President

Enclosure: (Job No.G031172)

1160 North Gilbert Street, Anaheim, CA. 92801, Tel# 714-520-9631, Fax#714-520-9637

Precision Geosynthetic Laboratories

CLIENT: GEOSYNTEC
PROJECT: Buena Vista Landfill

INTERFACE SHEAR TEST RESULTS
(PGL Job No. G031172)

SAMPLE IDENTIFICATIONS:

SAMPLE ID	PRECISION CONTROL NUMBER	DATE RECEIVED	ORIGIN OF MATERIAL
HDPE R#4989	94302	10/21/03	Geosyntec
GCL R# 2198	94355	10/23/03	Geosyntec

TESTS REQUIRED:

TEST METHOD	DESCRIPTION
ASTM D6243	Interface Shear

TEST CONDITIONS: The samples were conditioned for a minimum one hour in the laboratory at 22 ± 2°C (71.6 ± 3.6°F) and at 60 ± 10% relative humidity prior to test.

TEST RESULTS:

The test results are summarized in Table 1. The units in which the data are reported are included on this table.

PRECISION GEOSYNTHETIC LABORATORIES

Cora B. Queja
Vice President

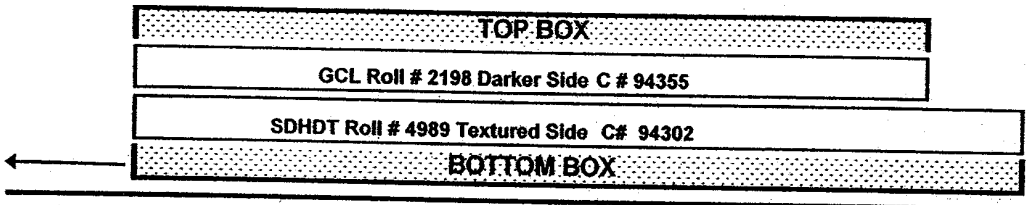
1160 North Gilbert Street, Anaheim, CA. 92801, Tel# 714-520-9631, Fax#714-520-9637

TABLE Config # 1
CLIENT: GEOSYNTEC
PROJECT: Buena Vista Landfill

INTERFACE SHEAR TEST RESULT (ASTM D 6243)
PGL Job No. Job No G031172

QC'd by: _____
Date: 11/11/03

TEST CONFIGURATION Config # 1



TEST CONDITIONS:

SAMPLE PREPARATION:

1. Specimens were cut along machine direction to 14" x 19" for the upper box, and 14" x 17" for the lower box, with an effective test area of 12" x 12".
2. Initial moisture content of the GCL was 17.33 %.

HYDRATION:

1. The GCL specimens were hydrated for 20 hrs with distilled water

CONSOLIDATION:

1. Each set of specimen was consolidated under wet/spray drained for 16 HRS @ normal load before shearing.
2. Normal loads were applied using Bladder for the highest load, Bladder for the 2 medium loads and DEAD WEIGHT for the lowest load.

SHEAR TEST:

1. Shear test was conducted @ 0.040 in/ min.
2. Sheared @ minimum 3.0 inch horizontal displacement.
3. The test specimens were sheared in wet/spray drained condition
4. Test were performed in general accordance with ASTM D6243-98 / ASTM D5321-92 using Brainard-Kilman LG-112 Direct Shear machine with effective test area of 12 in X 12 in.

TEST RESULTS:

Normal Stress (psi)	Normal Stress (psf)	FINAL MC (GCL) (%)	Asperity Heights Initial (Average in mils)	Asperity Heights Final (Average in mils)	PEAK STRENGTH SHEAR STRESS (psf)	PEAK STRENGTH PEAK SECANT ANGLE (degrees)	3.0 " DISPLACEMENT STRENGTH SHEAR STRESS (psf)	3.0 " DISPLACEMENT STRENGTH 3.0 " DISPLACEMENT SECANT ANGLE (degrees)
6.94	1000	144.79	24	23	631	32	413	22
17.36	2500	139.43	23	21	1233	26	762	17
34.72	5000	104.27	23	22	2348	25	1322	15
69.44	10000	93.24	24	23	4337	23	2272	13
					COHESION (psf):	226.88	242.10	
					COEFFICIENT OF FRICTION:	0.41	0.21	
					FRICTION ANGLE(degrees):	22.4	11.6	

TEST #1

NOTE: The friction angles and cohesion results given here are based on mathematically determined best fit line.

OBSERVATIONS:

See Figure #1 and #2

Failure occurred between the interface under 1000, 2500, 5000 and 10,000 psf

PGL Job Number: Job No G031172 **Config # 1**
Project Name: Buena Vista Landfill
GCL R# 2198 (Darker Side) C#94355 / HDPE R#4989 (Textured Side) C# 94302
QC'd By:

Figure #1
Normal Stress/ Interface Stress

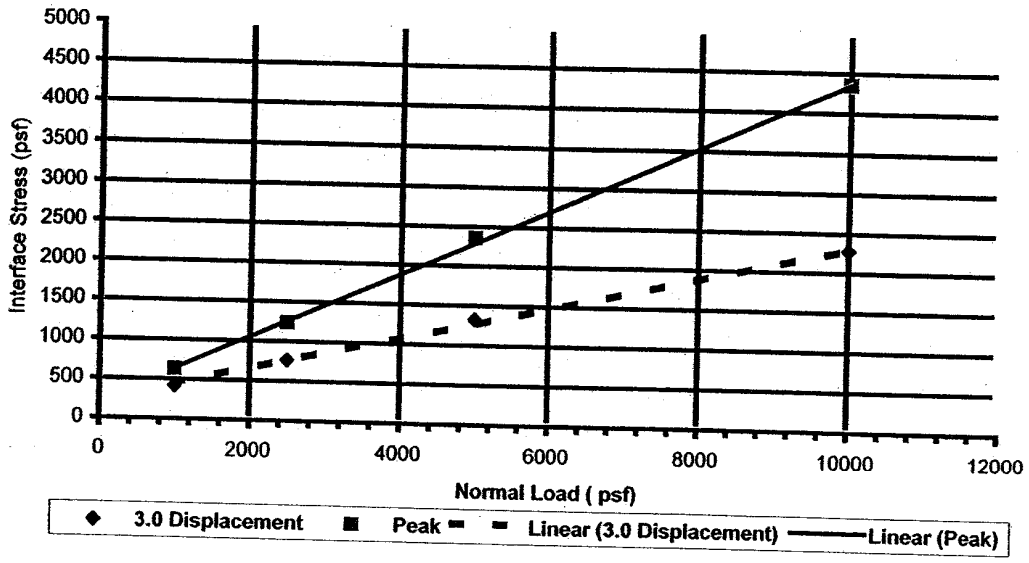
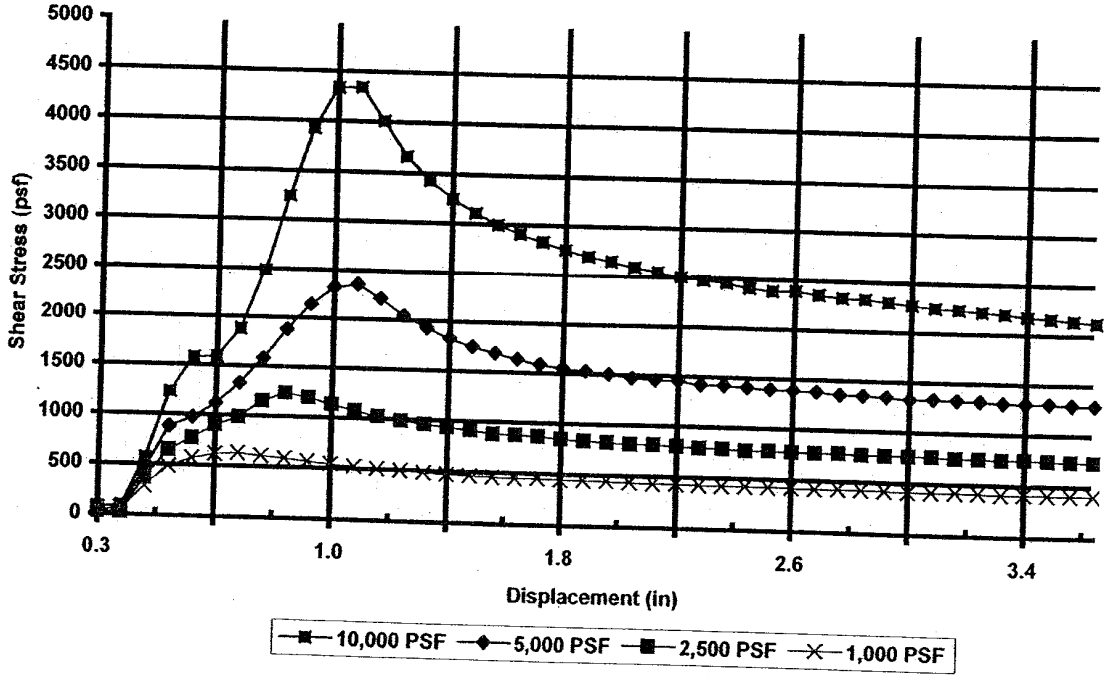


Figure #2
Shear Stress/ Displacement Curve



Reference: *Site Development Plan, Buena Vista Drive Sanitary Landfill, Watsonville, California* prepared by Geosyntec and dated 4 March 2005.

APPENDIX B

SLOPE STABILITY ANALYSES

Written by: FWS Date: 05/02/25 (YY/MM/DD) Reviewed by: Date: /// (YY/MM/DD)

Client: COSCan Project: SITE DEV PLANS Project/Proposal No.: WI0658 Task No: 9

STABILITY ANALYSES SUMMARY

(1) Analyses performed on temporary grades for Module 4A and 4B with South stockpile.

(2) Analyses performed on final grades for landfill for Modules 4A, 4B, 5 since new grading plan was developed. For areas South of Module 4A, grading plan remained similar to 1999 Site Development plan or lowered ∴ no analyses performed. CH2M Hill (1999) analyses assumed to be applicable.

(3) Final grading plan in area of Modules 4A, 4B, 5 and portion of Mod 6 shows a bench.

(4) Analyzed sections E-E', J-J' (by inspection), I-I', M-M' for final grading plan.

(5) Final grading plan in area of Modules 4A, 4B, 5 analyzed for MPE since it was modified. (MAXIMUM PROBABLE EARTHQUAKE, M = 7.9, rock acc = 0.48g)

(6) Effect of stockpiles: SOUTHWESTERN stockpile over unlined portion of site (Module 1); SOUTH Stockpile over composite-lined portion of site (Module 3). For South stockpile, Module 4A needs to be partially filled (over 70) when initial portion constructed. For South stockpile, Module 4B needs to be filled when south stockpile reaches final elevation. Southwestern stockpile not analyzed for slope stability since over unlined sta

Written by: FWS Date: 05/02/25 (YY/MM/DD) Reviewed by: ____ Date: ____/____/____

Client: CoSCny Project: SITE DEV. PLN Project/Proposal No.: WO658 Task No: 01

(7) Properties for waste fill based on Kavazanjian et al (1995).

(8) " " liner systems based on information from CQA Reports for Modules 3, 4A, 6. For future Modules 4B and 5, liner properties based on experience at site for GCL/HDPE and typical properties for CCL/HDPE. For Module 2, assumed it is lined with a clay liner that has an $S_u = 1{,}000$ psf. Module 3 was constructed in 1994.

Module 3 BASE (based on CQA tests)

$\sigma_N \leq 4900$ psf, $\phi = 8.5°$, $c = 0$ psf

$\sigma_N > 4900$ psf, $\phi = 4.1°$, $c = 381$ psf

SS

$\sigma_N \leq 7455$ psf, $\phi = 7°$, $c = 0$ psf

$\sigma_N > 7455$ psf, $\phi = 4.1°$, $c = 381$ psf

Module 6 BASE (CONSTRUCTED IN 1999, RETESTED IN 2004 W. SITE-SPECIFIC MATERIALS)

SELECTED BECAUSE LOWER STR. THAN NWGT/HDPE → CCL/TEXT HDPE

σ_N	τ
2000 psf	497 psf
4000	786
6000	1167
10000	1825
15000	1825

NW GT/TEXT HDPE

σ_N	τ
2000 psf	691 psf
4000	1114
10000	2676
15000	3783

SS $\phi = 17°$ (based on literature values for sandy subgrade to textured HDPE — reference: Thorne + Lewis (1994))

SANDY SUBGRADE (NATIVE)/TEXT. HDPE

Written by: AWS Date: 05/02/25 (YY/MM/DD) Reviewed by: ____ Date: ____/____/____

Client: CoStar Project: SITE DEV. PLAN Project/Proposal No.: WO658 Task No: 01

(8) Module 4A BASE (CONSTRUCTED IN 2003, CQA TESTS USING SITE-SPECIFIC MATERIALS)
(CONTINUED)

CCL/TEXT HDPE

$\sigma_N \leq 4000$ psf, $\phi = 19°$, $c = 0$ psf

$\sigma_N > 4000$ psf, $\phi = 9.4°$, $c = 700$ psf

SS (CQA TESTS USING SITE-SPECIFIC MATERIALS) GCL/TEXT HDPE

σ_N	τ
1000 psf	428 psf
2500	843
5000	1362
10000	2276

Module 4B + 5 (FUTURE)

BASE CCL/TEXT HDPE $\phi = 14°$, $c = 0$ psf

SS GCL/TEXT HDPE

$\sigma_N \leq 2500$ psf, $\phi = 20°$, $c = 0$ psf

$\sigma_N > 2500$ psf, $\phi = 2.3°$, $c = 831$ psf.

(9) Two stockpiles proposed: SOUTHWESTERN (located over Module 1 which is unlined) and SOUTH (located over Module 3 which is lined). For both, compression of waste expected and settlement cracks may result. For stability, evaluated SOUTH stockpile because located over composite liner (HDPE/GCL-PCM MAT). (Sections N-S', 1-1', 2-2')

Written by: FWS Date: 05/02/25 (YY/MM/DD) Reviewed by: ____ Date: ____/____/____

Client: CoSCuy Project: SITE DEV. PLAN Project/Proposal No.: WO658 Task No: 01

(10) For Temporary slopes evaluated Module 4B (H-H', G-G')

(11) Note that by filling Module 4B, Module 4A becomes stabilized and by filling Module 5, Module 4B becomes stabilized.

(12) For Final slopes, evaluated ~~the~~ effect of the MPE on the final slopes. The MPE M=7.9, ~~rock acc = 0.48g~~. Performed a dynamic response analyses and followed Newmark (1965) as modified by Makdisi + Seed (1978) to develop graphs of deformation versus k_y/k_{max} for two columns of waste (100' and 160') over bedrock.

CHANGED FOR 2008 PC/PCMP

(13) Minimum static FS = 1.5 (final + interim slopes)

~~(14) MAX Seismic deformations allowed = 12"~~
~~(Seed and Bonaparte, 1992; Stewart et al., 1994).~~

CHANGED FOR 2008 PC/PCMP

CONCLUSIONS

(A) STATIC FS ≥ 1.5 FOR FINAL GRADES

(B) " " ≥ 1.3 " INTERIM GRADES (STOCKPILE + MOD 4B)

~~(C) SEISMIC DEFORMATIONS < 12" FOR FINAL GRADES~~

CHANGED FOR 2008 PC/PCMP

Geosyntec consultants

Written by: FWS Date: 15/07/08 (DD/MM/YY) Reviewed by: _____ Date: ____/____/____

Client: CoSCuy Project: Site-Wide Risk Modification 2008 RCRGIP Project/Proposal No. WG1019 Task No. 9

(12) Modified – see previous page 4.
Accelerations changed with the new attenuation relationships (NGA) – refer to excerpts on pages 6, 7, 8, 9 (attached) from Appendix E – this report.
Acc. range from 0.29 g to 0.39 g.

(14) Modified – see previous page 4.
MAK Seismic def. Allowed = 6 inches –
See p. 10.11 (attached) from site's WDRs.

Geosyntec consultants

475 14th Street, Suite 400
Oakland, California 94612
PH 510.836.3034
FAX 510.836.3036
www.geosyntec.com

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Reference : Appendix E, 2008 PCPCMP – this report

SEISMIC SITE RESPONSE AND DEFORMATION ANALYSIS
BUENA VISTA LANDFILL
WATSONVILLE, CALIFORNIA

INTRODUCTION

This analysis package presents the selection of ground motions, seismic site response and deformation potential analyses performed for Buena Vista Drive Sanitary landfill, (BVDSL) at Watsonville, California. The analyses are based upon the results of the seismic hazard performed by Geosyntec [2003]. Geosyntec [2003] identified that the Maximum Probable Earthquake (MPE) at the site is either a Moment Magnitude (M_w) 6.2 event on the Zayante-Vergales Fault or M_w 7.9 event on the San Andreas fault system.

Geosyntec estimated the seismic hazard at the site using the Next Generation Attenuation (NGA) Relationships, developed as part of a research project by the Pacific Earthquake Engineering Research Center. The NGA relationships are widely acknowledged as representing the earthquake profession's best scientific understanding of ground motion attenuation. They have been adopted by the U.S. Geologic Survey in its National Hazard Mapping Project, and on critical projects such as the BART Earthquake Safety Program. A total of 8 ground motions were selected and their intensity was appropriately scaled to fit the target response spectrum at the site. One-dimensional equivalent-linear site response analyses for two representative waste columns (100 ft and 160 ft high) were then performed. Based on the results of the seismic response analyses, Newmark-type seismic deformation analyses were performed. The results of the seismic deformation analyses are presented in the form of charts relating calculated permanent seismic displacement to yield acceleration. These charts were developed for the landfill waste mass and for the cover.

The BVDSL is approximately 2.5 miles (4 km) west of Watsonville, California. The approximate location of the BVDSL is shown on Figure 1. Geotechnical investigations indicate that the soil conditions below the landfill consist primarily of native soils composed of dense silty and clayey sands and gravel [County of Santa Cruz, 1999].

The report was prepared by Dimitrios Zekkos, Ph.D., P.E., and reviewed by Jonathan D. Bray, Ph.D., P.E., and Hari Sharma, Ph.D., P.E., G.E., in accordance with Geosyntec's review policy.

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Table 2: Peak Ground Acceleration (PGA) at the site predicted by the NGA relationships

Attenuation Relationship	**PGA, g**
Abrahamson and Silva [2007]	0.30
Boore and Atkinson [2007]	0.33
Campbell and Bozorgnia [2007]	0.29
Chiou and Youngs [2006]	0.39
Idriss [2007]	0.37

BASE SLIDING, 100-FT COLUMN

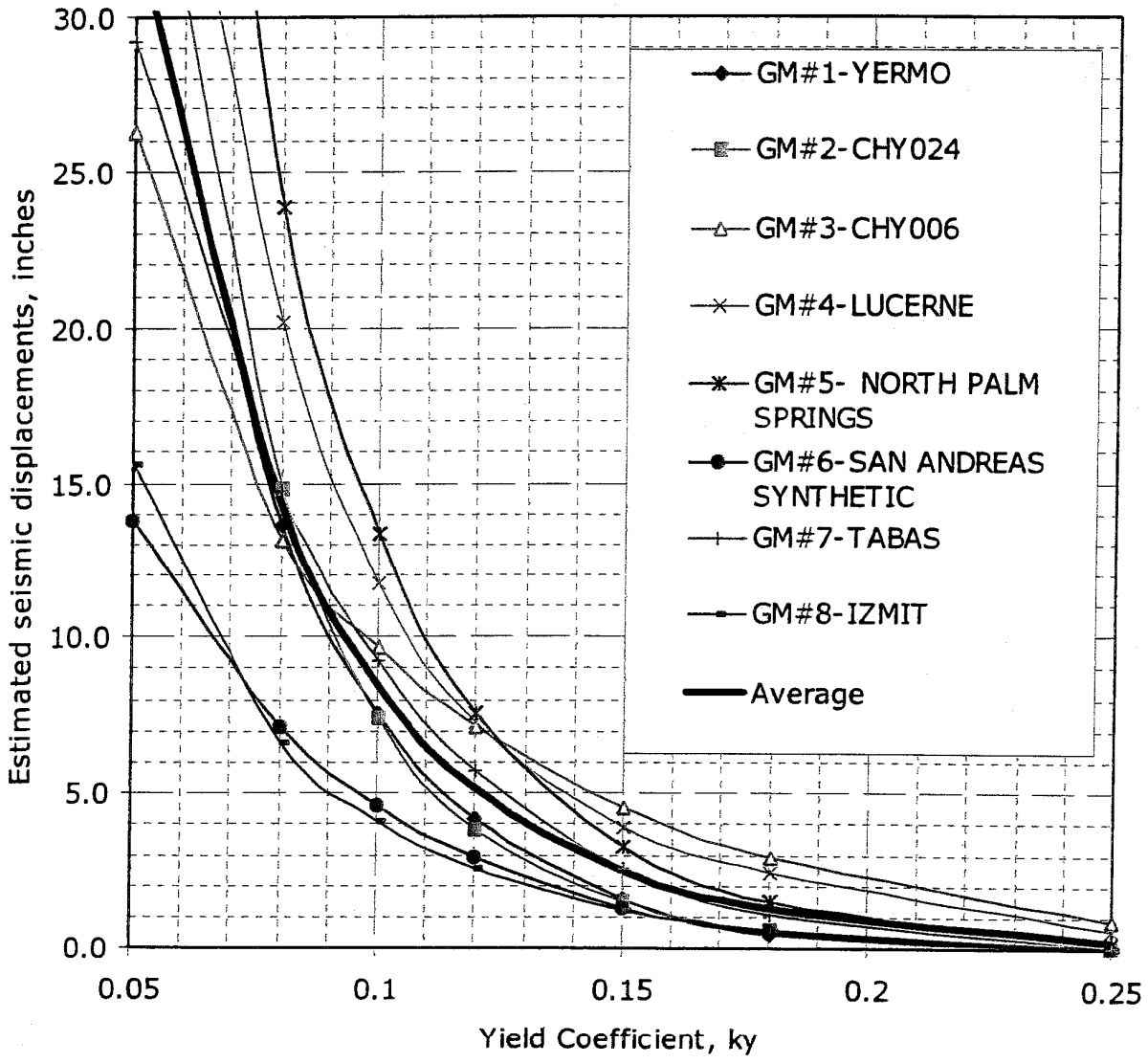


Figure 15: Seismic Displacements Estimates

December 2007	Buena Vista Landfill Santa Cruz, California	Geosyntec consultants

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BASE SLIDING, 160-FT COLUMN

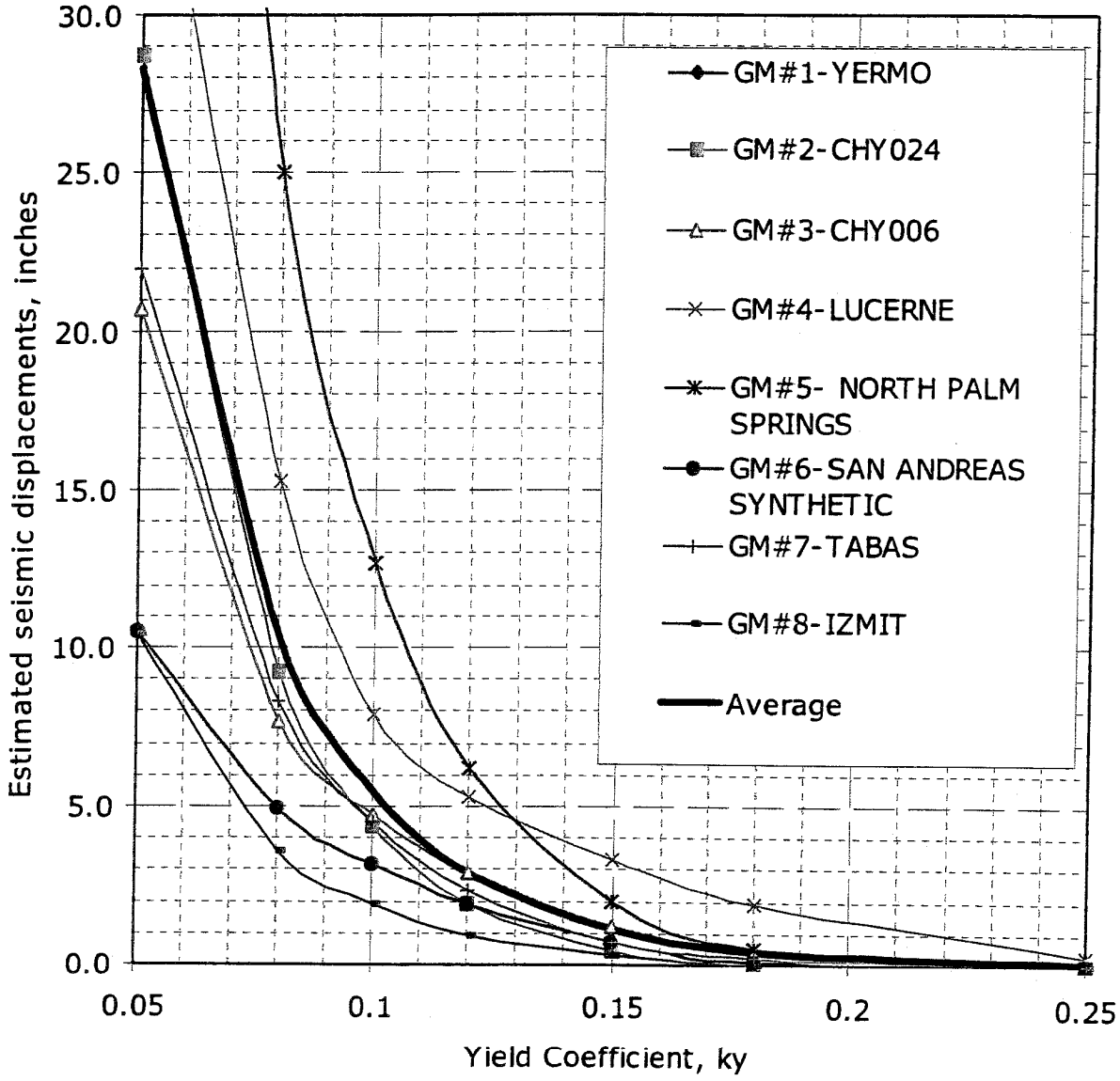


Figure 17: Seismic Displacements Estimates

December 2007	Buena Vista Landfill Santa Cruz, California	Geosyntec consultants

28. Drainage facilities shall be designed, constructed, and maintained to accommodate anticipated precipitation and peak surface runoff flows from a 100-year, 24-hour rain event.

29. Storage facilities associated with precipitation and drainage control systems shall be emptied immediately following each storm or otherwise managed to maintain the design capacity of the system. A minimum of two feet of freeboard shall be maintained in all storm water/sediment containment or percolation ponds.

Design Criteria

30. All waste disposal areas, containment structures and drainage facilities shall be designed and constructed under the direct supervision of a California Registered Civil Engineer or a Certified Engineering Geologist, and shall be certified by that individual as meeting the prescriptive standards and performance goals of all state and federal landfill regulations including, but not limited to, CCR Title 27 and 40 CFR parts 257 and 258. For containment structures (liners), certification of standards consistent with CCR Title 27, Sections 20324 and 20310 (e), shall be obtained prior to waste discharge.

31. Waste management units, containment structures, and drainage facilities shall be designed, constructed and maintained to limit, to the greatest extent possible, ponding, infiltration, inundation, erosion, slope failure, washout, overtopping, and damage due to natural disasters (e.g., floods with a predicted frequency of once in 100 years, and severe wind storms).

32. Wastes shall not be discharged to new areas (i.e., permitted areas that have not previously received wastes) unless equipped with a containment system, which meets either a. or b. below:

    a. A composite liner and a leachate collection and removal system consisting of the following components:

        - A well-prepared subgrade, engineered to support the Landfill and associated structures.
        - Lower Component: a minimum two-foot layer of compacted soil with a hydraulic conductivity of no more than $1x10^{-7}$ cm/sec.
        - Upper Component: a minimum 60-mil high-density polyethylene (HDPE). The upper component must be installed in direct and uniform contact with the lower component.
        - A Leachate Collection and Removal System (LCRS), designed so that leachate drains by gravity to a collection point/sump and is removed through gravity or pumping to a holding tank or sanitary sewer for volume measurement, testing and disposal.
        - A protective soil layer or operations layer shall be placed above the LCRS and liner system. This layer shall be a minimum of 12 inches thick

    b. An engineered alternative liner design, approved by the Executive Officer. Engineered alternative designs must satisfy the performance criteria in 40 CFR Section 258.40(a)(1) and (c), and satisfy the criteria for an engineered alternative to the above prescriptive design, as provided by CCR Title 27, Section 20080(b). Performance of the alternative composite liners' components, in combination, shall equal or exceed the waste containment capability of the prescriptive design outlined above.

33. All Landfill facilities shall be designed and constructed to prevent damage during the maximum probable earthquake.

34. The integrity of final slopes shall be maintained to handle design static and dynamic conditions to protect public health and safety and prevent damage to post-closure land uses, roads, structures, utilities, gas monitoring and control systems, leachate collection and control systems to prevent public contact with leachate, and prevent exposure of waste. Slope stability analyses shall be conducted and reported pursuant to the requirements of Division 2, Subdivision 1, Chapter 4, Subchapter 3, Article 4 Section 21750(f)(5). A minimum factor of safety of 1.5 is required for permanent and interim slopes under static slope stability analyses. **Unless otherwise approved by the Executive Officer**, for seismic deformation analysis, the acceptable limit for permanent slope displacement is 6 inches for bottom liners and slopes, and 12 inches for final cover system slopes. Up to 12 inches of slope displacement may be acceptable for bottom liners and

slopes, and up to 36 inches of slope displacement may be acceptable for final cover system slopes, if a report approved by the Executive Officer documents that the foundation, bottom liner, slopes, final cover system, and/or the structures, which control leachate, surface drainage, erosion, or gas can accommodate the permanent slope displacement **without jeopardizing the integrity of the containment structures** or be reasonably repaired to perform as originally intended.

35. The leachate collection and removal system shall:

    a. Be designed and constructed to prevent more than 12 inches of static hydraulic head on the liner.
    b. Be designed and operated to function without clogging through the scheduled closure of the waste management unit and during the post-closure maintenance period.
    c. Convey to a sump, or other appropriate collection area, all leachate that reaches the liner. The depth of fluid in any collection sump shall be kept at the minimum needed to ensure efficient pump operation.
    d. Be designed so that short and long term system performance can be monitored and evaluated [CCR Title 27, Section 20340 (d)].
    e. Above ground storage facilities shall have a secondary containment system sized to hold 100 percent of the primary containment system capacity.
    f. Sumps shall be constructed with double liners with leak detection capability.

Closure

36. Final Landfill configuration shall conform to the contours delineated in Figure 7 and Attachment 2, Site Development Plans, of the March 2005 JTD.

37. The Discharger shall implement final closure activities as the site operation progresses, in accordance with requirements consistent with the closure of the entire site as approved by the Executive Officer and the California Integrated Waste Management Board in accordance with the most recently approved closure plan.

38. Partial closure shall be accomplished by implementing closure activities, including but not limited to: placement of final cover, final grading, maintenance, revegetation, and installation of environmental monitoring control systems consistent with the closure the entire site. Units closed in accordance with a Closure Plan approved by the Executive Officer and the California Integrated Waste Management Board, are not subject to future regulatory changes unless monitoring data indicates impairment of beneficial uses of groundwater.

39. All Landfill waste disposal areas at final elevations shall receive final cover pursuant to CCR Title 27, Section 21090, which meets either a. or b. below:

    a. A final cover system consisting of the following components:

        - Minimum two-foot foundation layer placed over waste, compacted to maximum density obtainable at optimum moisture conditions [CCR Title 27, Section 21090 (a)(1)].
        - For units that have not been equipped with a Subtitle D composite liner system, a low hydraulic conductivity layer, consisting of compacted clay with a hydraulic conductivity of $1x10^{-6}$ cm/sec or less. Compacted clay may not be suitable for sites with VOC detections in point of compliance wells. In such cases a geosynthetic clay layer or geomembrane may be more appropriate.
        - For units that have been equipped with a Subtitle D composite liner system, a low hydraulic conductivity layer equal to or less than the hydraulic conductivity of the bottom liner system.
        - At least one foot of soil capable of supporting vegetation, resisting erosion, and protecting the underlying low hydraulic conductivity layer.

    b. An engineered alternative design, approved by the Executive Officer, will be considered for final cover areas. Engineered alternative designs must satisfy the performance criteria in 40 CFR Parts 257 and 258, and satisfy the criteria for an engineered alternative to the above prescriptive design, as provided by CCR Title 27. Performance of the alternative composite cover's components, in combination, shall equal or

GeoSyntec Consultants

GEOSYNTEC CONSULTANTS
COMPUTATION COVER SHEET

Client: SANTA CRUZ **Project:** BUENA VISTA SD **Project/Proposal #:** WL0658 **Task #:** 01

Title of Computations: FINAL COVER STABILITY

Computations By:
Ellen Rothman / M. Settepani — 2/28/05
SIGNATURE — DATE
ELLEN ROTHMAN / F. SETTEPANI
PRINTED NAME AND TITLE
STAFF ENGINEER

Assumptions and Procedures Checked By (Peer Reviewer):
M. Settepani – / Ellen Rothman — 1 MAR 05
SIGNATURE — DATE
F. SETTEPANI
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Computations Checked By:
M. Settepani – / Ellen Roth — 1 MAR 05
SIGNATURE — DATE
F. SETTEPANI
PRINTED NAME AND TITLE

Computations Backchecked By (Originator):
Ellen Rothman / M. Settepani – 1 MAR 05
SIGNATURE — DATE
PRINTED NAME AND TITLE

Approved By (PM or Designate):
SIGNATURE — DATE
PRINTED NAME AND TITLE

Approval Notes:

Revisions: (Number and Initial All Revisions)

No.	Sheet	Date	By	Checked By	Approval

Written by: FWS Date: 05/02/25 (YY/MM/DD) Reviewed by: _____ Date: _____ (YY/MM/DD)

Client: COSCO Project: SITE DEV PLANS Project/Proposal No.: WO658 Task No: 01

7/2008

FINAL GRADING PLAN

SECTION	STATIC F.S.	yield ACC	filename
E-E'	1.63	0.12g	E-E' REV. SLP , E-E'-REV-SEIS.SLP
M-M'	1.96	0.16g	M-M'. SLP M-M'-SEIS. SLP
I-I'	1.72	0.16g	I-I'. SLP I-I'-SEIS. SLP

J-J' by inspection – similar to E-E'.

Figure 1 BASE GRADING PLAN

2 FINAL " "

3 SECTION E-E' – Final Grades

4 SECTION M-M' – " "

5 SECTION I-I' – " "

J-J' – " "

CONCLUSIONS

(A) STATIC FS > 1.5 ∴ OK ✓

(B) kh ≥ 0.12g → ~~Estimated deformation ≤ 12" (Refer to Appendix C)~~

CHANGED FROM 2005 PCPCMP

Geosyntec consultants

Written by: FWS Date: 15/07/08 Reviewed by: _____ Date: 11/2008

Client: Calfm Project: SITE DEV PLAN Update w. 2008 PCPMP Project/Proposal No. CW1019 Task No. 01

(B) Estimated deformations based on seismicity using mean attenuation relationships (MAR) presented in Appendix E - this report are ≤ 6 inches.

Refer to attached excerpt p. 3, 4 (original in App E).

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BASE SLIDING, 100-FT COLUMN

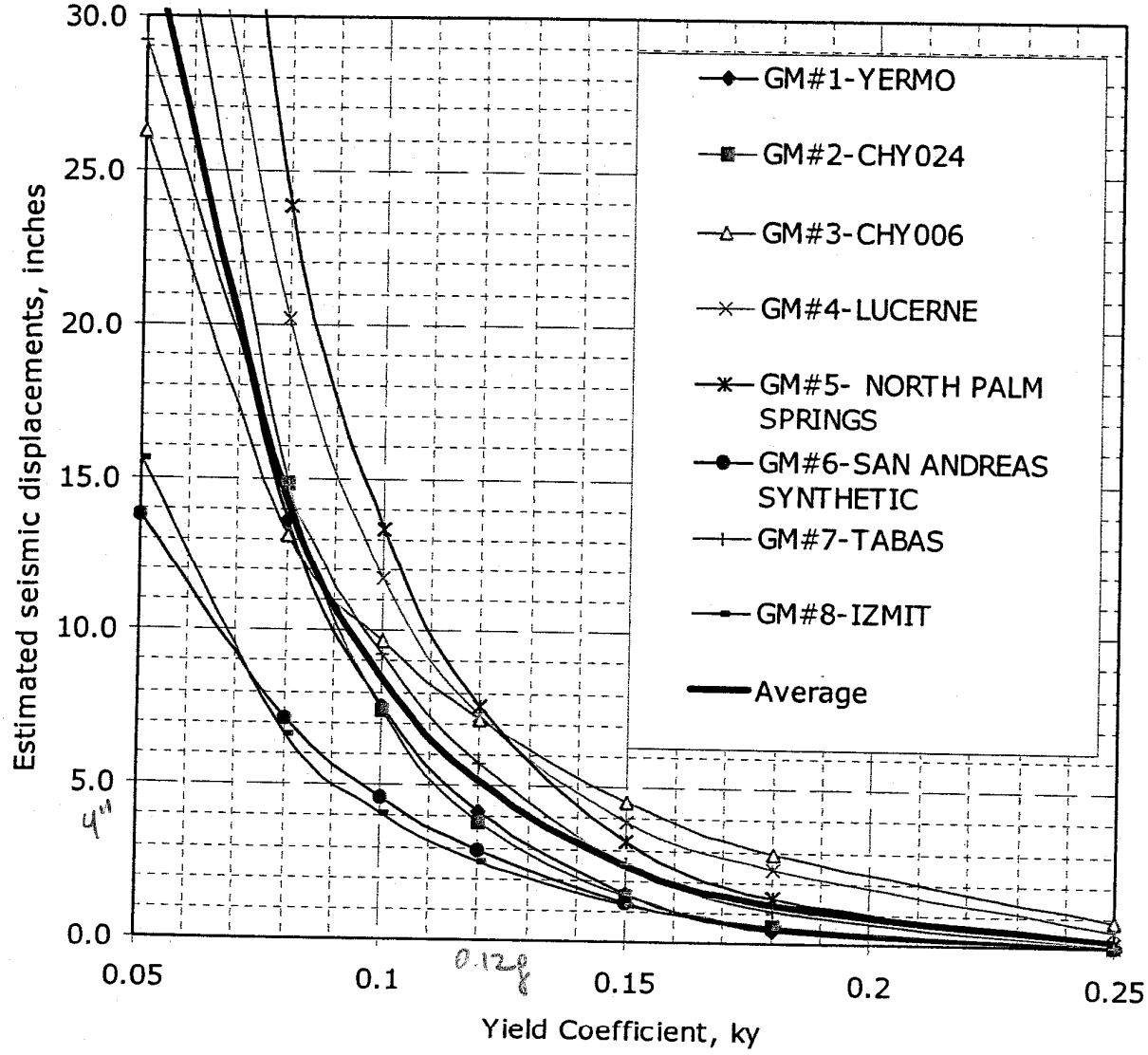


Figure 15: Seismic Displacements Estimates

December 2007	Buena Vista Landfill Santa Cruz, California	Geosyntec consultants

4
7/2008

BASE SLIDING, 160-FT COLUMN

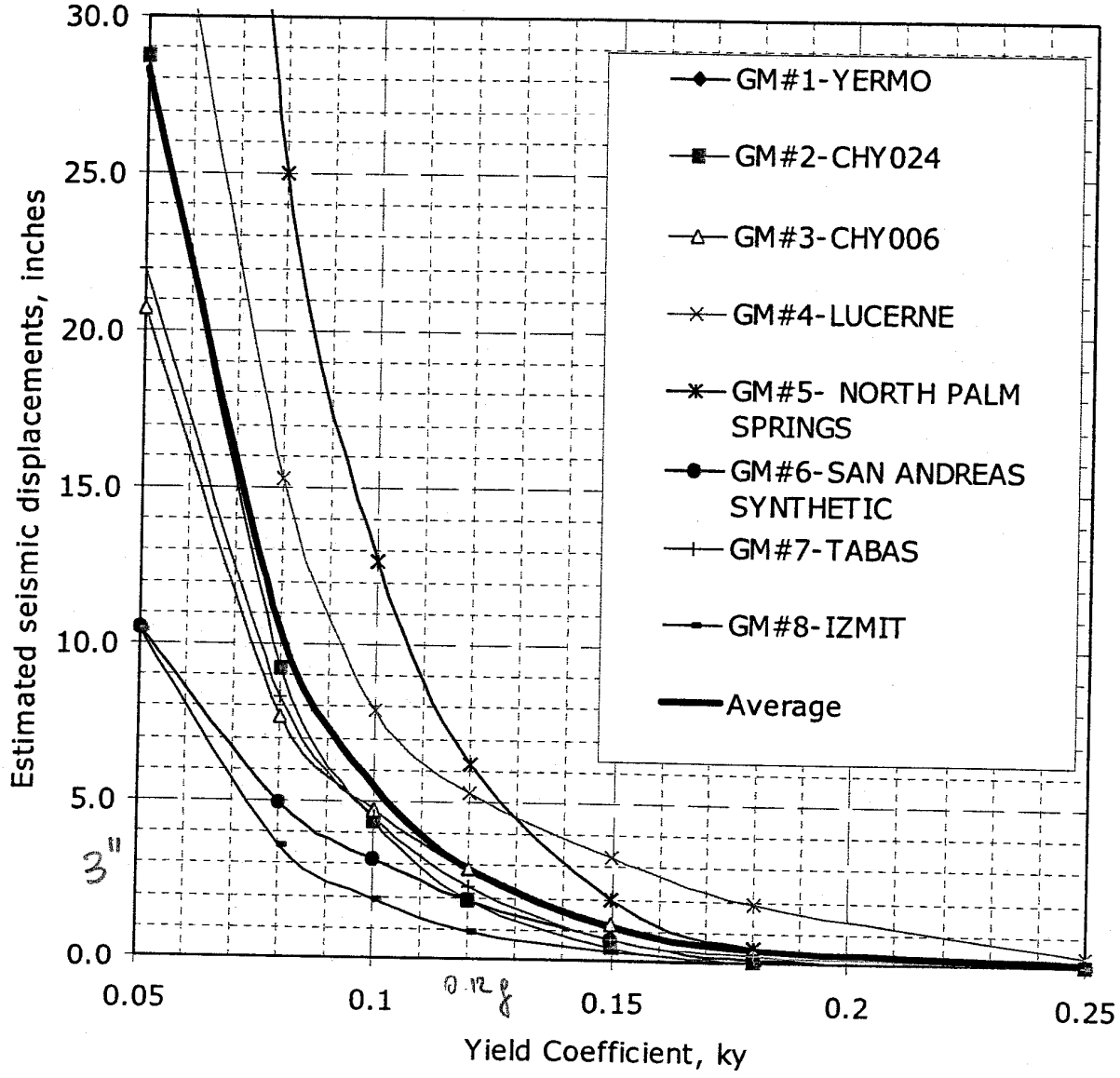
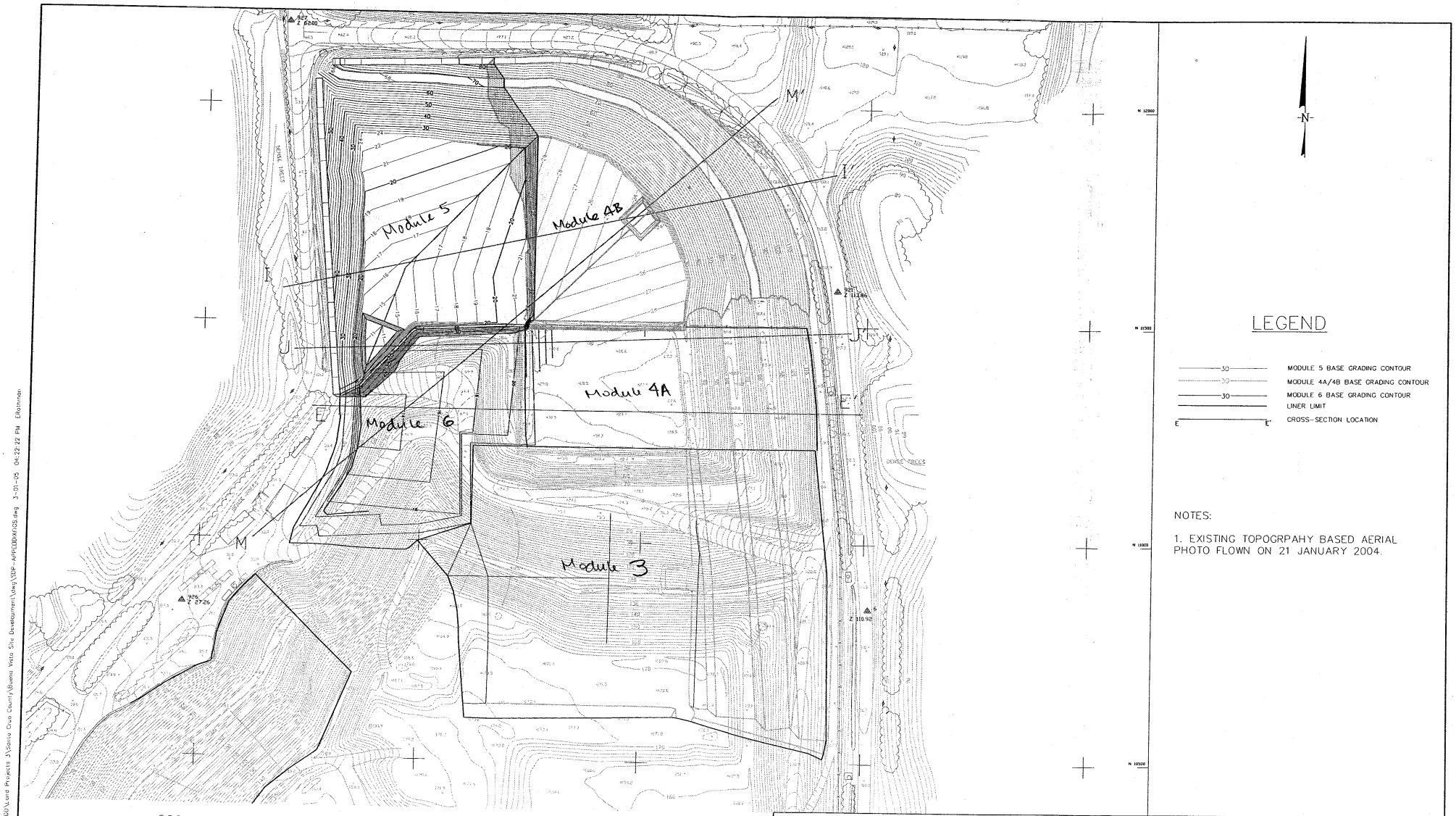


Figure 17: Seismic Displacements Estimates

December 2007	Buena Vista Landfill Santa Cruz, California	Geosyntec consultants



P:\CAD\Liners Projects 3\Santa Cruz County\Buena Vista Site Development\Dwg\SDP-APPENDIXFIG5.dwg 3-01-05 04:22:22 PM EHoffman

GeoSyntec Consultants

BASE GRADING PLAN
BUENA VISTA LANDFILL
SANTA CRUZ COUNTY, CALIFORNIA

FIGURE NO.	1
PROJECT NO.	WL0658
DATE:	FEBRUARY 2005

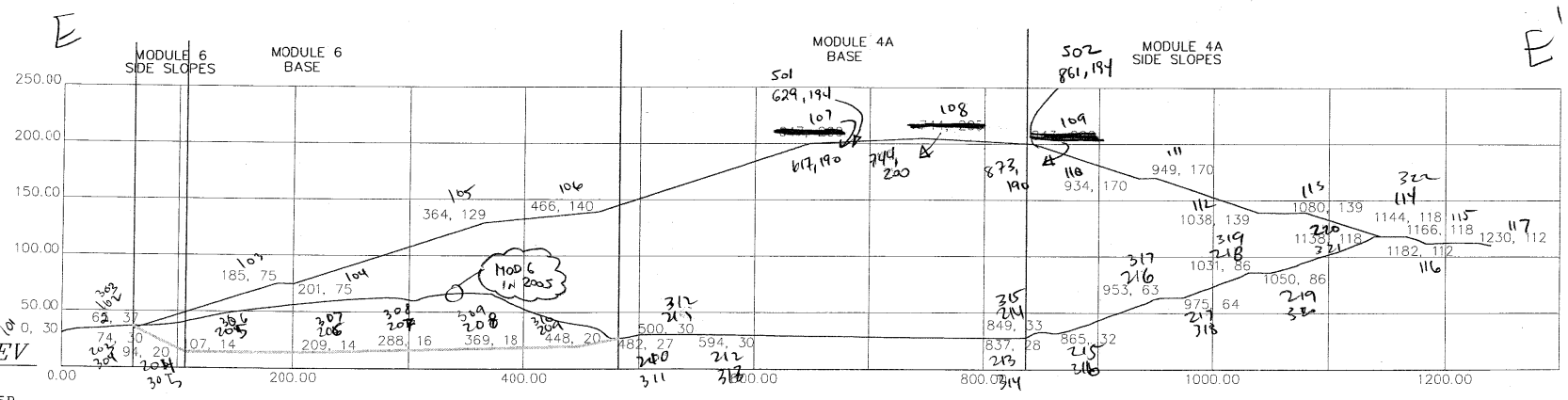


P:\CAD\Land Projects 3\Santa Cruz County\Buena Vista Site Development\Dwg\SUP-APPEDIX\FIG5.dwg 1-01-05 04:21:47 PM EBottman

GeoSyntec Consultants

BASE AND FINAL GRADING PLAN
BUENA VISTA LANDFILL
SANTA CRUZ COUNTY, CALIFORNIA

FIGURE NO.	2
PROJECT NO.	WL0658
DATE:	FEBRUARY 2005

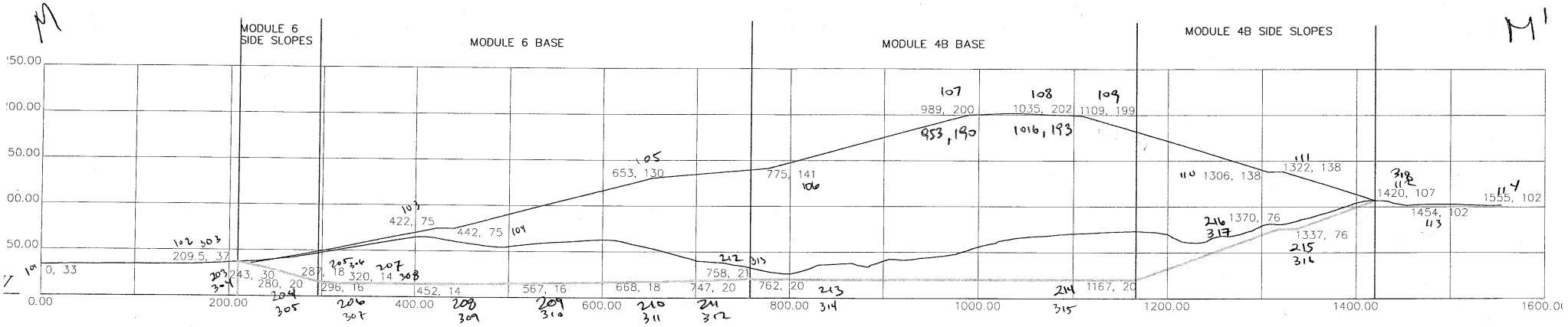


3,03 (scis)
58306.5

SCALE: 1"=100'

Section E-E'

Figure 3



303 (secs)

202, 3.6.5

NOTE: final iteration decrease to EL 190 top ditch

107	953, 190
108	1016, 193
109	1143, 189

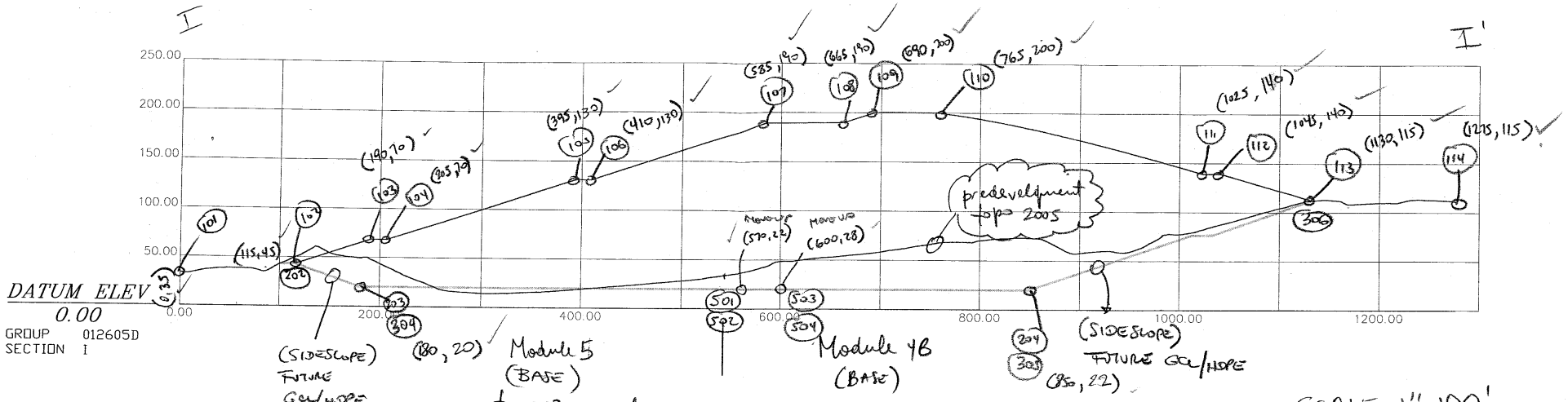
since pts. are lower than modelled; initially, left as-is.

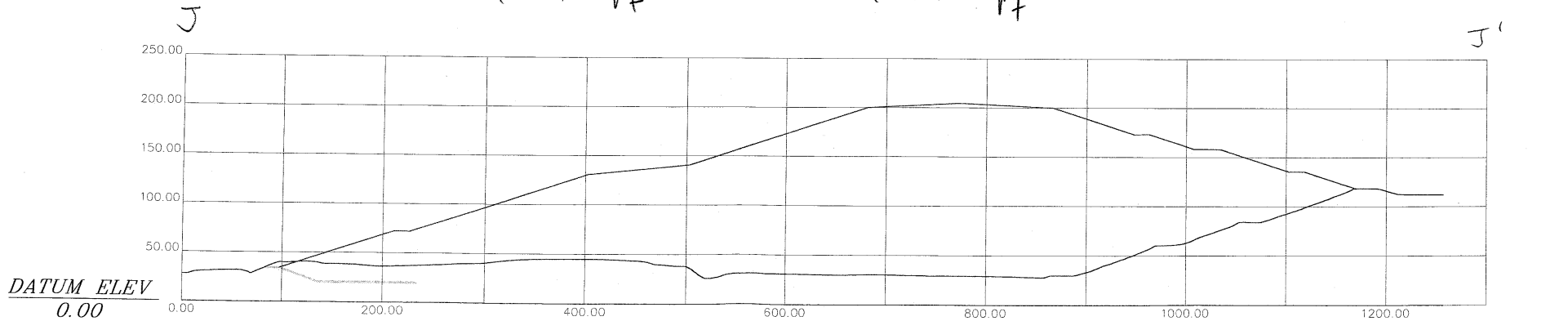
SECTION M-M'

Scale 1" = 100'

Figure 4

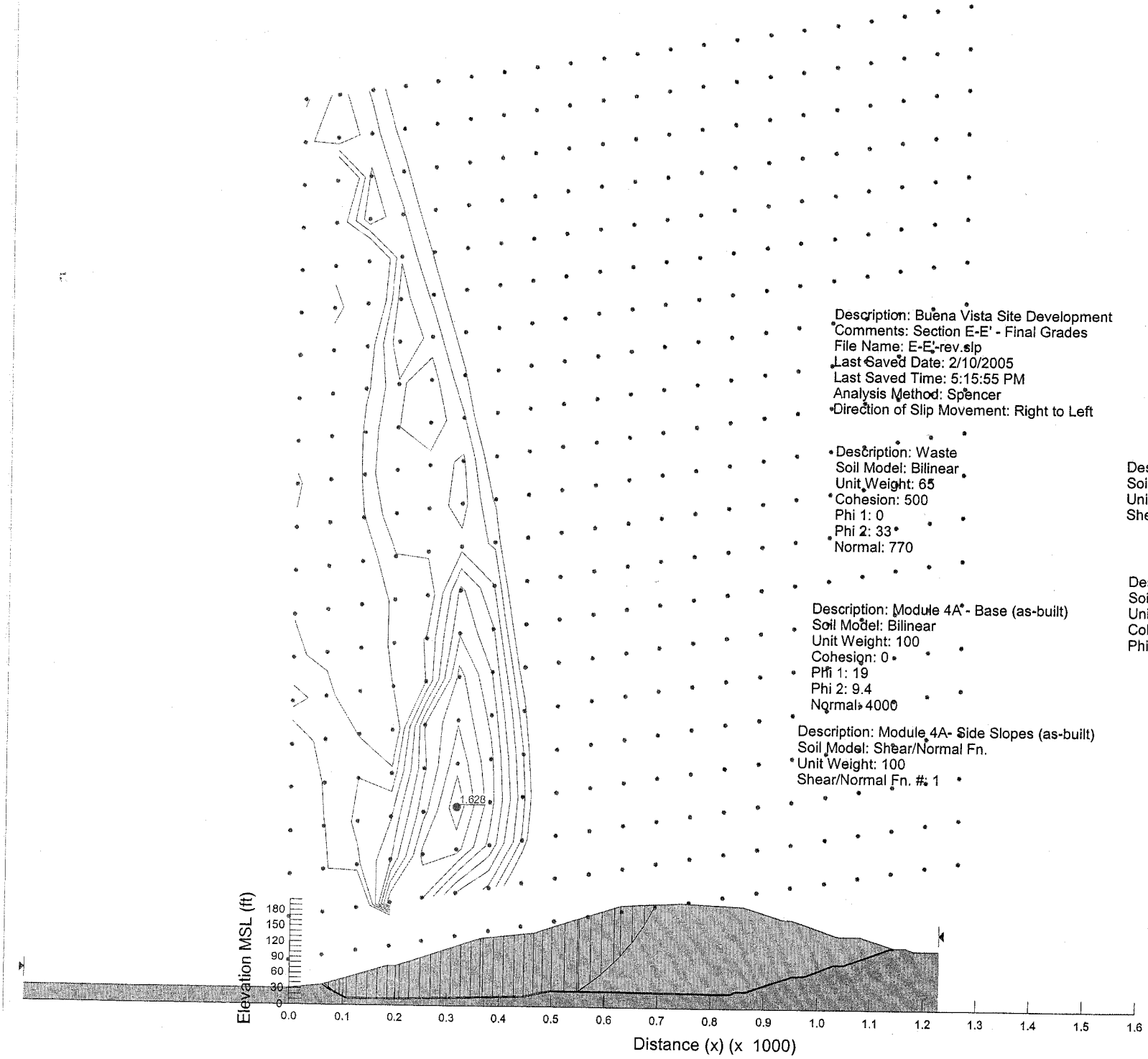
SECTION I-I'





BY INSPECTION J-J' SIMILAR TO E-E' SO MODELED E-E', ALSO, AT TOE, MODULE 5 LINER SYSTEM

FIGURE 5


Description: Buena Vista Site Development
Comments: Section E-E' - Final Grades
File Name: E-E'-rev.slp
Last Saved Date: 2/10/2005
Last Saved Time: 5:15:55 PM
Analysis Method: Spencer
Direction of Slip Movement: Right to Left
Description: Waste
Soil Model: Bilinear
Unit Weight: 65
Cohesion: 500
Phi 1: 0
Phi 2: 33
Normal: 770
Description: Module 4A - Base (as-built)
Soil Model: Bilinear
Unit Weight: 100
Cohesion: 0
Phi 1: 19
Phi 2: 9.4
Normal: 4000
Description: Module 4A- Side Slopes (as-built)
Soil Model: Shear/Normal Fn.
Unit Weight: 100
Shear/Normal Fn. #: 1
Description: Module 6 - Base Clay/HDPE (retest)
Soil Model: Shear/Normal Fn.
Unit Weight: 100
Shear/Normal Fn. #: 2
Description: Module 6 - Side Slopes HDPE/subgr
Soil Model: Mohr-Coulomb
Unit Weight: 100
Cohesion: 0
Phi: 17
Description: Bedrock
Soil Model: Bedrock
1.628
Elevation MSL (ft)
180
150
120
90
60
30
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
Distance (x) (x 1000)

```
FILEINFO
SLOPEW 4.24
TITLE
Buena Vista Site Development
Section E-E' - Final Grades
2/10/2005
5:15:55 PM
ANALYSIS
    2     0     1 +6.2400e+001     1     0
CONVERGE
   30 +1.0000e-002  1000
SIDE
    1
LAMBDA
+0.0000e+000 +9.9900e+002 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
SOIL            7
    1 +6.5000e+001 +5.0000e+002 +0.0000e+000 +3.3000e+001 +7.7000e+002
+0.0000e+000    5  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Waste
    2 +1.0000e+002 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000    9  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    1
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 4A- Side Slopes (as-built)
    3 +1.0000e+002 +0.0000e+000 +1.9000e+001 +9.4000e+000 +4.0000e+003
+0.0000e+000    5  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 4A - Base (as-built)
    4 +1.0000e+002 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000    9  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    2
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 6 - Base Clay/HDPE (retest)
    5 +1.0000e+002 +0.0000e+000 +1.7000e+001 +0.0000e+000 +0.0000e+000
+0.0000e+000    1  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 6 - Side Slopes HDPE/subgrade
```



```
    6 -1.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000    4  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Bedrock
    7 -1.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000    4  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Bedrock (2)
 SFUNCTION       2
    1     5 +0.0000e+000 +3.0000e+000
 Module 4A-CQA - GCL/HDPE
 +0.0000e+000 +0.0000e+000
 +1.0000e+003 +4.2800e+002
 +2.5000e+003 +8.4300e+002
 +5.0000e+003 +1.3620e+003
 +1.0000e+004 +2.2760e+003
    2     6 +0.0000e+000 +3.0000e+000
 Module 6 - Base (retest)
 +0.0000e+000 +0.0000e+000
 +2.0000e+003 +4.9700e+002
 +4.0000e+003 +7.8600e+002
 +6.0000e+003 +1.1670e+003
 +1.0000e+004 +1.8250e+003
 +1.5000e+004 +1.8250e+003
 AFUNCTION       0
 POINT         502
    1 +1.2639e+003 +2.8109e+002
    2 +1.4495e+003 +1.0818e+003
    3 -2.2568e+000 +1.7274e+003
    4 +2.2240e+001 -3.9221e+001
    5 +1.2376e+003 -5.4557e+001
    6 +1.2550e+003 +2.0995e+002
    7 +1.8743e+001 +5.5765e+000
    8 -2.2568e+000 +8.3880e+001
  100 -5.0000e+002 +3.0000e+001
  101 +0.0000e+000 +3.0000e+001
  102 +6.2000e+001 +3.7000e+001
  103 +1.8500e+002 +7.5000e+001
  104 +2.0100e+002 +7.5000e+001
  105 +3.6400e+002 +1.2900e+002
  106 +4.6600e+002 +1.4000e+002
  107 +6.1700e+002 +1.9000e+002
  108 +7.4400e+002 +2.0000e+002
  109 +8.7300e+002 +1.9000e+002
  110 +9.3400e+002 +1.7000e+002
  111 +9.4900e+002 +1.7000e+002
  112 +1.0380e+003 +1.3900e+002
  113 +1.0800e+003 +1.3900e+002
  114 +1.1440e+003 +1.1800e+002
```

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   116 +1.1820e+003 +1.1200e+002
   117 +1.2300e+003 +1.1200e+002
   203 +7.4000e+001 +3.0000e+001
   204 +9.4000e+001 +2.0000e+001
   205 +1.0700e+002 +1.4000e+001
   206 +2.0900e+002 +1.4000e+001
   207 +2.8800e+002 +1.6000e+001
   208 +3.6900e+002 +1.8000e+001
   209 +4.4800e+002 +2.0000e+001
   210 +4.8200e+002 +2.7000e+001
   211 +5.0000e+002 +3.0000e+001
   212 +5.9400e+002 +3.0000e+001
   213 +8.3700e+002 +2.8000e+001
   214 +8.4900e+002 +3.3000e+001
   215 +8.6500e+002 +3.2000e+001
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   217 +9.7500e+002 +6.4000e+001
   218 +1.0310e+003 +8.6000e+001
   219 +1.0500e+003 +8.6000e+001
   220 +1.1380e+003 +1.1800e+002
   303 +6.2500e+001 +3.5000e+001
   304 +7.4000e+001 +2.8000e+001
   305 +9.4000e+001 +1.8000e+001
   306 +1.0750e+002 +1.2000e+001
   307 +2.0900e+002 +1.2000e+001
   308 +2.8800e+002 +1.4000e+001
   309 +3.6900e+002 +1.6000e+001
   310 +4.4800e+002 +1.8000e+001
   311 +4.8250e+002 +2.5000e+001
   312 +5.0000e+002 +2.8000e+001
   313 +5.9400e+002 +2.8000e+001
   314 +8.3700e+002 +2.6000e+001
   315 +8.4950e+002 +3.1000e+001
   316 +8.6500e+002 +3.0000e+001
   317 +9.5300e+002 +6.1000e+001
   318 +9.7500e+002 +6.2000e+001
   319 +1.0310e+003 +8.4000e+001
   320 +1.0500e+003 +8.4000e+001
   321 +1.1380e+003 +1.1600e+002
   322 +1.1435e+003 +1.1600e+002
   401 -5.0000e+002 +0.0000e+000
   402 +1.2300e+003 +0.0000e+000
   501 +6.2900e+002 +1.9400e+002
   502 +8.6100e+002 +1.9400e+002
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   101
   102
   103
   104
   105
   106
   107
   501
   108
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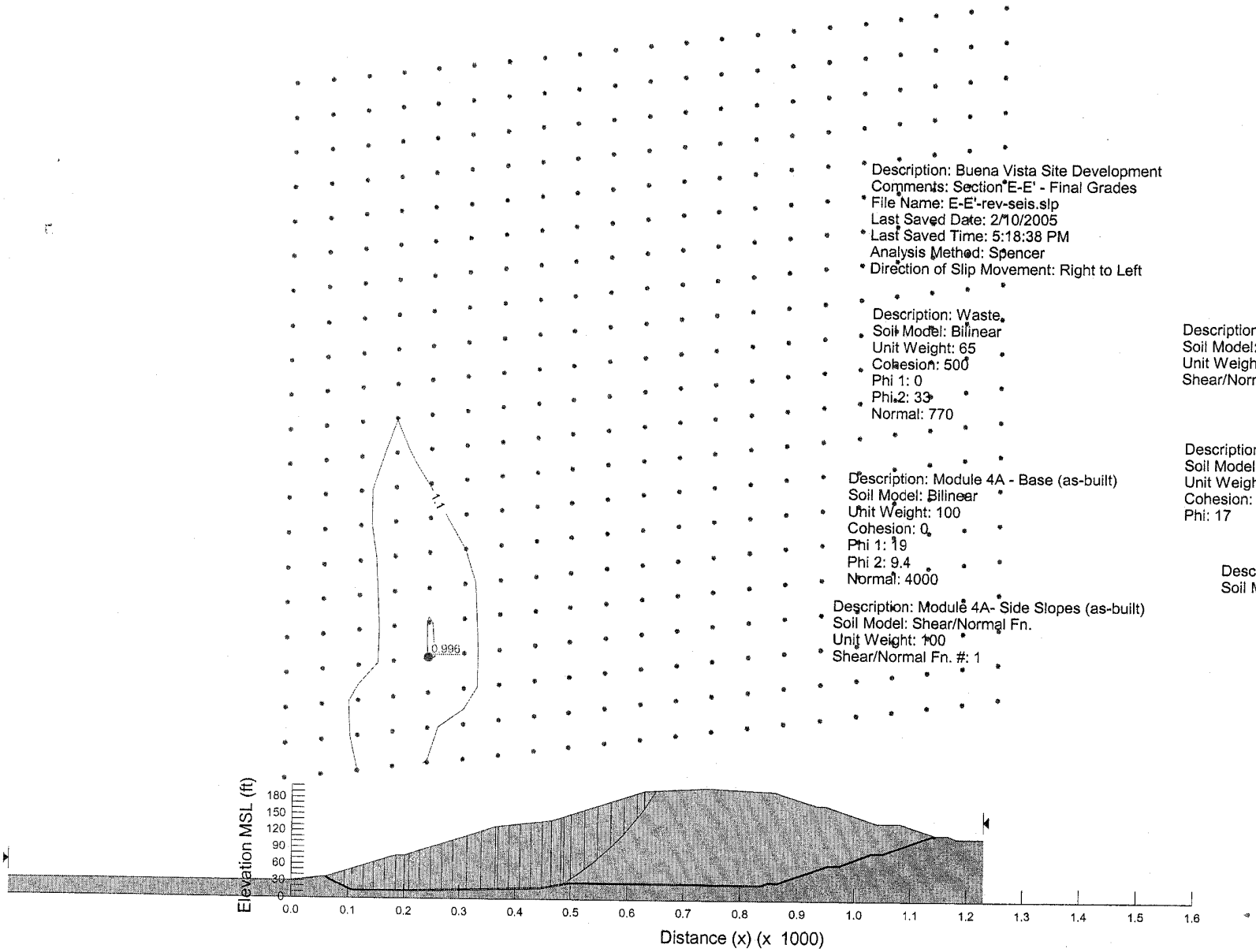
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   110
   111
   112
   113
   114
   115
   116
   117
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   100
   101
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   205
   206
   207
   208
   209
   210
   211
   212
   213
   214
   215
   216
   217
   218
   219
   220
   114
   115
   116
   117
     3    27
   100
   101
   102
   203
   204
   205
   206
   207
   208
   209
   210
   211
   212
   213
   214
   315
   316
   317
   318
   319
```

```
320
321
322
114
115
116
117
  4    27
100
101
102
203
204
205
206
207
208
209
210
311
312
313
314
315
316
317
318
319
320
321
322
114
115
116
117
  5    27
100
101
102
203
204
205
306
307
308
309
310
311
312
313
314
315
316
317
318
319
320
```



```
321
322
114
115
116
117
  6    27
100
101
102
303
304
305
306
307
308
309
310
311
312
313
314
315
316
317
318
319
320
321
322
114
115
116
117
  7     2
401
402
TENSION
    0 +9.8070e+000 +0.0000e+000 +0.0000e+000      0
GRID
    8     1     3    20    20 0 +0.0000e+000 0 +0.0000e+000
RADIUS
    5     4     6     7    10     7     6
AXIS
    0
LIMIT
0 -5.0000e+002 +1.2300e+003
SLIP           0
BLOCK
    0     0     0     0     0 +1.3500e+002 +1.3500e+002 0 0
    0     0     0     0     0 +4.5000e+001 +4.5000e+001 0 0
PORU           7 +0.0000e+000
    1 +0.0000e+000     0
    2 +0.0000e+000     0
    3 +0.0000e+000     0
    4 +0.0000e+000     0
    5 +0.0000e+000     0
```

```
     6 +0.0000e+000      0
     7 +0.0000e+000      0
 PIEZ            7 +0.0000e+000
     1      0      0
     2      0      0
     3      0      0
     4      0      0
     5      0      0
     6      0      0
     7      0      0
 PCON            0 +0.0000e+000
 POGH            0 +0.0000e+000
 POGP            0 +0.0000e+000
 POGR            0 +0.0000e+000
 PORA            7
     1 +0.0000e+000
     2 +0.0000e+000
     3 +0.0000e+000
     4 +0.0000e+000
     5 +0.0000e+000
     6 +0.0000e+000
     7 +0.0000e+000
 LOAD            0
 ANCHOR          0
 PBOUNDARY       0
 SEISMIC
 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
 NODE            0
 ELEMENT         0
 MATLCOLOR       7
     1   128   255   128
     2    64     0   128
     3   255     0     0
     4   128   255   255
     5   255   128    64
     6   255   128   128
     7   255     0   255
```


Description: Buena Vista Site Development
Comments: Section E-E' - Final Grades
File Name: E-E'-rev-seis.slp
Last Saved Date: 2/10/2005
Last Saved Time: 5:18:38 PM
Analysis Method: Spencer
Direction of Slip Movement: Right to Left
ky = 0.12 g
Description: Waste
Soil Model: Bilinear
Unit Weight: 65
Cohesion: 500
Phi 1: 0
Phi 2: 33
Normal: 770
Description: Module 6 - Base Clay/HDPE (retest)
Soil Model: Shear/Normal Fn.
Unit Weight: 100
Shear/Normal Fn. #: 2
Description: Module 6 - Side Slopes HDPE/subgrade
Soil Model: Mohr-Coulomb
Unit Weight: 100
Cohesion: 0
Phi: 17
Description: Module 4A - Base (as-built)
Soil Model: Bilinear
Unit Weight: 100
Cohesion: 0
Phi 1: 19
Phi 2: 9.4
Normal: 4000
Description: Bedrock
Soil Model: Bedrock
Description: Module 4A- Side Slopes (as-built)
Soil Model: Shear/Normal Fn.
Unit Weight: 100
Shear/Normal Fn. #: 1
1:1
0.996
Elevation MSL (ft)
180
150
120
90
60
30
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
Distance (x) (x 1000)

```
FILEINFO
SLOPEW 4.24
TITLE
Buena Vista Site Development
Section E-E' - Final Grades
2/10/2005
5:18:38 PM
ANALYSIS
    2     0     1 +6.2400e+001     1     0
CONVERGE
   30 +1.0000e-002  1000
SIDE
    1
LAMBDA
+0.0000e+000 +9.9900e+002 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
SOIL          7
    1 +6.5000e+001 +5.0000e+002 +0.0000e+000 +3.3000e+001 +7.7000e+002
+0.0000e+000   5  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Waste
    2 +1.0000e+002 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000   9  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    1
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 4A- Side Slopes (as-built)
    3 +1.0000e+002 +0.0000e+000 +1.9000e+001 +9.4000e+000 +4.0000e+003
+0.0000e+000   5  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 4A - Base (as-built)
    4 +1.0000e+002 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000   9  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    2
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 6 - Base Clay/HDPE (retest)
    5 +1.0000e+002 +0.0000e+000 +1.7000e+001 +0.0000e+000 +0.0000e+000
+0.0000e+000   1  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 6 - Side Slopes HDPE/subgrade
```



```
    6 -1.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000   4  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Bedrock
    7 -1.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000   4  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Bedrock (2)
 SFUNCTION      2
    1     5 +0.0000e+000 +3.0000e+000
 Module 4A-CQA - GCL/HDPE
 +0.0000e+000 +0.0000e+000
 +1.0000e+003 +4.2800e+002
 +2.5000e+003 +8.4300e+002
 +5.0000e+003 +1.3620e+003
 +1.0000e+004 +2.2760e+003
    2     6 +0.0000e+000 +3.0000e+000
 Module 6 - Base (retest)
 +0.0000e+000 +0.0000e+000
 +2.0000e+003 +4.9700e+002
 +4.0000e+003 +7.8600e+002
 +6.0000e+003 +1.1670e+003
 +1.0000e+004 +1.8250e+003
 +1.5000e+004 +1.8250e+003
 AFUNCTION      0
 POINT        502
    1 +1.2526e+003 +3.6363e+002
    2 +1.4495e+003 +1.0818e+003
    3 -1.3535e+001 +1.4696e+003
    4 +2.2240e+001 -3.9221e+001
    5 +1.2376e+003 -5.4557e+001
    6 +1.2550e+003 +2.0995e+002
    7 +1.8743e+001 +5.5765e+000
    8 -1.3535e+001 +2.1285e+002
  100 -5.0000e+002 +3.0000e+001
  101 +0.0000e+000 +3.0000e+001
  102 +6.2000e+001 +3.7000e+001
  103 +1.8500e+002 +7.5000e+001
  104 +2.0100e+002 +7.5000e+001
  105 +3.6400e+002 +1.2900e+002
  106 +4.6600e+002 +1.4000e+002
  107 +6.1700e+002 +1.9000e+002
  108 +7.4400e+002 +2.0000e+002
  109 +8.7300e+002 +1.9000e+002
  110 +9.3400e+002 +1.7000e+002
  111 +9.4900e+002 +1.7000e+002
  112 +1.0380e+003 +1.3900e+002
  113 +1.0800e+003 +1.3900e+002
  114 +1.1440e+003 +1.1800e+002
```

```
   115 +1.1660e+003 +1.1800e+002
   116 +1.1820e+003 +1.1200e+002
   117 +1.2300e+003 +1.1200e+002
   203 +7.4000e+001 +3.0000e+001
   204 +9.4000e+001 +2.0000e+001
   205 +1.0700e+002 +1.4000e+001
   206 +2.0900e+002 +1.4000e+001
   207 +2.8800e+002 +1.6000e+001
   208 +3.6900e+002 +1.8000e+001
   209 +4.4800e+002 +2.0000e+001
   210 +4.8200e+002 +2.7000e+001
   211 +5.0000e+002 +3.0000e+001
   212 +5.9400e+002 +3.0000e+001
   213 +8.3700e+002 +2.8000e+001
   214 +8.4900e+002 +3.3000e+001
   215 +8.6500e+002 +3.2000e+001
   216 +9.5300e+002 +6.3000e+001
   217 +9.7500e+002 +6.4000e+001
   218 +1.0310e+003 +8.6000e+001
   219 +1.0500e+003 +8.6000e+001
   220 +1.1380e+003 +1.1800e+002
   303 +5.8000e+001 +3.6500e+001
   304 +7.4000e+001 +2.8000e+001
   305 +9.4000e+001 +1.8000e+001
   306 +1.0750e+002 +1.2000e+001
   307 +2.0900e+002 +1.2000e+001
   308 +2.8800e+002 +1.4000e+001
   309 +3.6900e+002 +1.6000e+001
   310 +4.4800e+002 +1.8000e+001
   311 +4.8250e+002 +2.5000e+001
   312 +5.0000e+002 +2.8000e+001
   313 +5.9400e+002 +2.8000e+001
   314 +8.3700e+002 +2.6000e+001
   315 +8.4950e+002 +3.1000e+001
   316 +8.6500e+002 +3.0000e+001
   317 +9.5300e+002 +6.1000e+001
   318 +9.7500e+002 +6.2000e+001
   319 +1.0310e+003 +8.4000e+001
   320 +1.0500e+003 +8.4000e+001
   321 +1.1380e+003 +1.1600e+002
   322 +1.1435e+003 +1.1600e+002
   401 -5.0000e+002 +0.0000e+000
   402 +1.2300e+003 +0.0000e+000
   501 +6.2900e+002 +1.9400e+002
   502 +8.6100e+002 +1.9400e+002
LINE           7
     1    21
   100
   101
   303
   102
   103
   104
   105
   106
   107
   501
```



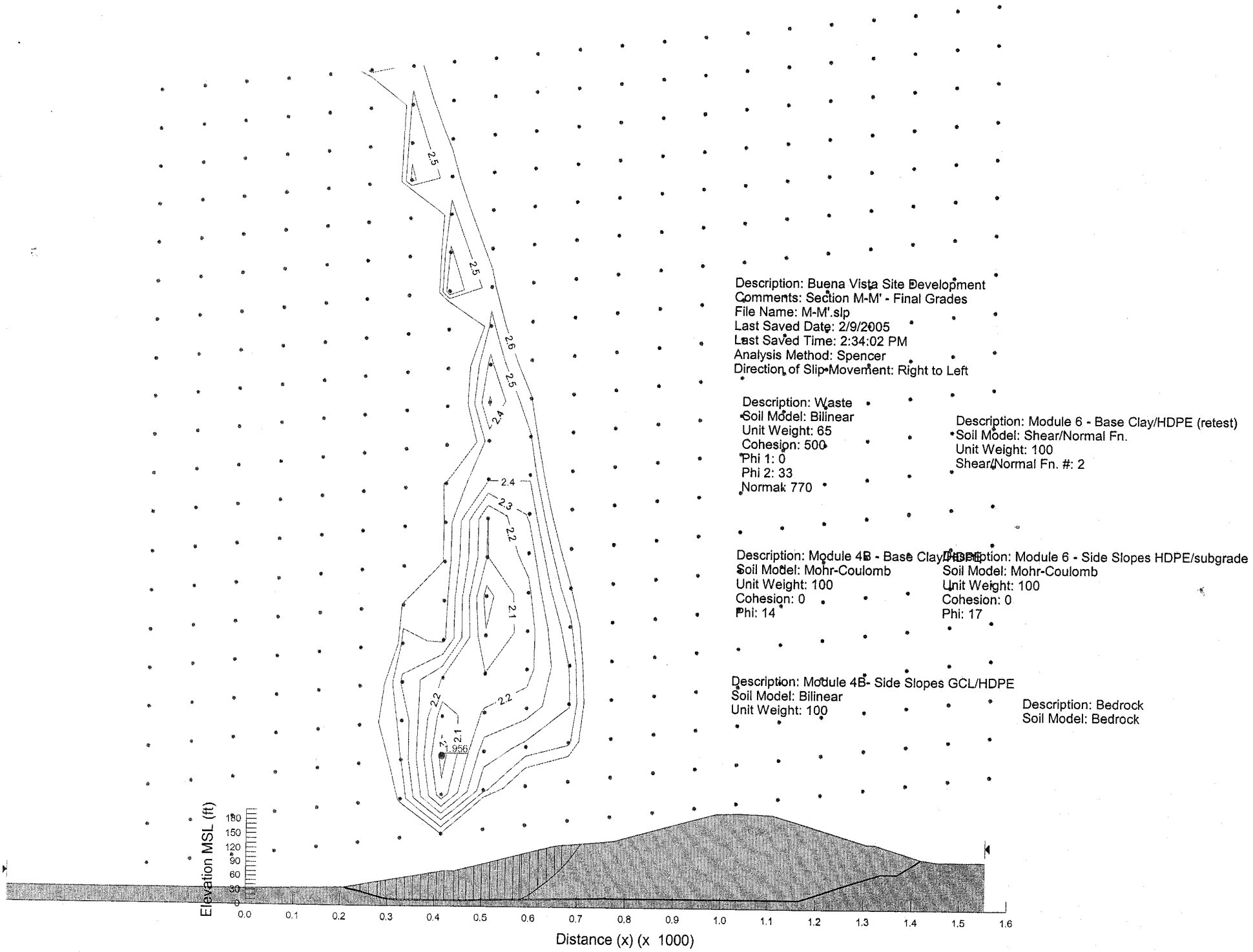
```
   108
   502
   109
   110
   111
   112
   113
   114
   115
   116
   117
     2    26
   100
   101
   303
   102
   203
   204
   205
   206
   207
   208
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   210
   211
   212
   213
   214
   215
   216
   217
   218
   219
   220
   114
   115
   116
   117
     3    28
   100
   101
   303
   102
   203
   204
   205
   206
   207
   208
   209
   210
   211
   212
   213
   214
   315
   316
```

```
317
318
319
320
321
322
114
115
116
117
  4    28
100
101
303
102
203
204
205
206
207
208
209
210
311
312
313
314
315
316
317
318
319
320
321
322
114
115
116
117
  5    28
100
101
303
102
203
204
205
306
307
308
309
310
311
312
313
314
315
```



```
316
317
318
319
320
321
322
114
115
116
117
  6    26
100
101
303
304
305
306
307
308
309
310
311
312
313
314
315
316
317
318
319
320
321
322
114
115
116
117
  7     2
401
402
TENSION
    0 +9.8070e+000 +0.0000e+000 +0.0000e+000      0
GRID
    8     1     3    20    20 0 +0.0000e+000 0 +0.0000e+000
RADIUS
    5     4     6     7    10     7     6
AXIS
    0
LIMIT
0 -5.0000e+002 +1.2300e+003
SLIP            0
BLOCK
    0     0     0     0     0 +1.3500e+002 +1.3500e+002 0 0
    0     0     0     0     0 +4.5000e+001 +4.5000e+001 0 0
PORU            7 +0.0000e+000
    1 +0.0000e+000      0
```

```
     2 +0.0000e+000      0
     3 +0.0000e+000      0
     4 +0.0000e+000      0
     5 +0.0000e+000      0
     6 +0.0000e+000      0
     7 +0.0000e+000      0
 PIEZ             7 +0.0000e+000
     1      0      0
     2      0      0
     3      0      0
     4      0      0
     5      0      0
     6      0      0
     7      0      0
 PCON             0 +0.0000e+000
 POGH             0 +0.0000e+000
 POGP             0 +0.0000e+000
 POGR             0 +0.0000e+000
 PORA             7
     1 +0.0000e+000
     2 +0.0000e+000
     3 +0.0000e+000
     4 +0.0000e+000
     5 +0.0000e+000
     6 +0.0000e+000
     7 +0.0000e+000
 LOAD             0
 ANCHOR           0
 PBOUNDARY        0
 SEISMIC
+1.2000e-001 +0.0000e+000 +0.0000e+000 +0.0000e+000
 NODE             0
 ELEMENT          0
 MATLCOLOR        7
     1   128   255   128
     2    64     0   128
     3   255     0     0
     4   128   255   255
     5   255   128    64
     6   255   128   128
     7   255     0   255
```


Description: Buena Vista Site Development
Comments: Section M-M' - Final Grades
File Name: M-M'.slp
Last Saved Date: 2/9/2005
Last Saved Time: 2:34:02 PM
Analysis Method: Spencer
Direction of Slip Movement: Right to Left
Description: Waste
Soil Model: Bilinear
Unit Weight: 65
Cohesion: 500
Phi 1: 0
Phi 2: 33
Normak 770
Description: Module 6 - Base Clay/HDPE (retest)
Soil Model: Shear/Normal Fn.
Unit Weight: 100
Shear/Normal Fn. #: 2
Description: Module 4B - Base Clay/HDPE
Soil Model: Mohr-Coulomb
Unit Weight: 100
Cohesion: 0
Phi: 14
Description: Module 6 - Side Slopes HDPE/subgrade
Soil Model: Mohr-Coulomb
Unit Weight: 100
Cohesion: 0
Phi: 17
Description: Module 4B - Side Slopes GCL/HDPE
Soil Model: Bilinear
Unit Weight: 100
Description: Bedrock
Soil Model: Bedrock
2.5
2.5
2.6
2.5
2.4
2.4
2.3
2.2
2.1
2.2
2.2
2.1
1.956
Elevation MSL (ft)
180
150
120
90
60
30
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
Distance (x) (x 1000)

```
FILEINFO
SLOPEW 4.24
TITLE
Buena Vista Site Development
Section M-M' - Final Grades
2/9/2005
2:34:02 PM
ANALYSIS
     2      0      1 +6.2400e+001      1      0
CONVERGE
    30 +1.0000e-002  1000
SIDE
     1
LAMBDA
+0.0000e+000 +9.9900e+002 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
SOIL            7
     1 +6.5000e+001 +5.0000e+002 +0.0000e+000 +3.3000e+001 +7.7000e+002
+0.0000e+000    5   0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Waste
     2 +1.0000e+002 +0.0000e+000 +2.0000e+001 +2.3000e+000 +2.5000e+003
+0.0000e+000    5   0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 4B- Side Slopes GCL/HDPE
     3 +1.0000e+002 +0.0000e+000 +1.4000e+001 +0.0000e+000 +0.0000e+000
+0.0000e+000    1   0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 4B - Base Clay/HDPE
     4 +1.0000e+002 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000    9   0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    2
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 6 - Base Clay/HDPE (retest)
     5 +1.0000e+002 +0.0000e+000 +1.7000e+001 +0.0000e+000 +0.0000e+000
+0.0000e+000    1   0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 6 - Side Slopes HDPE/subgrade
```



```
     6 -1.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000    4   0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Bedrock
     7 -1.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000    4   0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Bedrock (2)
 SFUNCTION       2
     1      5 +0.0000e+000 +3.0000e+000
 Module 4A-CQA - GCL/HDPE
 +0.0000e+000 +0.0000e+000
 +1.0000e+003 +4.2800e+002
 +2.5000e+003 +8.4300e+002
 +5.0000e+003 +1.3620e+003
 +1.0000e+004 +2.2760e+003
     2      6 +0.0000e+000 +3.0000e+000
 Module 6 - Base (retest)
 +0.0000e+000 +0.0000e+000
 +2.0000e+003 +4.9700e+002
 +4.0000e+003 +7.8600e+002
 +6.0000e+003 +1.1670e+003
 +1.0000e+004 +1.8250e+003
 +1.5000e+004 +1.8250e+003
 AFUNCTION       0
 POINT         402
     1 +1.5621e+003 +2.8109e+002
     2 +1.4495e+003 +1.0818e+003
     3 -2.0537e+002 +1.7274e+003
     4 -1.7304e+002 -3.1437e+001
     5 +1.5269e+003 -2.4692e+001
     6 +1.5081e+003 +2.9075e+002
     7 -1.7304e+002 -6.9087e+000
     8 -2.0537e+002 +8.3880e+001
   100 -5.0000e+002 +3.3000e+001
   101 +0.0000e+000 +3.3000e+001
   102 +2.0950e+002 +3.7000e+001
   103 +4.2200e+002 +7.5000e+001
   104 +4.4200e+002 +7.5000e+001
   105 +6.5300e+002 +1.3000e+002
   106 +7.7500e+002 +1.4100e+002
   107 +9.8900e+002 +2.0000e+002
   108 +1.0350e+003 +2.0200e+002
   109 +1.1090e+003 +1.9900e+002
   110 +1.3060e+003 +1.3800e+002
   111 +1.3220e+003 +1.3800e+002
   112 +1.4200e+003 +1.0700e+002
   113 +1.4540e+003 +1.0200e+002
   114 +1.5550e+003 +1.0200e+002
```

```
   203 +2.4300e+002 +3.0000e+001
   204 +2.8000e+002 +2.0000e+001
   205 +2.8700e+002 +1.8000e+001
   206 +2.9600e+002 +1.6000e+001
   207 +3.2000e+002 +1.4000e+001
   208 +4.5200e+002 +1.4000e+001
   209 +5.6700e+002 +1.6000e+001
   210 +6.6800e+002 +1.8000e+001
   211 +7.4700e+002 +2.0000e+001
   212 +7.5800e+002 +2.1000e+001
   213 +7.6200e+002 +2.0000e+001
   214 +1.1670e+003 +2.0000e+001
   215 +1.3370e+003 +7.6000e+001
   216 +1.3700e+003 +7.6000e+001
   303 +2.1000e+002 +3.5000e+001
   304 +2.4300e+002 +2.8000e+001
   305 +2.8000e+002 +1.8000e+001
   306 +2.8700e+002 +1.6000e+001
   307 +2.9650e+002 +1.4000e+001
   308 +3.2000e+002 +1.2000e+001
   309 +4.5200e+002 +1.2000e+001
   310 +5.6700e+002 +1.4000e+001
   311 +6.6800e+002 +1.6000e+001
   312 +7.4700e+002 +1.8000e+001
   313 +7.5850e+002 +1.9000e+001
   314 +7.6200e+002 +1.8000e+001
   315 +1.1675e+003 +1.8000e+001
   316 +1.3370e+003 +7.4000e+001
   317 +1.3700e+003 +7.4000e+001
   318 +1.4195e+003 +1.0500e+002
   401 -5.0000e+002 +0.0000e+000
   402 +1.5550e+003 +0.0000e+000
LINE           7
     1    15
   100
   101
   102
   103
   104
   105
   106
   107
   108
   109
   110
   111
   112
   113
   114
     2    20
   100
   101
   102
   203
   204
   205
   206
```

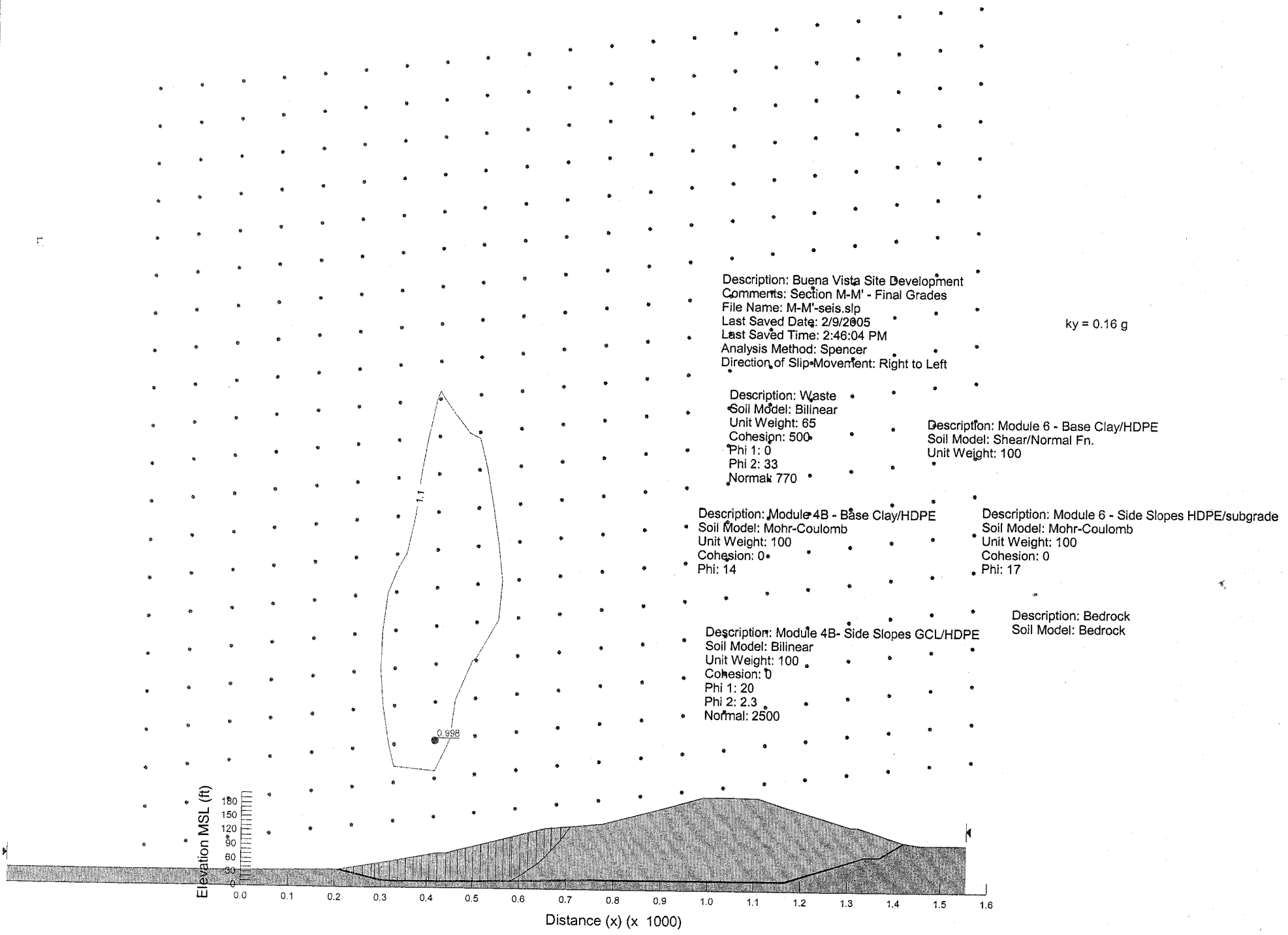


```
   207
   208
   209
   210
   211
   212
   213
   214
   215
   216
   112
   113
   114
     3    22
   100
   101
   102
   203
   204
   205
   206
   207
   208
   209
   210
   211
   212
   213
   214
   315
   316
   317
   318
   112
   113
   114
     4    22
   100
   101
   102
   203
   204
   205
   206
   207
   208
   209
   210
   211
   212
   313
   314
   315
   316
   317
   318
   112
```

```
 113
 114
   5     22
 100
 101
 102
 203
 204
 205
 206
 307
 308
 309
 310
 311
 312
 313
 314
 315
 316
 317
 318
 112
 113
 114
   6     22
 100
 101
 102
 303
 304
 305
 306
 307
 308
 309
 310
 311
 312
 313
 314
 315
 316
 317
 318
 112
 113
 114
   7      2
 401
 402
TENSION
    0 +9.8070e+000 +0.0000e+000 +0.0000e+000      0
GRID
    8      1      3     20     20 0 +0.0000e+000 0 +0.0000e+000
RADIUS
    5      4      6      7     10      7      5
```



```
AXIS
    0
LIMIT
0 -5.0000e+002 +1.5550e+003
SLIP            0
BLOCK
    0      0      0      0      0 +1.3500e+002 +1.3500e+002 0 0
    0      0      0      0      0 +4.5000e+001 +4.5000e+001 0 0
PORU            7 +0.0000e+000
    1 +0.0000e+000      0
    2 +0.0000e+000      0
    3 +0.0000e+000      0
    4 +0.0000e+000      0
    5 +0.0000e+000      0
    6 +0.0000e+000      0
    7 +0.0000e+000      0
PIEZ            7 +0.0000e+000
    1      0      0
    2      0      0
    3      0      0
    4      0      0
    5      0      0
    6      0      0
    7      0      0
PCON            0 +0.0000e+000
POGH            0 +0.0000e+000
POGP            0 +0.0000e+000
POGR            0 +0.0000e+000
PORA            7
    1 +0.0000e+000
    2 +0.0000e+000
    3 +0.0000e+000
    4 +0.0000e+000
    5 +0.0000e+000
    6 +0.0000e+000
    7 +0.0000e+000
LOAD            0
ANCHOR          0
PBOUNDARY       0
SEISMIC
+0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
NODE            0
ELEMENT         0
MATLCOLOR       7
    1   128   255   128
    2    64     0   128
    3   255     0     0
    4   128   255   255
    5   255   128    64
    6   255   128   128
    7   255     0   255
```


Description: Buena Vista Site Development
Comments: Section M-M' - Final Grades
File Name: M-M'-seis.slp
Last Saved Date: 2/9/2005
Last Saved Time: 2:46:04 PM
Analysis Method: Spencer
Direction of Slip Movement: Right to Left
ky = 0.16 g
Description: Waste
Soil Model: Bilinear
Unit Weight: 65
Cohesion: 500
Phi 1: 0
Phi 2: 33
Normal: 770
Description: Module 6 - Base Clay/HDPE
Soil Model: Shear/Normal Fn.
Unit Weight: 100
Description: Module 4B - Base Clay/HDPE
Soil Model: Mohr-Coulomb
Unit Weight: 100
Cohesion: 0
Phi: 14
Description: Module 6 - Side Slopes HDPE/subgrade
Soil Model: Mohr-Coulomb
Unit Weight: 100
Cohesion: 0
Phi: 17
Description: Module 4B- Side Slopes GCL/HDPE
Soil Model: Bilinear
Unit Weight: 100
Cohesion: 0
Phi 1: 20
Phi 2: 2.3
Normal: 2500
Description: Bedrock
Soil Model: Bedrock
1:1
0.998
Elevation MSL (ft)
180
150
120
90
60
30
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
Distance (x) (x 1000)

```
FILEINFO
SLOPEW 4.24
TITLE
Buena Vista Site Development
Section M-M' - Final Grades
2/9/2005
2:46:04 PM
ANALYSIS
    2     0     1 +6.2400e+001     1     0
CONVERGE
   30 +1.0000e-002  1000
SIDE
    1
LAMBDA
+0.0000e+000 +9.9900e+002 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
SOIL           7
    1 +6.5000e+001 +5.0000e+002 +0.0000e+000 +3.3000e+001 +7.7000e+002
+0.0000e+000    5  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Waste
    2 +1.0000e+002 +0.0000e+000 +2.0000e+001 +2.3000e+000 +2.5000e+003
+0.0000e+000    5  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 4B- Side Slopes GCL/HDPE
    3 +1.0000e+002 +0.0000e+000 +1.4000e+001 +0.0000e+000 +0.0000e+000
+0.0000e+000    1  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 4B - Base Clay/HDPE
    4 +1.0000e+002 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000    9  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    2
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 6 - Base Clay/HDPE
    5 +1.0000e+002 +0.0000e+000 +1.7000e+001 +0.0000e+000 +0.0000e+000
+0.0000e+000    1  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 6 - Side Slopes HDPE/subgrade
```



```
    6 -1.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000    4  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Bedrock
    7 -1.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000    4  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Bedrock (2)
 SFUNCTION      2
    1     5 +0.0000e+000 +3.0000e+000
 Module 4A-CQA - GCL/HDPE
 +0.0000e+000 +0.0000e+000
 +1.0000e+003 +4.2800e+002
 +2.5000e+003 +8.4300e+002
 +5.0000e+003 +1.3620e+003
 +1.0000e+004 +2.2760e+003
    2     6 +0.0000e+000 +3.0000e+000
 Module 6 -Base (retest)
 +0.0000e+000 +0.0000e+000
 +2.0000e+003 +4.9700e+002
 +4.0000e+003 +7.8600e+002
 +6.0000e+003 +1.1670e+003
 +1.0000e+004 +1.8250e+003
 +1.5000e+004 +1.8250e+003
 AFUNCTION      0
 POINT        402
    1 +1.5621e+003 +2.8109e+002
    2 +1.4495e+003 +1.0818e+003
    3 -2.0537e+002 +1.7274e+003
    4 -1.7304e+002 -3.1437e+001
    5 +1.5269e+003 -2.4692e+001
    6 +1.5081e+003 +2.9075e+002
    7 -1.7304e+002 -6.9087e+000
    8 -2.0537e+002 +8.3880e+001
  100 -5.0000e+002 +3.3000e+001
  101 +0.0000e+000 +3.3000e+001
  102 +2.0950e+002 +3.7000e+001
  103 +4.2200e+002 +7.5000e+001
  104 +4.4200e+002 +7.5000e+001
  105 +6.5300e+002 +1.3000e+002
  106 +7.7500e+002 +1.4100e+002
  107 +9.8900e+002 +2.0000e+002
  108 +1.0350e+003 +2.0200e+002
  109 +1.1090e+003 +1.9900e+002
  110 +1.3060e+003 +1.3800e+002
  111 +1.3220e+003 +1.3800e+002
  112 +1.4200e+003 +1.0700e+002
  113 +1.4540e+003 +1.0200e+002
  114 +1.5550e+003 +1.0200e+002
```

```
   203 +2.4300e+002 +3.0000e+001
   204 +2.8000e+002 +2.0000e+001
   205 +2.8700e+002 +1.8000e+001
   206 +2.9600e+002 +1.6000e+001
   207 +3.2000e+002 +1.4000e+001
   208 +4.5200e+002 +1.4000e+001
   209 +5.6700e+002 +1.6000e+001
   210 +6.6800e+002 +1.8000e+001
   211 +7.4700e+002 +2.0000e+001
   212 +7.5800e+002 +2.1000e+001
   213 +7.6200e+002 +2.0000e+001
   214 +1.1670e+003 +2.0000e+001
   215 +1.3370e+003 +7.6000e+001
   216 +1.3700e+003 +7.6000e+001
   303 +2.0200e+002 +3.6500e+001
   304 +2.4300e+002 +2.8000e+001
   305 +2.8000e+002 +1.8000e+001
   306 +2.8700e+002 +1.6000e+001
   307 +2.9650e+002 +1.4000e+001
   308 +3.2000e+002 +1.2000e+001
   309 +4.5200e+002 +1.2000e+001
   310 +5.6700e+002 +1.4000e+001
   311 +6.6800e+002 +1.6000e+001
   312 +7.4700e+002 +1.8000e+001
   313 +7.5850e+002 +1.9000e+001
   314 +7.6200e+002 +1.8000e+001
   315 +1.1675e+003 +1.8000e+001
   316 +1.3370e+003 +7.4000e+001
   317 +1.3700e+003 +7.4000e+001
   318 +1.4195e+003 +1.0500e+002
   401 -5.0000e+002 +0.0000e+000
   402 +1.5550e+003 +0.0000e+000
LINE            7
     1    16
   100
   101
   303
   102
   103
   104
   105
   106
   107
   108
   109
   110
   111
   112
   113
   114
     2    21
   100
   101
   303
   102
   203
   204
```

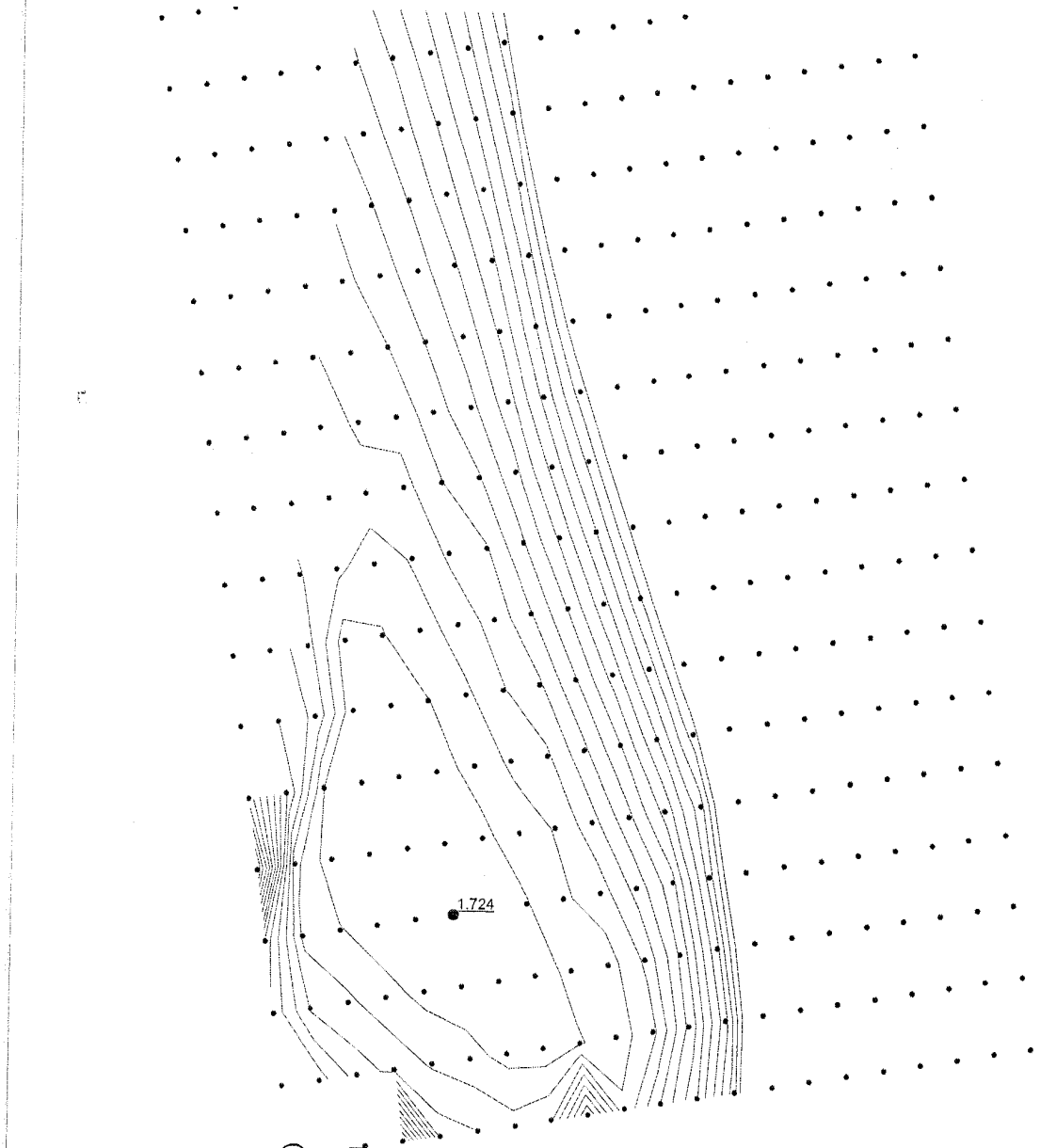


```
   205
   206
   207
   208
   209
   210
   211
   212
   213
   214
   215
   216
   112
   113
   114
     3    23
   100
   101
   303
   102
   203
   204
   205
   206
   207
   208
   209
   210
   211
   212
   213
   214
   315
   316
   317
   318
   112
   113
   114
     4    23
   100
   101
   303
   102
   203
   204
   205
   206
   207
   208
   209
   210
   211
   212
   313
   314
   315
```

```
  316
  317
  318
  112
  113
  114
    5     23
  100
  101
  303
  102
  203
  204
  205
  206
  307
  308
  309
  310
  311
  312
  313
  314
  315
  316
  317
  318
  112
  113
  114
    6     21
  100
  101
  303
  304
  305
  306
  307
  308
  309
  310
  311
  312
  313
  314
  315
  316
  317
  318
  112
  113
  114
    7      2
  401
  402
TENSION
    0 +9.8070e+000 +0.0000e+000 +0.0000e+000      0
```



```
GRID
    8     1     3    20    20 0 +0.0000e+000 0 +0.0000e+000
RADIUS
    5     4     6     7    10     7     5
AXIS
    0
LIMIT
0 -5.0000e+002 +1.5550e+003
SLIP            0
BLOCK
    0     0     0     0     0 +1.3500e+002 +1.3500e+002 0 0
    0     0     0     0     0 +4.5000e+001 +4.5000e+001 0 0
PORU            7 +0.0000e+000
    1 +0.0000e+000      0
    2 +0.0000e+000      0
    3 +0.0000e+000      0
    4 +0.0000e+000      0
    5 +0.0000e+000      0
    6 +0.0000e+000      0
    7 +0.0000e+000      0
PIEZ            7 +0.0000e+000
    1     0     0
    2     0     0
    3     0     0
    4     0     0
    5     0     0
    6     0     0
    7     0     0
PCON            0 +0.0000e+000
POGH            0 +0.0000e+000
POGP            0 +0.0000e+000
POGR            0 +0.0000e+000
PORA            7
    1 +0.0000e+000
    2 +0.0000e+000
    3 +0.0000e+000
    4 +0.0000e+000
    5 +0.0000e+000
    6 +0.0000e+000
    7 +0.0000e+000
LOAD            0
ANCHOR          0
PBOUNDARY       0
SEISMIC
+1.6000e-001 +0.0000e+000 +0.0000e+000 +0.0000e+000
NODE            0
ELEMENT         0
MATLCOLOR       7
    1   128   255   128
    2    64     0   128
    3   255     0     0
    4   128   255   255
    5   255   128    64
    6   255   128   128
    7   255     0   255
```



Description: Buena Vista Site Development
Comments: Section I-I' - Final Grades
File Name: I-I'.slp
Last Saved Date: 3/1/2005
Last Saved Time: 3:46:26 PM
Analysis Method: Spencer
Direction of Slip Movement: Right to Left

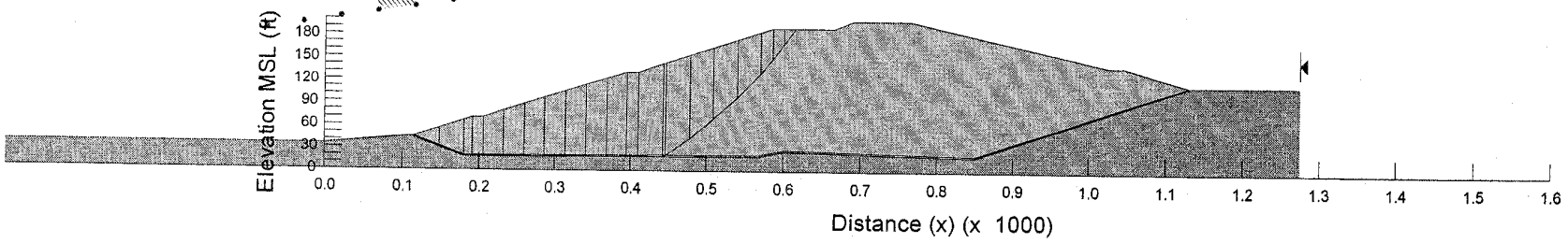
Description: Waste
Soil Model: Bilinear
Unit Weight: 65
Cohesion: 500
Phi 1: 0
Phi 2: 33
Normal: 770

Description: Bedrock
Soil Model: Bedrock

Description: Module 4B&5 - Base Clay/HDPE
Soil Model: Mohr-Coulomb
Unit Weight: 100
Cohesion: 0
Phi: 14

Description: Bedrock (2)
Soil Model: Bedrock

Description: Module 4B&5- Side Slopes GCL/HDPE
Soil Model: Bilinear
Unit Weight: 100
Cohesion: 0
Phi 1: 20
Phi 2: 2.3
Normal: 2500



```
FILEINFO
SLOPEW 4.24
TITLE
Buena Vista Site Development
Section I-I' - Final Grades
3/1/2005
3:46:26 PM
ANALYSIS
    2     0     1 +6.2400e+001     1     0
CONVERGE
   30 +1.0000e-002  1000
SIDE
    1
LAMBDA
+0.0000e+000 +9.9900e+002 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
SOIL          5
    1 +6.5000e+001 +5.0000e+002 +0.0000e+000 +3.3000e+001 +7.7000e+002
+0.0000e+000    5  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Waste
    2 +1.0000e+002 +0.0000e+000 +2.0000e+001 +2.3000e+000 +2.5000e+003
+0.0000e+000    5  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 4B&5- Side Slopes GCL/HDPE
    3 +1.0000e+002 +0.0000e+000 +1.4000e+001 +0.0000e+000 +0.0000e+000
+0.0000e+000    1  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 4B&5 - Base Clay/HDPE
    4 -1.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000    4  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Bedrock
    5 -1.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000    4  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Bedrock (2)
 SFUNCTION       2
```



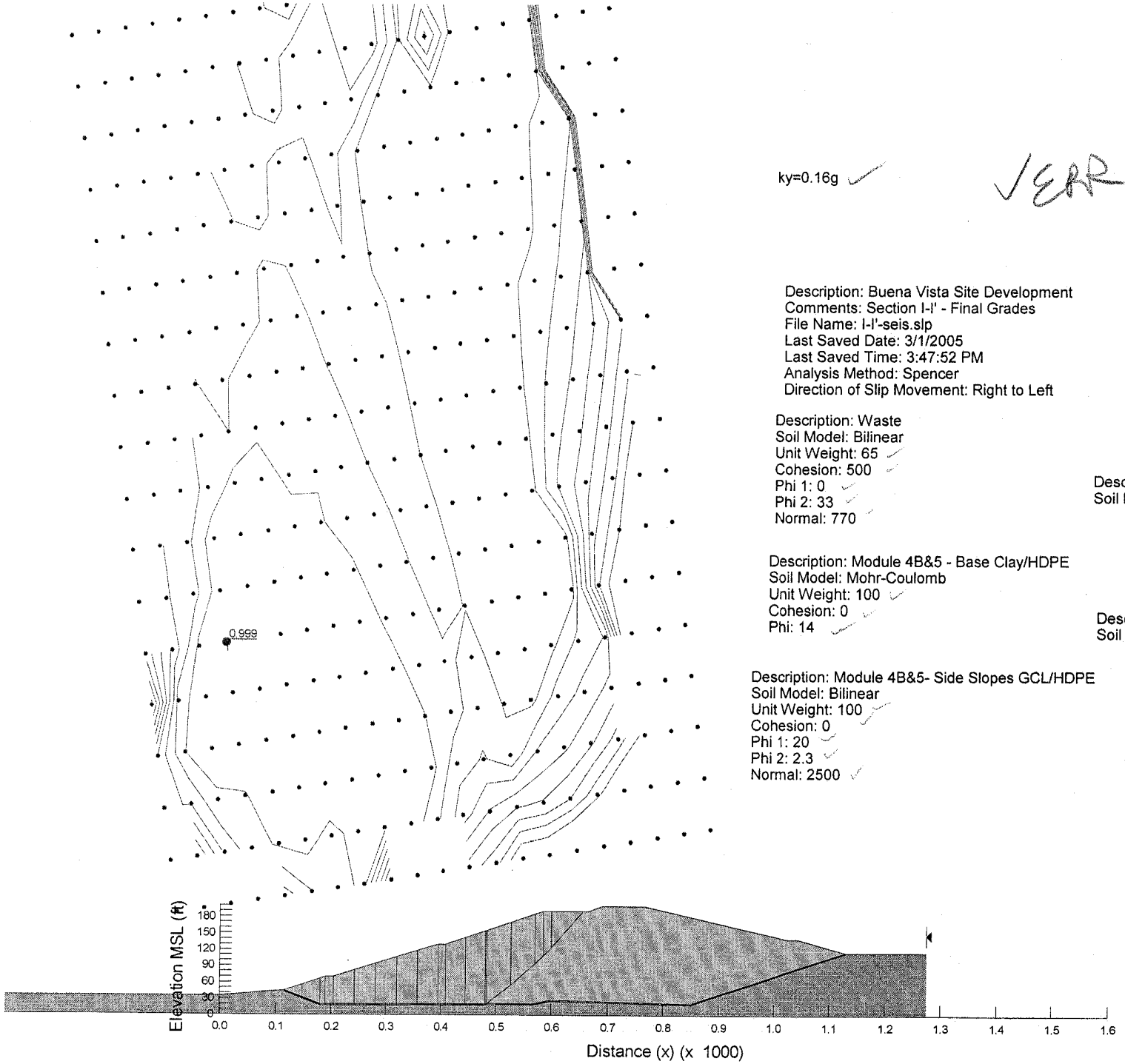
```
    1     5 +0.0000e+000 +3.0000e+000
 Module 4A-CQA - GCL/HDPE
 +0.0000e+000 +0.0000e+000
 +1.0000e+003 +4.2800e+002
 +2.5000e+003 +8.4300e+002
 +5.0000e+003 +1.3620e+003
 +1.0000e+004 +2.2760e+003
    2     6 +0.0000e+000 +3.0000e+000
 Module 6 - Base (retest)
 +0.0000e+000 +0.0000e+000
 +2.0000e+003 +4.9700e+002
 +4.0000e+003 +7.8600e+002
 +6.0000e+003 +1.1670e+003
 +1.0000e+004 +1.8250e+003
 +1.5000e+004 +1.8250e+003
 AFUNCTION       0
 POINT          704
    1 -3.2083e+002 +2.0654e+003
    3 +8.8425e+002 +3.3990e+002
    4 -2.8242e+002 -9.5390e+001
    5 +1.4876e+003 +2.2468e+002
    6 +1.5180e+003 -9.5390e+001
    7 -2.3761e+002 -1.4020e+002
    8 -7.5988e+001 +1.8668e+002
  101 +0.0000e+000 +3.5000e+001
  102 +1.1500e+002 +4.5000e+001
  103 +1.9000e+002 +7.0000e+001
  104 +2.0500e+002 +7.0000e+001
  105 +3.9500e+002 +1.3000e+002
  106 +4.1000e+002 +1.3000e+002
  107 +5.8500e+002 +1.9000e+002
  108 +6.6500e+002 +1.9000e+002
  109 +6.9000e+002 +2.0000e+002
  110 +7.6500e+002 +2.0000e+002
  111 +1.0250e+003 +1.4000e+002
  112 +1.0450e+003 +1.4000e+002
  113 +1.1300e+003 +1.1500e+002
  114 +1.2750e+003 +1.1500e+002
  202 +1.1510e+002 +4.3000e+001
  203 +1.8000e+002 +2.0000e+001
  204 +8.4990e+002 +2.2000e+001
  304 +1.7990e+002 +1.8000e+001
  305 +8.5000e+002 +2.0000e+001
  306 +1.1290e+003 +1.1300e+002
  401 +0.0000e+000 +0.0000e+000
  402 +1.2750e+003 +0.0000e+000
  501 +5.7000e+002 +2.2000e+001
  502 +5.7000e+002 +2.0000e+001
  503 +6.0000e+002 +2.8000e+001
  504 +6.0000e+002 +2.6000e+001
  700 -5.0000e+002 +3.5000e+001
  704 -5.0000e+002 +0.0000e+000
 LINE            5
    1    15
  700
  101
  102
```

NOT USED

```
   103
   104
   105
   106
   107
   108
   109
   110
   111
   112
   113
   114
     2      9
   700
   101
   102
   203
   501
   503
   204
   113
   114
     3     13
   700
   101
   102
   202
   304
   203
   501
   503
   204
   305
   306
   113
   114
     4     11
   700
   101
   102
   202
   304
   502
   504
   305
   306
   113
   114
     5      3
   704
   401
   402
TENSION
     0 +9.8070e+000 +0.0000e+000 +0.0000e+000      0
GRID
     8      3      1     20     20 0 +0.0000e+000 0 +0.0000e+000
RADIUS
```



```
     4      5      7      6      2      4      6
AXIS
     0
LIMIT
0 -5.0000e+002 +1.2750e+003
SLIP             0
BLOCK
     0      0      0      0      0 +1.3500e+002 +1.3500e+002 0 0
     0      0      0      0      0 +4.5000e+001 +4.5000e+001 0 0
PORU             5 +0.0000e+000
     1 +0.0000e+000      0
     2 +0.0000e+000      0
     3 +0.0000e+000      0
     4 +0.0000e+000      0
     5 +0.0000e+000      0
PIEZ             5 +0.0000e+000
     1      0      0
     2      0      0
     3      0      0
     4      0      0
     5      0      0
PCON             0 +0.0000e+000
POGH             0 +0.0000e+000
POGP             0 +0.0000e+000
POGR             0 +0.0000e+000
PORA             5
     1 +0.0000e+000
     2 +0.0000e+000
     3 +0.0000e+000
     4 +0.0000e+000
     5 +0.0000e+000
LOAD             0
ANCHOR           0
PBOUNDARY        0
SEISMIC
+0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
NODE             0
ELEMENT          0
MATLCOLOR        5
     1    128    255    128
     2     64      0    128
     3    255    255    128
     4    255    128    128
     5    255      0    255
```



ky=0.16g

VERR

Description: Buena Vista Site Development
Comments: Section I-I' - Final Grades
File Name: I-I'-seis.slp
Last Saved Date: 3/1/2005
Last Saved Time: 3:47:52 PM
Analysis Method: Spencer
Direction of Slip Movement: Right to Left

Description: Waste
Soil Model: Bilinear
Unit Weight: 65
Cohesion: 500
Phi 1: 0
Phi 2: 33
Normal: 770

Description: Bedrock
Soil Model: Bedrock

Description: Module 4B&5 - Base Clay/HDPE
Soil Model: Mohr-Coulomb
Unit Weight: 100
Cohesion: 0
Phi: 14

Description: Bedrock (2)
Soil Model: Bedrock

Description: Module 4B&5- Side Slopes GCL/HDPE
Soil Model: Bilinear
Unit Weight: 100
Cohesion: 0
Phi 1: 20
Phi 2: 2.3
Normal: 2500

```
FILEINFO
SLOPEW 4.24
TITLE
Buena Vista Site Development
Section I-I' - Final Grades
3/1/2005
3:47:52 PM
ANALYSIS
    2     0     1 +6.2400e+001     1     0
CONVERGE
   30 +1.0000e-002  1000
SIDE
    1
LAMBDA
+0.0000e+000 +9.9900e+002 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
SOIL          5
    1 +6.5000e+001 +5.0000e+002 +0.0000e+000 +3.3000e+001 +7.7000e+002
+0.0000e+000   5  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Waste
    2 +1.0000e+002 +0.0000e+000 +2.0000e+001 +2.3000e+000 +2.5000e+003
+0.0000e+000   5  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 4B&5- Side Slopes GCL/HDPE
    3 +1.0000e+002 +0.0000e+000 +1.4000e+001 +0.0000e+000 +0.0000e+000
+0.0000e+000   1  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 4B&5 - Base Clay/HDPE
    4 -1.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000   4  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Bedrock
    5 -1.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000   4  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Bedrock (2)
 SFUNCTION      2
```



```
    1     5 +0.0000e+000 +3.0000e+000
Module 4A-COA - GCL/HDPE
+0.0000e+000 +0.0000e+000
+1.0000e+003 +4.2800e+002
+2.5000e+003 +8.4300e+002
+5.0000e+003 +1.3620e+003
+1.0000e+004 +2.2760e+003
    2     6 +0.0000e+000 +3.0000e+000
Module 6 - Base (retest)
+0.0000e+000 +0.0000e+000
+2.0000e+003 +4.9700e+002
+4.0000e+003 +7.8600e+002
+6.0000e+003 +1.1670e+003
+1.0000e+004 +1.8250e+003
+1.5000e+004 +1.8250e+003
AFUNCTION      0
POINT        704
    1 -3.2083e+002 +2.0654e+003
    3 +8.8425e+002 +3.3990e+002
    4 -2.8242e+002 -9.5390e+001
    5 +1.4876e+003 +2.2468e+002
    6 +1.5180e+003 -9.5390e+001
    7 -2.3761e+002 -1.4020e+002
    8 -7.5988e+001 +1.8668e+002
  101 +0.0000e+000 +3.5000e+001
  102 +1.1500e+002 +4.5000e+001
  103 +1.9000e+002 +7.0000e+001
  104 +2.0500e+002 +7.0000e+001
  105 +3.9500e+002 +1.3000e+002
  106 +4.1000e+002 +1.3000e+002
  107 +5.8500e+002 +1.9000e+002
  108 +6.6500e+002 +1.9000e+002
  109 +6.9000e+002 +2.0000e+002
  110 +7.6500e+002 +2.0000e+002
  111 +1.0250e+003 +1.4000e+002
  112 +1.0450e+003 +1.4000e+002
  113 +1.1300e+003 +1.1500e+002
  114 +1.2750e+003 +1.1500e+002
  202 +1.1510e+002 +4.3000e+001
  203 +1.8000e+002 +2.0000e+001
  204 +8.4990e+002 +2.2000e+001
  304 +1.7990e+002 +1.8000e+001
  305 +8.5000e+002 +2.0000e+001
  306 +1.1290e+003 +1.1300e+002
  401 +0.0000e+000 +0.0000e+000
  402 +1.2750e+003 +0.0000e+000
  501 +5.7000e+002 +2.2000e+001
  502 +5.7000e+002 +2.0000e+001
  503 +6.0000e+002 +2.8000e+001
  504 +6.0000e+002 +2.6000e+001
  700 -5.0000e+002 +3.5000e+001
  704 -5.0000e+002 +0.0000e+000
LINE           5
    1    15
  700
  101
  102
```

```
  103
  104
  105
  106
  107
  108
  109
  110
  111
  112
  113
  114
    2      9
  700
  101
  102
  203
  501
  503
  204
  113
  114
    3     13
  700
  101
  102
  202
  304
  203
  501
  503
  204
  305
  306
  113
  114
    4     11
  700
  101
  102
  202
  304
  502
  504
  305
  306
  113
  114
    5      3
  704
  401
  402
TENSION
    0 +9.8070e+000 +0.0000e+000 +0.0000e+000      0
GRID
    8      3      1     20     20 0 +0.0000e+000 0 +0.0000e+000
RADIUS
```



```
    4      5      7      6      2      4      6
AXIS
    0
LIMIT
0 -5.0000e+002 +1.2750e+003
SLIP             0
BLOCK
    0      0      0      0      0 +1.3500e+002 +1.3500e+002 0 0
    0      0      0      0      0 +4.5000e+001 +4.5000e+001 0 0
PORU             5 +0.0000e+000
    1 +0.0000e+000      0
    2 +0.0000e+000      0
    3 +0.0000e+000      0
    4 +0.0000e+000      0
    5 +0.0000e+000      0
PIEZ             5 +0.0000e+000
    1      0      0
    2      0      0
    3      0      0
    4      0      0
    5      0      0
PCON             0 +0.0000e+000
POGH             0 +0.0000e+000
POGP             0 +0.0000e+000
POGR             0 +0.0000e+000
PORA             5
    1 +0.0000e+000
    2 +0.0000e+000
    3 +0.0000e+000
    4 +0.0000e+000
    5 +0.0000e+000
LOAD             0
ANCHOR           0
PBOUNDARY        0
SEISMIC
+1.6000e-001 +0.0000e+000 +0.0000e+000 +0.0000e+000
NODE             0
ELEMENT          0
MATLCOLOR        5
    1    128    255    128
    2     64      0    128
    3    255    255    128
    4    255    128    128
    5    255      0    255
```

GeoSyntec Consultants

GEOSYNTEC CONSULTANTS
COMPUTATION COVER SHEET

Client: SANTA CRUZ **Project:** BUENA VISTA **Project/Proposal #:** WL0658 **Task #:** 01

Title of Computations: MODULE 4B INTERIM FILL STABILITY

Computations By:
Ellen Rothman — SIGNATURE — 10 FEB 2005 — DATE
ELLEN ROTHMAN / STAFF ENGINEER — PRINTED NAME AND TITLE

Assumptions and Procedures Checked By (Peer Reviewer):
M. Settepani — SIGNATURE — 28 FEB 05 — DATE
F. SETTEPANI — PRINTED NAME AND TITLE

Computations Checked By:
M. Settepani — SIGNATURE — 28 FEB 05 — DATE
F. SETTEPANI — PRINTED NAME AND TITLE

Computations Backchecked By (Originator):
Ellen Rothman — SIGNATURE — 1 MARCH 2005 — DATE
ELLEN ROTHMAN — PRINTED NAME AND TITLE

Approved By (PM or Designate):
SIGNATURE — DATE
PRINTED NAME AND TITLE

Approval Notes:

Revisions: (Number and Initial All Revisions)

No.	Sheet	Date	By	Checked By	Approval

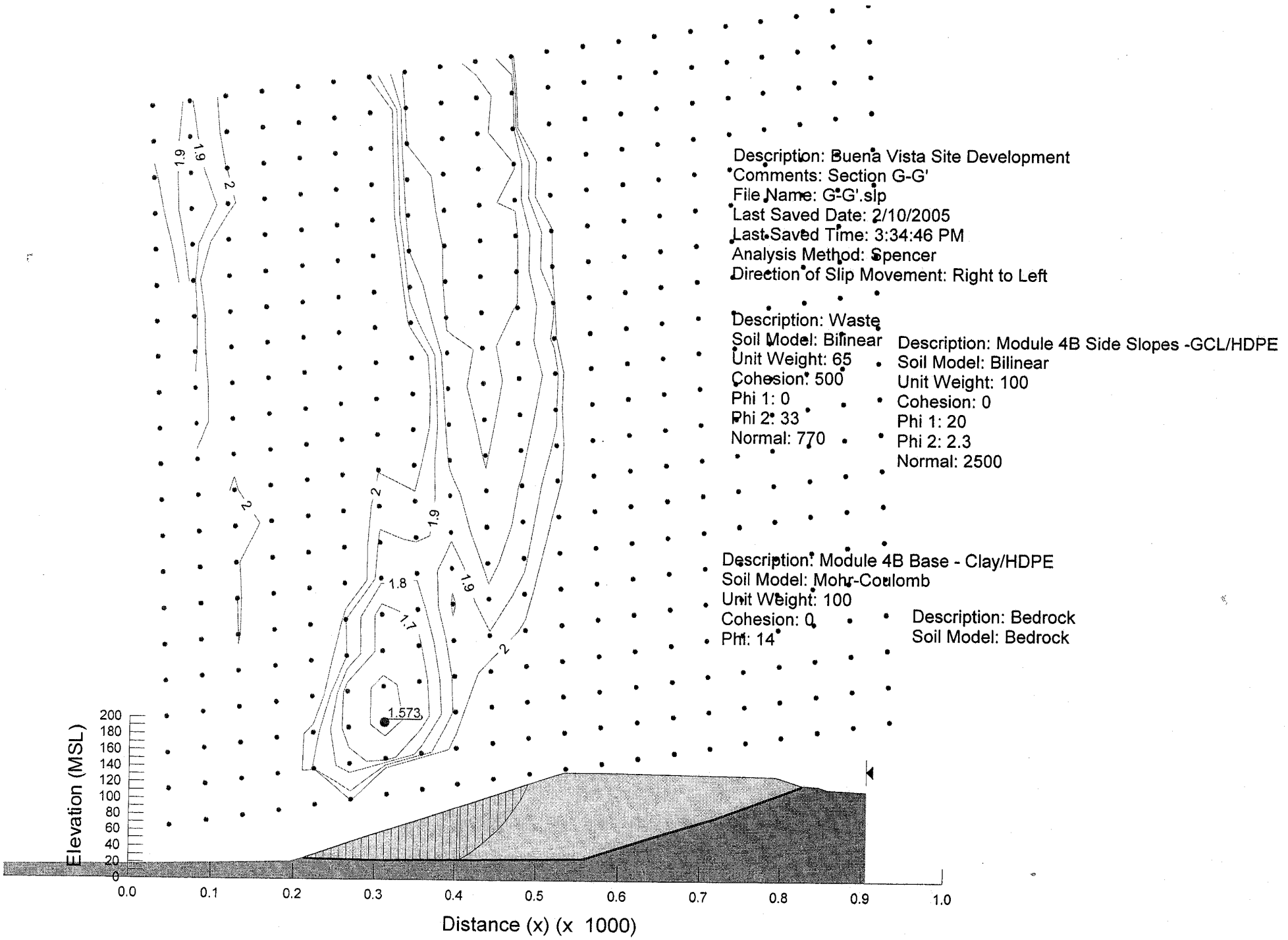
Written by: ERR Date: 05/02/10 Reviewed by: MJ Date: 05/02/28

Client: SANTA CRUZ Project: BUENA VISTA Project/Proposal No.: WL0658 Task No: 01

MODULE 4B INTERIM FILL STABILITY

- STATIC only because interim fill conditions.
- RESULTS: SECTION G-G', FS = 1.57
  SECTION H-H', FS = 1.45
  } (grades to EL 130ft)

- Material Properties - refer to introduction - Module 4B will have GCL/HDPE on base and GCL/HDPE on the side slopes. Values based on literature and site-experience.
- Figure 1 - Base grading plan
  2 - Fill grading plan
  3 - Section G-G'
  4 - Section H-H'


Description: Buena Vista Site Development
Comments: Section G-G'
File Name: G-G'.slp
Last Saved Date: 2/10/2005
Last Saved Time: 3:34:46 PM
Analysis Method: Spencer
Direction of Slip Movement: Right to Left
Description: Waste
Soil Model: Bilinear
Unit Weight: 65
Cohesion: 500
Phi 1: 0
Phi 2: 33
Normal: 770
Description: Module 4B Side Slopes -GCL/HDPE
Soil Model: Bilinear
Unit Weight: 100
Cohesion: 0
Phi 1: 20
Phi 2: 2.3
Normal: 2500
Description: Module 4B Base - Clay/HDPE
Soil Model: Mohr-Coulomb
Unit Weight: 100
Cohesion: 0
Phi: 14
Description: Bedrock
Soil Model: Bedrock
1.573
Elevation (MSL)
Distance (x) (x 1000)

```
FILEINFO
SLOPEW 4.24
TITLE
Buena Vista Site Development
Section G-G'
2/10/2005
3:34:46 PM
ANALYSIS
    2     0     1 +6.2400e+001     1     0
CONVERGE
   30 +1.0000e-002  1000
SIDE
    1
LAMBDA
 +0.0000e+000 +9.9900e+002 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 SOIL          5
     1 +6.5000e+001 +5.0000e+002 +0.0000e+000 +3.3000e+001 +7.7000e+002
+0.0000e+000    5  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Waste
     2 +1.0000e+002 +0.0000e+000 +2.0000e+001 +2.3000e+000 +2.5000e+003
+0.0000e+000    5  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.000Ce+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 4B Side Slopes -GCL/HDPE
     3 +1.0000e+002 +0.0000e+000 +1.4000e+001 +0.0000e+000 +0.0000e+000
+0.0000e+000    1  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 4B Base - Clay/HDPE
     4 -1.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000    4  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Bedrock
     5 -1.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000    4  0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
       +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Bedrock (2)
```

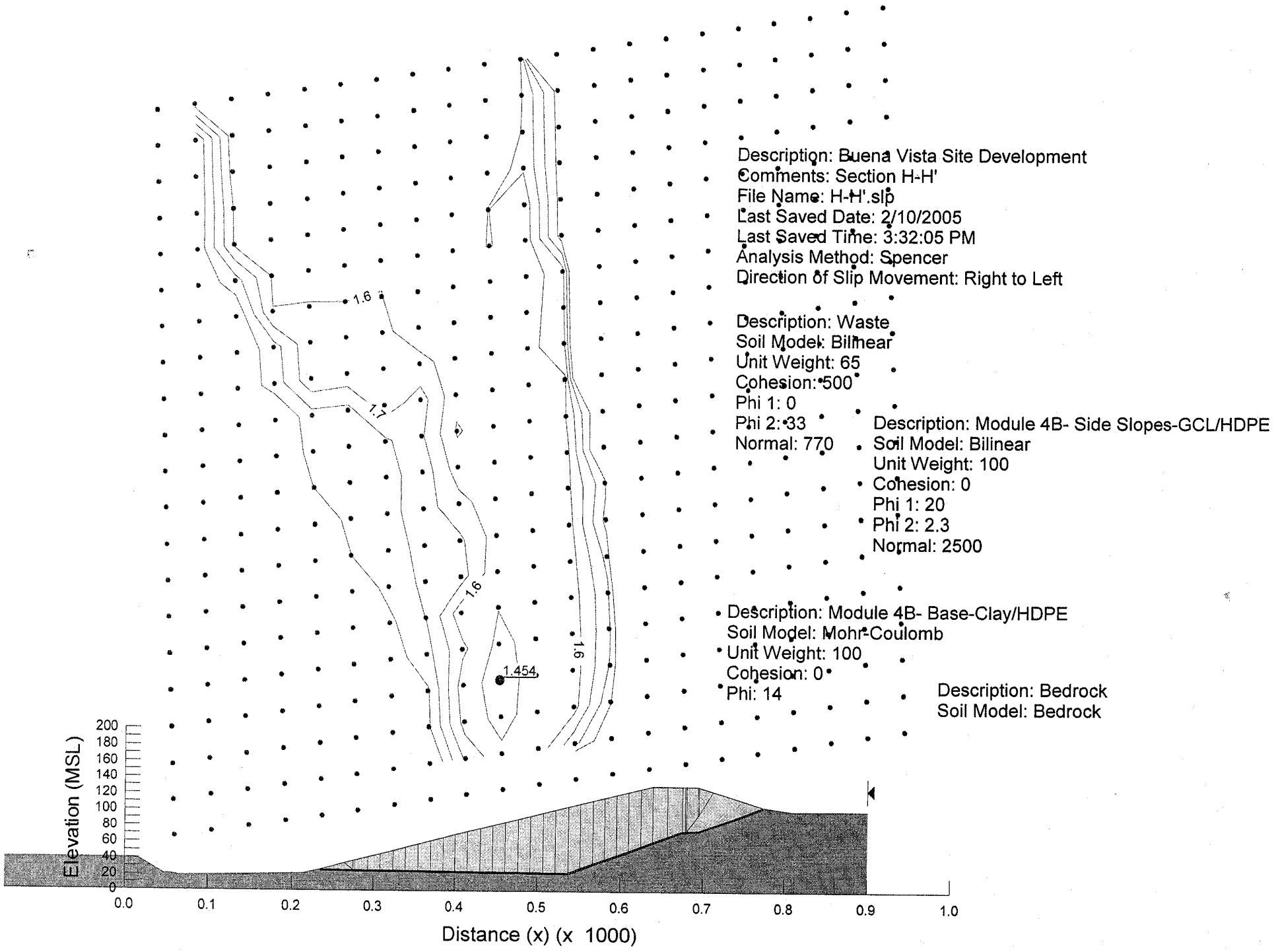


```
SFUNCTION       0
AFUNCTION       0
POINT         402
     1 +9.3356e+002 +1.9923e+002
     3 +1.5424e+001 +9.6252e+002
     4 +9.3283e+002 +1.4445e+002
     5 +9.3287e+002 -8.4279e+000
     6 +3.0163e+001 -1.2591e+001
     7 +3.1792e+001 +8.4062e+000
     8 +4.9896e+001 +6.5465e+001
   100 -5.0000e+002 +1.3000e+001
   101 +0.0000e+000 +1.7000e+001
   102 +1.9700e+002 +2.2000e+001
   103 +2.1300e+002 +2.7000e+001
   104 +5.3400e+002 +1.3400e+002
   105 +5.9500e+002 +1.3400e+002
   106 +7.9400e+002 +1.3000e+002
   107 +8.2700e+002 +1.1900e+002
   108 +8.4700e+002 +1.1800e+002
   109 +8.5800e+002 +1.1400e+002
   110 +9.0600e+002 +1.1200e+002
   204 +3.0300e+002 +2.5000e+001
   205 +5.5700e+002 +2.8000e+001
   206 +6.9800e+002 +7.3000e+001
   207 +7.1900e+002 +7.9000e+001
   304 +2.1350e+002 +2.5000e+001
   305 +3.0300e+002 +2.3000e+001
   306 +5.5750e+002 +2.6000e+001
   307 +6.9800e+002 +7.1000e+001
   308 +7.1900e+002 +7.7000e+001
   309 +8.2650e+002 +1.1700e+002
   401 -5.0000e+002 +0.0000e+000
   402 +9.0600e+002 +0.0000e+000
LINE            5
     1    11
   100
   101
   102
   103
   104
   105
   106
   107
   108
   109
   110
     2    12
   100
   101
   102
   103
   204
   205
   206
   207
   107
   108
```

```
     109
     110
       3     14
     100
     101
     102
     103
     204
     205
     306
     307
     308
     309
     107
     108
     109
     110
       4     14
     100
     101
     102
     103
     304
     305
     306
     307
     308
     309
     107
     108
     109
     110
       5      2
     401
     402
TENSION
       0 +9.8070e+000 +0.0000e+000 +0.0000e+000      0
GRID
       8      1      3     20     20 0 +0.0000e+000 0 +0.0000e+000
RADIUS
       7      4      6      5     10      6      4
AXIS
       0
LIMIT
0 -5.0000e+002 +9.0600e+002
SLIP              0
BLOCK
       0      0      0      0      0 +1.3500e+002 +1.3500e+002 0 0
       0      0      0      0      0 +4.5000e+001 +4.5000e+001 0 0
PORU              5 +0.0000e+000
       1 +0.0000e+000      0
       2 +0.0000e+000      0
       3 +0.0000e+000      0
       4 +0.0000e+000      0
       5 +0.0000e+000      0
PIEZ              5 +0.0000e+000
       1      0      0
```



```
       2      0      0
       3      0      0
       4      0      0
       5      0      0
PCON              0 +0.0000e+000
POGH              0 +0.0000e+000
POGP              0 +0.0000e+000
POGR              0 +0.0000e+000
PORA              5
       1 +0.0000e+000
       2 +0.0000e+000
       3 +0.0000e+000
       4 +0.0000e+000
       5 +0.0000e+000
LOAD              0
ANCHOR            0
PBOUNDARY         0
SEISMIC
+0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
NODE              0
ELEMENT           0
MATLCOLOR         5
       1    255    255    128
       2      0    128    255
       3    255      0      0
       4    255    128    128
       5    128    255    255
```


Description: Buena Vista Site Development
Comments: Section H-H'
File Name: H-H'.slp
Last Saved Date: 2/10/2005
Last Saved Time: 3:32:05 PM
Analysis Method: Spencer
Direction of Slip Movement: Right to Left
Description: Waste
Soil Model: Bilinear
Unit Weight: 65
Cohesion: 500
Phi 1: 0
Phi 2: 33
Normal: 770
Description: Module 4B- Side Slopes-GCL/HDPE
Soil Model: Bilinear
Unit Weight: 100
Cohesion: 0
Phi 1: 20
Phi 2: 2.3
Normal: 2500
Description: Module 4B- Base-Clay/HDPE
Soil Model: Mohr-Coulomb
Unit Weight: 100
Cohesion: 0
Phi: 14
Description: Bedrock
Soil Model: Bedrock
1.6
1.7
1.6
1.6
1.454
Elevation (MSL)
200
180
160
140
120
100
80
60
40
20
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Distance (x) (x 1000)

```
FILEINFO
SLOPEW 4.24
TITLE
Buena Vista Site Development
Section H-H'
2/10/2005
3:32:05 PM
ANALYSIS
     2     0     1 +6.2400e+001     1     0
CONVERGE
    30 +1.0000e-002  1000
SIDE
     1
LAMBDA
 +0.0000e+000 +9.9900e+002 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 SOIL           5
     1 +6.5000e+001 +5.0000e+002 +0.0000e+000 +3.3000e+001 +7.7000e+002
+0.0000e+000    5  0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Waste
     2 +1.0000e+002 +0.0000e+000 +2.0000e+001 +2.3000e+000 +2.5000e+003
+0.0000e+000    5  0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 4B- Side Slopes-GCL/HDPE
     3 +1.0000e+002 +0.0000e+000 +1.4000e+001 +0.0000e+000 +0.0000e+000
+0.0000e+000    1  0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 4B- Base-Clay/HDPE
     4 -1.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000    4  0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Bedrock
     5 -1.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000    4  0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Bedrock (2)
```

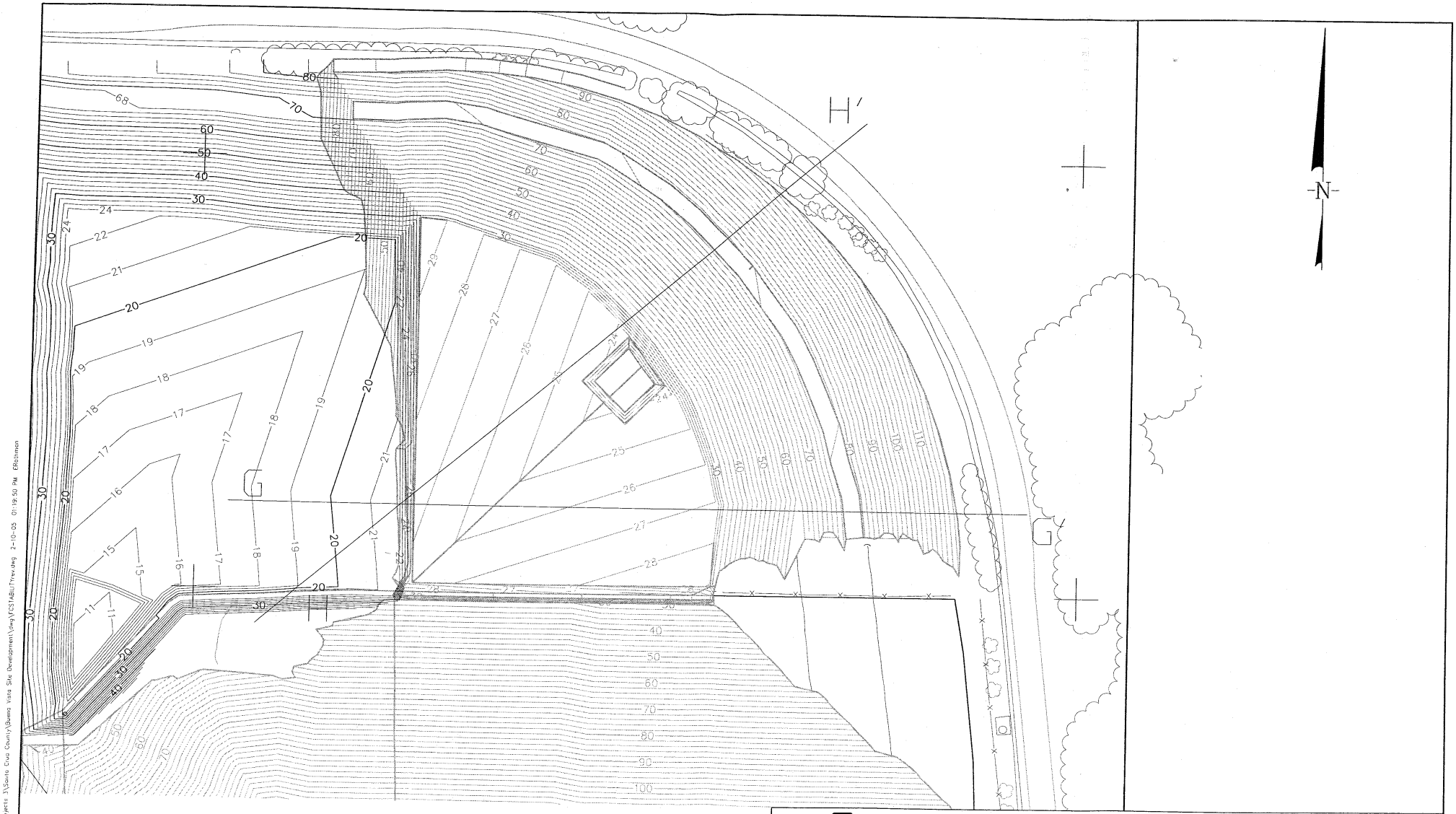


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AFUNCTION       0
POINT         402
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     3 +2.5491e+001 +9.5964e+002
     4 +9.6615e+002 +1.1166e+002
     5 +9.5588e+002 -1.1270e+002
     6 +3.7090e+001 -1.4115e+002
     7 +3.7090e+001 -8.5779e+001
     8 +5.9963e+001 +6.6185e+001
   100 -5.0000e+002 +4.0000e+001
   101 +0.0000e+000 +4.0000e+001
   102 +1.7000e+001 +3.9000e+001
   103 +4.7000e+001 +2.1000e+001
   104 +5.5000e+001 +2.1000e+001
   105 +6.6000e+001 +1.9000e+001
   106 +2.1400e+002 +2.2000e+001
   107 +2.3500e+002 +2.7000e+001
   108 +6.3900e+002 +1.3100e+002
   109 +6.9400e+002 +1.3000e+002
   110 +7.7400e+002 +1.0500e+002
   111 +8.0800e+002 +1.0000e+002
   112 +9.0000e+002 +1.0000e+002
   206 +5.3600e+002 +2.5000e+001
   207 +6.7500e+002 +7.5000e+001
   208 +5.3700e+002 +2.4000e+001
   209 +6.7400e+002 +7.5000e+001
   210 +6.9500e+002 +7.6000e+001
   308 +2.3550e+002 +2.5000e+001
   309 +5.3750e+002 +2.2000e+001
   310 +6.7500e+002 +7.3000e+001
   311 +6.9500e+002 +7.4000e+001
   312 +7.7350e+002 +1.0300e+002
   401 -5.0000e+002 +0.0000e+000
   402 +9.0000e+002 +0.0000e+000
LINE            5
     1    13
   100
   101
   102
   103
   104
   105
   106
   107
   108
   109
   110
   111
   112
     2    14
   100
   101
   102
   103
   104
   105
```

```
 106
 107
 208
 209
 210
 110
 111
 112
   3    16
 100
 101
 102
 103
 104
 105
 106
 107
 208
 309
 310
 311
 312
 110
 111
 112
   4    16
 100
 101
 102
 103
 104
 105
 106
 107
 308
 309
 310
 311
 312
 110
 111
 112
   5     2
 401
 402
TENSION
    0 +9.8070e+000 +0.0000e+000 +0.0000e+000      0
GRID
    8     1     3    20    20 0 +0.0000e+000 0 +0.0000e+000
RADIUS
    7     4     6     5    10     7     4
AXIS
    0
LIMIT
0 -5.0000e+002 +9.0000e+002
SLIP            0
BLOCK
```



```
    0     0     0     0     0 +1.3500e+002 +1.3500e+002 0 0
    0     0     0     0     0 +4.5000e+001 +4.5000e+001 0 0
PORU            5 +0.0000e+000
    1 +0.0000e+000     0
    2 +0.0000e+000     0
    3 +0.0000e+000     0
    4 +0.0000e+000     0
    5 +0.0000e+000     0
PIEZ            5 +0.0000e+000
    1     0     0
    2     0     0
    3     0     0
    4     0     0
    5     0     0
PCON            0 +0.0000e+000
POGH            0 +0.0000e+000
POGP            0 +0.0000e+000
POGR            0 +0.0000e+000
PORA            5
    1 +0.0000e+000
    2 +0.0000e+000
    3 +0.0000e+000
    4 +0.0000e+000
    5 +0.0000e+000
LOAD            0
ANCHOR          0
PBOUNDARY       0
SEISMIC
+0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
NODE            0
ELEMENT         0
MATLCOLOR       5
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    2     0   128   255
    3   255     0     0
    4   255   128   128
    5   128   255   255
```

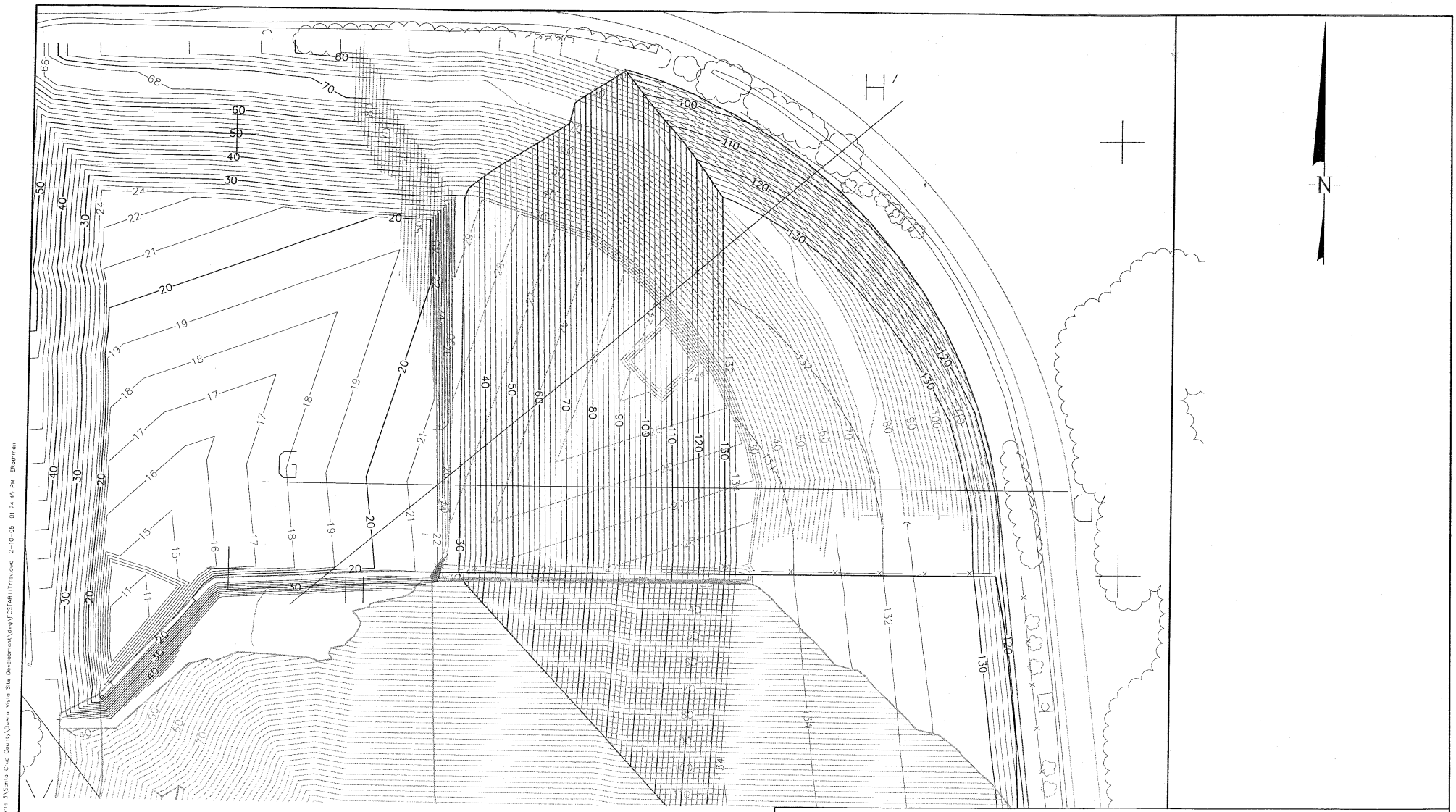


GeoSyntec Consultants

MODULE 4B AND MODULE 5 BASE GRADING PLAN
BUENA VISTA LANDFILL
WATSONVILLE, CALIFORNIA

FIGURE NO.	1
PROJECT NO.	WL0658
DATE:	FEBRUARY 2005

P:\CAD\Land Projects 3\Santa Cruz County\Buena Vista Site Development\dwg\CCSTABILITY.rev.dwg 2-10-05 01:19:50 PM ERothman

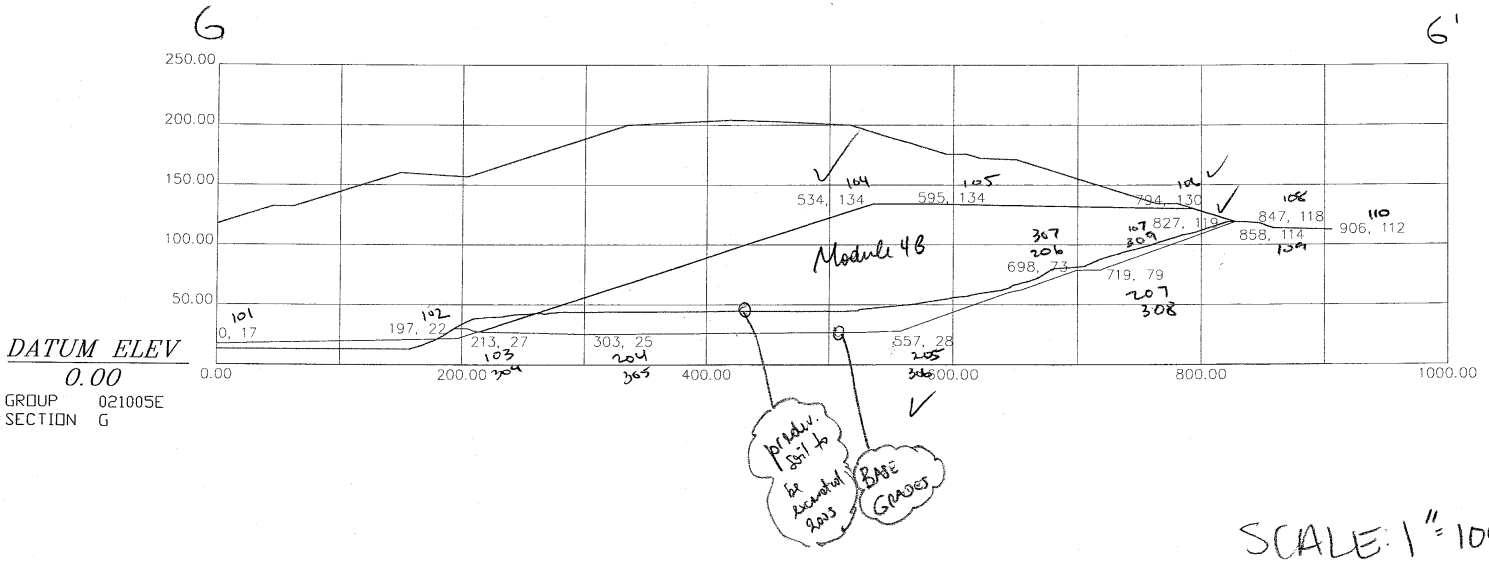


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GeoSyntec Consultants

MODULE 4B INTERIM FILL GRADING PLAN
BUENA VISTA LANDFILL
WATSONVILLE, CALIFORNIA

FIGURE NO.	2
PROJECT NO.	WL0658
DATE:	FEBRUARY 2005

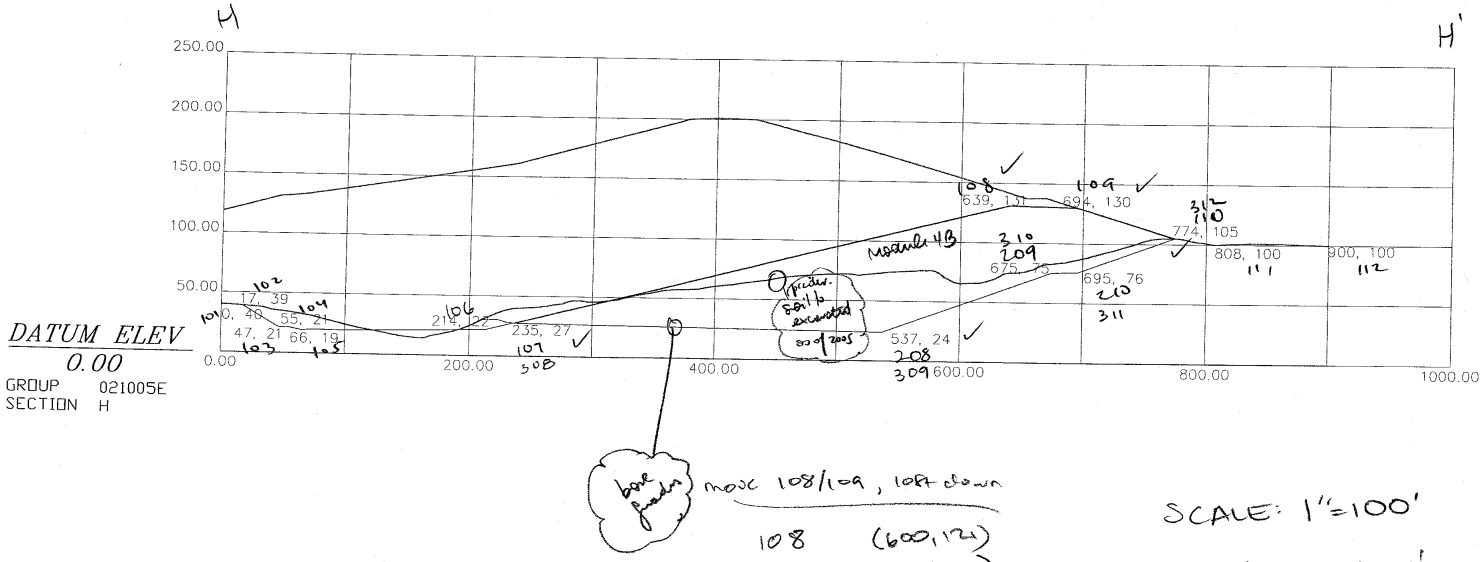


SCALE: 1" = 100'

Section G-G'

INTERIM MODULE 4B

Figure 3



bar graphs

mark 108/109, left down

108 (600, 124)

109 (727, 120)

SCALE: 1"=100'

Section H-H'

Interim Module 4B

Figure 4

GeoSyntec Consultants

GEOSYNTEC CONSULTANTS
COMPUTATION COVER SHEET

Client: SANTA CRUZ **Project:** BUENA VISTA **Project/Proposal #:** WL0658 **Task #:** 01

Title of Computations: BIG STOCKPILE STABILITY

Computations By: Ellen Rothman (SIGNATURE) — 09 FEB 05 (DATE)
ELLEN ROTHMAN / STAFF ENGINEER (PRINTED NAME AND TITLE)

Assumptions and Procedures Checked By (Peer Reviewer): F. Settepani (SIGNATURE) — 28 FEB 05 (DATE)
F. SETTEPANI (PRINTED NAME AND TITLE)

Computations Checked By: F. Settepani (SIGNATURE) — 28 FEB 05 (DATE)
F. SETTEPANI (PRINTED NAME AND TITLE)

Computations Backchecked By (Originator): Ellen Rothman (SIGNATURE) — 01 MARCH 05 (DATE)
ELLEN ROTHMAN (PRINTED NAME AND TITLE)

Approved By (PM or Designate): _____ (SIGNATURE) — _____ (DATE)
_____ (PRINTED NAME AND TITLE)

Approval Notes: _____

Revisions: (Number and Initial All Revisions)

No.	Sheet	Date	By	Checked By	Approval

Written by: FWS Date: 05/02/__ Reviewed by: ____ Date: __/__/__

Client: CoSan Project: BVL - Site DW Project/Proposal No.: WO658 Task No: 01

STOCKPILE STABILITY EVALUATION

(1) Evaluate effect of stockpile geometry shown on Figure 1 on existing landfill.

(2) Assume that southwest stockpile will be constructed as part of Module 4B development. Southwest stockpile will be constructed over Modules 1 and 2. Since these Modules are not lined with a composite liner, slope stability evaluated by inspection.

(3) Assume that south stockpile will be partially constructed as part of Module 4B. However, most of South stockpile will be constructed after Module 4B has been filled as part of Module 5 construction.

(4) Stockpile side slopes are 2:1 (H:V) - Raveling / shallow movements expected, however, these can be repaired.

(5) Unit weight of excavated soil = 100pcf. Material will be onsite soils → Sandy. Assume $\phi = 33°$ and $c = 0$ psf. $FS_{\text{INFINITE SLOPE}} = \frac{\tan\phi}{\tan\beta} = \frac{0.65}{0.5} = 1.3$

(6) Evaluated cases when: Mod 4A being filled and Mod 4B being excavated; Mod 4A filled and Module 4B being filled and Mod 5 being excavated.

(7) Stockpiles are not part of final grades of landfill; therefore, did not evaluate seismic slope stability.

Written by: FWS Date: 05/02/25 (YY/MM/DD) Reviewed by: ____ Date: ____/____/____

Client: CoSCny Project: SITE DEV. PLN Project/Proposal No.: CR0658 Task No: 01

(8) Properties for waste fill based on Kavazanjian et al (1995). $\gamma = 65$ pcf

(9) " " liner systems based on information from CQA Reports for Modules 3, 4A, 6. For future Modules 4B and 5, liner properties based on experience at site for GCL/HDPE and typical properties for CCL/HDPE. For Module 2, assumed it is lined with a clay liner that has an $S_u = 1{,}000$ psf. Module 3 was constructed in 1994.

Module 3 (based on CQA tests)

BASE $\sigma_N \leq 4900$ psf, $\phi = 8.5°$, $c = 0$ psf

$\sigma_N > 4900$ psf, $\phi = 4.1°$, $c = 381$ psf

SS $\sigma_N \leq 7455$ psf, $\phi = 7°$, $c = 0$ psf

$\sigma_N > 7455$ psf, $\phi = 4.1°$, $c = 381$ psf

Module 6 BASE (CONSTRUCTED IN 1999, RETESTED IN 2004 W. SITE-SPECIFIC MATERIALS)

SELECTED BECAUSE LOWER STR. THAN NWGT/HDPE

CCL/TEXT HDPE

σ_N	τ
2000 psf	497 psf
4000	786
6000	1167
10000	1825
15000	1825

NW GT/TEXT HDPE

σ_N	τ
2000 psf	691 psf
4000	1114
10000	2676
15000	3783

SS $\phi = 17°$ (based on literature values for sandy subgrade to textured HDPE — reference: Thorne + Lewis (1994))

SANDY SUBGRADE (NATIVE)/TEXT. HDPE

Written by: FWS Date: 05/02/25 Reviewed by: ____ Date: ____/____/____

Client: CoSCny Project: SITE DEV. PLAN Project/Proposal No.: WL0658 Task No: 01

(10) Module 4A BASE (CONSTRUCTED IN 2003, CQA TESTS USING SITE-SPECIFIC MATERIALS)
(CONTINUED)

CCL/TEXT HDPE

$\sigma_N \leq 4000$ psf, $\phi = 19°$, $c = 0$ psf

$\sigma_N > 4000$ psf, $\phi = 9.4°$, $c = 700$ psf

SS (CQA TESTS USING SITE-SPECIFIC MATERIALS) GCL/TEXT HDPE

σ_N	τ
1000 psf	428 psf
2500	843
5000	1362
10000	2276

Module 4B + 5 (FUTURE)

BASE CCL/TEXT HDPE $\phi = 14°$, $c = 0$ psf

SS GCL/TEXT HDPE

$\sigma_N \leq 2500$ psf, $\phi = 20°$, $c = 0$ psf

$\sigma_N > 2500$ psf, $\phi = 2.3°$, $c = 831$ psf.

(11) Two stockpiles proposed: SOUTHWESTERN (located over Module 1 which is unlined) and SOUTH (located over Module 3 which is lined). For both, compression of waste expected and settlement cracks may result. For stability, evaluated SOUTH stockpile because located over composite liner (HDPE/low-perm waste).

Written by: FWS Date: 05/02/__ Reviewed by: ____ Date: __/__/__

Client: CoSCny Project: BVL-Stk Dw Project/Proposal No.: WO658 Task No: 01

(12)

FILENAME	CASE	STATIC F.S
NS5-CHECK.SLP	General Case when Mod 4A being filled and south stockpile may be started. Assumed elevation in Mod 4A is higher than 70'. Assumption reasonable because Mod 4B will be constructed when Mod 4A about to be @ design elevation given waste stream.	1.55
STOCKPILE-1-1'.SLP	Assumes that Mod 4A + 4B @ elevation 130' and Mod 5 being excavated. Section goes through Modules 6, 3, and 2. For stability, need 100'-wide bench @ elev. 160'. The stockpile reaches elev. 200'.	1.63
STOCKPILE-2-2'.SLP	Same as above	1.46

Figure 1 - grading plan Southwest stockpile and south stockpile @ max. capacity.

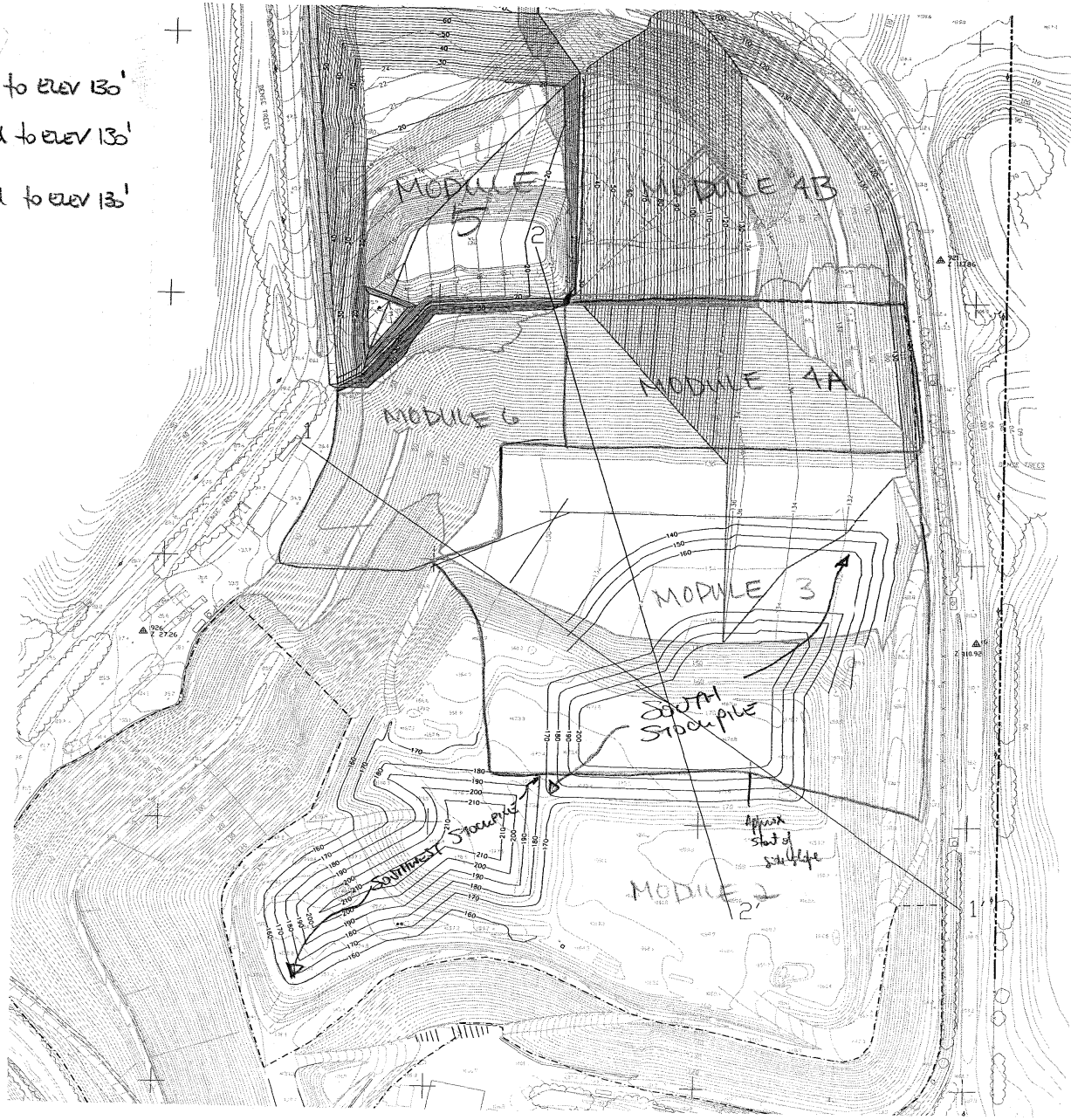
Figure 2 - grading plan southwest stockpile and south stockpile @ initial capacity

Figure 3 - section N-S cut through Mod 3 w. south stockpile @ initial capacity.

Figure 4 - section 1-1 - ultimate capacity. south stockpile

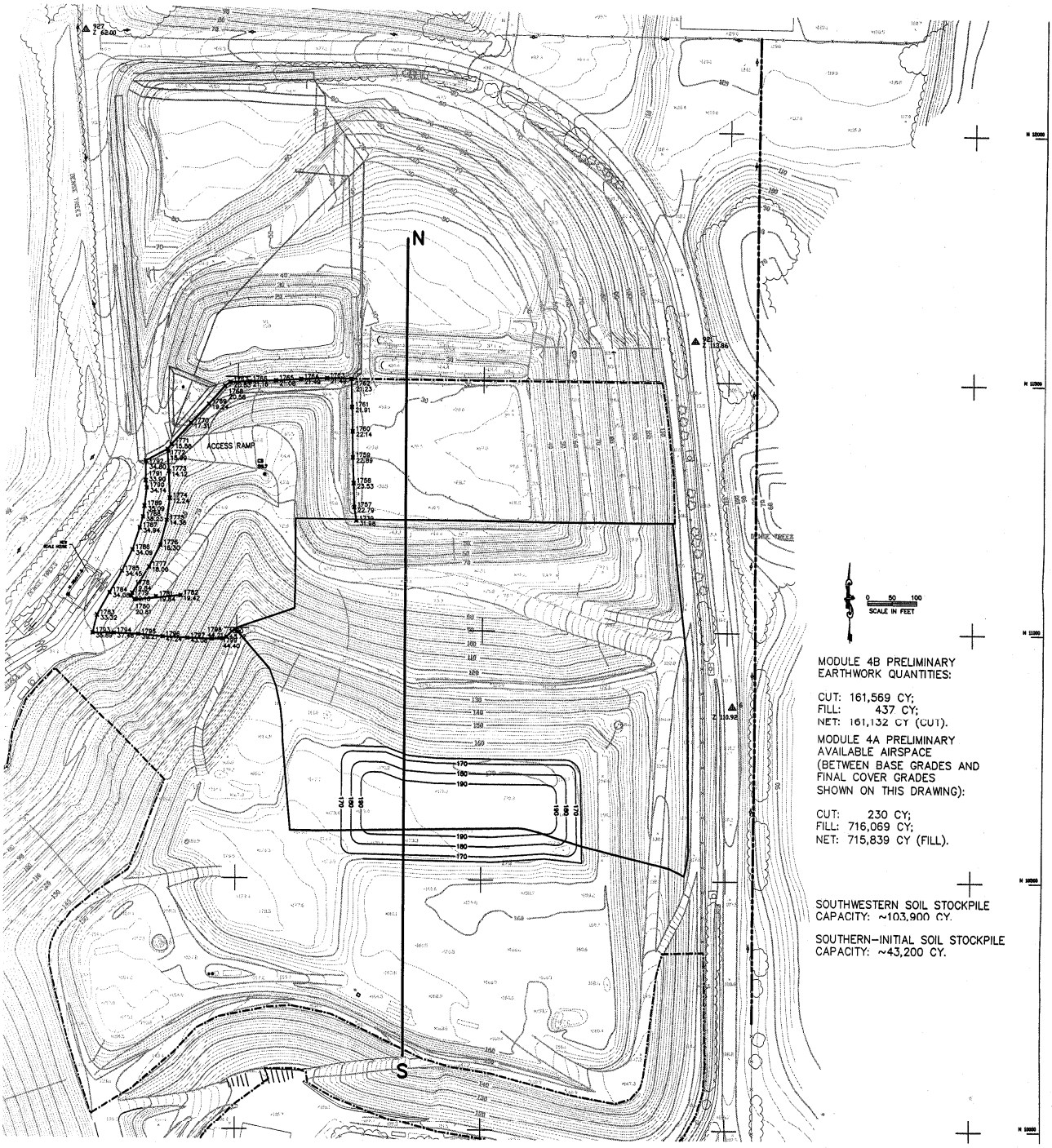
Figure 5 - Section 2-2 - " " " "

- Module 4A filled to elev 130'
- Module 4B filled to elev 130'
- Module 6 filled to elev 130'



SCALE: 1"=200'

FIGURE 1



MODULE 4B PRELIMINARY
EARTHWORK QUANTITIES:

CUT: 161,569 CY;
FILL: 437 CY;
NET: 161,132 CY (CUT).

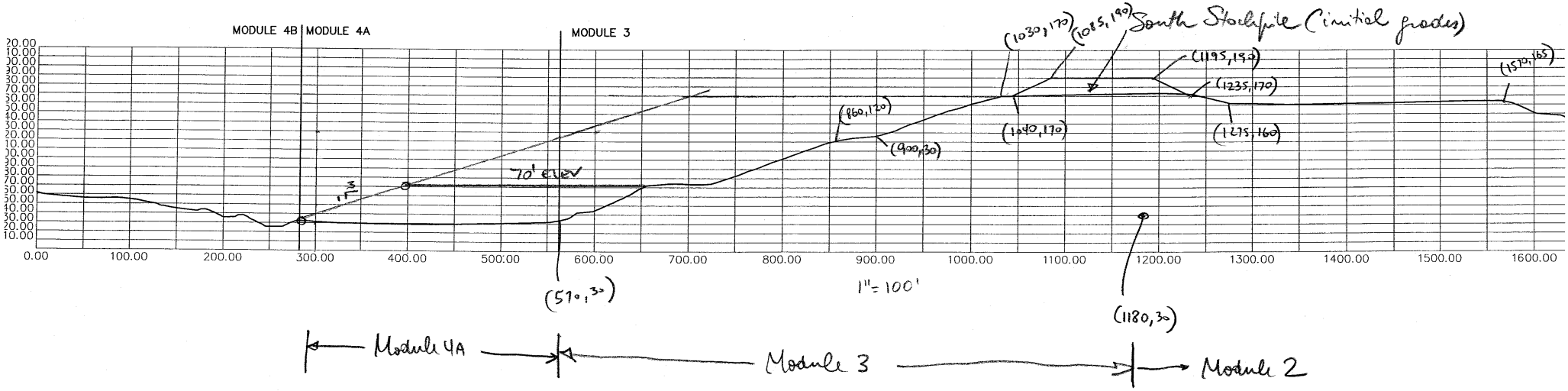
MODULE 4A PRELIMINARY
AVAILABLE AIRSPACE
(BETWEEN BASE GRADES AND
FINAL COVER GRADES
SHOWN ON THIS DRAWING):

CUT: 230 CY;
FILL: 716,069 CY;
NET: 715,839 CY (FILL).

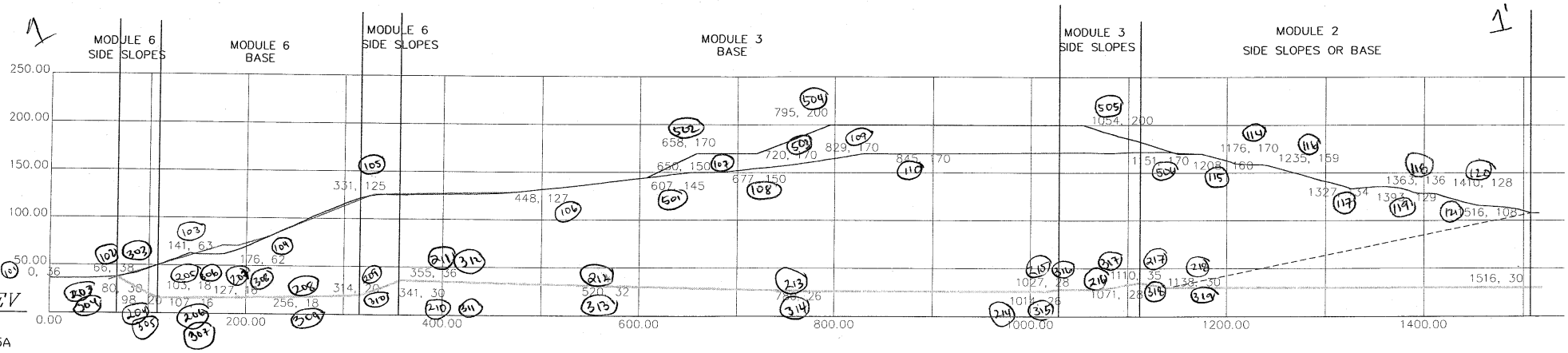
SOUTHWESTERN SOIL STOCKPILE
CAPACITY: ~103,900 CY.

SOUTHERN–INITIAL SOIL STOCKPILE
CAPACITY: ~43,200 CY.

Figure 2
N-S
Scale 1" = 200'



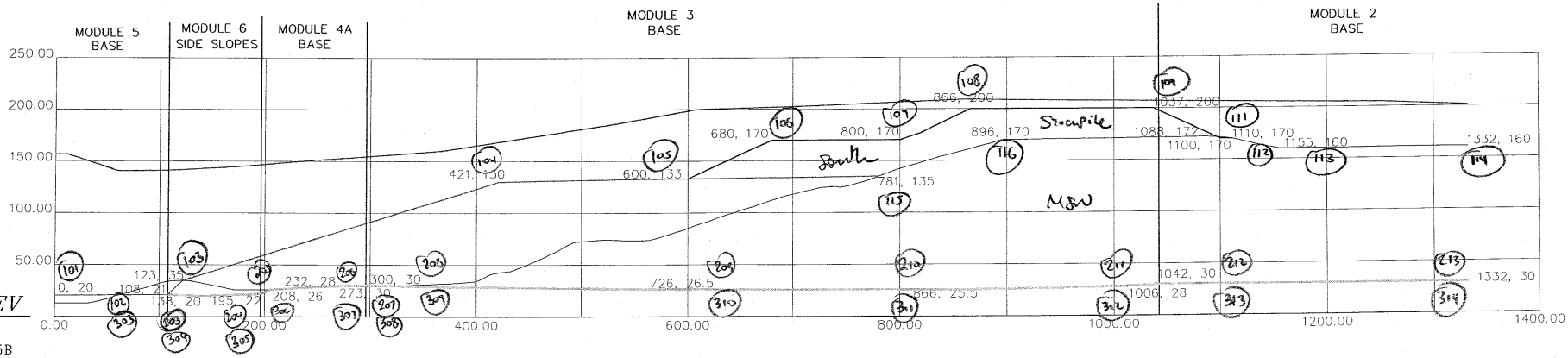
Section N-S
Figure 3
Scale 1" = 100'



'M ELEV
0.00
020905A
N 1

SCALE: 1"=100'

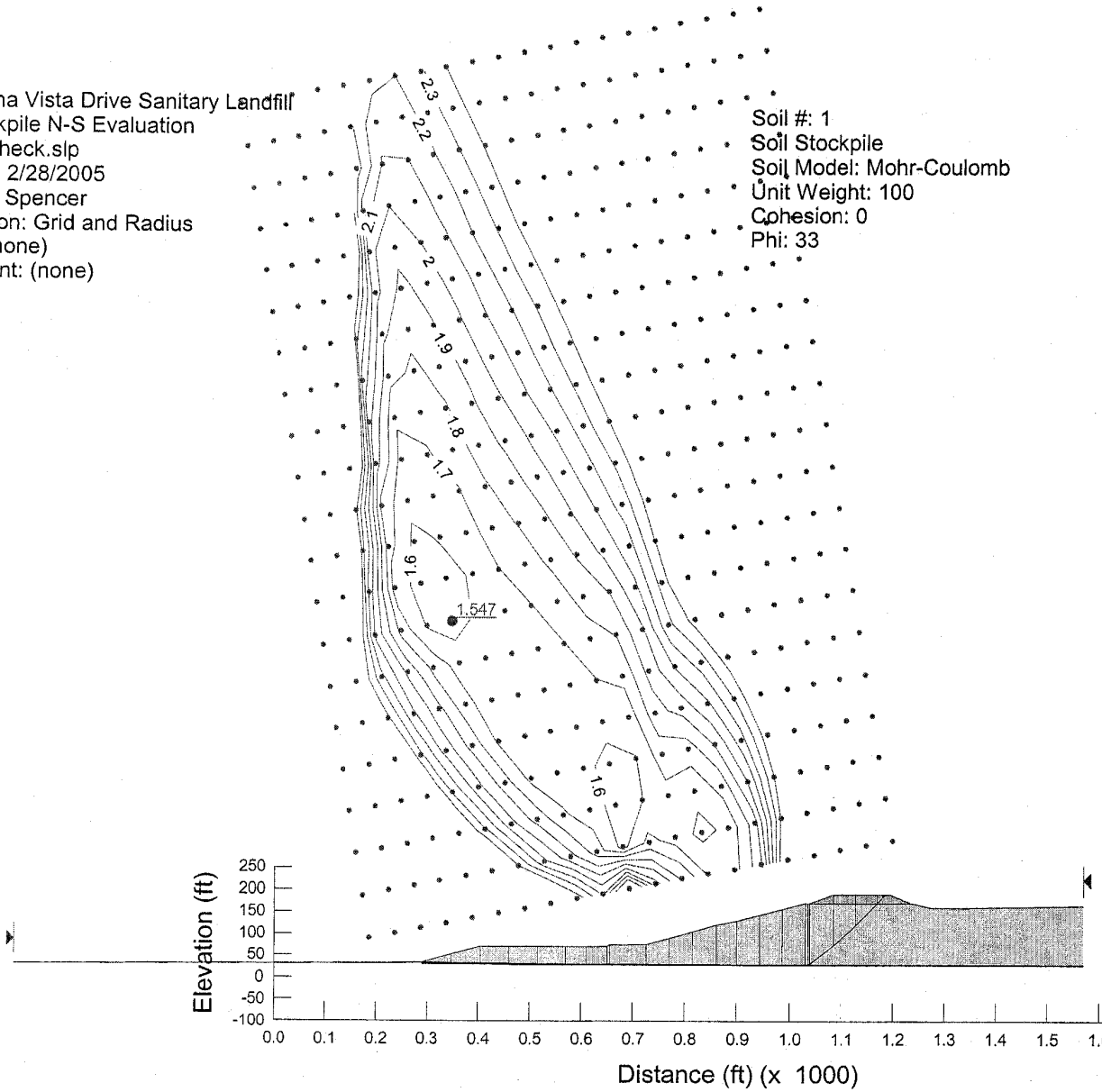
Figure 4
Section 1-1



DATUM ELEV
0.00
GROUP 020805B
SECTION 2

Scale 1" = 100'
Figure 5
Section 2-2

Description: Buena Vista Drive Sanitary Landfill
Comments: Stockpile N-S Evaluation
File Name: ns5-check.slp
Last Saved Date: 2/28/2005
Analysis Method: Spencer
Slip Surface Option: Grid and Radius
P.W.P. Option: (none)
Seismic Coefficient: (none)



Soil #: 1
Soil Stockpile
Soil Model: Mohr-Coulomb
Unit Weight: 100
Cohesion: 0
Phi: 33

Soil #: 2
Waste
Soil Model: Bilinear
Unit Weight: 65
Cohesion: 500
Phi 1: 0
Phi 2: 33
Normal: 770

Soil #: 3
Module 4 Base Liner (with CQA data Mod 4a)
Soil Model: Bilinear
Unit Weight: 110
Cohesion: 0
Phi 1: 19
Phi 2: 9.4
Normal: 4000

Soil #: 4
Module 3 Base Liner (As-built)
Soil Model: Bilinear
Unit Weight: 110
Cohesion: 0
Phi 1: 8.5
Phi 2: 4.1
Normal: 4900

Soil #: 5
Module 2 Base Liner (assumed to be clay)
Soil Model: Undrained (Phi=0)
Unit Weight: 130
Cohesion: 1000

Soil #: 6
Bedrock
Soil Model: Bedrock

```
FILEINFO
SLOPEW 4.20
TITLE
Buena Vista Drive Sanitary Landfill
Stockpile N-S Evaluation
2/28/2005
8:32:09 AM
ANALYSIS
     2     0     1 +6.2400e+001     1     0
CONVERGE
    30 +1.0000e-002  1000
SIDE
     1
LAMBDA
 +0.0000e+000 +9.9900e+002 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 SOIL          6
     1 +1.0000e+002 +0.0000e+000 +3.3000e+001 +0.0000e+000 +0.0000e+000
+0.0000e+000    1   0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Soil Stockpile
     2 +6.5000e+001 +5.0000e+002 +0.0000e+000 +3.3000e+001 +7.7000e+002
+0.0000e+000    5   0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Waste
     3 +1.1000e+002 +0.0000e+000 +1.9000e+001 +9.4000e+000 +4.0000e+003
+0.0000e+000    5   0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 4 Base Liner (with CQA data Mod 4a)
     4 +1.1000e+002 +0.0000e+000 +8.5000e+000 +4.1000e+000 +4.9000e+003
+0.0000e+000    5   0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 3 Base Liner (As-built)
     5 +1.3000e+002 +1.0000e+003 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000    2   0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 2 Base Liner (assumed to be clay)
```



```
     6 -1.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000    4   0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Bedrock
 SFUNCTION       1
     1     5 +1.9953e-003 +3.0000e+000
 As Built (Mod 4a CQA)
 +0.0000e+000 +0.0000e+000
 +2.0000e+003 +7.9800e+002
 +4.0000e+003 +1.3660e+003
 +8.0000e+003 +2.0340e+003
 +1.2000e+004 +2.7560e+003
 AFUNCTION       0
 POINT         308
     1 +0.0000e+000 +3.0000e+001
     2 +2.9000e+002 +3.2000e+001
     3 +7.6000e+002 +1.7000e+002
     4 +1.0300e+003 +1.7000e+002
     5 +1.0400e+003 +1.7000e+002
     6 +1.0850e+003 +1.9000e+002
     7 +1.1950e+003 +1.9000e+002
     8 +1.2350e+003 +1.7000e+002
     9 +1.2750e+003 +1.6000e+002
    10 +2.9050e+002 +3.0000e+001
    11 +5.7010e+002 +3.0000e+001
    12 +5.7000e+002 +2.8000e+001
    13 +1.1801e+003 +3.0000e+001
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    15 +1.5000e+003 +3.0000e+001
    16 +1.5000e+003 +2.8000e+001
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    19 +1.1990e+003 +3.1354e+002
    20 +4.3060e+001 -9.0224e+001
    21 +1.6826e+003 +4.7672e+001
    22 +1.6983e+003 -1.8607e+002
    23 +5.0042e+001 -2.4227e+002
    24 +1.8709e+002 +9.0442e+001
   100 -5.0000e+002 +2.5000e+001
   200 +4.0500e+002 +7.0000e+001
   201 +6.5000e+002 +7.0000e+001
   202 +6.5500e+002 +7.3000e+001
   203 +7.2500e+002 +7.5000e+001
   204 +8.6000e+002 +1.2000e+002
   205 +9.0000e+002 +1.3000e+002
   206 +1.3500e+003 +1.6000e+002
   207 +1.5700e+003 +1.6500e+002
   208 +1.5700e+003 +3.0000e+001
   308 +1.5700e+003 +2.8000e+001
 LINE            6
     1    17
   100
     1
     2
```

✓ tested values

```
  200
  201
  202
  203
  204
  205
    4
    5
    6
    7
    8
    9
  206
  207
    2     15
  100
    1
    2
  200
  201
  202
  203
  204
  205
    4
    5
    8
    9
  206
  207
    3      7
  100
    1
    2
   11
   13
   15
  208
    4      9
  100
    1
    2
   10
   12
   11
   13
   15
  208
    5      9
  100
    1
    2
   10
   12
   14
   13
   15
```



```
  208
    6      8
  100
    1
    2
   10
   12
   14
   16
  308
TENSION
    0 +9.8070e+000 +0.0000e+000 +0.0000e+000      0
GRID
   24     19     17     20     20 0 +0.0000e+000 0 +0.0000e+000
RADIUS
   20     21     23     22     10     20     22
AXIS
    0
LIMIT
0 -5.0000e+002 +1.5700e+003
SLIP            0
BLOCK
    0      0      0      0      0 +1.2000e+002 +1.8000e+002 2 0
    0      0      0      0      0 +4.5000e+001 +8.0000e+001 2 2
PORU            6 +0.0000e+000
    1 +0.0000e+000      0
    2 +0.0000e+000      0
    3 +0.0000e+000      0
    4 +0.0000e+000      0
    5 +0.0000e+000      0
    6 +0.0000e+000      0
PIEZ            6 +0.0000e+000
    1      0      0
    2      0      0
    3      0      0
    4      0      0
    5      0      0
    6      0      0
PCON            0 +0.0000e+000
POGH            0 +0.0000e+000
POGP            0 +0.0000e+000
POGR            0 +0.0000e+000
PORA            6
    1 +0.0000e+000
    2 +0.0000e+000
    3 +0.0000e+000
    4 +0.0000e+000
    5 +0.0000e+000
    6 +0.0000e+000
LOAD            0
ANCHOR          0
PBOUNDARY       0
SEISMIC
+0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
NODE            0
ELEMENT         0
MATLCOLOR       6
```

no seismic

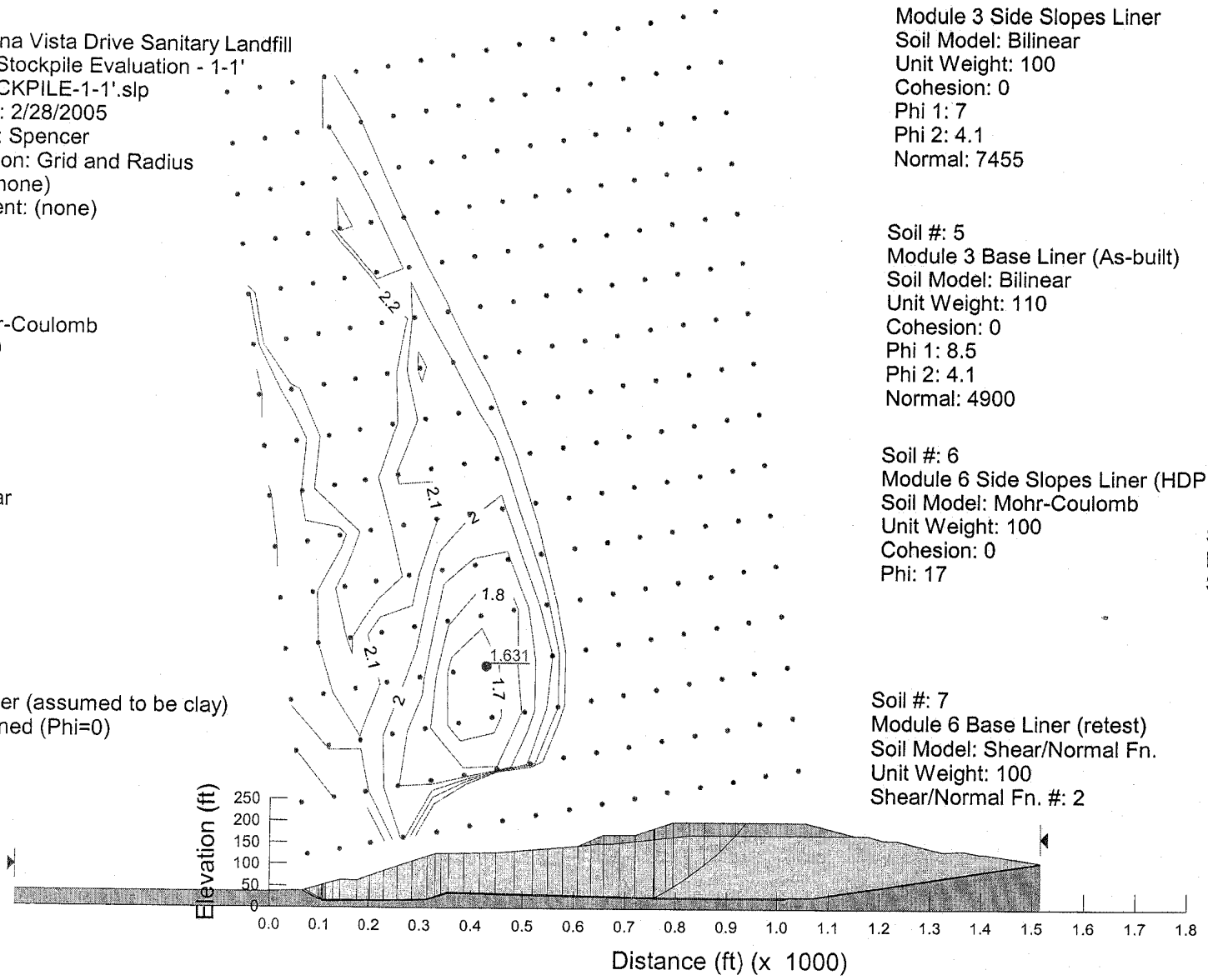
1	128	255	128
2	255	255	128
3	0	128	255
4	255	0	0
5	0	128	0
6	192	192	192

Description: Buena Vista Drive Sanitary Landfill
Comments: Big Stockpile Evaluation - 1-1'
File Name: STOCKPILE-1-1'.slp
Last Saved Date: 2/28/2005
Analysis Method: Spencer
Slip Surface Option: Grid and Radius
P.W.P. Option: (none)
Seismic Coefficient: (none)

Soil #: 1
Soil Stockpile
Soil Model: Mohr-Coulomb
Unit Weight: 100
Cohesion: 0
Phi: 33

Soil #: 2
Waste
Soil Model: Bilinear
Unit Weight: 65
Cohesion: 500
Phi 1: 0
Phi 2: 33
Normal: 770

Soil #: 3
Module 2 Base Liner (assumed to be clay)
Soil Model: Undrained (Phi=0)
Unit Weight: 130
Cohesion: 1000



Soil #: 4
Module 3 Side Slopes Liner
Soil Model: Bilinear
Unit Weight: 100
Cohesion: 0
Phi 1: 7
Phi 2: 4.1
Normal: 7455

Soil #: 5
Module 3 Base Liner (As-built)
Soil Model: Bilinear
Unit Weight: 110
Cohesion: 0
Phi 1: 8.5
Phi 2: 4.1
Normal: 4900

Soil #: 6
Module 6 Side Slopes Liner (HDPE/subgrade)
Soil Model: Mohr-Coulomb
Unit Weight: 100
Cohesion: 0
Phi: 17

Soil #: 8
Bedrock
Soil Model: Bedrock

Soil #: 7
Module 6 Base Liner (retest)
Soil Model: Shear/Normal Fn.
Unit Weight: 100
Shear/Normal Fn. #: 2

```
FILEINFO
SLOPEW 4.20
TITLE
Buena Vista Drive Sanitary Landfill
Big Stockpile Evaluation - 1-1'
2/28/2005
9:04:35 AM
ANALYSIS
     2      0      1 +6.2400e+001      1      0
CONVERGE
    30 +1.0000e-002  1000
SIDE
     1
LAMBDA
+0.0000e+000 +9.9900e+002 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
SOIL            9
     1 +1.0000e+002 +0.0000e+000 +3.3000e+001 +0.0000e+000 +0.0000e+000
+0.0000e+000   1  0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Soil Stockpile
     2 +6.5000e+001 +5.0000e+002 +0.0000e+000 +3.3000e+001 +7.7000e+002
+0.0000e+000   5  0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Waste
     3 +1.3000e+002 +1.0000e+003 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000   2  0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 2 Base Liner (assumed to be clay)
     4 +1.0000e+002 +0.0000e+000 +7.0000e+000 +4.1000e+000 +7.4550e+003
+0.0000e+000   5  0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 3 Side Slopes Liner
     5 +1.1000e+002 +0.0000e+000 +8.5000e+000 +4.1000e+000 +4.9000e+003
+0.0000e+000   5  0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 3 Base Liner (As-built)
```



```
     6 +1.0000e+002 +0.0000e+000 +1.7000e+001 +0.0000e+000 +0.0000e+000
+0.0000e+000   1  0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 6 Side Slopes Liner (HDPE/subgrade)
     7 +1.0000e+002 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000   9  0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    2
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 6 Base Liner (retest)
     8 -1.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000   4  0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Bedrock
     9 -1.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000   4  0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Bedrock
 SFUNCTION       2
     1      5 +1.9953e-003 +3.0000e+000
 As Built (Mod 4a CQA)
 +0.0000e+000 +0.0000e+000
 +2.0000e+003 +7.9800e+002
 +4.0000e+003 +1.3660e+003
 +8.0000e+003 +2.0340e+003
 +1.2000e+004 +2.7560e+003
     2      6 +0.0000e+000 +3.0000e+000
 Module 6-Base (retest)
 +0.0000e+000 +0.0000e+000
 +2.0000e+003 +4.9700e+002
 +4.0000e+003 +7.8600e+002
 +6.0000e+003 +1.1670e+003
 +1.0000e+004 +1.8250e+003
 +1.5000e+004 +1.8250e+003
 AFUNCTION       0
 POINT         506
     1 +1.0406e+003 +3.2121e+002
     2 +7.5556e+001 +1.2181e+002
     3 -1.0720e+002 +1.8904e+003
     4 -1.1929e+001 -1.1697e+001
     5 -7.2742e+000 -8.0668e+001
     6 +1.5810e+003 -8.3736e+001
     7 +1.5849e+003 +1.5402e+002
```

not used for 1-1'

V retest

```
 100 -5.0000e+002 +3.6000e+001
 101 +0.0000e+000 +3.6000e+001
 102 +6.6000e+001 +3.8000e+001
 103 +1.4100e+002 +6.3000e+001
 104 +1.7600e+002 +6.2000e+001
 105 +3.3100e+002 +1.2500e+002
 106 +4.4800e+002 +1.2700e+002
 107 +6.5000e+002 +1.5000e+002
 108 +6.7700e+002 +1.5000e+002
 109 +8.2900e+002 +1.7000e+002
 110 +8.4500e+002 +1.7000e+002
 114 +1.1760e+003 +1.7000e+002
 115 +1.2080e+003 +1.6000e+002
 116 +1.2350e+003 +1.5900e+002
 117 +1.3270e+003 +1.3400e+002
 118 +1.3630e+003 +1.3600e+002
 119 +1.3930e+003 +1.2900e+002
 120 +1.4100e+003 +1.2800e+002
 121 +1.5160e+003 +1.0800e+002
 203 +8.0000e+001 +3.0000e+001
 204 +9.8000e+001 +2.0000e+001
 205 +1.0300e+002 +1.8000e+001
 206 +1.0700e+002 +1.6000e+001
 207 +1.2700e+002 +1.6000e+001
 208 +2.5600e+002 +1.8000e+001
 209 +3.1400e+002 +2.0000e+001
 210 +3.4100e+002 +3.0000e+001
 211 +3.5500e+002 +3.6000e+001
 212 +5.2000e+002 +3.2000e+001
 213 +7.8000e+002 +2.6000e+001
 214 +1.0140e+003 +2.6000e+001
 215 +1.0270e+003 +2.8000e+001
 216 +1.0710e+003 +2.8000e+001
 217 +1.1100e+003 +3.5000e+001
 303 +6.6500e+001 +3.6000e+001
 304 +8.0000e+001 +2.8000e+001
 305 +9.7500e+001 +1.8000e+001
 306 +1.0300e+002 +1.6000e+001
 307 +1.0650e+002 +1.4000e+001
 308 +1.2700e+002 +1.4000e+001
 309 +2.5600e+002 +1.6000e+001
 310 +3.1450e+002 +1.8000e+001
 311 +3.4100e+002 +2.8000e+001
 312 +3.5550e+002 +3.4000e+001
 313 +5.2000e+002 +3.0000e+001
 314 +7.8000e+002 +2.4000e+001
 315 +1.0145e+003 +2.4000e+001
 316 +1.0270e+003 +2.6000e+001
 317 +1.0715e+003 +2.6000e+001
 318 +1.1105e+003 +3.3000e+001
 320 +1.5160e+003 +1.0600e+002
 401 -5.0000e+002 +0.0000e+000
 402 +1.5160e+003 +0.0000e+000
 501 +6.0700e+002 +1.4500e+002
 502 +6.5800e+002 +1.7000e+002
 503 +7.2000e+002 +1.7000e+002
 504 +7.9500e+002 +2.0000e+002
```



```
 505 +1.0540e+003 +2.0000e+002
 506 +1.1510e+003 +1.7000e+002
LINE            9
   1    21
 100
 101
 102
 103
 104
 105
 106
 501
 502
 503
 504
 505
 506
 114
 115
 116
 117
 118
 119
 120
 121
   2    21
 100
 101
 102
 103
 104
 105
 106
 501
 107
 108
 109
 110
 506
 114
 115
 116
 117
 118
 119
 120
 121
   3    19
 100
 101
 102
 203
 204
 205
 206
 207
 208
```

209
210
211
212
213
214
215
216
217
121
4 20
100
101
102
203
204
205
206
207
208
209
210
211
212
213
214
215
216
217
318
320
5 20
100
101
102
203
204
205
206
207
208
209
210
211
212
213
214
315
316
317
318
320
6 19
100
101
102
203

204
205
206
207
208
209
211
312
313
314
315
316
317
318
320
7 22
100
101
102
303
304
305
306
307
206
207
208
209
310
311
312
313
314
315
316
317
318
320
8 20
100
101
102
303
304
305
306
307
308
309
310
311
312
313
314
315
316
317

```
   318
   320
     9      2
   401
   402
 TENSION
      0 +9.8070e+000 +0.0000e+000 +0.0000e+000      0
 GRID
      2      1      3     15     15 0 +0.0000e+000 0 +0.0000e+000
 RADIUS
      4      7      5      6     10      4      7
 AXIS
      0
 LIMIT
 0 -5.0000e+002 +1.5160e+003
 SLIP             0
 BLOCK
      0      0      0      0      0 +1.2000e+002 +1.8000e+002 2 0
      0      0      0      0      0 +4.5000e+001 +8.0000e+001 2 2
 PORU             9 +0.0000e+000
      1 +0.0000e+000      0
      2 +0.0000e+000      0
      3 +0.0000e+000      0
      4 +0.0000e+000      0
      5 +0.0000e+000      0
      6 +0.0000e+000      0
      7 +0.0000e+000      0
      8 +0.0000e+000      0
      9 +0.0000e+000      0
 PIEZ             9 +0.0000e+000
      1      0      0
      2      0      0
      3      0      0
      4      0      0
      5      0      0
      6      0      0
      7      0      0
      8      0      0
      9      0      0
 PCON             0 +0.0000e+000
 POGH             0 +0.0000e+000
 POGP             0 +0.0000e+000
 POGR             0 +0.0000e+000
 PORA             9
      1 +0.0000e+000
      2 +0.0000e+000
      3 +0.0000e+000
      4 +0.0000e+000
      5 +0.0000e+000
      6 +0.0000e+000
      7 +0.0000e+000
      8 +0.0000e+000
      9 +0.0000e+000
 LOAD             0
 ANCHOR           0
 PBOUNDARY        0
 SEISMIC
```



```
 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
 NODE             0
 ELEMENT          0
 MATLCOLOR        9
      1    128    255    128
      2    255    255    128
      3      0    128      0
      4    128    255    255
      5    128    128    255
      6    255      0    128
      7    255      0      0
      8    255    128    128
      9      0    128      0
```

Description: Buena Vista Drive Sanitary Landfill
Comments: Big Stockpile Evaluation - 2-2'
File Name: STOCKPILE-2-2'.slp
Last Saved Date: 2/10/2005
Analysis Method: Spencer
Slip Surface Option: Grid and Radius
P.W.P. Option: (none)
Seismic Coefficient: (none)

Soil #: 1
Soil Stockpile
Soil Model: Mohr-Coulomb
Unit Weight: 100
Cohesion: 0
Phi: 33

Soil #: 2
Waste
Soil Model: Bilinear
Unit Weight: 65
Cohesion: 500
Phi 1: 0
Phi 2: 33
Normal: 770

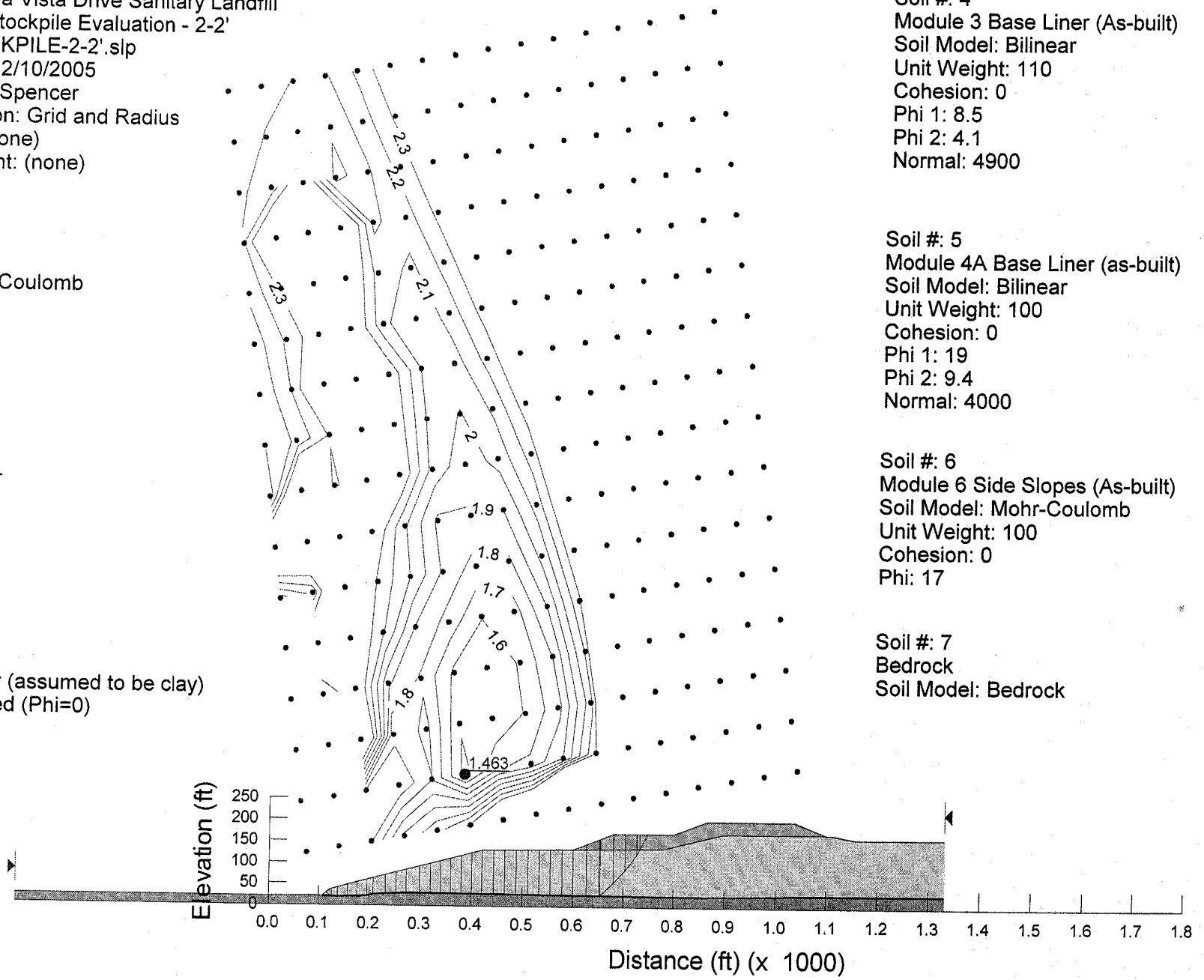
Soil #: 3
Module 2 Base Liner (assumed to be clay)
Soil Model: Undrained (Phi=0)
Unit Weight: 130
Cohesion: 1000

Soil #: 4
Module 3 Base Liner (As-built)
Soil Model: Bilinear
Unit Weight: 110
Cohesion: 0
Phi 1: 8.5
Phi 2: 4.1
Normal: 4900

Soil #: 5
Module 4A Base Liner (as-built)
Soil Model: Bilinear
Unit Weight: 100
Cohesion: 0
Phi 1: 19
Phi 2: 9.4
Normal: 4000

Soil #: 6
Module 6 Side Slopes (As-built)
Soil Model: Mohr-Coulomb
Unit Weight: 100
Cohesion: 0
Phi: 17

Soil #: 7
Bedrock
Soil Model: Bedrock



```
FILEINFO
SLOPEW 4.24
TITLE
Buena Vista Drive Sanitary Landfill
Big Stockpile Evaluation - 2-2'
2/10/2005
11:23:35 AM
ANALYSIS
     2      0      1 +6.2400e+001      1      0
CONVERGE
    30 +1.0000e-002  1000
SIDE
     1
LAMBDA
+0.0000e+000 +9.9900e+002 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
SOIL            8
     1 +1.0000e+002 +0.0000e+000 +3.3000e+001 +0.0000e+000 +0.0000e+000
+0.0000e+000    1   0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Soil Stockpile
     2 +6.5000e+001 +5.0000e+002 +0.0000e+000 +3.3000e+001 +7.7000e+002
+0.0000e+000    5   0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Waste
     3 +1.3000e+002 +1.0000e+003 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000    2   0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 2 Base Liner (assumed to be clay)
     4 +1.1000e+002 +0.0000e+000 +8.5000e+000 +4.1000e+000 +4.9000e+003
+0.0000e+000    5   0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 3 Base Liner (As-built)
     5 +1.0000e+002 +0.0000e+000 +1.9000e+001 +9.4000e+000 +4.0000e+003
+0.0000e+000    5   0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 4A Base Liner (as-built)
```



```
     6 +1.0000e+002 +0.0000e+000 +1.7000e+001 +0.0000e+000 +0.0000e+000
+0.0000e+000    1   0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Module 6 Side Slopes (As-built)
     7 -1.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000    4   0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Bedrock
     8 -1.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000    4   0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000    0    0
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
        +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
+0.0000e+000
 Bedrock
 SFUNCTION       1
     1      5 +1.9953e-003 +3.0000e+000
 As Built (Mod 4a CQA)
 +0.0000e+000 +0.0000e+000
 +2.0000e+003 +7.9800e+002
 +4.0000e+003 +1.3660e+003
 +8.0000e+003 +2.0340e+003
 +1.2000e+004 +2.7560e+003
 AFUNCTION       0
 POINT         402
     1 +1.0406e+003 +3.2121e+002
     2 +7.5556e+001 +1.2181e+002
     3 -1.0720e+002 +1.8904e+003
     4 -1.1929e+001 -1.1697e+001
     5 -7.2742e+000 -8.0668e+001
     6 +1.5810e+003 -8.3736e+001
     7 +1.5849e+003 +1.5402e+002
   100 -5.0000e+002 +2.0000e+001
   101 +0.0000e+000 +2.0000e+001
   102 +1.0800e+002 +2.1000e+001
   103 +1.2300e+002 +3.5000e+001
   104 +4.2100e+002 +1.3000e+002
   105 +6.0000e+002 +1.3300e+002
   106 +6.8000e+002 +1.7000e+002
   107 +8.0000e+002 +1.7000e+002
   108 +8.6600e+002 +2.0000e+002
   109 +1.0370e+003 +2.0000e+002
   110 +1.0380e+003 +2.0000e+002
   111 +1.1000e+003 +1.7000e+002
   112 +1.1100e+003 +1.7000e+002
   113 +1.1550e+003 +1.6000e+002
   114 +1.3320e+003 +1.6000e+002
   115 +7.8100e+002 +1.3500e+002
```

P:\PRJ2003Geo\Santa Cruz Co\Site Development (2004)\Slope Stability Stockpile\STOCKPILE-2-2'.slp 2/10/2005

```
   116 +8.9600e+002 +1.7000e+002
   117 +1.0880e+003 +1.7200e+002
   203 +1.3800e+002 +2.0000e+001
   204 +1.9500e+002 +2.2000e+001
   205 +2.0800e+002 +2.6000e+001
   206 +2.3200e+002 +2.8000e+001
   207 +2.7300e+002 +3.0000e+001
   208 +3.0000e+002 +3.0000e+001
   209 +7.2600e+002 +2.6500e+001
   210 +8.6600e+002 +2.5500e+001
   211 +1.0060e+003 +2.8000e+001
   212 +1.0420e+003 +3.0000e+001
   213 +1.3320e+003 +3.0000e+001
   303 +1.0850e+002 +1.9000e+001
   304 +1.3800e+002 +1.8000e+001
   305 +1.9550e+002 +2.0000e+001
   306 +2.0800e+002 +2.4000e+001
   307 +2.3200e+002 +2.6000e+001
   308 +2.7350e+002 +2.8000e+001
   309 +3.0000e+002 +2.8000e+001
   310 +7.2600e+002 +2.4500e+001
   311 +8.6600e+002 +2.3500e+001
   312 +1.0060e+003 +2.6000e+001
   313 +1.0425e+003 +2.8000e+001
   314 +1.3320e+003 +2.8000e+001
   401 -5.0000e+002 +0.0000e+000
   402 +1.3320e+003 +0.0000e+000
LINE            8
     1     15
   100
   101
   102
   103
   104
   105
   106
   107
   108
   109
   110
   111
   112
   113
   114
     2     13
   100
   101
   102
   103
   104
   105
   115
   116
   117
   111
   112
   113
```



```
   114
     3     14
   100
   101
   102
   203
   204
   205
   206
   207
   208
   209
   210
   211
   212
   213
     4     15
   100
   101
   102
   203
   204
   205
   206
   207
   208
   209
   210
   211
   212
   313
   314
     5     15
   100
   101
   102
   203
   204
   205
   206
   207
   308
   309
   310
   311
   312
   313
   314
     6     15
   100
   101
   102
   203
   204
   305
   306
   307
```

P:\PRJ2003Geo\Santa Cruz Co\Site Development (2004)\Slope Stability Stockpile\STOCKPILE-2-2'.slp 2/10/2005

```
    308
    309
    310
    311
    312
    313
    314
      7     15
    100
    101
    102
    303
    304
    305
    306
    307
    308
    309
    310
    311
    312
    313
    314
      8      2
    401
    402
TENSION
      0 +9.8070e+000 +0.0000e+000 +0.0000e+000      0
GRID
      2      1      3     15     15 0 +0.0000e+000 0 +0.0000e+000
RADIUS
      4      7      5      6     10      4      7
AXIS
      0
LIMIT
0 -5.0000e+002 +1.3320e+003
SLIP            0
BLOCK
      0      0      0      0      0 +1.2000e+002 +1.8000e+002 2 0
      0      0      0      0      0 +4.5000e+001 +8.0000e+001 2 2
PORU            8 +0.0000e+000
      1 +0.0000e+000      0
      2 +0.0000e+000      0
      3 +0.0000e+000      0
      4 +0.0000e+000      0
      5 +0.0000e+000      0
      6 +0.0000e+000      0
      7 +0.0000e+000      0
      8 +0.0000e+000      0
PIEZ            8 +0.0000e+000
      1      0      0
      2      0      0
      3      0      0
      4      0      0
      5      0      0
      6      0      0
      7      0      0
```



```
      8      0      0
PCON            0 +0.0000e+000
POGH            0 +0.0000e+000
POGP            0 +0.0000e+000
POGR            0 +0.0000e+000
PORA            8
      1 +0.0000e+000
      2 +0.0000e+000
      3 +0.0000e+000
      4 +0.0000e+000
      5 +0.0000e+000
      6 +0.0000e+000
      7 +0.0000e+000
      8 +0.0000e+000
LOAD            0
ANCHOR          0
PBOUNDARY       0
SEISMIC
+0.0000e+000 +0.0000e+000 +0.0000e+000 +0.0000e+000
NODE            0
ELEMENT         0
MATLCOLOR       8
      1    128    255    128
      2    255    255    128
      3      0    128      0
      4    128    128    255
      5    255    128      0
      6    255      0      0
      7    255    128    128
      8    255      0    128
```

No Dimic

P:\PRJ2003Geo\Santa Cruz Co\Site Development (2004)\Slope Stability Stockpile\STOCKPILE-2-2'.slp 2/10/2005

APPENDIX H
Preliminary Closure Cost Estimate

2021 PRELIMINARY CLOSURE COST ESTIMATE (1)
BUENA VISTA SANITARY LANDFILL
Santa Cruz County, California

FINAL COVER REQUIREMENTS:	Plan Area	Surface Area (2)(3)
Area Requiring Final Cover:	52 acres	53 acres
	2,265,120 sf	2,310,422 sf

		Unit	Quantity		Unit Cost	E M & L Markup (31)		Total Cost
A. FINAL COVER								
1. MOBILIZATION/DEMOBILIZATION and BONDING (4)								
a. Mobilization (5)		ls	1		$160,000	0%	$	160,000
b. Payment Bond (6)		ls	1		$56,651	0%	$	56,651
c. Performance Bond (6)		ls	1		$56,651	0%	$	56,651
d. Demobilization		ls	1		$53,333	0%	$	53,333
	Mobilization/Demobilization:						**$**	**326,636**
2. SOIL LAYERS (7) (8)								
a. Clearing, Grubbing, Stripping, Stockpiling (9)	6 in.	cy	42,786	$	2.83	0%	$	121,083
b. Foundation Layer - Recompaction (10)	12 in.	cy	85,571	$	3.33	0%	$	284,952
c. Foundation Layer - from Quarry (11)	12 in.	cy	85,571	$	15.28	0%	$	1,307,528
d. Vegetative Layer - from Quarry (11)	6 in.	cy	42,786	$	15.28	0%	$	653,764
e. Vegetative Layer - from Stripped (12)	6 in.	cy	42,786	$	9.69	0%	$	414,658
	Final Cover Soil Layers:						**$**	**2,781,985**
3. DRAINAGE LAYER								
a. Geocomposite (material) (8)(13)(29)		sf	1,855,269	$	0.90	15%	$	1,920,204
b. Geocomposite (installation) (8)(13)(29)		sf	1,855,269	$	0.30	35%	$	751,384
c. Cover Drains (6 in. Perforated Pipes)		ft	18,700	$	22.00	15%	$	473,110
d. Cover Drains (Gravel Around Pipes)		cy	1,560	$	45.00	15%	$	80,730
	Final Cover Drainage Layer:						**$**	**3,225,428**

4. BARRIER LAYER (13)							
a. 60-mil DST HDPE Geomembrane Top Deck and Slopes (material) (8)(14)	sf	2,541,465	$	0.80	15%	$	2,338,147
b. 60-mil DST HDPE Geomembrane Top Deck and Slopes (installation) (8)(14)	sf	2,541,465	$	0.37	35%	$	1,269,462
c. Geosynthetic Clay Liner Top Deck (material) (8)(14)	sf	686,195	$	0.65	15%	$	512,931
d. Geosynthetic Clay Liner Top Deck (installation) (8)(14)	sf	686,195	$	0.30	35%	$	277,909
e. Geosynthetic Boots for 100 wells (installed)	each	100	$	350	35%	$	47,250
Final Cover Barrier Layer:						**$**	**4,445,699**
5. ENGINEERING AND CONSTRUCTION MANAGEMENT							
a. Final Closure Plan (4)(15)(16)	ls	1	$	60,000	0%	$	60,000
b. Bid Documents (4)(15)(16)	ls	1	$	150,000	0%	$	150,000
c. Construction Management (4)	acre	53	$	3,000	0%	$	159,000
d. Surveying (4)	acre	53	$	1,500	0%	$	79,560
e. CQA Services (4)(17)(18)	acre	53	$	17,000	0%	$	901,680
f. As-Builts (4)	acre	53	$	1,200	0%	$	63,648
Final Cover Engineering and CM:						**$**	**1,413,888**
TOTAL FINAL COVER COSTS						**$**	**12,193,636**
B. EROSION CONTROL/REVEGETATION							
a. Hydroseeding (30)	acre	53		7,364	0%	$	390,568
b. Silt Fences and Fiber Rolls (Wattles)	ft	9,000		3.60	15%	$	37,260
Final Cover Revegetation:						**$**	**427,828**
	Unit	Quantity		Unit Cost			Total Cost
C. LEACHATE AND LANDFILL GAS MONITORING AND CONTROL							
a. LFG Monitoring Probe Installation (19)	ls	1	$	-	0%	$	-
b. LFG Extraction System (20)(21)	ls	1	$	18,000	0%	$	18,000
c. Leachate Extraction System (20)(21)	ls	1	$	12,000	0%	$	12,000
Leachate and LFG Monitoring and Control:						**$**	**30,000**

D. GROUNDWATER MONITORING SYSTEM						
a. Groundwater Monitoring System (22)	ls	1	$ -	0%		$0
GDW Monitoring System:					**$**	**-**
E. STORM-WATER MANAGEMENT SYSTEM						
a. Miscellaneous (23)	ls	1	$ 400,000	0%	$	400,000
Surface-Water Management System:					**$**	**400,000**
F. SECURITY INSTALLATION						
a. Security Fence (24)(25)	ft	150	$ 30	15%	$	5,175
b. Security Gates (24)	ls	1	$ -	0%	$	-
c. Signs (26)	each	3	$ 1,200	15%	$	4,140
Security Installation:					**$**	**9,315**
G. STRUCTURE REMOVAL						
a. Miscellaneous Structures (27)	ls	1	40,000	0%	$	40,000
Structure Removal:					**$**	**40,000**
H. ENVIRONMENTAL SYSTEM DECOMMISSIONING						
a. System Decommissioning (28)	ls	1	0	0%		$0
Environmental System Decommissioning:					**$**	**-**

PRELIMINARY CLOSURE COST SUMMARY

ITEM		COST
A. FINAL COVER	$	12,193,636
B. EROSION CONTROL/REVEGETATION	$	427,828
C. LEACHATE AND LANDFILL GAS MONITORING AND CONTROL	$	30,000
D. GROUNDWATER MONITORING SYSTEM	$	-
E. STORM-WATER MANAGEMENT SYSTEM	$	400,000
F. SECURITY INSTALLATION	$	9,315
G. STRUCTURE REMOVAL	$	40,000
H. ENVIRONMENTAL SYSTEM DECOMMISSIONING	$	-
SUBTOTAL	$	13,100,779
20% CONTINGENCY	$	2,620,156
TOTAL CLOSURE COSTS:	**$**	**15,720,935**

Notes:
ft - foot/feet; sf - square foot/foot; cy - cubic yard; ls - lump sum; sy - square yard; oz - ounce
1 - in 2021 Dollars. Costs include prevailing wages for labor, material and equipment costs, and taxes
2 - Assumes approximately 52 (in-plan) acres of closure area
3 - Assumes an average slope of 3H:1V
4 - Assumes closure performed in one phase
5 - Includes mobilization of earthwork equipment, office trailer(s), toilet(s), etc., and project management
6 - Payment and performance bond prices assumed as 0.5% of construction cost for items A2, A3, A4, A5, B, E, F, G
7 - Assumes soil materials not available on-site and will be delivered from the Aromas Quarry, approx. 15 miles from the BVSL
8 - Assumes anchor trenches included
9 - Assumes reusing the 6-in. stripped material for the upper 6-in. vegetative layer
10 - First 12 in. of 18-in. thick existing intermediate cover (after 6-in. stripping) will be used for the foundation layer. Assumes that the existing 12 in. of intermediate cover will have to be recompacted to meet the foundation layer specifications.
11 - Assumes Select Fill material delivered from the Aromas Quarry
12 - Includes soil from on-site stockpile and placement over geosynthetics with LGP equipment
13 - Area increased by 10% to include wastage and overlapping
14 - HDPE geomembrane and reinforced GCL (or equivalent) are included in BVSL final cover system
15 - Includes engineering analyses
16 - Includes Construction Drawings, Technical Specifications, CQA Plan and Bid Documents
17 - Includes laboratory conformance testing and CQA Report
18 - Includes leak location testing performed on the HDPE geomembrane
19 - No additional LFG monitoring probes are required
20 - Assumes that the leachate and LFG monitoring and extraction (control) systems will be in place and operational at the time of BVSL closure and only minor adjustments will be required
21 - Includes partially disassembling (and assembling) LFG and leachate system piping during final cover construction
22 - No additional groundwater monitoring wells are anticipated at time of closure
23 - Assumes that most of the Storm Water Management System (SWMS) will be constructed as part of landfill operations by the time of closure; only downdrains/overside drains above the final cover will need to be constructed
24 - Assumes that all security fencing and gates have already been installed at the time of closure since similar system needed during operations
25 - Supplemental fencing to fill gaps in the existing fencing
26 - Assumes that 3 additional bilingual signs will be installed around the BVSL
27 - Includes the mechanic shed, portable toilets, portable trailers, portable storage containers, bone yard area, etc.
28 - All environmental control and monitoring systems to remain through the closure period
29 - Double-sided geocomposite with 300 mil geonet sandwiched between two 8 oz/sy non-woven geotextiles
30 - EM&L Markup for Force Account - see Section 9-1.04 Force Account Caltrans 2018 Standard Specifications: Labor=35% (9-1.04B) Material=15% (9-1.04C) Equipment =15% (9-1.04D). This markup cost is included in the unit cost for some of the cost items.
31 - Construction water available on-site free of charge

BASIS FOR PRICES

Mobilization/Demobilization:
- Based on costs from 2 bidders for Altamont Landfill expansion projects in 2021
- Split mob/demob cost as 2/3 mob and 1/3 demob

Earthwork
- Aromas Quarry in Aromas, California 95004 - Don Barrett - Quarry Manager - personal communication on 29 April 2021
- Used Altamont LF, 2021 project bid for expansion project.
- RSMeans "Heavy Construction Cost Data," 2021 edition

Geosynthetics
- AgruAmerica, Inc., Walter Steinbeck - email dated 19 April 2021

Hydroseeding
- Superior Hydroseeding, Inc. - Josh Freeman (Manager) - email dated 27 May 2016
- For 2021, adjusted Superior Hydroseeding's cost by 3.5% per year for five years (2016-2021); verified with Means 2021 edition

Explanations:
- used a conversion factor of 1.3 tons/cy (per Caterpillar Performance Handbook, Edition 36, p. 27-4)

A2c/A2d - $11.75/ton or $15.28/cy Select Fill material (100% passing 1 inch sieve) delivered to the BVSL (for the upper 12 in. of foundation layer and lower 6 in. of the vegetative layer)

APPENDIX I
Preliminary Postclosure Cost Estimate

2021 PRELIMINARY POSTCLOSURE MAINTENANCE COST ESTIMATE
SUMMARY OF COSTS
Buena Vista Sanitary Landfill

Work Element	Annual Cost ($)
A. WORK ELEMENT - FINAL COVER INSPECTION	2,964
B. WORK ELEMENT - FINAL COVER MAINTENANCE AND REPAIR	44,883
C. WORK ELEMENT - REVEGETATION	20,195
D. WORK ELEMENT - LEACHATE MANAGEMENT SYSTEM MAINTENANCE AND REPAIR	28,363
E. WORK ELEMENT - LEACHATE MONITORING	5,302
F. WORK ELEMENT - LFG EXTRACTION SYSTEM MONITORING, MAINTENANCE AND REPAIR	91,023
G. WORK ELEMENT - LFG MONITORING	28,287
H. WORK ELEMENT - GROUNDWATER NETWORK MONITORING, MAINTENANCE AND REPAIR	58,834
I. WORK ELEMENT - STORMWATER MONITORING	3,743
J. WORK ELEMENT - SITE SECURITY INSPECTION AND MAINTENANCE	3,996
K. WORK ELEMENT - SETTLEMENT MONITORING AND SURVEY MONUMENT MAINTENANCE	5,899
L. WORK ELEMENT - POSTCLOSURE CERTIFICATION	624
Annual Postclosure Costs	**246,266**
30-YR POSTCLOSURE COSTS	**7,387,969**

General Notes:
- Prices in 2021 dollars
- Assumes approximately 52 acres in-plan area or 53 acres adjusted for slope
- Assumes an average slope of 3H:1V (horizontal to vertical) and top deck
- For contractors, use Caltrans 1Apr2021-31Mar22 rates for equipment
- For contractor equipment, labor, and material, add surcharges for Force Account work
  see Section 9-1.04B-D (Labor, Materials, Equipment) of Caltrans 2018 Standard Specifications
- For contractors labor rates use 2021 prevailing wages by the Director of Industrial Relations
  for Santa Cruz County and pay scales of wages plus benefits
- Estimated costs for services such as engineering inspections, surveying, monitoring, and sampling
  are based on consultants and laboratory 2021 rate schedules
- Water available on-site at no cost

ANNUAL COST

A. WORK ELEMENT - FINAL COVER INSPECTION

Labor Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Environmental Technician (1)(2)	16	hr	95	0%	1,520
Project Management (1)(3)	4	hr	220	0%	880
Subtotal					**2,400**

Material Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Miscellaneous	1	ls	150	0%	150
Tax	1	ls	9.00%		14
Subtotal					**164**

Equipment Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Service Truck (4)	2	day	200	0%	400
Subtotal					**400**

TOTAL	**2,964**

1 - Reporting included in GDW Monitoring Reports
2 - 4 hrs/qtr or 16 hrs/yr
3 - 1 hr/qtr or 4 hrs/yr
4 - 0.5 day/qtr or 2 days/yr

ANNUAL COST

B. WORK ELEMENT - FINAL COVER MAINTENANCE AND REPAIR

Labor Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Operating Engineer Area 1 Group 4 (1)	80	hr	78.66	35%	8,495
Operating Engineer Area 1 Group 4 (1)	40	hr	78.66	35%	4,248
Driver, Dump Truck (8-24 cy)	80	hr	32.83	35%	3,546
Laborer Area 2 Group 3, 3a (1)	80	hr	57.34	35%	6,193
Subtotal					**22,481**

Material Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Erosion Control Mat	1	ls	1,500	15%	1,725
Miscellaneous	1	ls	2,500	15%	2,875
Tax	1	ls	9.00%		414
Subtotal					**5,014**

Equipment Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
CAT D6M LGP Crawler Tractor (1)	80	hr	83.12	15%	7,647
Case 580B w/Backhoe (3)	40	hr	34.71	15%	1,597
Service Truck (1)	80	hr	36.92	15%	3,397
Truck On Highway 2 axles	80	hr	44.60	15%	4,103
Truck Mileage	1000	mile	0.56	15%	644
Subtotal					**17,388**

TOTAL	**44,883**

1 - 2 days/qtr or 8 days/yr or 80 hrs/yr
2 - 4 hrs/qtr or 16 hrs/yr
3 - 1 day/qtr or 4 days/yr or 40 hrs/yr
4 - assumes no geosynthetics are damaged

ANNUAL COST

C. WORK ELEMENT - REVEGETATION

Labor Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Project Management/Administration	1	ls	1500	0%	1,500
Total					**1,500**

Material Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Hydroseeding (2)(3)(4)	2	ac	7,364	15%	16,936
Tax (5)	1	ls	9.00%		1,524
Total					**18,461**

Equipment Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Service Truck	4	hr	36.92	15%	170
Truck Mileage	100	mile	0.56	15%	64
Total					**234**

TOTAL	**20,195**

1 - Includes truck, mileage and labor to coordinate and oversee revegetation
2 - Assumes that approx. 4% of 52 acres (or 2 acres) of landfill vegetated areas will require annual revegetation
3 - Cost per Superior Hydroseeding, Inc. in 2016; increased by 3.5%/year for five years in 2021
4 - Assumes no use of the "3-Step" method utilized for closure (therefore, lower unit cost)
5 - Taxes included in hydroseeding cost

ANNUAL COST

D. WORK ELEMENT - LEACHATE MANAGEMENT SYSTEM MAINTENANCE AND REPAIR

Labor Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Maintenance Technician (1)	60	hr	95.00	0%	5,700
Laborer Area 2 Group 3, 3a (2)	20	hr	57.34	35%	1,548
Project Management (3)	24	hr	220.00	0%	5,280
Total					**12,528**

Material Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Electricity	12	month	300	0%	3,600
Pump Replacement (4)	1	yr	3,500	15%	4,025
Computerized Control System (5)	1	yr	1,667	15%	1,917
Tax	1	ls	9.00%		859
Total					**10,401**

Equipment Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Service Truck (1)	60	hr	36.92	15%	2,547
Truck Mileage	600	mile	0.56	15%	386
Total					**2,934**

Leachate Disposal Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Leachate per year (6)	250000	gallons	0.01	0%	2,500
Total					**2,500**

TOTAL	**28,363**

1 - 5 hrs per month or 60 hrs/yr
2 - Assistance with pump replacement, etc.
3 - Assumes 2 hr/month or 24 hrs/yr
4 - Assumes 6 sumps; therefore, 6 pumps and each pump replaced every 5 yrs (or 30 pumps over 30 yrs) at a cost of $3,500/pump (or total cost of $105,000) - annualized cost of $3,500
5 - Assumes the $50,000 system replaced once in 30 yrs - annualized cost - $1,667
6 - Actual cost from County: Santa Cruz County POTW equals $0.01/gallon

ANNUAL COST

E. WORK ELEMENT - LEACHATE MONITORING

Labor Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Environmental Technician (1)(2)	8	hr	95	0%	760
Project Manager (1)	2	hr	220	0%	440
Total					**1,200**

Material Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Analytical Cost (2)(3)(4)(5)	6	sample	555	0%	3,330
Miscellaneous (ice, cooler, towel, etc.)	1	ls	250	0%	250
Tax	1	ls	9.00%		322
Total					**3,902**

Equipment Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Sampling Truck (2)	1	day	200	0%	200
Total					**200**

TOTAL	**5,302**

1 - Reporting included in the Semiannual Groundwater Monitoring Report
2 - Per the WDRs, the 6 sumps are to be sampled annually and samples analyzed for the parameters/constituents
3 - Undiscounted prices provided by Test America Laboratories, Inc.
4 - Analytical test unit prices: VOCs = $104; nitrate + chloride + sulfate + sodium = $76; TDS = $19; COD = $36; Dissolved Manganese = $16; Dissolved Iron = $16; Total Iron = $16; Total Chromium = $16 (Total $299 per sample) Increased by 3.5%/year since 2016 (i.e., 5 years); therefore, total $355 per sample
5 - $200/sample increase to account for COC testing every 5 years

ANNUAL COST

F. WORK ELEMENT - LFG EXTRACTION SYSTEM MONITORING, MAINTENANCE AND REPAIR

Labor Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Staff Engineer (1)	40	hr	130	0%	5,200
Operation/Maintenance Technician (2) (3)	457.6	hr	95	0%	43,472
Project Manager (4)	30	hr	220	0%	6,600
Total					**55,272**

Material Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Flare Electricity	12	month	400	0%	4,800
LFG Wellhead (5)	1	yr	3,168	15%	3,643
LFG Pipeline (6)	500	ft	19.94	15%	11,466
Miscellaneous (7)	1	ls	3,000	15%	3,450
Tax	1	ls	9.00%		432
Total					**23,791**

Equipment Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Field Truck (8)	52	day	200	15%	11,960
Total					**11,960**

TOTAL	**91,023**

1 - 10 hrs/qtr or 40 hrs/yr, incl., reporting
2 - Assumes 8 hrs/week or 416 hrs/yr plus 10% assistant technician's time
3 - Assistance with pump replacement, etc.
4 - Includes data review and reporting
5 - Assuming 100 LFG wells and wellheads replaced two times at each well over 30 yrs;
i.e., 200 wellheads x $400 each = $80,000 - annualized cost $2,667;
increased by 3.5% per year for 2016-2021 ($3,168)
6 - Assumes pipe replacement of 500 ft/yr; increased 2016 cost by 3.5%/year to 2021 (5 years)
7 - Includes valves, header pipes, etc.
8 - 1 day/week or 52 days/yr

ANNUAL COST

G. WORK ELEMENT - LFG MONITORING

Labor Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Environmental Technician (1)	48	hr	95	0%	4,560
Staff Engineer (2)	20	hr	130	0%	2,600
Project Manager (3)	16	hr	220	0%	3,520
Clerical (4)	8	hr	68	0%	544
Total					**11,224**

Material Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Analytical Cost (5)	2	sample	328	0%	656
Analytical Cost (6)(8)	60	sample	205	0%	12,300
Tax	1	ls	9.00%		1,107
Total					**14,063**

Equipment Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Field Truck (7)	6	day	200	0%	1,200
Field LFG Analyzer (7)	6	day	300	0%	1,800
Total					**3,000**

TOTAL	**28,287**

1 - 12 hrs/qt or 48 hr/yr, incl., perimeter + surface + buildings monitoring, and probe sampling
2 - 5 hrs/qr or 20 hrs/yr, incl. reporting
3 - 4 hrs/qr or 16 hrs/yr, incl. reporting
4 - 2 hr/qr or 8 hrs/yr
5 - Per the WDRs, annual sampling of LFG condensate and LFG collection header
6 - 15 LFG probes x 4 quarters (see Figure 2, Geosyntec May 2019 GW Monit Report)
Account for CalRecycle compliance probes only
7 - 1.5 days per quarter (or 6 days per yr)
8 - LFG probes to be sampled/analyzed quarterly for VOCs (TO-14) and field tested for methane, carbon dioxide and oxygen

ANNUAL COST

H. WORK ELEMENT - GROUNDWATER NETWORK MONITORING, MAINTENANCE AND REPAIR

Labor Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Environmental Technician (1)	80	hr	95	0%	7,600
Staff Engineer (2)	80	hr	130	0%	10,400
Project Manager (3)	20	hr	220	0%	4,400
Clerical	12	hr	68	0%	816
Total					**23,216**

Material Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Well Repair Materials (5)	1	yr	200	15%	230
Pump Replacement (6)	1	yr	1,120	15%	1,288
Analytical Cost (7)(8)(4)	30	sample	490	0%	14,700
Tax	1	ls	9.00%		1,460
Total					**17,678**

Equipment Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Well Replacement (9)(10)	1	yr	14,000	15%	16,100
Sampling Truck	8	day	200	15%	1,840
Total					**17,940**

TOTAL	**58,834**

1 - 40 hrs/semiannually measure quarterly water Levels in 15 wells + sample 15 wells semiannually +well maintenance and repair (as needed)
2 - Includes sampling coordination and reporting (incl. statistical analysis)
3 - 5 hrs/qr or 20 hrs/yr, including reporting and project management
4 - $200/sample increase to account for COC testing every 5 years (Total cost for COC testing = $1,000/sample spread out over 5 years)
5 - Includes well materials such as well cap, security stove pipe, bollards, etc
6 - Assumes each pump replaced every 10 yrs at $800/each so 3 pumps in each well in 30 yrs or a total of 42 pumps at $33,600 in 30 yrs - annualized cost = $1,120
7 - Per the WDRs, 15 monitoring wells are to be sampled/analyzed semiannually (or 30 samples/yr)
8 - Analytical test unit prices: VOCs = $70; nitrate + chloride + sulfate + sodium = $85; TDS = $15; COD = $20; Dissolved Manganese = $25; Dissolved Iron = $25; Total Iron = $25; Total Chromium = $25 (Total $290/sample)
9 - Assumes 1 well replaced every 20 yrs at $20,000 per well. There are 14 wells and each well would be replaced 1.5 times in 30 yr. Based on this, estimated 21 replacement wells (1.5 x 14 wells) in 30 yrs = $420,000 (21 wells x $20K) - annualized cost = $14,000
Assume water supply which is not owned by County is not part of well replacement program
10 - Includes consulting/supervision costs

ANNUAL COST

I. WORK ELEMENT - STORMWATER MONITORING

Labor Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Environmental Technician (1)	8	hr	95.00	0%	760
Project Management (2)(3)	2	hr	220.00	0%	440
Total					**1,200**

Material Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Total Dissolved Solids (TDS) [7]	2	ea	47.25	0%	95
Total Organic Carbon (TOC) [7]	2	ea	78.75	0%	158
Total Alkalinity (as CaCO3) [7]					
Carbonate (as CO3) [7]	2	ea	47.25	0%	95
Bicarbonate (as HCO3) [7]					
Chloride [7]					
Nitrate (as Nitrogen) [7]	2	ea	126.00	0%	252
Sulfate [7]					
Sulfide [6]	2	ea	20.00	0%	40
Fluoride (F) [6,10]	2	ea	30.00	0%	60
Ammonia (as Nitrogen) [7]	2	ea	47.25	0%	95
Iron (Fe) [7]					
Calcium (Ca) [7]					
Magnesium (Mg) [7]					
Manganese (Mn) [6]	2	ea	56.00	0%	112
Sodium (Na) [7]					
Aluminum (Al)					
Potassium (K) [7]					
Nitrate as N, Nitrite as N, Orthophosphorus as PO4 [6,10]	2	ea	30.00	0%	60
Boron (B) [6]	2	ea	8.00	0%	16
Total Petroleum Hydrocarbons (TPH) (gasoline, diesel, crude oil) [7]	2	ea	72.50	0%	145
Volatile Organic Compounds (VOCs) [7]	2	ea	183.75	0%	368
TDS (Sum of Ions) vs TDS (Measured) [11]	2	ea	0.00	0%	0
TDS/Electrical Conductivity [6,8,10]	2	ea	7.00	0%	14
Cation/Anion Balance[9]	2	ea	0.00	0%	0
Tax	1	ls	0.09		136
Total					**1,643**

Equipment Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Field Truck (4)	2	day	200.00	0%	400
Miscellaneous (5)	2	event	250.00	0%	500
Total					**900**

TOTAL	**3,743**

1 - Includes sampling 2 times a year (2 events) and includes travel
2 - 4 hr per sampling event, 2 events per year
3 - Reporting included in groundwater monitoring/reporting
4 - Assumes 1 sample and 2 events per year
5 - Field meters (turbidity, multiparameter meter)
6 - Cost estimate provided by Eurofins Calscience LLC on April 21, 2021
7 - Cost estimate provide by Torrent Laboratory Inc. on April 20, 2021
8 - Estimate for analyzing electrical conductivity for calculation.
9 - No testing cost listed because Cation/Anion Balance will be estimated using the LENNTECH Water Analysis Accuracy Tester Calculatur retrieved from https://www.lenntech.com/calculators/accuracy/accuracy-water-analysis.htm

10 - Nitrate as N, Nitrite as N, Orthophosphorus as PO4 and Fluoride were added to estimate the TDS-Electrical Conductivity LENNTECH Calculator retrieved from https://www.lenntech.com/calculators/tds/tds-ec_engels.htm
11 - No testing cost listed because calculation is based on TDS test data

ANNUAL COST

J. WORK ELEMENT - SITE SECURITY INSPECTION AND MAINTENANCE

Labor Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Operating Engineer Area 1 Group 4 (1)	8	hr	78.66	35%	850
Laborer Area 2 Group 3, 3a (1)	8	hr	57.34	35%	619
Subtotal					**1,469**

Material Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Miscellaneous (2)	1	ls	1,000	15%	1,150
Tax	1	ls	9.00%		104
Subtotal					**1,254**

Equipment Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Crawler Mounted Auger/Watson 2000CM (1)	8	hr	101.57	15%	934
Service Truck (1)	8	hr	36.92	15%	340
Subtotal					**1,274**

TOTAL	**3,996**

1 - Assumes 8 hrs/yr

2 - Fencing and gate supplies

ANNUAL COST

K. WORK ELEMENT - SETTLEMENT MONITORING AND SURVEY MONUMENT MAINTENANCE

Labor Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Survey Ground Control (1)	1	yr	960	0%	960
Topographic Map (2)	1	yr	2,200	0%	2,200
Iso-Settlement Map (3)	1	yr	364	0%	364
Project Manager (4)(5)	1	yr	440	0%	440
Monument Maintenance	1	yr	300	0%	300
Subtotal					**4,264**

Material Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Miscellaneous	1	ls	300	0%	300
Tax	1	ls	9.00%		27
Subtotal					**327**

Equipment Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Field Truck (5)	6	day	200	0%	1,200
Tax	1	ls	9.00%		108
Subtotal					**1,308**

TOTAL	**5,899**

1 - $300/hr for 16 hrs for 2-man crew every 5 yrs or 6 events in 30 yrs - total cost = $28,800 - annualized cost of $960

2 - Topo map needed every 5 years. Over 30 years, need 6 events. Each topo map approx. $11,000 x 6 = $66,000 - annualized cost - $2,200

3 - Estimated $1,820 x 6 = $10,920 - annualized cost - $364 (i.e., $10,920 divided by 30 years)

4 - 10 hrs/event x $220/hour x 6 events in 30 yrs = $13,200 - annualized cost - $440

5 - One site meeting every 5 years over 30 years (6 meetings)

ANNUAL COST

L. WORK ELEMENT - POSTCLOSURE CERTIFICATION

Labor Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Report (1)(2)	1	yr	460	0%	460
Subtotal					**460**

Material Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
Miscellaneous	1	ls	150	0%	150
Tax	1	ls	9.00%		14
Subtotal					**164**

Equipment Cost

Description	Quantity	Unit	Unit Rate ($)	Surcharge (%)	Total Cost ($)
None					
Tax	1	ls	9.00%		0
Subtotal					**0**

TOTAL	**624**

1 - Assumes one certification report costing approx. 50 hrs of Staff Engineer (50 hrs x $130=$6,500), 30 hrs of Project Manager (30 hrs x $220=$6,600) and 10 hrs clerical (10 hrs x $68=$680)

2 - Annualized costs - $13,780 x 1 report / 30 years = $460

APPENDIX J
Financial Mechanism Documentation

OPERATING LIABILITY, SELF-INSURANCE CERTIFICATION WITH RELATED DOCUMENTS AND APPROVALS

#

STATE OF CALIFORNIA

Pete Wilson, Governor

CALIFORNIA INTEGRATED WASTE MANAGEMENT BOARD

1020 Ninth Street, Suite 100
Sacramento, California 95814

JUN 15 1993



John A. Fantham, Director
County of Santa Cruz Department
of Public Works
701 Ocean Street
Santa Cruz, CA 95060-4070

Subject: Certificate of Self-Insurance and Risk Management/Closure and Postclosure Maintenance for Buena Vista Landfill, Facility No. 44-AA-0004

Dear Mr. Fantham:

The Financial Assurances Section evaluated the Certificate of Self-Insurance and Risk Management, submitted by the County of Santa Cruz in support of liability coverage for the subject facility.

As a result of the evaluation, we determined that the Certificate meets the requirements of Title 14, California Code of Regulations, Division 7, Chapter 5, Article 3.3, section 18237.

As a reminder, we have not yet received the financial assurance mechanism to cover closure and postclosure maintenance of the subject facility. Please submit the appropriate documentation to this office as soon as possible.

Thank you for your cooperation.

If you have any questions, please contact me at (916) 255-2445.

Sincerely,

Diana Thomas

Diana Thomas
Associate Governmental Program Analyst
Financial Assurances Section
Permitting and Compliance Division

cc: Jeff Hackett, Compliance Branch, CIWMB
Amalia Fernandez, Permits Branch, CIWMB
David Melendrez, Closure and Remediation Branch, CIWMB

Folder 111

DEPARTMENT OF
PUBLIC WORKS

COUNTY OF SANTA CRUZ

GOVERNMENTAL CENTER

701 OCEAN STREET SANTA CRUZ, CALIFORNIA 95060-

FAX (408) 454-2385

JOHN A. FANTHAM
DIRECTOR OF PUBLIC WORKS

THOMAS L. BOLICH (408) 454-2302
(CALNET #) 564-2302
ASST. DIRECTOR OPERATIONS

BRIAN H. TURPEN (408) 454-2160
(CALNET #) 564-2160
ASST. DIRECTOR PUBLIC SERVICES
ENGINEERING

June 7, 1993

MR. JEFF HACKETT
California Integrated Waste Management Board
8800 Cal Center Drive
Sacramento, CA 95826

SUBJECT: CERTIFICATE OF SELF-INSURANCE AND RISK MANAGEMENT

Dear Mr. Hackett:

Attached you will find the signed Certificate of Self Insurance and Risk Management as required under Title 14, Division 7, Chapter 5, Article 3.3 "Financial Responsibility for Operating Liability Claims." Included with the certificate are copies of the Departmental Liability Claims Review Procedures, Department of Public Works Liability Management Program, County Injury and Illness Prevention Program, and the Department of Public Works letter to the County Board of Supervisors summarizing the requirements, directives, and personnel responsibilities for landfill operational liability prevention.

The attached Certificate of Self-Insurance and Risk Management and supplemental information fulfills the requirements of the above cited regulations. The Santa Cruz County Department of Public Works respectfully requests a letter of approval from your Board acknowledging the County's compliance with the landfill operators liability requirements.

If you have any questions concerning this matter or require additional information, please direct them to Patrick Mathews of my staff at (408) 454-2160.

Yours truly,

JOHN A. FANTHAM
Director of Public Works

RPM:mg
Attachments
Copy to: Ron Whipp, Risk Management (w/certificate)
Samuel Torres, County Counsel (w/certificate)
CAO (w/certificate)
Ray Dodson, Public Works (w/certificate)

jhm

CERTIFICATE OF SELF-INSURANCE AND RISK MANAGEMENT

(If additional space is needed, add attachment.)

Operator SANTA CRUZ COUNTY DEPARTMENT OF PUBLIC WORKS SOLID WASTE DIVISION	Address 701 OCEAN STREET, ROOM 410 SANTA CRUZ, CA 95060
Risk Manager RONALD WHIPP	Address (if different from above) 701 OCEAN STREET, ROOM 510 SANTA CRUZ CA 95060

Solid Waste Disposal Facilities Covered: (Enter Information for Each Facility) LIMITS OF LIABILITY

Name	Address	Facility Information Number	Per Occurrence*	Annual Aggregate*
BUENA VISTA LANDFILL	1231 BUENA VISTA DRIVE	44-AA-0004	$1,000,000.00	$1,000,000.00
	WATSONVILLE, CA			
	95076			
			$1,000,000.00 TOTAL	$1,000,000.00 TOTAL

*Excluding legal defense costs

CERTIFICATION:

1. The operator and risk manager named above hereby certify that the facilities listed above are self-insured for third party bodily injury and property damage in connection with the operator's obligation to demonstrate financial responsibility under Title 14, California Code of Regulations, Division 7, Chapter 5, Article 3.3. The coverage applies to the above-listed facility(ies) for accidental occurrences arising from the operations of the facility(ies).

2. The limits of liability are the amounts stated above for "per occurrence" and "annual aggregate", exclusive of legal defense costs.

3. Indicate whether this coverage is ☒ primary or ☐ excess coverage.

4. Upon request by the Board, the operator agrees to furnish to the Board any documents pertinent to this coverage.

5. Termination of this coverage, will be effective only upon written notice, sent by certified mail, and only after the expiration of 60 days after a copy of such written notice is received by the Board and the local enforcement agency for the jurisdiction in which the facility is located, as evidenced by the return receipts.

The parties below certify and sign under penalty of perjury that the information in this document is true and correct to the best of his or her knowledge, and that this document is being executed in accordance with the requirements of Title 14, California Code of Regulations, Division 7, Chapter 5, Article 3.3, Section 18237.

Operator's Signature	Title DIRECTOR OF PUBLIC WORKS
Typed or Printed Name of Person Signing JOHN A. FANTHAM	Date 5/25/93
Risk Manager's Signature Ronald D. Whipp	Title RISK MANAGER
Typed or Printed Name of Person Signing RONALD WHIPP	Date 5/26/93

PRIVACY STATEMENT

This information is requested by the California Integrated Waste Management Board under Title 14, California Code of Regulations, Division 7, Chapter 5, Article 3.3, Section 18237 in order to verify adequate financial assurance of solid waste disposal facilities. Completion of this form is mandatory. The consequence of not completing the form is denial or revocation of a permit to operate a solid waste disposal facility. Information may be provided to the U.S. Environmental Protection Agency, State Attorney General, Air Resources Board, California Department of Toxic Substances Control, Energy Resources Conservation and Development Commission, Water Resources Control Board, and California Regional Water Quality Control Boards. For more information or access to your records, contact the California Integrated Waste Management Board, 8800 Cal Center Drive, Sacramento, California 95826, (916) 255-2200.

CERTIFICATE OF SELF-INSURANCE AND RISK MANAGEMENT

(If additional space is needed, add attachment.)

Operator: SANTA CRUZ COUNTY DEPARTMENT OF PUBLIC WORKS SOLID WASTE DIVISION	Address: 701 OCEAN STREET, ROOM 410 SANTA CRUZ, CA 95060
Risk Manager: RONALD WHIPP	Address (if different from above): 701 OCEAN STREET, ROOM 510 SANTA CRUZ CA 95060

Solid Waste Disposal Facilities Covered: (Enter Information for Each Facility)

Name	Address	Facility Information Number	LIMITS OF LIABILITY Per Occurrence*	Annual Aggregate*
BUENA VISTA LANDFILL	1231 BUENA VISTA DRIVE	44-AA-0004	$1,000,000.00	$1,000,000.00
	WATSONVILLE, CA			
	95076			
			$1,000,000.00 TOTAL	$1,000,000.00 TOTAL

*Excluding legal defense costs

CERTIFICATION:

1. The operator and risk manager named above hereby certify that the facilities listed above are self-insured for third party bodily injury and property damage in connection with the operator's obligation to demonstrate financial responsibility under Title 14, California Code of Regulations, Division 7, Chapter 5, Article 3.3. The coverage applies to the above-listed facility(ies) for accidental occurrences arising from the operations of the facility(ies).

2. The limits of liability are the amounts stated above for "per occurrence" and "annual aggregate", exclusive of legal defense costs.

3. Indicate whether this coverage is ☒ primary or ☐ excess coverage.

4. Upon request by the Board, the operator agrees to furnish to the Board any documents pertinent to this coverage.

5. Termination of this coverage, will be effective only upon written notice, sent by certified mail, and only after the expiration of 60 days after a copy of such written notice is received by the Board and the local enforcement agency for the jurisdiction in which the facility is located, as evidenced by the return receipts.

The parties below certify and sign under penalty of perjury that the information in this document is true and correct to the best of his or her knowledge, and that this document is being executed in accordance with the requirements of Title 14, California Code of Regulations, Division 7, Chapter 5, Article 3.3, Section 18237.

Operator's Signature	Title DIRECTOR OF PUBLIC WORKS
Typed or Printed Name of Person Signing JOHN A. FANTHAM	Date 5/25/93
Risk Manager's Signature	Title RISK MANAGER
Typed or Printed Name of Person Signing RONALD WHIPP	Date 5/26/93

PRIVACY STATEMENT

This information is requested by the California Integrated Waste Management Board under Title 14, California Code of Regulations, Division 7, Chapter 5, Article 3.3, Section 18237 in order to verify adequate financial assurance of solid waste disposal facilities. Completion of this form is mandatory. The consequence of not completing the form is denial or revocation of a permit to operate a solid waste disposal facility. Information may be provided to the U.S. Environmental Protection Agency, State Attorney General, Air Resources Board, California Department of Toxic Substances Control, Energy Resources Conservation and Development Commission, Water Resources Control Board, and California Regional Water Quality Control Boards. For more information or access to your records, contact the California Integrated Waste Management Board, 8800 Cal Center Drive, Sacramento, California 95826, (916) 255-2200.

AGENDA: MARCH 23, 1993

DEPARTMENT OF
PUBLIC WORKS

GOVERNMENTAL CENTER

JOHN A. FANTHAM
DIRECTOR OF PUBLIC WORKS

THOMAS L. BOLICH (408) 454-2302
(CALNET #) 564-2302
ASST. DIRECTOR OPERATIONS

BRIAN H. TURPEN (408) 454-2160
(CALNET #) 564-2160
ASST. DIRECTOR PUBLIC SERVICES
ENGINEERING

COUNTY OF SANTA CRUZ

701 OCEAN STREET SANTA CRUZ, CALIFORNIA 95060-4070

FAX (408) 454-2385

March 16, 1993

Board of Supervisors	After Board Action copies mailed to:	No.
APPROVED	Auditor	
County of Santa Cruz	C.A.O.	
Date 3/23/93 Vol. 93	Co. Counsel	
By _____	Public Works	
Deputy Clerk of the Board		

SANTA CRUZ COUNTY BOARD OF SUPERVISORS
701 Ocean Street
Santa Cruz, California 95060

SUBJECT: CERTIFICATION OF SELF-INSURANCE AND RISK MANAGEMENT FOR OPERATING LIABILITY AT THE BUENA VISTA LANDFILL

Members of the Board:

Risk Management, Public Works and County Counsel have reviewed the options available to the County for compliance with mandated operating liability coverage for solid waste disposal facilities in accordance with Title 14 California Code of Regulations, Division 7, Chapter 5, Article 3.3, Section 18237. It is this group's consensus that the most cost effective method of complying with these regulations is through the development of a Self-Insurance and Risk Management Program.

Under Section 18237 of the above referenced code, to be eligible to use the self-insurance and risk management mechanism an operator must meet the following criteria:

1. Be a public entity.
2. Be self-insured.
3. Employ a Risk Manager.
4. Have an active safety and loss prevention program that seeks to minimize the frequency and magnitude of third party damages caused by accidental occurrences and other self-insured losses.
5. Have procedures for, and a recent history of, timely investigation and resolution of any claims for third party damages caused by accidental occurrences and other self-insured losses.
6. Satisfy any other reasonable conditions that the California Integrated Waste Management Board determines are needed to ensure that the assured amount of funds shall be available in a timely manner.

FILED 3/23/93
SUSAN A. MAURIELLO, COUNTY ADMINISTRATIVE OFFICER AND EX-OFFICIO CLERK OF THE BOARD OF SUPERVISORS OF THE COUNTY OF SANTA CRUZ, CALIFORNIA

BY _____ DEPUTY

The County meets or exceeds all of the above criteria necessary to qualify for use of the self-insurance risk management mechanism. The County is self-insured and employs a full time Risk Manager. The Risk Manager is assisted by a full time Liability Programs Analyst and, where necessary, contracted professional investigators. In addition, the County also employs a full time Occupational Safety and Health Program Manager, responsible for the safety and health of the work environments for county employees, safety programs and implementation of the County Injury and Illness Prevention Plan; a Hazardous Materials Programs Specialist, responsible for coordination of all County hazardous materials/waste management programs; a Public Works Safety Officer, responsible for management and implementation of all Public Works safety programs, including the Solid Waste Division; a Solid Waste Engineering and Environmental Compliance Manager, responsible for all aspects of solid waste facility environmental management programs; and a Solid Waste Operations Manager, responsible for landfill personnel and public safety at County solid waste facilities. Additionally, monthly tailgate safety training and annual reviews of procedural guidelines are conducted with all solid waste employees by the site manager, safety officer or engineering manager.

The Public Works Department has also established a Departmental Liability Committee composed of Public Works Managers, the County Risk Manager and County Counsel. The purpose of this committee is to regularly review third party liability claims and implement changes in Department policy necessary to minimize future claims. This committee developed the Department of Public Works Liability Management Program as adopted by your Board on February 23, 1993. Risk Management within the County is self administered using computerized claims tracking. Liability Programs Procedures (XXIII.I) and Departmental Claims Review Procedures (XXIII.9) are outlined in the County Policies and Procedures Manual.

The County's Buena Vista Landfill operates under permit conditions from the Integrated Waste Management, Regional Water Quality Control Board, Monterey Bay Unified Air Pollution Control District, California Department of Toxic Substances Control (Household Hazardous Waste Program), County Environmental Health and Planning (land use). Conditions established under each of these permits are site specific and are intended to maintain strict compliance with all applicable Federal, State and Local environmental, health and safety regulation. Frequent environmental monitoring is required under each of these permits to verify compliance with permit conditions.

It is recommended that the Board of Supervisors take the following action:

1. Accept and file this report.

2. Authorize the County Risk Manager and the Director of Public Works to sign the attached Certificate of Self-Insurance and Risk Management on behalf of the County.

3. Direct Public Works to submit the signed Certificate of Self-Insurance and Risk Management, along with all above referenced materials, to the Integrated Waste Management Board for approval.

Yours truly,

JOHN A. FANTHAM
Director of Public Works

RPM:pf

Attachments

RECOMMENDED FOR APPROVAL:

_____
County Administrative Officer

Copy to: Ron Whipp, Risk Management
Tom Franco, Occupational Safety and Health Manager
Samuel Torres, County Counsel
Peter Cota-Robles, CAO
Auditor-Controller
✓Public Works

CSp

RESOLUTIONS ESTABLISHING CLOSURE/POST-CLOSURE FUNDING MECHANISMS WITH RELATED DOCUMENTS AND APPROVALS

STATE OF CALIFORNIA

Pete Wilson, Governor

CALIFORNIA INTEGRATED WASTE MANAGEMENT BOARD

8800 Cal Center Drive
Sacramento, California 95826



October 7, 1993

John A. Fantham, Director
County of Santa Cruz
Department of Public Works
701 Ocean Street
Santa Cruz, CA 95060-4070

Dear Mr. Fantham:

Subject: Approval of Financial Assurance Mechanisms for Closure and Postclosure Maintenance Costs for the Buena Vista Landfill, Facility No. 44-AA-0004

The California Integrated Waste Management Board (Board) staff reviewed the financial assurance mechanisms for the subject facility.

As a result of this review, the Board finds that the Enterprise Fund and Pledge of Revenue Agreement meet the requirements of Title 14, California Code of Regulations, Division 7, Chapter 5, Article 3.5, sections 18285 and 18290, and as such, is approved by the Board.

If you have any questions regarding this determination, please contact Diana Thomas of the Financial Assurances Section at (916) 255-2700.

Respectfully,

Ralph E. Chandler
Executive Director

cc: Jeff Hackett, CIWMB, Enforcement Agency

NO.	ROUTE DATA	INFO	COPY	ATTACH	SIGN
1	DIRECTOR	✓	✓		
	ASST. DIR. OPR.				
	S.W. DRAINAGE				
	RD./RD. MAINT.				
	SANITATION				
	TRAF./PERM.				
	CSA/PARKING				
2	ASST. DIR. P.S.	✓	✓		✓
	DRAINAGE				
	CONSTRUCTION				
	[illegible]				
3	SOLID WASTE		✓	✓	
	ASST. DIR. R.E.				
	DESIGN				
	SURV. PLAN REV.				
	R.D.A.				
	ROAD PLANNING				
4	CHIEF ADM SVC	✓	✓	✓	✓
	REAL PROPERTY				

PLEDGE OF REVENUE AGREEMENT ESTABLISHING FINANCIAL ASSURANCE FOR POSTCLOSURE MAINTENANCE OF THE BUENA VISTA LANDFILL

This agreement establishes a Pledge of Revenue to assure that adequate funds are available to carry out the Postclosure Maintenance of the Buena Vista Landfill ("Landfill").

This Agreement shall become effective immediately, and is made and entered into by and between the County of Santa Cruz and the California Integrated Waste Management Board ("Board").

WHEREAS, California Public Resources Code Sections 43500-43610 and Title 14 of the California Code of Regulations ("Regulations"), Division 7, Chapter 5, Article 3.5 starting with Section 18280, require operators of solid waste landfills to demonstrate the availability of financial resources to conduct closure and postclosure maintenance activities; and

WHEREAS, Sections 18283 and 18290 of the Regulations specify a pledge of revenue as an acceptable mechanism to demonstrate financial responsibility for postclosure maintenance of a solid waste landfill; and

WHEREAS, the County operates the Landfill, a solid waste landfill, in conformance with the findings, conditions, prohibitions, and requirements contained in Solid Waste Facilities Permit No. 44-AA-0004 issued by the Santa Cruz County Environmental Health Department, the previous Local Enforcement Agency at the time of issuance for the Board. Current enforcement activities are conducted by the Board; and

WHEREAS, the County is pledging revenues from service area fees deposited into the County Service Area No. 9C Refuse Disposal Fund; and

WHEREAS, the County has determined that projected net revenues from fees during the thirty (30) year period of postclosure maintenance shall during each year of this period be greater than the yearly monitoring and postclosure maintenance cost contained in the most recent Cost Estimate for the Buena Vista Landfill, submitted to the Board, in accordance with Section 18266 of the Regulations.

NOW THEREFORE, The County and Board do agree as follows:

1. The County shall establish a pledge of revenue to demonstrate financial responsibility for postclosure maintenance of the Landfill in accordance with Sections 18283 and 18290 of the Regulations.

2. The County agrees to pledge net revenues from County Service Area No. 9C, Refuse Disposal Funds as described herein.

3. The amount of the pledged revenue shall be equal to $153,400.00 per year for the 30-year period of postclosure maintenance for the Landfill; this represents the most recent monitoring and postclosure maintenance cost estimate for the landfill. It is agreed that the amount of this pledge may increase or decrease to match any adjustment to the identified cost estimate which is mutually agreed to by the County and the Board.

4. If the County ceases at any time to retain control of its ability to allocate the pledged revenue as identified herein to pay postclosure maintenance costs, the County shall notify the Board and the local enforcement agency and shall obtain alternate coverage within sixty (60) days after the control of funds lapses, pursuant to Section 18290 of the regulations.

5. In the event that the Board determines that the County has failed to perform postclosure maintenance as required by law, the Board may direct the Auditor-Controller to pay from the pledged revenues such amounts as are necessary to insure sufficient postclosure maintenance, and such funds shall be disbursed for postclosure maintenance in accordance with the directive of the Board.

IN WITNESS HEREOF, the parties have executed this agreement on the date and year as set forth below.

By County this 10th day of August 1993

By Board this _____ day of _____ 1993

STATE OF CALIFORNIA
Integrated Waste
Management Board

By: _____
Ralph E. Chandler
Executive Director

APPROVED AS TO FORM
AND PROCEDURE

By: _____
Robert F. Conheim
General Counsel

APPROVED AS TO FORM:

_____
Assistant County Counsel

COUNTY OF SANTA CRUZ

By: _____
John A. Fantham

ATTEST:

By: _____
Clerk of the Board

40 efm

RPM

DEPARTMENT OF
PUBLIC WORKS

COUNTY OF SANTA CRUZ

GOVERNMENTAL CENTER

701 OCEAN STREET SANTA CRUZ, CALIFORNIA 95060-4070

JOHN A. FANTHAM
DIRECTOR OF PUBLIC WORKS
(408) 454-2160

FAX (408) 454-2385

September 9, 1993

MS. DIANA THOMAS
California Integrated Waste Management Board
Financial Assurances Section
8800 Cal Center Drive
Sacramento, CA 95826

SUBJECT: BUENA VISTA LANDFILL MECHANISMS FOR CLOSURE AND POST-CLOSURE MAINTENANCE OF THE BUENA VISTA LANDFILL FACILITY NO. 44-AA-0004

Dear Ms. Thomas:

The following items regarding establishment of Closure and Post-Closure financial assurance mechanisms for the Buena Vista Landfill are attached for your approval:

1. Copy of County Board of Supervisors letter from August 10, 1993 agenda establishing financial assurance mechanism for Closure and Post-Closure Maintenance.

2. Copy of Resolution 477-93 Establishing Enterprise Fund for Closure Financial Assurance.

3. Verification of establishment of Enterprise Fund signed by the County Treasurer.

4. Copy of Resolution 478-93 Establishing Pledge of Revenue for Post-Closure Maintenance Financial Assurance.

5. Original Pledge of Revenue Agreement between County and CIWMB.

The attached Pledge of Revenue Agreement, approved in draft per your letter of August 23, 1993, has been fully executed by the County. Please have the original signed by Counsel and the Executive Director and return a fully executed copy to the County. After execution of the Pledge of Revenue Agreement, please forward two (2) copies of each of the attached documents to Jeff Hackett in your Permits and Compliance Division for amendment to the previously submitted Preliminary Closure and Post-Closure, Appendix I.

If you have any questions concerning this issue, please contact Patrick Mathews of my staff at (408) 454-2160.

Yours truly,

JOHN A. FANTHAM
Director of Public Works

RPM:bbs

Attachments

Copy to: Jeff Hackett, Integrated Waste Management Board
County Administrative Office

BVLb

AGENDA: AUGUST 10, 1993 P.W.

DEPARTMENT OF PUBLIC WORKS

GOVERNMENTAL CENTER

JOHN A. FANTHAM
DIRECTOR OF PUBLIC WORKS

(408) 454-2160

COUNTY OF SANTA CRUZ

701 OCEAN STREET, SANTA CRUZ, CALIFORNIA 95060-4070

FAX (408) 454-2385

August 3, 1993

Board of Supervisors APPROVED	After Board Action copies mailed to:	No.
	Auditor	
County of Santa Cruz	C.A.O.	
Date 8/10/93 Vol.	Co. Counsel	
	Public Works	
By		
Deputy Clerk of the Board		

SANTA CRUZ COUNTY BOARD OF SUPERVISORS
701 Ocean Street
Santa Cruz, California 95060

SUBJECT: ESTABLISHMENT OF PLEDGE OF REVENUE FROM NEW ENTERPRISE FUND AS FINANCIAL ASSURANCES FOR CLOSURE/POSTCLOSURE MAINTENANCE OF THE BUENA VISTA LANDFILL

Members of the Board:

As was done last year for the County's closed landfill at Ben Lomond, the Public Works Department is now preparing to submit to the California Integrated Waste Management Board (CIWMB) the preliminary closure and postclosure maintenance plans for the Buena Vista Landfill for approval as required by law.

The CIWMB staff will be reviewing the submittal to determine whether the described closure and postclosure maintenance is consistent with the requirements of Title 14, California Code of Regulations. In addition to these technical issues required by the CIWMB, a financial assurance mechanism is required in order to establish financial responsibility for closure and postclosure maintenance by landfill owners. Title 14, Division 7, Chapter 5, Article 3.5 of the California Code of Regulations mandates that a trust fund or an equivalent financial arrangement be established by landfill operators as evidence of financial ability to pay for the costs of closure and postclosure maintenance of their facilities.

The California Integrated Waste Management Board adopted Closure/Post-Closure Regulations for Sanitary Landfills in 1989. As a result of these regulations, the County was first required to submit initial cost projections for closure and post-closure of the Buena Vista and Ben Lomond Landfills. Operating landfills were then required to divide the initial cost estimate by the remaining life of the active landfill and deposit an equivalent share each year into a secured fund until closure occurs. The purpose of these regulations is to insure that as active landfills reach capacity, there are sufficient funds available to properly close the site and maintain the site for a minimum 15-year post-closure period. As of fiscal year 1993/94, the County has set aside $720,408.00 towards the eventual closure of the Buena Vista Landfill based on the initial cost projections and projected life of the landfill.

FILED 8/10/93
SUSAN A. MAURIELLO, COUNTY ADMINISTRATIVE OFFICER AND EX-OFFICIO CLERK OF THE BOARD OF SUPERVISORS OF THE COUNTY OF SANTA CRUZ, CALIFORNIA
DEPUTY

The recently promulgated Federal Resource Conservation and Recovery Act, Subtitle "D" Regulations, covering solid waste landfill design and operations, have increased the projected costs of the Buena Vista Landfill closure. At the same time the life expectancy for the Buena Vista Landfill has been projected to increase, based on the future Materials Recovery Facility waste diversion projections. Based on the revised preliminary cost estimates and site life projections, the current fund is under budgeted. Adjustments will be made to future yearly deposits to adjust for this shortfall. The current fund has been accruing at approximately $180,000.00 per year, including inflationary adjustments, and will increase to approximately $220,000 per year plus future inflationary adjustments.

The Department of Public Works is currently completing an application for permit revision to develop the next module of the Buena Vista Landfill. Applications for permit revision after July 1, 1991, also require submittal of a preliminary Closure/Post-Closure Plan with revised cost estimates and financial assurance mechanism.

In order to meet the financial assurance mechanism required by the CIWMB, it is necessary to establish an enterprise fund and a subsidiary mechanism into which revenue from the enterprise fund must be deposited for closure funding. A pledge of revenue to provide adequate financial assurance for postclosure maintenance funding is also required. Attached for your consideration are the resolutions to meet these requirements of the CIWMB for financial assurance. Sufficient funds have been budgeted in the CSA-9c Closure Fund for this purpose.

It is recommended that the Board of Supervisors take the following action:

1 Adopt the resolution establishing an Enterprise Fund as the Financial Assurance for Closure and Postclosure Maintenance of the Buena Vista Landfill.

2. Adopt the resolution establishing a Pledge of Revenue as the Financial Assurance for Postclosure Maintenance of the Buena Vista Landfill.

3. Authorize the Director of Public Works to sign the agreement (copy attached) with CIWMB pledging revenue to assure funds for postclosure maintenance on behalf of the County of Santa Cruz.

4. Approve the attached AUD-74, Request for Transfer of Appropriations, allowing for the transfer of $720,408.00 from the existing Closure Fund into the newly established Buena Vista Closure Fund.

5. Direct the County Treasurer to complete the written verification to the CIWMB (copy attached) upon establishment of the new Enterprise Fund and return to Public Works for processing.

6. Direct the Clerk of the Board to return the fully executed document to Public Works for further processing.

Yours truly,

JOHN A. FANTHAM
Director of Public Works

RPM:mg

Attachments

RECOMMENDED FOR APPROVAL:

_____
County Administrative Officer

Copy to: Auditor-Controller
Treasurer
California Integrated Waste Management Board
Public Works Department

epm

COUNTY OF SANTA CRUZ
REQUEST FOR TRANSFER OR REVISION OF BUDGET APPROPRIATIONS AND/OR FUNDS

Distribution:
1. Board of Supv/Dist Board - white
2. Auditor-Controller - yellow
3. Administrative Officer - green
4. Originating Dept. - pink
5. Dept. Control Copy - goldenrod

dget Unit or Dept. Name PUBLIC WORKS

TO: Board of Supervisors/County Administrative Officer/District Board

I hereby request your approval of the following transfer of budget appropriations and/or funds in the fiscal year ending June 30, 19 94

BATCH 5 6 DATE 11

	CODING BLOCK				NOT KEY DATA
	12 INDEX 16	17 ACCOUNT 21	22 T/C 24	30 AMOUNT 48	97 LINE NO. 101	DESCRIPTION OF APPROPRIATION
TRANSFER TO	81136	35117		720,408		BEN LOMOND CLOSURE OPERATING TRANSFER OUT
	32000	40166		720,408		PUBLIC WORKS ISF OPERATING TRANSFER OUT BEN LOMOND
	81137	25103		720,408		BUENA VISTA CLOSURE PUBLIC WORKS SERVICES
	32000	40165		720,408		PUBLIC WORKS ISF BUENA VISTA CLOSURE
TRANSFER FROM	81136	25103		(720,408)		BEN LOMOND CLOSURE PUBLIC WORKS SERVICES
	32000	40157		(720,408)		PUBLIC WORKS ISF BEN LOMOND CLOSURE
	81137	96967		(720,408)		BUENA VISTA CLOSURE OPERATING TRANSFERS IN
	32093	96941		(720,408)		PUBLIC WORKS ISF JOB COST BILLING

Explanation:

TO TRANSFER APPROPRIATIONS FROM DEPARTMENT OF PUBLIC WORKS SERVICES TO OPERATING TRANSFERS OUT IN THE BEN LOMOND CLOSURE FUND, AND TO ESTABLISH APPROPRIATIONS IN THE BUENA VISTA CLOSURE FUND USING OPERATING TRANSFERS IN.

Name [illegible]
Title CHIEF OF ADMINISTRATIVE SERVICES

Auditor – Controller's Action: – I hereby certify that unencumbered balance(s) is/are available in the appropriations/funds and in the amounts indicated above.

GARY A. KNUTSON, Auditor-Controller By [illegible] Deputy Date

County Administrative Officer's Action: ☐ Recommended to Board ☐ Approved ☐ Not Recommended or Approved

Co. Admin. Officer [illegible] Date 8/4/93

State of California)
County of Santa Cruz) ss.

As the Clerk of the Board of Supervisors of the County of Santa Cruz, State of California, I do hereby certify that the foregoing request for transfer was approved by said Board of Supervisors as recommended by the County Administrative Officer by an order duly entered in the minutes of said Board on

_____ 19 93 By _____ Deputy Clerk

D-74 (REV. 8/87)

P.W.

265

BEFORE THE BOARD OF SUPERVISORS
OF THE COUNTY OF SANTA CRUZ, STATE OF CALIFORNIA

RESOLUTION NO. 477-93

On the motion of Supervisor Keeley
duly seconded by Supervisor Beautz
the following resolution is adopted:

RESOLUTION ESTABLISHING AN ENTERPRISE FUND AS THE FINANCIAL ASSURANCE FOR CLOSURE OF THE BUENA VISTA LANDFILL

WHEREAS, Public Resources Code 43500 through 43610 and Title 14 of the California Code of Regulations ("Regulations"), Division 7, Chapter 5, Article 3.5, starting with Section 18280 require operators of solid waste landfills to demonstrate the availability of financial resources to conduct closure and postclosure maintenance activities; and

WHEREAS, Sections 18283 and 18285 of the Regulations specify an Enterprise Fund and related financial assurance mechanism as an acceptable mechanism to demonstrate financial responsibility for financing closure of a solid waste landfill;

NOW, THEREFORE, BE IT RESOLVED by the Board of the County of Santa Cruz that:

1. The Director of Public Works of the County of Santa Cruz ("Director") is authorized and directed to establish and maintain an Enterprise Fund ("Enterprise Fund") for the Buena Vista Landfill ("Landfill") and to deposit in the Enterprise Fund all revenue derived from the operations of the Landfill and from the existing Ben Lomond Closure Fund.

2. The Director of Public Works is further directed to withdraw funds from the Enterprise Fund, for deposit into the financial assurance mechanism hereafter provided, sufficient to meet the requirements of Sections 18282 and 18285 of the Regulations on a timely basis.

3. The funds referred to in Section 2 above shall be deposited and retained by the Treasurer of Santa Cruz County ("Treasurer") in a separate fund to be known as the Buena Vista Landfill Closure Fund ("Closure Fund") established by the Auditor-Controller of Santa Cruz County ("Auditor-Controller") and shall be used to pay only for closure of the Landfill.

4. The Closure Fund shall be and remain inviolate against all other claims, including claims of this County or its Board of Supervisors or the creditors thereof, it being the intent of this Resolution that the mechanism established hereby will provide equivalent protection to a trust fund in ensuring that the assured amounts of funds will be available in a timely manner for closure of the Landfill.

5. Disbursement of funds for closure shall be in accordance with Section 18262.3 of these regulations.

6. The Closure Fund shall be invested by the Treasurer in the manner provided by law.

7. In the event the California Integrated Waste Management Board determines that this County has failed to perform closure as required by law, the Board may direct the Auditor Controller to pay the Director from the Closure Fund such amounts as are necessary to insure sufficient closure, who then shall be obligated to use such funds for closure in accordance with the directive of the California Integrated Waste Management Board.

8. The Director is directed to produce an annual report for transmittal to the California Integrated Waste Management Board containing the following information concerning the Landfill:

   (a) As appropriate, a revised closure cost estimate prepared as specified by Section 18263 of the Regulations.

   (b) Status, including current balance of the Buena Vista Landfill Closure Fund.

   (c) The number of current members of the Board of Supervisors of this County who voted affirmatively when resolution was adopted or last reaffirmed.

PASSED AND ADOPTED by the Board of Supervisors of the County of Santa Cruz, State of California, this 10th day of August, 1993, by the following vote:

AYES: SUPERVISORS Beautz, Symons, Patton, Keeley & Belgard

NOES: SUPERVISORS None

ABSENT: SUPERVISORS None

RAY BELGARD
Chairman of said Board

ATTEST: SUSAN M. MAURIELLO
Clerk of said Board

Approved as to form:
Pamela Fyfe
Assistant County Counsel

Distribution: County Counsel
Auditor-Controller
Public Works

STATE OF CALIFORNIA)
COUNTY OF SANTA CRUZ) ss

I, SUSAN A. MAURIELLO, County Administrative Officer and ex-officio Clerk of the Board of Supervisors of the County of Santa Cruz, State of California do hereby certify that the foregoing is a true and correct copy of a resolution passed and adopted by and entered in the minutes of the said board. In witness whereof I have hereunto set my hand and affixed the seal of the said Board on 8/26 19 93.

SUSAN A. MAURIELLO, County Administrative Officer

By Valerie Vaccaro Deputy

bvm

TREASURER-
TAX COLLECTOR

GOVERNMENTAL CENTER
701 OCEAN STREET
P.O. BOX 1817
SANTA CRUZ, CALIFORNIA 95061

COUNTY OF SANTA CRUZ

WILLIAM P. MURPHY
TREASURER AND TAX COLLECTOR

LOIS J. THOMAS
ASSISTANT
TREASURER AND TAX COLLECTOR

CALIFORNIA INTEGRATED WASTE MANAGEMENT BOARD
8800 Cal Center Drive
Sacramento, CA 95826

SUBJECT: VERIFICATION OF ESTABLISHMENT OF FUNDS

To Whom It May Concern:

Please be advised that the following funds have been established pursuant to Resolution(s) No. 477-93, adopted on August 10, 1993 by the Board of Supervisors of Santa Cruz County.

1. Buena Vista Closure Fund.

It is understood that these funds shall be used by the Director of Public Works of Santa Cruz County only for closure at the identified landfills and are intended to meet applicable requirements of State Law. These monies are being held in these funds to preserve their integrity and inviolacy. I will perform my duties and responsibilities in accordance with the terms and conditions of the Title 14, Division 7, Chapter 5, Article 3.5.

This letter shall serve as verification that the Treasurer of Santa Cruz County has established these funds in accordance with the resolutions referenced above. The Treasurer is an officer of the County of Santa Cruz.

Sincerely,

William P. Murphy
Treasurer

WPM:mg

40 wpm

BEFORE THE BOARD OF SUPERVISORS
OF THE COUNTY OF SANTA CRUZ, STATE OF CALIFORNIA

RESOLUTION NO. 478-93

On the motion of Supervisor Keeley
duly seconded by Supervisor Beautz
the following resolution is adopted:

RESOLUTION ESTABLISHING A PLEDGE OF REVENUE AS THE FINANCIAL ASSURANCE FOR POSTCLOSURE MAINTENANCE OF THE BUENA VISTA LANDFILL

WHEREAS, Public Resources Code Section 43500 through 43610 and Title 14 of the California Code of Regulations ("Regulations"), Division 7, Chapter 5, Article 3.5 starting with Section 18280, require operators of solid waste landfills to demonstrate the availability of financial resources to conduct closure and postclosure maintenance activities; and

WHEREAS, Sections 18283 and 18290 of the Regulations specify a Pledge of Revenue as an acceptable mechanism to demonstrate financial responsibility for financing postclosure maintenance of a solid waste landfill;

NOW, THEREFORE, BE IT RESOLVED by the Board of Supervisors of the County of Santa Cruz that:

1. The County of Santa Cruz ("County") operates the Buena Vista Landfill ("Landfill"), a solid waste landfill, in conformance with the findings, conditions, prohibitions, and requirements contained in Facility Information No. 44-AA-0004 issued by the Santa Cruz County Environmental Health Department, the previous Local Enforcement Agency at the time of issuance for the California Integrated Waste Management Board ("Board"). Current enforcement activities are conducted by the Board.

2. The County shall establish a Pledge of Revenue to demonstrate financial responsibility for postclosure maintenance of the Landfill in accordance with Sections 18283 and 18290 of the Regulations.

3. Disbursement of funds for postclosure maintenance shall be in accordance with the final plan, as approved by the Board.

4. In the event the Board determines that this County has failed to perform postclosure maintenance as required by law, the Board may direct the Director of Public Works to pay from the pledged revenues such amounts as are necessary to insure sufficient postclosure maintenance, who then shall be obligated to use such funds for postclosure maintenance in accordance with the directive of the Board.

5. The Director of Public Works is directed to produce an annual report for transmittal to the California Integrated Waste Management Board, containing the following information concerning the Buena Vista Landfill.

   (a) As appropriate, a revised postclosure maintenance cost estimate, prepared as specified by Section 18266 of the regulations.

   (b) The number of current members of the Board of Supervisors of this County who voted affirmatively when this resolution was adopted or last reaffirmed.

6. The Director of Public Works is hereby authorized to sign the attached Pledge of Revenue Agreement on behalf of the County of Santa Cruz.

PASSED AND ADOPTED by the Board of Supervisors of the County of Santa Cruz, State of California, this 10th day of August, 1993, by the following vote:

AYES: SUPERVISORS Beautz, Symons, Patton, Keeley & Belgard

NOES: SUPERVISORS None

ABSENT: SUPERVISORS None

RAY BELGARD
Chairman of said Board

ATTEST: SUSAN M. ROZARIO
Clerk of said Board

Approved as to form:
Assistant County Counsel

Distribution: County Counsel
Auditor-Controller
Public Works

STATE OF CALIFORNIA)
COUNTY OF SANTA CRUZ) ss

I, SUSAN A. MAURIELLO, County Administrative Officer and ex-officio Clerk of the Board of Supervisors of the County of Santa Cruz, State of California do hereby certify that the foregoing is a true and correct copy of a resolution passed and entered in the minutes of the said Board. In witness whereof I have hereunto set my hand and affixed the seal of said Board on 8/10/93 by [illegible].

SUSAN A. MAURIELLO, County Administrative Officer

By [illegible] Deputy

40 rcm

PLEDGE OF REVENUE AGREEMENT ESTABLISHING FINANCIAL ASSURANCE FOR POSTCLOSURE MAINTENANCE OF THE BUENA VISTA LANDFILL

This agreement establishes a Pledge of Revenue to assure that adequate funds are available to carry out the Postclosure Maintenance of the Buena Vista Landfill ("Landfill").

This Agreement shall become effective immediately, and is made and entered into by and between the County of Santa Cruz and the California Integrated Waste Management Board ("Board").

WHEREAS, California Public Resources Code Sections 43500-43610 and Title 14 of the California Code of Regulations ("Regulations"), Division 7, Chapter 5, Article 3.5 starting with Section 18280, require operators of solid waste landfills to demonstrate the availability of financial resources to conduct closure and postclosure maintenance activities; and

WHEREAS, Sections 18283 and 18290 of the Regulations specify a pledge of revenue as an acceptable mechanism to demonstrate financial responsibility for postclosure maintenance of a solid waste landfill; and

WHEREAS, the County operates the Landfill, a solid waste landfill, in conformance with the findings, conditions, prohibitions, and requirements contained in Solid Waste Facilities Permit No. 44-AA-0004 issued by the Santa Cruz County Environmental Health Department, the previous Local Enforcement Agency at the time of issuance for the Board. Current enforcement activities are conducted by the Board; and

WHEREAS, the County is pledging revenues from service area fees deposited into the County Service Area No. 9C Refuse Disposal Fund; and

WHEREAS, the County has determined that projected net revenues from fees during the thirty (30) year period of postclosure maintenance shall during each year of this period be greater than the yearly monitoring and postclosure maintenance cost contained in the most recent Cost Estimate for the Buena Vista Landfill, submitted to the Board, in accordance with Section 18266 of the Regulations.

NOW THEREFORE, The County and Board do agree as follows:

1. The County shall establish a pledge of revenue to demonstrate financial responsibility for postclosure maintenance of the Landfill in accordance with Sections 18283 and 18290 of the Regulations.

2. The County agrees to pledge net revenues from County Service Area No. 9C, Refuse Disposal Funds as described herein.

3. The amount of the pledged revenue shall be equal to $153,400.00 per year for the 30-year period of postclosure maintenance for the Landfill; this represents the most recent monitoring and postclosure maintenance cost estimate for the landfill. It is agreed that the amount of this pledge may increase or decrease to match any adjustment to the identified cost estimate which is mutually agreed to by the County and the Board.

4. If the County ceases at any time to retain control of its ability to allocate the pledged revenue as identified herein to pay postclosure maintenance costs, the County shall notify the Board and the local enforcement agency and shall obtain alternate coverage within sixty (60) days after the control of funds lapses, pursuant to Section 18290 of the regulations.

5. In the event that the Board determines that the County has failed to perform postclosure maintenance as required by law, the Board may direct the Auditor-Controller to pay from the pledged revenues such amounts as are necessary to insure sufficient postclosure maintenance, and such funds shall be disbursed for postclosure maintenance in accordance with the directive of the Board.

IN WITNESS HEREOF, the parties have executed this agreement on the date and year as set forth below.

By County this 10th day of August 1993

By Board this _____ day of _____ 1993

STATE OF CALIFORNIA
Integrated Waste
Management Board

By: _____
Ralph E. Chandler
Executive Director

APPROVED AS TO FORM
AND PROCEDURE

By: _____
Robert F. Conheim
General Counsel

APPROVED AS TO FORM:

Assistant County Counsel

COUNTY OF SANTA CRUZ

By: _____
John A. Fantham

ATTEST:

By: _____
Clerk of the Board

40 efm

RESOLUTION ESTABLISHING CORRECTIVE ACTION FUNDING MECHANISM WITH RELATED DOCUMENTS AND APPROVALS

STATE OF CALIFORNIA — PETE WILSON, *Governor*

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD —
CENTRAL COAST REGION
HIGUERA STREET, SUITE 200
N LUIS OBISPO, CA 93401-5427
(805) 549-3147

MAR 1994
RECEIVED
PUBLIC WORKS DEPT
SANTA CRUZ, CA.

March 7, 1994

Patrick, discuss with BHT
3/14/94

Mr. John Fantham, Director
Santa Cruz County Public Works Department
701 Ocean Street
Santa Cruz, CA 95060-4070

Attention: Patrick Mathews

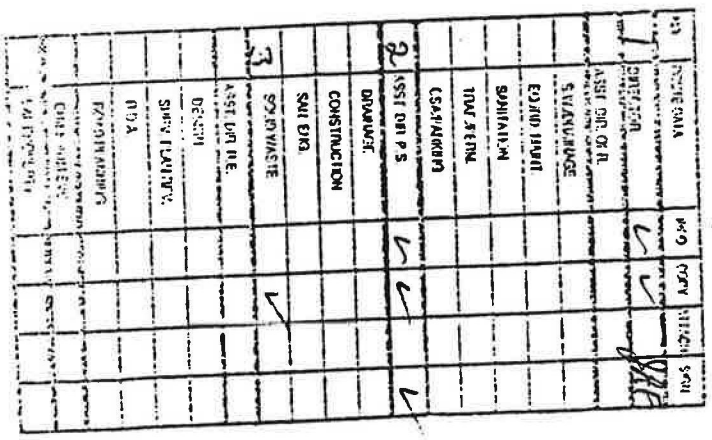
Dear Mr. Fantham:

FINANCIAL ASSURANCE MECHANISM CLARIFICATION

Recent questions raised by Patrick Mathews concerning the status of the County's July 1992 Pledge of Revenue Agreement have resulted in the following clarification's concerning financial agreement documentation.

In order to comply with Article 5 §2550.0.(b) the discharger must submit assurance of financial responsibility which stands alone, absent of Board action. The assurance document may take a variety of forms. Most importantly it must be independent of Board action and it must address responsibility for completing corrective action for all known or reasonably foreseeable releases.

Returned to you along with this letter are the County's Pledge of Revenue Agreements for the Ben Lomond and Buena Vista landfills. These documents required Board action to initiate and therefore go beyond the intent of Article 5. The County's foreseeable release scenarios, submitted with the Proposed Monitoring Programs of each landfill, are acceptable and may be used as a cost basis for financial assurance re-submittal. Please re-submit proposed "stand-alone" assurances of financial responsibility by March 28, 1994.



If you have any questions regarding these comments or any questions in general regard to the Buena Vista Drive landfill, please contact Michael LeBrun of my staff at (805) 546-4645.

Sincerely,

Jay Coons

for WILLIAM R. LEONARD
Executive Officer

MSL:sg

cc: Jeff Hackett
Compliance Division
CA Integrated Waste Management Board
8800 Cal Center Drive
Sacramento, CA 95826

MSL1/BVCOM4.ltr

AGENDA: APRIL 26, 1994

#3

DEPARTMENT OF
PUBLIC WORKS

GOVERNMENTAL CENTER

JOHN A. FANTHAM
DIRECTOR OF PUBLIC WORKS

(408) 454-2160

COUNTY OF SANTA CRUZ

701 OCEAN STREET, SANTA CRUZ, CALIFORNIA 95060-4070

FAX (408) 454-2385

MAY 1994
RECEIVED
PUBLIC WORKS DEPT
SANTA CRUZ, CA.

Board of Supervisors
APPROVED
April 15, 1994
County of Santa Cruz
Date APR 26 1994
By SUZY ROCK
Deputy Clerk of the Board

After Board Action copies mailed to	No.
Auditor	
C.A.C	
Co Counsel	
Public Works	

SANTA CRUZ COUNTY BOARD OF SUPERVISORS
701 Ocean Street
Santa Cruz, California 95060

SUBJECT: FINANCIAL ASSURANCE FOR ENVIRONMENTAL CORRECTIVE ACTIONS FOR THE BUENA VISTA AND BEN LOMOND LANDFILLS

Members of the Board:

As required under California Code Regulations, Title 23, Chapter 15, Article 5, Section 2550.0(b), all operators of active and closed landfills must provide for or demonstrate financial assurance to initiate environmental corrective actions in the event of a contaminant release from the site. On June 26, 1992, your Board approved Resolutions 348-92 and 349-92 establishing Pledges of Revenue as the desired financial assurance method for corrective actions for both County landfills. Included with the Resolutions were agreements with the Regional Water Quality Control Board (RWQCB) for initiating and completing environmental Corrective Actions at the Buena Vista and Ben Lomond Landfills.

Though these financial assurance documents were mandated to be in place by July 1, 1992, the RWQCB has only recently reviewed and commented on their acceptability. The original documents were returned to Public Works on March 7, 1994, along with a requested change. The RWQCB does not want formal agreements, only resolutions establishing the financial mechanism, as the agreements go beyond the intent of the regulations. In order to maintain continued compliance with our Waste Discharge Requirements for both landfill sites, it is necessary to revise the Pledge of Revenue Resolutions as stand alone financial assurance mechanisms.

Attached for your approval and execution are three copies each of Resolutions establishing a Pledge of Revenue as the financial assurance mechanism for initiating and completing corrective actions in the event of a release from the Buena Vista and Ben Lomond Landfills. They have been modified to reflect the RWQCB's comment and will replace the existing Resolutions 348-92 and 349-92.

APR 2 6 1994

FILED
SUSAN A. MAURIELLO, COUNTY ADMINISTRATIVE OFFICER AND EX-OFFICIO CLERK OF THE BOARD OF SUPERVISORS OF THE COUNTY OF SANTA CRUZ, CALIFORNIA

BY SUZY ROCK DEPUTY

It is therefore recommended that the Board of Supervisors take the following action:

1. Approve three copies each of the the attached Resolutions establishing a Pledge of Revenue as the financial assurance mechanism for initiating and completing corrective actions in the event of a release from the Buena Vista or Ben Lomond Landfills.

2. Direct the Clerk of the Board to Return two fully executed Resolutions for each landfill to Public Works for further processing and transmittal to the Regional Water Quality Control Board.

Yours truly,

JOHN A. FANTHAM
Director of Public Works

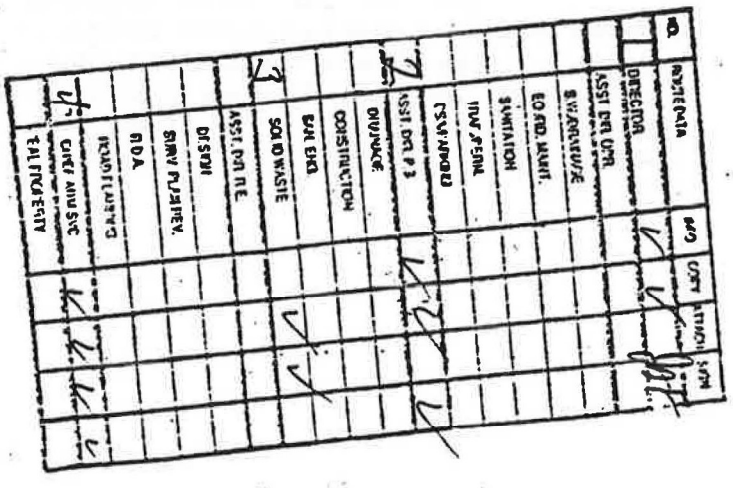
RPM:mg

Attachments

RECOMMENDED FOR APPROVAL:

County Administrative Officer

Copy to: County Counsel
Risk Management
Auditor-Controller
Jeff Hackett, CA Integrated Waste Management Board
Mike LeBrun, Regional Water Quality Control Board
Public Works



2nm

BEFORE THE BOARD OF SUPERVISORS
OF THE COUNTY OF SANTA CRUZ, STATE OF CALIFORNIA

RESOLUTION NO. 184-94

On the motion of Supervisor Keeley
duly seconded by Supervisor Symons
the following resolution is adopted:

RESOLUTION ESTABLISHING A PLEDGE OF REVENUE AS THE FINANCIAL ASSURANCE FOR INITIATING AND COMPLETING CORRECTIVE ACTION FOR ALL KNOWN OR REASONABLY FORESEEABLE RELEASES FROM THE BUENA VISTA LANDFILL

WHEREAS, Title 23 of the California Code of Regulations("Regulations"), Chapter 15, Article 5, Section 2550.0(b), requires owners/operators of solid waste landfill units to demonstrate the availability of financial resources to conduct corrective actions necessary to remediate any known or reasonably foreseeable release from active and closed waste management units; and

WHEREAS, the Regulations do not specifically define acceptable methods of financial assurance, the Regional Water Quality Control Board, Central Coast Region("Board") has approved the use a Pledge of Revenue as an acceptable method for government entities;

NOW, THEREFORE, BE IT RESOLVED by the Board of Supervisors of the County of Santa Cruz that:

1. The County of Santa Cruz ("County") owns and maintains the Buena Vista Landfill ("Landfill"), a solid waste management unit currently in operation, in conformance with the findings, conditions, prohibitions and requirements contained in Solid Waste Facilities Operating Permit 44-AA-004 under authority of the California Integrated Waste Management Board, the acting Local Enforcement Agency; and in conformance with the findings, conditions, prohibitions and requirements contained in Waste Discharge Requirements Order No. 94-29 issued by the Board; and

2. The County shall establish a Pledge of Revenue in the amount of $750,000.00 to demonstrate financial responsibility for corrective actions necessary to remediate any known or reasonably foreseeable release from the Landfill in accordance with Section 2550.0(b) of the Regulations; and

3. The County resolves to pledge up to $750,000.00 in net revenues from County Solid Waste Enterprise Funds as described herein, if corrective actions are deemed necessary as defined under Sections 2550.9 and 2550.10 of the Regulations; and

4. The amount of funds shall be equal to a sum deemed sufficient to accomplish corrective actions necessary to comply with the provisions set forth in the Regulations. It is agreed that the amount of this pledge may increase or decrease to match any adjustment to the identified cost estimate which is mutually agreed to by the County and the Board; and

5. Disbursement of funds for corrective actions shall be in accordance with Section 2550.10 of the Regulations; and

6. In the event the Board determines that this County has failed to perform corrective actions as required by law or Board order, the Board may direct the Director of Public Works to pay from the pledged revenues such amounts as are necessary to insure corrective actions are completed, who then shall be obligated to use such funds for corrective actions in accordance with the directive of the Board; and

7. The terms of this Resolution shall become inoperative to the extent the State legislature eliminates or reduces the County's mandate to provide "financial assurances" as described in this Resolution; and

8. The terms of this financial assurance Resolution shall remain in effect through the active life and mandated post-closure period of this site or until the Board determines that this site no longer poses a threat to State waters. This Resolution shall be subject to annual review by the Santa Cruz County Board of Supervisors as part of its annual budget process.

PASSED AND ADOPTED by Board of Supervisors of the County of Santa Cruz, State of California, this 26th day of April, 1994, by the following vote:

AYES: SUPERVISORS Beautz, Symons, Belgard, Keeley and Patton

NOES: SUPERVISORS None

ABSENT: SUPERVISORS None

Chairperson of the Board

ATTEST: _____
Clerk of the Board

Approved as to form:
Pamela Fyfe
Assistant County Counsel

Distribution: County Counsel
Auditor-Controller
Public Works

CLOSURE/POST-CLOSURE AND CORRECTIVE ACTION FUNDING REPORTS

A-8-d

County of Santa Cruz

DEPARTMENT OF PUBLIC WORKS

701 OCEAN STREET, ROOM 410, SANTA CRUZ, CA 95060-4070
(831) 454-2160 FAX (831) 454-2385 TDD (831) 454-2123

MATT MACHADO
DEPUTY CAO
DIRECTOR OF PUBLIC WORKS

Via electronic mail
June 10, 2020

MR. GARTH ADAMS
CALRECYCLE
FINANCIAL ASSURANCES SECTION
P.O. Box 4025
Sacramento, CA 95812-4025

SUBJECT: BUENA VISTA LANDFILL CLOSURE, POST-CLOSURE, AND CORRECTIVE ACTION FUNDS 2019 REPORT FOR FACILITY NO. 44-AA-0004

Dear Mr. Adams:

Attached you will find the 2019 Annual Inflation Factor Worksheet for Santa Cruz County's Buena Vista Landfill as required under Title 27, Section 22236. Closure costs are accrued annually in a dedicated fund, and post-closure costs are covered through a Pledge of Revenue against future enterprise funds issued by our County on August 10, 1993.

The attached worksheet outlines the annual inflation adjustment starting with the base year of 1992. The number represents the annual pledge amount, in 2019 dollars, over the 30-year post-closure period. Inflation adjustments will continue through the 30-year post-closure period. Sufficient funds to cover closure activities have been appropriated in the 2019/2020 Budget.

The required corrective action funding for the Buena Vista Landfill is covered through a Pledge of Revenue issued by our County on June 22, 2005. The attached worksheet outlines the annual inflation adjustment starting with the base year of 1992, as required under Title 27, Sections 22220 through 22223, and Title 23, Section 2550.0.(b). The County also maintains an Environmental and Operating Liability Reserve Fund (EOLR) to supplement our self-insurance program and provide additional reserves for any unforeseen future corrective action. The EOLR balance is $1,400,000.

If you have any further questions concerning this report, please contact the undersigned at (831) 454-2160.

Yours truly,

MATT MACHADO
Deputy CAO
Director of Public Works

By:

Kasey Kolassa
Recycling and Solid Waste Services Manager

KK:jv

Attachments

Copy to: Martin Fletcher, Regional Water Quality Control Board (w/a)
Jon Whitehall, CalRecycle (w/a)
Kim Moore, Public Works (w/a)

California Environmental Protection Agency

Gavin Newsom
California Governor

CalRecycle
Department of
Resources Recycling and Recovery

Jared Blumenfeld
Secretary for Environmental Protection

Ken DaRosa
CalRecycle Acting Director

April 02, 2020

TO ALL OPERATORS/OWNERS OF SOLID WASTE LANDFILLS

Title 27, California Code of Regulations (27 CCR), Division 2, Subdivision 1, Chapter 6, Subchapter 3, Article 1, section 22236, requires you to submit a report annually to the California Department of Resources Recycling and Recovery (CalRecycle). The report calculates the inflationary increase in the closure, postclosure maintenance, and/or corrective action cost estimates for the previous calendar year.

Based on information obtained from the U.S. Department of Commerce, Bureau of Economic Analysis, Table 4, dated March 26, 2020 the inflation factor for **2019** is **1.018 (1.8%)**. Please complete the **2019 Annual Inflation Factor Report** for each landfill you own and/or operate, and send it to the **Financial Assurances Unit** at the following email address by **June 1, 2020**:

FAU@CALRECYCLE.CA.GOV

If you would prefer to mail it, please send it to:

CalRecycle, Financial Assurances Unit, MS 10A-15, P.O. Box 4025, Sacramento, CA 95812-4025

Previous years' Inflation Factor Reports can be found at:
https://www.calrecycle.ca.gov/SWFacilities/Financial/Bulletins

Following are previous years' inflation factors:

1989 - 1.041	**1990** - 1.054	**1991** - 1.036	**1992** - 1.033
1993 - 1.026	**1994** - 1.020	**1995** - 1.024	**1996** - 1.020
1997 - 1.020	**1998** - 1.010	**1999** - 1.015	**2000** - 1.021
2001 - 1.022	**2002** - 1.011	**2003** - 1.017	**2004** - 1.021
2005 - 1.028	**2006** - 1.029	**2007** - 1.027	**2008** - 1.022
2009 - 1.012	**2010** - 1.010	**2011** - 1.021	**2012** - 1.018
2013 - 1.015	**2014** - 1.015	**2015** - 1.010	**2016** - 1.013
2017 - 1.018	**2018** - 1.022		

If you have not made the previous years' adjustments, please do so before calculating the 2020 adjusted total cost estimates. Apply subsequent inflation factors to the previous year's total cost estimate, beginning with the inflation factor that corresponds with the year the plan was prepared. For example, if the plan was prepared in 1989, apply the 1989 inflation factor to your 1989 initial certified total closure and postclosure maintenance cost estimates and so forth until the current inflation factor is applied.

Do not disregard this notice, if you recently revised your estimates due to changes in your closure, postclosure maintenance and/or corrective action plans, and the revised estimates reflect 2020 dollars. Please report your updated 2020 cost estimates.

Information regarding the total and remaining permitted capacity at your landfill(s) should be submitted under a separate mailing.

For public operators utilizing a Pledge of Revenue Agreement, the operator is required by 27 CCR section 22233(b)(4)(B) to submit the CalRecycle 114 form to demonstrate the pledged revenue continues to be available when needed and will cover the postclosure maintenance and/or corrective action cost estimate(s) identified in the updated 2019 Annual Inflation Factor Report required by 27 CCR section 22236. The operator is required to submit annual certifications of the CalRecycle 114 form with the 2019 Annual Inflation Factor Report (copies of the resolution and agreement are not required annually, unless amended).

If you have any questions regarding this report, please contact staff of the Financial Assurances Unit identified for your county through the following link: https://www2.calrecycle.ca.gov/SWFacilities/LEA/CalRecycleContacts/

Thank you for your cooperation.

CalRecycle
Department of
Resources Recycling and Recovery

ANNUAL INFLATION FACTOR REPORT 2019

FACILITY NAME: BUENA VISTA LANDFILL

FACILITY NO.: 44-AA-0004

1.) Identify the highest approved or subsequently submitted cost estimate on record and the date of the plan:

$ 6,499,000 Highest Closure Cost Estimate Approved or Subsequently Submitted	1992 Base Year Date of Plan
$ 153,000 Highest Postclosure Maintenance Cost Estimate Approved or Subsequently Submitted	1992 Base Year Date of Plan
$ 750,000 Highest Corrective Action Cost Estimate Approved or Subsequently Submitted	1992 Base Year Date of Plan

2.) Multiply each cost estimate by the inflation factor to determine the new adjusted cost estimates as illustrated below:

The ABC Landfill's cost estimate for CLOSURE in 2019 was $2,000,000. Using the 2019 inflation factor of 1.018, they recalculated their ADJUSTED CLOSURE COST for 2020 to $2,036,000. Their POSTCLOSURE MAINTENANCE (PCM) COST with a Multiplier of 30 in 2019 was $1,500,000. Using the 2019 inflation factor of 1.018, their ADJUSTED PCM COST for 2020 is $1,527,000. Their cost estimate for CORRECTIVE ACTION in 2019 was $1,000,000. Using the 2019 inflation factor of 1.018, they recalculated their ADJUSTED CORRECTIVE ACTION COST for 2020 to $1,018,000.

NOTE: If the cost estimates identified above were prepared in 2020 dollars, do not inflate below.

ANNUAL INFLATION FACTOR REPORT 2019

$ 10,258,307	x 1.018 =	$ 10,442,957
Closure Costs (2019 Dollars)		Estimate in 2020 Dollars
$ 242,134	x 1.018 =	$ 246,492
Annual PCM Costs x PCM Multiplier of 30 or other approved PCM Multiplier (2019 Dollars)		Estimate in 2020 Dollars
$ 1,241,613	x 1.018 =	$ 1,263,962
Corrective Action Costs (2019 Dollars)		Estimate in 2020 Dollars

Choose Either:
Water [X]
or Non-Water [ ]

I certify under penalty of perjury under the laws of the State of California that the information in this document is true and correct to the best of my knowledge and is being provided in accordance with the regulations. To sign, click the "Fill & Sign" button on the right pane. Click "Sign" at the top and click "Add Signature".

Operator/Owner Signature	Kasey Kolassa Printed Name of Person Signing
Santa Cruz County, Dept. of Public Works 701 Ocean St., Rm. 410, Santa Cruz, CA 95060 Mailing Address	Recycling and Solid Waste Services Manager Title of Person Signing

(831) 454-2160	kasey.kolassa@santacruzcounty.us	June 9, 2020
Phone Number	Email	Date of Report

APPENDIX K
Landfill Gas Monitoring Probe
As-Built Logs

Table 1- Onsite Structures and Miscellaneous Landfill Gas Probes
Buena Vista Drive Sanitary Landfill
Watsonville, CA

Gas Probe	Northing Note 1	Easting Note 1	Ground Elevation Note 1 (feet)	Total Depth (feet)	Notes/Comments
GP-1 [2]	9847.00	10200.00	106.2	5.0	Single level probe with rubber stopper
GP-2 [2]	9818.00	10090.00	106.3	4.0	Single level probe with rubber stopper
GP-3 [2]	9747.00	10015.00	103.9	unknown	Rubber stopper stuck about 4 inches down top of probe. Depth not measureable.
GP-5	9792.00	9825.00	102.9	unknown	Unable to remove rubber stoppers to measure depths.
GP-7	9963.00	9995.00	106.6	6.0	Single level probe with rubber stopper
GP-8	10043.00	10025.00	107.7	unknown	Unable to remove rubber stoppers to measure depths.
GP-9	9973.00	10200.00	106.0	84.0	Converted to LFG extraction well January 2006 to clear LFG from recurring at GP-17. S 10 27 M 30 54 D 57 83

Note 1: Northings, eastings, elevations obtained from Site Plan.
1 - Screen Interval information obtained from Geomatrix Memo dated 5 August 1996
2 - "Top of Casing Elevation" obtained from Geomatrix memo dated 5 August 1996 used for Ground Elevation
3 - "Total Depth" obtained from Geomatrix memo dated 5 August 1996

PROJECT NUMBER	BORING NUMBER
SJC35521.LG.SR	GP-4A SHEET 1 OF 3

SOIL BORING LOG

PROJECT BUENA VISTA LANDFILL LOCATION WATSONVILLE, CA

ELEVATION 101.3 MSL top of casing DRILLING CONTRACTOR SPECTRUM

DRILLING METHOD AND EQUIPMENT AIR ROTARY - 8" DIA. CASING

WATER LEVELS 89.0 START 5-17-93 FINISH 5-17-93 LOGGER C.POLITO

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Soil Descriptions from cuttings.	Continuously observing soil cuttings.
					SANDY LEAN CLAY, (CL), brown, moist, fine grained sand.	
5.0					SANDY LEAN CLAY, (CL), similar to above, except fine to coarse grained sand.	
10.0					SANDY LEAN CLAY, (CL), similar to above except fine grained sand.	
15.0					SANDY LEAN CLAY, (CL), light brown, moist to wet, approximately 30% fine grained sand, clay is moderately plastic.	
20.0						
25.0					SANDY LEAN CLAY, (CL), similar to above, except contains fine to coarse grained sand and 1" minus gravel.	

PROJECT NUMBER	BORING NUMBER
SJC35521.LG.SR	GP-4A
	SHEET 2 OF 3

SOIL BORING LOG

PROJECT BUENA VISTA LANDFILL LOCATION WATSONVILLE, CA

ELEVATION 101.3 MSL top of casing DRILLING CONTRACTOR SPECTRUM

DRILLING METHOD AND EQUIPMENT AIR ROTARY - 8" DIA. CASING

WATER LEVELS 89.0 START 5-17-93 FINISH 5-17-93 LOGGER C.POLITO

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					SANDY LEAN CLAY WITH GRAVEL, (CL), brown, moist, well graded sand, micaceous, 3/4" minus gravel, some silt.	
35.0					SANDY LEAN CLAY, (CL), brown, moist, fine grained sand.	
40.0					SANDY LEAN CLAY, (CL), brown, moist, medium grained sand.	
45.0					SANDY LEAN CLAY, (CL), brown, moist, fine grained sand, some silt, micaceous sand.	
50.0						
55.0					POORLY GRADED SAND, (SP), brown and gray, dry, medium to coarse grained sand, some 3/8" minus fine gravel.	

PROJECT NUMBER	BORING NUMBER
SJC35521.LG.SR	GP-4A SHEET 3 OF 3

SOIL BORING LOG

PROJECT BUENA VISTA LANDFILL LOCATION WATSONVILLE, CA

ELEVATION 101.3 MSL top of casing DRILLING CONTRACTOR SPECTRUM

DRILLING METHOD AND EQUIPMENT AIR ROTARY - 8" DIA. CASING

WATER LEVELS 89.0 START 5-17-93 FINISH 5-17-93 LOGGER C.POLITO

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					POORLY GRADED SAND WITH CLAY AND GRAVEL, (SP-SC), brown, moist, 3/8" minus gravel, approximately 10% clay.	
65.0					WELL GRADED SAND WITH GRAVEL, (SW), brown and gray, dry, 3/8" minus gravel.	
70.0						
75.0						
					CLAYEY SAND, (SC), brown, moist to wet, fine to medium grained sand.	
80.0						
					POORLY GRADED SAND WITH CLAY, (SP-SC), brown, moist, fine to medium grained sand.	
85.0					WELL GRADED SAND, (SW), brown and gray, moist, some 3/8" minus gravel.	
					END OF BORING AT 89.0 FEET.	Hit water.

PROJECT NUMBER	BORING NUMBER
SJC35521.LG.SR	GP-4A SHEET 1 OF

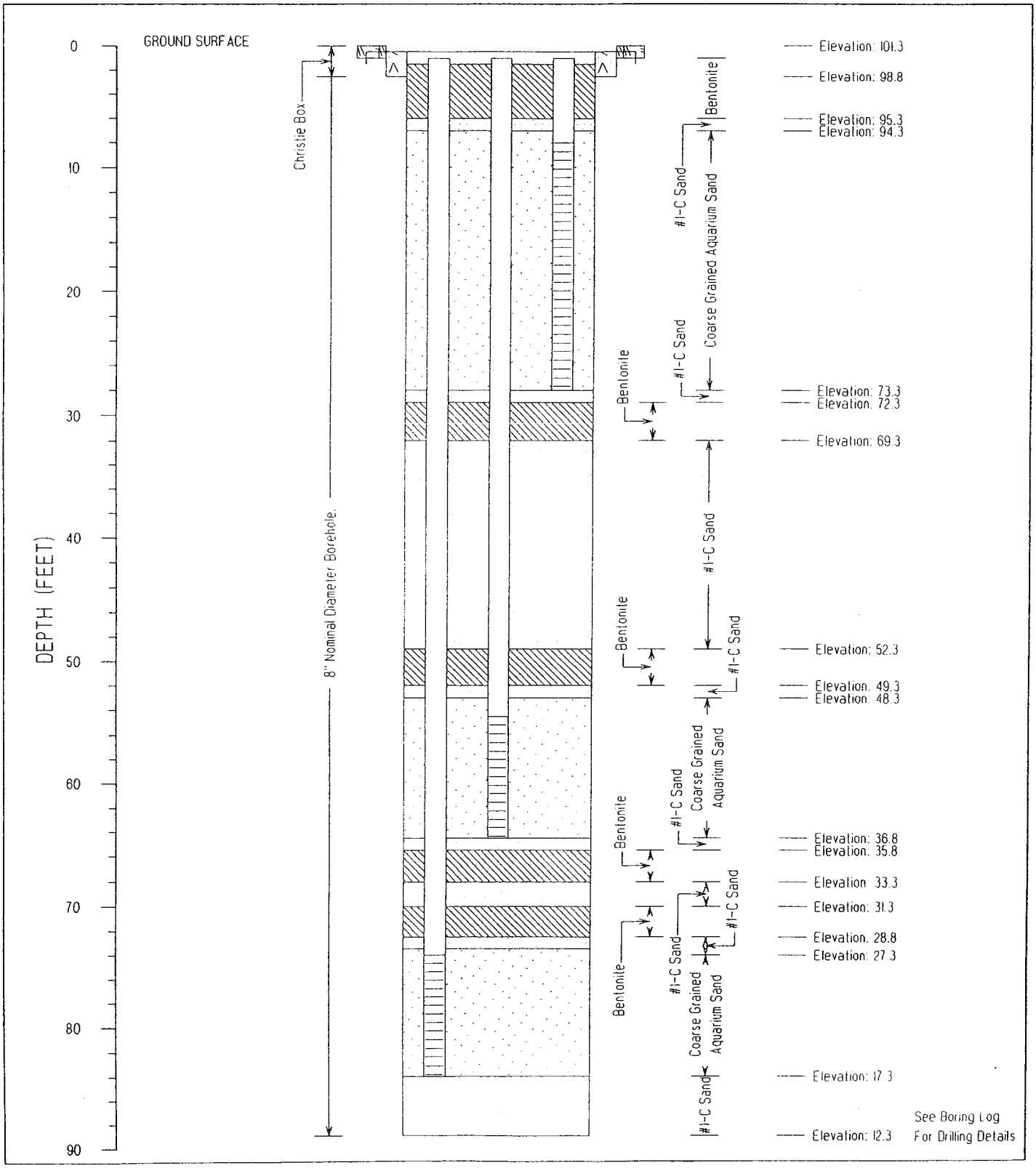
WELL COMPLETION LOG

PROJECT BUENA VISTA LANDFILL LOCATION WATSONVILLE, CA

ELEVATION 101.3 MSL top of casing DRILLING CONTRACTOR SPECTRUM

DRILLING METHOD AND EQUIPMENT AIR ROTARY - 8" DIA. CASING

WATER LEVELS 89.0 START 5-17-93 FINISH 5-17-93 LOGGER C.POLITO



EMCON
SOCIATES
onsultants in Wastes
Management and
nvironmental Control

November 8, 1991
Project 307-01.53

Mr. R. Patrick Mathews
County of Santa Cruz
Department of Public Works
701 Ocean Street
Santa Cruz, California 95060

Note
P-9 = GP-9
P-10 = GP-10
P-11 = GP-11

Re: Installation of gas probes and wells

Dear Mr. Mathews:

EMCON Associates (EMCON) is submitting this report on the installation of a ground-water monitoring well, a piezometer, and soil-gas probes at the Buena Vista landfill, Buena Vista Road, Watsonville, California (figure 1). This work was performed in accordance with the workplan submitted to the County of Santa Cruz on March 25, 1991. The well is used to monitor water quality near the Module 2 expansion area, the piezometer, to monitor water levels west of the existing landfill, and the soil gas probes to monitor potential soil gas migration from the landfill.

Well and Piezometer Installation Procedures

One monitoring well (MW-6) and one piezometer (PZ-1) were installed at the site on June 14 and July 2, 1991, respectively (figure 2). The exploratory borings were drilled with hollow-stem auger drilling equipment. The augers were steam-cleaned between borings to prevent possible cross-contamination.

Soil samples were collected for geologic logging at 5-foot intervals with a 2-inch-diameter split-spoon sampler. A field geologist supervised by a California-state-registered geologist logged the samples according to the Unified Soils Classification System. The boring logs are provided in appendix A.

PJ3 3070153.G0W

Well MW-6 was constructed of 4.5-inch-diameter polyvinyl chloride (PVC) casing with 0.020-inch slotted screen from 109 to 129 feet below ground surface (BGS). Piezometer PZ-1 was constructed of 2-inch-diameter PVC casing with 0.020-inch slots from 26 to 46 feet BGS. Well construction details are provided in appendix A and summarized in table 1.

Well Development

Well MW-6 and piezometer PZ-1 were developed on August 8 and 15, 1991, respectively, by a bailer, a surge block, and a submersible pump. Turbidity of the purge water was measured with an Imhoff cone, and pH with an electronic pH meter. The well-development equipment was steam-cleaned before use in each well, and the water generated during purging and steam-cleaning was discharged to the ground surface of the landfill.

Pump System Installation

An electric submersible pump and a bladder pump were installed in well MW-6 on August 8, 1991. The intake of the submersible pump was approximately 128 feet BGS and that of the bladder pump approximately 126 feet BGS. Installation details are summarized in table 2.

Soil-Gas Probes Installation Procedures

On June 2 and 3, 1991, three multi-level soil-gas probes, P-9, P-10, and P-11, were installed outside the limits of the refuse fill at the locations shown in figure 2. Installation of the soil-gas probes involved the drilling of exploratory borings, logging of subsurface lithology, and conversion of the borings to multi-level soil-gas probes.

The exploratory borings were drilled with 8-inch-diameter hollow-stem auger drilling equipment. An EMCON geologist supervised the drilling and logged the stratigraphy by examining soil cuttings. Logs of exploratory borings are provided in appendix A.

Upon completion, each exploratory boring was converted to a multi-level gas probe. The gas probe casing is 0.5-inch-diameter PVC pipe connected at the bottom to a length of slotted PVC screen located within a predetermined sampling interval. An inner Teflon® tubing connects the sampling interval to the top of the probe casing. Some gas volatilizes through the tubing, reducing the purging volumes required before

sampling (figure 2). Soil-gas probe wells P-10 and P-11 have two sampling levels, and well P-9 has three.

In the slotted pipe was installed in a sand pack separated by intervals of bentonite. Each boring was filled with native sand to the base of the deepest gas probe. The deepest probe was then installed and the annular space filled with 1/4-inch gravel to the top of the screened interval. A bentonite seal at least 3 feet thick was placed the high-permeability sand pack and hydrated with water. The second gas probe was then installed and the well building procedure repeated. Upon completion of sand pack placement for the shallowest soil-gas probes, the annulus was sealed with bentonite to 1 foot BGS. Eight-inch-diameter locking steel casings were installed in concrete at the surface to protect the probes. Construction details for the probes are summarized in table 3.

Soil Gas Probe Monitoring Results

The soil-gas probes were initially monitored for methane on July 2, 1991, and again on July 9, 12, 16, 19, and 26, and on August 1, 10, and 23, 1991 (table 4). Combustible soil-gas concentrations as methane equivalent were measured with portable combustible gas analyzers, either the GasTech® Model GX-3N or the GasTech® Model 1939-OX. Both instruments contain motorized pumps that allow continuous sampling and analysis of the soil-gas. The soil-gas probes were generally monitored in the early afternoon, typically the time when methane concentrations are highest.

Fluctuations in methane concentrations and soil-gas quantities are characteristic in landfills. However, the data trends indicate an overall decrease of methane concentrations at most of the probes. Table 4 shows that soil-gas migration at probes P-1, P-2, P-3, P-5, and P-7 in the vicinity of the Sheriff's Rehabilitation Facility (south of the existing landfill) is being decreased by the operation of the soil-gas control system. Probe P-8 has shown sustained elevated methane readings throughout the monitoring program. Extending the soil-gas control system to include the new gas collectors in Module 2 may help to reduce methane gas concentrations at P-8, near the equipment maintenance building.

If you have any questions, please call.

Very truly yours,

EMCON Associates

Kevin Elliott

Kevin Elliot
Staff Geologist

Mark Smolley

Mark Smolley
Project Supervisor, RG 4650

Attachments: Limitations
Table 1 - Ground-water monitoring well construction details
Table 2 - Pump installation data
Table 3 - Soil-gas probe construction details
Table 4 - Soil-gas probe monitoring results
Figure 1 - Site location
Figure 2 - Monitoring devices and controls location
Appendix A - Boring logs and well details

LIMITATIONS

The purpose of a geologic/hydrogeologic study is to reasonably characterize existing site conditions based on the geology/hydrogeology of the area. In performing such a study, it is understood that a balance must be struck between a reasonable inquiry into the site conditions and an exhaustive analysis of each conceivable environmental characteristic. The following paragraphs discuss the assumptions and parameters under which such an opinion is rendered.

No investigation is thorough enough to describe all geologic/hydrogeologic conditions of interest at a given site. If conditions have not been identified during the study, such a finding should not therefore be construed as a guarantee of the absence of such conditions at the site, but rather as the result of the services performed within the scope, limitations, and cost of the work performed.

We are unable to report on or accurately predict events that may change the site conditions after the described services are performed, whether occurring naturally or caused by external forces. We assume no responsibility for conditions we were not authorized to evaluate, or conditions not generally recognized as predictable when services were performed.

Geologic/hydrogeologic conditions may exist at the site that cannot be identified solely by visual observation. Where subsurface exploratory work was performed, our professional opinions are based in part on interpretation of data from discrete sampling locations that may not represent actual conditions at un-sampled locations.

Table 1
Ground-Water Monitoring
Well Construction Details

Well or Piezometer	Date Drilled	Boring Depth (feet BGS)	Casing Depth (feet BGS)	Casing Diameter (inches)	Seal Interval (feet BGS)	Screen Interval (feet BGS)	Screen Slot Size (inches)	Ground Surface Elevation (ft-MSL)
PZ-1	7/12/91	46	46	2	18 to 20	26 to 46	0.02	≈ 20
MW-6	6/14/91	130	129	4.5	104 to 107	109 to 129	0.02	≈ 105

Notes:
Top of casing elevations to be surveyed by Santa Cruz County.
BGS: below ground surface
MSL: mean sea level

Table 2
Pump Installation Data
August 1991

Well Identification	Type of Pumps Installed	Approximate Length of Stainless Steel Pipe Installed for Electrical Submersible Pump (feet)	Approximate Length of Tubing Installed for Bladder Pump (feet)	Depth to Electric Submersible Pump Inlet (feet BGS)	Depth to Bladder Pump Inlet (feet BGS)	Total Well Depth (feet BGS)
MW-6	Grundfos® 5S03-9 Electrical submersible and QED® Well Wizard P1201 Bladder Pump	127	122.5	128.1	126	130

Table 3
Soil Gas Probe
Construction Details

Soil Gas Probe	Total Boring Length (feet)	Multi-Level I.D.	Boring Diameter (inches)	Screened Interval (depth from TOC) (feet)	Sand Pack Interval (depth, feet BGS)	Bentonite Seal Interval (depth, feet BGS)	Ground Surface Elevation (feet, MSL)
P-9	84	S M D	8	10 to 26.5 29.5 to 54 57 to 83	10 to 26.5 29.5 to 54 57 to 83	1 to 10 26.5 to 29.5 54 to 57	≈ 100
P-10	84	S M	8	13 to 25 30 to 42	13 to 25 30 to 42	1 to 13 25 to 30	≈ 100
P-11	83	S D	8	10 to 28 66 to 83	10 to 28 66 to 83	1 to 10 28 to 66	≈ 105

Notes:
TOC: Top of casing
All gas probes are 0.5-inch-diameter PVC casing.
NA: Not Applicable
BGS: Below Ground Surface

Table 4
Soil-Gas Probe Monitoring Results

Soil Gas Probe	Methane Concentrations								
	07/02/91	07/09/91	07/12/91	07/16/91	07/19/91	07/26/91	08/01/91	08/10/91	08/23/91
P-1	4	NM	0	0	0	0	0	0	0
P-2	TR	NM	0	0	0	0	0	0	0
P-3	TR	NM	0	0	0	0	0	0	0
P-5B	24	NM	40	10 LEL	7	10	0	5 LEL	0
P-5O	14	NM	41	0	0	0	5 LEL	0	0
P-5W	7	NM	37	5 LEL	5	0	0	0	0
P-7	56	NM	70 LEL	0	5	7	17	15	0
P-8B	58	NM	56	50	NM	55	48	48	52
P-8O	59	NM	56	55	NM	48	42	42	49
P-8W	56	NM	45	20	NM	0	0	0	0
P-9S	NM	25 LEL	0	10 LEL	15 LEL	NM	20	0	40
P-9M	NM	13	25	25	25	NM	30	NM	50
P-9D	NM	35	34	35	35	NM	33	NM	42
P-10S	NM	32 LEL	NM	NM	NM	NM	NM	NM	0
P-10D	NM	32 LEL	NM	NM	NM	NM	NM	NM	0
P-11S	NM	32 LEL	NM	NM	NM	NM	NM	NM	0
P-11D	NM	17 LEL	NM	NM	NM	NM	NM	NM	0

Probes P-4 and P-6 have been destroyed by landfilling operations
LEL = percent of low exlosive limit; all other data are percent by volume
TR = trace concentration
NM = not measured
D = probe at depths ranging between 57 and 83 feet
M = probe at depths ranging between 29 and 54 feet
S = probe at depths ranging between 10 and 27 feet

LOG OF EXPLORATORY BORING

PROJECT NUMBER 307-01.50 BORING NO. P-9

PROJECT NAME Buena Vista Landfill PAGE 1 OF 5

BY L. Gallagher DATE 7/3/91 SURFACE ELEV. ft.

RECOVERY (ft/ft)		PENETRATION (blws/ft)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION	WELL DETAIL
				5			SANDY CLAY (CL), dark olive brown (2.5YR, 5/5); 15-20% fine to medium sand; trace gravel, angular to subrounded; damp.	
				10			CLAYEY SAND (SC), dark olive brown (2.5Y, 3/3); 25-30% moderate-plasticity fines; 70-75% fine to medium grained; trace gravel, angular to subrounded; damp.	
				15			SANDY CLAY (CL), olive brown (2.5Y, 4/4); low- to moderate-plasticity fines; 5-10% very fine to medium sand, subangular to subrounded; moist.	
				20				

EMCON ASSOCIATES

REMARKS

Boring drilled using 8-inch-diameter hollow-stem augers and completed as Tri-level Gas Probe. Boring logged from drill cuttings collected every 5 feet.

LOG OF EXPLORATORY BORING

PROJECT NUMBER 307-01.50 BORING NO. P-9

PROJECT NAME Buena Vista Landfill PAGE 2 OF 5

BY L. Gallagher DATE 7/3/91 SURFACE ELEV. ft.

RECOVERY (ft/ft)		PENETRATION (blws/ft)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION	WELL DETAIL
				25			SANDY CLAY (CL), continued. @20': trace pebbles. @25': 20-25% very fine to medium sand; gravel and pebbles absent.	
				30				
				35			GRAVEL (G), olive brown (2.5Y, 4/4); 5-10% fines; 15-20% fine to coarse sand; 30-35% gravel; 35-40% pebbles, subangular to rounded; damp.	
				40				

EMCON ASSOCIATES

REMARKS

Boring drilled using 8-inch-diameter hollow-stem augers and completed as Tri-level Gas Probe. Boring logged from drill cuttings collected every 5 feet.

LOG OF EXPLORATORY BORING

PROJECT NUMBER 307-01.50 BORING NO. P-9

PROJECT NAME Buena Vista Landfill PAGE 3 OF 5

BY L. Gallagher DATE 7/3/91 SURFACE ELEV. ft.

RECOVERY (ft/ft)		PENETRATION (blws/ft)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION	WELL DETAIL
				45			CLAYEY SAND (SC), olive brown (2.5Y, 4/4); 10-15% low- to moderate-plasticity fines; 70-75% very fine to medium sand, subangular to subrounded; 5-10% gravel, rounded to subrounded; damp.	
							@45': trace cobbles, <15mm-dia., subangular to subrounded.	
				50			SANDY CLAY (CL), olive brown (2.5Y, 4/4); 75-80% low- to moderate-plasticity fines; 20-25% medium to very coarse sand; trace gravel, rounded to subangular; damp.	
				55			@55': trace cobbles, <25mm-dia., subangular to subrounded.	
				60				

REMARKS

Boring drilled using 8-inch-diameter hollow-stem augers and completed as Tri-level Gas Probe. Boring logged from drill cuttings collected every 5 feet.

EMCON ASSOCIATES

LOG OF EXPLORATORY BORING

PROJECT NUMBER 307-01.50 BORING NO. P-9

PROJECT NAME Buena Vista Landfill PAGE 4 OF 5

BY L. Gallagher DATE 7/3/91 SURFACE ELEV. ft.

RECOVERY (ft/ft)		PENETRATION (blws/ft)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION	WELL DETAIL
				65			SANDY CLAY (CL), continued.	
							GRAVEL (GW), olive brown (2.5Y, 4/4); 5-10% fines; 15-20% very fine to very coarse sand; 45-50% gravel; 15-20% pebbles <15mm-dia., subrounded to subangular; damp.	
				70			CLAYEY GRAVEL (GC), light olive brown (2.5Y, 5/3); 10-15% fines; 5-10% sand; 5-10% gravel; 65-75% pebbles <15mm-dia., subangular to rounded; damp.	
				75				
				80				

REMARKS

Boring drilled using 8-inch-diameter hollow-stem augers and completed as Tri-level Gas Probe. Boring logged from drill cuttings collected every 5 feet.

EMCON ASSOCIATES

LOG OF EXPLORATORY BORING

PROJECT NUMBER 307-01.50 BORING NO. P-9

PROJECT NAME Buena Vista Landfill PAGE 5 OF 5

BY L. Gallagher DATE 7/3/91 SURFACE ELEV. ft.

RECOVERY (ft/ft)		PENETRATION (blws/ft)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION	WELL DETAIL
				85			CLAYEY GRAVEL (GC), continued.	
				90			BORING TERMINATED AT 84 FEET.	
				95				
				100				

REMARKS

Boring drilled using 8-inch-diameter hollow-stem augers and completed as Tri-level Gas Probe. Boring logged from drill cuttings collected every 5 feet.

EMCON ASSOCIATES

LOG OF EXPLORATORY BORING

PROJECT NUMBER 307-01.50 BORING NO. P-10

PROJECT NAME Buena Vista Landfill PAGE 1 OF 5

BY L. Gallagher DATE 7/2/91 SURFACE ELEV. ft.

RECOVERY (ft/ft)		PENETRATION (blws/ft)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION	WELL DETAIL
				5			CLAYEY SAND (SC), dark yellowish brown (10YR, 4/6); 10-15% fines; well-graded mixture of fine to very coarse grained sand, rounded to subrounded; trace iron-oxide staining; trace rootlets; damp.	
				10			@10': 15-20% fines; trace fines sand.	
				15			SANDY CLAY (CL), dark yellowish brown (10YR, 3/6); 5-10% medium to very coarse sand, subangular to subrounded; moist.	
				20				

REMARKS

Boring drilled using 8-inch-diameter hollow-stem augers and completed as Bi-level Gas Probe. Boring logged from drill cuttings collected every 5 feet.

EMCON ASSOCIATES

LOG OF EXPLORATORY BORING

PROJECT NUMBER 307-01.50 BORING NO. P-10

PROJECT NAME Buena Vista Landfill PAGE 2 OF 5

BY L. Gallagher DATE 7/2/91 SURFACE ELEV. ft.

RECOVERY (ft/ft)		PENETRATION (blws/ft)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION	WELL DETAIL
				25			**SANDY CLAY (CL)**, continued. @25': sand absent.	
				30			**CLAYEY SAND (SC)**, olive brown (2.5Y, 4/3); 10-15% plastic fines; 85-90% very fine to medium grained sands, subangular to rounded; moist.	
				35			@35': 5-10% fines.	
				40				

REMARKS

Boring drilled using 8-inch-diameter hollow-stem augers and completed as Bi-level Gas Probe. Boring logged from drill cuttings collected every 5 feet.

EMCON ASSOCIATES

LOG OF EXPLORATORY BORING

PROJECT NUMBER 307-01.50 BORING NO. P-10

PROJECT NAME Buena Vista Landfill PAGE 3 OF 5

BY L. Gallagher DATE 7/2/91 SURFACE ELEV. ft.

RECOVERY (ft/ft)		PENETRATION (blws/ft)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION	WELL DETAIL
				45			CLAYEY SAND (SC), continued. @45': very moist.	
				50			@50': 25-30% fines; 60-75% well graded mix of fine sand to gravel (<3mm-dia. clasts, subangular to rounded.)	
				55				
				60				

REMARKS

Boring drilled using 8-inch-diameter hollow-stem augers and completed as Bi-level Gas Probe. Boring logged from drill cuttings collected every 5 feet.

EMCON ASSOCIATES

LOG OF EXPLORATORY BORING

PROJECT NUMBER 307-01.50 BORING NO. P-10

PROJECT NAME Buena Vista Landfill PAGE 4 OF 5

BY L. Gallagher DATE 7/2/91 SURFACE ELEV. ft.

RECOVERY (ft/ft)		PENETRATION (blws/ft)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION	WELL DETAIL
				65			CLAYEY SAND (SC), continued. @60': light olive brown (2.5Y, 5/4).	
				70			@70': gravel clasts <4mm-dia.; wet.	
				75				
				80				

REMARKS

Boring drilled using 8-inch-diameter hollow-stem augers and completed as Bi-level Gas Probe. Boring logged from drill cuttings collected every 5 feet.

EMCON ASSOCIATES

LOG OF EXPLORATORY BORING

PROJECT NUMBER 307-01.50 BORING NO. P-10

PROJECT NAME Buena Vista Landfill PAGE 5 OF 5

BY L. Gallagher DATE 7/2/91 SURFACE ELEV. ft.

RECOVERY (ft/ft)		PENETRATION (blws/ft)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION	WELL DETAIL
				85			CLAYEY SAND (SC), continued. BORING TERMINATED AT 84 FEET.	
				90				
				95				
				100				

REMARKS

Boring drilled using 8-inch-diameter hollow-stem augers and completed as Bi-level Gas Probe. Boring logged from drill cuttings collected every 5 feet.

EMCON ASSOCIATES

LOG OF EXPLORATORY BORING

PROJECT NUMBER 307-01.50 BORING NO. P-11

PROJECT NAME Buena Vista Landfill PAGE 1 OF 5

BY L. Gallagher DATE 7/3/91 SURFACE ELEV. ft.

RECOVERY (ft/ft)		PENETRATION (blws/ft)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION	WELL DETAIL
				5			SANDY CLAY (CL), dark yellowish brown (10YR, 3/6); 15-20% fine to medium sand; trace gravel, angular to subangular; damp.	
				10				
				15			@15': 20-25% sand; 5-10% gravel; trace pebbles.	
				20				

REMARKS

Boring drilled using 8-inch-diameter hollow-stem augers and completed as Bi-level Gas Probe. Boring logged from drill cuttings collected every 5 feet.

EMCON ASSOCIATES

LOG OF EXPLORATORY BORING

PROJECT NUMBER 307-01.50 BORING NO. P-11

PROJECT NAME Buena Vista Landfill PAGE 2 OF 5

BY L. Gallagher DATE 7/3/91 SURFACE ELEV. ft.

RECOVERY (ft/ft)		PENETRATION (blws/ft)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION	WELL DETAIL
				25			**CLAYEY SAND (SC)**, olive brown (2.5Y, 4/4); 20-30% low- to moderate-plasticity fines; 35-40% fine to very coarse sand; 30-35% gravel, rounded to subangular; trace iron-oxide staining; damp.	
							SANDY CLAY (CL), olive brown (2.5Y, 4/4); low- to moderate-plasticity; 20-25% very fine to medium sand, subangular to subrounded; trace gravel; moist.	
				30				
				35				
				40				

REMARKS

Boring drilled using 8-inch-diameter hollow-stem augers and completed as Bi-level Gas Probe. Boring logged from drill cuttings collected every 5 feet.

EMCON ASSOCIATES

LOG OF EXPLORATORY BORING

PROJECT NUMBER 307-01.50 BORING NO. P-11

PROJECT NAME Buena Vista Landfill PAGE 3 OF 5

BY L. Gallagher DATE 7/3/91 SURFACE ELEV. ft.

RECOVERY (ft/ft)		PENETRATION (blws/ft)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION	WELL DETAIL
				45			SANDY CLAY (CL), continued.	
				50			CLAYEY SAND (SC), olive brown (2.5Y, 4/4); 30-35% low- to moderate-plasticity fines; 60-65% fine to coarse sand; 2-5% gravel to pebble size clasts (<15mm dia.), rounded to subangular; damp.	
				55			GRAVEL (GW), olive brown (2.5Y, 4/4); 5-10% fines; 15-20% fine to coarse sands; 30-35% gravel; 35-40% pebbles (<40mm-dia.), subangular to rounded; damp.	
				60			CLAYEY SAND (SC), olive brown (2.5Y, 4/4); 30-40% fines; 60-65% fine to very coarse sand; 2-5% gravel, rounded to subangular; damp.	

REMARKS

Boring drilled using 8-inch-diameter hollow-stem augers and completed as Bi-level Gas Probe. Boring logged from drill cuttings collected every 5 feet.

EMCON ASSOCIATES

LOG OF EXPLORATORY BORING

PROJECT NUMBER 307-01.50 BORING NO. P-11

PROJECT NAME Buena Vista Landfill PAGE 4 OF 5

BY L. Gallagher DATE 7/3/91 SURFACE ELEV. ft.

RECOVERY (ft/ft)		PENETRATION (blws/ft)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION	WELL DETAIL
				65			CLAYEY SAND (SC), continued. GRAVEL (GP), olive brown (2.5Y, 4/4); 15-20% fines; 5-10% medium to coarse sand; 5-15% gravel; 60-65% pebbles clasts (<50mm-dia.), subangular to subrounded; damp.	
				70			CLAYEY SAND (SC), olive brown (2.5Y, 4/3); 25-35% fines; 60-70% fine to coarse sand; trace gravel to pebble clasts (<40mm-dia.), subrounded to subangular; damp.	
				75			GRAVEL (GP), olive brown (2.5Y, 4/4); 15-20% fines; 30-40% fine to coarse grained sand; 10-15% gravels; 30-35% pebbles (<25mm-dia.), rounded to subangular; damp.	
				80				

REMARKS

Boring drilled using 8-inch-diameter hollow-stem augers and completed as Bi-level Gas Probe. Boring logged from drill cuttings collected every 5 feet.

EMCON ASSOCIATES

LOG OF EXPLORATORY BORING

PROJECT NUMBER 307-01.50 BORING NO. P-11

PROJECT NAME Buena Vista Landfill PAGE 5 OF 5

BY L. Gallagher DATE 7/3/91 SURFACE ELEV. ft.

RECOVERY (ft/ft)		PENETRATION (blws/ft)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION	WELL DETAIL
				85			GRAVEL (GP), continued.	
				90			BORING TERMINATED AT 83 FEET.	
				95				
				100				

REMARKS

Boring drilled using 8-inch-diameter hollow-stem augers and completed as Bi-level Gas Probe. Boring logged from drill cuttings collected every 5 feet.

EMCON ASSOCIATES

LOG OF EXPLORATORY BORING

PROJECT NUMBER 307-01.53 BORING NO. MW-6

PROJECT NAME Buena Vista Landfill PAGE 1 OF 7

BY K. Elliot DATE 6/13/91 SURFACE ELEV. ft.

RECOVERY (ft/ft)		PENETRATION (blws/ft)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION	WELL DETAIL
							TOPSOIL	
18/18		24		5			GRAVELLY SAND (SP) SANDY SILT (ML), dark brown (10YR, 3/3); 15-20% fine sand; very stiff; damp.	
18/18		17		10			CLAYEY SAND (SC), light yellowish brown (10YR, 6/4); 20-30% low-plasticity fines; 70-80% fine to medium sand; abundant iron-oxide staining; medium dense; damp.	
18/18		19		15			SAND (GP), brownish yellow (10YR, 6/6); 5-10% fines; 90-95% fine to medium sand; trace gravel <0.5 inch; medium dense; damp.	
							CLAYEY SAND (SC), brownish yellow (10YR, 6/6); 30-40% low- to moderate-plasticity fines; trace coarse sand; micaceous; medium dense; damp.	
				20				

REMARKS

Boring drilled with 10-inch-diameter hollow-stem augers and sampled with a split-spoon sampler. The boring was converted into a 4.5-inch-diameter PVC monitoring well. See Well Details for more information.

EMCON ASSOCIATES

LOG OF EXPLORATORY BORING

PROJECT NUMBER 307-01.53 BORING NO. MW-6

PROJECT NAME Buena Vista Landfill PAGE 2 OF 7

BY K. Elliot DATE 6/13/91 SURFACE ELEV. ft.

RECOVERY (ft/ft)		PENETRATION (blws/ft)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION	WELL DETAIL
18/18		24					CLAYEY SAND, continued.	
							@21': high-plasticity clay lens.	
							SILTY SAND (SM), light yellowish brown (10YR, 6/4); 20-30% fines; 70-80% fine sand; (<1/4") clay lenses; medium dense; damp.	
12/18		27		25				
12/18		36		30			@30': 10-20% fines.	
8/18		27		35			@35': trace to 5% coarse sand.	
							@36': 2-inch thick clay lens.	
							SAND (SP), olive brown (2.5Y, 4/4) trace to 5% fines; fine grained sand; dense; damp.	
				40				

EMCON ASSOCIATES

REMARKS

Boring drilled with 10-inch-diameter hollow-stem augers and sampled with a split-spoon sampler. The boring was converted into a 4.5-inch-diameter PVC monitoring well. See Well Details for more information.

LOG OF EXPLORATORY BORING

PROJECT NUMBER 307-01.53 BORING NO. MW-6

PROJECT NAME Buena Vista Landfill PAGE 3 OF 7

BY K. Elliot DATE 6/13/91 SURFACE ELEV. ft.

RECOVERY (ft/ft)		PENETRATION (blws/ft)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION	WELL DETAIL
18/18		73					SAND (SP), continued. @40.5': 3"-thick lens of fine grained cemented sand; moderate hardness; overlain by 2"-layer of fine gravel and fine to coarse sand; 3 to 6" water perched above sandstone.	
18/18		76		45			@45': 6"-thick lens of fine to coarse sand; saturated. @45.5': 5-10% fines.	
12/18		69		50			@50': trace fine gravel. @51': 6" sand lens with whitish hue; 5-10% freshly fractured medium to coarse sand; some iron-oxide staining on surfaces of medium to coarse sand.	
12/18		78		55			@56': fine to coarse sand larger grains show fresh fracturing; 5-10% fines; some iron-oxide staining; some cementation; 5-10% fine gravel.	
				60				

REMARKS

Boring drilled with 10-inch-diameter hollow-stem augers and sampled with a split-spoon sampler. The boring was converted into a 4.5-inch-diameter PVC monitoring well. See Well Details for more information.

EMCON ASSOCIATES

LOG OF EXPLORATORY BORING

PROJECT NUMBER 307-01.53 BORING NO. MW-6

PROJECT NAME Buena Vista Landfill PAGE 4 OF 7

BY K. Elliot DATE 6/13/91 SURFACE ELEV. ft.

RECOVERY (ft/ft)		PENETRATION (blws/ft)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION	WELL DETAIL
18/18		71					GRAVELLY SAND (SW), light olive brown (2.5Y, 5/4); 5-10% fines; 65-70% fine to medium sand; 20-30% fine to medium gravel; very dense; damp.	
18/18		66		65			@65': 10-20% fine gravel.	
18/18		70		70			@70': 10-20% fine to medium gravel.	
18/18		3		75			SAND (SP), olive (5Y, 4/3); 0-5% fines; 95-100% fine grained sand; dense; damp.	
				80				

REMARKS

Boring drilled with 10-inch-diameter hollow-stem augers and sampled with a split-spoon sampler. The boring was converted into a 4.5-inch-diameter PVC monitoring well. See Well Details for more information.

EMCON ASSOCIATES

LOG OF EXPLORATORY BORING

PROJECT NUMBER 307-01.53 BORING NO. MW-6

PROJECT NAME Buena Vista Landfill PAGE 5 OF 7

BY K. Elliot DATE 6/13/91 SURFACE ELEV. ft.

RECOVERY (ft/ft)		PENETRATION (blws/ft)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION	WELL DETAIL
18/18		93					SAND (SP), continued. @~80': 12"-thick gravelly sand lens. GRAVELLY SAND (SW), olive (5Y, 4/3). SAND (SP), olive (5Y, 4/3); 0-5% fines; 95-100% fine grained sand; dense; damp. @~81.5': thoroughly iron-oxide stained.	
18/18		72		85			@85': 5-10% fines; iron-oxide staining.	
18/18		90		90				
17/18		50 for 5"		95				
				100				

REMARKS

Boring drilled with 10-inch-diameter hollow-stem augers and sampled with a split-spoon sampler. The boring was converted into a 4.5-inch-diameter PVC monitoring well. See Well Details for more information.

EMCON ASSOCIATES

LOG OF EXPLORATORY BORING

PROJECT NUMBER 307-01.53 BORING NO. MW-6

PROJECT NAME Buena Vista Landfill PAGE 6 OF 7

BY K. Elliot DATE 6/13/91 SURFACE ELEV. ft.

RECOVERY (ft/ft)		PENETRATION (blws/ft)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION	WELL DETAIL
18/18		83					SAND (SP), continued. @100': highly micaceous.	
18/18		82		105				
18/18		86		110				
			6/13/91					
		125		115			GRAVELLY SAND (SW), 60-70% fine to coarse sand; 30-40% fine gravel. @~116.5': strong iron-oxide staining. SAND (SP), olive (5Y, 4/3); 0-5% fines; 95-100% fine grained sand; dense; damp.	
			6/13/91					
				120				

REMARKS

Boring drilled with 10-inch-diameter hollow-stem augers and sampled with a split-spoon sampler. The boring was converted into a 4.5-inch-diameter PVC monitoring well. See Well Details for more information.

EMCON ASSOCIATES

LOG OF EXPLORATORY BORING

PROJECT NUMBER 307-01.53 BORING NO. MW-6

PROJECT NAME Buena Vista Landfill PAGE 7 OF 7

BY K. Elliot DATE 6/13/91 SURFACE ELEV. ft.

RECOVERY (ft/ft)		PENETRATION (blws/ft)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION	WELL DETAIL
18/18		183					SAND (SP), continued.	
							@121.5': strong iron-oxide staining.	
		120		125				
12/12		88		130			BORING TERMINATED AT 131 FEET.	
				135				
				140				

REMARKS

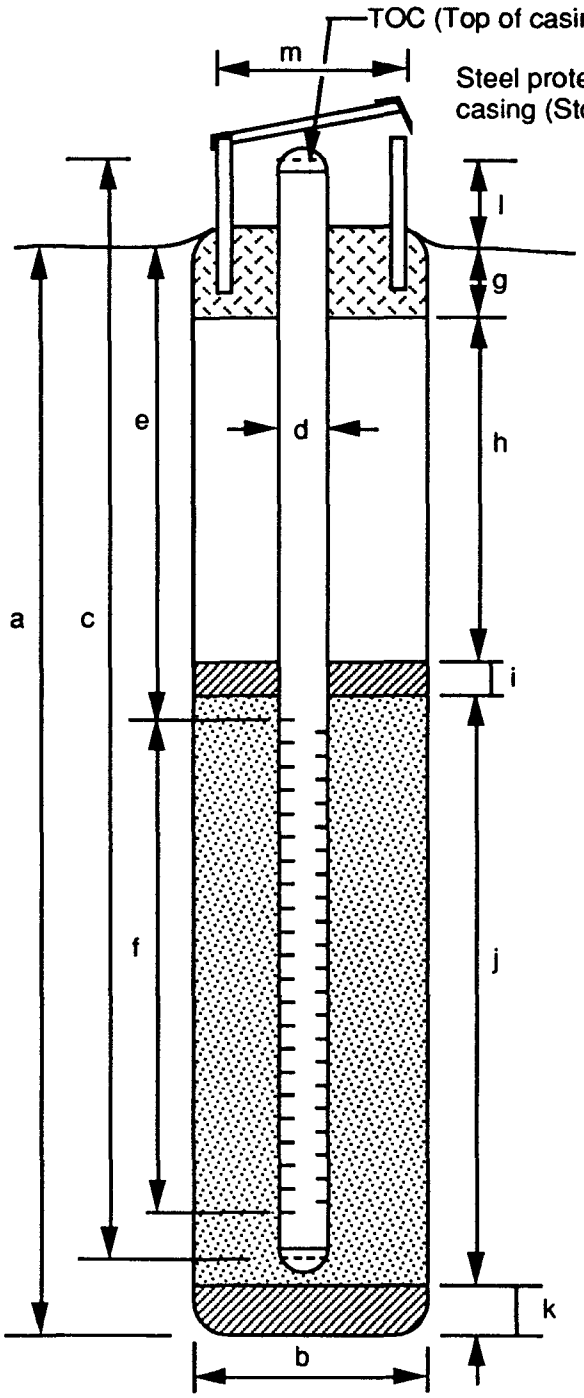
Boring drilled with 10-inch-diameter hollow-stem augers and sampled with a split-spoon sampler. The boring was converted into a 4.5-inch-diameter PVC monitoring well. See Well Details for more information.

EMCON ASSOCIATES

WELL DETAILS

PROJECT NUMBER 307-01.53
PROJECT NAME Buena Vista Landfill
LOCATION Watsonville, California
WELL PERMIT NO. _____

BORING / WELL NO. MW-6
TOP OF CASING ELEV. _____
GROUND SURFACE ELEV. _____
DATUM MSL
INSTALLATION DATE 6/13/91



EXPLORATORY BORING

a. Total depth 131.0 ft.
b. Diameter 10 in.
Drilling method Hollow-stem Auger

WELL CONSTRUCTION

c. Total casing length 129.0 ft.
Material Schedule 40 PVC
d. Diameter 4.5 in.
e. Depth to top perforations 109.0 ft.
f. Perforated length 20.0 ft.
Perforated interval from 109.0 to 129.0 ft.
Perforation type Machine Slotted
Perforation size 0.020 inch
g. Surface seal 1 ft.
Material Concrete
h. Backfill 103.0 ft.
Material Bentonite/Cement
i. Seal 3.0 ft.
Material Bentonite
j. Gravel pack 22.0 ft.
Gravel pack interval from 107.0 to 129.0 ft.
Material #1/20 Sand
k. Bottom seal/fill 1 ft.
Material Slough
l. Casing stickup 1 ft.
m. Protective casing diameter 24 in.

Form prepared by KE

PROJECT NUMBER	BORING NUMBER
SJC35521.LG.SR	GP-12 SHEET 1 OF 4

SOIL BORING LOG

PROJECT BUENA VISTA LANDFILL LOCATION WATSONVILLE, CA

ELEVATION 104.5 (106.56 top of casing) DRILLING CONTRACTOR SPECTRUM

DRILLING METHOD AND EQUIPMENT SCHRAMM AIR ROTARY - 8" DIA. CASING

WATER LEVELS None Encountered START 5-13-93 FINISH 5-14-93 LOGGER C.POLITO

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Soil Descriptions from cuttings.	Continuously observing soil cuttings.
					SANDY LEAN CLAY, (CL), reddish brown, moist, fine grained sand.	
5.0						
10.0					SANDY LEAN CLAY, (CL), similar to above, except less moist and contains some medium to coarse grained sand to 1/8" diameter.	
					POORLY GRADED GRAVEL, (GP), gray and brown, dry, fine to medium gravel, some sand.	
15.0	15.0					
	16.0	G-1			FAT CLAY, (CH), brown, moist.	
20.0						
	22.0					
	23.0	G-2			POORLY GRADED SAND, (SP), brown, moist, very fine grained sand with trace silt.	
25.0					WELL GRADED SAND, (SW), brown, moist, contains some fine, 1/2" minus gravel.	
	30.0					

PROJECT NUMBER	BORING NUMBER
SJC35521.LG.SR	GP-12
	SHEET 2 OF 4

SOIL BORING LOG

PROJECT BUENA VISTA LANDFILL LOCATION WATSONVILLE, CA

ELEVATION 104.5 (106.56 top of casing) DRILLING CONTRACTOR SPECTRUM

DRILLING METHOD AND EQUIPMENT SCHRAMM AIR ROTARY - 8" DIA. CASING

WATER LEVELS None Encountered START 5-13-93 FINISH 5-14-93 LOGGER C.POLITO

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION	COMMENTS
					SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 31.0	G-4			CLAYEY SAND, (SC), brown, moist, fine to medium grained sand, with occasional 1/2" minus gravel.	
35.0					SANDY LEAN CLAY WITH GRAVEL, (CL), brown, moist, fine to medium grained sand, with approximately 5% 1/2" minus gravel.	
40.0					WELL GRADED SAND WITH GRAVEL, (SW), brown, moist, with trace fines and approximately 5-10% 1/2" minus gravel	
	42.0					
	43.0	G-5			CLAYEY SAND WITH GRAVEL, (SC), brown, moist to wet, coarse grained sand, with fine, 3/8" minus gravel.	Sample is wet.
45.0					WELL GRADED SAND, (SW), brown, moist, fine to coarse grained sand, contains some 1/4" minus gravel, with trace of clay clinging to larger particles.	
					SANDY CLAY, (CL), brown, moist, fine to medium grained sand, approximately 40% sand, approximately 60% clay.	
50.0						
55.0					WELL GRADED SAND WITH SILT, (SW-SM), brown, moist, fine to medium grained sand.	
					SANDY CLAY, (CL), brown, moist, fine to medium grained sand, approximately 40% sand, approximately 60% clay.	

PROJECT NUMBER	BORING NUMBER
SJC35521.LG.SR	GP-12 SHEET 3 OF 4

SOIL BORING LOG

PROJECT BUENA VISTA LANDFILL LOCATION WATSONVILLE, CA

ELEVATION 104.5 (106.56 top of casing) DRILLING CONTRACTOR SPECTRUM

DRILLING METHOD AND EQUIPMENT SCHRAMM AIR ROTARY - 8" DIA. CASING

WATER LEVELS None Encountered START 5-13-93 FINISH 5-14-93 LOGGER C.POLITO

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					WELL GRADED SAND, (SW-SC), brown, moist, predominately fine to medium grained sand, with some coarse grained sand.	
65.0					WELL GRADED SAND, (SW), similar to above, except contains 1/2" minus gravel.	
					WELL GRADED SAND, (SW), similar to above, except contains no gravel.	
70.0					WELL GRADED SAND WITH GRAVEL, (SW), brown and gray, dry, 1/2" minus gravel.	
75.0					POORLY GRADED SAND WITH GRAVEL, (SP), brown, moist, approximately 50% 1/2" minus gravel.	
					WELL GRADED SAND, (SW), brown, dry, contains some fine, 1/4" minus gravel.	
80.0					SILTY SAND, (SM), brown, moist, fine grained sand, with occasional 1/2" minus gravel.	
85.0					WELL GRADED SAND, (SW), brown, dry, approximately 5% 3/8" minus gravel, trace silt.	

PROJECT NUMBER	BORING NUMBER
SJC35521.LG.SR	GP-12 SHEET 4 OF 4

SOIL BORING LOG

PROJECT BUENA VISTA LANDFILL LOCATION WATSONVILLE, CA

ELEVATION 104.5 (106.56 top of casing) DRILLING CONTRACTOR SPECTRUM

DRILLING METHOD AND EQUIPMENT SCHRAMM AIR ROTARY - 8" DIA. CASING

WATER LEVELS None Encountered START 5-13-93 FINISH 5-14-93 LOGGER C.POLITO

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6" -6" -6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					LEAN CLAY (CL), grayish brown, moist, contains some fine grained sand.	
					END OF BORING AT 92.0 FEET.	
95.0						
100.0						
105.0						
110.0						
115.0						

PROJECT NUMBER	BORING NUMBER
SJC35521.LG.SR	GP-12 SHEET 1 OF

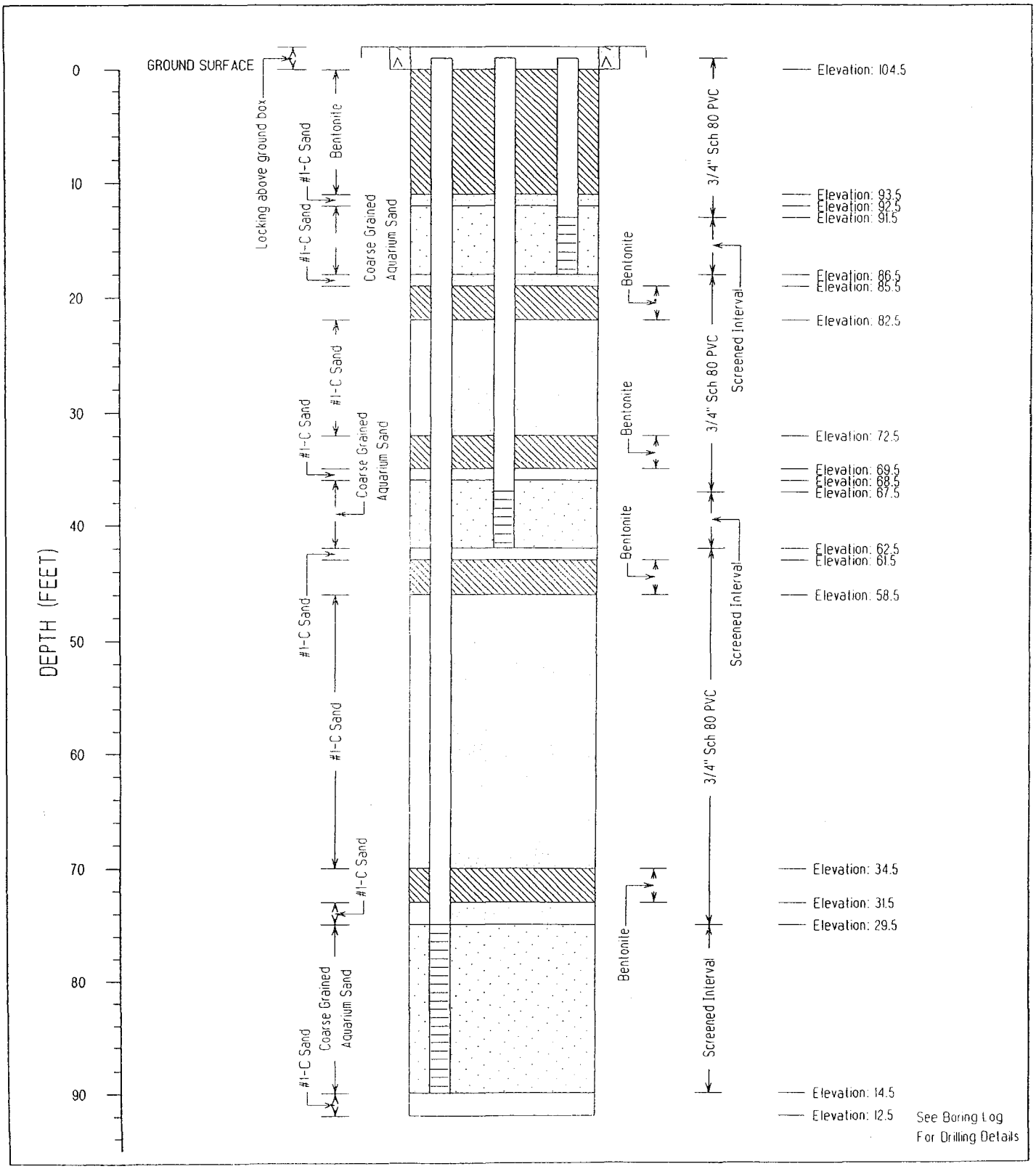
WELL COMPLETION LOG

PROJECT BUENA VISTA LANDFILL LOCATION WATSONVILLE, CA

ELEVATION 104.5 (106.56 top of casing) DRILLING CONTRACTOR SPECTRUM

DRILLING METHOD AND EQUIPMENT SCHRAMM AIR ROTARY - 8" DIA. CASING

WATER LEVELS None Encountered START 5-13-93 FINISH 5-14-93 LOGGER C.POLITO



PROJECT NUMBER	BORING NUMBER
BAE35903.MW.CW	GP-13 SHEET 1 OF

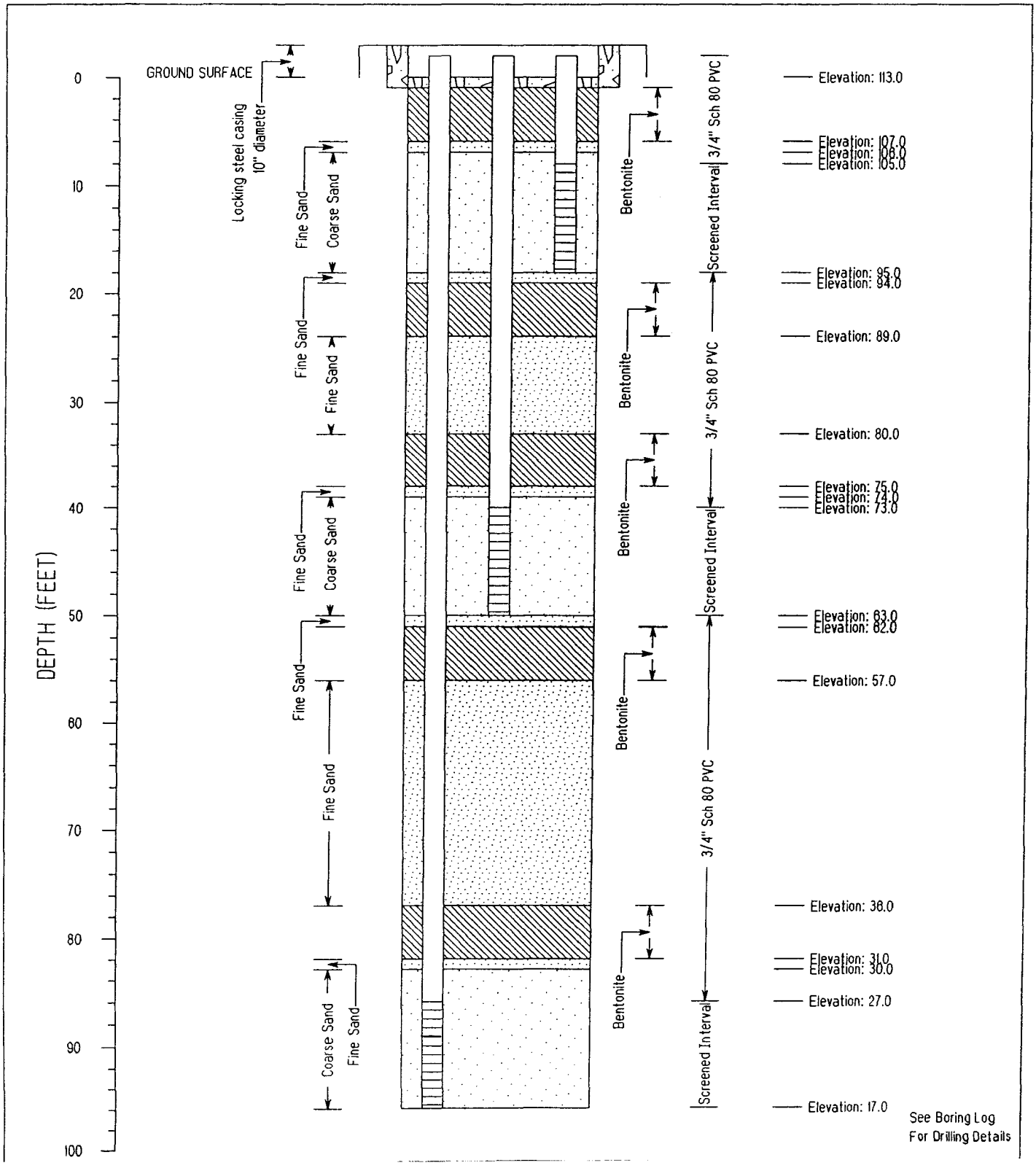
WELL COMPLETION LOG

PROJECT Buena Vista Landfill, County of Santa Cruz **LOCATION** Harkins Slough Rd., East of Module 3

ELEVATION 113 ft MSL (115.20 ft, top of casing) **DRILLING CONTRACTOR** Kvilhaug Well Drilling, Concord, CA

DRILLING METHOD AND EQUIPMENT Mobile B-61, 10-inch o.d. hollow stem auger

WATER LEVELS Not Encountered **START** 6-15-94 **FINISH** 6-16-94 **LOGGER** B. Tom Boardman



PROJECT NUMBER	BORING NUMBER
BAE35903.MW.CW	GP-13 SHEET 1 OF 2

SOIL BORING LOG

PROJECT Buena Vista Landfill, County of Santa Cruz **LOCATION** Harkins Slough Rd., East of Module 3

ELEVATION 113 ft MSL (115.20 ft. top of casing) **DRILLING CONTRACTOR** Kvilhaug Well Drilling, Concord, CA

DRILLING METHOD AND EQUIPMENT Mobile B-61, 10-inch o.d. hollow stem auger

WATER LEVELS Not Encountered **START** 6-15-94 **FINISH** 6-16-94 **LOGGER** B. Tom Boardman

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Organic topsoil to 4.5 ft	Driller: Mike Helper: George
						Standard penetration sampler, 1.4 in. inner diameter, 140 lb hammer, 30 in. drop
					LEAN CLAY w/SAND, (CL), tan with rust staining, moist, firm to stiff, fine grained sand	
	10.0					
10.0	11.5	S-1	1.0	11-14-20 (34)	SILTY SAND, (SM), tan with rust staining, moist, dense, fine grained sand	
						Driller notes sandy gravel at 18 ft
	20.0					
20.0	21.5	S-2	0.8	19-20-21 (41)	POORLY GRADED SAND, (SP), tan with rust staining, moist, dense, fine grained sand, similar to above	
	30.0					
30.0	31.5	S-3	0.7	44-50 (5") (>50)	Sandstone cobble, tan, moist, uncemented, fine grained	Driller notes hard object
	40.0					
40.0	41.5	S-4	0.9	28-41-50 (>50)	POORLY GRADED SAND, (SP), tan with rust staining, moist, very dense, fine grained sand	
	50.0					
50.0	51.5	S-5	1.0	25-50 (5") (>50)	WELL GRADED GRAVELLY SAND, (SW), tan with rust staining, moist, very dense, medium to coarse sand, 1/4 to 1/2 in. subrounded gravel	
	60.0					

PROJECT NUMBER	BORING NUMBER
BAE 35903.MW.CW	GP-13 SHEET 2 OF 2

SOIL BORING LOG

PROJECT Buena Vista Landfill, County of Santa Cruz **LOCATION** Harkins Slough Rd., East of Module 3

ELEVATION 113 ft MSL (115.20 ft. top of casing) **DRILLING CONTRACTOR** Kvilhaug Well Drilling, Concord, CA

DRILLING METHOD AND EQUIPMENT Mobile B-61, 10-inch o.d. hollow stem auger

WATER LEVELS Not Encountered **START** 6-15-94 **FINISH** 6-16-94 **LOGGER** B. Tom Boardman

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	60.0 61.5	S-6	1.0	41-50 (5") (>50)	SANDY GRAVEL, (GP-GW), tan to gray, moist, subangular to subrounded gravel up to 1/2 in., very dense	
						Driller notes subrounded gravel up to 1 in. at 65 ft
70.0	70.0 71.5	S-7	1.0	28-50-50 (5") (>50)	POORLY GRADED SAND w/CLAY and GRAVEL, (SP), tan, moist, subangular gravel, lean clay	
	80.0 81.5	S-8	0.7	44-50 (3") (>50)	POORLY GRADED SAND w/GRAVEL, (SP), similar to above	broken up gravel (angular chips) due to sampling
90.0	90.0 91.5	S-9	0.4	50 (5") (>50)	SANDY GRAVEL, (GW-GP), tan, moist, very dense, subangular gravel up to 1 in.	
					Total Depth = 96.0 ft	Stop drilling with 8 in. at 10:30am Start reaming with 10 in. at 12:00pm Stop reaming at 2:30pm
100.0						
110.0						

GP-14

PROJECT NUMBER	BORING NUMBER	
BAE 45259.L6.CN	GP-14	SHEET 1 OF

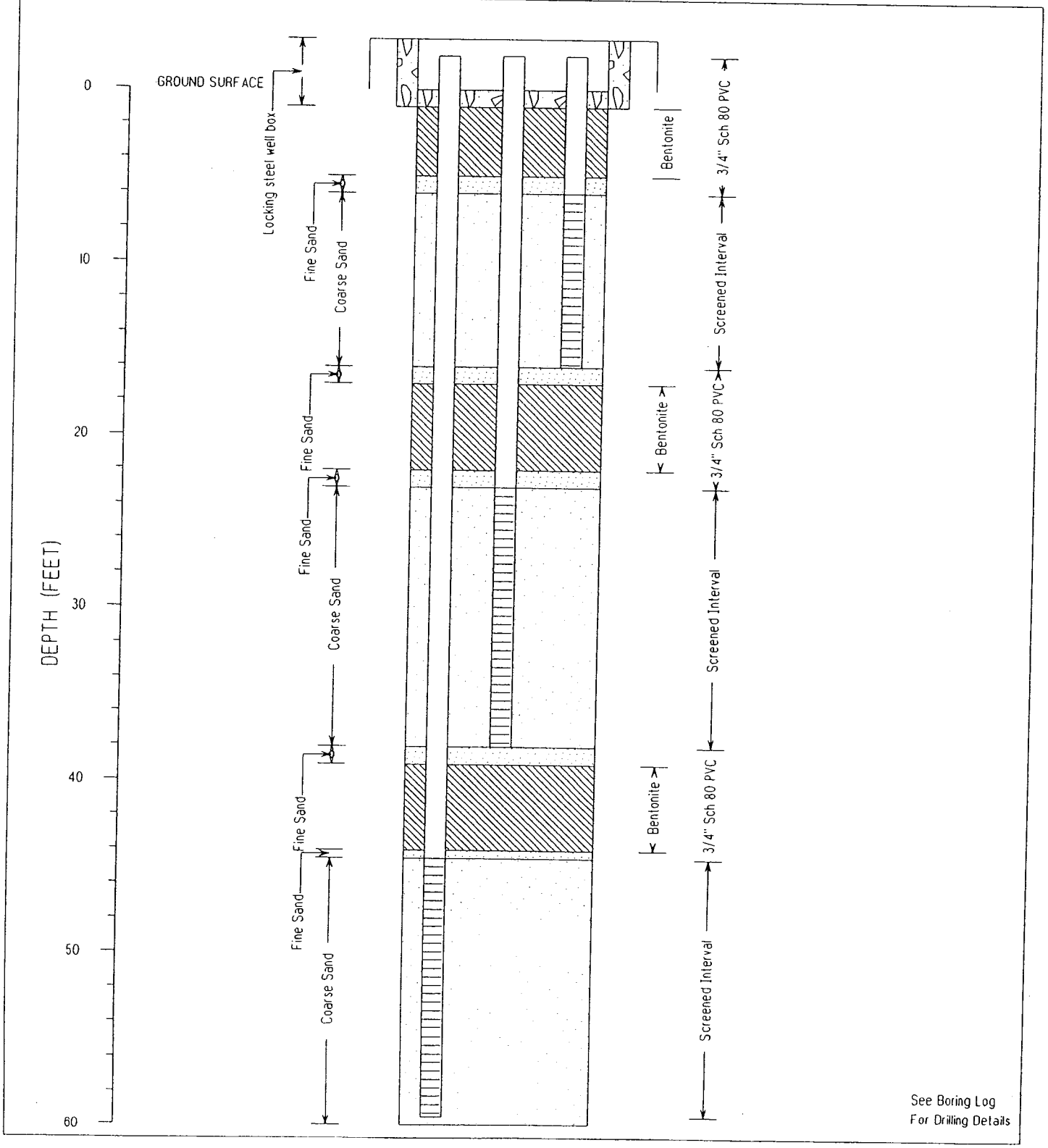
WELL COMPLETION LOG

PROJECT Buena Vista Landfill, County of Santa Cruz **LOCATION** Near MW-4, Southeast Corner of Old Landfill

ELEVATION 76.00 MSL (Top of Casing) **DRILLING CONTRACTOR** Kvilhaug Well Drilling, Concord, CA

DRILLING METHOD AND EQUIPMENT Mobile B-61, 8-inch o.d. hollow stem auger

WATER LEVELS Perched water at 27'BGS **START** 2-22-95 **FINISH** 2-23-95 **LOGGER** Thom Little



GP-14

CRM HILL

PROJECT NUMBER	BORING NUMBER
BAE 45250.18 CN	GP-15

SHEET 1 OF 2

SOIL BORING LOG

PROJECT Buena Vista Landfill, County of Santa Cruz LOCATION Near MW-4, Southeast Corner of Old Landfill

ELEVATION 76.00 MSL (Top of Casing) DRILLING CONTRACTOR Kvilhaug Well Drilling, Concord, CA

DRILLING METHOD AND EQUIPMENT Mobile B-61, 8-inch o.d. hollow stem auger

WATER LEVELS Perched water at 27'BGS START 2-22-95 FINISH 2-23-95 LOGGER Thom Little

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Use geologic log from MW-4 for geologic description. No samples during the drilling and installation of this cluster of gas probes.	Driller: Mike Helper: George
5.0						Clayey Sand
					Boring terminated 60 feet below ground surface.	wet, perched water flowing off of side slope west of rig.
10.0						@12', perched water interval continues
15.0						Clay interbed.
20.0						
25.0						Clayey Sand to Clayey Gravel, appears wet. Drill to 40' BGS and stop. Wait overnight. Water rises to 27 feet BGS inside augers.

GP-14

PROJECT NUMBER	BORING NUMBER
BAE.35259.LG.CN	GP-15 SHEET 2 OF 2

SOIL BORING LOG

PROJECT Buena Vista Landfill, County of Santa Cruz LOCATION Near MW-4, Southeast Corner of Old Landfill

ELEVATION 76.00 MSL (Top of Casing) DRILLING CONTRACTOR Kvilhaug Well Drilling, Concord, CA

DRILLING METHOD AND EQUIPMENT Mobile B-61, 8-inch O.D. hollow stem auger

WATER LEVELS Perched water at 27'BGS START 2-22-95 FINISH 2-23-95 LOGGER Thom Little

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
35.0						
40.0						
45.0						methane gas coming out of augers 2/23/95, continue drilling
50.0						
55.0						

County of Santa Cruz

DEPARTMENT OF PUBLIC WORKS

701 OCEAN STREET, ROOM 410, SANTA CRUZ, CA 95060-4070
(831) 454-2160 FAX (831) 454-2385 TDD (831) 454-2123

JOHN J. PRESLEIGH
DIRECTOR OF PUBLIC WORKS

February 25, 2010
Via Electronic Mail

MR. JON WHITEHILL
Compliance Evaluation and Enforcement Division
California Department of Resources Recycling and Recovery
1001 I Street
P.O. Box 4025
Sacramento, CA 95812

SUBJECT: ADDENDUM TO REMEDIAL ACTION, WORK PLAN FOR LANDFILL GAS MIGRATION CONTROL NOTICE AND ORDER EA-2009-03 FOR THE COUNTY OF SANTA CRUZ BUENA VISTA SANITARY LANDFILL FACILITY NO. 44-AA-00004

Dear Mr. Whitehill:

Attached is the addendum to remedial action work plan for Landfill Gas Migration Control submitted October 26, 2009. This addendum addresses remedial mitigation proposed to clear and control subsurface migration of landfill gas at additional monitoring probes at the Buena Vista Landfill. This addendum was prepared by our landfill gas engineering consultant, SCS Engineers, in response to the California Integrated Waste Management Board's (now known as California Department of Resources Recycling and Recovery) conditional approval letter dated November 5, 2009. Included in the addendum is a request for a 30-day extension to the compliance deadline of March 25, 2010.

If you have any questions or require additional information, please contact the undersigned at (831) 454-2160.

Yours truly,

JOHN J. PRESLEIGH
Director of Public Works

By:

Kasey Kolassa
Recycling and Solid Waste
Services Manager

KK:rw
Attachment
Copy to: Thea Tryon, RWQCB (w/a)
Ed Kendig, MBUAPCD (w/a)
Steve Simmons, Ameresco (w/a)
Susan Mauriello, County Administrative Officer (w/a)
Brian Van Straten, Public Works (w/a)
Art Jones, SCS Engineers

BV Remedialrw.wpd

Environmental Consultants
and Contractors

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Sacramento, CA 95827

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www.scsengineers.com

SCS ENGINEERS

February 18, 2010
File No. 07201057.00; Task 5

Mr. Jon Whitehill
Compliance Evaluation and Enforcement Division
California Integrated Waste Management Board
1001 I Street, 10th Floor
P.O. Box 4025
Sacramento, California 95812

Subject: Addendum to Remediation Work Plan for Landfill Gas Migration Control
for Buena Vista Landfill (44-AA-0004)
Santa Cruz County, California

Dear Mr. Whitehill:

SCS Engineers (SCS) has prepared this addendum to the landfill gas (LFG) migration control and remediation work plan (Plan), dated October 9, 2009, submitted by SCS on behalf of the County of Santa Cruz, Recycling and Solid Waste Services Department (County). This addendum presents information regarding other nearby probes at Buena Vista Landfill (Site) (Figure 1) that were found to have exceeded regulatory requirements for methane concentration at the landfill compliance boundary as put forth in Title 27 of the California Code of Regulations, Sections 20921-20937 (27 CCR 20921-20937).

Responses put forth is this addendum include new monitoring data from compliance gas probe (GP) GP-23 and other recently installed GPs that have been identified as exceeding the lower explosive limit (LEL) for methane per 27 CCR 20921. Further, information on these concern probes; and remedial activities aimed at rectifying these concern probes is presented in this addendum, per the California Integrated Waste Management Board's (CIWMB) conditional approval letter, dated November 5, 2009 (Attached).

REMEDIAL PLAN UPDATE

Under Item 3) of the above referenced CIWMB letter, the remediation plan will include information on other compliance probes that are exceeding regulatory limits. These additional probes have been identified as GP-15 and GP-23. Therefore, this addendum will be limited to investigation and remedial efforts to these well areas (Appendix B, Drawing 1). Please note that the County takes no exception to Items 1) and 2) of the CIWMB letter which provided clarification to required lab analysis and directed the County to coordinate implementation of the Plan and associated addendum with the Regional Quality Control Board (RWQCB) and the Air Pollution Control District (APCD), respectively. Newly discovered methane migration issues near GP-15 and GP-23 are discussed in the following sections of this addendum.

INVESTIGATION AND ANALYSIS

SCS has reviewed the probe and nearby extraction well construction details; and recent readings in the vicinity of GP-15 and GP-23 at the Site. The following info presents details of the investigation and provides information required for Milestone 1 as outlined in the previous Notice and Order (EA-2009-03).

Corrective Measures Taken

The corrective measures taken to reduce gas migration on the subject probes to protect public health and safety and the environment are discussed below. During the last three months, SCS Field Services (SCSFS) optimized the LFG extraction system by adjusting extraction wells EW-1A, near GP-15; and EW-28, EW-45 and EW-46 near GP-23. This corrective measure was performed by SCSFS to ensure that wells proximate to compliance probes are within proper operating parameters and have sufficient vacuum to draw gas migration back from the compliance boundary. In general, SCSFS increased vacuum on all aforementioned wells to ensure that LFG migration to the subject probes would be limited to the extent possible. SCSFS also measured methane concentrations in these extraction wells with a Landtec GEM 2000 during each monitoring event. Table 1 presents the monitoring results for corrective measures for each of these wells over the last 3 months. Presently, both GP-15 and GP-23 continue to exceed the methane LEL.

Please note that the above corrective measures have not yielded any reduction to present migration issues; therefore, installation of additional VZ wells and LFG extraction wells are planned for installation under this addendum. Further, installation of these wells will occur in concert with well installations previously approved in the Plan and will be monitored consistent with the Site's current approved monitoring regimens.

Nearby LFG Extraction Wells

EW-1A is a 4-inch vertical well that is completed to approximately 50 feet deep, per the County, and located 100 feet northwest of GP-15. It should be noted that the well has historically had poor gas quality (25% methane) and induced vacuum is typically minimal [0.1 to 1-inch water gauge (wg)]. EW-28 is a 4-inch vertical extraction well that was previously measured at 28 feet deep on February 1, 2010, and is suspected of being pinched off at this depth due to settlement and previous waste placement activities; therefore, this well is not providing the radius of influence as originally constructed and may be contributing methane migration issues near GP-23. Wells EW-45 and EW-46 are shallow horizontal collectors with tees that run upslope and are connected to an existing 10-inch LFG header. Construction details of the collectors are not known; although, the Site's operations personnel believe the collectors reside in waste on the upper benches of the 3:1 excavation slopes of Module 2 (Inactive). Wells EW-28, -45, and -46 are proximate to GP-23. Table 1 is a summary of gas readings for nearby LFG extraction wells for the time frame that methane in compliance probes GP-15 and GP-23 exceeded 5 percent. Details on these probes are discussed below.

Compliance Probe GP-15

GP-15 has exceeded 5 percent methane requirement from time to time since December 2006. Recently, GP-15 has exceeded the Lower Explosive Limit (LEL) for methane on September 29, October 27, November 24, and December 22, 2009 (Table 2). Please note that the boring log for GP-15 shows that the gas probe was completed with 4 measuring zones, the deepest of which is completed as a 2-inch piezometer advanced into groundwater; therefore, this completion is not used to detect LFG migration. GP-15 was installed by CH2MHill in February 2005 and was constructed using ¾-inch Schedule 80 PVC and measures intervals of 16-26, 33-53, and 60-80 feet bgs, for the shallow, medium, and deep vadose zones, respectively. Evaluation of this data indicated that LFG migration at GP-15 is occurring at all three depths of the triple completion probe. A well completion log and boring log for GP-15 is included in this addendum as Appendix A. GP-15 is part of the LFG perimeter compliance monitoring network for the Site.

Compliance Probe GP-23

GP-23 has exceeded 5 percent methane since installation in September 2009. Exceedances have occurred on September 29, October 27, and November 24, 2009 (Table 2). Please note that the probes were wet and methane concentrations were neither measured nor obtainable during the monthly monitoring event on December 22, 2009. Evaluation of this data indicated that LFG migration at GP-23 is occurring at all three depths of the triple completion probe. GP-23 was installed by Geosyntec Consultants in September 2009 and was constructed using ¾-inch Schedule 80 PVC and measures intervals of 5-20, 35-50, and 65-90 feet below ground surface (bgs), for the shallow, medium, and deep vadose zones, respectively. A well completion log and boring log for GP-23 is included in this addendum as Appendix A.

Since discovery of the methane concentration in this probe, LFG extraction wells EW-28, EW-45 and EW-46 have been adjusted to ensure that adequate vacuum was being applied to this nearby well area. Although this corrective measure was implemented, methane exceedances are still being found at the compliance boundary in the vicinity of GP-23 and thought to have occurred by the lack of extraction capability of the horizontal collectors (EW-45 and EW-46) and/or the reduced influence of EW-28 near this probe. Recent methane readings have exceeded 5 percent by volume, which exceeds the allowable levels at points of compliance in accordance with California Code of Regulations, Title 27, Section 20921 (27 CCR 20921). GP-23 is part of the LFG perimeter compliance monitoring network for the Site.

Other Nearby Gas Probe Information

Review of other gas probes, in the vicinity of GP-15 and GP-23, that have previously been monitored for methane by the County and found to exceed the methane LEL are discussed below by proximity to the recently discovered non-compliance GPs.

GPs near GP-15

GP-14, located approximately 1,400 feet southeast of GP-15, was not found to have exceeded the LEL for methane since May 2008. This probe is triple-completed and has had minimal methane LEL exceedances limited to the medium probe prior to 2008. Further, this probe has been maintained well below acceptable methane levels over the last 6 months. Please note that GP-14 is a compliance probe for the Site.

GP-25, located approximately 550 feet north of GP-15, was never found to have exceeded the methane LEL at the perimeter gas probe compliance boundary since its construction in September 2009. This probe is a single completion probe and was installed to comply with the spacing requirements under 27 CCR 20925(b). Review of data since September 2009 indicates that this probe has not had any exceedance issues within the last 4 months of probe monitoring. GP-25 is a compliance probe for the Site.

GPs near GP-23

GP-10, located approximately 250 feet south of GP-23, was investigated and found to have not exceeded the methane LEL since December 2004. This probe is double-completed and measures shallow and deep zones that were identified as the transmissive vadose zones during construction. Please note that GP-10 is not a part of the compliance monitoring network.

GP-11, located approximately 500 feet north along the southeastern corner of eastern most permitted refuse boundary, was found to not have any methane LEL exceedences since November 2009. GP-11 is a double-completed and measures the shallow and deep zones identified during construction. Please note that this probe is not a part of the regulatory approved compliance network; further, migration along this portion of the permitted waste boundary for the Site is assessed by probes GP-13 and GP-23.

Other Site Operations

Site operations that are believed to be contributing to former and recent violations found in GP-23 include the on-site energy facility's operation schedule. During certain hours of facility operation, extraction wells EW-45 and EW-46 are shut down when LFG is not needed. During these facility shut-down periods, exceedances of the LEL have been found in GP-23. In an effort to rectify the current methane migration issues in this probe vicinity, this addendum proposes the construction of a vadose zone well in native soils and a LFG extraction well placed in waste above GP-23 which will be connected to the existing LFG extraction system to draw LFG back from the compliance boundary. This proactive solution is expected to reduce or eliminate current issues in this probe vicinity, as opposed to, determining what other site operations are required to be modified to gain regulatory compliance.

There are no other site operations that could contribute to recent violations found near GP-15.

Migration Pathways and Extent of Gas Migration

GP-15 Migration Pathways

The migration pathway for methane near GP-15 is suspected to be occurring from a limited portion of the landfill's old closed area of the Site. This old closed area is unlined and was historically used as a burn dump in the area adjacent to the subject probe (Figure 2). Please note that LFG extraction well EW-1A, located 100 feet northeast of GP-15, has historically had poor gas quality (25% methane) and was installed in 2003 by the Shaw Group; although, no well completion report is available. According to the Operator, this well was completed to 50 feet bgs and constructed of 4-inch diameter HDPE.

Migration of LFG near GP-15 is most likely occurring through the unlined area and through the transmissive zone of native soils residing outside the old closed portion of the Site. This zone resides between approximately 15 feet and 80 feet bgs and consists of sandy silt in the upper portion; and gravelly sand in the lower portion as determined by review of the previous boring log and well construction details for GP-15 (CH2MHill, 1995) (Appendix A).

The extent of the migration near GP-15 is limited to the southern area of the Site outside the somewhat undefined old waste area waste boundary and proximate to this probe location. Please note that the closest nearby probes have not had methane LEL exceedences.

The nearest off-site habitable structure is located approximately 360 feet to the southwest and across the southern pacific railroad from the portion of the waste cell suspected of causing methane migration issues near GP-15.

GP-23 Migration Pathways

The migration pathway for methane near GP-23 is suspected to be occurring from a limited portion of the landfill's old expansion area adjacent to the eastern boundary of inactive Module 2. Liner construction of the old expansion fill area is unknown and may be contributing to LFG migration in the area adjacent to the newly constructed GP-23 (Figure 2).

Migration of LFG near GP-23 is most likely occurring through the suspected unlined area and through the transmissive zone of native soils. This zone resides between approximately 10 feet and 90 feet bgs and consists of well graded sand with clay in the upper portion; and poorly graded sand in the middle portion and deeper portions of the vadose zone as determined by review of the boring logs for GP-23 (Geosyntec, September 2009) (Appendix A). It should also be noted that there is an approximately 5 foot layer of well graded gravel that resides in the geological strata between 68.5 to 73 feet bgs that is likely providing a migration pathway to the deep probe of GP-23.

The extent of the migration near GP-23 is limited to the east to southeastern area of the Site outside of the old expansion area waste boundary and proximate to this probe location. The

extent of migration is further delineated as GP-11 as the northern extent and GP-23 as the southern extent of migration along the eastern most area along the permitted waste boundary.

The nearest off-site habitable structure is located approximately 300 feet to the east from the portion of the old expansion area.

Gas Probe Sampling Protocol

Sampling protocol to be used in subsequent monitoring events will consist of increasing the purge volume to 1.5 well volumes prior to taking readings or establishing a stable peak, whichever happens first. The EA may require that sampling of probes with exceedances be collected for laboratory analysis for specified trace gases when there is a possibility of acute or chronic exposure due to hazardous materials under 27 CCR 20932(a). The County requests that if this sampling is directed by the EA that it be limited to collection and sampling consistent with EPA TO-14A (equivalent to EPA TO-15) on an as needed basis. This new protocol, accepted by the EA, has previously been instituted at the Site and will continue in subsequent monitoring events.

REMEDIAL RECOMMENDATIONS

Based on SCS's assessment of LFG collection within the waste mass near GP-15 and GP-23, SCS believes that the following actions should take place. Mitigation efforts will be stopped when GP-15 and GP-23 consistently maintain acceptable methane levels. The following recommendations are intended to satisfy the remedial actions under Milestone 2 of the Site's previous Notice and Order (EA-2009-03).

1. Install one additional LFG extraction well (EW-58) in waste midway between EW-45, EW-46, and EW-28 and one additional vadose zone (VZ) well, VZ-3, near GP-23 as shown in Appendix B, Drawing 1. Please note that the locations for the VZ well may require field adjustments depending on the findings of subsurface utilities in that location. Construct the LFG well with a bore of 24-inches in diameter and match the depth of EW-45 and EW-46 or to the greatest depth possible without harming the cell floor as shown in Appendix B, Drawing 2. Construct the vadose zone well, VZ-3, with a bore of 24-inch diameter to a depth of 90 feet with a single extraction phase and a 4-inch casing as shown in Appendix B, Drawing 2. Connect both wells to the nearest header; and apply and maintain a vacuum of 0.2 to 0.5 inches of water to the wells and observe the reaction at GP-23.

2. Install one additional VZ well, VZ-4, near GP-15 as shown in Appendix B, Drawing 1. As stated above, the location for VZ-4 may require field adjustments depending on the findings of subsurface utilities in that location. Ensure proper operation of EW-1A and construct the vadose zone well, VZ-4, with a bore of 24-inch diameter to a depth of 80 feet with a single extraction phase and a 4-inch casing as shown in Appendix B, Drawing 2. Connect this well to the nearest header; and apply and maintain a vacuum of 0.2 to 0.5 inches of water to the well and observe the reaction at GP-15.

The above recommendations are intended to provide a long-term solution for the Site's migration issue near these GP areas. Further, this recommendation strives to rectify migration issues that may or may not be associated with onsite energy facility operations.

SCHEDULE

The following schedule is intended to reach a practical and rapid solution for lowering methane to acceptable levels in gas probes GP-15 and GP-23. Please note that this schedule will include installation of other LFG and VZ wells approved under the original remedial work plan.

Action	Duration	Demonstration
Install one LFG well (EW-58) & two vadose zone wells (VZ-3, VZ-4)	30 days	March 25, 2010*

* Dependent of LEA approval of this addendum.

CLOSING

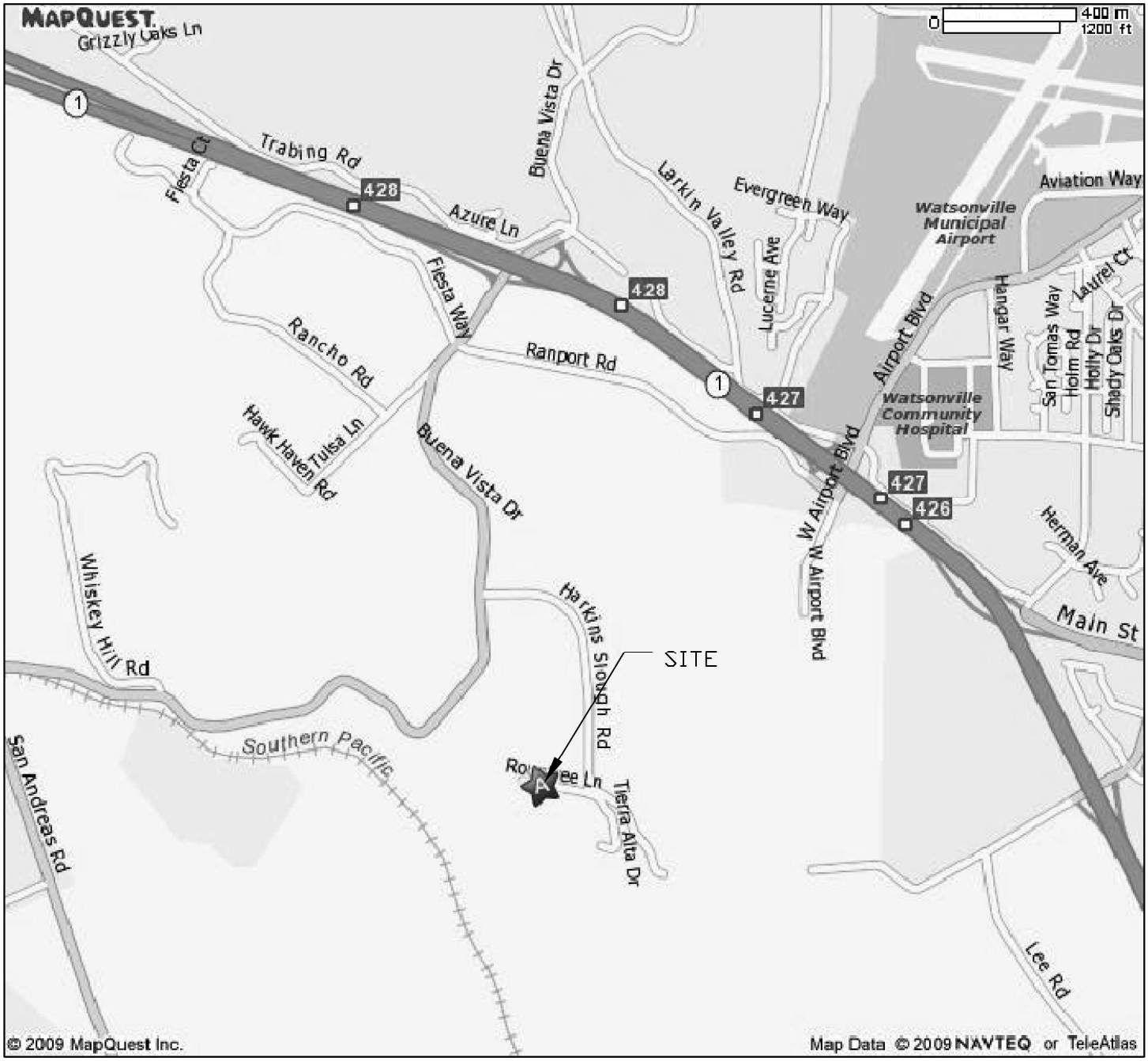
SCS trusts that the actions outlined in this addendum meet the objectives of CIWMB and the required time frames for compliance. Since we are nearing the compliance deadline and given the delays of installation of previously approved wells due to inclement weather, the County hereby requests that a 30-day extension be granted for the compliance deadline. Further, incorporation of the latest Site migration concerns, as directed by the CIWMB, resulting in this addendum and installation schedule changes warrants the need to increase the compliance deadline. Given the above and urgency of rectifying compliance probe issues, review and approval of this work plan addendum at the earliest possible date is requested. Please note that permits for all VZ wells are in-place (Appendix C) and SCS has tentatively scheduled drilling to occur in the first week of March.

Sincerely,

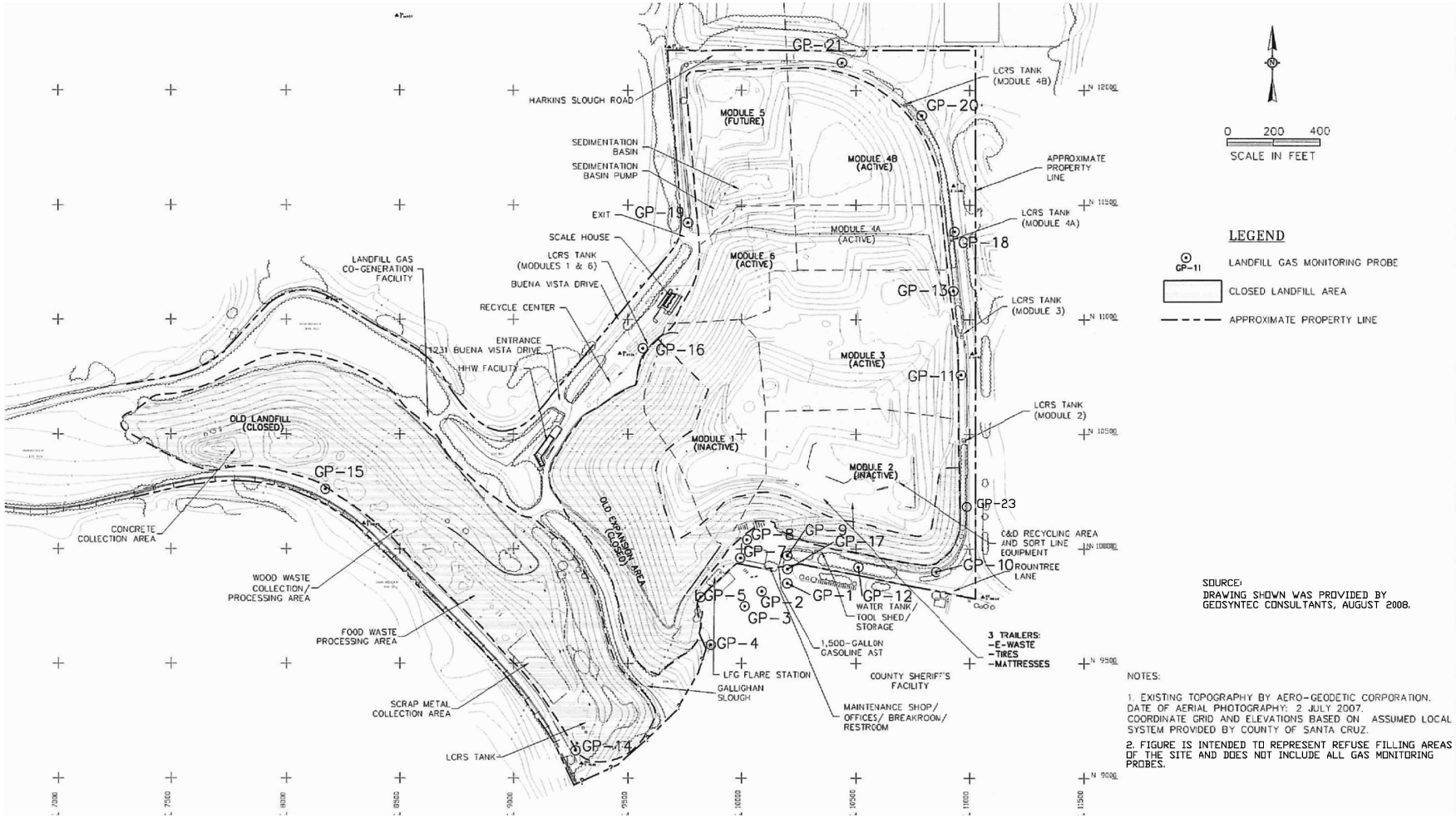
Ambrose A. McCready, P.E.
Sr. Technical Civil Engineer
SCS ENGINEERS

Cc Kasey Kolassa
Art Jones, SCS

FIGURES



SCS ENGINEERS ENVIRONMENTAL CONSULTANTS 3117 FITE CIRCLE, SUITE 108 SACRAMENTO, CA 95827 PH. (916) 361-1297 FAX. (916) 361-1299	SHEET TITLE SITE LOCATION MAP	DATE: 09/14/09
	PROJECT TITLE BUENA VISTA LANDFILL WATSONVILLE, CALIFORNIA	SCALE: AS SHOWN
		FIGURE NO. 1
PROJ. NO. 07201057.00 / ACAD FILE: FIG 1		
DWN. BY: MJE / CHECK BY: AAM		



SOURCE:
DRAWING SHOWN WAS PROVIDED BY GEOSYNTEC CONSULTANTS, AUGUST 2008.

NOTES:

1. EXISTING TOPOGRAPHY BY AERO-GEODETIC CORPORATION. DATE OF AERIAL PHOTOGRAPHY: 2 JULY 2007. COORDINATE GRID AND ELEVATIONS BASED ON ASSUMED LOCAL SYSTEM PROVIDED BY COUNTY OF SANTA CRUZ.

2. FIGURE IS INTENDED TO REPRESENT REFUSE FILLING AREAS OF THE SITE AND DOES NOT INCLUDE ALL GAS MONITORING PROBES.

NO.	REVISION	DATE
	WORK PLAN	09-15-09
	ADDENDUM FIGURE	02-18-10

SHEET TITLE: FILL AREAS

PROJECT TITLE: BUENA VISTA LANDFILL WATSONVILLE, CALIFORNIA

SCS ENGINEERS
ENVIRONMENTAL CONSULTANTS
3117 FITE CIRCLE, SUITE 108
SACRAMENTO, CA 95827
PH. (916) 361-1297 FAX. (916) 361-1299

PROJECT NO. 01057.00.T5 | FILE NO. BVLF0057.00 FIG2
DRN. BY: MJE | CHK. BY: AAM
DGN. BY: MJE | APP. BY: AAM

DATE: 10-23-2009

SCALE: AS SHOWN

FIGURE: 2

TABLES

TABLE 1

Buena Vista Landfill Well Data - 11/01/2009 through 01/31/2010

Field Technician and Weather Conditions						
Technician	**Date**	**Ambient Temp**	**Barometric Pressure (in - Hg)**	**General Weather**	**Wind Speed**	**Wind Direction**
Chris Carver	01/20/2010	48	29.0	Raining	High Winds	N
Chris Carver	01/25/2010	48	29.8	Raining	Light Wind	N
Chris Carver	11/12/2009	60	29.7	Cloudy	Light Wind	N
Chris Carver	11/12/2009	65	29.7	Cloudy	Light Wind	N
Chris Carver	12/23/2009	60	29.9	Clear	Light Wind	N
Chris Carver	12/24/2009	37	29.9	Clear	Light Wind	N

Name	**Date**	**Time**	**Methane (% by vol)**	**Carbon Dioxide (% by vol)**	**Oxygen (% by vol)**	**Balance Gas (% by vol)**	**Init Static Press (Inch H2O)**	**Adj Static Press (Inch H2O)**	**Init Temp (Deg F)**	**Adj Temp (Deg F)**
EW-28	11/12/2009	09:56	60.3	39.5	0.1	0.1	-15.7	-15.7	62	62
EW-28	12/23/2009	12:30	61.2	38.7	0.0	0.1	-18.7	-18.8	66	66
EW-28	01/20/2010	13:56	57.0	42.8	0.1	0.1	-15.5	-15.4	58	58
EW-45	11/12/2009	10:52	54.7	38.1	0.0	7.2	-6.1	-6.2	66	67
EW-45	11/12/2009	10:52	54.7	38.1	0.0	7.2	-6.1	-7.1	66	66
EW-45	12/24/2009	07:33	55.9	35.9	0.2	8.0	-8.6	-8.8	35	36
EW-45	12/24/2009	07:34	55.9	35.9	0.2	8.0	-8.6	-10.2	35	35
EW-45	01/25/2010	10:39	51.9	37.7	0.0	10.4	-8.6	-8.6	47	47
EW-45	01/25/2010	10:40	51.9	37.7	0.0	10.4	-8.6	-9.7	47	47
EW-46	11/12/2009	10:54	51.8	38.2	0.1	9.9	-3.0	-3.0	64	64
EW-46	11/12/2009	10:55	51.8	38.2	0.1	9.9	-3.0	-3.3	64	64
EW-46	12/24/2009	07:36	40.8	33.4	0.2	25.6	-2.5	-2.6	36	36
EW-46	12/24/2009	07:37	40.8	33.4	0.2	25.6	-2.5	-2.5	36	35
EW-46	01/25/2010	10:42	50.7	37.4	0.0	11.9	-1.8	-1.9	48	47
EW-46	01/25/2010	10:42	50.7	37.4	0.0	11.9	-1.8	-2.0	48	47
EW-01A	11/12/2009	06:39	23.0	19.7	0.0	57.3	0.5	-0.1	63	62
EW-01A	12/23/2009	09:14	38.9	26.2	0.0	34.9	-0.8	-0.8	69	68
EW-01A	01/20/2010	09:22	21.0	18.1	0.0	60.9	3.1	3.1	59	56
EW-01A	01/20/2010	09:23	21.0	18.1	0.0	60.9	3.1	0.0	59	55

County of Santa Cruz | **TABLE 2** | **July through December 2009**

Buena Vista Landfill Gas Probes

DATE	GP-1S			GP-2S			GP-3S			GP-4S			GP-4M			GP-4D			GP-5S			GP-5M			GP-5D		
	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure
07/20/09	**0.10**	19.50	0.00	**0.10**	19.60	0.00	**0.10**	20.60	0.00	**0.00**	20.50	-0.20	**0.10**	20.50	0.00	**0.10**	20.50	-0.30	**0.10**	20.50	-0.20	**0.10**	20.40	-0.10	**0.10**	20.30	0.00
08/11/09	**0.10**	20.70	-0.10	**0.10**	20.60	-0.10	**0.10**	20.60	-0.10	**0.10**	20.60	-0.20	**0.10**	20.60	0.00	**0.10**	20.50	-0.20	**0.10**	20.60	-0.10	**0.10**	20.40	-0.10	**0.10**	20.60	0.00
09/29/09	**0.20**	20.50	-0.20	**0.20**	19.00	0.00	**0.20**	20.50	-0.10	**0.10**	20.50	-0.60	**0.10**	20.50	0.00	**0.10**	20.50	-0.50	**0.20**	20.50	-0.10	**0.20**	20.40	-0.30	**0.20**	20.10	0.00
10/27/09	**0.10**	20.00	0.00	**0.10**	15.00	0.10	**0.10**	16.50	0.00	**0.10**	17.00	-0.10	**0.10**	20.20	0.10	**0.10**	20.10	0.10	**0.10**	20.40	0.00	**0.10**	16.70	-0.10	**0.20**	18.20	-0.20
11/24/09	**0.10**	20.50	0.30	**0.10**	20.50	0.20	**0.10**	18.70	0.30	**0.10**	20.40	0.00	**0.10**	20.50	0.20	**0.10**	20.50	0.20	**0.10**	20.40	0.10	**0.10**	19.60	0.00	**0.10**	19.80	0.00
12/22/09	**0.10**	19.20	0.00	**0.10**	20.50	0.00	**0.10**	18.20	0.00	**0.10**	20.50	0.00	**0.10**	17.70	0.00	**0.10**	19.50	0.00	**0.10**	19.40	0.00	**0.10**	19.90	0.00	**0.10**	18.70	0.00

DATE	GP-7S			GP-8S[1]			GP-8M[1]			GP-8D[1]			GP-9S			GP-9M			GP-9D			GP-10S			GP-10D		
	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure
07/20/09	**0.10**	20.50	-0.10	**0.00**	20.60	-0.30	**0.10**	20.60	-0.10	**12.50**	15.10	-0.10	**39.00**	0.60	-27.60	**as extraction well**			-	-	-	**0.10**	20.70	0.00	**0.10**	20.70	0.00
08/11/09	**0.10**	20.60	-0.20	**0.10**	20.70	0.00	**0.10**	20.70	0.00	**0.10**	20.60	0.00	**40.30**	0.50	-11.80	**as extraction well**			-	-	-	**0.10**	20.70	0.00	**0.10**	20.70	0.00
09/29/09	**0.20**	20.50	-0.10	**0.20**	20.40	0.00	**0.20**	20.40	0.00	**0.20**	20.30	0.00	**36.30**	2.30	-27.20	**as extraction well**			-	-	-	**0.20**	20.60	0.10	**0.20**	20.60	0.10
10/27/09	**0.20**	20.70	-0.30	**25.20**	11.70	0.20	**37.80**	4.90	0.20	**0.10**	16.10	-0.10	**22.50**	8.30	-22.70	**as extraction well**			-	-	-	**0.10**	20.40	0.10	**0.10**	20.40	0.20
11/24/09	**0.10**	20.60	-0.40	**53.90**	1.60	0.30	**0.10**	4.90	0.30	**0.10**	19.70	0.10	**34.10**	1.50	-16.70	**as extraction well**			-	-	-	**0.10**	14.40	-0.30	**0.10**	13.80	0.30
12/22/09	**0.10**	20.50	0.00	**18.90**	13.70	0.10	**25.70**	9.90	0.10	**0.20**	17.40	0.00	**33.40**	1.50	-23.60	**as extraction well**			-	-	-	**0.10**	20.20	0.00	**0.10**	20.30	0.00

DATE	GP-11S			GP-11D			GP-12S			GP-12M			GP-12D			GP-13S			GP-13M			GP-13D			GP-14S[1]		
	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure
07/20/09	**0.10**	17.00	0.00	**6.40**	17.70	-0.20	**0.10**	20.70	-0.20	**0.10**	20.70	-0.30	**0.10**	20.60	-0.40	**0.00**	17.40	0.00	**0.00**	18.80	-0.40	**0.00**	20.50	-0.30	**0.10**	18.80	-0.10
08/11/09	**0.30**	16.20	-0.10	**0.00**	20.60	-0.10	**0.10**	20.60	0.00	**0.10**	20.60	-0.30	**0.10**	20.70	-0.50	**0.00**	18.40	0.10	**0.10**	18.70	-0.10	**0.10**	20.50	-0.10	**1.40**	10.70	0.00
09/29/09	**0.10**	20.50	0.00	**0.20**	20.50	-0.60	**0.20**	20.40	0.00	**0.20**	20.50	0.00	**0.20**	19.70	0.00	**0.10**	17.70	0.00	**0.10**	18.10	-0.60	**0.10**	20.50	-0.60	**0.10**	16.00	0.00
10/27/09	**26.60**	0.40	-0.20	**47.40**	0.30	0.20	**0.10**	19.60	0.00	**0.10**	20.30	0.00	**0.10**	20.30	0.10	**0.10**	13.10	-0.10	**0.10**	18.20	0.20	**0.10**	14.70	0.20	**0.10**	6.60	0.20
11/24/09	**24.50**	0.60	0.20	**46.40**	0.60	0.90	**0.10**	20.50	0.90	**0.10**	20.50	0.50	**0.10**	20.00	0.40	**0.10**	17.40	0.20	**0.10**	19.00	0.80	**0.10**	20.00	0.80	**1.00**	10.70	0.20
12/22/09	**0.10**	20.50	0.00	**0.10**	20.50	0.00	**0.10**	18.80	0.10	**0.10**	20.20	0.10	**0.10**	20.20	0.30	**0.00**	18.00	0.00	**0.00**	17.10	0.00	**0.00**	16.50	0.00	**0.10**	17.20	0.00

DATE	GP-14M[1]			GP-14D[1]			GP-15S[1]			GP-15M[1]			GP-15D[1]			GP-16S[1,2]			GP-16M[1]			GP-17S			GP-17M		
	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure
07/20/09	**2.20**	9.50	-0.40	**0.10**	20.30	-0.30	**10.40**	15.80	-0.10	**0.10**	20.50	-0.70	**0.10**	20.10	-0.60	**52.60**	0.10	0.00	**51.90**	0.10	0.00	**0.00**	13.80	-0.60	**0.00**	20.40	-0.50
08/11/09	**0.10**	15.00	-0.60	**0.10**	20.70	-0.50	**22.40**	11.30	-0.20	**0.10**	20.70	-1.10	**0.10**	20.70	-1.10	**53.70**	0.30	0.00	**51.40**	0.40	0.00	**0.10**	20.50	-6.00	**0.10**	20.50	-0.70
09/29/09	**1.00**	9.20	0.10	**0.10**	1.50	0.10	**48.40**	0.20	0.10	**41.00**	0.00	0.20	**25.30**	0.00	0.20	**0.30**	20.70	0.10	**new location**			**0.10**	9.10	-0.30	**41.80**	0.00	-0.10
10/27/09	**1.10**	9.20	0.50	**0.10**	5.60	0.50	**43.70**	1.50	0.00	**41.40**	0.10	0.10	**22.90**	20.30	0.10	**0.20**	20.10	0.00	**no medium depth probe**			**0.10**	11.00	-0.30	**32.40**	3.60	-0.10
11/24/09	**0.10**	15.80	0.40	**0.00**	20.70	0.40	**47.70**	0.50	0.00	**40.20**	0.20	-0.50	**8.10**	13.60	-0.50	**0.70**	20.40	-0.90	**new location**			**0.10**	12.10	0.40	**7.70**	16.00	0.70
12/22/09	**0.10**	20.30	0.00	**1.20**	9.70	0.00	**41.50**	1.60	0.00	**34.60**	1.40	-0.10	**14.10**	7.60	-0.10	**0.30**	20.10	-0.10	**no medium depth probe**			**0.10**	13.40	-0.20	**39.60**	0.00	0.10

DATE	GP-17D			GP-18S			GP-18M			GP-18D			GP-19S			GP-19D			GP-20S			GP-20M			GP-20D		
	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure
07/20/09	**0.10**	20.40	-0.50	**0.00**	13.90	0.00	**0.00**	15.00	-0.30	**0.00**	17.70	-0.40	**0.00**	9.50	0.00	**0.00**	8.50	0.00	**0.00**	20.40	0.00	**0.00**	20.30	-0.40	**0.00**	20.40	-0.40
08/11/09	**0.10**	20.60	-0.70	**0.00**	20.20	-0.10	**0.00**	16.60	0.10	**0.10**	15.80	0.00	**0.10**	9.50	0.00	**0.10**	8.90	0.00	**0.10**	20.60	0.00	**0.10**	20.60	-0.30	**0.20**	18.40	-0.30
09/29/09	**47.50**	0.00	-0.20	**0.10**	14.80	-0.10	**0.10**	18.50	-0.50	**0.20**	20.00	-0.60	**0.30**	9.80	0.00	**0.20**	8.90	0.00	**0.10**	20.30	0.00	**0.10**	20.30	-0.70	**0.10**	20.30	-0.70
10/27/09	**45.90**	0.30	-0.20	**0.10**	17.70	0.20	**0.20**	13.90	-0.10	**0.20**	15.90	0.10	**0.10**	10.30	-0.20	**0.20**	8.60	-0.20	**0.10**	16.10	-0.20	**0.10**	15.00	0.40	**0.10**	16.10	0.30
11/24/09	**47.20**	0.20	0.60	**0.10**	14.10	0.10	**0.00**	17.20	0.80	**0.00**	15.10	0.70	**0.00**	9.00	0.10	**0.10**	10.30	0.20	**0.00**	16.40	0.80	**0.00**	15.40	0.80	**0.00**	16.10	0.80
12/22/09	**46.80**	0.00	0.00	**0.10**	20.50	0.00	**0.10**	20.50	0.00	**0.10**	20.50	0.00	**0.00**	11.50	0.00	**0.00**	9.90	0.00	**0.00**	16.00	0.00	**0.00**	18.50	0.00	**0.00**	16.80	0.00

DATE	GP-21S			GP-21D			GP-22S			GP-22D			GP-23S			GP-23M			GP-23D			GP-24S			GP-24D			GP-25S		
	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_2	Pressure	CH_4	O_3	Pressure	CH_4	O_3	Pressure	CH_4	O_4	Pressure	CH_4	O_4	Pressure	CH_4	O_5	Pressure	CH_4	O_5	Pressure
07/20/09	**0.00**	20.40	0.00	**0.00**	20.50	0.00																								
08/11/09	**0.10**	20.70	0.00	**0.10**	20.70	0.00																								
09/29/09	**0.10**	20.40	-0.10	**0.10**	20.30	0.00	0.60	19.40	0.00	0.10	20.30	-0.50	1.30	18.40	0.00	24.90	6.30	0.00	0.70	20.30	0.00	0.80	16.30	0.00	0.90	12.50	0.00	0.30	14.00	0.00
10/27/09	**0.10**	15.20	0.00	**0.20**	15.40	-0.10	0.30	19.80	-0.20	0.20	15.20	0.20	30.40	0.50	-0.30	34.50	0.30	0.10	29.40	0.40	0.20	0.30	15.20	-0.20	0.10	4.60	0.30	0.10	11.70	-0.20
11/24/09	**0.00**	15.10	0.40	**0.00**	15.60	0.30	0.10	20.30	0.10	0.10	19.80	0.70	30.40	0.60	0.50	27.80	4.30	0.80	28.80	0.40	0.80	0.70	17.30	0.00	0.10	20.40	-0.40	0.10	16.20	0.00
12/22/09	**0.00**	15.50	0.00	**0.00**	15.70	0.00	0.00	18.90	0.00	0.00	16.50	0.00	Wet Probes - Unable to Sample									0.30	16.70	0.00	0.20	20.00	0.20	0.10	16.70	0.00

New Probes Installed September 2009

Indicates compliance probe per Buena Vista Landfill Gas Plan submitted to CIWMB August 2009

[1] Probes located in or directly adjacent to refuse

[2] GP-16 moved to new location per Buena Vista Landfill Gas Plan submitted to CIWMB August 2009

S = shallow; M = medium; D = deep

ATTACHMENT

CIWMB RESPONSE LETTER
NOVEMBER 5, 2009

LINDA S. ADAMS
SECRETARY FOR ENVIRONMENTAL PROTECTION

CALIFORNIA INTEGRATED WASTE MANAGEMENT BOARD

ARNOLD SCHWARZENEGGER
GOVERNOR

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November 5, 2009

John J. Presleigh, Director of Public Works
Santa Cruz County Department of Public Works
701 Ocean Street, Room 410
Santa Cruz, CA 95060-4070

Subject: Landfill Gas Migration Investigation Report and Remediation Plan
Buena Vista Landfill (44-AA-0004)

Dear Mr. Kolassa:

California Integrated Waste Management Board (IWMB) staff is in receipt of the subject document dated October 26, 2009.

Board staff has reviewed the plan for consistency with applicable regulation and with the Notice and Order EA-2009-03 issued on September 25, 2009.

The proposed remediation plan for control of landfill gas migration at the facility property boundary near GP-17 is hereby approved with the following conditions:

1) Any required detailed lab analysis of landfill gas shall be consistent with EPA TO-14A as proposed in the plan unless directed by the EA to use EPA TO-15.
2) Please continue to coordinate implementation of the remediation plan the with RWQCB and MBUAPCD staff as appropriate.
3) Update the remediation plan as needed or as directed by the EA to include new monitoring data from GP-23 and other recently installed gas monitoring probes.

Please be reminded that the final compliance due date for compliance with Notice and Order EA-2009-03 is March 25, 2010.

If you have any questions, please call me at (916) 341-6403.

Sincerely,

Jon Whitehill
MSW Facilities & EA Inspection & Enforcement B
Compliance, Evaluation, and Enforcement Division

INTEGRATED WASTE MANAGEMENT BOARD

ORIGINAL PRINTED ON 100 % POST-CONSUMER CONTENT, PROCESSED CHLORINE FREE PAPER

cc: Kasey Kolassa, Recycling and Solid Waste Services Manager (via email)
Brian Van Straten, Public Works (via email)
Thea Tryon, RWQCB (via email)
Ed Kendig, Monterey Bay Unified Air Pollution Control District (via email)
Alfred Worcester, CIWMB Engineering Geologist (via email)

APPENDIX A

BORING LOGS AND WELL COMPLETION DIAGRAMS
GP-15 & GP-23

PROJECT NUMBER	BORING NUMBER
[illegible]	GP-16/P-15 SHEET 1 OF 5

SOIL BORING LOG

PROJECT Buena Vista Landfill, County of Santa Cruz **LOCATION** West of Old Landfill

ELEVATION 104.95 MSL (Top of Casing) **DRILLING CONTRACTOR** Kvilhaug Well Drilling, Concord, CA

DRILLING METHOD AND EQUIPMENT Mobile B-61, 11-inch o.d. hollow stem auger

WATER LEVELS Perched water at 85', Aromas at 114' **START** 2-22-95 **FINISH** 2-28-95 **LOGGER** Thom Little

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					FILL, debris and clay from previous landfilling activities at the site	Driller: Mike Helper: George
						Standard penetration sampler, 1.4 in. inner diameter, 140 lb hammer, 30 in. drop sample every 10 feet
5.0	05.0					
	06.5	S-1	1.0	10-17-24 (41)	SAND (SP), olive (5Y, 5/6), 5% low plasticity fines, 95% fine sand; locally laminated, pin-up blasts associated with laminations, Fe/Mn staining common; dense, damp	13.37 first sample
10.0						
	15.0					
15.0	16.5	S-2	1.5	8-16-20 (36)	SILT (ML), olive (5Y, 5/3), 100% non-plastic fines; trace fine sand; locally laminated, herringbone banding common; FeO nodule at 15.2 feet BGS; trace amounts of organic material, very stiff to hard; damp; Mn/Fe staining on fractured slickensided surface.	
20.0						
	25.0					
25.0	26.5	S-3	1.5	11-16-32 (48)	SANDY SILT (ML), olive (5Y, 5/3) intercalated with reddish yellow (7.5YR, 6/8), 70% non-plastic fines, 30% fine to medium sand, locally interlaminated with Sand (SP), organic debris present, hard, damp	

PROJECT NUMBER	BORING NUMBER
BAE 1525.01.LOG.CN	SHEET 1 OF 5

SOIL BORING LOG

PROJECT Buena Vista Landfill, County of Santa Cruz **LOCATION** West of Old Landfill

ELEVATION 104.95 MSL (Top of Casing) **DRILLING CONTRACTOR** Kvilhaug Well Drilling, Concord, CA

DRILLING METHOD AND EQUIPMENT Mobile B-61, 11-inch o.d. hollow stem auger

WATER LEVELS Perched water at 85', Aromas at 114' **START** 2-22-95 **FINISH** 2-28-95 **LOGGER** Thom Little

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS: 6" - 6" - 6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					GRAVELLY SAND (continued)	
65.0	65.0					
		S-7	.50	50 (6") (>50)	@ 65.5' localized occurance of SILTY GRAVEL (gravel supported by a matrix)	0 to 10 methane gas coming out of augers 2/23/95 stop drilling. @ 8:47 2/24/95 no visible gas vapor Gastech LEL 0% Oxygen 20.8%
	66.5					
70.0						
75.0	75.0					
		S-8	.4	50 (5") (>50)	AS ABOVE	
	76.5					
80.0						
85.0	85.0					
		S-9	1.0	20-50 (6") (>50)	AS ABOVE: moderately sorted; 5% fines; 55% fine to coarse sand; (f:m:c=1:2:10); 40% fine gravel; gravel is rounded; sand is subrounded ; dense; wet.	Water on sampling hammer, perched water.
	86.5					

PROJECT NUMBER	BORING NUMBER	
645.[illegible].05.CN	GP-16/P-15	SHEET 5 OF 5

SOIL BORING LOG

PROJECT Buena Vista Landfill, County of Santa Cruz **LOCATION** West of Old Landfill

ELEVATION 104.95 MSL (Top of Casing) **DRILLING CONTRACTOR** Kvilhaug Well Drilling, Concord, CA

DRILLING METHOD AND EQUIPMENT Mobile B-61, 11-inch o.d. hollow stem auger

WATER LEVELS Perched water at 85', Aromas at 114' **START** 2-22-95 **FINISH** 2-28-95 **LOGGER** Thom Little

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					SAND (continued)	
125.0	125					
	126.5	S-13	15	10-12-15 (27)	@ 125' SAND, fine to coarse sand (Fm.-15 YR) wet	good water production. No odor
	128.5					
	130.0	S-14	.5	5-5-11 (16)	AS ABOVE @ 125 feet	
130.0					Total Depth = 130.0 ft	
135.0						
140.0						
145.0						

PROJECT NUMBER	BORING NUMBER	
BAE 462591.LG.LDN	GP-16/P-15	SHEET 1 OF

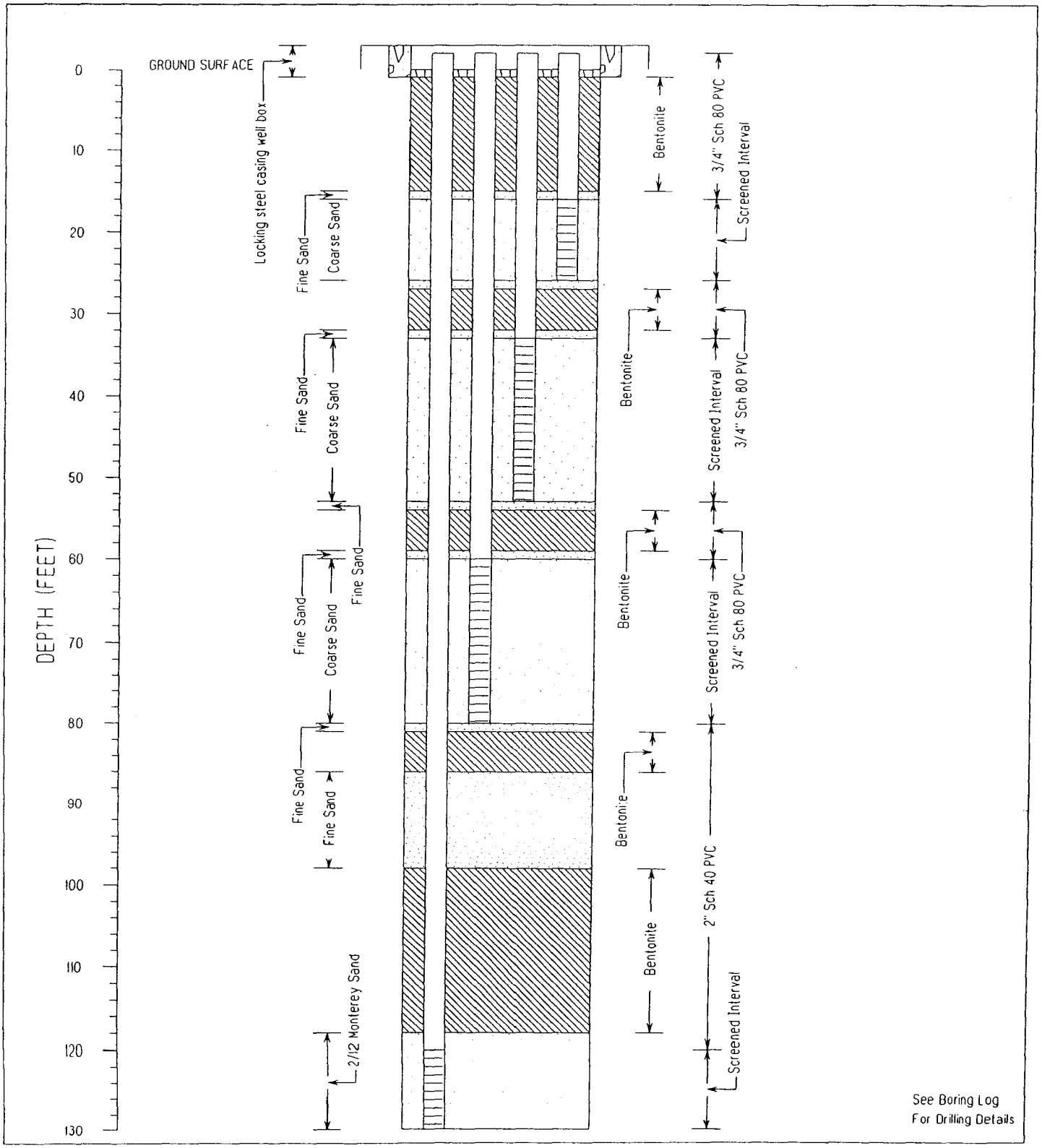
WELL COMPLETION LOG

PROJECT Buena Vista Landfill, County of Santa Cruz **LOCATION** West of Old Landfill

ELEVATION 104.95 MSL (Top of Casing) **DRILLING CONTRACTOR** Kvilhaug Well Drilling, Concord, CA

DRILLING METHOD AND EQUIPMENT Mobile B-61, 11-inch o.d. hollow stem auger

WATER LEVELS Perched water at 85', Aromas at 114' **START** 2-22-95 **FINISH** 2-28-95 **LOGGER** Thom Little



See Boring Log
For Drilling Details

PROJECT NUMBER	BORING NUMBER
[illegible]	GP-16/P-15 SHEET 2 OF 5

SOIL BORING LOG

PROJECT Buena Vista Landfill, County of Santa Cruz **LOCATION** West of Old Landfill

ELEVATION 104.95 MSL (Top of Casing) **DRILLING CONTRACTOR** Kvilhaug Well Drilling, Concord, CA

DRILLING METHOD AND EQUIPMENT Mobile B-61, 11-inch o.d. hollow stem auger

WATER LEVELS Perched water at 85', Aromas at 114' **START** 2-22-95 **FINISH** 2-28-95 **LOGGER** Thom Little

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
						driller notes change in drilling conditions
35.0	35.0					
	36.5	S-4	75	45-50 (5") (>50)	SAND (SP), olive (5Y, 4/3), trace fines, 100% fine to medium sand, framework grains are mostly quartz and lithic (rock) fragments forming a litharenite mineralogy; grains are subrounded; dense; damp; moderately well sorted.	14:23
40.0						
45.0	45.0					
	46.5	S-5	[illegible]	[illegible]	AS ABOVE, localized occurrences of gravel, increase in gravel content to 30%	
50.0						
55.0	55.0					
	56.5	S-6	1.0	40-50 (5") (>50)	GRAVELLY SAND (SW), olive (5Y, 4/3); 60% sand; 40% gravel; gravel is predominantly granitic rock fragments with lesser amounts of metasedimentary rock fragments, dense.	14:45

PROJECT NUMBER	BORING NUMBER	
BAE 35259.L6.CN	GP-16/P-15	SHEET 4 OF 5

SOIL BORING LOG

PROJECT Buena Vista Landfill, County of Santa Cruz **LOCATION** West of Old Landfill

ELEVATION 104.95 MSL (Top of Casing) **DRILLING CONTRACTOR** Kvilhaug Well Drilling, Concord, CA

DRILLING METHOD AND EQUIPMENT Mobile B-61, 11-inch o.d. hollow stem auger

WATER LEVELS Perched water at 85', Aromas at 114' **START** 2-22-95 **FINISH** 2-28-95 **LOGGER** Thom Little

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					GRAVELLY SAND (continued).	add rods to downhole sampling hammer due to water in hole.
95.0	95.0					
	96.5	S-10	1.5	12-18-27 (45)	CLAY (CL), olive (5Y, 5/3), 95% low to medium plasticity fines, 5% fine sand; thickly laminated to thinly bedded, contains minor amount of organic matter, interbed of Silty Sand at 95.4', transitional contact with underlying Silt; hard; damp.	not saturated
100.0					SILT (ML), yellowish brown (10YR, 5/6), 95% non-plastic fines; 5% fine sand, thinly laminated at the upper contact; becomes more thickly laminated toward the base of the sample; hard; damp.	
105.0	105					
	106.5	S-11	1.5	10-25-37 (62)	SILTY SAND (SM), olive (5Y, 4/4) intercalated with strong brown (7.5YR, 5/8); 15% non-plastic fines; 85% fine sand; micaceous; strong brown color occurs as a result of FeO mottling; dense; damp.	
110.0						
115.0	115					
	116.5	S-12	1.0	NR (NR)	SAND (SP), olive (5Y, 5/6); 100% fine to medium sand; (f:m=1:10); sand is subangular to subrounded; litharenite mineralogy (abundant rock fragmments admixed with quartz); dense; wet.	sample is saturated.

Geosyntec consultants
475 14th Street, Suite 400
Oakland, California 94612
Telephone: 510.836.3034
Fax: 510.836.3036

LOG OF GP-23

Project: Buena Vista Landfill

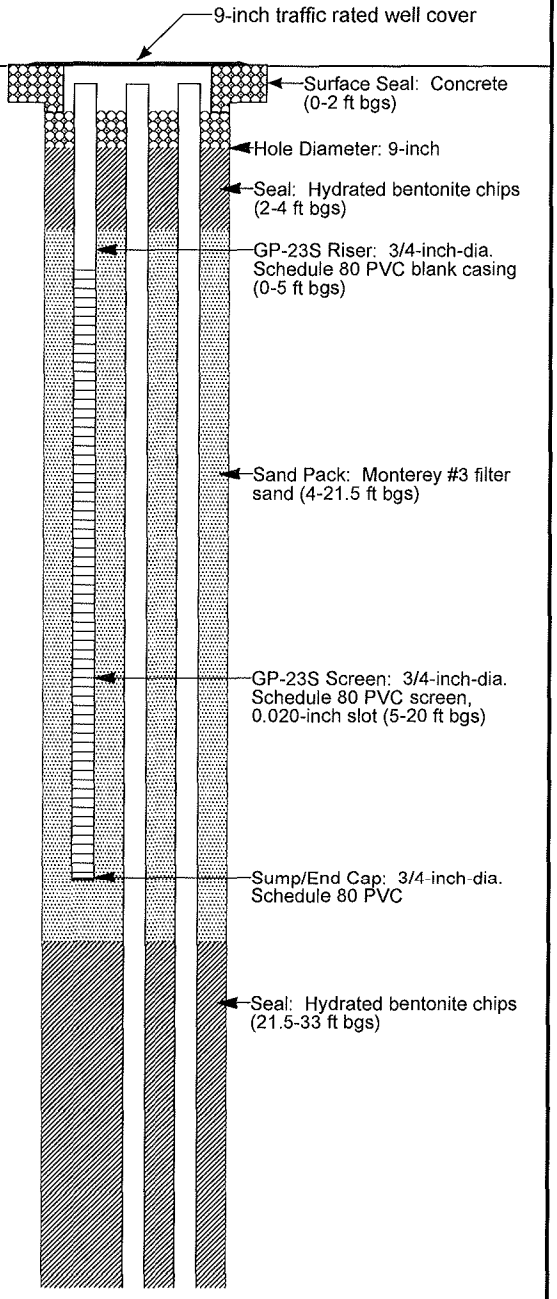
Location: Watsonville, CA **Project Number: WG1169**

Start Date	**9/23/09**	Finish Date	**9/23/09**	Total Depth Drilled (feet bgs)	**90.0**		
Drilling Method	**Air Percussion Hammer**	Drilling Contractor	**Layne Christensen**	Ground Surface Elevation (feet MSL)	**Not available**		
Drill Rig	**AP1000 Percussion Hammer**	Sampling Method	**SPT split spoon**	Top of PVC Casing Elevation (feet MSL)	**Not Available**		
Borehole Diameter	**9-inches**	Hammer Data	**140-lb percussion hammer**	Logger	**N. Gotberg**	Reviewer	**J. Fortuna**
Coordinate Location	**Not surveyed**	Remarks					

Elevation, feet / Depth, feet	Sample Interval	Blows per 6 inches	MATERIAL DESCRIPTION
0			[Borehole logged from cuttings in upper 8.5 feet.]
10	8/13/17	90%	WELL GRADED SAND WITH CLAY (SW-SC), dark yellowish brown (10YR 4/4), dry, 30% clay, 20% fine sand, 20% medium sand, 20% coarse sand, 10% gravel up to 1 cm diameter rounded to subangular, low plasticity, medium dense.
20	4/8/11	80%	POORLY GRADED SAND WITH CLAY (SP-SC), dark yellowish brown (10YR 4/6), dry, 30% clay, 70% fine sand, low plasticity, loose.
30	11/32/50/4"	80%	POORLY GRADED SAND (SP), dark yellowish brown (10YR 3/4), moist, 70% medium sand, 25% fine sand,

Graphic Log

WELL CONSTRUCTION DIAGRAM



Template: OAKLAND_WELL; Proj ID: WG1169.REVISED.GPJ; Printed: 10/1/2009

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Fax: 510.836.3036

LOG OF GP-23

Project: Buena Vista Landfill

Location: Watsonville, CA **Project Number: WG1169**

Elevation, feet / Depth, feet	Sample Interval / Blows per 6 inches	MATERIAL DESCRIPTION	Graphic Log	WELL CONSTRUCTION DIAGRAM
30		5% silt, dense.		GP-23M Riser: 3/4-inch-dia. Schedule 80 PVC blank casing (0-35 ft bgs)
35				
40	12/17/24 70%	POORLY GRADED SAND (SP), dark yellowish brown (10YR 4/4), dry, 90% fine sand, 10% silt, medium dense.		Sand Pack: Monterey #3 filter sand (33-52 ft bgs)
45				GP-23M Screen: 3/4-inch-dia. Schedule 80 PVC screen, 0.020-inch slot (35-50 ft bgs)
50	13/23/30 70%	Same as above.		Sump/End Cap: 3/4-inch-dia. Schedule 80 PVC
55				Seal: Hydrated bentonite chips (52-63 ft bgs)
60	17/25/27 50%	POORLY GRADED SAND (SP), brown (10YR 4/3), dry, 30% medium sand, 65% fine sand, 5% silt, medium dense.		GP-23D Riser: 3/4-inch-dia. Schedule 80 PVC blank casing (0-65 ft bgs)
65				

Template: OAKLAND_WELL; Proj ID: WG1169.REVISED.GPJ; Printed: 10/1/2009

Geosyntec consultants
475 14th Street, Suite 400
Oakland, California 94612
Telephone: 510.836.3034
Fax: 510.836.3036

LOG OF GP-23

Project: Buena Vista Landfill

Location: Watsonville, CA **Project Number: WG1169**

Elevation, feet / Depth, feet	Sample Interval / Blows per 6 inches	MATERIAL DESCRIPTION	Graphic Log	WELL CONSTRUCTION DIAGRAM
65				
70	13/5/3" 20%	WELL GRADED GRAVEL (GW), dark yellowish brown (10YR 4/4), dry, 5% fine sand, 10% medium sand, 20% coarse sand, 60% gravel, 5% cobbles, rounded to subangular up to 3 cm in diameter, very dense.		Sand Pack: Monterey #3 filter sand (63-90 ft bgs)
		Change in cuttings to sand observed at 73 ft.		
75				GP-23D Screen: 3/4-inch-dia. Schedule 80 PVC screen, 0.020-inch slot (65-90 ft bgs)
80	14/26/31 70%	POORLY GRADED SAND (SP), dark yellowish brown (10YR 4/6), dry, 70% fine sand, 20% medium sand, 10% clay, medium dense.		
85				
90		POORLY GRADED SAND (SP), brown (10YR 5/3), moist, 40% fine sand, 55% medium sand, 5% cobbles, rounded up to 3 cm in diameter, medium dense.		Sump/End Cap: 3/4-inch-dia. Schedule 80 PVC
		Total Depth = 90 ft		
95				
100				

Template: OAKLAND_WELL; Proj ID: WG1169.REVISED.GPJ; Printed: 10/1/2009

APPENDIX B

REMEDIAL WORK PLAN DESIGN DRAWINGS



NO.	REVISION	DATE
	WORK PLAN	09-15-09
	ADDENDUM FIGURE	02-18-10

SHEET TITLE
VADOSE ZONE WELL LOCATIONS

PROJECT TITLE
BUENA VISTA LANDFILL
WATSONVILLE, CALIFORNIA

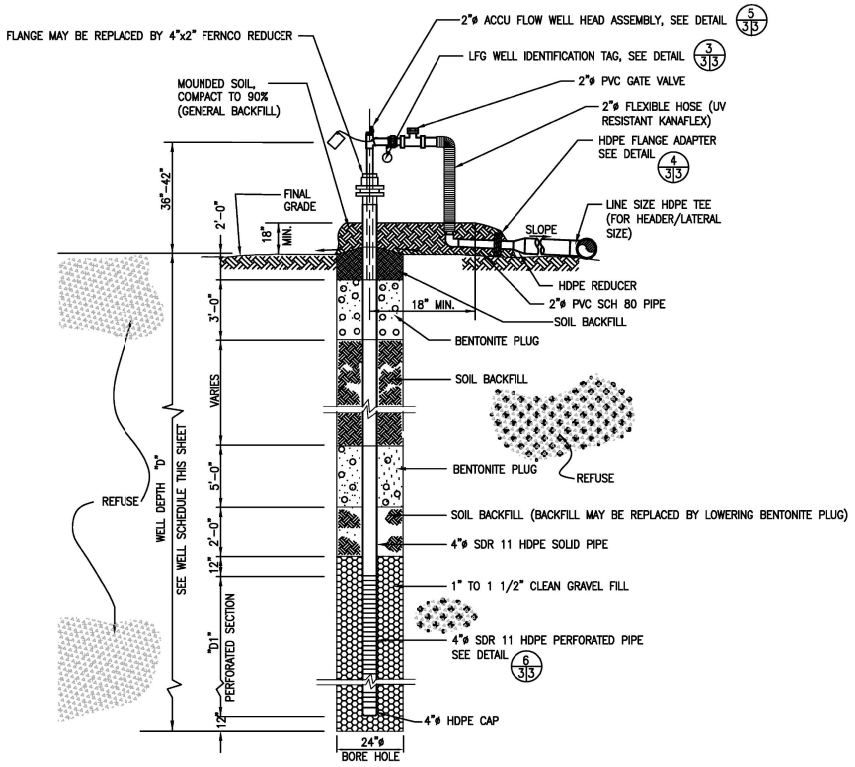
SCS ENGINEERS
ENVIRONMENTAL CONSULTANTS
3117 FITE CIRCLE, SUITE 108
SACRAMENTO, CA 95827
PH. (916) 361-1297 FAX. (916) 361-1299

PROJ. NO. 01207057.00 TS
DSN. BY: MJE
DRN. BY: MJE
CHK. BY: AAM
APP. BY: AAM
DWG. NO. Permit Fig

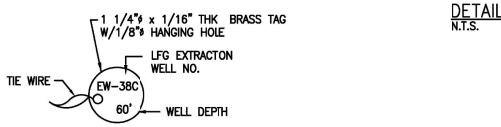
DATE: 10-23-2009

SCALE: AS SHOWN

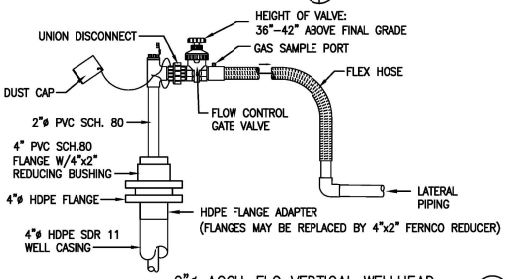
DRAWING: 1



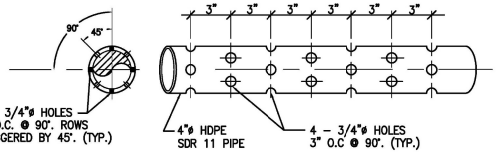
DETAIL – LFG EXTRACTION WELL 1/3
N.T.S.



DETAIL – IDENTIFICATION TAG 3/3
N.T.S.



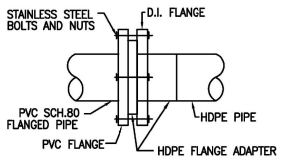
2"ø ACCU-FLO VERTICAL WELLHEAD 5/3
N.T.S.



DETAIL – PERFORATED PIPE 6/3
N.T.S.



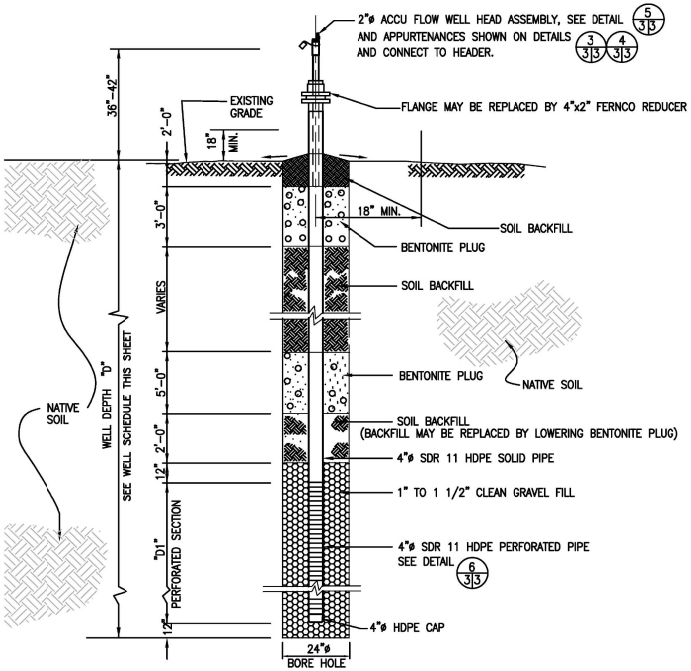
TOP VIEW DETAIL



DETAIL 4/3
N.T.S.

LFG EXTRACTION/VADOSE WELL SCHEDULE

WELL No.	LOCATION COORDINATES		FINAL GRADE ELEVATIONS	EXISTING GRADE ELEVATIONS	WELL DEPTH 'D' FT.	SLOTTED LENGTH 'D1' FT.	REMARKS
	NORTHING	EASTING					
EW-38C	10196.62	10247.84	152	148	60	40	EXTRACTION WELL
EW-58	10187.21	10850.81	150	146	45	25	EXTRACTION WELL
VZ-1	9996.85	10192.34	110	106	90	70	VADOSE ZONE WELL
VZ-2	9992.62	9998.99	111	107	90	70	VADOSE ZONE WELL
VZ-3	1025'.73	10993.83	114	108	90	70	VADOSE ZONE WELL
VZ-4	1030'.08	8126.91	109	104.75	80	60	VADOSE ZONE WELL



DETAIL – VADOSE ZONE WELLS 2/3
VZ-1 THROUGH VZ-4
N.T.S.

NOTE:

WELL DEPTHS, SHOWN IN THE ABOVE WELL SCHEDULE, HAVE BEEN COMPUTED BASED ON LATEST TOPOGRAPHY, AS PROVIDED TO SCS BY THE COUNTY OF SANTA CRUZ. WELL DESIGN MAY BE MODIFIED BASED ON THE ACTUAL FIELD CONDITIONS ENCOUNTERED DURING DRILLING AND THE ENGINEER WILL IMMEDIATELY REVISE THE WELL DESIGN AND FURNISH INFORMATION TO THE CONTRACTOR.

NO.	REVISION	DATE
1	WORK PLAN	9-28-09
2	WORK PLAN ADDENDUM	02-18-10

SHEET TITLE: WELL SCHEDULE AND DETAILS

PROJECT TITLE: BUENA VISTA LANDFILL WATSONVILLE, CALIFORNIA

SCS ENGINEERS
ENVIRONMENTAL CONSULTANTS
3645 LONG BEACH BLVD. SUITE 108
LONG BEACH, CA 90807
PH. (916) 361-1297 FAX. (916) 361-1299

PROJ. NO. 07201057.00 T4 | DWN. BY: MJE | CHK. BY: AAM | ACAD FILE: BVLF WELL SCHED/DET | APP'D. BY: AAM

DATE: 09-28-09

SCALE: N.T.S.

DRAWING: 2

APPENDIX C

VADOSE ZONE WELL PERMITS

SANTA CRUZ COUNTY HEALTH SERVICES AGENCY - ENVIRONMENTAL HEALTH SERVICE - 701 OCEAN ST, RM 312, SANTA CRUZ, CA 95060 (831) 454-2022

APPLICATION FOR WELL PERMIT

☑ New ☐ Replacement ☐ Supplemental ☐ Destruction ☐ Other _____ ☐ Geothermal ☑ Monitoring Well

052-021-33 | 052-061-01 052-061-25 | 09-217 (Permit #) | SR2525 (Envision #) | 2380 Program Element
Site Parcel Number | Other Parcels Served

Site Address 150 ROUNDTREE LANE, WATSONVILLE, CA 95076

Owner COUNTY OF SANTA CRUZ Address 701 OCEAN STREET, ROOM 410 SANTA CRUZ, CA 95060

Drilling Contractor S.D. DRILLING License # 819365 Phone 760-789-4935

Directions To Site HWY 1 TO BUENA VISTA DRIVE, HARKINS SLOUGH. ESTIMATED WORK DATES: START 12/1/09 COMPLETION 12/3/09

Mail Correspondence To: SCS ENGINEERS, 3843 BRICKWAY BLVD, SITE 208, SANTA ROSA, CA 95403 C/O MARK ERICKSON

DESIGN SPECIFICATIONS:

INTENDED USE
DOMESTIC: ___
#Homes Served _____
WATER SYSTEM WELL: ___
Name of Water System
_____
IRRIGATION ____ Acres: ____
Crop: _____
Water Use: _____af/yr
COMMERCIAL/INDUSTRIAL _____ Type: _____
WITHIN WATER DISTRICT SERVICE AREA ___ NO ___ YES NAME: _____ (FORM HSA-579-REQUIRED)

DISTANCE FROM WELL SITE TO:
SEPTIC SYSTEMS _____
SEWER _____
NEAREST PROPERTY LINE 75-100'

MONITORING WELL: MW-1
GRDWTR ___ VADOSE ✓
OTHER: _____ (SPECIFY)

TYPE OF WELL CONSTRUCTION
ROTARY ____
CABLE ____
DUG ____
OTHER BUCKET/AUGER METHOD

CASING
SINGLE ✓ DOUBLE ____
MATERIAL HDPE
TYPE OF JOINT WELDED
GRAVEL PACK 1 to 1 1/2" CLEAN GRAVEL

CONSTRUCTION DEPTH (FT.) 90 DIAMETER (IN.) 4 DEPTH OF SEAL (FT.) 20 WIDTH OF SEAL (IN.) 24

EXISTING WELLS ON PROPERTY:
1. OTHER WELLS ON PROPERTY: NUMBER: _____ TYPES: DOMESTIC ___ IRRIGATION ___ COMMERCIAL USE ___ OTHER _____
2. CONDITION OF OTHER WELLS ON PROPERTY: IN USE _____ TO BE DESTROYED _____
3. IF NEW WELL REPLACES AN EXISTING WELL, INDICATE INTENTIONS FOR USE OF REPLACED WELL:
___ TO SUPPLEMENT NEW WELL ___ TO BE DESTROYED ___ OTHER _____

WELL DESTRUCTION: Depth Of Well _____ Depth Of Seal: _____ Number Of Water Formations Penetrated _____ Perforation?: _____
Cleaning Of Well Required Yes:___ No:___ Sealing Material _____ Other measures: _____

Plot Plan: Attach 2 copies of plot plan (see reverse for requirements)

I hereby agree to comply with all laws and regulations of the county of Santa Cruz and state of California pertaining to well construction, and declare under penalty of perjury the information submitted on this application is true and correct. I will contact the environmental health service when I commence the work. Within 15 days after completion of work I will furnish the environmental health service a report of the work performed and notify them before putting the well into use. **I understand that this permit expires one year from date of issuance.** I understand approval of the well permit does not indicate whether this property is suitable for an individual sewage disposal system or that a permit to install such system will be granted.

WORKER'S COMPENSATION CERTIFICATE

___ A CURRENTLY EFFECTIVE CERTIFICATION OF WORKERS COMPENSATION INSURANCE IS ON FILE WITH THIS OFFICE.
INSURANCE CARRIER State Compensation Ins. Fund POLICY # 1907850-07
___ I CERTIFY THAT IN THE PERFORMANCE OF THE WORK FOR WHICH THIS PERMIT IS ISSUED I SHALL NOT EMPLOY ANY

PROPERTY OWNER _____ DRILLING CONTRACTOR _____ 11/24/09

FOR OFFICE USE ONLY:

	DATE	EHS SPECIALIST	MGR
SITE INSPECTION			
SUPPLEMENTAL WATER USE SHEET			
APPLICATION APPROVAL	12/10/09	TEP	
PAD INSPECTION			
RECEIPT OF WELL LOG			
FINAL			

ANNULAR WELL SEAL WITNESSED:
___ YES DATE _____
___ NO DEPTH _____
SEAL MATERIAL _____
SACKS CEMENT/YARD _____
WATER QUALITY DATA RECEIVED _____ **OK?**

WATER EFFICIENCY EVALUATION REQUIRED YES ___ NO ___ COMPLETE: _____ INSTALLATION VERIFIED _____
GEOPHYSICAL LOG REQUIRED YES ___ NO ___ RECEIVED: _____

COMMENTS: _____

DISTRIBUTION: WHITE - EHS /YELLOW - WELL DRILLER /PINK - FISCAL CONTROL /GOLDENROD - RECEIPT

SANTA CRUZ COUNTY HEALTH SERVICES AGENCY - ENVIRONMENTAL HEALTH SERVICE - 701 OCEAN ST, RM 312, SANTA CRUZ, CA 95060 (831) 454-2022

APPLICATION FOR WELL PERMIT

☑ New ☐ Replacement ☐ Supplemental ☐ Destruction ☐ Other _____ ☐ Geothermal ☑ Monitoring Well

052-21-33 _____ 052-061-01 052-061-25 09718 _____ 2350
Site Parcel Number | Other Parcels Served | (Permit #) | (Envision #) | Program Element

Site Address 150 ROUNDTREE LANE, WATSONVILLE, CA 95076

Owner COUNTY OF SANTA CRUZ Address 701 OCEAN STREET, ROOM 410, SANTA CRUZ, CA 95060

Drilling Contractor SD DRILLING License # 819365 Phone 768-787-4935

Directions To Site 4W/1 TO BUENA VISTA DR. HARKINS SLOUGH RD ESTIMATED WORK DATES: START 12/1/09 COMPLETION 12/31/09

Mail Correspondence To: SCS ENGINEERS, 3843 BRICKWAY BLVD, STE 208 C/O MARK ERICKSON
DESIGN SPECIFICATIONS: SANTA ROSA, CA 95403

INTENDED USE
DOMESTIC: ___
#Homes Served _____
WATER SYSTEM WELL: ___
Name of Water System
_____
IRRIGATION _____ Acres: _____
Crop: _____
Water Use: _____af/yr
COMMERCIAL/INDUSTRIAL _____ Type: _____
WITHIN WATER DISTRICT SERVICE AREA ___ NO ___ YES NAME: _____ (FORM HSA-579-REQUIRED)

DISTANCE FROM WELL SITE TO:
SEPTIC SYSTEMS _____
SEWER _____
NEAREST PROPERTY LINE 75-100'

MONITORING WELL: ✓ VE-2
GRDWTR ___ VADOSE ✓
OTHER: _____ (SPECIFY)

TYPE OF WELL CONSTRUCTION
ROTARY _____
CABLE _____
DUG
OTHER BUCKET / AUGER METHOD

CASING ✓
SINGLE ✓ DOUBLE
MATERIAL HDPE
TYPE OF JOINT WELDED
GRAVEL PACK 1 to 1½" CLEAN GRAVEL

CONSTRUCTION DEPTH (FT.) 90 DIAMETER (IN.) 4 DEPTH OF SEAL (FT.) 20 WIDTH OF SEAL (IN.) 24

EXISTING WELLS ON PROPERTY:
1. OTHER WELLS ON PROPERTY: NUMBER: _____ TYPES: DOMESTIC ___ IRRIGATION ___ COMMERCIAL USE ___ OTHER _____
2. CONDITION OF OTHER WELLS ON PROPERTY: IN USE _____ TO BE DESTROYED _____
3. IF NEW WELL REPLACES AN EXISTING WELL, INDICATE INTENTIONS FOR USE OF REPLACED WELL:
___ TO SUPPLEMENT NEW WELL ___ TO BE DESTROYED ___ OTHER _____

WELL DESTRUCTION: Depth Of Well _____ Depth Of Seal: _____ Number Of Water Formations Penetrated _____ Perforation?: _____
Cleaning Of Well Required Yes:___ No:___ Sealing Material _____ Other measures: _____

Plot Plan: Attach 2 copies of plot plan (see reverse for requirements)

I hereby agree to comply with all laws and regulations of the county of Santa Cruz and state of California pertaining to well construction, and declare under penalty of perjury the information submitted on this application is true and correct. I will contact the environmental health service when I commence the work. Within 15 days after completion of work I will furnish the environmental health service a report of the work performed and notify them before putting the well into use. **I understand that this permit expires one year from date of issuance.** I understand approval of the well permit does not indicate whether this property is suitable for an individual sewage disposal system or that a permit to install such system will be granted.

WORKER'S COMPENSATION CERTIFICATE

___ A CURRENTLY EFFECTIVE CERTIFICATION OF WORKERS COMPENSATION INSURANCE IS ON FILE WITH THIS OFFICE.
INSURANCE CARRIER State Compensation Ins Fund POLICY # 1907850-09

___ I CERTIFY THAT IN THE PERFORMANCE OF THE WORK FOR WHICH THIS PERMIT IS ISSUED I SHALL NOT EMPLOY ANY

PROPERTY OWNER _____ DRILLING CONTRACTOR _____ 11/24/09

FOR OFFICE USE ONLY:

	DATE	EHS SPECIALIST	MGR
SITE INSPECTION			
SUPPLEMENTAL WATER USE SHEET			
APPLICATION APPROVAL	12/10/9	TVE	___
PAD INSPECTION			
RECEIPT OF WELL LOG			
FINAL			

ANNULAR WELL SEAL WITNESSED:
___ YES DATE _____
___ NO DEPTH _____
SEAL MATERIAL _____
SACKS CEMENT/YARD _____
WATER QUALITY DATA RECEIVED _____ OK?

WATER EFFICIENCY EVALUATION REQUIRED YES ___ NO ___ COMPLETE: _____ INSTALLATION VERIFIED _____
GEOPHYSICAL LOG REQUIRED YES ___ NO ___ RECEIVED: _____

COMMENTS: _____

DISTRIBUTION: WHITE - EHS /YELLOW - WELL DRILLER /PINK - FISCAL CONTROL /GOLDENROD - RECEIPT

SANTA CRUZ COUNTY HEALTH SERVICES AGENCY - ENVIRONMENTAL HEALTH SERVICE - 701 OCEAN ST. RM 312, SANTA CRUZ, CA 95060 (831) 454-2022

APPLICATION FOR WELL PERMIT

✓ New Replacement Supplemental Destruction Other _____ Geothermal ✓ Monitoring Well

052-021-33 | 052-061-01 | 052-061-25 | 09-219 (Permit #) | (Envision #) | 2380 Program Element
Site Parcel Number | Other Parcels Served

Site Address 150 ROUNDTREE LANE, WATSONVILLE, CA 95076

Owner COUNTY OF SANTA CRUZ Address 701 OCEAN STREET, ROOM 410, SANTA CRUZ CA 95060

Drilling Contractor SD DRILLING License # 719365 Phone 760-789-4935

Directions To Site Hwy 1 TO ELENA VISTA DRIVE ESTIMATED WORK DATES; START 12/7/09 COMPLETION 1/7/10

Mail Correspondence To: SCS ENGINEERS, 3843 BRICKWAY BLVD, SUITE 208, SANTA ROSA CA 95403

DESIGN SPECIFICATIONS: C/O MARK ERICKSON

INTENDED USE
DOMESTIC: ___
#Homes Served _____
WATER SYSTEM WELL: ___
Name of Water System
_____
IRRIGATION ____ Acres: _____
Crop: _____
Water Use: _____af/yr
COMMERCIAL/INDUSTRIAL _____ Type: _____

DISTANCE FROM WELL SITE TO:
SEPTIC SYSTEMS _____
SEWER _____
NEAREST PROPERTY LINE 250'

MONITORING WELL: MW-3
GRDWTR ___ VADOSE ✓
OTHER: _____(SPECIFY)

TYPE OF WELL CONSTRUCTION
ROTARY ____
CABLE ____
DUG ____
OTHER ✓ BUCKET/AUGER METHOD

CASING
SINGLE ✓ DOUBLE ___
MATERIAL HDPE
TYPE OF JOINT WELDED
GRAVEL PACK 1 to 1½" CLEAN GRAVEL

WITHIN WATER DISTRICT SERVICE AREA ___ NO ___ YES NAME: _____ (FORM HSA-579-REQUIRED)

CONSTRUCTION DEPTH (FT.) 90 DIAMETER (IN.) 4 DEPTH OF SEAL (FT.) 20 WIDTH OF SEAL (IN.) 24

EXISTING WELLS ON PROPERTY:
1. OTHER WELLS ON PROPERTY: NUMBER: _____ TYPES: DOMESTIC ___ IRRIGATION ___ COMMERCIAL USE ___ OTHER _____
2. CONDITION OF OTHER WELLS ON PROPERTY: IN USE _____ TO BE DESTROYED _____
3. IF NEW WELL REPLACES AN EXISTING WELL, INDICATE INTENTIONS FOR USE OF REPLACED WELL:
___ TO SUPPLEMENT NEW WELL ___ TO BE DESTROYED ___ OTHER _____

WELL DESTRUCTION: Depth Of Well _____ Depth Of Seal: _____ Number Of Water Formations Penetrated _____ Perforation?: _____
Cleaning Of Well Required Yes:___ No:___ Sealing Material _____ Other measures: _____

Plot Plan: Attach 2 copies of plot plan (see reverse for requirements)

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WORKER'S COMPENSATION CERTIFICATE

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INSURANCE CARRIER State Compensation Ins Fund POLICY # 1907850-09

___ I CERTIFY THAT IN THE PERFORMANCE OF THE WORK FOR WHICH THIS PERMIT IS ISSUED I SHALL NOT EMPLOY ANY

PROPERTY OWNER _____ DRILLING CONTRACTOR _____ ___/___/___

FOR OFFICE USE ONLY:

	DATE	EHS SPECIALIST	MGR
SITE INSPECTION			
SUPPLEMENTAL WATER USE SHEET			
APPLICATION APPROVAL	12/10/09		
PAD INSPECTION			
RECEIPT OF WELL LOG			
FINAL			

ANNULAR WELL SEAL WITNESSED:
___ YES DATE _____
___ NO DEPTH _____
SEAL MATERIAL _____
SACKS CEMENT/YARD _____
WATER QUALITY DATA RECEIVED _____ OK?

WATER EFFICIENCY EVALUATION REQUIRED YES ___ NO ___ COMPLETE: _____ INSTALLATION VERIFIED _____
GEOPHYSICAL LOG REQUIRED YES ___ NO ___ RECEIVED: _____

COMMENTS: _____

DISTRIBUTION: WHITE - EHS /YELLOW - WELL DRILLER /PINK - FISCAL CONTROL /GOLDENROD - RECEIPT

SANTA CRUZ COUNTY HEALTH SERVICES AGENCY - ENVIRONMENTAL HEALTH SERVICE - 701 OCEAN ST, RM 312, SANTA CRUZ, CA 95060 (831) 454-2022

APPLICATION FOR WELL PERMIT

✓ New Replacement Supplemental Destruction Other _____ Geothermal ✓ Monitoring Well

052-021-33 (Site Parcel Number) 052-061-01 (Other Parcels Served) 052-061-25 09-270 (Permit #) 2380 (Envision #) (Program Element)

Site Address 150 RANDTREE LANE, WATSONVILLE, CA 95076

Owner COUNTY OF SANTA CRUZ Address 701 OCEAN STREET, ROOM 410, SANTA CRUZ, CA 95060

Drilling Contractor SD DRILLING License # 819365 Phone 760-789-4935

Directions To Site HWY 1 TO BUENA VISTA DRIVE ESTIMATED WORK DATES: START 12/7/09 COMPLETION 1/7/10

Mail Correspondence To: SCS ENGINEERS, 3843 BRICKWAY BLVD, STE 208, SANTA ROSA CA, 95403

DESIGN SPECIFICATIONS: C/O MARK ERICKSON

INTENDED USE
DOMESTIC: ___
#Homes Served _____
WATER SYSTEM WELL: ___
Name of Water System _____
IRRIGATION ___ Acres: ___
Crop: _____
Water Use: _____af/yr
COMMERCIAL/INDUSTRIAL ___ Type: _____

DISTANCE FROM WELL SITE TO:
SEPTIC SYSTEMS _____
SEWER _____
NEAREST PROPERTY LINE 750'

MONITORING WELL: VZ-4
GRDWTR ___ VADOSE ✓
OTHER: _____(SPECIFY)

TYPE OF WELL CONSTRUCTION
ROTARY ___
CABLE ___
DUG ___
OTHER ✓ BUCKET/AUGER METHOD

CASING
SINGLE ✓ DOUBLE ___
MATERIAL HDPE
TYPE OF JOINT WELDED
GRAVEL PACK 1 to 1 1/2" CLEAN GRAVEL

WITHIN WATER DISTRICT SERVICE AREA ___ NO ___ YES NAME: _____ (FORM HSA-579-REQUIRED)

CONSTRUCTION DEPTH (FT.) 80 DIAMETER (IN.) 4 DEPTH OF SEAL (FT.) 20 WIDTH OF SEAL (IN.) 24

EXISTING WELLS ON PROPERTY:
1. OTHER WELLS ON PROPERTY: NUMBER: _____ TYPES: DOMESTIC ___ IRRIGATION ___ COMMERCIAL USE ___ OTHER _____
2. CONDITION OF OTHER WELLS ON PROPERTY: IN USE _____ TO BE DESTROYED _____
3. IF NEW WELL REPLACES AN EXISTING WELL, INDICATE INTENTIONS FOR USE OF REPLACED WELL:
___ TO SUPPLEMENT NEW WELL ___ TO BE DESTROYED ___ OTHER _____

WELL DESTRUCTION: Depth Of Well _____ Depth Of Seal: _____ Number Of Water Formations Penetrated _____ Perforation?: _____
Cleaning Of Well Required Yes:___ No:___ Sealing Material _____ Other measures: _____

Plot Plan: Attach 2 copies of plot plan (see reverse for requirements)

I hereby agree to comply with all laws and regulations of the county of Santa Cruz and state of California pertaining to well construction, and declare under penalty of perjury the information submitted on this application is true and correct. I will contact the environmental health service when I commence the work. Within 15 days after completion of work I will furnish the environmental health service a report of the work performed and notify them before putting the well into use. **I understand that this permit expires one year from date of issuance.** I understand approval of the well permit does not indicate whether this property is suitable for an individual sewage disposal system or that a permit to install such system will be granted.

WORKER'S COMPENSATION CERTIFICATE

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INSURANCE CARRIER State Compensation Ins Fund POLICY # 1907850-09

___ I CERTIFY THAT IN THE PERFORMANCE OF THE WORK FOR WHICH THIS PERMIT IS ISSUED I SHALL NOT EMPLOY ANY

PROPERTY OWNER _____ DRILLING CONTRACTOR _____ ___/___/___

FOR OFFICE USE ONLY:

	DATE	EHS SPECIALIST	MGR	ANNULAR WELL SEAL WITNESSED:
SITE INSPECTION				___ YES DATE _____
SUPPLEMENTAL WATER USE SHEET				___ NO DEPTH _____
APPLICATION APPROVAL	12/10/09	TEM		SEAL MATERIAL _____
PAD INSPECTION				# SACKS CEMENT/YARD _____
RECEIPT OF WELL LOG				WATER QUALITY DATA RECEIVED _____ OK?
FINAL				

WATER EFFICIENCY EVALUATION REQUIRED YES ___ NO ___ COMPLETE:_____ INSTALLATION VERIFIED_____

GEOPHYSICAL LOG REQUIRED YES ___ NO ___ RECEIVED:_____

COMMENTS: _____

DISTRIBUTION: WHITE - EHS /YELLOW - WELL DRILLER /PINK - FISCAL CONTROL /GOLDENROD - RECEIPT

Geosyntec consultants

475 14th Street, Suite 400
Oakland, California 94612
PH 510.836.3034
FAX 510.836.3036
www.geosyntec.com

22 October 2009

Mr. Jon Whitehill
California Integrated Waste Management Board
1001 I Street, PO Box 4025
Sacramento, CA 95812

Subject: Installation of Landfill Gas Monitoring Probes
Buena Vista Landfill
150 Rountree Lane
Watsonville, California

Dear Mr. Whitehill:

This letter describes the installation of five new landfill gas (LFG) monitoring probes at the Buena Vista Landfill in Watsonville, California (Figure 1). Geosyntec Consultants (Geosyntec) prepared this report on behalf of the County of Santa Cruz Department of Public Works (the County). The work described in this report was performed in response to the California Integrated Waste Management Board (CIWMB) requirements under the California Code of Regulations (CCR) Title 27, Chapter 3 (Criteria for All Waste Management Units, Facilities, and Disposal Sites), §20917 through §20939.

SITE DESCRIPTION

The Buena Vista Landfill is a Class III municipal solid waste landfill located in Watsonville, California (Figure 1). The Site is located approximately 1 mile west of Highway 1 and access to the facility is from Buena Vista Drive. The Buena Vista

Landfill comprises 126 acres and incorporates all or portions of five parcels, as shown in Figure 2. The three main areas of the site include the Old Landfill (closed), the Old Landfill Expansion Area (closed) and the Buena Vista Landfill (active).

The Old Landfill comprises approximately 28-acres of a 39-acre parcel, (APN #052-531-01) that was operated as a quarry and private landfill prior to the County's acquisition of the property in the 1960s. This portion of the landfill stopped receiving refuse in 1981 and was certified closed in 1986.

The Old Landfill Expansion Area is located on a 93-acre parcel (APN #052-531-03) that is shared with the Sheriff's detention facilities. The Old Landfill Expansion Area is east of Gallighan Slough and the Old Landfill. Approximately 20 acres of this parcel are dedicated to landfill activities and the remainder is used by the County Sheriff's Department and as migrant housing. Of the 20 acres in this parcel dedicated to landfill uses, 15 acres were landfilled between 1981 and 1985, and this area was certified closed as of December 1995. The Old Landfill Expansion Area is coincident with the southwest perimeter of the current active site.

The Buena Vista Landfill currently permitted for disposal is located on 61 acres of the 69-acre parcel (APN #052-021-33). The active landfill was designed to be constructed in 6 modules; however, the originally planned Module 4 was constructed as two separate modules, Modules 4A and 4B and an Ecopark transfer station is planned to be constructed in place of Module 5. Currently, active landfilling is occurring in Modules 3, 4A, 4B, and 6.

The Site currently operates under permit number 44-AA-0004, renewed by the CIWMB on 4 April 2005. The landfill has a maximum permitted throughput of 906 tons/day allowed for the 2009 year. The Buena Vista Landfill is permitted to accept agricultural, construction/demolition, contaminated soils, dead animals, industrial, inert, mixed/municipal solid waste, sewage sludge, tires (not landfilled), household hazardous waste (not landfilled), and compostable material (food waste compost pilot project).

BACKGROUND

In order to comply with 19 April 2007 CIWMB revisions to the regulations governing landfill gas monitoring and control for active disposal sites, Geosyntec compiled information on the existing LFG monitoring network at the Site and submitted it the CIWMB, on behalf of the County, on 22 August 2008. The August 2008, a "Summary of the Landfill Gas Monitoring Network" for the Site also included a Work Plan for installation of additional LFG probes. In a 14 November 2008 letter, the CIWMB identified deficiencies in the plan and requested additional information prior to plan approval. In particular, the CIWMB requested additional information on geologic and hydrogeologic conditions, and said that additional monitoring points were required around the perimeter of the "Old", closed portion of the landfill.

On 2 February 2009 Geosyntec submitted a letter on behalf of the County that described landfill boundaries in detail, and reiterated our request to exclude the "Old" landfill from perimeter monitoring requirements. The CIWMB responded with a letter on 17 March 2009 stating: "...the proposed alternative monitoring boundary cannot be approved. The regulations state that the entire permitted facility landfill boundary is required to be monitored.....the old closed unit located at the east side of the permitted facility boundary is not considered a separately closed landfill and is not exempt from the of 27 CCR 20920 et seq."

On 9 April 2009, the CIWMB and the County met at the site to discuss potential landfill gas probe locations and alternatives to spacing requirements based on site conditions. During the site inspection that followed the meeting, the CIWMB and County verbally agreed to new required LFG Probe locations, which included some probes around the perimeter of the Old landfill at alternative spacing based on site conditions. A memorandum summarizing the meeting notes from the 9 April 2009 site walk was submitted to the CIWMB on 14 May 2009. However, shortly after the site walk, the CIWMB informed the County that the agreed-upon LFG probe locations would not be sufficient to meet regulatory requirements.

On 30 June 2009 the County submitted a "Request for Dispute Resolution" to the CIWMB to appeal the decision that the portion of the landfill closed in 1986 must be included in the monitoring network under the California Code of Regulations (CCR)

Title 27, Chapter 3 (Criteria for All Waste Management Units, Facilities, and Disposal Sites), §20917 through §20939. In response in a 15 July 2009 phone conversation the CIWMB requested that the Old Landfill be included in the monitoring program with the alternatives discussed during the April 2009 site walk.

On 17 July 2009, a revised figure and table of the proposed LFG probe locations and construction details was submitted to the CIMWB. In a 3 August 2009 letter the CIMWB approved the revised monitoring probe network on the condition that existing monitoring probe GP-17 be included. On 17 August 2009 the County submitted a revised figure of the proposed LFG monitoring network including GP-17 to the CIMWB.

LANDFILL GAS PROBE INSTALLATIONS

The new LFG monitoring probes were installed between 21 and 23 September 2009. In preparation for the fieldwork, Geosyntec completed the following activities:

- Confirmed the proposed drilling locations with County personnel;
- Marked the drilling locations and notified Underground Service Alert (USA) 48 hours in advance of the fieldwork;
- Obtained gas probe installation permits from Santa Cruz County Health Services;
- Updated the site-specific Health and Safety Plan.

Under direction from Geosyntec, Layne Christensen Company of Fontana, California (Layne) installed gas probes using a dual wall air percussion hammer rig and 9-inch outer diameter dual wall drill casing. A total of five new LFG probes were installed: GP-16, GP-22, GP-23, GP-24 and GP-25. Probe locations are shown in Figure 3. During probe installation, soil cores were collected at ten foot intervals for geologic logging using a 2-inch diameter SPT split-spoon sampler and 140-lb downhole drop hammer. The Geosyntec field geologist prepared boring logs using the Unified Soil Classification System, under the direction of a California Professional Geologist (P.G.). The geologic and LFG probe construction logs are included in Attachment 1. A summary of the LFG probe construction details are included in Table 1.

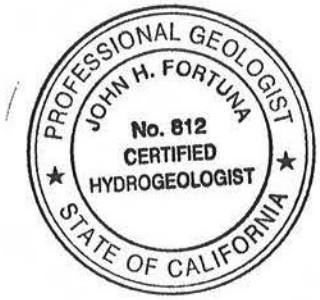
The probes were constructed of flush threaded joint, ¾-inch diameter, schedule 80 PVC with factory cut 0.020-inch slot screens. Filter packs (Monterey #3) were tremied into the annular space around the screened intervals and the annular space between filter packs was sealed with bentonite chips, which were intermittently hydrated during installation. The annular space above the uppermost filter pack was also sealed with hydrated bentonite, and a 2-ft thick pad of concrete to the ground surface.

Surveying

The horizontal coordinates of gas probes were surveyed by County personnel on 6 October 2009. The survey coordinates are summarized below.

	Northing	Easting
GP-16	1794728.620	6177615.539
GP-22	1796277.938	6178416.408
GP-23	1794412.400	6179381.824
GP-24	1794859.685	6175801.843
GP-25	1794997.997	6176474.869

If you have any questions or comments regarding this gas probe installation report, please contact Kasey Kolassa of Santa Cruz County at (831) 454-2377 or the undersigned at (510) 285-2700.



Sincerely,

Nicole Gotberg
Senior Staff Geologist

John H. Fortuna, C.HG.
Senior Hydrogeologist

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Copy w/attachments to:
Mr. Kasey Kolassa, Santa Cruz County Department of Public Works
Ms. Sangeeta Lewis, Geosyntec Consultants

Attachments:

Table 1	LFG Probe construction details
Figure 1	Site Location Map
Figure 2	Site Settings and Property Boundary
Figure 3	LFG Migration Monitoring Probe Locations
Attachment 1	LFG Probe Lithologic Logs and Construction Diagrams

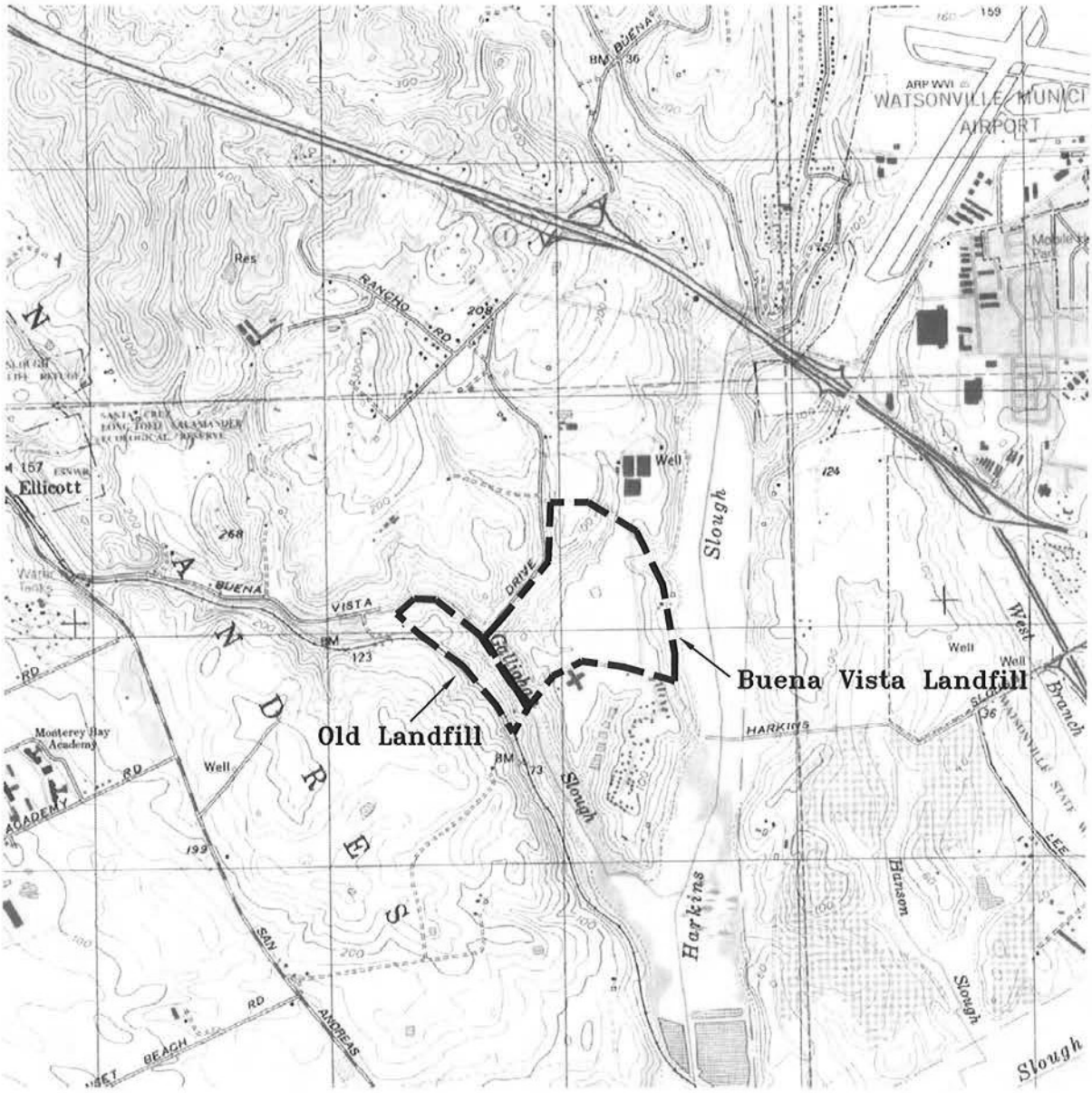
TABLES

Table 1
New Perimeter Monitoring Landfill Gas Probe Details
Buena Vista Drive Sanitary Landfill
Watsonville, CA

New Gas Probe	Proposed Total Depth in Work Plan (feet bgs)	Total Depth Installed (feet bgs)	Proposed Screen Intervals in Work Plan		Screen Intervals Installed		Description of Field Conditions Resulting in Screen Interval Modifications
			From (feet)	To (feet)	From (feet)	To (feet)	
GP-16	20.0	22.0	S 5	20	S 5	20	NA
GP-22	50.0	50.0	S 5 M 35	20 50	S 6 M 35	16 50	Shallow screen interval modified based on transition from sand to clay at 17 ft bgs
GP-23	90.0	90.0	S 5 M 35 D 75	20 50 90	S 5 M 35 D 65	20 50 90	Deep screen interval modified in order to overlap gravel unit located between 68-73 ft bgs
GP-24	40.0	40.0	S 5 M 30	20 40	S 5 M 30	10 40	Shallow screen interval modified based on transition from sand to clay at 15 ft bgs and formation collapse between 10-17 ft bgs
GP-25	20.0	15.0	S 5	20	S 5	15	Screen interval modified due to groundwater encountered in boring at 15.5 ft bgs

bgs = below ground surface
NA = not applicable

FIGURES



Topo Source: U.S.G.S. 7.5 Minute Series,
Watsonville West, CA Quadrangle (1991)
Contour Interval = 20 ft

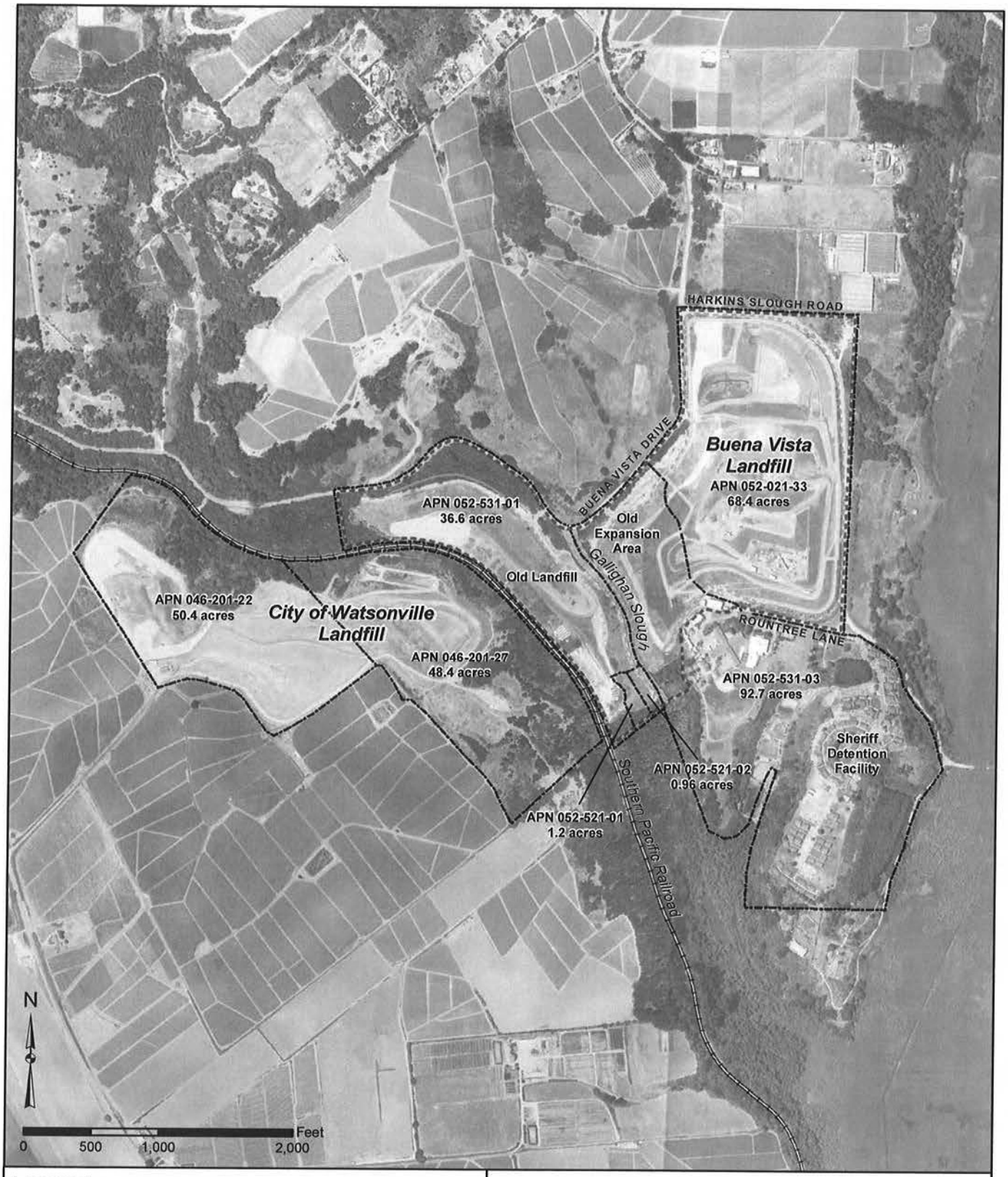
0 1,800 Feet

Figure 1
Site Location Map

Buena Vista Landfill
Santa Cruz County, California

Project: WG1169	Date: October 2009	Geosyntec consultants

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Legend

- Approximate Parcel Boundary
- Landfill Property Boundary
- Active Permitted Disposal Area

Image Source: TerraServer, Saturday, June 12, 1993.

Figure 2
Site Settings & Property Boundary
Buena Vista Landfill
Santa Cruz County, California

Project: WG1169	October 2009	Geosyntec consultants

P:\GIS\santacruz\buenavista\project\2009Oct\SiteSettings.mxd

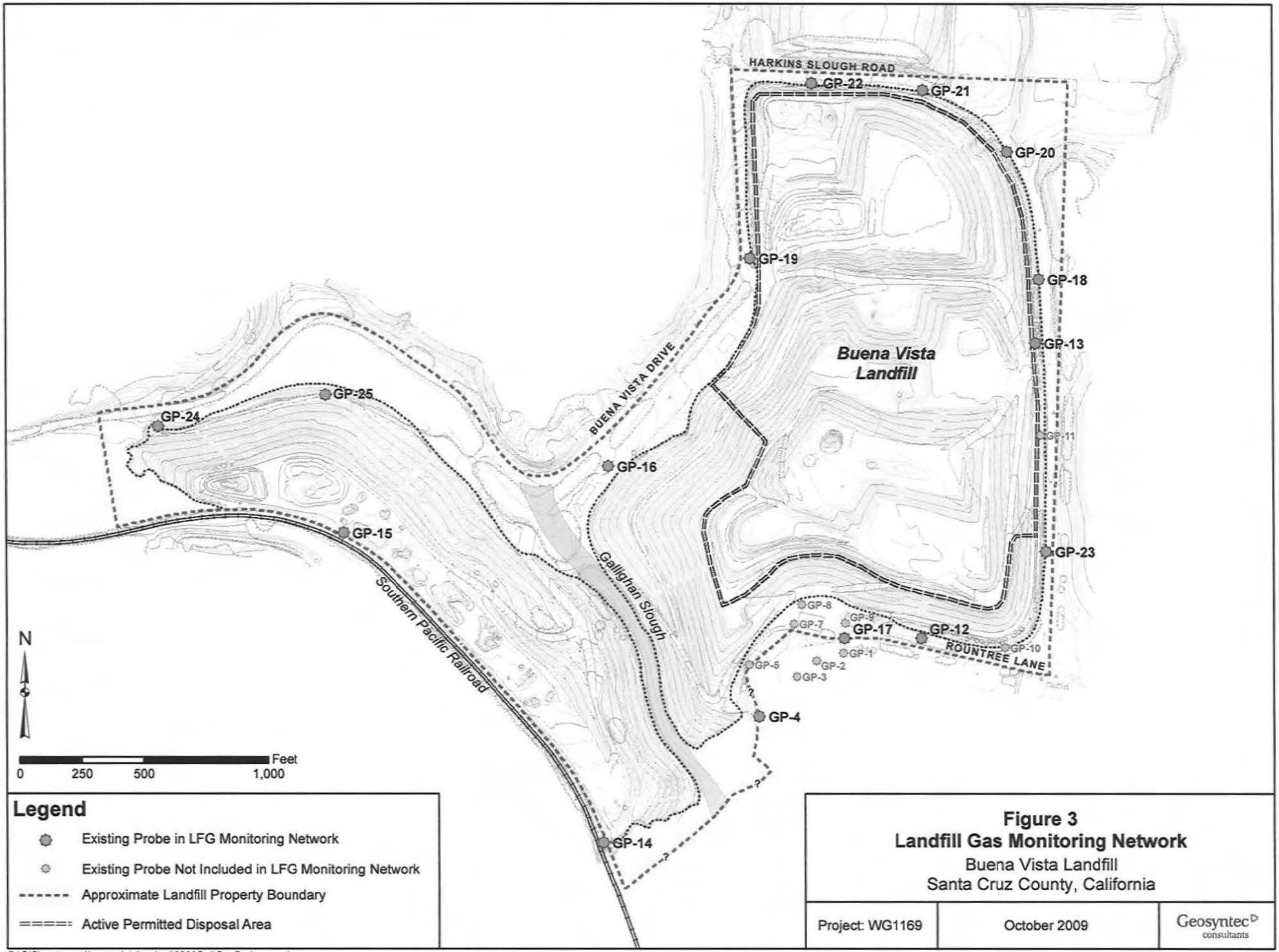


Figure 3
Landfill Gas Monitoring Network
Buena Vista Landfill
Santa Cruz County, California

Project: WG1169	October 2009	Geosyntec consultants

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ATTACHMENT 1

LANDFILL GAS PROBE LITHOLOGIC LOGS AND CONSTRUCTION DIAGRAMS

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LOG OF GP-16

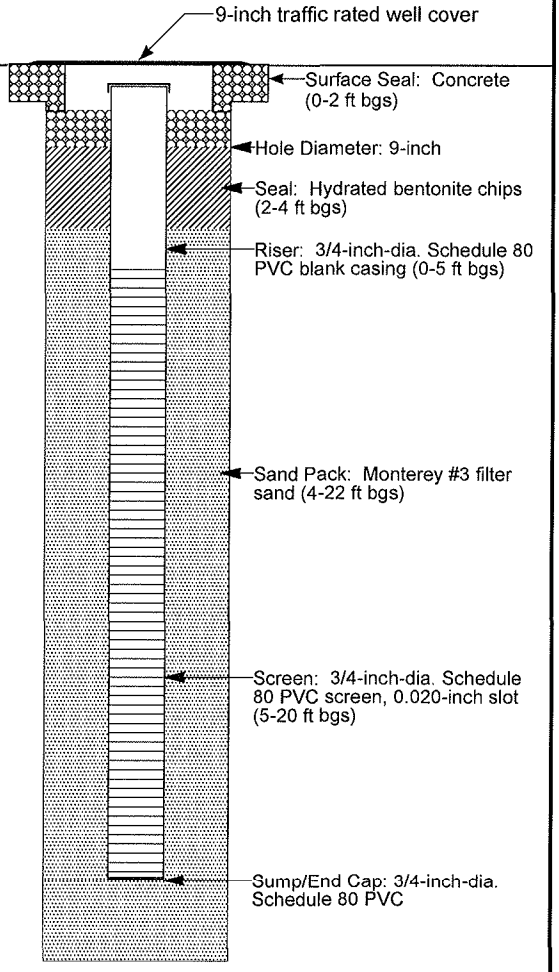
Project: Buena Vista Landfill

Location: Watsonville, CA | **Project Number: WG1169**

Start Date	**9/22/09**	Finish Date	**9/22/09**	Total Depth Drilled (feet bgs)	**22.0**		
Drilling Method	**Air Percussion Hammer**	Drilling Contractor	**Layne Christensen**	Ground Surface Elevation (feet MSL)	**Not available**		
Drill Rig	**AP1000 Percussion Hammer**	Sampling Method	**SPT split spoon**	Top of PVC Casing Elevation (feet MSL)	**Not Available**		
Borehole Diameter	**9-inches**	Hammer Data	**140-lb percussion hammer**	Logger	**N. Gotberg**	Reviewer	**J. Fortuna**
Coordinate Location	**Not surveyed**	Remarks					

Elevation, feet / Depth, feet	Sample Interval	Blows per 6 inches	MATERIAL DESCRIPTION	Graphic Log
0			[Borehole logged from cuttings in upper 8.5 feet.]	
5				
10	12/6/9	5%	WELL-GRADED SAND WITH GRAVEL (SW), dark brown (10YR 3/3), dry, 20% gravel, 15% rounded to subrounded cobbles up to 5 cm diameter, 30% coarse sand, 15% medium sand, 10% fine sand, 10% clay, loose.	
15				
20	3/5/7	100%	LEAN CLAY (CL), Reddish black (10R 2.5/1), moist, 100% clay, medium plasticity, medium stiff.	
			Total Depth = 22 ft	
25				
30				

WELL CONSTRUCTION DIAGRAM



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LOG OF GP-22

Project: Buena Vista Landfill

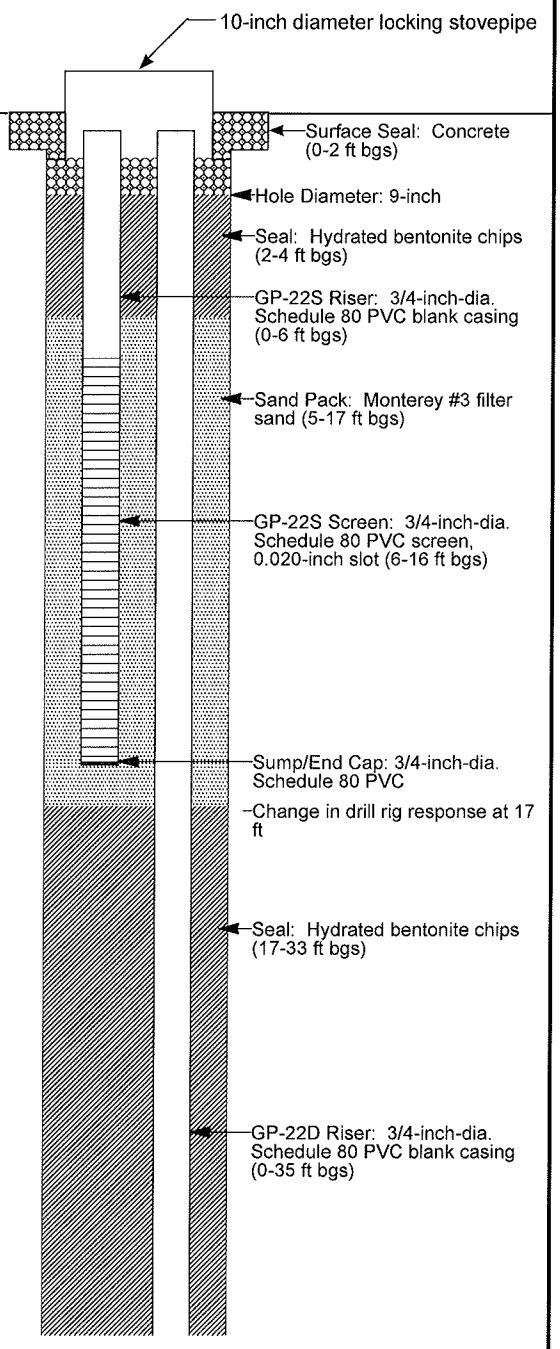
Location: Watsonville, CA **Project Number: WG1169**

Start Date	9/22/09	Finish Date	9/22/09	Total Depth Drilled (feet bgs)	50.0		
Drilling Method	Air Percussion Hammer	Drilling Contractor	Layne Christensen	Ground Surface Elevation (feet MSL)	Not available		
Drill Rig	AP1000 Percussion Hammer	Sampling Method	SPT split spoon	Top of PVC Casing Elevation (feet MSL)	Not Available		
Borehole Diameter	9-inches	Hammer Data	140-lb percussion hammer	Logger	N. Gotberg	Reviewer	J. Fortuna
Coordinate Location	Not surveyed	Remarks					

Elevation, feet	Depth, feet	Sample Interval	Blows per 6 inches	MATERIAL DESCRIPTION
	0			[Borehole logged from cuttings in upper 8.5 feet.]
	10	9/11/16	70%	POORLY GRADED SAND (SP), yellowish brown (10YR 5/6), moist, 85% fine sand, 10% silt, 5% medium sand, medium dense.
	20	9/7/17	100%	LEAN CLAY (CL), dark grey (10YR 4/1), moist, 100% clay, medium plasticity, medium stiff.
	30	13/21/34	90%	CLAYEY SAND (SC), yellowish brown (10YR 5/4), moist, 80% fine grained sand, 20% clay, medium dense.

Graphic Log

WELL CONSTRUCTION DIAGRAM



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LOG OF GP-22

Project: Buena Vista Landfill

Location: Watsonville, CA **Project Number: WG1169**

Elevation, feet / Depth, feet	Sample Interval / Blows per 6 inches	MATERIAL DESCRIPTION	Graphic Log	WELL CONSTRUCTION DIAGRAM
30				
35				
40	20/45/48 70%	WELL GRADED SAND (SW), yellowish brown (10YR 5/6), moist, 5% silt, 20% fine sand, 30% medium sand, 30% course sand, 10% rounded to subangular gravel up to 2 cm in diameter, dense.		Sand Pack: Monterey #3 filter sand (33-50 ft bgs)
45				GP-22D Screen: 3/4-inch-dia. Schedule 80 PVC screen, 0.020-inch slot (35-50 ft bgs)
50	43-50/3" 20%	WELL GRADED SAND (SW), yellowish brown (10YR 5/6), moist, 10% fine sand, 30% medium sand, 30% course sand, 20% gravel, 10% cobbles rounded up to 10 cm in diameter, very dense.		Sump/End Cap: 3/4-inch-dia. Schedule 80 PVC
		Total Depth = 50 ft		
55				
60				
65				

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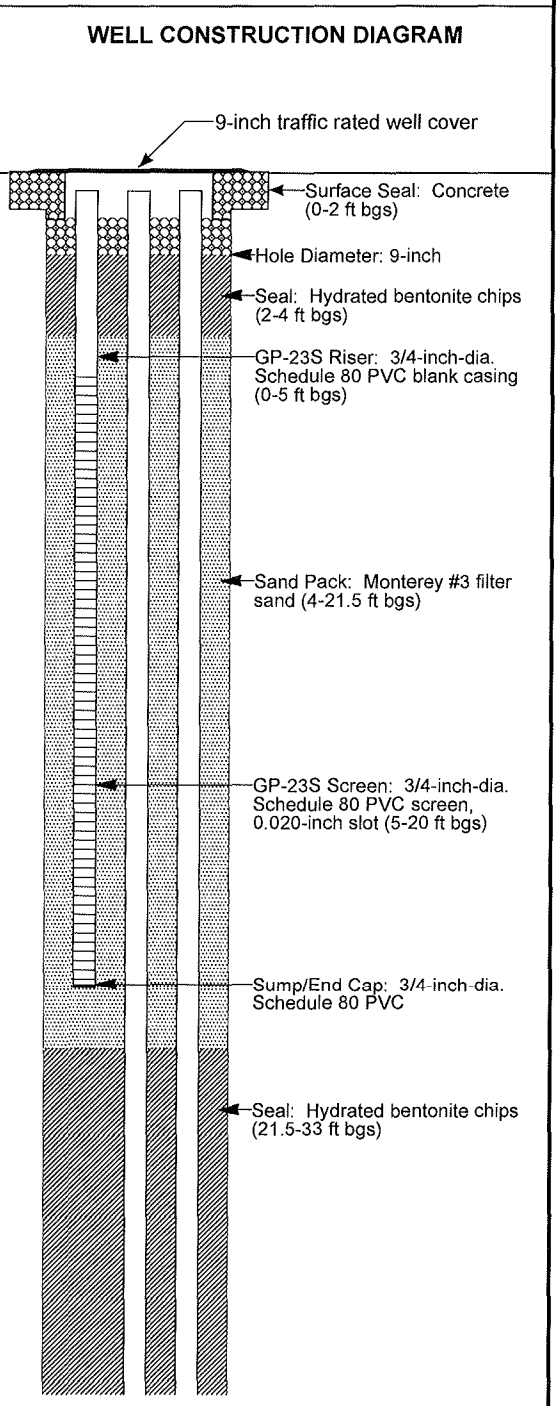
LOG OF GP-23

Project: Buena Vista Landfill

Location: Watsonville, CA | **Project Number: WG1169**

Start Date	9/23/09	Finish Date	9/23/09	Total Depth Drilled (feet bgs)	90.0		
Drilling Method	Air Percussion Hammer	Drilling Contractor	Layne Christensen	Ground Surface Elevation (feet MSL)	Not available		
Drill Rig	AP1000 Percussion Hammer	Sampling Method	SPT split spoon	Top of PVC Casing Elevation (feet MSL)	Not Available		
Borehole Diameter	9-inches	Hammer Data	140-lb percussion hammer	Logger	N. Gotberg	Reviewer	J. Fortuna
Coordinate Location	Not surveyed	Remarks					

Elevation, feet / Depth, feet	Sample Interval / Blows per 6 inches	MATERIAL DESCRIPTION	Graphic Log
0		[Borehole logged from cuttings in upper 8.5 feet.]	
10	8/13/17 90%	WELL GRADED SAND WITH CLAY (SW-SC), dark yellowish brown (10YR 4/4), dry, 30% clay, 20% fine sand, 20% medium sand, 20% coarse sand, 10% gravel up to 1 cm diameter rounded to subangular, low plasticity, medium dense.	
20	4/8/11 80%	POORLY GRADED SAND WITH CLAY (SP-SC), dark yellowish brown (10YR 4/6), dry, 30% clay, 70% fine sand, low plasticity, loose.	
30	11/32/50/4" 80%	POORLY GRADED SAND (SP), dark yellowish brown (10YR 3/4), moist, 70% medium sand, 25% fine sand,	



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LOG OF GP-23

Project: Buena Vista Landfill

Location: Watsonville, CA **Project Number: WG1169**

Elevation, feet / Depth, feet	Sample Interval / Blows per 6 inches	MATERIAL DESCRIPTION	Graphic Log	WELL CONSTRUCTION DIAGRAM
30		5% silt, dense.		GP-23M Riser: 3/4-inch-dia. Schedule 80 PVC blank casing (0-35 ft bgs)
35				
40	12/17/24 70%	POORLY GRADED SAND (SP), dark yellowish brown (10YR 4/4), dry, 90% fine sand, 10% silt, medium dense.		Sand Pack: Monterey #3 filter sand (33-52 ft bgs)
45				GP-23M Screen: 3/4-inch-dia. Schedule 80 PVC screen, 0.020-inch slot (35-50 ft bgs)
50	13/23/30 70%	Same as above.		Sump/End Cap: 3/4-inch-dia. Schedule 80 PVC
55				Seal: Hydrated bentonite chips (52-63 ft bgs)
60	17/25/27 50%	POORLY GRADED SAND (SP), brown (10YR 4/3), dry, 30% medium sand, 65% fine sand, 5% silt, medium dense.		GP-23D Riser: 3/4-inch-dia. Schedule 80 PVC blank casing (0-65 ft bgs)
65				

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LOG OF GP-23

Project: Buena Vista Landfill

Location: Watsonville, CA **Project Number: WG1169**

Elevation, feet / Depth, feet	Sample Interval / Blows per 6 inches	MATERIAL DESCRIPTION	Graphic Log	WELL CONSTRUCTION DIAGRAM
65				
70	13/5/3" 20%	WELL GRADED GRAVEL (GW), dark yellowish brown (10YR 4/4), dry, 5% fine sand, 10% medium sand, 20% coarse sand, 60% gravel, 5% cobbles, rounded to subangular up to 3 cm in diameter, very dense.		Sand Pack: Monterey #3 filter sand (63-90 ft bgs)
		Change in cuttings to sand observed at 73 ft.		
75				GP-23D Screen: 3/4-inch-dia. Schedule 80 PVC screen, 0.020-inch slot (65-90 ft bgs)
80	14/26/31 70%	POORLY GRADED SAND (SP), dark yellowish brown (10YR 4/6), dry, 70% fine sand, 20% medium sand, 10% clay, medium dense.		
85				
90		POORLY GRADED SAND (SP), brown (10YR 5/3), moist, 40% fine sand, 55% medium sand, 5% cobbles, rounded up to 3 cm in diameter, medium dense.		Sump/End Cap: 3/4-inch-dia. Schedule 80 PVC
		Total Depth = 90 ft		
95				
100				

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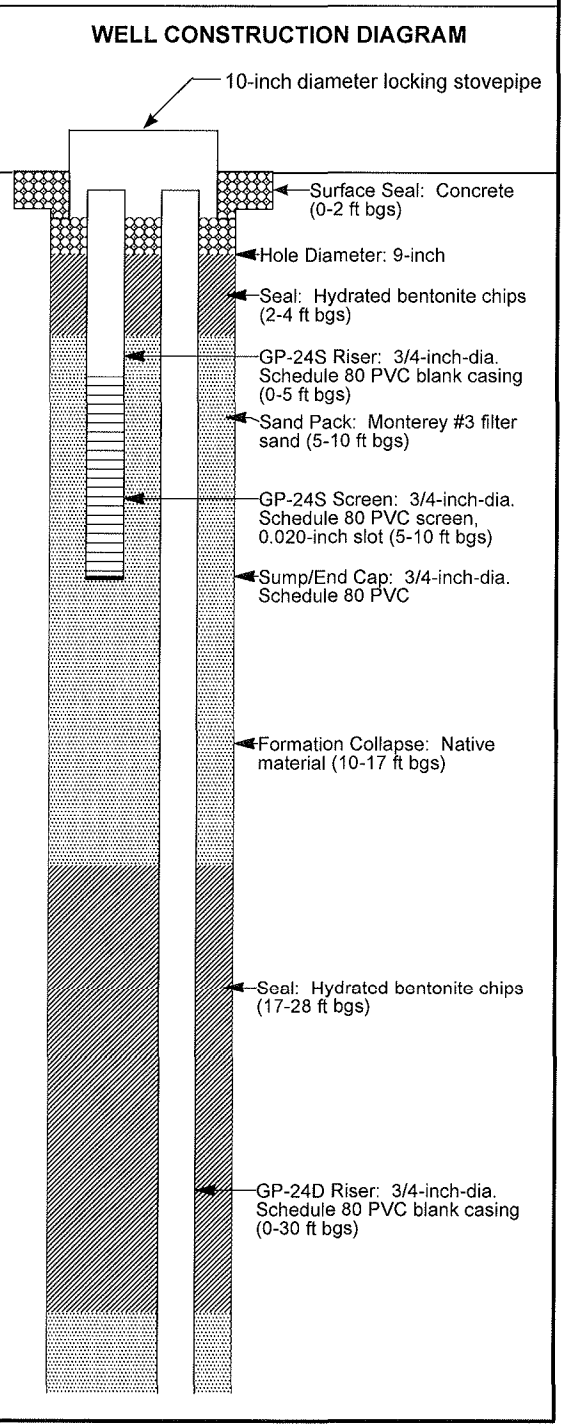
LOG OF GP-24

Project: Buena Vista Landfill

Location: Watsonville, CA | **Project Number: WG1169**

Start Date	9/21/09	Finish Date	9/21/09	Total Depth Drilled (feet bgs)	40.0		
Drilling Method	Air Percussion Hammer	Drilling Contractor	Layne Christensen	Ground Surface Elevation (feet MSL)	Not available		
Drill Rig	AP1000 Percussion Hammer	Sampling Method	SPT split spoon	Top of PVC Casing Elevation (feet MSL)	Not Available		
Borehole Diameter	9-inches	Hammer Data	140-lb percussion hammer	Logger	N. Gotberg	Reviewer	J. Fortuna
Coordinate Location	Not surveyed	Remarks					

Elevation, feet / Depth, feet	Sample Interval / Blows per 6 inches	MATERIAL DESCRIPTION	Graphic Log
0		[Borehole logged from cuttings in upper 8.5 feet.]	
10	9/10/8 100%	POORLY GRADED SAND (SP), very dark grey (7.5YR 2/1), wet, 90% fine grained sand, 5% silt, 5% medium sand, loose.	
15		Change in cuttings to clay observed at 15 ft.	
20	8/10/13 100%	LEAN CLAY WITH SAND (CL), very dark brown (7.5 YR 2/2), moist, 85% clay, 15% fine sand, stiff, medium plasticity.	
25		Change in drill rig response at 27 ft.	
30	8/11/13 100%	CLAYEY SAND (SC), very dark grayish brown (10YR 3/2), moist, 40% lean clay, 60% fine grained sand,	



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LOG OF GP-24

Sheet 2 of 2

Project: Buena Vista Landfill

Location: Watsonville, CA **Project Number: WG1169**

Elevation, feet / Depth, feet	Sample Interval / Blows per 6 inches	MATERIAL DESCRIPTION	Graphic Log	WELL CONSTRUCTION DIAGRAM
30		medium dense.		Sand Pack: Monterey #3 filter sand (28-40 ft bgs)
35				GP-24D Screen: 3/4-inch-dia. Schedule 80 PVC screen, 0.020-inch slot (30-40 ft bgs)
40	9/11/18 100%	POORLY GRADED SAND (SP), dark yellowish brown (10YR 4/4), moist, 85% fine grained sand, 15% clay, medium dense.		Sump/End Cap: 3/4-inch-dia. Schedule 80 PVC
		Total Depth = 40 ft		
45				
50				
55				
60				
65				

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LOG OF GP-25

Sheet 1 of 1

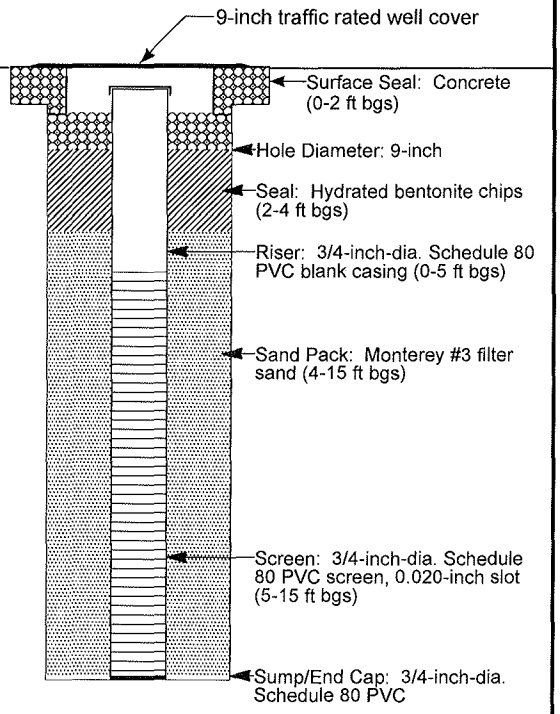
Project: Buena Vista Landfill

Location: Watsonville, CA | **Project Number: WG1169**

Start Date	9/21/09	Finish Date	9/21/09	Total Depth Drilled (feet bgs)	16.0		
Drilling Method	Air Percussion Hammer	Drilling Contractor	Layne Christensen	Ground Surface Elevation (feet MSL)	Not available		
Drill Rig	AP1000 Percussion Hammer	Sampling Method	SPT split spoon	Top of PVC Casing Elevation (feet MSL)	Not Available		
Borehole Diameter	9-inches	Hammer Data	140-lb percussion hammer	Logger	N. Gotberg	Reviewer	J. Fortuna
Coordinate Location	Not surveyed	Remarks					

Elevation, feet	Depth, feet	Sample Interval	Blows per 6 inches	MATERIAL DESCRIPTION	Graphic Log
	0			[Borehole logged from cuttings in upper 8.5 feet.]	
	5				
	10		41/29/31 30%	WELL GRADED SAND (SW), light grey (5YR 7/2), dry, 15% silt, 30% fine sand, 20% medium sand, 20% course sand, 15% gravel, rounded to subangular, dense.	
	15			Becomes wet at 15.5 ft.	
				Total Depth = 16 ft	
	20				
	25				
	30				

WELL CONSTRUCTION DIAGRAM



Template: OAKLAND_WELL; Proj ID: WG1169.REVISED.GPJ; Printed: 10/1/2009

Buena Vista Landfill - Gas Probe Installation

PREPARED FOR: Patrick Mathews/County of Santa Cruz
Brian Kennedy/ County of Santa Cruz

PREPARED BY: Mike Baillie/SFO

COPIES: Ana Demorest/SFO

DATE: July 30, 1999

Note
-GP-18 referred to in this report got buried and does not exist.
-GP-9A is existing GP-17.

Introduction

On July 27 and 28, 1999 CH2M HILL installed nested gas probes in two locations in Buena Vista Landfill in Santa Cruz County. The first probe location denoted GP-9A, is located along the west end of the landfill, adjacent to Rountree Lane near the jail facilities. The second probe location denoted GP-18 was located approximately 100 feet west of future Module 6, east of the Household Hazardous Waste facility.

Geotechnical Investigation

CH2M HILL performed a geotechnical investigation prior to installing the gas probes to evaluate the soil and groundwater conditions. Kvilhaug Well Drilling of Concord, California performed the drilling using an 8-inch outside diameter hollow stem auger. Disturbed soil samples were collected every 5 feet using the Standard Penetration Test (ASTM D1586) and were visually classified in general accordance with ASTM D2487. Gas probes were installed upon completion of the boreholes. Boring Logs are included in Appendix A.

Borehole GP-9A was drilled to a depth of 80 feet. The soil profile consists of sandy lean clay and clayey sand to a depth of approximately 15 feet underlain by dense to very dense, poorly graded sand with occasional interbedded silt to approximately 60 feet. Below 60 feet the sand grades into very dense, poorly graded gravel. No groundwater was encountered in GP-9A.

Borehole GP-18 was drilled to a depth of 35 feet. The soil profile consisted of approximately 25 feet of medium stiff to stiff, sandy lean clay and silt underlain by very dense, poorly graded sand. Groundwater was encountered approximately 33 feet below ground surface and the borehole was terminated at 35 feet.

Gas Probe Installation

Three gas probes were installed in borehole GP-9A and two were installed in GP-18. Each probe consists of 0.5-inch schedule 40 PVC, with 10 feet of 0.020-inch slotted well screen. Construction of the nested probes in GP-9A included placing the screens from 70 to 80 feet, 40 to 50 feet and 4 to 14 feet bgs. The nested probes in GP-18 had screen intervals from 20 to 30 feet and 5 to 15 feet bgs. Backfilling included #2/12 graded sand from the bottom of the

boring to 2 feet above the top of the lowest screened section. A 2 to 6-foot bentonite plug was placed above the sand layer. Sand was then placed from the top of the bentonite plug to 2 feet above the next screened section. Subsequent screened intervals were constructed similarly. The top of the boring was sealed with a 2-foot bentonite plug followed by Portland cement to finish grade for GP-9A and Portland cement only for GP-18. Well protection is provided by an at-grade traffic box for GP-9A and an above grade stovepipe for GP-18. Gas Probe completion diagrams are included in Appendix B.

Appendix A

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
151768.GW.ZZ	GP - 9A	SHEET 1 OF 3

SOIL BORING LOG

7/27/99

PROJECT : Buena Vista Landfill - Gass Probes — LOCATION : West end of Rountree Lane

ELEVATION : 108 ft. — DRILLING CONTRACTOR : Kvilhaug Well Drilling, Concord

DRILLING METHOD AND EQUIPMENT USED : 8" Hollow Stem Auger, Mobile B-61

WATER LEVELS : No Water Encountered — START : 08:00 — END : 17:00 — LOGGER : M. Baillie

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
	3.5				Approx. 4 inches Asphalt Road Base	
5	5.0	1.5	S-1	4 - 9 - 14 (23)*	SANDY LEAN CLAY (CL), brown, moist, medium stiff	*2-inch Sampler PP = 2.75 TSF
	8.5					
10	10.0	1.5	S-2	8 - 15 - 16 (31)	CLAYEY SAND (SC), yellowish-red, moist, medium dense to dense, medium grained sand	PP spilts sample
	13.5					
15	15.0	1.5	S-3	15 - 17 - 25 (42)	CLAYEY SAND (SC) as above grading to POORLY GRADED SAND (SP), brown to brownish yellow, moist, dense	
	18.5					
20	20.0	1.5	S-4	6 - 5 - 5 (10)	SILT (ML), brown, moist, soft	PP = 0.75 TSF
	23.5					
25	25.0	1.5	S-5	14 - 24 - 34 (58)	POORLY GRADED SAND (SP), brown, moist, very dense, coarse grained	
	28.5					
30	30.0	1.5	S-6	20 - 22 - 38 (60)	POORLY GRADED SAND (SP), dark brown, moist, very dense, finer grained sand	

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
151768.GW.ZZ	GP - 9A	SHEET 2 OF 3

SOIL BORING LOG

7/27/99

PROJECT : Buena Vista Landfill - Gass Probes — LOCATION : West end of Rountree Lane

ELEVATION : 108 ft. — DRILLING CONTRACTOR : Kvilhaug Well Drilling, Concord

DRILLING METHOD AND EQUIPMENT USED : 8" Hollow Stem Auger, Mobile B-61

WATER LEVELS : No Water Encountered — START : 08:00 — END : 17:00 — LOGGER : M. Baillie

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
	33.5					
35	35.0	1.5	S-7	20 - 30 - 47 (77)	POORLY GRADED SAND (SP), brown, moist, very dense, coarse grained	
	38.5					
40	40.0	1.5	S-8	18 - 25 - 32 (57)	POORLY GRADED SAND (SP) with interbedded silt, brown, moist, very dense	
	43.5					
45	45.0	1.4	S-9	24 - 30 - 50/5"	POORLY GRADED SAND (SP), brown, moist, very dense	
	48.5					
50	50.0	1.3	S-10	22 - 40 - 50/3"	POORLY GRADED SAND (SP), brown, moist, very dense, interspersed gravel	
	53.5					
55	55.0	1.4	S-11	28 - 30 - 50/5"	POORLY GRADED SAND (SP), brown, moist, very dense, coarse grained, interspersed gravel	
	58.5					
60	60.0	0.4	S-12	50/5"	POORLY GRADED SAND (SP), similar to S-11, interspersed gravel	

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
151768.GW.ZZ	GP - 9A	SHEET 3 OF 3

SOIL BORING LOG

7/27/99

PROJECT : Buena Vista Landfill - Gass Probes — LOCATION : West end of Rountree Lane

ELEVATION : 108 ft. — DRILLING CONTRACTOR : Kvilhaug Well Drilling, Concord

DRILLING METHOD AND EQUIPMENT USED : 8" Hollow Stem Auger, Mobile B-61

WATER LEVELS : No Water Encountered — START : 08:00 — END : 17:00 — LOGGER : M. Baillie

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
	63.5					
65	65.0	0.4	S-13	30 - 50/3"	POORLY GRADED GRAVEL (GP), brown, moist, very dense	
	68.5					
70	70.0	0.4	S-14	50/5"	POORLY GRADED GRAVEL (GP), brown, moist, very dense	
	73.5					
75	75.0	1.4	S-15	30 - 40 - 50/5"	POORLY GRADED GRAVEL (GP), brown, moist, very dense, increasing gravel size	
	78.5					
80	80.0	0.4	S-16	50/5"	POORLY GRADED GRAVEL (GP), brown, moist, very dense	
					End Borehole GP - 9A Install Gas Probes	
85						

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475 14th Street, Suite 450
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LOG OF BORING / WELL GP-18

Project: Buena Vista Landfill

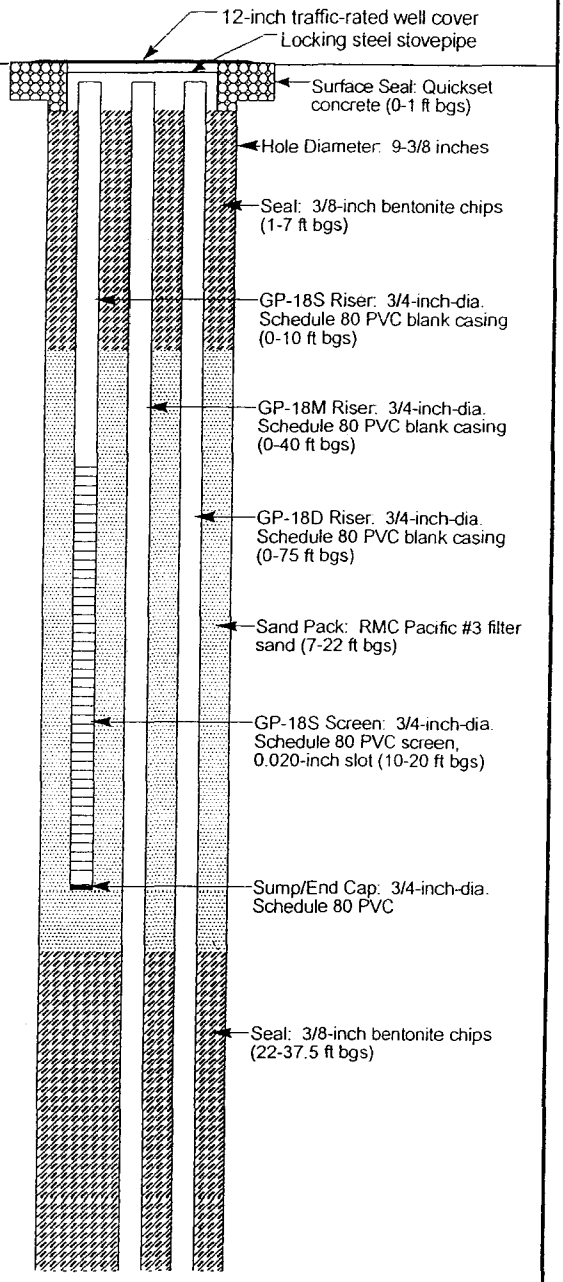
Location: Watsonville, California **Project Number: WL0658/04**

Start Date	2/11/04 at 09:00	Finish Date	2/11/04 at 16:00	Total Depth Drilled (feet bgs)	87.6
Drilling Method	Air Rotary with Dual-Walled Percussion Hammer	Drilling Contractor	Layne Christensen (Fontana)	Ground Surface Elevation (feet MSL)	N/A
Drill Rig	Foremost AP-1000	Sampling Method	SPT split spoon	Top of PVC Casing Elevation (feet MSL)	112.70
Borehole Diameter	9-3/8 inches	Hammer Data	Downhole hammer; 140 lbs, 30-inch drop	Logger G. Bradner	Reviewer S. Skoc
Coordinate Location	N 11383.700, E 10935.324	Remarks	Sampled with 24-inch-long SPT; blow counts recorded for first 18 inches of drive only.		

Elevation, feet / Depth, feet	Sample Interval	Recovery, %	Blows per 6 inches	MATERIAL DESCRIPTION
0		60	5-7-10	SANDY SILT (ML), dark yellowish brown (10YR 4/6), moist, 55% low to medium plasticity fines, 45% fine sand, trace fine subrounded gravel to 1/4 inch, very stiff
5		80	11-14-15	
10		100	4-8-17	SILTY SAND (SM), dark yellowish brown (10YR 4/6) with weak red (10R 4/4) and black (10YR 2/1) mottling, moist, 40% low to medium plasticity fines, 60% fine sand, trace fine subrounded gravel to 1/4 inch, medium dense
15		90	8-16-18	Becomes dense; increasing sand content, 25% low to medium plasticity fines, 75% fine sand
20		100	19-38-33	WELL-GRADED SAND WITH SILT (SW-SM), dark yellowish brown (10YR 4/6), moist, 10% low to medium plasticity fines, 90% fine to coarse sand, trace fine subrounded gravel to 3/4 inch, very dense
25		100	16-21-20	POORLY GRADED SAND (SP), yellowish brown (10YR 5/6), moist, 5% low to medium plasticity fines, 95% fine sand, dense
30				WELL-GRADED SAND WITH GRAVEL (SW), dark yellowish brown (10YR 4/6) with red (2.5YR 4/6) staining, moist, 5% low to medium plasticity fines, 65% fine to coarse sand, 30% fine to coarse gravel to 1-1/2 inches, subangular to subrounded, dense
				Decreasing gravel content, 80% fine to coarse sand, 15% fine subrounded gravel to 3/4 inch

Graphic Log

WELL CONSTRUCTION DIAGRAM



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LOG OF BORING / WELL GP-18

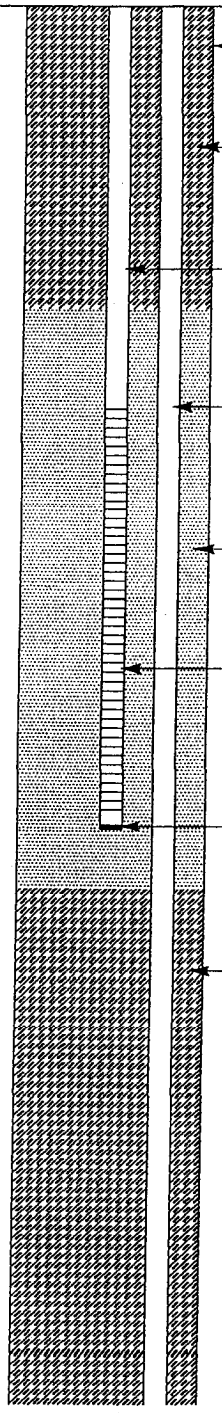
Project: Buena Vista Landfill

Location: Watsonville, California **Project Number: WL0658/04**

Elevation, feet / Depth, feet	Sample Interval / Recovery, %	Blows per 6 inches	MATERIAL DESCRIPTION
30	100	10-15-15	WELL-GRADED SAND WITH GRAVEL (SW), dark yellowish brown (10YR 4/6) with red (2.5YR 4/6) staining, moist, 5% low to medium plasticity fines, 80% fine to coarse sand, 15% fine subrounded gravel to 3/4 inch, dense (continued)
35	100	20-46-26	Increasing gravel content, 5% low to medium plasticity fines, 55% fine to coarse sand, 40% fine to coarse gravel to 1-1/2 inches, angular to subrounded limestone, shale, and sandstone clasts, very dense
40	90	22-16-21	POORLY GRADED SAND (SP), yellowish brown (10YR 5/6), moist, 5% low to medium plasticity fines, 95% fine sand, dense
45	100	13-18-23	Becomes slightly coarser
50	10	20-11-17	Becomes medium dense
55	50	—	Becomes slightly finer
60	40	9-50	WELL-GRADED SAND WITH GRAVEL (SW), yellowish brown (10YR 5/4), moist, 5% low to medium plasticity fines, 55% fine to coarse sand, 40% fine to coarse gravel to 1-1/2 inches, angular to subrounded shale and limestone clasts, very dense
65			

Graphic Log

WELL CONSTRUCTION DIAGRAM



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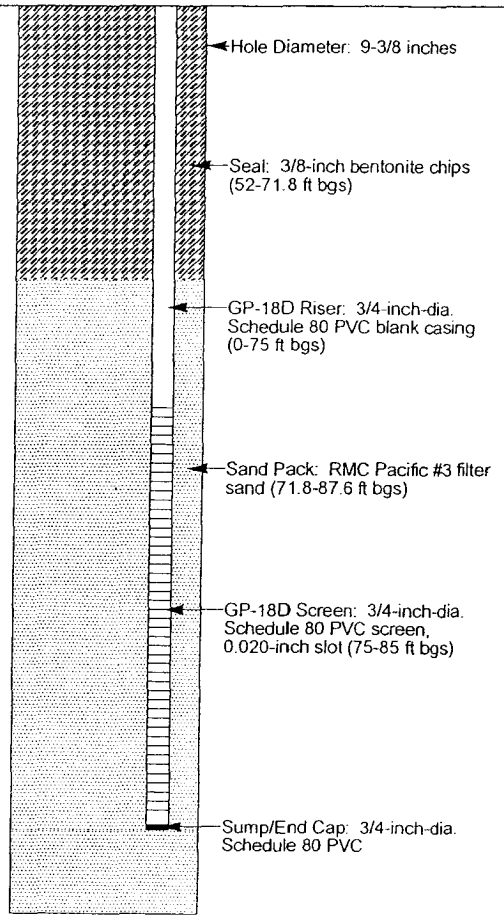
LOG OF BORING / WELL GP-18

Project: Buena Vista Landfill

Location: Watsonville, California **Project Number: WL0658/04**

Elevation, feet / Depth, feet	Sample Interval / Recovery, %	Blows per 6 inches	MATERIAL DESCRIPTION
65	90	20-32-31	POORLY GRADED SAND WITH SILT (SP-SM), dark yellowish brown (10YR 4/6), moist to wet, 10% low to medium plasticity fines, 90% fine sand, very dense
70	80	30-50	SANDY LEAN CLAY (CL), yellowish brown (10YR 5/6), dry to moist, 85% medium plasticity fines, 15% fine sand, trace fine subrounded gravel to 1/2 inch, hard, low to no dilatancy POORLY GRADED SAND WITH GRAVEL (SP), yellowish brown (10YR 5/6), dry to moist, 5% low to medium plasticity fines, 80% fine sand, 15% fine to coarse subangular to subrounded gravel to 1 inch, very dense
75	50	38-50	WELL-GRADED SAND WITH GRAVEL (SW), dark yellowish brown (10YR 4/6), dry to moist, 5% low to medium plasticity fines, 60% fine to coarse sand, 35% fine to coarse gravel to 1-1/2 inches, angular to subrounded shale and limestone clasts, very dense
80	60	15-50	
85	80	35-50	
			Bottom of boring at 87.6 feet bgs
90			
95			
100			

Graphic Log



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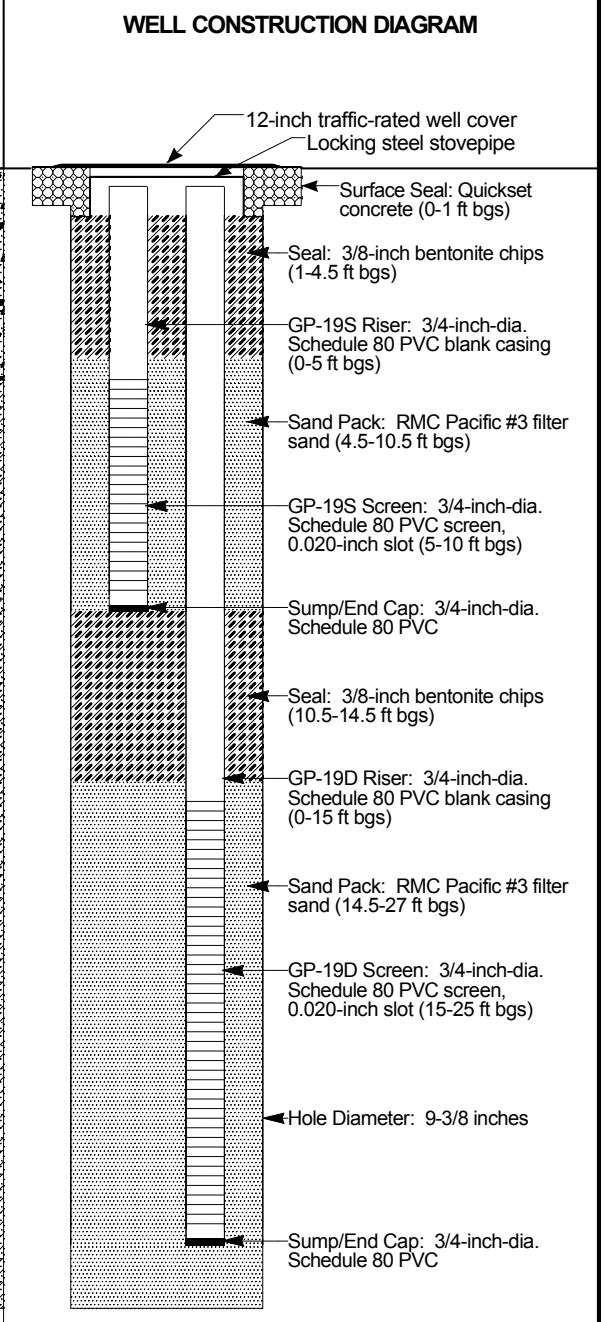
LOG OF BORING / WELL GP-19

Project: Buena Vista Landfill

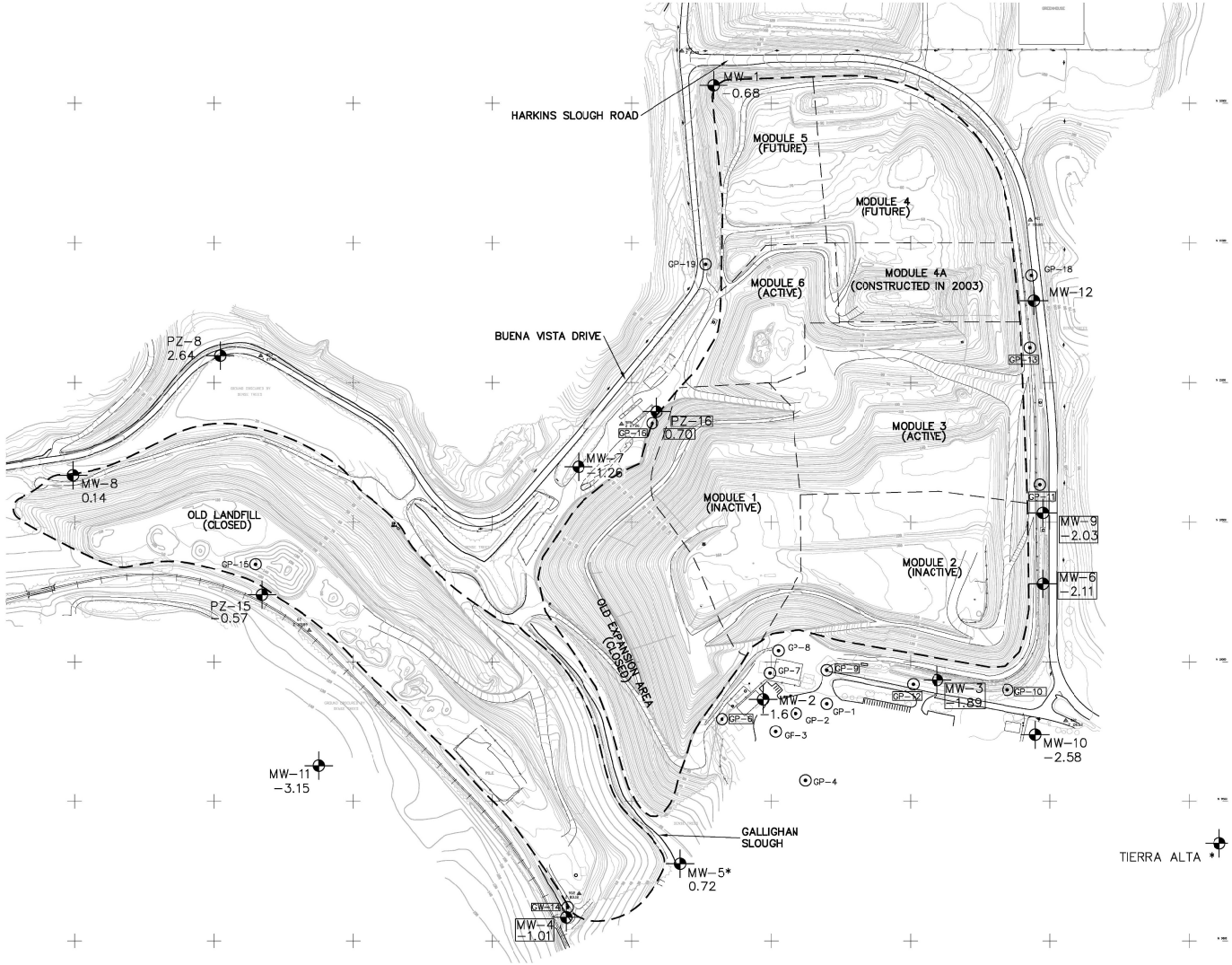
Location: Watsonville, California **Project Number: WL0658/04**

Start Date	**2/12/04 at 08:25**	Finish Date	**2/12/04 at 12:20**	Total Depth Drilled (feet bgs)	**27.0**		
Drilling Method	**Air Rotary with Dual-Walled Percussion Hammer**	Drilling Contractor	**Layne Christensen (Fontana)**	Ground Surface Elevation (feet MSL)	**N/A**		
Drill Rig	**Foremost AP-1000**	Sampling Method	**SPT split spoon**	Top of PVC Casing Elevation (feet MSL)	**32.04**		
Borehole Diameter	**9-3/8 inches**	Hammer Data	**Downhole hammer; 140 lbs, 30-inch drop**	Logger	**G. Bradner**	Reviewer	**S. Skoe**
Coordinate Location	N 11423.359, E 9765.413	Remarks	**Sampled with 24-inch-long SPT; blow counts recorded for first 18 inches of drive only.**				

Elevation, feet / Depth, feet	Sample Interval / Recovery, %	Blows per 6 inches	MATERIAL DESCRIPTION
0	60	---	SILTY SAND WITH GRAVEL (SM), dark brown (10YR 3/3), moist, 15% low plasticity fines, 55% fine to medium sand, 30% fine to coarse gravel and asphalt fragments to to 1-1/4 inches
5	70	12-10-15	CLAYEY SAND (SC), brown (10YR 4/3), moist, 30% medium plasticity fines, 65% fine sand, 5% fine angular gravel to 1/2 inch, medium dense
10	100	17-12-12	With red (2.5YR 4/6) and gray (10YR 5/1) mottling
15	100	5-7-10	Decreasing fines and gravel content, 25% medium plasticity fines, 75% fine sand
20	100	3-3-7	Becomes wet
25	90	9-14-9	
30			**Bottom of boring at 27.0 feet bgs**



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LEGEND

MW-5 0.72 — GROUNDWATER MONITORING WELL/ PIEZOMETER LOCATION WITH WATER LEVEL (FEET, MSL).

GP-11 — LANDFILL GAS MOINTORING PROBE LOCATION.

NOTES:

1. EXISTING TOPOGRAPHY BY AERO-GEODETIC CORPORATION.
DATE OF AERIAL PHOTOGRAPHY: 24 OCTOBER 2001.
COORDINATE GRID AND ELEVATIONS BASED ON ASSUMED LOCAL SYSTEM PROVIDED BY COUNTY OF SANTA CRUZ.

GeoSyntec Consultants

SITE MAP

BUENA VISTA LANDFILL
COUNTY OF SANTA CRUZ

FIGURE NO.	2
PROJECT NO.	WL0658
DATE:	1 JUNE 2004

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LOG OF BORING / WELL GP-20

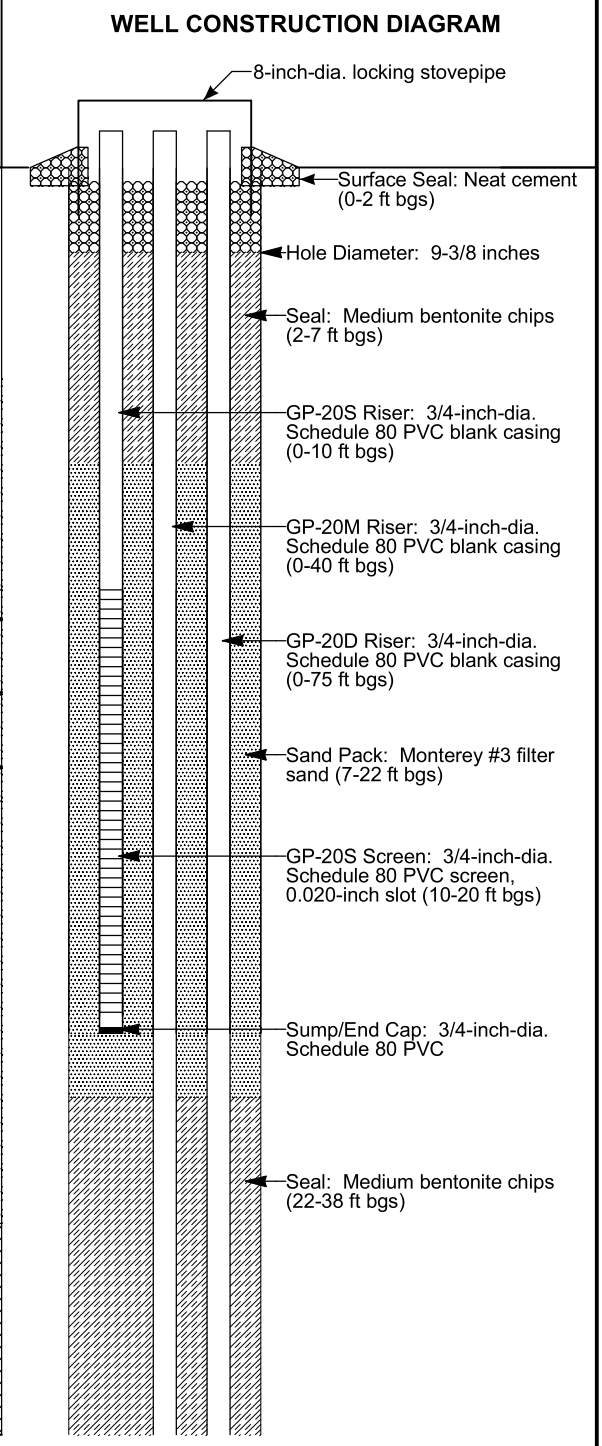
Project: Buena Vista Landfill

Location: Watsonville, California **Project Number: WG1019 / 02**

Start Date	**7/17/07**	Finish Date	**7/18/07**	Total Depth Drilled (feet bgs)	**86.0**
Drilling Method	**ARCH**	Drilling Contractor	**Layne Christensen (Fontana)**	Ground Surface Elevation (feet MSL)	**Not available**
Drill Rig	**AP1000 Percussion Hammer**	Sampling Method	**SPT split spoon**	Top of PVC Casing Elevation (feet MSL)	**Not available**
Borehole Diameter	**9-3/8 inches**	Hammer Data	**140-lb percussion hammer**	Logger **N. Mullaugh**	Reviewer **E. Benede**
Coordinate Location	**Not surveyed**	Remarks			

Elevation, feet	Depth, feet	Sample Interval	Blows per 6 inches	MATERIAL DESCRIPTION
	0			[Borehole not logged in upper 5 feet.]
	5		---	SILTY SAND (SM), dark yellowish brown (10YR 3/6), moist, 70% fine sand, 25% low plasticity fines, 5% fine subangular quartzite gravel
	10		50/5"	SILTY SAND WITH GRAVEL (SM), dark yellowish brown (10YR 3/6), moist, 60% fine sand, 20% low plasticity fines, 20% fine subangular to subrounded granitic and quartzite gravel to 1/4 inch, very dense
	15		20-25-35	POORLY GRADED SAND WITH SILT (SP-SM), yellowish brown (10YR 5/4), moist, 90% fine sand, 10% low plasticity fines, very dense
	20			
	25		10-20-27	LEAN CLAY (CL), very pale brown (10YR 7/3), moist, 100% low plasticity fines, stiff [Sand coming out of cyclone at 26 feet.]
	30			

Graphic Log



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LOG OF BORING / WELL GP-20

Project: Buena Vista Landfill

Location: Watsonville, California **Project Number: WG1019 / 02**

Elevation, feet	Depth, feet	Sample Interval	Blows per 6 inches	MATERIAL DESCRIPTION	Graphic Log	WELL CONSTRUCTION DIAGRAM
	30			WELL-GRADED SAND (SW), dark yellowish brown (10YR 3/6), moist, 100% fine to coarse sand, subangular to subrounded coarse-sand-size granitic fragments, very dense		Hole Diameter: 9-3/8 inches
						Seal: Medium bentonite chips (22-38 ft bgs)
	35		40-50/4"			GP-20M Riser: 3/4-inch-dia. Schedule 80 PVC blank casing (0-40 ft bgs)
	40					GP-20D Riser: 3/4-inch-dia. Schedule 80 PVC blank casing (0-75 ft bgs)
						Sand Pack: Monterey #3 filter sand (38-52 ft bgs)
	45		50/5"	[Coarse gravel to cobbles coming out of cyclone.]		GP-20M Screen: 3/4-inch-dia. Schedule 80 PVC screen, 0.020-inch slot (40-50 ft bgs)
	50					Sump/End Cap: 3/4-inch-dia. Schedule 80 PVC
						Seal: Medium bentonite chips (52-73 ft bgs)
	55		50/5"	Sand grades finer; 95% fine to medium sand, 5% coarse sand-size subangular to subrounded granitic fragments		
	60					
	65					

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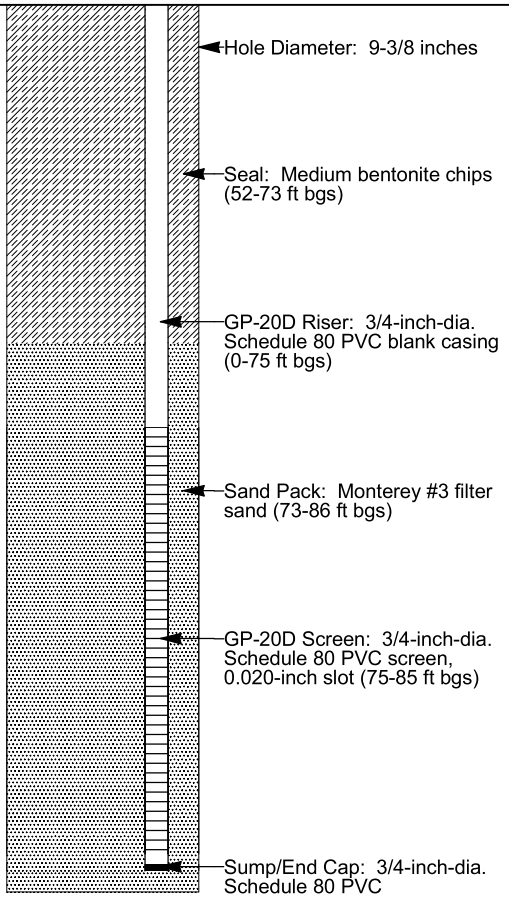
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Fax: 510.836.3036

LOG OF BORING / WELL GP-20

Project: Buena Vista Landfill

Location: Watsonville, California **Project Number: WG1019 / 02**

Elevation, feet	Depth, feet	Sample Interval	Blows per 6 inches	MATERIAL DESCRIPTION	Graphic Log
	65			WELL-GRADED SAND (SW) (continued)	
			27-50/3"	LEAN CLAY (CL), dark yellowish brown (10YR 4/6), moist, 95% low plasticity fines, 5% fine subrounded gravel to 1/4 inch	
				WELL-GRADED SAND (SW), dark yellowish brown (10YR 3/6), moist, 95% fine to medium sand, 5% coarse subrounded sand	
	70				
	75		28-50/3"		
	80				
	85		30-50/2"	WELL-GRADED SAND WITH GRAVEL (SW), very dark grayish brown (10YR 3/2), moist, 75% medium to coarse sand, 25% fine subangular to subrounded gravel to 1/4 inch	
				Bottom of boring at 86.0 feet bgs	
	90				
	95				
	100				



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LOG OF BORING / WELL GP-21

Project: Buena Vista Landfill

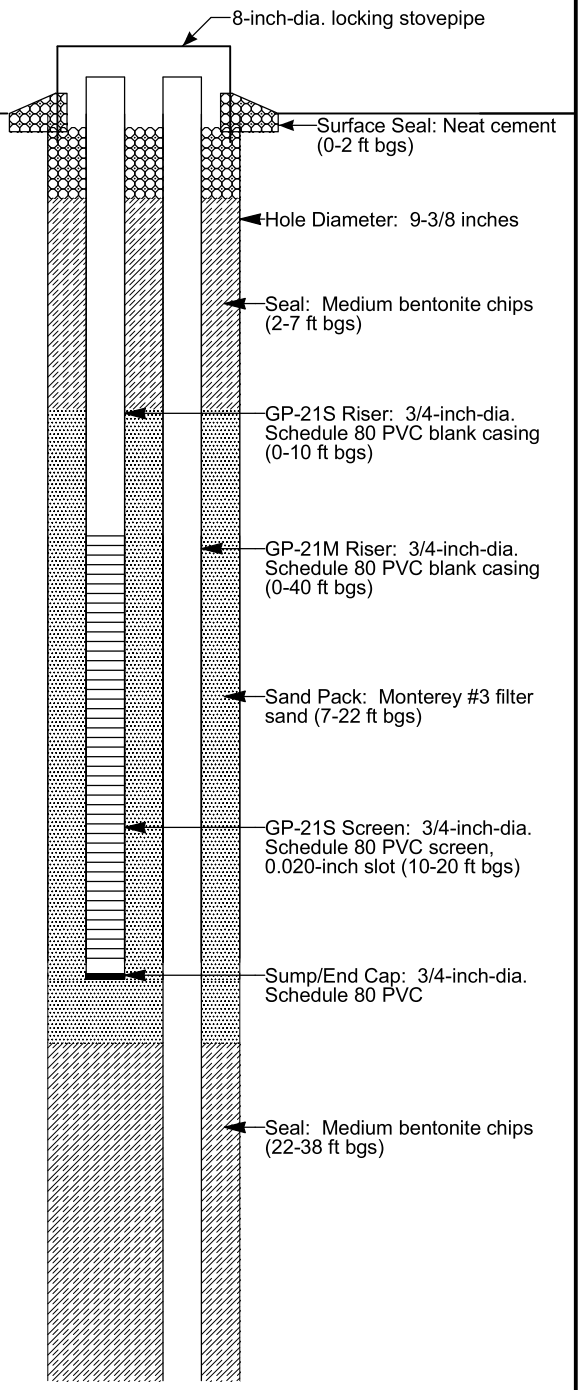
Location: Watsonville, California **Project Number: WG1019 / 02**

Start Date	**7/19/07**	Finish Date	**7/20/07**	Total Depth Drilled (feet bgs)	**51.5**		
Drilling Method	**ARCH**	Drilling Contractor	**Layne Christensen (Fontana)**	Ground Surface Elevation (feet MSL)	**Not available**		
Drill Rig	**AP1000 Percussion Hammer**	Sampling Method	**SPT split spoon**	Top of PVC Casing Elevation (feet MSL)	**Not available**		
Borehole Diameter	**9-3/8 inches**	Hammer Data	**140-lb percussion hammer**	Logger	**N. Mullaugh**	Reviewer	**E. Benede**
Coordinate Location	**Not surveyed**	Remarks	**Used sand catcher in SPT sampler.**				

Elevation, feet	Depth, feet	Sample Interval	Blows per 6 inches	MATERIAL DESCRIPTION
	0			[Borehole not logged in upper 5 feet.]
	5		22-30-42	LEAN CLAY (CL), yellowish brown (10YR 5/4), moist, 95% low plasticity fines, 5% fine sand, firm
	10		13-26-30	SILT (ML), dark yellowish brown (10YR 5/4) with trace orange mottling, moist, 100% nonplastic fines, stiff
	15		40-50/4"	
	20		25-50/3"	POORLY GRADED SAND (SP), light yellowish brown (10YR 6/4), moist, 95% fine sand, 5% nonplastic fines, dense to very dense
	25		27-50/4"	WELL-GRADED SAND (SW), yellowish brown (10YR 5/6), moist, 95% fine to medium sand, 5% fine subrounded gravel to 1/4 inch, dense to very dense
	30			

Graphic Log

WELL CONSTRUCTION DIAGRAM



Template: GEOSYNTEC_WELL; Proj ID: BUENVIST.GPJ; Printed: 6/16/2008

Geosyntec consultants
475 14th Street, Suite 400
Oakland, California 94612
Telephone: 510.836.3034
Fax: 510.836.3036

LOG OF BORING / WELL GP-21

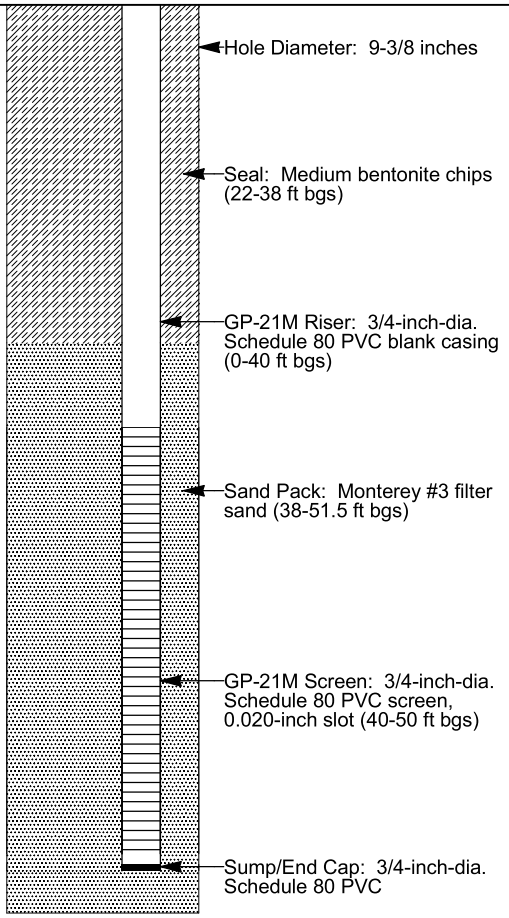
Project: Buena Vista Landfill

Location: Watsonville, California **Project Number: WG1019 / 02**

Elevation, feet	Depth, feet	Sample Interval	Blows per 6 inches	MATERIAL DESCRIPTION
	30		50/2"	WELL-GRADED SAND WITH CLAY AND GRAVEL (SW-SC), dark yellowish brown (10YR 4/6), moist, 70% fine to coarse sand, 20% fine subangular to subrounded gravel to 1/4 inch, 10% low plasticity fines
	35		28-50/3"	WELL-GRADED SAND (SW), dark yellowish brown (10YR 4/4), moist, 95% fine to medium sand, 5% fine subangular gravel to 1/4 inch, dense to very dense
	40		27-50/3"	CLAYEY SAND WITH GRAVEL (SC), dark yellowish brown (10YR 3/6), moist, 60% fine to coarse sand, 20% low plasticity fines, 20% fine subrounded gravel to 1/4 inch, dense to very dense
	45		50/5"	WELL-GRADED SAND WITH GRAVEL (SW), dark brown (10YR 3/3), moist, 80% fine to coarse sand, 20% fine subangular to subrounded gravel to 1/4 inch, very dense
	50		--	Gravel content increases to 30%
				Bottom of boring at 51.5 feet bgs
	55			
	60			
	65			

Graphic Log

WELL CONSTRUCTION DIAGRAM



Template: GEOSYNTEC_WELL; Proj ID: BUENVIST.GPJ; Printed: 6/16/2008

APPENDIX L
Non-Water Quality Corrective Action Plan
(2021 Update)

LEWIS ENGINEERING
98 RAMONA AVE., PIEDMONT, CA 94611 TEL: 510.601.7223 CELL: 510.207.9431

April 27, 2021

Mr. Kasey Kolassa
Solid Waste Programs Manager
County of Santa Cruz
Department of Public Works
701 Ocean Street, Room 410
Santa Cruz, California 95060

SUBJECT: NON-WATER RELEASE CORRECTIVE ACTION PLAN EVALUATION
BUENA VISTA LANDFILL
SANTA CRUZ COUNTY, CALIFORNIA

Dear Kasey:

This letter report provides an evaluation of the 2016 Site-Specific Non-Water Quality Release Action Plan (NWRCAP) (RMC Geoscience, May 2016), and associated cost estimate, to assess whether the reasonably foreseeable causal events and analyses detailed in the Plan for the Buena Vista Landfill (BVLF) are still current and remain in accordance with the current regulations outlined in CCR Title 27.

For ease in reference, the evaluation follows the sequence outlined in Section 5 of the 2016 NWRCAP.

REASONABLY FORSEEABLE CAUSAL EVENTS

5.1 EARTHQUAKE

5.1.1 Seismic Hazard Zoning, Liquefaction, and Ground Rupture

As noted in the 2016 NWRCAP, the landfill is not zoned under the Alquist-Priolo Fault Rupture Zone Act. It has also not been evaluated under the California Geologic Survey (CGS) Seismic Hazards Mapping Program and, therefore, no hazard zones have been designated to date by the CGS. The current conditions and maps are consistent with the 2016 assessment. Therefore, evaluation for potential damage associated with liquefaction or fault rupture is not necessary.

5.1.2 MCE Ground Shaking

No recent significant seismic events have occurred in the region. Databases from the Pacific Earthquake Engineering Research Center (Databases | Pacific Earthquake Engineering Research Center (berkeley.edu)) were reviewed to confirm that the

maximum credible earthquake (MCE) causal event presented in the 2016 NWRCAP is still current and applicable to present landfill conditions. Therefore, this NWRCAP update does not require further assessment of refuse or cover slope failure due to the design seismic event.

5.2 PRECIPITATION

The 2016 NWRCAP noted that damage to the surface water drainage system in response to a 1,000-yr 24-hour storm is reasonably foreseeable. The most recent information for the 1,000-yr 24-hr storm in the NOAA Atlas 14 was checked and it was confirmed that the 2016 value of 9.5-inches is still applicable.

Potential corrective action(s) associated with these mechanisms are summarized in the following subsections.

5.2.1 Erosion

The 2016 NWRCAP assessed that some erosion of the interim and final cover in response to the relatively intense precipitation expected during a 1,000-year 24-hour storm is considered to be reasonably foreseeable. The 2016 cost estimate assumed that mitigation work could include general clean up, removing sediment from inlets and culverts, repairing damaged drainage channels, repairing erosion gullies, and performing additional erosion control measures, such as a limited hydroseeding and/or placing additional straw wattles where warranted. The 2016 cost estimate has been updated to current dollars.

5.2.2 Final Cover Sloughing or Sliding

The 2016 NWRCAP assumed some potential sloughing of the final cover to be reasonably foreseeable and assumed limited regrading of portions of the final cover and hydroseeding could be required. The 2016 cost estimate has been updated to current dollars.

5.3 FLOODING

The 2016 NWRCAP noted that the landfill is located in an area determined to be outside the 0.2 percent annual chance floodplain (Zone X). The conditions have not changed since 2016 and flooding is not considered a reasonably foreseeable causal event.

5.4 TSUNAMI

The current California Emergency Management Agency tsunami inundation map for the Watsonville Quadrangle and the University of Southern California Tsunami Research Center map for Watsonville-West indicate that BVLF is located inland and is not subject to inundation by tsunami. Therefore, consistent with the 2016 analysis, tsunami inundation is not a reasonably foreseeable causal event.

5.5 SEICHE

The 2016 analysis noted that BVLF is not located within one-half mile of a lake or landlocked bay. Therefore, consistent with the 2016 assessment, inundation by seiche is not a reasonably foreseeable causal event.

5.6 FIRE

5.6.1 Surface Structure Fire

The 2016 NWRCAP noted that BVLF is located in a Local Responsibility Area unzoned to Moderate FHSZ (a Moderate FHSZ is the lowest category shown on the maps). A review of the most current maps indicates that BVLF remains in this category.

As noted in the 2016 NWRCAP, damage to structures is not reasonably foreseeable because BVLF implements a fire prevention program. BVLF continues to maintain this program and, therefore, the threat to structures continues to be not reasonably foreseeable.

5.6.2 Subsurface Fire

As noted in the 2016 NWRCAP, damage from subsurface fires is not reasonably foreseeable because of the placement of final cover on portions of the site, limited acceptance of hot loads, and controlled operations of the LFG system. BVLF continues to maintain these practices and, therefore, the threat from subsurface fires continues to be not reasonably foreseeable.

5.6.3 Off-Site Wild Fire

As discussed in the 2016 NWRCAP, because there is little vegetation present on the landfill surface or surrounding area and the facility maintains a fire break and fire hydrants, there is minimal potential threat from off-site wildfires. However, because wildfires have affected other similar facilities, costs were calculated in 2016 to address potential damage to environmental control systems, such as LFG extraction wells, from off-site wildfires. The 2016 costs have been updated to current dollars.

5.7 EVALUATION OF FINAL COVER SYSTEM

The 2016 NWRCAP noted that cover maintenance costs beyond those incorporated in the Preliminary Closure and Postclosure Maintenance Plan are not warranted. Because the final cover conditions remain the same, additional costs continue to not be warranted.

5.8 DEGRADED OR INADEQUATE CONTAINMNET OR ENVIRONMENTAL MONITORING AND CONTROL SYSTEMS

The 2016 NWRCAP addressed the adequacy of the useful life of the containment or environmental monitoring system and assessed that they had not exceeded their useful life. The County routinely maintains the environmental control system and the containment systems have been designed for long-term life. As with the 2016 NWRCAP, no additional costs are deemed to be warranted.

SUMMARY OF ESTIMATED NON-WATER RELEASE MITIGATION COST ESTIMATE

Based on the 2016 NWRCAP and the current analysis presented in this letter report, the updated cost estimate for each causal event is:

• Earthquake non-water release:	$0
• Flood non-water release:	$0
• Precipitation non-water release:	$191,212
• Tsunami non-water release:	$0
• Seiche non-water release:	$0
• Fire non-water release:	$255,080
• Additional final cover maintenance:	$0
• Additional costs for environmental monitoring and control:	$0
TOTAL	**$446,292**

Based on CalRecycle requirements, the highest potential cost of a reasonably foreseeable causal event (non-water related) is the cost to be used in the NWRCAP. Based on the evaluation in this letter report, the two reasonably foreseeable release scenarios are associated with the precipitation and fire causal events and the estimated costs for both total about $446,292.

The most recent corrective action cost estimate for BVLF is $1,263,962 in 2020 dollars. Because the most recent foreseeable release to groundwater cost is higher than the foreseeable impact due to non-water hazards, the associated cost of the water release is required to be in-place for BVLF.

CERTIFICATION AND LIMITATIONS

7.1 LIMITATIONS

This letter report is based on the project described herein and relies on available engineering and geotechnical data obtained in this and earlier studies of the Buena Vista Landfill. Lewis Engineering should be notified of any pertinent changes in the project

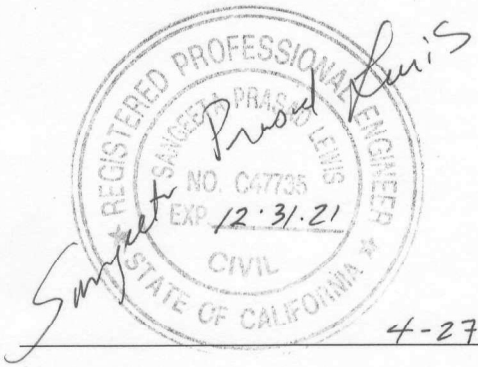
that may differ from those described in this report to allow re-evaluation of the conclusions and recommendations, if necessary.

This report has been prepared for use by the County of Santa Cruz in accordance with generally accepted engineering practices and makes no other warranties, either expressed or implied, as to the professional advice or data included herein.

7.2 CERTIFICATION

This letter report has been prepared under the supervision of Sangeeta P. Lewis, whose seal as a Registered Professional Engineer in the State of California is affixed below.

Based on my review of the data and discussions with the persons responsible for collecting the data, I certify that it is my knowledge and belief that the information contained within the report is true, complete, and correct. This report was prepared consistent with current and generally accepted geologic and environmental consulting principles and practices that are within the limitations provided herein.



I appreciate the opportunity to provide solid waste services for the County of Santa Cruz. If you have any questions regarding this letter, please call me at 510.601.7223.

Sincerely,

Ms. Sangeeta Lewis, P.E.
Lewis Engineering

c: Fabrizio Settepani, Geosyntec

encl: Table 1 – Summary of Estimated Costs Associated with Reasonably Foreseeable Non-Water Release Scenarios

Table 1
SUMMARY OF ESTIMATED COSTS ASSOCIATED WITH REASONABLY FORESEEABLE NON-WATER RELEASE SCENARIOS
Buena Vista Landfill
Santa Cruz County, California

WORK ITEM	UNIT	NUMBER	UNIT COST	EXTENDED COST	RATE BASIS
EARTHQUAKE CAUSAL EVENT	Site location and stability calculations indicate final cover damage from the MCE is not reasonably foreseeable.				
PRECIPITATION CAUSAL EVENT	Damage associated with the 24-hour, 1000-year storm is assumed to consist of local wash-outs of drainage channels, and clogging of inlets. Cost estimate assumptions include: 1. Post-storm cleanup will consist of onsite and offsite sediment removal and will require a total of 24 hours with one foreman, two laborers, and one equipment operator. Equipment will include a CAT 420D backhoe/loader and a highway rated haul truck. 2. Repair or replacement of the drainage system channels and inlets will require 32 hours to complete. Work will include replacing four inlets/culverts, and 150 feet of ADS drain pipe. 3. Final cover repair to fill erosion rills and gullies and to regrade areas of sloughing will require 32 hours to complete. A dozer will be required for the full 32 hours. A backhoe/loader and soil compactor will be required 16 hours each. About 25 acres of the total landfill area was assumed to require hydroseeding and repaired erosion control. 4. All soil required for construction will be obtained onsite.				
Post-Storm Cleanup					
Backhoe/Loader (CAT 420D) & Operating Engineer	Hour	24	$ 158.36	$ 3,800.64	Caltrans 2021 Equipment Rates and Special Single Shift California Prevailing Wage Rates (Area 1, Group 3)
Haul Truck (2 Axle Highway Rated) & Driver: Dump Truck	Hour	24	$ 77.43	$ 1,858.32	Caltrans 2021 Equipment Rates and Driver: Dump Truck California Prevailing Wage Rates (S. Benito, S. Cruz)
Foreman (Operating Engineer)	Hour	24	$ 112.67	$ 2,704.08	Caltrans 2021 Equipment Rates and Special Single California Prevailing Wage Rates (Area 1, Group 3); add $1/hr for foreman
Laborers (2)	Hour	48	$ 61.34	$ 2,944.32	Special Single California Prevailing Wage Rates (Area 2, Group 3)
Repair or Replace Drainage System Channels and Inlets					
Replace Culverts/Drainage Inlets	Each	4	$ 5,050.50	$ 20,202.00	Based on 2021 Contractor bid estimate for local project
Replace 18-in Drain Pipe	LF	150	$ 65.00	$ 9,750.00	Based on 2021 Contractor bid estimate for local project
Foreman (Operating Engineer)	Hour	32	$ 112.67	$ 3,605.44	Caltrans 2021 Equipment Rates and Special Single California Prevailing Wage Rates (Area 1, Group 3); add $1/hr for foreman
Laborers (2)	Hour	64	$ 61.34	$ 3,925.76	Special Single California Prevailing Wage Rates (Area 2, Group 3)
Final Cover Surface Sloughing and Erosion Repair					
Dozer (D6H LGP or Equal) & Operating Engineer	Hour	32	$ 172.46	$ 5,518.72	Caltrans 2021 Equipment Rates and Special Single Shift California Prevailing Wage Rates (Area 1, Group 4)
Soil Compactor (CAT 815B or equal) & Operating Engineer	Hour	16	$ 213.26	$ 3,412.16	Caltrans 2021 Equipment Rates and Special Single Shift California Prevailing Wage Rates (Area 1, Group 5)
Backhoe/Loader (CAT 420D) & Operating Engineer	Hour	16	$ 158.36	$ 2,533.76	Caltrans 2021 Equipment Rates and Special Single Shift California Prevailing Wage Rates (Area 1, Group 3)
Hydroseed and Erosion Control	Acre	25	$ 2,600.00	$ 65,000.00	Average of recent bids from 4 local projects
Foreman (Operating Engineer)	Hour	32	$ 112.67	$ 3,605.44	Caltrans 2021 Equipment Rates and Special Single California Prevailing Wage Rates (Area 1, Group 3); add $1/hr for foreman
Laborers (2)	Hour	64	$ 61.34	$ 3,925.76	Special Single California Prevailing Wage Rates (Area 2, Group 3)
Construction Subtotal				**$ 132,786.40**	
Engineering, Design, & Permitting Subtotal				**$ 13,278.64**	Assumed as 10% of Construction
CQA & CM Subtotal				**$ 13,278.64**	Assumed as 10% of Construction
Contingency				**$ 31,868.74**	Assumed as 20% of Total
PRECIPITATION EVENT TOTAL				**$ 191,212.42**	

Table 1
SUMMARY OF ESTIMATED COSTS ASSOCIATED WITH REASONABLY FORESEEABLE NON-WATER RELEASE SCENARIOS
Buena Vista Landfill
Santa Cruz County, California

WORK ITEM	UNIT	NUMBER	UNIT COST	EXTENDED COST	RATE BASIS
FLOODING CAUSAL EVENT	Review of Federal Emergency Management Agency (FEMA) flood map for the landfill area indicates the site is in an area determined to be outside the 0.2 percent annual chance floodplain (i.e., outside the 500 year flood zone). Therefore, flooding is not a reasonably foreseeable causative event.				
TSUNAMI CAUSAL EVENT	The landfill is located inland and is not in an area prone to inundation by tsunami. Therefore, tsunami inundation is not a reasonably foreseeable causative event.				
SEICHE CAUSAL EVENT	The landfill is not located within one-half mile of a lake or landlocked bay. Therefore, inundation by seiche is not a reasonably foreseeable causative event.				
FIRE CAUSAL EVENT	Total fire causal event estimated costs were based on the following assumptions: 1. Post-fire cleanup will require 16 total hours with one foreman and two laborers and will be supported by a backhoe and loader for 16 hours of the total time; 2. Fire-related debris will be disposed off-site for a lump sum cost of $10,000; 3. Ten LFG wells will be damaged above ground and require replacement above ground; 4. Approximately 250 ft of main collection header and 1000 ft of lateral piping will be damaged and require replacement; 5. The wells will be resurveyed assumed one survey crew field day; and 6. Other costs incorporated into the estimate include (i) engineering; design, and permitting as 10 percent of total construction; (ii) construction quality assurance (CQA) and construction management as 10 percent of construction; and (iii) a contingency of 20 percent.				
Post-Fire Cleanup					
Backhoe/Loader (CAT 420D) & Operating Engineer	Hour	16	$ 158.36	$ 2,533.76	Caltrans 2021 Equipment Rates and Special Single Shift California Prevailing Wage Rates (Area 1, Group 3)
Haul Truck (2 Axle Highway Rated) & Driver: Dump Truck	Hour	16	$ 77.43	$ 1,238.88	Caltrans 2021 Equipment Rates and Driver: Dump Truck California Prevailing Wage Rates (S. Benito, S. Cruz)
Foreman (Operating Engineer)	Hour	16	$ 112.67	$ 1,802.72	Caltrans 2021 Equipment Rates and Special Single California Prevailing Wage Rates (Area 1, Group 3); add $1/hr for foreman
Laborers (2)	Hour	32	$ 61.34	$ 1,962.88	Special Single California Prevailing Wage Rates (Area 2, Group 3)
Off-Site Disposal	LS	1	$ 10,000.00	$ 10,000.00	Assumed - Includes Transportation
Repair LFG System (Labor, Equipment, and Materials)					
Extend Well Heads/Replacement	Each	10	$ 3,515.00	$ 35,150.00	Documented 2021 Third Party Costs (TT)
Synthetic Boots	Each	10	$ 687.15	$ 6,871.54	Documented 2015 Third Party Costs (TT-BAS, 2015) adjusted with CalRecycle Inflation Factor; increased by 3.5%/year (2015-2021)
Main Collection Header	LF	250	$ 92.19	$ 23,048.54	Documented 2015 Third Party Costs (TT-BAS, 2015) adjusted with CalRecycle Inflation Factor; increased by 3.5%/year (2015-2021)
Lateral Piping	LF	1000	$ 43.02	$ 43,023.94	Documented 2015 Third Party Costs (TT-BAS, 2015) adjusted with CalRecycle Inflation Factor; increased by 3.5%/year (2015-2021)
Valves, Joints, Ports, Etc.	LS	1	$ 46,506.30	$ 46,506.30	Assumed as a percentage (35%) of total well head, boot, main, and lateral costs
Surveying	Day	1	$ 5,000.00	$ 5,000.00	Typical Cost Including Data Reduction
Construction Subtotal				**$ 177,138.55**	
Engineering, Design, & Permitting Subtotal				**$ 17,713.85**	Assumed as 10% of Construction
CQA & CM Subtotal				**$ 17,713.85**	Assumed as 10% of Construction
Contingency				**$ 42,513.25**	Assumed as 20% of Total
FIRE EVENT TOTAL				**$ 255,079.51**	
SUMMARY COSTS					

Table 1
SUMMARY OF ESTIMATED COSTS ASSOCIATED WITH REASONABLY FORESEEABLE NON-WATER RELEASE SCENARIOS
Buena Vista Landfill
Santa Cruz County, California

WORK ITEM	UNIT	NUMBER	UNIT COST	EXTENDED COST	RATE BASIS
Earthquake Non-Water Release				$ -	Not reasonably foreseeable
Flood Non-Water Release				$ -	Not reasonably foreseeable
Precipitation Non-Water Release				$ 191,212.42	
Tsunami Non-Water Release				$ -	Not reasonably foreseeable
Seiche Non-Water Release				$ -	Not reasonably foreseeable
Fire Non-Water Release				$ 255,079.51	Not reasonably foreseeable
Additional Final Cover Maintenance				$ -	Not reasonably foreseeable
Additional Degraded System Cost				$ -	Not reasonably foreseeable
TOTAL COST				**$ 446,291.93**	

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Appendix E. Mitigation Monitoring and Reporting Program

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County of Santa Cruz
701 OCEAN STREET, SANTA CRUZ, CA 95060

MITIGATION MONITORING AND REPORTING PROGRAM for Buena Vista Landfill Redevelopment Project Proposed Project

This Mitigation Monitoring and Reporting Program (MMRP) for the Buena Vista Landfill Redevelopment Project – Proposed Project (Project) includes:

- Mitigation Measures identified in the Environmental Impact Report (EIR)
- Best Management Practices included as part of the Proposed Project
- Environmental Enhancement and Habitat Restoration Features included as part of the Proposed Project

Figures, tables, and appendices referenced herein are included as attachments at the end of the MMRP. If full documents are referenced, a link to the website is provided as a footnote.

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
Biological Resources				
BIO-1a	**Conduct Environmental Training Prior to Construction** The County or their construction contractor will be responsible for hiring a qualified USFWS/CDFW-approved biologist (agency-approved biologist[1]) to conduct an environmental training session for all construction personnel regarding the sensitive wildlife species that have potential to occur in or near the project area. This mitigation measure applies to all project components. The environmental training will cover the following topics: • Description, identification, and photograph of sensitive species (Crotch's bumble bee, California red-legged frog, northwestern pond turtle, sensitive bird species and other nesting birds, San Francisco dusky-footed woodrat, sensitive bats and other roosting bats); • Natural history information;	County of Santa Cruz or construction contractor and a qualified biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	Prior to construction

[1] Agency-Approved Biologist. A minimum of 30 days prior to project initiation, biologists contracted to provide biological monitoring services for a project are typically required to submit in writing or by email their qualifications for approval to U.S. Fish and Wildlife Service (USFWS) and/or the California Department of Fish and Wildlife (CDFW), as applicable. Required qualifications will vary depending on the species. These agency-approved biologists will conduct any required species-specific surveys, provide worker's environmental awareness training, and handle and relocate wildlife in accordance with permit conditions and agency requirements.

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	• Protective measures and best management practices to be implemented to protect sensitive wildlife species and their habitat; and • The importance of avoiding impacts to sensitive species and the procedures to follow if individuals are encountered, alive or dead, including contacting the USFWS/CDFW-approved biologist. Printed hand-outs summarizing key project permit conditions and sensitive biological resources (with photographs) will be provided. All construction personnel will receive the training prior to beginning work. Any new crew members that join after work has been initiated will also receive the training prior to beginning work. A sign-in sheet will document completion of the training.			
BIO-1b	**Schedule Construction to Avoid Impacts to Sensitive Biological Resources** Whenever feasible, the County or their contractor will schedule construction to avoid impacts to sensitive biological resources including sensitive habitats, aquatic and riparian habitats, and sensitive wildlife species. **Table 3.4-4**, Recommended Construction Timing to Avoid/Minimize Impacts to Sensitive Biological Resources, lists the preferred construction windows to avoid and minimize impacts to biological resources, as well as a brief overview of required best management practices to implement during construction activities.	County of Santa Cruz with construction contractor and qualified biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	Prior to and during construction
BIO-1c	**Conduct Pre-construction Surveys and Implement Buffers for Crotch's Bumble Bee** For project construction activities to be initiated in non-native or ruderal grassland habitats during the peak active colony period (April–June), the County or their construction contractor will be responsible for hiring an agency-approved biologist to conduct a pre-construction survey for nesting and foraging bumble bees. If Project activities are initiated outside of the active colony period, surveys will be conducted during the peak of the active colony period immediately preceding the project start date.	County of Santa Cruz with construction contractor and qualified biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	Prior to construction

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	• Surveys will occur prior to beginning construction activities and will include all work, staging, and access areas and a buffer radius of 100 feet within suitable grassland habitat. • Surveys will occur when temperatures are at or above 60 degrees Fahrenheit and at or below 90 degrees Fahrenheit on sunny or partially sunny days when wind speeds are below 8 miles per hour. Surveys will begin no earlier than 2 hours after sunrise and no later than 3 hours before sunset. • If Crotch's bumble bee are detected, the biologist will consult with CDFW prior to initiating Project activities. • Crotch's bumble bee nests will be given a buffer of 50 feet in which no project activities will occur. The agency-approved biologist will develop a plan with CDFW to prevent the take of the nest or any individual within the project area.			
BIO-1d	**Restore and Promote Crotch's Bumble Bee Habitat** Where feasible, the County will promote suitable habitat for Crotch's bumble bee through restoration activities, such as planting of native thatched grasses, native nectar and pollen-producing plants, and placement of downed logs. The restoration activities can be incorporated into temporary impact areas and the planned wildlife movement corridor to be located across the southern portion of the closed landfill (as shown on **Figure 2-4**, Environmental Enhancement and Restoration Features).	County of Santa Cruz and a qualified biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	After Construction
BIO-3	**Implement Protective Measures and Biological Monitoring for California Red-Legged Frog and Northwestern Pond Turtle** During project construction activities, the County or their construction contractor, in coordination with an agency-approved biologist, will employ the following protective measures and biological monitoring for sensitive wildlife species, the California red-legged frog (CRLF) and northwestern pond turtle (NWPT): • Prior to initiation of construction activities, an agency-approved biologist will identify and/or clearly mark in the field all areas to be avoided and/or protected. No construction activities will be conducted within these areas.	County of Santa Cruz or construction contractor and a qualified biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	During construction

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	• Prior to initiation of construction activities, an agency-approved biologist with experience in the identification of all life stages of CRLF (egg masses, tadpoles, juveniles, and adults) and NWPT (nests, juveniles, adults) will perform a pre-construction survey. The survey will occur no more than 48 hours before construction activities start. • An agency-approved biologist will be present during all work within aquatic features, adjacent riparian habitat, and initial activities involving vegetation removal, clearing, grubbing, trenching, or earth movement (in all habitat types). If the biologist detects any life stage of CRLF or NWPT in the project area during construction, work will cease immediately; and with the authorization of USFWS via the Biological Opinion, the biologist will capture and relocate the animal to a previously identified agency-approved relocation habitat. • Construction activities in or near known or potential habitat or designated critical habitat will take place during the dry season between May 1 and October 15 (refer to **Mitigation Measures BIO-1a** and **BIO-1b** and **Table 3.4-4**) or until the first rain of the season, especially vegetation removal, soil disturbance, and work in or near aquatic features. Avoid working at night or during rain events when special-status amphibians and mammals are generally more active. Consult weather forecasts from the National Weather Service at least 72 hours prior to performing work. • The agency-approved biologist will check under all equipment for wildlife before use. If any special-status wildlife is observed under equipment or within the work area, the approved biologist will be permitted to handle and relocate it. • The agency-approved biologist will permanently remove any individuals of exotic species (such as bullfrogs, crayfish, and centrarchid fishes) from the project area to the maximum extent possible. The biologist will be responsible for ensuring his or her activities are in compliance with the California Fish and Game Code.			

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	• To ensure that diseases are not conveyed between work sites, the agency-approved biologist(s) will adhere to Recommended Equipment Decontamination Procedures outlined in Appendix B of the Revised Guidance on Site Assessments and Field Surveys for the California Red-Legged Frog (USFWS 2005).[2] • At the end of each workday, excavations shall be secured with a cover, or a ramp installed to prevent wildlife entrapment. • All trenches, pipes, culverts or similar structures shall be inspected for animals prior to burying, capping, moving, or filling. • To minimize vehicle strikes of CRLF and NWPT, restrict parking to daytime hours, if feasible.			
BIO-5a	**Avoid Vegetation Removal During Breeding Bird Season or Conduct Nesting Bird Surveys** The County or their construction contractor will schedule construction to avoid vegetation removal during breeding bird season or conduct pre-construction nesting bird surveys. Typically, the avian breeding season occurs between February 1 and August 31 (see **Table 3.4-4**,) with some species (e.g., hummingbirds and owls) nesting outside of this period. If feasible, perform vegetation removal activities outside of breeding bird season (ideally between September 1 and October 15) to avoid direct harm or mortality to potential nesting bird species and other sensitive biological resources. For all construction activities initiated during the breeding bird season, or if construction activities lapse for a period of one week or more during breeding bird season, an agency-approved biologist will conduct a breeding bird survey for nesting birds, including raptors. Surveys will be conducted within 7 days, prior to beginning construction activities and will include all work, staging, access areas, and minimum survey radii surrounding the work area as follows: ▪ 250 feet for non-raptors; ▪ 500 feet for small raptors such as accipiters; and	County of Santa Cruz or construction contractor	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	Prior to and during construction

[2] U.S. Fish and Wildlife Service (USFWS). 2005. Revised Guidance on Site Assessments and Field Surveys for the California Red-legged Frog. Prepared August 2005. https://www.fws.gov/sites/default/files/documents/guidance-on-site-assessments-and-field-surveys-for-california-red-legged-frog.pdf.

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	▪ 1,000 feet for larger raptors such as buteos. The survey will include potential habitat for raptors, sensitive and common nesting avian species and will include trees, other vegetation and suitable habitat (buildings, equipment, ruderal areas, brush piles, gravel, rocks) for ground-nesting and opportunistic species (e.g., house finch, California towhee, dark-eyed junco, and/or kildeer). The following measures will be implemented based on the survey results. ▪ If no nesting sensitive or common avian species are observed during breeding bird surveys no additional measures would be required. ▪ If common nesting birds are observed within or adjacent to the project area, postpone activities until young have fledged to avoid direct harm or mortality of nesting birds and/or establish buffers appropriate to the species, such as protective buffers recommended in PG&E et al. (2015). The size of the buffer would also depend on the location of the nest relative to the project area, construction activities proposed for this location, and other specific conditions (e.g., equipment operation). ▪ Sensitive bird species, if nesting in or near the project area, will be given special consideration and may require additional protective measures as determined through consultation with the relevant agency (USFWS or CDFW), such as protective buffers recommended in PG&E et al. (2015): ▫ Bald eagle, golden eagle: 2,640 feet ▫ White-tailed kite, and other raptors: 300 feet ▫ California gull and western gull: 150 feet ▫ California thrasher, Bullock's oriole, grasshopper sparrow, Lawrence's goldfinch, yellow warbler, wrentit: 75 feet ▫ Allen's hummingbird, oak titmouse, olive-sided flycatcher, Nuttall's woodpecker: 50 feet ▪ An agency-approved biologist will monitor active nest sites for construction-related disturbances and adjust protective buffers as necessary to prevent disruption of nesting activities. ▪ No construction activity shall be allowed in the buffer until the biologist determines that the nest is no longer active, or unless monitoring determines that a smaller buffer will protect the active nest. The buffer may be reduced if the biologist monitors			

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	the construction activities and determines that no disturbance to the active nest is occurring. ▪ If an active nest is identified in or adjacent to the construction zone after construction has started, the above measures will be implemented to ensure construction is not causing disturbance to the nest.			
BIO-5b	**Conduct Surveys for Wintering Sensitive Bird Species** The County or their construction contractor will ensure an agency-approved biologist conducts surveys for wintering sensitive bird species. The following measures will be implemented to protect wintering sensitive bird species, if present: ▪ If any work is performed during the burrowing owl wintering period (November–March), conduct a survey for these species. The survey will be conducted by an agency-approved biologist and include the Project area and suitable habitat within 490 feet. ▪ If burrowing owls are detected: ▫ Avoid destruction of fossorial mammal burrows during construction; ▫ Place visible markers near occupied burrows and fence off suitable habitat; ▫ Avoid direct destruction of burrows, and ▫ Include the burrowing owl in the environmental training for construction personnel (**Mitigation Measure BIO-1a**).	County of Santa Cruz or construction contractor and a qualified biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	Prior to and during construction
BIO-6	**Schedule Tree Removal to Avoid Bat Maternity Roosts and Winter Hibernacula and/or Conduct Pre-construction Surveys and Implement Protective Measures for Bat Roosts** If feasible, the County or their construction contractor will conduct limbing/tree removal operations between September 15 and November 1 to avoid bat maternity roosts and winter hibernacula. During all months, prior to limbing/tree removal, the County or their construction contractor shall ensure an agency-approved biologist conducts a pre-construction survey for bats to determine if crevice or foliage-roosting bats are present, as follows:	County of Santa Cruz or construction contractor and a qualified biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	Prior to and during construction

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	▪ An agency-approved biologist shall determine if bats are utilizing the area for roosting. For any buildings, culverts, or trees/snags that could provide roosting space for cavity or foliage-roosting bats, potential bat roost features shall be thoroughly evaluated to determine if bats are present. Visual inspection and/or acoustic surveys shall be utilized as initial techniques. If roosting bats are found, the biologist shall develop and implement acceptable passive exclusion methods in coordination with or based on CDFW recommendations. Exclusion shall take place during the appropriate windows (September 1 and November 1) to avoid harming bat maternity roosts and/or winter hibernacula. (Authorization from CDFW is required to evict winter hibernacula for bats). ▪ If established maternity colonies are found, in coordination with CDFW, a buffer shall be established around the colony to protect pre-volant young from construction disturbances until the young can fly; or implement other measures acceptable to CDFW. ▪ If a building or tree is determined not to be an active roost site for roosting bats, proceed with work immediately. For trees to be limbed or removed, proceed as follows: ▫ If foliage-roosting bats are determined to be present in the Project area (e.g., hoary bat or western red bat), limbs shall be lowered, inspected for bats by an agency-approved biologist, and if no bats are found, chipped immediately or moved to a dump site. Alternatively, limbs may be lowered and left on the ground until the following day, when they can be chipped or moved to a dump site. No logs or tree sections shall be dropped on downed limbs or limb piles that have not been in place since the previous day. ▫ If the tree is not limbed or removed within four days of the survey, the survey efforts shall be repeated.			
BIO-7	**Conduct Pre-construction Surveys and Flag Woodrat Nests** Prior to construction, the County or their construction contractor will ensure an agency-approved biologist conducts a pre-construction survey for San Francisco dusky-footed woodrat houses and clearly	County of Santa Cruz or construction contractor and a qualified biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County	Prior to construction

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	flags all houses within the Project area and immediate surroundings, as follows: ▪ The agency-approved biologist will determine, to the extent feasible, whether the houses are active or inactive [e.g., freshly chewed (green) vegetation is visible on the house, at least some entrances are clear and free of cobwebs, fresh sticks are piled on the top of the house, the house is not composed entirely of old dry sticks and has a flattened shape (has collapsed over time)]. If this determination cannot be made, the house will be presumed to be active. ▪ If an active woodrat house is found during surveys, it will be protected during construction with flagging or silt fencing between the work area and the house. ▪ The construction contractor will avoid woodrat houses to the extent feasible by installing a buffer with silt fencing or other material that shall prohibit encroachment. If this buffer and avoidance is not feasible, the agency-approved biologist shall allow encroachment into the buffer, but preserve microhabitat conditions such as shade, cover and adjacent food sources. If avoidance of woodrat houses is not possible, the agency-approved biologist will dismantle woodrat houses, capturing woodrats if feasible, or allowing woodrats to flee. The biologist will preserve sticks, food caches, and nesting materials separately. The materials will be relocated to the nearest unoccupied suitable habitat. The relocation site will mimic the original house site in terms of vegetation and environmental conditions, if feasible. The agency-approved biologist will create an artificial shelter using a pine box as a base, installing food and nesting materials inside the shelter, and piling sticks on top. An effort will be made to protect the opening from predators. A scent trail will be left from the original house site to the artificial shelter, if needed. If feasible, relocation will occur during the appropriate time of year (August 1–September 30) to avoid impacting dependent young that may be present within the stick house.		and construction contractor	
BIO-8a	**Implement Measures to Protect Sensitive and Native Habitats during Construction**	County of Santa Cruz or construction contractor and a qualified biologist	Compliance monitored by qualified agency-approved biologist with	During construction

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	The County, in coordination with their construction contractor and agency-approved biologists, will implement the following measures to protect sensitive and native habitats during construction: ▪ Follow all conservation regulations, policies, and principles in Chapter 5, Conservation and Open Space, of the Santa Cruz County General Plan and LCP (2024)[3]. For wildlife habitats and sensitive communities, including wetlands, follow applicable regulations from Chapter 16.30 and 16.32 of the Environmental and Resource Protection section of County of Santa Cruz Municipal Code[4], wherever feasible. Obtain exceptions to these regulations, as applicable. ▪ Avoid and reduce impacts to sensitive and native habitats. The construction footprint will be minimized. ▪ Stage equipment in ruderal and/or developed areas. ▪ Confine construction activities and operation of equipment and vehicles, including site access and parking, to designated staging, access, and work areas. ▪ Except as necessary for project implementation, avoid grubbing and construction within 100 feet of the edge of aquatic features (wetlands and other waters), including Harkins Slough Road Drainage, Buena Vista Drive Tributary, Channelized Gallighan Slough, freshwater emergent marsh (by the main landfill entrance), and the seasonal wetland adjacent to the Old Landfill. Where work occurs within 100 feet of aquatic features, secondary containment measures (e.g., Visqueen sheeting and/or drip pans under staged equipment and for maintenance) will be employed. ▪ Prior to initiation of construction activities, an agency-approved biologist will identify all areas to be avoided and/or protected and will mark sensitive habitats in the field. ▪ Minimize removal and disturbance of native vegetation, and implement the following when disturbance to native vegetation is required:		oversight by the County and construction contractor	

[3] https://cdi.santacruzcountyca.gov/Portals/35/CDI/Planning/Policy/GeneralPlanTownPlans/General%20Plan%20Chapters/GP%20Chapter%205_ARC.pdf?ver=M2Gmi8vz3QbSOh-rKdOA7A%3d%3d

[4] https://www.codepublishing.com/CA/SantaCruzCounty/

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	▫ Limbing of native trees and cutting (above the ground) of shrubs will be favored in lieu of removal. Stumps of native vegetation will be retained to allow for re-sprouting following Project completion where vegetation will not interfere with the Project features. ▫ Maintain native understory plants to the extent feasible. Do not grub within sensitive habitat types unless no other alternative exists. ▪ Preserve native edge habitats wherever feasible, such as boundaries between coast live oak woodland/forest and grassland, and transitions between riparian and wetland vegetation. ▪ The County, in coordination with their construction contractor and an agency-approved biologist, will remove invasive non-native plants from the work area as designated by the California Invasive Plant Council (Cal-IPC 2026)[5] as having "high" potential for "severe ecological impacts on physical processes, plant and animal communities, and vegetation structure."			
BIO-8b	**Implement Best Management Practices During Construction** The County, in coordination with their construction contractor, will implement the following best management practices during construction: ▪ Prior to staging equipment on-site, clean all equipment caked with mud, soil, or debris from off-site sources or previous project sites to avoid introducing or spreading invasive exotic plant species. All equipment used on the premises will be cleaned prior to leaving the area for future projects. ▪ Refueling and/or maintenance of vehicles and equipment will be performed in designated staging areas. Workers will be informed of the importance of preventing spills and of the appropriate measures to take should a spill occur. Follow all state and federal laws pertaining to hazardous material handling and management.	County of Santa Cruz or construction contractor	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	During construction

[5] https://www.cal-ipc.org/plants/inventory/

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	▪ Position all stationary equipment such as motors, pumps, generators, and/or compressors over drip pans. Store vehicles and equipment in designated staging area. Position parked equipment over drip pans or absorbent material. ▪ All construction vehicles and equipment will be checked daily for fuel, oil, and hydraulic fluid leaks or other problems that could result in spills of toxic materials. ▪ Prohibit smoking. During construction, all food trash that may attract predators into the work area will be properly contained and removed from the work site on a daily basis. Construction debris and trash should also be properly contained and removed from the work site on a regular basis.			
BIO-8c	**Stabilize and Restore Temporary Habitat Impact Areas** The County and/or their construction contractor, in coordination with an agency-approved biologist, will stabilize and restore sensitive and native habitat areas that are temporarily impacted by construction activities, as described below: ▪ During construction, stabilize all exposed or disturbed areas within the construction area. Install erosion control measures such as silt fences, weed-free straw bales, plywood, straw wattles, water check bars, and broadcast weed-free straw wherever silt laden water has the potential to leave the work site and enter the nearby drainages. Modify, repair, and/or replace erosion control measures as needed. ▪ During construction, to minimize the risk of entangling and strangling wildlife, erosion control materials containing synthetic (e.g., plastic or nylon) monofilament netting will not be used, and any geo-textile material or filter fabric used will not contain any petroleum-based products. Geotextiles, fiber rolls, and other erosion control measures will be made of loose-weave mesh, such as jute or coconut (coir) fiber. ▪ At the end of construction activities, restore habitat contours to their original (or agency-approved) configuration in all sensitive	County of Santa Cruz or construction contractor and a qualified biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	During and after construction

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	habitats or adjacent areas (**Figures 3.4-1, 3.4-2a-e**) that have been temporarily disturbed by activities associated with construction. ▪ At the end of construction activities, where temporary impacts to sensitive and native habitats occur, revegetate as needed with native seed mix or locally sourced native plantings. Revegetate all disturbed areas. An agency-approved biologist will determine a palette/seed mix suitable to the location. Adjacent non-native grasslands and ruderal habitats may also be planted with native vegetation, preserving edge effects, where appropriate.			
BIO-8d	**Prepare and Implement a Habitat Mitigation Plan for Permanent Impacts to Sensitive Habitats, Including Aquatic Features for Proposed Project** The County, in coordination with qualified biologists, will prepare and implement a Habitat Mitigation Plan (HMP or plan), as described below, for permanent impacts to sensitive habitats, including aquatic features. This plan will help mitigate impacts to coast live oak woodland and forest, riverine habitat (Harkins Slough Road Drainage), and significant trees. In addition, the plan will provide additional recommendations for implementation and monitoring of the Environmental Enhancement and Restoration Features. This plan will also help mitigate impacts to sensitive wildlife species, if present (Crotch's bumble bee, California red-legged frog, northwestern pond turtle, avian and bat species, San Francisco dusky-footed woodrat), habitat for these species, and wildlife movement. This plan will include establishing sensitive habitat off site as compensatory mitigation. The plan will be prepared prior to submission of permit applications with the resource agencies and approved prior to initiation of construction: ▪ Coast live oak woodland and/or forest will be established at a location and ratio to be determined in coordination and consultation with the County Environmental Planning Division, the California Coastal Commission (CCC), and an agency-approved biologist. ▪ A Habitat Mitigation Plan (HMP) will be prepared that includes the following:	County of Santa Cruz or construction contractor and a qualified biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	HMP completed prior to submission of permit applications HMP implemented during and after construction

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	▫ Description of the project elements including acreage of temporary and permanent impacts to sensitive habitats, including coast live oak woodland and riverine habitat (Harkins Slough Road Drainage) and the number of significant trees removed for the Project. ▫ Description of Environmental Enhancement and Restoration Features including acreage of restoration areas within sensitive habitat types and tree removal, if required. ▫ Goals of compensatory mitigation project including types and areas of habitat to be created, restored, and/or enhanced, and mitigation ratios (created/restored/enhanced: impacted). ▫ Ratio and species composition for significant tree mitigation as determined in coordination with the County Environmental Planning Division (for coast live oak woodland and forest) and the CCC; and with the County, CCC, California Regional Water Quality Control Board (Regional Board), and California Department of Fish and Wildlife (CDFW) for tree removal in mixed willow riparian habitat. ▫ In-kind restoration and/or enhancement of riverine habitat onsite at Harkins Slough Road Drainage. ▫ Location and acreage of mitigation areas, and Significant Tree replacement planting, including size and ownership status. ▫ Detailed construction and planting techniques. ▫ Description and design of habitat requirements for special-status wildlife, including California red-legged frog and northwestern pond turtle. ▫ Strategies for protecting the habitat values of the larger Watsonville Sloughs ecosystem, including wildlife movement. ▫ Maintenance activities during the monitoring period, including replanting native vegetation and weed removal, that will not result in take of special-status plant and wildlife species.			

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	▫ Performance standards and specific success criteria, quantitative and qualitative monitoring and reporting, documenting ability to meet or surpass success criteria. ▫ Adaptive management strategies to ensure long-term viability of mitigation areas. ▪ The following Environmental Enhancement and Habitat Restoration Features, included as part of the Proposed Project, will be developed by qualified biologists in coordination with County engineers and implemented on-site as both in-kind and out-of-kind mitigation. ▫ **Wildlife Movement Corridor between Gallighan Slough and Harkins Slough**. Establish a Wildlife Movement Corridor between Gallighan Slough and Harkins Slough on the southern portion of the landfill after closure, by establishing shallow-rooted native perennial vegetation (see **Appendix G4**),[6] including suffrutescents,[7] shrubs, and vine plantings that will not compromise the landfill cap, to facilitate refuge and cover opportunities for wildlife moving across the area. The landfill cap will have a minimum of 24 inches (30–36 inches is preferred) of vegetative layer/topsoil to allow for shrub plantings. Place downed logs on flatter portions of the corridor, and any appropriate areas of the already closed landfill to provide additional shelter for wildlife. ▫ **Culvert Modification with Small Wildlife Crossing at Main Entrance**. Modify the culvert under the main entrance to the landfill to add a ledge within the culvert to facilitate safe passage of CRLF and other small wildlife species under most hydrologic conditions. ▫ **Culvert Replacement under the Internal Roadway to the Old Landfill**. Replace the existing culvert with a larger structure (e.g., a larger culvert with a natural streambed			

[6] A 20-year study demonstrated that the roots of shallow-rooted scrub vegetation grow laterally when the roots reach the barrier membrane layer of the landfill cap and do not penetrate through the membrane into the foundation layer or into the waste below the cap (Holl and McStay 2014).

[7] A suffrutescent plant has a woody lower portion at the base of its stems that persists year to year, while the upper softer growth is herbaceous (non-woody). See also **Appendix G4** for a planting palette of shallow-rooted shrubs, perennial herbs, and vines proposed for the landfill cap.

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	or a clear-span bridge) designed to reduce the hydraulic constriction, associated flooding, and sedimentation upstream within Channelized Gallighan Slough and the Buena Vista Drive Tributary. ▫ **Wildlife Directional Features at Key Locations**. Construct wildlife directional features such as angled fencing to direct wildlife away from high operational activity areas, including transfer stations and internal roadways toward Channelized Gallighan Slough, the Wildlife Movement Corridor, and the culvert with wildlife passage. ▫ **Restoration of Harkins Slough Road Drainage**. Rehabilitate the Harkins Slough Road Drainage through re-grading the elevation profile of the channel to repair existing incision, accommodate storm flows and transport sediment effectively. Remove red ironbark trees adjacent to the drainage and plant with suitable native riparian plant species including willows, dogwood, elderberry, and (above the break in bank) coast live oaks. ▪ If ODF Option 2 is approved for the top deck of the Old Landfill, the following measures will be implemented on site where the existing seasonal wetland and drainage extends along the southern boundary. ▫ **Restore and/or enhance the Old Landfill Seasonal Wetland and Drainage**. The existing seasonal wetland and drainage will be recontoured to channel elevations that existed prior to the 2022–2023 storm season, and sediments will be removed to restore native wetland vegetation and wildlife habitat.			
BIO-9a	**Replace, Restore and/or Enhance with In-Kind Riparian Vegetation Onsite** Following project construction, the County will mitigate for temporary and permanent impacts to riparian forest on site, as necessary at the main landfill entrance (Buena Vista Drive Tributary), at the internal roadway to Old Landfill (Channelized Gallighan Slough), and along Harkins Slough Road Drainage, through in-kind replacement, restoration, and/or enhancement at a ratio to be determined in	County of Santa Cruz and relevant resource agencies (CCC, Regional Board, and CDFW)	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	After construction

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	coordination with the relevant resource agencies (County, CCC, Regional Board, and CDFW). In addition, the County in coordination with qualified biologists will plant suitable native trees and understory plants (including mixed willow riparian scrub and forest, mixed broadleaved riparian forest, and coast live oak woodland) where suitable space is available, such as along the Harkins Slough Road Drainage.			
BIO-9b	**Transplant Willows to Restore Riparian Areas** During construction activities within riparian habitat, if tree removal is required, the County or their contractor will excavate willow roots, cover with burlap, and set aside during construction. Following construction activities in this area, the willow roots will be replanted along the embankments of the Buena Vista Drive Tributary, Channelized Gallighan Slough, and/or Harkins Slough Road Drainage, as applicable.	County of Santa Cruz or construction contractor and a qualified biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	During and after construction
BIO-13	**Install Protective Fencing and Conduct Wildlife Relocation if Necessary** ▪ The County or their construction contractor will work with an agency-approved biologist to ensure the following measures are implemented prior to and during construction. ▪ Prior to construction, an agency-approved biologist will determine locations for the installation of protective fencing with openings every 50 feet that would allow passage of wildlife. ▪ With agency approval, an agency-approved biologist will be present during construction to relocate wildlife species, as needed. The biologist will work with the County and contractor to implement monitoring measures, as determined in consultation with the resource agencies (County Environmental Planning, California Coastal Commission, U.S. Fish and Wildlife Service, and California Department of Fish and Wildlife). The monitor will be present during initial vegetation removal, grubbing, grading or other ground disturbance and other activities that may impact sensitive wildlife species, as determined by the agencies and the	County of Santa Cruz or construction contractor and a qualified biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	Prior to and during construction

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	agency-approved biologist. After these activities have been completed, the agency-approved biologist will remain on call to verify the identity of sensitive wildlife species and relocate animals, as needed.			
BIO-14	**Implement Tree Replacement Planting and Habitat Enhancement** The County will mitigate for significant trees removed by confirming the number of trees required to be removed and implementing associated tree replacement planting at a ratio and species composition to be determined in coordination with the County Environmental Planning Division, the California Coastal Commission (CCC) and, for willow trees, the California Regional Water Quality Control Board (Regional Board) and California Department of Fish and Wildlife (CDFW). Wherever feasible, tree replacement will occur onsite. Off-site locations (such as Freedom Lake County Park) will be identified for tree replacement planting and to replace displaced sensitive habitat (coast live oak woodland and forest) through habitat enhancement or creation. The areas designated for replacement tree planting will be situated to improve the ecological landscape, including species richness, structural complexity, and an overall habitat mosaic that reflects plant communities present in or suitable to the surroundings.	County of Santa Cruz or construction contractor and the CCC, Regional Board, and CDFW	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	After construction
Cultural Resources/Tribal Cultural Resources				
CR-2a	**Stop Work if Inadvertent Encounter of Undiscovered Archaeological Resources during Ground-Disturbing Activities** In the event that archaeological resources are unexpectedly encountered during ground-disturbing construction activities, the construction contractor shall halt work within 200 feet of the find, and the County of Santa Cruz shall contact an archaeologist meeting the Secretary of the Interior's Professional Qualifications Standards for Archaeology to immediately evaluate the find, if an archaeological monitor is not already present. If the find is determined by the qualified archaeologist to be prehistoric and a Native American monitor is not already present, then the County of Santa Cruz shall	County of Santa Cruz or construction contractor and a qualified archaeologist	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	contact a Native American representative to participate in the evaluation of the find. If necessary, archaeological testing for California Register of Historical Resources eligibility shall be completed by the qualified archaeologist. If the discovery proves to be eligible for the California Register of Historical Resources, and if impacts to the resource cannot be avoided via project redesign, a qualified archaeologist shall prepare a data recovery plan tailored to the physical nature and characteristics of the deposit, per the requirements of California Public Resources Code, Section 15126.4(b)(3)(C). The data recovery plan shall identify data recovery excavation methods, measurable objectives, and data thresholds to reduce any significant impacts to cultural resources. Pursuant to the data recovery plan, the qualified archaeologist and Native American representative, as appropriate, shall recover and document the scientifically consequential information that justifies the resource's significance. The County of Santa Cruz shall review and approve the treatment plan and archaeological testing as appropriate, and the resulting documentation shall be submitted to the regional repository of the California Historical Resources Information System, per California Public Resources Code, Section 15126.4(b)(3)(C).			
CR-2b	**Archaeologist and Native American Monitoring during Initial Ground-Disturbing Activities in Specific Areas** All initial ground-disturbing activities in the following specific areas shall be monitored by a qualified archaeologist and a representative from the local Native American community. **Main Landfill Entrance**. The culvert modification with small wildlife crossing, located below the driveway at the Main Entrance, will be implemented as part of the Proposed Project. **Northeast Corner of Landfill Property**. The undeveloped northeast corner of the landfill property, between Harkins Slough Road and the northern property line will be developed as part of the Proposed	County of Santa Cruz or construction contractor and a qualified archaeologist	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	Project (for Transfer Station A). Additionally, the Harkins Slough Road Drainage will be restored as part of the Proposed Project. **South of Rountree/Tierra Alta Intersection**. The approximately 1-acre undeveloped area on the south side of the Rountree Lane/Tierra Alta Drive intersection will be developed with an equipment parking and storage area as part of the Proposed Project, if the County decides to implement this optional project feature. The County of Santa Cruz shall retain a qualified archaeologist and a Native American monitor from a locally affiliated Tribe to monitor initial ground-disturbing activities. Archaeological monitoring shall be performed under the direction of an archaeologist meeting or exceeding the Secretary of the Interior's Professional Qualifications Standards for Archaeology. Either monitors shall have the authority to halt and redirect work should any archaeological resources be identified during monitoring. If archaeological resources are encountered during ground-disturbing activities, work in the immediate area shall halt, and Mitigation Measure CR-2a (Stop Work if Inadvertent Encounter of Undiscovered Archaeological Resources during Ground-Disturbing Activities) shall be implemented. Archaeological monitoring may be reduced or halted at the discretion of the monitor, in consultation with the County environmental coordinator, as warranted by conditions such as encountering bedrock, sediments that are planned to be excavated are composed of fill, or negative findings during the first 50 percent of ground disturbance. If monitoring is reduced to spot-checking, spot-checking shall occur when ground disturbance moves to a new location within the Project area and when ground disturbance will extend to depths not previously reached (unless those depths are within bedrock). Furthermore, monitoring may be terminated if it is determined that the soils within the Project area do not have the potential to contain cultural resources. The monitor shall submit a report within 30 days of completion of all ground-disturbing activities to the County to document compliance.			

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
Geology and Soils				
GEO-2	**Old Landfill Site Stability Evaluation for Organics Diversion Facility Option 2** Due to the high potential for liquefaction at the Old Landfill site where ODF Option 2 is under consideration, the County and qualified geotechnical engineer shall implement the following to evaluate the site stability of the Old Landfill: 1. Prior to design of the ODF Option 2, updated seismic hazard analysis shall be prepared to obtain up to date earthquake motions that address the requirements in the latest edition of the California Building Code and in Title 27 of the California Code of Regulations. 2. A Deformation Analysis shall be prepared to assess the potential movement of the ODF Option 2 and its associated infrastructure. The Deformation Analysis shall evaluate liquefaction and its potential consequences (e.g., sand boils, seismic settlement, lateral spreading, and slope instability) that could be caused by lateral spreading of the liquefiable layer under design earthquake conditions. 3. The ODF Option 2 and its associated infrastructure shall be designed and constructed to accommodate the anticipated deformation and settlement including items such as a mat slab foundation and flexible utility connections 4. Following a seismic event at the Project area that measures IV or greater on the Modified Mercalli scale, the Old Landfill final cover and the ODF Option 2 will be inspected and repaired as necessary to maintain the environmental and structural integrity of the landfill cap and all organic diversion facility infrastructure.	County of Santa Cruz or construction contractor	Compliance monitored the County and construction supervisor or qualified consultant representative assigned to overall construction monitoring	Prior to, during, and after construction
GEO-4	**Expansive Soils Design Measures for Specific Structures** Due to the presence of expansive soils where specific structures will be located, the County and their design consultant shall ensure that the final design for the following structures includes design measures for building footings or other structures on or adjacent to these potentially expansive soils, such as excavation and replacement with non-expansive soils, amendment of the expansive soils with lime or cement,	County of Santa Cruz or construction contractor	Compliance monitored the County and contractor	Prior to and during construction

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	construction of moisture barriers, grading of surfaces to drain away from the area, and/or restrictions on the use of irrigation and/or infiltration of stormwater into the subsurface. Proposed Project: Transfer Stations A and B			
Greenhouse Gas Emissions				
BIO-14	See Mitigation Measure BIO-14 under Biological Resources			
Noise				
N-1	**Implement Noise-Reducing Measures for Construction Equipment Used within 200 Feet of Occupied Residences** The County of Santa Cruz shall include the following in the construction specifications. The construction contractor shall employ the following noise-reducing measures where use of construction equipment occurs within 200 feet of an occupied residence: ▪ Use acoustical shelters around any air compressors, generators, and any other stationary construction equipment not fitted with baffled enclosures ▪ Use baffling around stationary construction equipment to reduce noise and vibration levels ▪ Properly muffle and maintain all construction equipment powered by internal combustion engines ▪ Prohibit unnecessary idling of internal combustion engines ▪ Whenever feasible, use electrical power to run air compressors and similar power tools	County of Santa Cruz with construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction
N-2a	**Implement Noise-Reducing Design Features at Transfer Station B** Before the start of any operations of Transfer Station B, the County of Santa Cruz shall demonstrate that noise shielding features have been incorporated into Transfer Station B design to reduce noise levels to below an hourly average of 65 dBA at the nearest occupied building at Rountree Medium (Jail) Facility, and 60 dBA at the lodging facility. Measures to reduce noise exposure may include, but are not limited to, installation of industrial sound-proofing panels or curtains on all building walls or individual pieces of equipment to dampen noise.	County of Santa Cruz with construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	Prior to the start of operations

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
N-2b	**Implement Noise-Reducing Features for Organics Diversion Facility Option 2 Equipment Operation** Before the start of any operations of the ODF Option 2 (located at the Old Landfill), the County of Santa Cruz shall demonstrate that the proposed stationary equipment, including industrial fans and the preprocessing grinder, will include noise shielding or that a noise barrier will be installed on the site such that noise exposure will not exceed an hourly average of 65 dBA at the nearest occupied building at Rountree Medium (Jail) Facility, and 60 dBA at the lodging facility.	County of Santa Cruz with construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	Before the start of operations

Best Management Practices (part of Project Description)	Responsibility for Compliance	Method of Compliance	Timing of Compliance
1. Limit vehicle speeds on unpaved roads to a maximum of 25 miles per hour.	County of Santa Cruz with construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During and after construction
2. Limit fugitive dust by watering exposed dirt surfaces in construction areas twice daily, keeping all trenches dry to protect their integrity.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction
3. Apply soil stabilizers on inactive construction areas (disturbed lands unused for four consecutive days) and cover inactive storage piles.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction
4. Apply native hydro-seed or non-toxic binders to exposed areas after cut/fill operations.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction
5. Install perimeter protection (e.g., silt fence, fiber rolls) for construction near drainages and open space, including Transfer Station A (including Harkins Slough Road realignment), ODF Option 2 (if selected), and culvert and roadway improvements near drainages, to prevent contaminated construction runoff from leaving the construction site.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction
6. Minimize removal or disturbance of existing vegetation outside the footprint of project construction activities.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned	During construction

Best Management Practices (part of Project Description)	Responsibility for Compliance	Method of Compliance	Timing of Compliance
		to overall construction monitoring	
7. Limit site access and parking, equipment storage, and stationary construction activities to the designated staging areas to the maximum extent feasible.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction
8. Store, maintain, and refuel all equipment and materials in designated portions of the staging areas in accordance with permit requirements. As such, no staging will occur in areas with sensitive biological resources. Staging of material and equipment will be at least 100 feet from any drainages or include secondary containment for fueling and maintenance of equipment. Spill kits will be present on site at all times and will include absorbent materials, booms, disposable bags, and Personal Protective Equipment (gloves, goggles, coveralls). Examples of secondary containment include drip pans, spill trays, absorbent mats, and polyethylene or polypropylene sheeting. Secondary containment should have the capacity to hold the contents of portable fuel tanks, as well as the fuel and fluid tanks, systems, and reservoirs of all equipment.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction
9. Prior to staging equipment on site, clean all equipment caked with mud, soils, or debris from off-site sources to avoid introducing or spreading invasive exotic plant species.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	Prior to staging and construction
10. Position all stationary equipment, such as motors, pumps, generators, and/or compressors, over drip pans.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction

Best Management Practices (part of Project Description)	Responsibility for Compliance	Method of Compliance	Timing of Compliance
11. Erosion and sediment control measures shall be maintained continuously, repaired when and as necessary and shall be inspected within 24 hours of each rainfall event. Seeded areas shall be checked regularly and shall be watered, fertilized, reseeded and mulched as necessary to obtain a dense stand of grass.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction
12. All drain inlets shall be protected from siltation (e.g., inlet filters, fiber rolls, gravel bags). Ineffective protection devices shall be immediately replaced and the inlet cleaned. Flushing is not an acceptable method of cleaning.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction
13. When the crushed stone construction entrance has been covered with soil or has been pushed into the soil by construction traffic, it shall be replaced with a depth of stone equal to that of original application.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction
14. All materials used for fill or back-fill shall be free of wood, roots, rocks, boulders or any other non-compactable soil type material. Unsatisfactory materials also include man-made fills and refuse debris derived from any source. All material shall be inspected and approved by the County's construction manager and/or other qualified personnel.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction
15. Materials used to construct embankments for any purpose, back-fill around drainage structures or in utility trenches or any other depression requiring fill or back-fill shall be compacted the percentage determined by the County's construction manager and/or other qualified personnel following in ASTM Standard D-1557.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction
16. Certifications for materials including, but not limited to stone, concrete, pipes, precast units, handrails, stabilization mats, traffic signal items, must be	Construction contractor	Compliance monitored by County and qualified consultant	Prior to installation, during construction

Best Management Practices (part of Project Description)	Responsibility for Compliance	Method of Compliance	Timing of Compliance
provided to the County's construction manager and/or other qualified personnel prior to installation.		representative assigned to overall construction monitoring	
17. Embankment fill and trench back-fill shall be placed in lifts at a maximum uncompacted depth of 8-inches and 6-inches, respectively. Density test types and frequencies will be per the design engineer's recommendations.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction
18. Any discrepancies found between the drawings and specifications and site conditions or any inconsistencies or ambiguities in drawings or specifications shall be immediately reported to the County's construction manager and the design engineer, in writing, who shall promptly address such inconsistencies or ambiguities. Work done by the contractor after his discovery of such discrepancies, inconsistencies or ambiguities shall be done at the contractor's risk.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction

Environmental Enhancement and Habitat Restoration Features (part of Project Description)	Responsibility for Compliance	Method of Compliance	Timing of Compliance
These Environmental Enhancement and Habitat Restoration Features are shown in **Figure 2-4**.			
Restoration of Harkins Slough Road Drainage An existing seasonal to perennial drainage (hereinafter Harkins Slough Road Drainage) flows along the north side of Harkins Slough Road, from the unpaved roadway accessing the property to the north of the Landfill (the westernmost corner of the site proposed for Transfer Station A) westward to Buena Vista Drive. This drainage would be minimally impacted by the construction of Transfer Station A and the Harkins Slough Road realignment. In addition, as part of the Project, the drainage would be required to accommodate increased stormwater runoff from new impervious surfaces at Transfer Station A. The Project also includes the restoration of approximately 800 linear feet of the drainage, which would include re-grading the unvegetated channel to an elevation profile designed to repair existing incision and bank failure, and transport sediment without deposition (i.e., channel aggradation). Restoration would also include planting suitable riparian vegetation (such as willows, dogwood, and elderberry) on the upslope (north) embankment and replacing the iron bark eucalyptus trees with native trees, including riparian species and (above the break in bank) coast live oak, California bay, or other appropriate native tree species. Native low growing vegetation would be planted on the south (roadside) embankment. The final restoration design would retain and enhance the ecological functions and values[8] of the drainage and be developed by a qualified water resources engineer and qualified biologists, in coordination with the County Environmental Planning Section.	County of Santa Cruz or restoration contractor and a qualified USFWS/CDFW-approved biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County	During and after construction
Culvert Modification with Small Wildlife Crossing at Main Entrance An existing culvert is positioned beneath the driveway at the main landfill entrance from Buena Vista Drive, and it conveys an unnamed tributary (hereinafter Buena Vista Drive Tributary) to Gallighan Slough. As part of the Project, the grade of the landfill entrance would be modified to meet the new	County of Santa Cruz or restoration contractor and a qualified USFWS/CDFW-approved biologist and County Transportation Division engineers	Compliance monitored by qualified agency-approved biologist with oversight by the County	During Construction

[8] Ecological functions are the natural processes and physical, chemical, and biological activities within an ecosystem, such as nutrient cycling or carbon sequestration, that maintain its health and stability. "Ecological values" are the benefits derived from the functions such as: habitat and refuge for plants and wildlife, water storage and flood control, water quality protection and purification, groundwater recharge, and food chain support.

Environmental Enhancement and Habitat Restoration Features (part of Project Description)	Responsibility for Compliance	Method of Compliance	Timing of Compliance
grade of Buena Vista Drive[9]. This activity would not require any work within the tributary. The Project also includes adding a ledge within the culvert to facilitate safe passage of the federally threatened California red-legged frog (CRLF) and other small wildlife species under most hydrologic conditions. A known breeding pond for CRLF exists approximately 0.7 miles northwest of the wildlife crossing, and an individual CRLF was observed in Channelized Gallighan Slough, south (downstream) of the landfill entrance. The culvert modifications would be developed in coordination with qualified biologists and County Transportation Division engineers, and would not compromise culvert capacity.			
Culvert Replacement under Internal Roadway to Old Landfill An existing 7-foot-diameter culvert conveys Channelized Gallighan Slough beneath the internal roadway leading to the Old Landfill within the landfill property. The existing culvert is undersized, resulting in upstream backwater ponding and sediment deposition, and would be replaced with a larger structure (e.g., a larger culvert with a natural streambed or with a clear-span bridge) Design to reduce the hydraulic constriction and associated flooding and sedimentation upstream within Channelized Gallighan Slough and the Buena Vista Drive Tributary. Sediment are largely derived from nearby row-crop agricultural fields. The final design would be developed in coordination with qualified biologists to incorporate wildlife passage (as needed and feasible, depending on the final design) and would accommodate existing utilities (e.g., landfill gas pipe and water pipe along the south side of the roadway). The larger capacity replacement culvert or bridge would improve ecological and hydrologic conditions in channelized Gallighan Slough, as well as in Buena Vista Drive Tributary, by maintaining sediment transport competence and reducing aggradation of the stream channels, thereby extending the return interval for maintenance and reducing frequent flood conditions near the current Landfill main entrance. Specifically, reducing sediment deposition in the channels would maintain a more stable bed, bank, and ordinary high-water mark while improving overall ecological conditions of the streams by supporting open-water riverine conditions and an associated diverse riparian habitat. The upsized culvert or bridge would restore functional riverine habitat and reduce or eliminate the conversion to	County of Santa Cruz or restoration contractor and a qualified USFWS/CDFW-approved biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County	During Construction

[9] As part of a separate project, the County is planning to rehabilitate Buena Vista Drive, which includes raising the roadway along the landfill frontage to improve the geometry and address local flooding issues,

Environmental Enhancement and Habitat Restoration Features (part of Project Description)	Responsibility for Compliance	Method of Compliance	Timing of Compliance
instream freshwater marsh features which have established on the agricultural sediments. The instream freshwater marsh that has developed within the Buena Vista Drive Tributary is associated with the following negative ecological effects: shorter hydroperiod; lack of running water, pools or riffles; poor water quality (e.g., turbidity, less dissolved oxygen); loss of temperature gradients (that support species diversity); absent or degraded habitat for invertebrates (which are the basis of the food chain for fish and amphibians); and diminished hydrologic capacity of the stream, exacerbating flood risk. The larger capacity culvert or bridge would reduce or eliminate this conversion of habitat from riverine to instream freshwater marsh. Extensive freshwater marsh habitat would remain at the confluence with Gallighan Slough and in off-channel locations along the streams.			
Restoration of Old Landfill Wetland and Drainage (ODF Option 2 Only) ODF Option 2 would be located on the top deck of the Old Landfill. An existing wetland swale and drainage is present, along the southern half of the southwestern boundary, between the Old Landfill and the Santa Cruz Branch Rail Line (SCBRL) railroad tracks. This aquatic feature flows directly to Gallighan Slough. If ODF Option 2 is selected, the wetland and drainage would be restored and enhanced as part of the Project. ODF Option 2 includes a new drainage ditch to be installed parallel to and northeast of the existing seasonal wetland swale to accommodate increased stormwater runoff from the ODF Option 2 facility. The new drainage ditch would tie into the seasonal wetland and drainage downgradient from the ODF Option 2 facility through an outlet feature between the ditch and wetland swale. Additionally, to restore the naturalized aquatic feature, the existing seasonal wetland and drainage would be recontoured to channel elevations that existed prior to the 2022–2023 storm season, and accumulated sediments would be removed to restore native wetland vegetation and wildlife habitat. The wetland feature was inundated by agricultural sediments during the 2022-2023 storm season, and the depressional swale that existed previously was filled in such that there was no longer a topographic transition between the Old Landfill deck and the adjacent wetland. While wetland vegetation (primarily arroyo willow and relictual cattails) persists in some locations, ponding, pooling, and variation in wetland type, depth and associated vegetation was eliminated, along with	County of Santa Cruz or restoration contractor and a qualified USFWS/CDFW-approved biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County	During Construction

Environmental Enhancement and Habitat Restoration Features (part of Project Description)	Responsibility for Compliance	Method of Compliance	Timing of Compliance
diverse habitat for common and sensitive amphibians. The restoration design would restore variation in wetland depth (i.e. ponding), and herbaceous freshwater emergent marsh would be re-established. The restoration design would be developed by a qualified biologist in coordination with the County Environmental Planning Section. The seasonal wetland and drainage would not be restored if ODF Option 2 is not approved.			
Wildlife Movement Corridor between Gallighan Slough and Harkins Slough To facilitate opportunities for wildlife movement between key aquatic features (Gallighan Slough and Harkins Slough), a wildlife movement corridor would be established across the southern portion of the closed landfill. This would include planting low growing, shallow-rooted native perennial vegetation[10] on portions of the landfill cap (where feasible). Where there is sufficient soil depth in the vegetative layer of the cap above the barrier membrane, shallow-rooted native perennial species (including suffrutescents[11], shrubs, and vine plantings) would be planted. Native perennial plantings would require a minimum of 24 inches (30–36 inches is preferred) of vegetative layer/topsoil on top of the barrier membrane; therefore, perennial plantings would be limited to locations where this is feasible (where more topsoil can be added without causing potential slope stability issues). Downed logs would be placed on flatter portions of the corridor and any appropriate areas of the already closed landfill to provide shelter for wildlife.	County of Santa Cruz or restoration contractor	Compliance monitored by qualified agency-approved biologist with oversight by the County	During Construction
Wildlife Directional Features at Key Locations Directional fencing and other protective features would be included in the final project design to direct wildlife away from high operational activity areas. For example, fencing would be included to direct wildlife away from internal roadways and toward Gallighan Slough, which extends between the north and south portions of the landfill. It would also include fencing around Transfer Station A to direct wildlife toward adjacent open space and drainages.	County of Santa Cruz or restoration contractor	Compliance monitored by the County of Santa Cruz	During Construction

[10] A 20-year study demonstrated that the roots of shallow-rooted scrub vegetation grow laterally when reaching the landfill cap and do not penetrate the cap (Holl and McStay 2014).

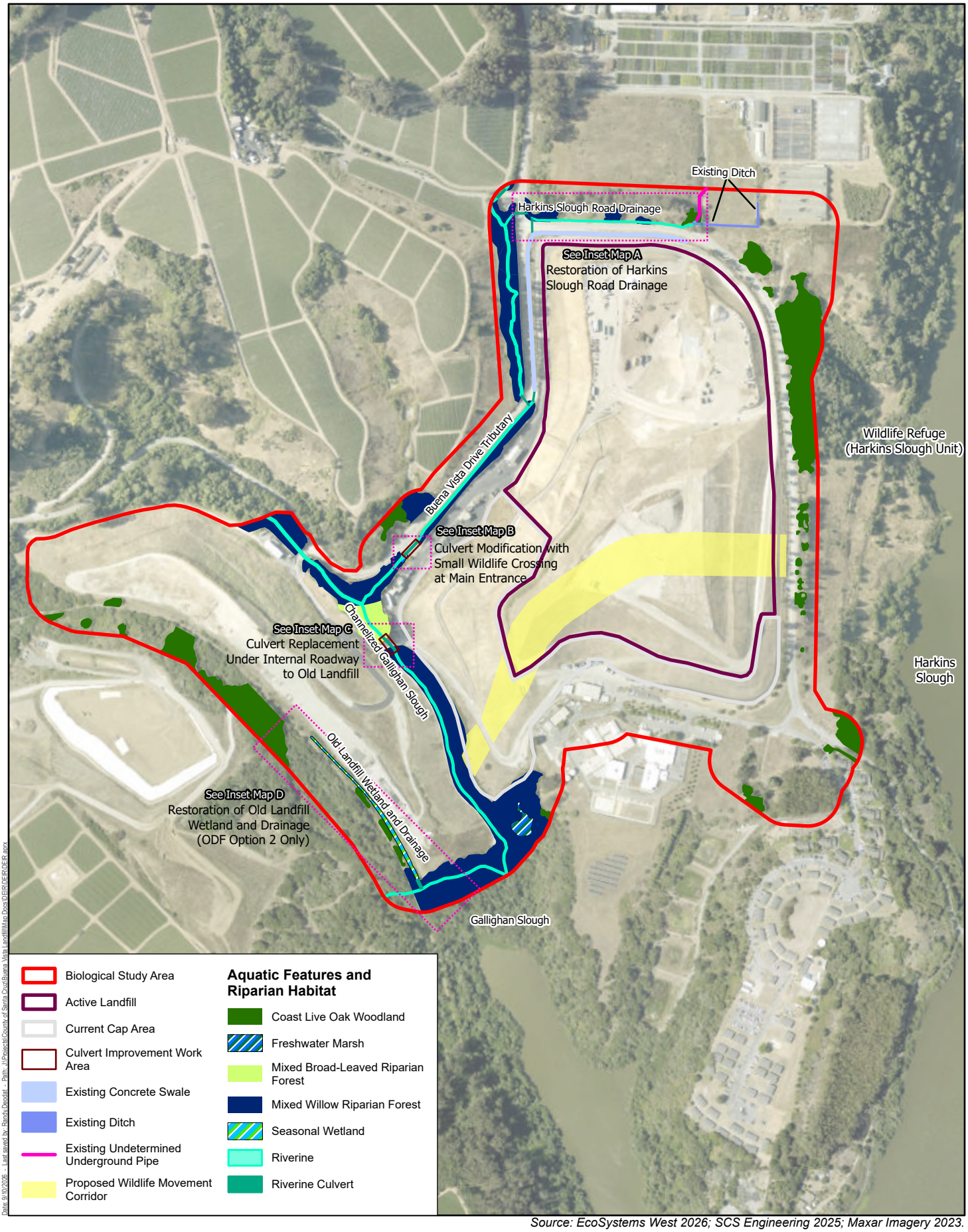
[11] A suffrutescent plant has a woody lower portion at the base of its stems that persists year to year, while the upper softer growth is herbaceous (non-woody).

Table 3.4-1. Recommended Construction Timing to Avoid/Minimize Impacts to Sensitive Biological Resources

Biological Resource	Relevant Habitat Type	Preferred Period of Avoidance	Preferred Construction Window	Resource/Life Events/Functions/ Values to be Protected	Required Best Management Practices
Aquatic/adjacent riparian	-	Rainy season, approximately October 15–April 15[1]	April 16–October 14	Water quality, vegetation, stable banks and slopes	Silt fencing Dewatering, diversion/bypass, If needed Confine Project footprint
Oak woodland	-	Rainy season, approximately October 15–April 15	April 16–October 14	Trees and dripline of canopy, stable slopes, soils, and understory	Silt fencing Confine Project footprint
Crotch's bumble bee	Non-Native/Ruderal Grassland	-	-	Individual bees, nest sites, foraging habitat	Pre-construction survey during the April–August period preceding construction
California red-legged frog	Buena Vista Drive Tributary Harkins Slough Road Drainage Channelized Gallighan Slough Old Landfill Wetland/Drainage Adjacent Riparian Adjacent Uplands	Rainy season, approximately October 15–April 15	April 16–October 14	Individual frogs, aquatic and upland habitat quality, movement and dispersal	Pre-construction survey Biological monitoring
Northwestern pond turtle	Channelized Gallighan Slough Adjacent Uplands	N/A	N/A	Individual turtles, movement/basking in aquatic habitat, nesting in adjacent upland habitat (May–July)	Pre-construction survey Biological monitoring
Bird species	All	February 1–August 31	September 1–January 31	Adults, nests, eggs, and young, nesting activities	Breeding bird surveys February 1–August 31
Bat species	Trees, Buildings, Culverts	November 1–February 15 and May 1–August 31	September 1–October 31	Individual bats, roosting, especially maternity roosts and winter hibernacula	Pre-construction Acoustic/emergence survey All times
San Francisco dusky-footed woodrat	Oak Woodland Riparian	October 1–July 31	August 1–September 30	Individual woodrats, woodrat houses, especially during breeding and rearing	Pre-construction survey All times
Tree/vegetation removal	All	October 15–August 31	September 1–October 14	All	-

Notes:

[1] While this time period aligns with the typical rainy season in coastal Santa Cruz County, agencies such as the Regional Board use other rainy season time periods (October 1–May 31) that may further restrict Program implementation or require filing a Request for an Early Start or Extended Work Period, if aquatic features requiring agency permits are present.



Source: EcoSystems West 2026; SCS Engineering 2025; Maxar Imagery 2023.

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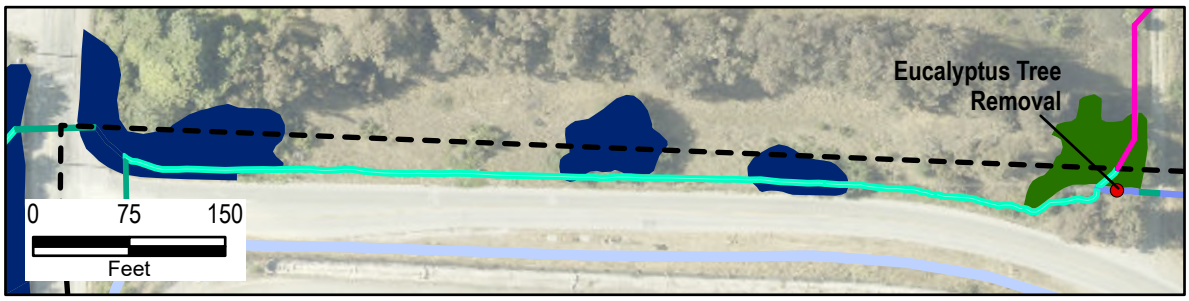
Figure 2-4a

Environmental Enhancement and Habitat Restoration Features

Buena Vista Landfill Redevelopment Project

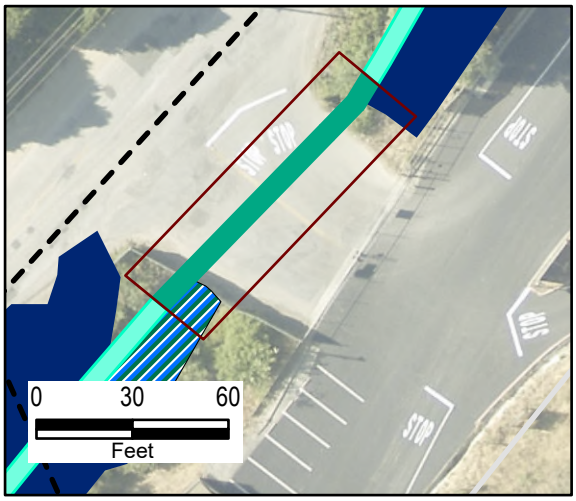
Inset Map A

Restoration of Harkins
Slough Road Drainage



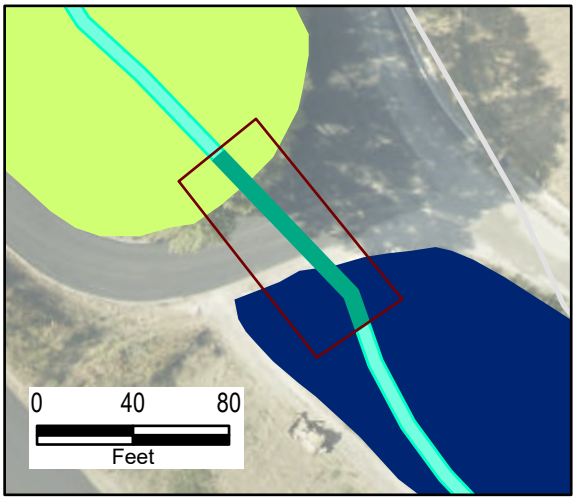
Inset Map B

Culvert Modification with Small
Wildlife Crossing at Main Entrance



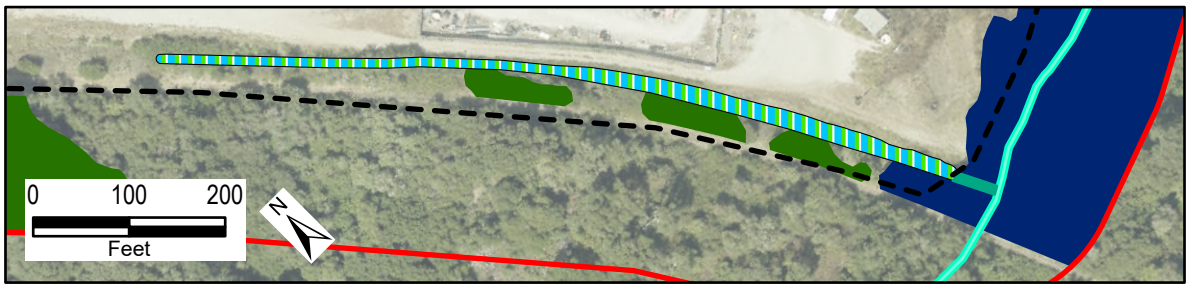
Inset Map C

Culvert Replacement Under
Internal Roadway to Old Landfill



Inset Map D

Restoration of Old Landfill Wetland
and Drainage (ODF Option 2 Only)



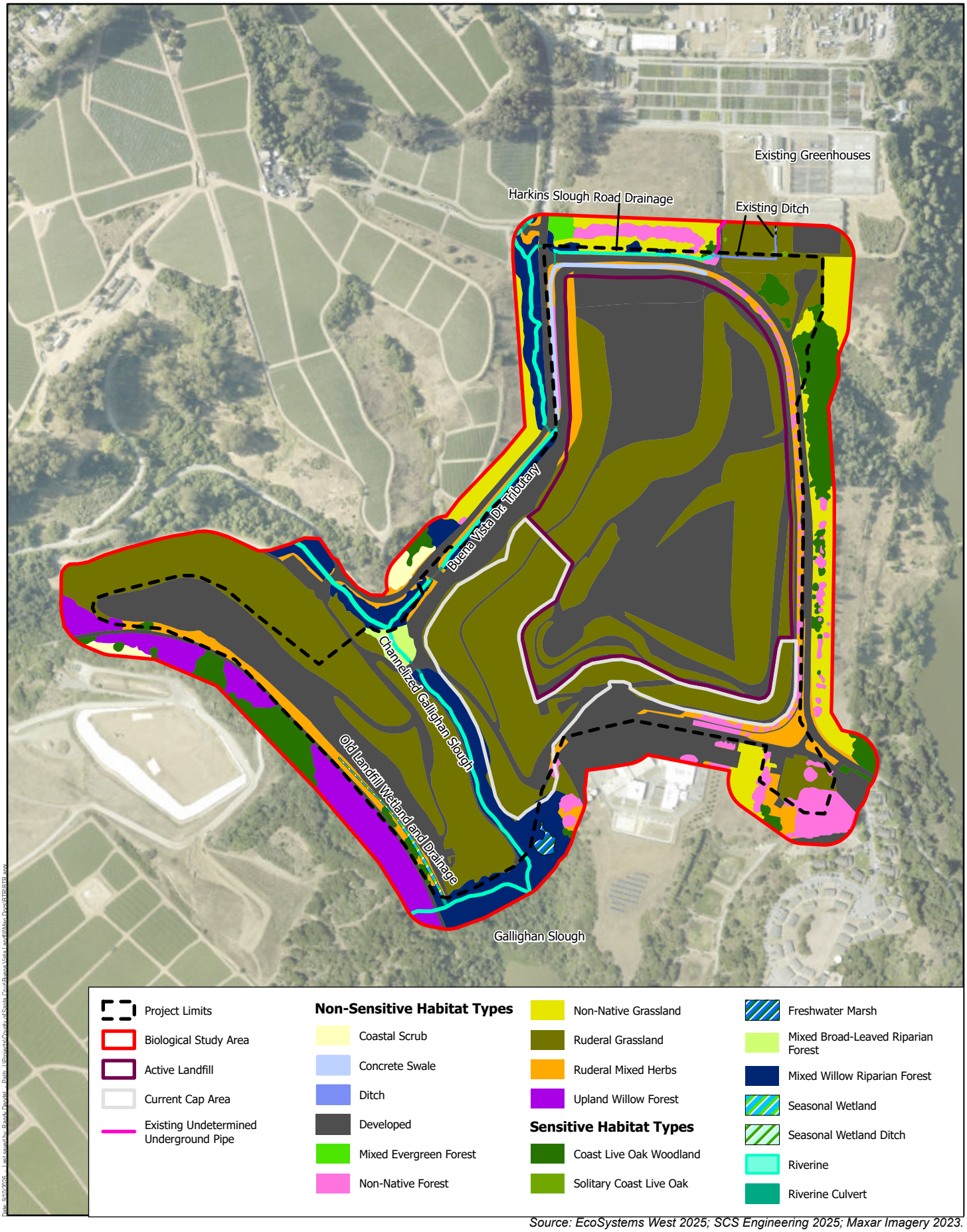
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Source: EcoSystems West 2026; SCS Engineering 2025; Maxar Imagery 2023.

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Figure 2-4b
Environmental Enhancement and
Habitat Restoration Features
Buena Vista Landfill Redevelopment Project



Source: EcoSystems West 2025; SCS Engineering 2025; Maxar Imagery 2023.

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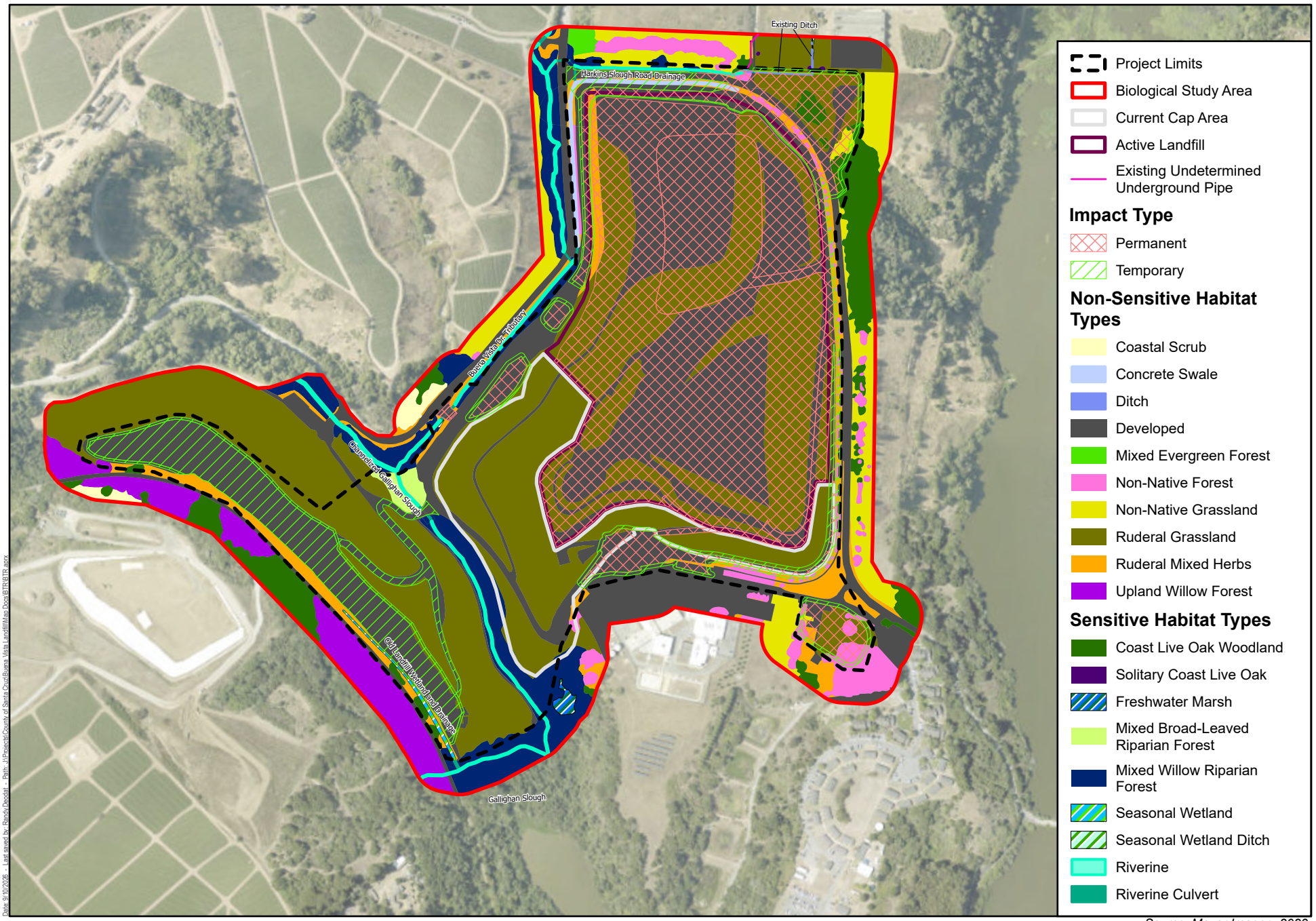
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Figure 3.4-1

Habitat Types within the Study Area

Buena Vista Landfill Redevelopment Project



Source: Maxar Imagery 2023.

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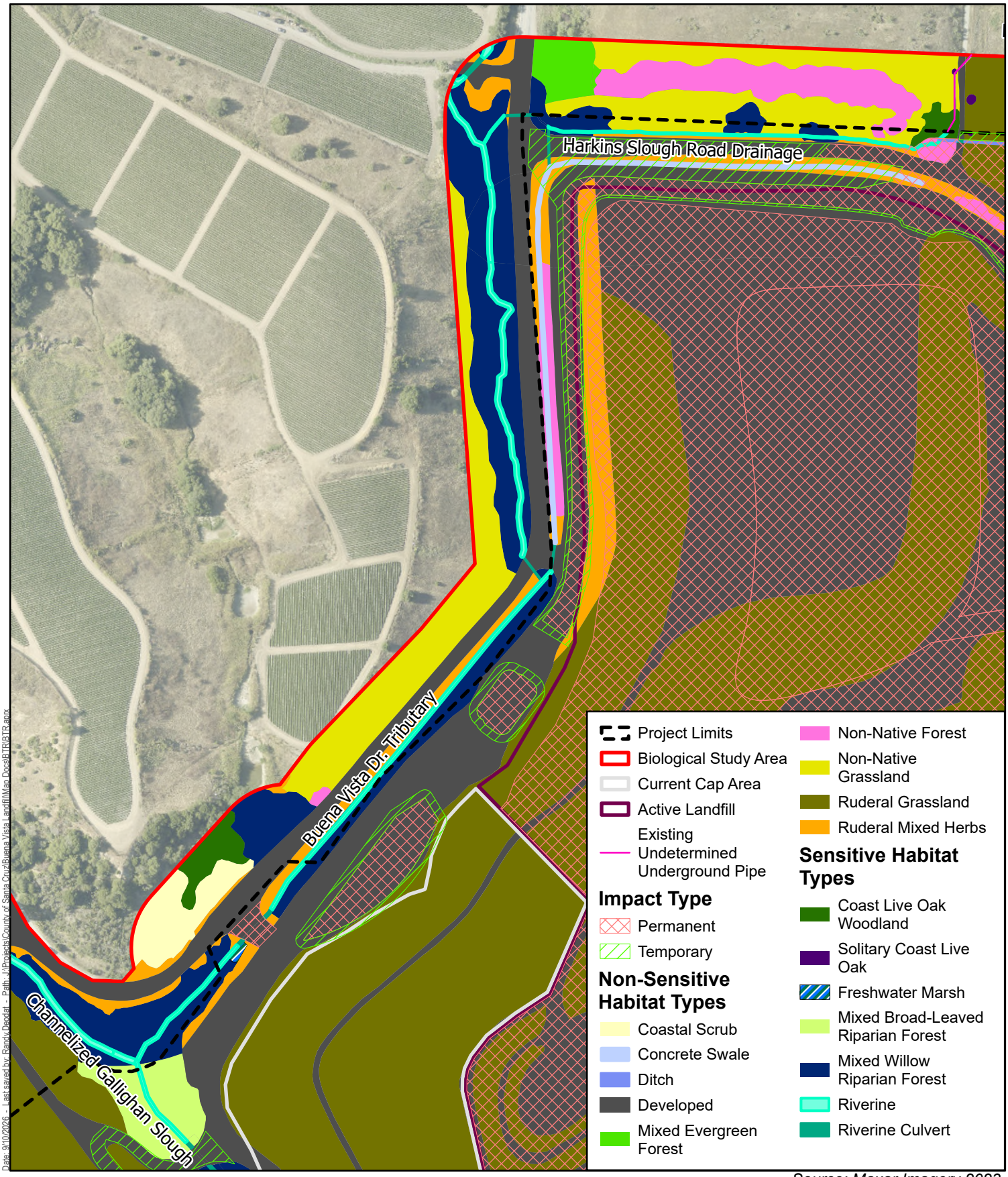
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Figure 3.4-2A

Habitat Type Impacts for Proposed Project

Buena Vista Landfill Redevelopment Project



Source: Maxar Imagery 2023.

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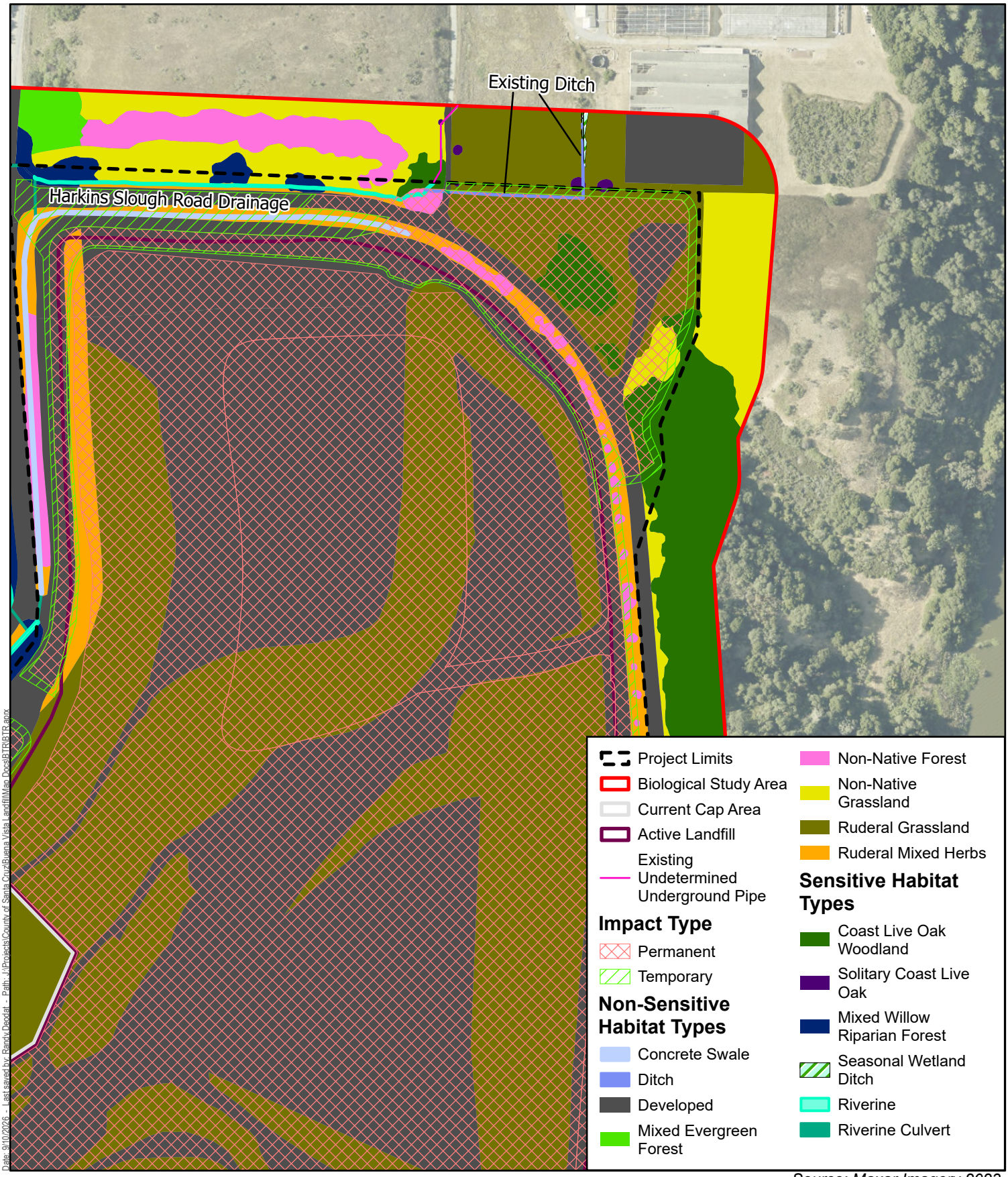
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Figure 3.4-2a

Habitat Type Impacts for Proposed Project

Buena Vista Landfill Redevelopment Project



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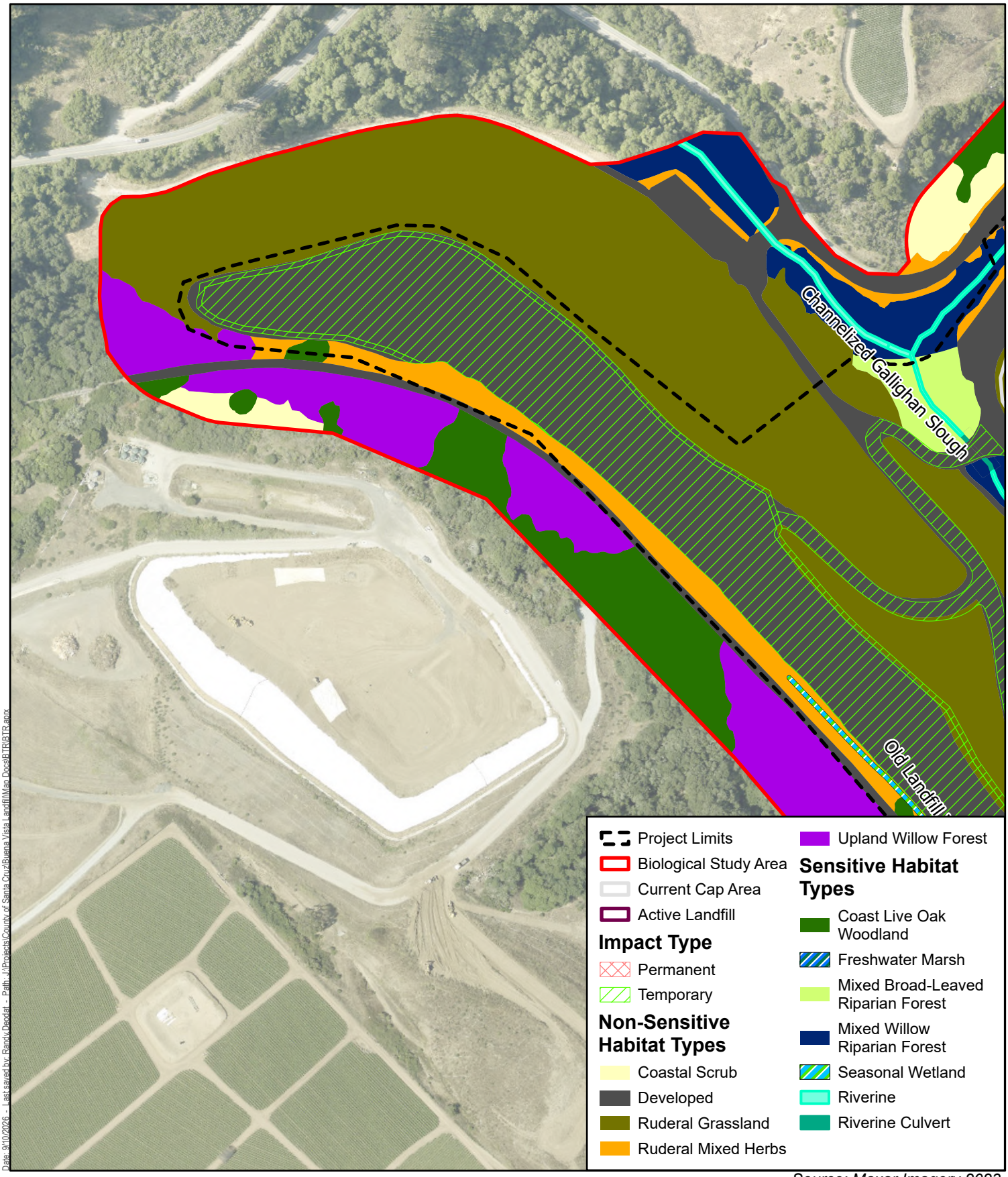
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Figure 3.4-2b

Habitat Type Impacts for Proposed Project

Buena Vista Landfill Redevelopment Project



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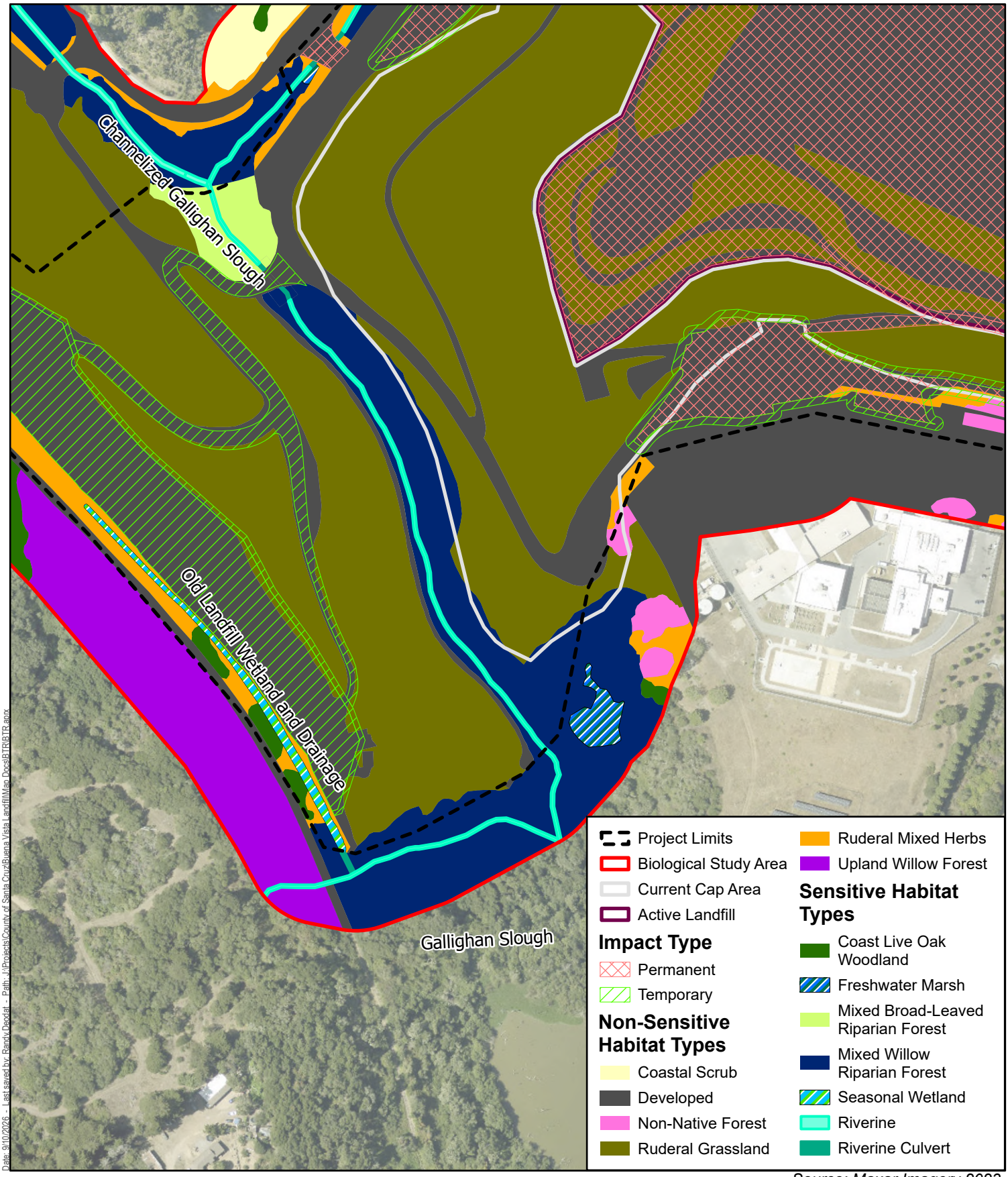
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Figure 3.4-2c

Habitat Type Impacts for Proposed Project

Buena Vista Landfill Redevelopment Project



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Source: Maxar Imagery 2023.

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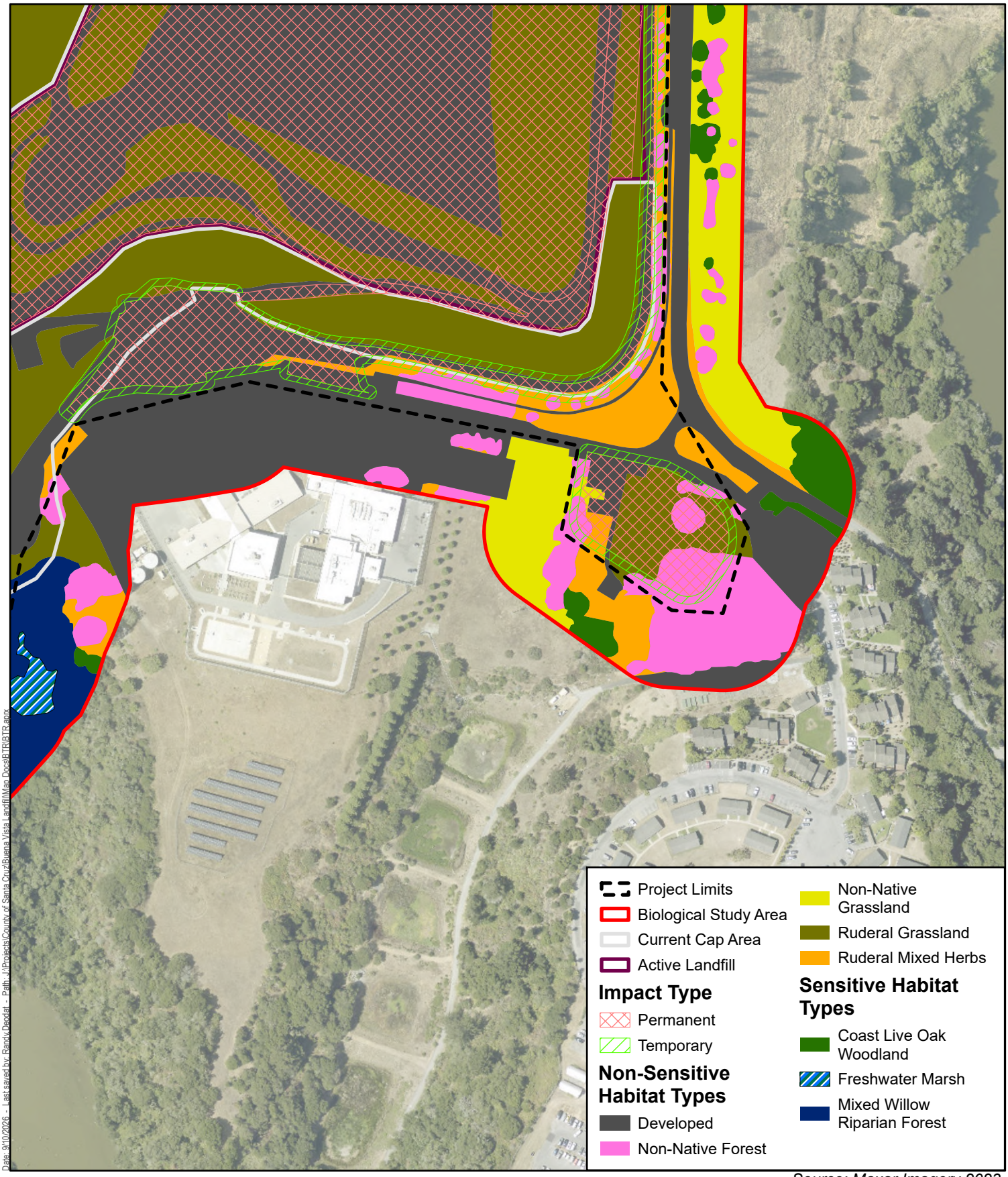
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Figure 3.4-2d

Habitat Type Impacts for Proposed Project

Buena Vista Landfill Redevelopment Project



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Source: Maxar Imagery 2023.

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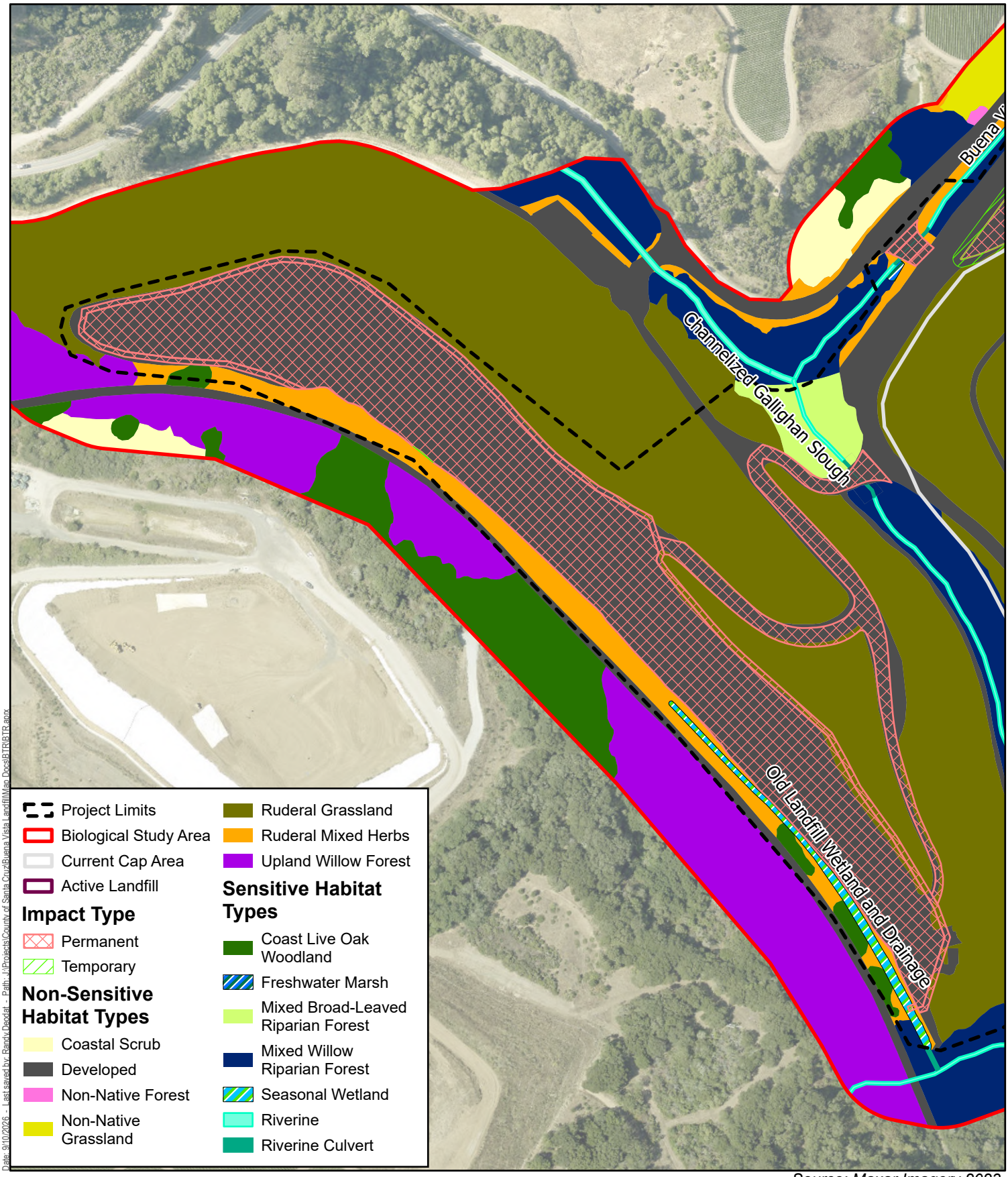
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Figure 3.4-2e

Habitat Type Impacts for Proposed Project

Buena Vista Landfill Redevelopment Project



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Source: Maxar Imagery 2023.

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Figure 3.4-2B

Habitat Type Impacts for ODF Option 2

Buena Vista Landfill Redevelopment Project

APPENDIX G4 NATIVE SHALLOW-ROOTED SHRUBS, PERENNIAL HERBS, AND VINES PROPOSED THE FOR THE LANDFILL CAP

UPLAND SPECIES

Baldhip rose (*Rosa gymnocarpa*)
Black sage (*Salvia mellifera*)
Blue elderberry (*Sambucus Mexicana*)
Blueblossum (*Ceanothus thyrsiflorus*)
Brittle leaf manzanita (*Arctostaphylos crustacea*)
California buckwheat (*Eriogonum fasciculatum*)
California fuchsia (*Epilobium canum*)
California poppy (*Escholzia californica*)
California sagebrush (*Artemisia californica*)
Chamise (*Adenostoma fasciculatus*)
Chaparral currant (*Ribes malvaceum*)
Coast silk tassel (*Garrya elliptica*)
Coffeeberry (*Frangula californica*)
Columbine (*Aquilegia Formosa*)
Creeping snowberry (*Symphoricarpos mollis*)
Flannel bush (*Fremontodendron californicum*)
Fuchsia flowered gooseberry (*Ribes speciosum*)
Giant vetch (*Vicia gigantea*)
Gooseberry (*Ribes mensiesii*)
Lemonade berry (*Rhus integrifolia*)
Lupine (*Lupinus bicolor*)
Naked buckwheat (*Eriogonum nudum*)
Osoberry (*Oemleria cerasiformis*)
Paintbrush (*Castilleja affinis*)
Pink honeysuckle (*Lonicera hispidula*)
Pitcher sage (*Lepechinia calycina*)
Sticky-monkey flower (*Diplacus aurantiacus*)
Toyon (*Heteromeles arbutifolia*)
Wartleaf ceanothus (*Ceanothus papillosus*)
Wooly leaf manzanita (*Arctostaphylos tomentosa*)
Yarrow (*Achillea millefolium*)

RIPARIAN BUFFER SPECIES

California aster (*Symphyotrichum chilense*)
California blackberry (*Rubus ursinus*)
California wild rose (*Rosa californica*)
Cardinal monkey flower (*Erythranthe cardinalis*)
Coast twinberry (*Lonicera involucrate*)
Spreading gooseberry (*Ribes divaricatum*)
Western goldenrod (*Euthamia occidentalis*)
Western verbena (*Verbena lasiostachys*)

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County of Santa Cruz
701 OCEAN STREET, SANTA CRUZ, CA 95060

MITIGATION MONITORING AND REPORTING PROGRAM for Buena Vista Landfill Redevelopment Project Alternative 3 (Combined Facilities)

This Mitigation Monitoring and Reporting Program (MMRP) for the Buena Vista Landfill Redevelopment Project – Alternative 3 (Combined Facilities) includes:

- Mitigation Measures identified in the Environmental Impact Report (EIR)
- Best Management Practices included as part of the Alternative 3 (Combined Facilities)
- Environmental Enhancement and Habitat Restoration Features included as part of Alternative 3 (Combined Facilities)

Figures, tables, and appendices referenced herein are included as attachments at the end of the MMRP. If full documents are referenced, a link to the website is provided as a footnote.

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
AG-2	**Agricultural Buffer (Solid Board Fencing and Evergreen Vegetation) along Northern Property Line** Prior to the start of construction, a solid fence at least six feet in height and a vegetative barrier shall be installed along the northern property line to provide a physical buffer between the Alternative 3 site and the adjacent commercial agricultural property. The fencing and vegetative barrier shall extend laterally at least 25 feet beyond the extent of any development or area of intensive human use located within 200 feet of the adjacent commercial agricultural property. The proposed barrier shall be reviewed by the Santa Cruz County Agricultural Policy Advisory Commission (APAC) to ensure consistency with applicable County policies, verify that the barrier provides adequate protection from potential land use conflicts, and ensure that the height and design of the barrier do not detrimentally affect the adjacent agricultural property through excessive shading. The vegetative barrier shall consist of plant varieties identified on the County's Agricultural Buffer Plant List.	County of Santa Cruz or Construction Contractor and Santa Cruz County Agricultural Policy Advisory Commission (APAC)	Compliance monitored by the County of Santa Cruz with review by the Agricultural Policy Advisory Commission (APAC) and implementation by the Project Applicant and construction contractor	Prior to construction

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	Both the fencing and vegetative barrier shall be maintained for the operational life of the facility.			
BIO-1a	**Conduct Environmental Training Prior to Construction** The County or their construction contractor will be responsible for hiring a qualified USFWS/CDFW-approved biologist (agency-approved biologist[1]) to conduct an environmental training session for all construction personnel regarding the sensitive wildlife species that have potential to occur in or near the project area. This mitigation measure applies to all project components. The environmental training will cover the following topics: • Description, identification, and photograph of sensitive species (Crotch's bumble bee, California red-legged frog, northwestern pond turtle, sensitive bird species and other nesting birds, San Francisco dusky-footed woodrat, sensitive bats and other roosting bats); • Natural history information; • Protective measures and best management practices to be implemented to protect sensitive wildlife species and their habitat; and • The importance of avoiding impacts to sensitive species and the procedures to follow if individuals are encountered, alive or dead, including contacting the USFWS/CDFW-approved biologist. Printed hand-outs summarizing key project permit conditions and sensitive biological resources (with photographs) will be provided. All construction personnel will receive the training prior to beginning work. Any new crew members that join after work has been initiated will also receive the training prior to beginning work. A sign-in sheet will document completion of the training.	County of Santa Cruz or construction contractor and a qualified USFWS/CDFW-approved biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	Prior to construction

[1] Agency-Approved Biologist. A minimum of 30 days prior to project initiation, biologists contracted to provide biological monitoring services for a project are typically required to submit in writing or by email their qualifications for approval to U.S. Fish and Wildlife Service (USFWS) and/or the California Department of Fish and Wildlife (CDFW), as applicable. Required qualifications will vary depending on the species. These agency-approved biologists will conduct any required species-specific surveys, provide worker's environmental awareness training, and handle and relocate wildlife in accordance with permit conditions and agency requirements.

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
BIO-1b	**Schedule Construction to Avoid Impacts to Sensitive Biological Resources** Whenever feasible, the County or their contractor will schedule construction to avoid impacts to sensitive biological resources including sensitive habitats, aquatic and riparian habitats, and sensitive wildlife species. **Table 3.4-4**, Recommended Construction Timing to Avoid/Minimize Impacts to Sensitive Biological Resources, lists the preferred construction windows to avoid and minimize impacts to biological resources, as well as a brief overview of required best management practices to implement during construction activities.	County of Santa Cruz with construction contractor and qualified biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	Prior to and during construction
BIO-1c	**Conduct Pre-construction Surveys and Implement Buffers for Crotch's Bumble Bee** For project construction activities to be initiated in non-native grassland or ruderal habitats during the peak of the active colony period (April–June), the County or their construction contractor will be responsible for hiring a qualified biologist to conduct a pre-construction survey for nesting and foraging bumble bees. Surveys will be conducted during the peak of the active colony period immediately preceding the project start date. • Surveys will occur prior to beginning construction activities and will include all work, staging, and access areas and a buffer radius of 100 feet within suitable grassland habitat. • Surveys will occur when temperatures are at or above 60 degrees Fahrenheit and at or below 90 degrees Fahrenheit on sunny or partially sunny days when wind speeds are below 8 miles per hour. Surveys will begin no earlier than 2 hours after sunrise and no later than 3 hours before sunset.	County of Santa Cruz with construction contractor and qualified biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	Prior to construction

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	• If Crotch's bumble bee are detected, the biologist will consult with CDFW prior to initiating Project activities. Crotch's bumble bee nests will be given a buffer of 50 feet in which no project activities will occur. The qualified biologist will develop a plan with CDFW to prevent the take of the nest or any individual within the project area.			
BIO-1d	**Restore and Promote Crotch's Bumble Bee Habitat** Where feasible, the County will promote suitable habitat for Crotch's bumble bee through restoration activities, such as planting of native thatched grasses, native nectar and pollen-producing plants, and placement of downed logs. The restoration activities can be incorporated into temporary impact areas and the planned wildlife movement corridor to be located across the southern portion of the closed landfill (as shown on **Figure 2-4 and Figure 5-13**, Environmental Enhancement and Restoration Features).	County of Santa Cruz and qualified biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	During and after construction
BIO-3	**Implement Protective Measures and Biological Monitoring for California Red-Legged Frog and Northwestern Pond Turtle** During project construction activities, the County or their construction contractor, in coordination with an agency-approved biologist, will employ the following protective measures and biological monitoring for sensitive wildlife species, the California red-legged frog (CRLF) and northwestern pond turtle (NWPT). • Prior to initiation of construction activities, an agency-approved biologist will identify and/or clearly mark in the field all areas to be avoided and/or protected. No construction activities will be conducted within these areas. • Prior to initiation of construction activities, an agency-approved biologist with experience in the identification of all life stages of CRLF (egg masses, tadpoles, juveniles, and adults) and NWPT (nests, juveniles, adults) will perform a pre-construction survey. The survey will occur no more than 48 hours before construction activities start.	County of Santa Cruz or construction contractor and a qualified biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	During construction

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	• An agency-approved biologist will be present during all work within aquatic features, adjacent riparian habitat, and initial activities involving vegetation removal, clearing, grubbing, trenching, or earth movement (in all habitat types). If the biologist detects any life stage of CRLF or NWPT in the project area during construction, work will cease immediately; and with the authorization of USFWS via the Biological Opinion, the biologist will capture and relocate the animal to a previously identified agency-approved relocation habitat. • Construction activities in or near known or potential habitat or designated critical habitat will take place during the dry season between May 1 and October 15 (refer to **Mitigation Measures BIO-1a** and **BIO-1b** and **Table 3.4-4**) or until the first rain of the season, especially vegetation removal, soil disturbance, and work in or near aquatic features. Avoid working at night or during rain events when special-status amphibians and mammals are generally more active. Consult weather forecasts from the National Weather Service at least 72 hours prior to performing work. • The agency-approved biologist will check under all equipment for wildlife before use. If any special-status wildlife is observed under equipment or within the work area, the approved biologist will be permitted to handle and relocate it. • The agency-approved biologist will permanently remove any individuals of exotic species (such as bullfrogs, crayfish, and centrarchid fishes) from the project area to the maximum extent possible. The biologist will be responsible for ensuring his or her activities are in compliance with the California Fish and Game Code. • To ensure that diseases are not conveyed between work sites, the agency-approved biologist(s) will adhere to Recommended Equipment Decontamination Procedures outlined in Appendix B of the Revised Guidance on Site			

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	Assessments and Field Surveys for the California Red-Legged Frog (USFWS 2005).[2] • At the end of each workday, excavations shall be secured with a cover, or a ramp installed to prevent wildlife entrapment. • All trenches, pipes, culverts or similar structures shall be inspected for animals prior to burying, capping, moving, or filling. • To minimize vehicle strikes of CRLF and NWPT, restrict parking to daytime hours, if feasible.			
BIO-5a	**Avoid Vegetation Removal During Breeding Bird Season or Conduct Nesting Bird Surveys** The County or their construction contractor will schedule construction to avoid vegetation removal during breeding bird season or conduct pre-construction nesting bird surveys. Typically, the avian breeding season occurs between February 1 and August 31 (see **Table 3.4-4**,) with some species (e.g., hummingbirds and owls) nesting outside of this period. If feasible, perform vegetation removal activities outside of breeding bird season (ideally between September 1 and October 15) to avoid direct harm or mortality to potential nesting bird species and other sensitive biological resources. For all construction activities initiated during the breeding bird season, or if construction activities lapse for a period of one week or more during breeding bird season, an agency-approved biologist will conduct a breeding bird survey for nesting birds, including raptors. Surveys will be conducted within 7 days, prior to beginning construction activities and will include all work, staging, access areas, and minimum survey radii surrounding the work area as follows: • 250 feet for non-raptors;	County of Santa Cruz or construction contractor	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	Prior to and during construction

[2] U.S. Fish and Wildlife Service (USFWS). 2005. Revised Guidance on Site Assessments and Field Surveys for the California Red-legged Frog. Prepared August 2005. https://www.fws.gov/sites/default/files/documents/guidance-on-site-assessments-and-field-surveys-for-california-red-legged-frog.pdf.

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance

	• 500 feet for small raptors such as accipiters; and
	• 1,000 feet for larger raptors such as buteos.
	
	The survey will include potential habitat for raptors, sensitive and common nesting avian species and will include trees, other vegetation and suitable habitat (buildings, equipment, ruderal areas, brush piles, gravel, rocks) for ground-nesting and opportunistic species (e.g., house finch, California towhee, dark-eyed junco, and/or kildeer). The following measures will be implemented based on the survey results.
	• If no nesting sensitive or common avian species are observed during breeding bird surveys no additional measures would be required.
	• If common nesting birds are observed within or adjacent to the project area, postpone activities until young have fledged to avoid direct harm or mortality of nesting birds and/or establish buffers appropriate to the species, such as protective buffers recommended in PG&E et al. (2015). The size of the buffer would also depend on the location of the nest relative to the project area, construction activities proposed for this location, and other specific conditions (e.g., equipment operation).
	• Sensitive bird species, if nesting in or near the project area, will be given special consideration and may require additional protective measures as determined through consultation with the relevant agency (USFWS or CDFW), such as protective buffers recommended in PG&E et al. (2015):
	  ○ Bald eagle, golden eagle: 2,640 feet
	  ○ White-tailed kite, and other raptors: 300 feet
	  ○ California gull and western gull: 150 feet
	  ○ California thrasher, Bullock's oriole, grasshopper sparrow, Lawrence's goldfinch, yellow warbler, wrentit: 75 feet
	  ○ Allen's hummingbird, oak titmouse, olive-sided flycatcher, Nuttall's woodpecker: 50 feet			

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	• An agency-approved biologist will monitor active nest sites for construction-related disturbances and adjust protective buffers as necessary to prevent disruption of nesting activities. • No construction activity shall be allowed in the buffer until the biologist determines that the nest is no longer active, or unless monitoring determines that a smaller buffer will protect the active nest. The buffer may be reduced if the biologist monitors the construction activities and determines that no disturbance to the active nest is occurring. • If an active nest is identified in or adjacent to the construction zone after construction has started, the above measures will be implemented to ensure construction is not causing disturbance to the nest.			
BIO-5b	**Conduct Surveys for Wintering Sensitive Bird Species** The County or their construction contractor will ensure an agency-approved biologist conducts surveys for wintering sensitive bird species. The following measures will be implemented to protect wintering sensitive bird species, if present: • If any work is performed during the burrowing owl wintering period (November–March), conduct a survey for these species. The survey will be conducted by an agency-approved biologist and include the Project area and suitable habitat within 490 feet. • If burrowing owls are detected: ▫ Avoid destruction of fossorial mammal burrows during construction; ▫ Place visible markers near occupied burrows and fence off suitable habitat; ▫ Avoid direct destruction of burrows, and ▫ Include the burrowing owl in the environmental training for construction personnel (**Mitigation Measure BIO-1a**).	County of Santa Cruz or construction contractor and a qualified biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	Prior to and during construction activities

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
BIO-6	**Schedule Tree Removal to Avoid Bat Maternity Roosts and Winter Hibernacula and/or Conduct Pre-construction Surveys and Implement Protective Measures for Bat Roosts** If feasible, the County or their construction contractor will conduct limbing/tree removal operations between September 15 and November 1 to avoid bat maternity roosts and winter hibernacula. During all months, prior to limbing/tree removal, the County or their construction contractor shall ensure an agency-approved biologist conducts a pre-construction survey for bats to determine if crevice or foliage-roosting bats are present, as follows: • A qualified biologist shall determine if bats are utilizing the area for roosting. For any buildings, culverts, or trees/snags that could provide roosting space for cavity or foliage-roosting bats, potential bat roost features shall be thoroughly evaluated to determine if bats are present. Visual inspection and/or acoustic surveys shall be utilized as initial techniques. If roosting bats are found, the biologist shall develop and implement acceptable passive exclusion methods in coordination with or based on CDFW recommendations. Exclusion shall take place during the appropriate windows (September 1 and November 1) to avoid harming bat maternity roosts and/or winter hibernacula. (Authorization from CDFW is required to evict winter hibernacula for bats). • If established maternity colonies are found, in coordination with CDFW, a buffer shall be established around the colony to protect pre-volant young from construction disturbances until the young can fly; or implement other measures acceptable to CDFW. • If a building or tree is determined not to be an active roost site for roosting bats, proceed with work immediately. For trees to be limbed or removed, proceed as follows:	County of Santa Cruz or construction contractor and a qualified biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	Prior to and during construction activities

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	▫ If foliage-roosting bats are determined to be present (e.g., hoary bat or western red bat), limbs shall be lowered, inspected for bats by a bat biologist, and chipped immediately or moved to a dump site. Alternatively, limbs may be lowered and left on the ground until the following day, when they can be chipped or moved to a dump site. No logs or tree sections shall be dropped on downed limbs or limb piles that have not been in place since the previous day. ▫ If the tree is not limbed or removed within four days of the survey, the survey efforts shall be repeated.			
BIO-7	**Conduct Pre-construction Surveys and Flag Woodrat Nests** Prior to construction, the County or their construction contractor will ensure an agency-approved biologist conducts a pre-construction survey for San Francisco dusky-footed woodrat houses and clearly flags all houses within the Project area and immediate surroundings, as follows: • The agency-approved biologist will determine, to the extent feasible, whether the houses are active or inactive [e.g., freshly chewed (green) vegetation is visible on the house, at least some entrances are clear and free of cobwebs, fresh sticks are piled on the top of the house, the house is not composed entirely of old dry sticks and has a flattened shape (has collapsed over time)]. If this determination cannot be made, the house will be presumed to be active. • If an active woodrat house is found during surveys, it will be protected during construction with flagging or silt fencing between the work area and the house. • The construction contractor will avoid woodrat houses to the extent feasible by installing a buffer with silt fencing or other material that shall prohibit encroachment. If this buffer and avoidance is not	County of Santa Cruz or construction contractor and a qualified biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County and Construction contractor	Prior to construction

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	feasible, the agency-approved biologist shall allow encroachment into the buffer, but preserve microhabitat conditions such as shade, cover and adjacent food sources. • If avoidance of woodrat houses is not possible, the agency-approved biologist will dismantle woodrat houses, capturing woodrats if feasible, or allowing woodrats to flee. The biologist will preserve sticks, food caches, and nesting materials separately. The materials will be relocated to the nearest unoccupied suitable habitat. The relocation site will mimic the original house site in terms of vegetation and environmental conditions, if feasible. The agency-approved biologist will create an artificial shelter using a pine box as a base, installing food and nesting materials inside the shelter, and piling sticks on top. An effort will be made to protect the opening from predators. A scent trail will be left from the original house site to the artificial shelter, if needed. If feasible, relocation will occur during the appropriate time of year (August 1–September 30) to avoid impacting dependent young that may be present within the stick house.			
BIO-8a	**Implement Measures to Protect Sensitive and Native Habitats during Construction** The County, in coordination with their construction contractor and agency-approved biologists, will implement the following measures to protect sensitive and native habitats during construction: ▪ Follow all conservation regulations, policies, and principles in Chapter 5, Conservation and Open Space, of the Santa Cruz County General Plan and LCP (2024)[3]. For wildlife habitats and sensitive communities, including wetlands, follow applicable regulations from	County of Santa Cruz or construction contractor and a qualified biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	During construction

[3] https://cdi.santacruzcountyca.gov/Portals/35/CDI/Planning/Policy/GeneralPlanTownPlans/General%20Plan%20Chapters/GP%20Chapter%205_ARC.pdf?ver=M2Gmi8vz3QbSOh-rKdOA7A%3d%3d

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	Chapter 16.30 and 16.32 of the Environmental and Resource Protection section of County of Santa Cruz Municipal Code[4], wherever feasible. Obtain exceptions to these regulations, as applicable. ▪ Avoid and reduce impacts to sensitive and native habitats. The construction footprint will be minimized. • Stage equipment in ruderal and/or developed areas. • Confine construction activities and operation of equipment and vehicles, including site access and parking, to designated staging, access, and work areas. • Except as necessary for project implementation, avoid grubbing and construction within 100 feet of the edge of aquatic features (wetlands and other waters), including Harkins Slough Road Drainage, Buena Vista Drive Tributary, Channelized Gallighan Slough, freshwater emergent marsh (by the main landfill entrance), and the seasonal wetland adjacent to the Old Landfill. Where work occurs within 100 feet of aquatic features, secondary containment measures (e.g., Visqueen sheeting and/or drip pans under staged equipment and for maintenance) will be employed. • Prior to initiation of construction activities, an agency-approved biologist will identify all areas to be avoided and/or protected and will mark sensitive habitats in the field. • Minimize removal and disturbance of native vegetation, and implement the following when disturbance to native vegetation is required: ▫ Limbing of native trees and cutting (above the ground) of shrubs will be favored in lieu of removal. Stumps of native vegetation will be retained to allow for re-sprouting following Project completion where vegetation will not interfere with the Project features.			

[4] https://www.codepublishing.com/CA/SantaCruzCounty/

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	▫ Maintain native understory plants to the extent feasible. Do not grub within sensitive habitat types unless no other alternative exists. • Preserve native edge habitats wherever feasible, such as boundaries between coast live oak woodland/forest and grassland, and transitions between riparian and wetland vegetation. • The County, in coordination with their construction contractor and an agency-approved biologist, will remove invasive non-native plants from the work area as designated by the California Invasive Plant Council (Cal-IPC 2026)[5] as having "high" potential for "severe ecological impacts on physical processes, plant and animal communities, and vegetation structure."			
BIO-8b	**Implement Best Management Practices During Construction** The County, in coordination with their construction contractor, will implement the following best management practices during construction: • Prior to staging equipment on-site, clean all equipment caked with mud, soil, or debris from off-site sources or previous Project sites to avoid introducing or spreading invasive exotic plant species. All equipment used on the premises will be cleaned prior to leaving the area for future projects. • Refueling and/or maintenance of vehicles and equipment will be performed in designated staging areas. Workers will be informed of the importance of preventing spills and of the appropriate measures to take should a spill occur. Follow all state and federal laws pertaining to hazardous material handling and management.	County of Santa Cruz or construction contractor	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	During construction

[5] https://www.cal-ipc.org/plants/inventory/

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	• Position all stationary equipment such as motors, pumps, generators, and/or compressors over drip pans. Store vehicles and equipment in designated staging area. Position parked equipment over drip pans or absorbent material. • All construction vehicles and equipment will be checked daily for fuel, oil, and hydraulic fluid leaks or other problems that could result in spills of toxic materials. Prohibit smoking • During construction, all food trash that may attract predators into the work area will be properly contained and removed from the work site on a daily basis. Construction debris and trash should also be properly contained and removed from the work site on a regular basis.			
BIO-8c	**Stabilize and Restore Temporary Habitat Impact Areas** The County and/or their construction contractor, in coordination with an agency-approved biologist, will stabilize and restore sensitive and native habitat areas that are temporarily impacted by construction activities, as described below. • During construction, stabilize all exposed or disturbed areas within the construction area. Install erosion control measures such as silt fences, weed-free straw bales, plywood, straw wattles, water check bars, and broadcast weed-free straw wherever silt laden water has the potential to leave the work site and enter the nearby drainages. Modify, repair, and/or replace erosion control measures as needed. • During construction, to minimize the risk of entangling and strangling wildlife, erosion control materials containing synthetic (e.g., plastic or nylon) monofilament netting will not be used, and any geo-textile material or filter fabric used will not contain any petroleum-based products. Geotextiles, fiber rolls, and	County of Santa Cruz or construction contractor and a qualified biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	During and after construction

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	other erosion control measures will be made of loose-weave mesh, such as jute or coconut (coir) fiber. • At the end of construction activities, restore habitat contours to their original (or agency-approved) configuration in all sensitive habitats or adjacent areas (**Figures 3.4-1, 3.4-2a-e, and Figure 6.4-1**) that have been temporarily disturbed by activities associated with construction. • At the end of construction activities, where temporary impacts to sensitive and native habitats occur, revegetate as needed with native seed mix or locally sourced native plantings. Revegetate all disturbed areas. An agency-approved biologist will determine a palette/seed mix suitable to the location. Adjacent non-native grasslands and ruderal habitats may also be planted with native vegetation, preserving edge effects, where appropriate.			
BIO-8e	**Prepare and Implement a Habitat Mitigation Plan for Permanent Impacts to Sensitive Habitats, Including Aquatic Features, for Alternative 3** The County, in coordination with qualified biologists, will prepare and Habitat Mitigation Plan (HMP or plan), as described below, for permanent impacts to sensitive habitats, including aquatic features. This plan will help mitigate impacts to wetlands (Reorientation and Expansion of Existing Irrigation Ditch Wetland), as well as riparian and riverine habitat (Harkins Slough Road Drainage Restoration). In addition, the Plan will provide additional recommendations for implementation and monitoring of the Environmental Enhancement and Restoration Features. This plan will also help mitigate impacts to sensitive wildlife species, if present (Crotch's bumble bee, California red-legged frog, northwestern pond turtle, avian and bat species, San Francisco dusky-footed woodrat), habitat for these species, and wildlife movement. The plan will be prepared prior to submission of permit applications with the	County of Santa Cruz or construction contractor and a qualified biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County and Construction contractor	HMP completed prior to submission of permit applications HMP implemented during and after construction

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	resource agencies and approved prior to initiation of construction. • Habitat Mitigation Plan (HMP) will be prepared that includes the following: ▫ Description of the Project elements including acreage of temporary and permanent impacts to sensitive habitats, including coast live oak woodland and riverine habitat (Harkins Slough Road Drainage) and the number of significant trees removed for the project. ▫ Description of Environmental Enhancement and Restoration Features including acreage of restoration areas within sensitive habitat types and tree removal, if required. ▫ Goals of compensatory mitigation project including types and areas of habitat to be created, restored, and/or enhanced, and mitigation ratios (created/restored/enhanced: impacted). ▫ Ratio and species composition for significant tree mitigation as determined in coordination with the County Environmental Planning Division, California Coastal Commission (CCC), California Regional Water Quality Control Board (Regional Board), and California Department of Fish and Wildlife (CDFW) for tree removal in mixed willow riparian habitat. ▫ In-kind restoration and/or enhancement of riverine habitat onsite from impacts to wetlands (Reorientation and Expansion of Existing Irrigation Ditch Wetland) and riparian and riverine habitat (Harkins Slough Road Drainage). ▫ Location and acreage of mitigation areas, and tree replacement planting, including size and ownership status. ▫ Detailed construction and planting techniques.			

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	▫ Description and design of habitat requirements for special-status wildlife, including California red-legged frog and northwestern pond turtle. ▫ Strategies for protecting the habitat values of the larger Watsonville Sloughs ecosystem, including wildlife movement. ▫ Maintenance activities during the monitoring period, including replanting native vegetation and weed removal, that will not result in take of special-status plant and wildlife species. ▫ Performance standards and specific success criteria, quantitative and qualitative monitoring and reporting, documenting ability to meet or surpass success criteria. ▫ Adaptive management strategies to ensure long-term viability of mitigation areas. • The following Environmental Enhancement and Habitat Restoration Features, included as part of Alternative 3, will be developed by qualified biologists in coordination with County engineers and implemented on-site as both in-kind and out-of-kind mitigation. ▫ **Wildlife Movement Corridor between Gallighan Slough and Harkins Slough**. Establish a Wildlife Movement Corridor between Gallighan Slough and Harkins Slough on the southern portion of the landfill after closure, by establishing shallow-rooted native perennial vegetation (see **Appendix G4**),[6] including suffrutescents,[7] shrubs, and vine plantings that will not compromise the landfill cap, to facilitate refuge and cover opportunities for wildlife moving across the area. The landfill cap will			

[6] A 20-year study demonstrated that the roots of shallow rooted scrub vegetation grow laterally when the roots reach the barrier membrane layer of the landfill cap and do not penetrate through the membrane into the foundation layer or into the waste below the cap (Holl and McStay 2014).

[7] A suffrutescent plant has a woody lower portion at the base of its stems that persists year to year, while the upper softer growth is herbaceous (non-woody). See also **Appendix G4** for a planting palette of shallow-rooted shrubs, perennial herbs, and vines proposed for the landfill cap.

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	have a minimum of 24 inches (30–36 inches is preferred) of vegetative layer/topsoil to allow for shrub plantings. Place downed logs on flatter portions of the corridor, and any appropriate areas of the already closed landfill to provide additional shelter for wildlife. ▫ **Culvert Modification with Small Wildlife Crossing at Main Entrance**. Modify the culvert under the main entrance to the landfill to add a ledge within the culvert to facilitate safe passage of CRLF and other small wildlife species under most hydrologic conditions. ▫ **Culvert Replacement under the Internal Roadway to the Old Landfill**. Replace the existing culvert with a larger structure (e.g., a larger culvert with a natural streambed or a clear-span bridge) designed to reduce the hydraulic constriction, associated flooding, and sedimentation upstream within Channelized Gallighan Slough and the Buena Vista Drive Tributary. ▫ **Wildlife Directional Features at Key Locations**. Construct wildlife directional features such as angled fencing to direct wildlife away from high operational activity areas, including transfer stations and internal roadways toward Channelized Gallighan Slough, the Wildlife Movement Corridor, and the culvert with wildlife passage. ▫ **Restoration of Harkins Slough Road Drainage**. Rehabilitate the Harkins Slough Road Drainage through re-grading the elevation profile of the channel to repair existing incision, accommodate storm flows and transport sediment effectively. Remove red ironbark trees adjacent to the drainage and plant with suitable native riparian plant species including willows,			

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	dogwood, elderberry, and (above the break in bank) coast live oaks. ▫ **Re-establishment of Open Drainage along North-South Roadway.** Re-establish an open drainage along the west side of the north-south roadway and remove the buried pipe that currently conveys stormwater into the Harkins Slough Road Drainage to the south. This feature will capture runoff from areas to the north and west, and the west bank will be planted with suitable native vegetation to shade the drainage and provide cover for wildlife. Because the ravine that previously contained the drainage was filled and the existing elevation is 10-30 feet higher than the historical ravine, the re-established open drainage is not intended to re-create historical conditions. ▫ **Reorientation and Expansion of Existing Irrigation Ditch Wetland.** Reorient and expand the seasonal irrigation ditch wetland and irrigation ditch that runs along the east side of the low-lying terrace to establish new stormwater detention basins and wetlands. While designed to receive additional run-off from new impervious surfaces (an analogous purpose to the existing irrigation ditch), the basins/wetlands will provide enhanced ecosystems services through their larger capacity and connectivity to the proposed Wildlife Movement Corridor (see below). The basins/wetlands will be positioned outside of the southwest corner of the new facilities such that they will be accessible to wildlife moving along the southern perimeter of the Combined Facilities site. These basins will be maintained initially during project construction; and shortly afterwards, portions of the features will be			

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	planted with native wetland vegetation and other suitable native plant species (i.e. on the upland embankments). The basins/wetlands will be designed to flow into the Harkins Slough Road Drainage through drop structures and/or outlet structures. ▫ **Wildlife Movement Corridor between USFWS Refuge and Undeveloped Open Space to the West.** Preserve and enhance a wildlife movement corridor along the southern perimeter of the Combined Facilities, to provide connectivity between the USFWS Refuge to the east and undeveloped land and habitats patches to the west. The corridor includes 100 feet along the frontage of Harkins Slough Road, including existing coast live oak woodland. Other suitable native vegetation will be planted to provide cover and refuge along the corridor. ▫ **Culvert and Fencing Designed for Wildlife Movement Within and Around the Combined Facilities Site.** Several new stormwater culverts will be installed for stormwater management at the Combined Facilities site. A culvert under the new driveway from Harkins Slough Road will be flat bottom to facilitate amphibian movement. Additionally, the stormwater basins/wetlands will be located outside the facility fencing, and wildlife- friendly fencing will be installed around the ponds to allow wildlife movement, while discouraging humans and vehicles from entering the basins.			
BIO-9a	**Replace, Restore and/or Enhance with In-Kind Riparian Vegetation Onsite** Following project construction, the County will mitigate for temporary and permanent impacts to riparian forest on site, as necessary at the main landfill entrance (Buena Vista Drive	County of Santa Cruz and relevant resource agencies (CCC, Regional Board, and CDFW)	Compliance monitored by qualified agency-approved biologist with oversight by the County and Construction contractor	After construction

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	Tributary), at the internal roadway to Old Landfill (Channelized Gallighan Slough), and along Harkins Slough Road Drainage, through in-kind replacement, restoration, and/or enhancement at a ratio to be determined in coordination with the relevant resource agencies (County, CCC, Regional Board, and CDFW). In addition, the County in coordination with qualified biologists will plant suitable native trees and understory plants (including mixed willow riparian scrub and forest, mixed broadleaved riparian forest, and coast live oak woodland) where suitable space is available, such as along the Harkins Slough Road Drainage.			
BIO-9b	**Transplant Willows to Restore Riparian Areas** During construction activities at the Harkins Slough Road Drainage, the County or their contractor will excavate willow roots, cover with moistened burlap, and set aside during construction. Following construction activities in this area, the willow roots will be replanted along the newly contoured embankment on the north side of the embankment (away from Harkins Slough Road).	County of Santa Cruz or construction contractor and a qualified biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County and Construction contractor	During and after construction
BIO-13	**Install Protective Fencing and Conduct Wildlife Relocation if Necessary** • The County or their construction contractor will work with an agency-approved biologist to ensure the following measures are implemented prior to and during construction. • Prior to construction, an agency-approved biologist will determine locations for the installation of protective fencing with openings every 50 feet that would allow passage of wildlife. • With agency approval, an agency-approved biologist will be present during construction to relocate wildlife	County of Santa Cruz or construction contractor and a qualified biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County and Construction contractor	Prior to and during construction

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	species, as needed. The biologist will work with the County and contractor to implement monitoring measures, as determined in consultation with the resource agencies (County Environmental Planning, California Coastal Commission, U.S. Fish and Wildlife Service, and California Department of Fish and Wildlife). The monitor will be present during initial vegetation removal, grubbing, grading or other ground disturbance and other activities that may impact sensitive wildlife species, as determined by the agencies and the agency-approved biologist. After these activities have been completed, the agency-approved biologist will remain on call to verify the identity of sensitive wildlife species and relocate animals, as needed.			
BIO-14	**Implement Tree Replacement Planting and Habitat Enhancement** The County will mitigate for significant trees removed by confirming the number of trees required to be removed and implementing associated tree replacement planting at a ratio and species composition to be determined in coordination with the County Environmental Planning Division, the California Coastal Commission (CCC) and, for willow trees, the California Regional Water Quality Control Board (Regional Board) and California Department of Fish and Wildlife (CDFW). Wherever feasible, tree replacement will occur onsite. Off-site locations (such as Freedom Lake County Park) will be identified for tree replacement planting and to replace displaced sensitive habitat (coast live oak woodland and forest) through habitat enhancement or creation. The areas designated for replacement tree planting will be situated to improve the ecological landscape, including species richness, structural complexity, and an overall habitat mosaic that reflects plant communities present in or suitable to the surroundings.	County of Santa Cruz or construction contractor and the CCC, Regional Board, and CDFW	Compliance monitored by qualified agency-approved biologist with oversight by the County and construction contractor	After construction

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
Cultural Resources/Tribal Cultural Resources				
CR-2a	**Stop Work if Inadvertent Encounter of Undiscovered Archaeological Resources during Ground-Disturbing Activities** In the event that archaeological resources are unexpectedly encountered during ground-disturbing construction activities, the construction contractor shall halt work within 200 feet of the find, and the County of Santa Cruz shall contact an archaeologist meeting the Secretary of the Interior's Professional Qualifications Standards for Archaeology to immediately evaluate the find, if an archaeological monitor is not already present. If the find is determined by the qualified archaeologist to be prehistoric and a Native American monitor is not already present, then the County of Santa Cruz shall contact a Native American representative to participate in the evaluation of the find. If necessary, archaeological testing for California Register of Historical Resources eligibility shall be completed by the qualified archaeologist. If the discovery proves to be eligible for the California Register of Historical Resources, and if impacts to the resource cannot be avoided via project redesign, a qualified archaeologist shall prepare a data recovery plan tailored to the physical nature and characteristics of the deposit, per the requirements of California Public Resources Code, Section 15126.4(b)(3)(C). The data recovery plan shall identify data recovery excavation methods, measurable objectives, and data thresholds to reduce any significant impacts to cultural resources. Pursuant to the data recovery plan, the qualified archaeologist and Native American representative, as appropriate, shall recover and document the scientifically consequential information that justifies the resource's significance. The County of Santa Cruz shall review and	County of Santa Cruz or construction contractor and a qualified archaeologist	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	approve the treatment plan and archaeological testing as appropriate, and the resulting documentation shall be submitted to the regional repository of the California Historical Resources Information System, per California Public Resources Code, Section 15126.4(b)(3)(C).			
CR-2b	**Archaeologist and Native American Monitoring during Initial Ground-Disturbing Activities in Specific Areas** All initial ground-disturbing activities in the following specific areas shall be monitored by a qualified archaeologist and a representative from the local Native American community. **Main Landfill Entrance.** The culvert modification with small wildlife crossing, located below the driveway at the Main Entrance, will be implemented as part of Alternative 3. (**Northeast Corner of Landfill Property**. The undeveloped northeast corner of the landfill property, between Harkins Slough Road and the northern property line will be developed as part of Alternative 3 (for driveways and drainage infrastructure). Additionally, the Harkins Slough Road Drainage will be restored as part of Alternative 3. The County of Santa Cruz shall retain a qualified archaeologist and a Native American monitor from a locally affiliated Tribe to monitor initial ground-disturbing activities. Archaeological monitoring shall be performed under the direction of an archaeologist meeting or exceeding the Secretary of the Interior's Professional Qualifications Standards for Archaeology. Either monitors shall have the authority to halt and redirect work should any archaeological resources be identified during monitoring. If archaeological resources are encountered during ground-disturbing activities, work in the immediate area shall halt, and Mitigation Measure CR-2a (Stop Work if Inadvertent Encounter of Undiscovered Archaeological	County of Santa Cruz or construction contractor and a qualified archaeologist	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
	Resources during Ground-Disturbing Activities) shall be implemented. Archaeological monitoring may be reduced or halted at the discretion of the monitor, in consultation with the County environmental coordinator, as warranted by conditions such as encountering bedrock, sediments that are planned to be excavated are composed of fill, or negative findings during the first 50 percent of ground disturbance. If monitoring is reduced to spot-checking, spot-checking shall occur when ground disturbance moves to a new location within the Project area and when ground disturbance will extend to depths not previously reached (unless those depths are within bedrock). Furthermore, monitoring may be terminated if it is determined that the soils within the Project area do not have the potential to contain cultural resources. The monitor shall submit a report within 30 days of completion of all ground-disturbing activities to the County to document compliance.			
Geology and Soils				
GEO-4	**Expansive Soils Design Measures for Specific Structures** Due to the presence of expansive soils where specific structures will be located, the County and their design consultant shall ensure that the final design for the following structures includes design measures for building footings or other structures on or adjacent to these potentially expansive soils, such as excavation and replacement with non-expansive soils, amendment of the expansive soils with lime or cement, construction of moisture barriers, grading of surfaces to drain away from the area, and/or restrictions on the use of irrigation and/or infiltration of stormwater into the subsurface. Combined Facilities on Adjacent Property: Transfer Station, including the office; Organics Diversion Facility; Recycling Center; and Scale House	County of Santa Cruz or construction contractor	Compliance monitored the County and Construction contractor	Prior to and during construction activities

No.	Mitigation Measures	Responsibility for Compliance	Method of Monitoring	Timing of Compliance
Greenhouse Gas Emissions				
BIO-14	See Mitigation Measure BIO-14 under Biological Resources			
Noise				
N-1	**Implement Noise-Reducing Measures for Construction Equipment Used within 200 Feet of Occupied Residences** The County of Santa Cruz shall include the following in the construction specifications. The construction contractor shall employ the following noise-reducing measures where use of construction equipment occurs within 200 feet of an occupied residence: • Use acoustical shelters around any air compressors, generators, and any other stationary construction equipment not fitted with baffled enclosures • Use baffling around stationary construction equipment to reduce noise and vibration levels • Properly muffle and maintain all construction equipment powered by internal combustion engines • Prohibit unnecessary idling of internal combustion engines • Whenever feasible, use electrical power to run air compressors and similar power tools	County of Santa Cruz with construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring.	During construction
N-2d	**Implement Noise-Reducing Design Features at Alternative 3 Combined Facilities** Before the start of any operations of the transfer station, organics diversion facility, or recycling center the County of Santa Cruz shall demonstrate that noise shielding features have been incorporated into building design to reduce noise levels to below an hourly average of 65 dBA at the nearest occupied non-residential structure, and 60 dBA at the nearest occupied residential structure. Measures to reduce noise exposure may include, but are not limited to, installation of industrial sound-proofing panels or curtains on all building walls or individual pieces of equipment to dampen noise.	County of Santa Cruz with construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring.	Prior to the start of operations
CR-2a	See above CR-2a			
CR-2b	See above CR-2b			

Best Management Practices	Responsibility for Compliance	Method of Compliance	Timing of Compliance
1. Limit vehicle speeds on unpaved roads to a maximum of 25 miles per hour.	County of Santa Cruz with construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During and after construction
2. Limit fugitive dust by watering exposed dirt surfaces in construction areas twice daily, keeping all trenches dry to protect their integrity.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction
3. Apply soil stabilizers on inactive construction areas (disturbed lands unused for four consecutive days) and cover inactive storage piles.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction
4. Apply native hydro-seed or non-toxic binders to exposed areas after cut/fill operations.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction
5. Install perimeter protection (e.g., silt fence, fiber rolls) on downslope areas and near drainages and open space to prevent contaminated construction runoff from leaving the construction site.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction
6. Minimize removal or disturbance of existing vegetation outside the footprint of project construction activities.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring.	During construction
7. Limit site access and parking, equipment storage, and stationary construction activities to the designated staging areas to the maximum extent feasible.	Construction contractor	Compliance monitored by County and qualified consultant representative	During construction

Best Management Practices	Responsibility for Compliance	Method of Compliance	Timing of Compliance
		assigned to overall construction monitoring	
8. Store, maintain, and refuel all equipment and materials in designated portions of the staging areas in accordance with permit requirements. As such, no staging would occur in areas with sensitive biological resources. Staging of material and equipment will be at least 100 feet from any drainages or include secondary containment for fueling and maintenance of equipment. Spill kits will be present on site at all times and will include absorbent materials, booms, disposable bags, and Personal Protective Equipment (gloves, goggles, coveralls). Examples of secondary containment include drip pans, spill trays, absorbent mats, and polyethylene or polypropylene sheeting. Secondary containment should have the capacity to hold the contents of portable fuel tanks, as well as the fuel and fluid tanks, systems, and reservoirs of all equipment	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction
9. Prior to staging equipment on site, clean all equipment caked with mud, soils, or debris from off-site sources to avoid introducing or spreading invasive exotic plant species.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	Prior to staging and construction
10. Position all stationary equipment, such as motors, pumps, generators, and/or compressors, over drip pans.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction
11. Erosion and sediment control measures shall be maintained continuously, repaired when and as necessary and shall be inspected within 24 hours of each rainfall event. Seeded areas shall be checked regularly and shall be watered, fertilized, reseeded and mulched as necessary to obtain a dense stand of grass.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction

Best Management Practices	Responsibility for Compliance	Method of Compliance	Timing of Compliance
12. All drain inlets shall be protected from siltation (e.g., inlet filters, fiber rolls, gravel bags). Ineffective protection devices shall be immediately replaced and the inlet cleaned. Flushing is not an acceptable method of cleaning.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction
13. When the crushed stone construction entrance has been covered with soil or has been pushed into the soil by construction traffic, it shall be replaced with a depth of stone equal to that of original application.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction
14. All materials used for fill or back-fill shall be free of wood, roots, rocks, boulders or any other non-compactable soil type material. Unsatisfactory materials also include man-made fills and refuse debris derived from any source. All material shall be inspected and approved by the County's construction manager and/or other qualified personnel.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction
15. Materials used to construct embankments for any purpose, back-fill around drainage structures or in utility trenches or any other depression requiring fill or back-fill shall be compacted the percentage determined by the County's construction manager and/or other qualified personnel following in ASTM Standard D-1557.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction
16. Certifications for materials including, but not limited to stone, concrete, pipes, precast units, handrails, stabilization mats, traffic signal items, must be provided to the County's construction manager and/or other qualified personnel prior to installation.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	Prior to installation, during construction
17. Embankment fill and trench back-fill shall be placed in lifts at a maximum uncompacted depth of 8-inches and 6-inches, respectively. Density test types and frequencies will be per the design engineer's recommendations.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction

Best Management Practices	Responsibility for Compliance	Method of Compliance	Timing of Compliance
18. Any discrepancies found between the drawings and specifications and site conditions or any inconsistencies or ambiguities in drawings or specifications shall be immediately reported to the County's construction manager and the design engineer, in writing, who shall promptly address such inconsistencies or ambiguities. Work done by the contractor after his discovery of such discrepancies, inconsistencies or ambiguities shall be done at the contractor's risk.	Construction contractor	Compliance monitored by County and qualified consultant representative assigned to overall construction monitoring	During construction

Environmental Enhancement and Habitat Restoration Features (part of Alternative 3, Combined Facilities on Adjacent Property)	Responsibility for Compliance	Method of Compliance	Timing of Compliance
These Environmental Enhancement and Habitat Restoration Features are shown in **Figure 2-4** and **Figure 5-13.**			
Restoration of Harkins Slough Road Drainage An existing seasonal to perennial drainage (hereinafter Harkins Slough Road Drainage) flows along the north side of Harkins Slough Road, from the unpaved roadway accessing the property to the north of the Landfill westward to Buena Vista Drive. This drainage would be minimally impacted by the construction of the transfer trailer exit driveway. In addition, as part of the Project, the drainage would be required to accommodate increased stormwater runoff from new impervious surfaces at the combined facilities. The Project also includes the restoration of approximately 800 linear feet of the drainage, which would include re-grading the unvegetated channel to an elevation profile designed to repair existing incision and bank failure, and transport sediment without deposition (i.e., channel aggradation). Restoration would also include planting suitable riparian vegetation (such as willows, dogwood, and elderberry) on the upslope (north) embankment and replacing the iron bark eucalyptus trees with native trees, including riparian species and (above the break in bank) coast live oak, California bay, or other appropriate native tree species. Native low growing vegetation would be planted on the south (roadside) embankment. The final restoration design would retain and enhance the ecological functions and values[8] of the drainage and be developed by a qualified water resources engineer and qualified biologists, in coordination with the County Environmental Planning Section.	County of Santa Cruz or restoration contractor and a qualified USFWS/CDFW-approved biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County.	During and after construction activities
Culvert Modification with Small Wildlife Crossing at Main Entrance An existing culvert is positioned beneath the driveway at the main landfill entrance from Buena Vista Drive, and it conveys an unnamed tributary (hereinafter Buena Vista Drive Tributary) to Gallighan Slough. As part of the Project, the grade of the landfill entrance would be	County of Santa Cruz or restoration contractor and a qualified USFWS/CDFW-approved biologist and County Transportation Division engineers	Compliance monitored by qualified agency-approved biologist with oversight by the County.	During construction

[8] Ecological functions are the natural processes and physical, chemical, and biological activities within an ecosystem, such as nutrient cycling or carbon sequestration, that maintain its health and stability. "Ecological values" are the benefits derived from the functions such as: habitat and refuge for plants and wildlife, water storage and flood control, water quality protection and purification, groundwater recharge, and food chain support**.**

Environmental Enhancement and Habitat Restoration Features (part of Alternative 3, Combined Facilities on Adjacent Property)	Responsibility for Compliance	Method of Compliance	Timing of Compliance
modified to meet the new grade of Buena Vista Drive[9]. This activity would not require any work within the tributary. The Project also includes adding a ledge within the culvert to facilitate safe passage of the federally threatened California red-legged frog (CRLF) and other small wildlife species under most hydrologic conditions. A known breeding pond for CRLF exists approximately 0.7 miles northwest of the wildlife crossing, and an individual CRLF was observed in Channelized Gallighan Slough, south (downstream) of the landfill entrance. The culvert modifications would be developed in coordination with qualified biologists and County Transportation Division engineers, and would not compromise culvert capacity.			
Culvert Replacement under Internal Roadway to Old Landfill An existing 7-foot-diameter culvert conveys Channelized Gallighan Slough beneath the internal roadway leading to the Old Landfill within the landfill property. The existing culvert is undersized, resulting in upstream backwater ponding and sediment deposition, and would be replaced with a larger structure (e.g., a larger culvert with a natural streambed or with a clear-span bridge) Design to reduce the hydraulic constriction and associated flooding and sedimentation upstream within Channelized Gallighan Slough and the Buena Vista Drive Tributary. Sediment are largely derived from nearby row-crop agricultural fields. The final design would be developed in coordination with qualified biologists to incorporate wildlife passage (as needed and feasible, depending on the final design) and would accommodate existing utilities (e.g., landfill gas pipe and water pipe along the south side of the roadway). The larger capacity replacement culvert or bridge would improve ecological and hydrologic conditions in channelized Gallighan Slough, as well as in Buena Vista Drive Tributary, by maintaining sediment transport competence and reducing aggradation of the stream channels, thereby extending the return interval for maintenance and reducing frequent flood conditions near the current Landfill main entrance. Specifically, reducing sediment deposition in the channels would maintain a more stable bed,	County of Santa Cruz or restoration contractor and a qualified USFWS/CDFW-approved biologist	Compliance monitored by qualified agency-approved biologist with oversight by the County.	During construction

[9] As part of a separate project, the County is planning to rehabilitate Buena Vista Drive, which includes raising the roadway along the landfill frontage to improve the geometry and address local flooding issues,

Environmental Enhancement and Habitat Restoration Features (part of Alternative 3, Combined Facilities on Adjacent Property)	Responsibility for Compliance	Method of Compliance	Timing of Compliance
bank, and ordinary high-water mark while improving overall ecological conditions of the streams by supporting open-water riverine conditions and an associated diverse riparian habitat. The upsized culvert or bridge would restore functional riverine habitat and reduce or eliminate the conversion to instream freshwater marsh features which have established on the agricultural sediments. The instream freshwater marsh that has developed within the Buena Vista Drive Tributary is associated with the following negative ecological effects: shorter hydroperiod; lack of running water, pools or riffles; poor water quality (e.g., turbidity, less dissolved oxygen); loss of temperature gradients (that support species diversity); absent or degraded habitat for invertebrates (which are the basis of the food chain for fish and amphibians); and diminished hydrologic capacity of the stream, exacerbating flood risk. The larger capacity culvert or bridge would reduce or eliminate this conversion of habitat from riverine to instream freshwater marsh. Extensive freshwater marsh habitat would remain at the confluence with Gallighan Slough and in off-channel locations along the streams.			
Wildlife Movement Corridor between Gallighan Slough and Harkins Slough To facilitate opportunities for wildlife movement between key aquatic features (Gallighan Slough and Harkins Slough), a wildlife movement corridor would be established across the southern portion of the closed landfill. This would include planting low growing, shallow-rooted native perennial vegetation[10] on portions of the landfill cap (where feasible). Where there is sufficient soil depth in the vegetative layer of the cap above the barrier membrane, shallow-rooted native perennial species (including suffrutescents[11], shrubs, and vine plantings) would be planted. Native perennial plantings would require a minimum of 24 inches (30–36 inches is preferred) of vegetative layer/topsoil on top of the barrier membrane; therefore, perennial plantings would be limited to locations where this is feasible (where more topsoil can be added without causing potential slope stability issues). Downed logs would be	County of Santa Cruz or contractor	Compliance monitored by qualified agency-approved biologist with oversight by the County.	During construction

[10] A 20-year study demonstrated that the roots of shallow-rooted scrub vegetation grow laterally when reaching the landfill cap and do not penetrate the cap (Holl and McStay 2014).

[11] A suffrutescent plant has a woody lower portion at the base of its stems that persists year to year, while the upper softer growth is herbaceous (non-woody).

Environmental Enhancement and Habitat Restoration Features (part of Alternative 3, Combined Facilities on Adjacent Property)	Responsibility for Compliance	Method of Compliance	Timing of Compliance
placed on flatter portions of the corridor and any appropriate areas of the already closed landfill to provide shelter for wildlife.			
Wildlife Directional Features at Key Locations Directional fencing and other protective features would be included in the final project design to direct wildlife away from high operational activity areas. For example, fencing would be included to direct wildlife away from internal roadways and toward Gallighan Slough, which extends between the north and south portions of the landfill.	County of Santa Cruz or contractor	Compliance monitored by the County of Santa Cruz	During construction
Re-establishment of Open Drainage along North-South Roadway Alternative 3 includes re-establishing an open drainage along the west side of the existing north-south roadway and removing the buried pipe. This feature would capture runoff from areas to the north and west, and the west bank would be planted with suitable native vegetation to shade the drainage and provide cover for wildlife. Because the ravine that previously contained the drainage was filled and the existing elevation is 10-30 feet higher than the historical ravine, the proposed drainage is not intended to re-create historical conditions. Rather, the drainage would enhance the existing modified landscape through the provision of an above ground aquatic feature and associated native vegetation.	County of Santa Cruz or contractor	Compliance monitored by the County of Santa Cruz	During construction
Reorientation and Expansion of Existing Irrigation Ditch Wetland Alternative 3 includes reorienting and expanding the existing irrigation ditch wetland to establish new stormwater basins and wetlands (refer to *Stormwater Management* above). The irrigation ditch runs along the east side of the low-lying terrace, and a wetland has established in a portion of the ditch due to a nutrient-rich substrate and an elevation profile that limits flows through the downstream culvert to larger storm events. While designed to receive additional run-off from new impervious surfaces (a similar purpose as the existing ditch), the basins/wetlands would provide enhanced ecosystems services through their larger capacity and connectivity to the proposed Wildlife Movement Corridor (see below). The basins/wetlands would be positioned outside of the southwest corner of the new facilities such that they would be accessible to wildlife moving along the perimeter.	County of Santa Cruz and contractor	Compliance monitored by the County of Santa Cruz	During and after construction

Environmental Enhancement and Habitat Restoration Features (part of Alternative 3, Combined Facilities on Adjacent Property)	Responsibility for Compliance	Method of Compliance	Timing of Compliance
These basins would be maintained initially during project construction; and shortly afterwards, portions of the features would be planted with native wetland vegetation and other suitable native plant species (i.e. on the upland embankments). The basins/wetlands would be designed to flow into the Harkins Slough Road Drainage through drop structures and/or outlet structures.			
Wildlife Movement Corridor between USFWS Refuge and Undeveloped Open Space to the West. Alternative 3 includes the preservation and enhancement of a wildlife movement corridor along the southern perimeter of the combined facilities, to provide connectivity between the USFWS Refuge to the east and undeveloped land and habitats patches to the west. The corridor includes 100 feet along the frontage of Harkins Slough Road, including existing coast live oak woodland. Other suitable native vegetation would be planted to provide cover and refuge along the corridor. The USFWS Refuge is positioned immediately east of the combined facilities (Alternative 3 site) and extends to Harkins Slough. An elevated terrace of native and non-native grassland, eucalyptus forest, with pockets of mixed evergreen and wetland habitats along Buena Vista Drive are located immediately west of the combined facilities. Harkins Slough Road Drainage runs along the frontage of the roadway immediately west of and connecting to the corridor, and would also be restored and enhanced (see above). Although Buena Vista Drive is a semi-permeable barrier to movement, the corridor would also enable wildlife to reach habitat patches further west (such as eucalyptus groves and remnant riparian habitat), as well as the riparian corridor associated with Buena Vista Drive Tributary.	County of Santa Cruz and contractor	Compliance monitored by the County of Santa Cruz	During construction
Culvert and Fencing Designed for Wildlife Movement As part of the Stormwater Management plan described above, several stormwater culverts would be installed. The culvert under the new driveway from Harkins Slough Road would be flat bottom to facilitate amphibian movement. Additionally, the stormwater basins/wetlands would be located outside the facility fence; and wildlife- friendly fencing would be installed around the ponds to allow wildlife movement, while discouraging humans and vehicles from entering the basins.	County of Santa Cruz and contractor	Compliance monitored by the County of Santa Cruz	During construction

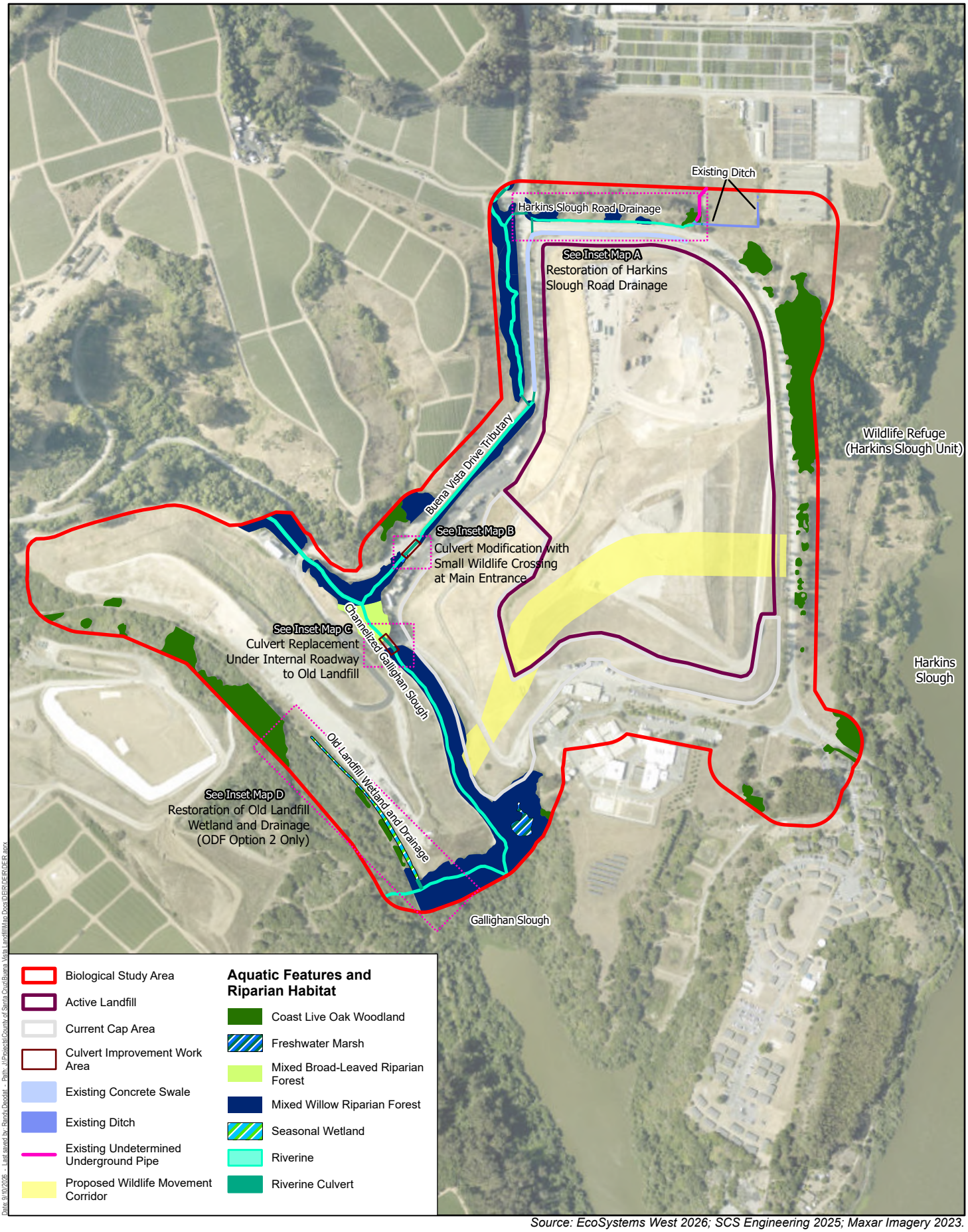
Table 3.4-4

Table 3.4-1. Recommended Construction Timing to Avoid/Minimize Impacts to Sensitive Biological Resources

Biological Resource	Relevant Habitat Type	Preferred Period of Avoidance	Preferred Construction Window	Resource/Life Events/Functions/ Values to be Protected	Required Best Management Practices
Aquatic/adjacent riparian	-	Rainy season, approximately October 15–April 15[1]	April 16–October 14	Water quality, vegetation, stable banks and slopes	Silt fencing Dewatering, diversion/bypass, If needed Confine Project footprint
Oak woodland	-	Rainy season, approximately October 15–April 15	April 16–October 14	Trees and dripline of canopy, stable slopes, soils, and understory	Silt fencing Confine Project footprint
Crotch's bumble bee	Non-Native/Ruderal Grassland	-	-	Individual bees, nest sites, foraging habitat	Pre-construction survey during the April–August period preceding construction
California red-legged frog	Buena Vista Drive Tributary Harkins Slough Road Drainage Channelized Gallighan Slough Old Landfill Wetland/Drainage Adjacent Riparian Adjacent Uplands	Rainy season, approximately October 15–April 15	April 16–October 14	Individual frogs, aquatic and upland habitat quality, movement and dispersal	Pre-construction survey Biological monitoring
Northwestern pond turtle	Channelized Gallighan Slough Adjacent Uplands	N/A	N/A	Individual turtles, movement/basking in aquatic habitat, nesting in adjacent upland habitat (May–July)	Pre-construction survey Biological monitoring
Bird species	All	February 1–August 31	September 1–January 31	Adults, nests, eggs, and young, nesting activities	Breeding bird surveys February 1–August 31
Bat species	Trees, Buildings, Culverts	November 1–February 15 and May 1–August 31	September 1–October 31	Individual bats, roosting, especially maternity roosts and winter hibernacula	Pre-construction Acoustic/emergence survey All times
San Francisco dusky-footed woodrat	Oak Woodland Riparian	October 1–July 31	August 1–September 30	Individual woodrats, woodrat houses, especially during breeding and rearing	Pre-construction survey All times
Tree/vegetation removal	All	October 15–August 31	September 1–October 14	All	-

Notes:

[1] While this time period aligns with the typical rainy season in coastal Santa Cruz County, agencies such as the Regional Board use other rainy season time periods (October 1–May 31) that may further restrict Program implementation or require filing a Request for an Early Start or Extended Work Period, if aquatic features requiring agency permits are present.



Source: EcoSystems West 2026; SCS Engineering 2025; Maxar Imagery 2023.

Harris & Associates

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Feet

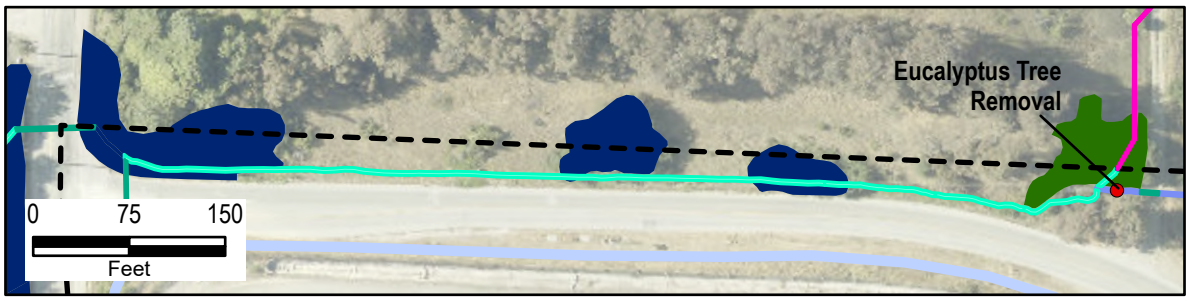
Figure 2-4a

Environmental Enhancement and Habitat Restoration Features

Buena Vista Landfill Redevelopment Project

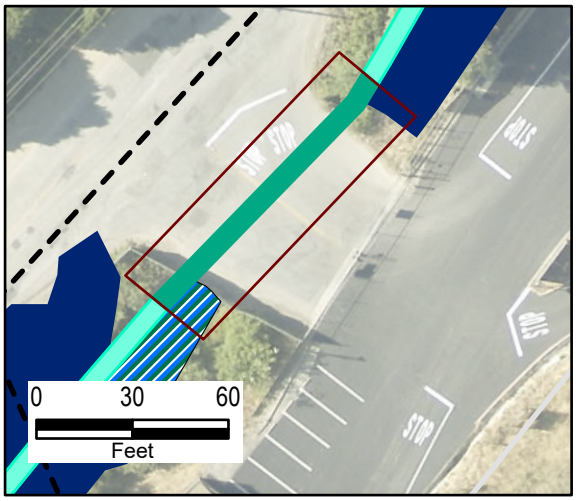
Inset Map A

Restoration of Harkins
Slough Road Drainage



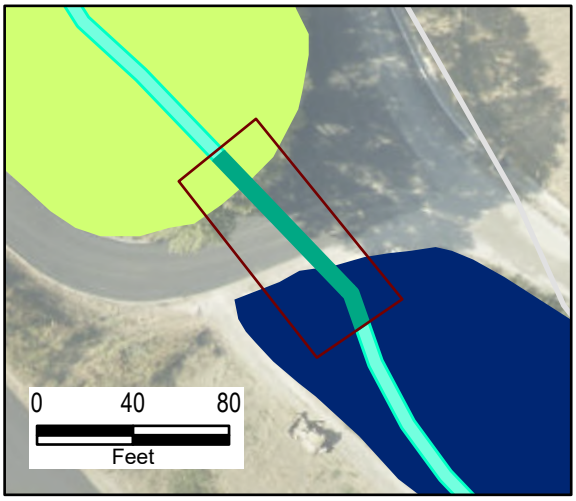
Inset Map B

Culvert Modification with Small
Wildlife Crossing at Main Entrance



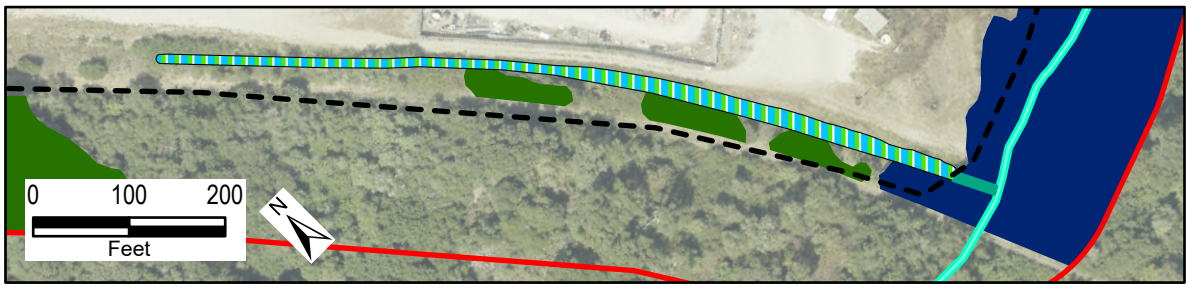
Inset Map C

Culvert Replacement Under
Internal Roadway to Old Landfill



Inset Map D

Restoration of Old Landfill Wetland
and Drainage (ODF Option 2 Only)



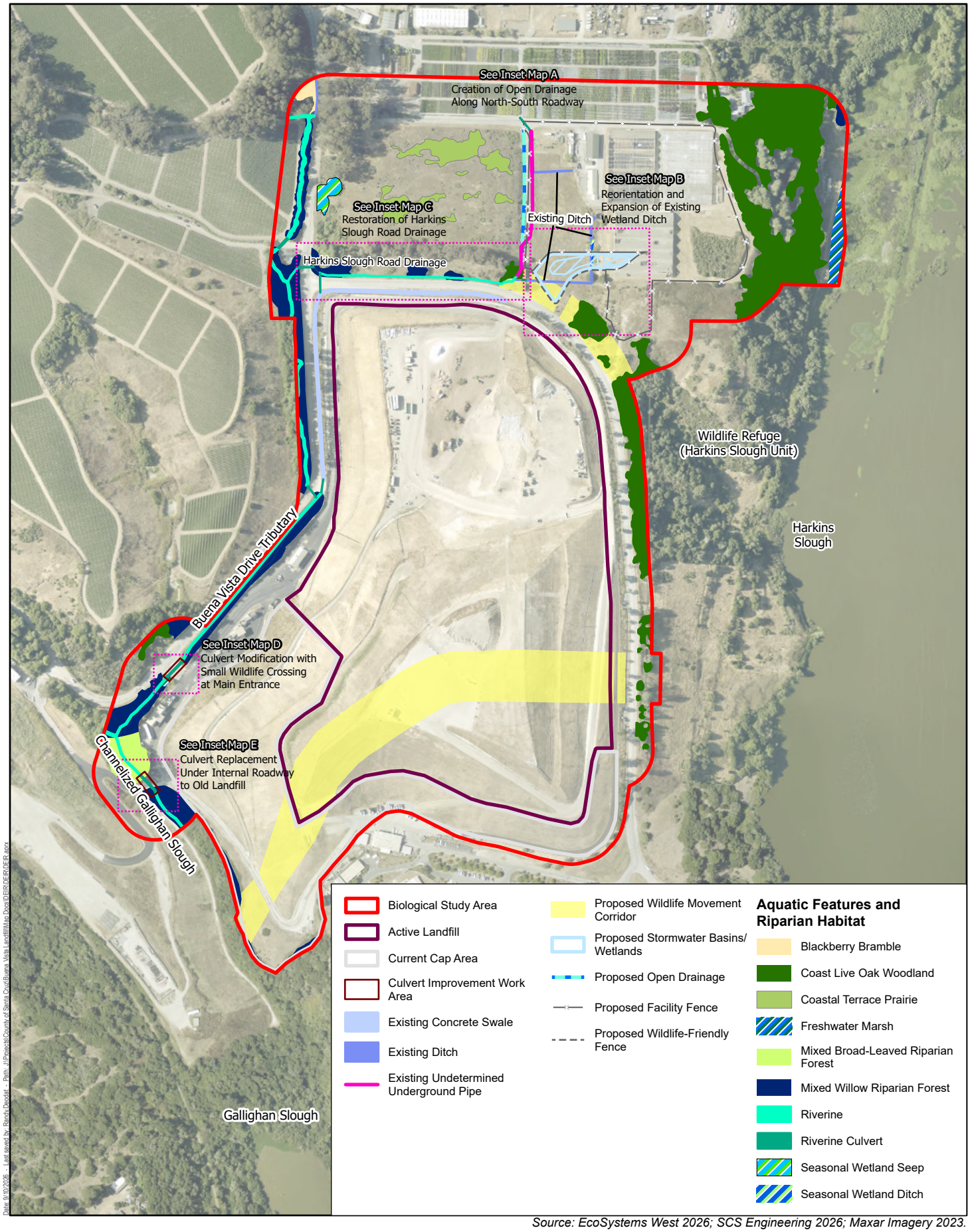
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Source: EcoSystems West 2026; SCS Engineering 2025; Maxar Imagery 2023.

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Figure 2-4b
Environmental Enhancement and
Habitat Restoration Features
Buena Vista Landfill Redevelopment Project



Source: EcoSystems West 2026; SCS Engineering 2026; Maxar Imagery 2023.

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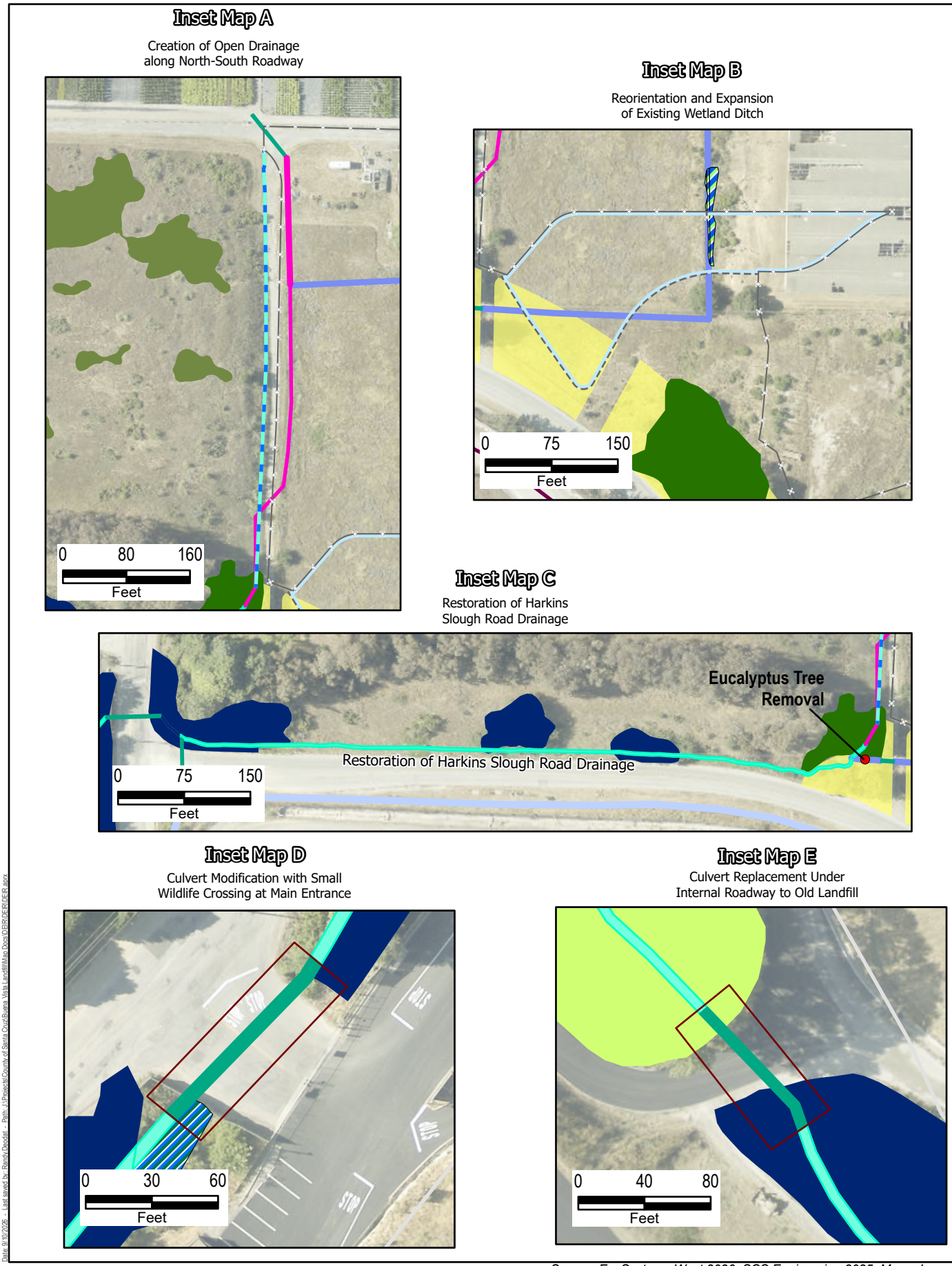
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Figure 5-13a

Alternative 3 Environmental Enhancement and Habitat Restoration Features

Buena Vista Landfill Redevelopment Project



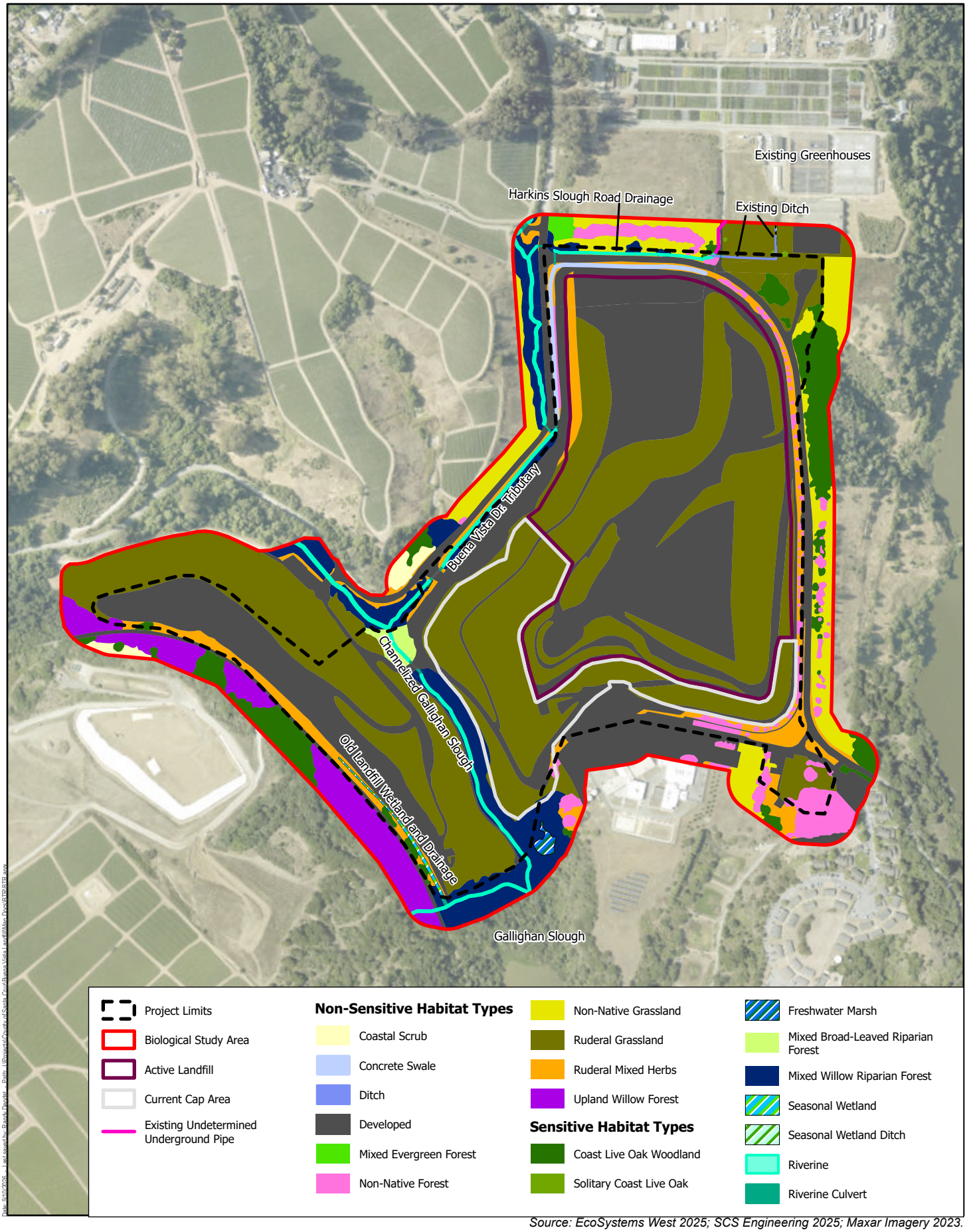
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Source: EcoSystems West 2026; SCS Engineering 2025; Maxar Imagery 2023.

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Figure 5-13b
Alternative 3 Environmental Enhancement
and Habitat Restoration Features
Buena Vista Landfill Redevelopment Project



Source: EcoSystems West 2025; SCS Engineering 2025; Maxar Imagery 2023.

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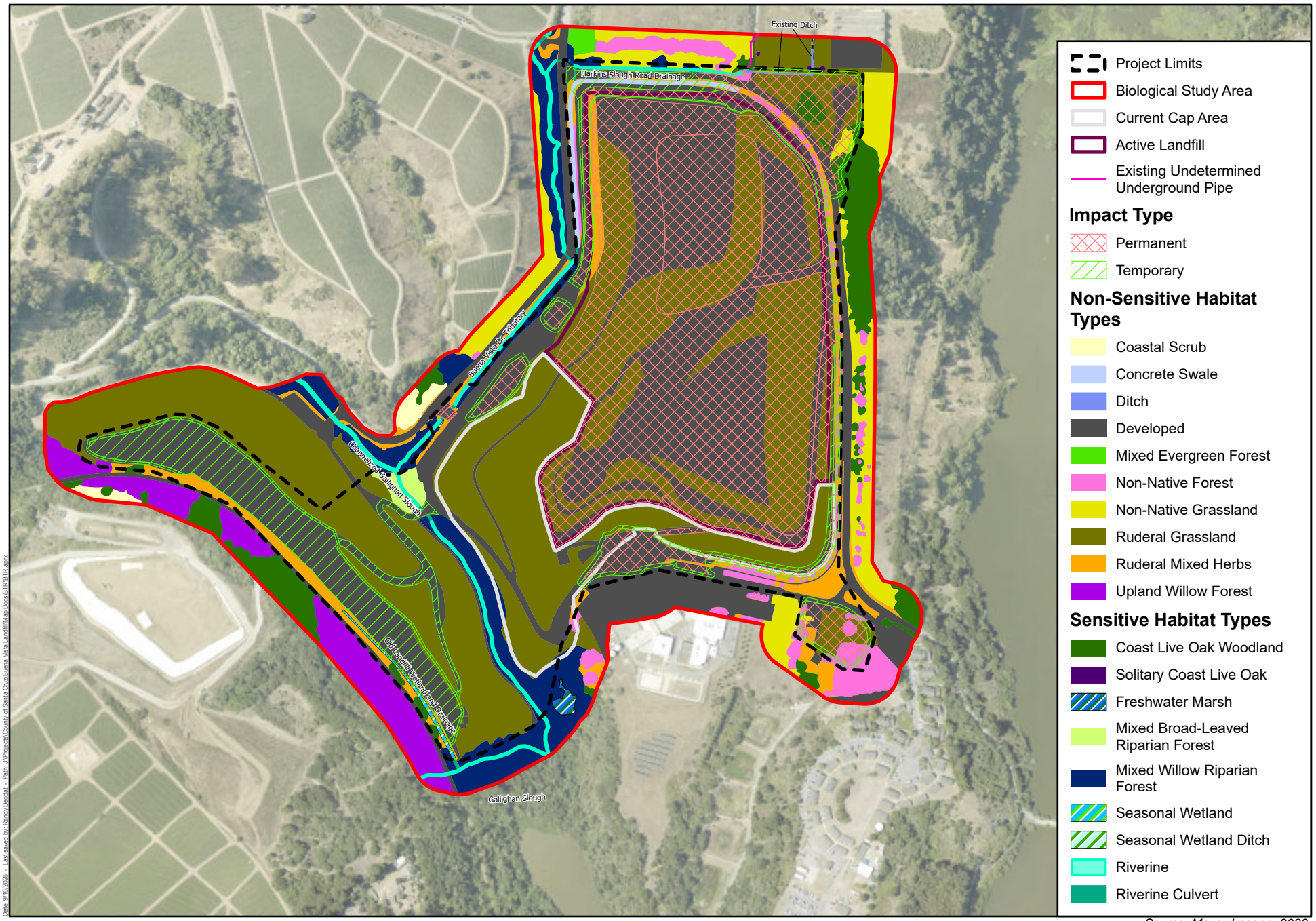
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Figure 3.4-1

Habitat Types within the Study Area

Buena Vista Landfill Redevelopment Project



Source: Maxar Imagery 2023.

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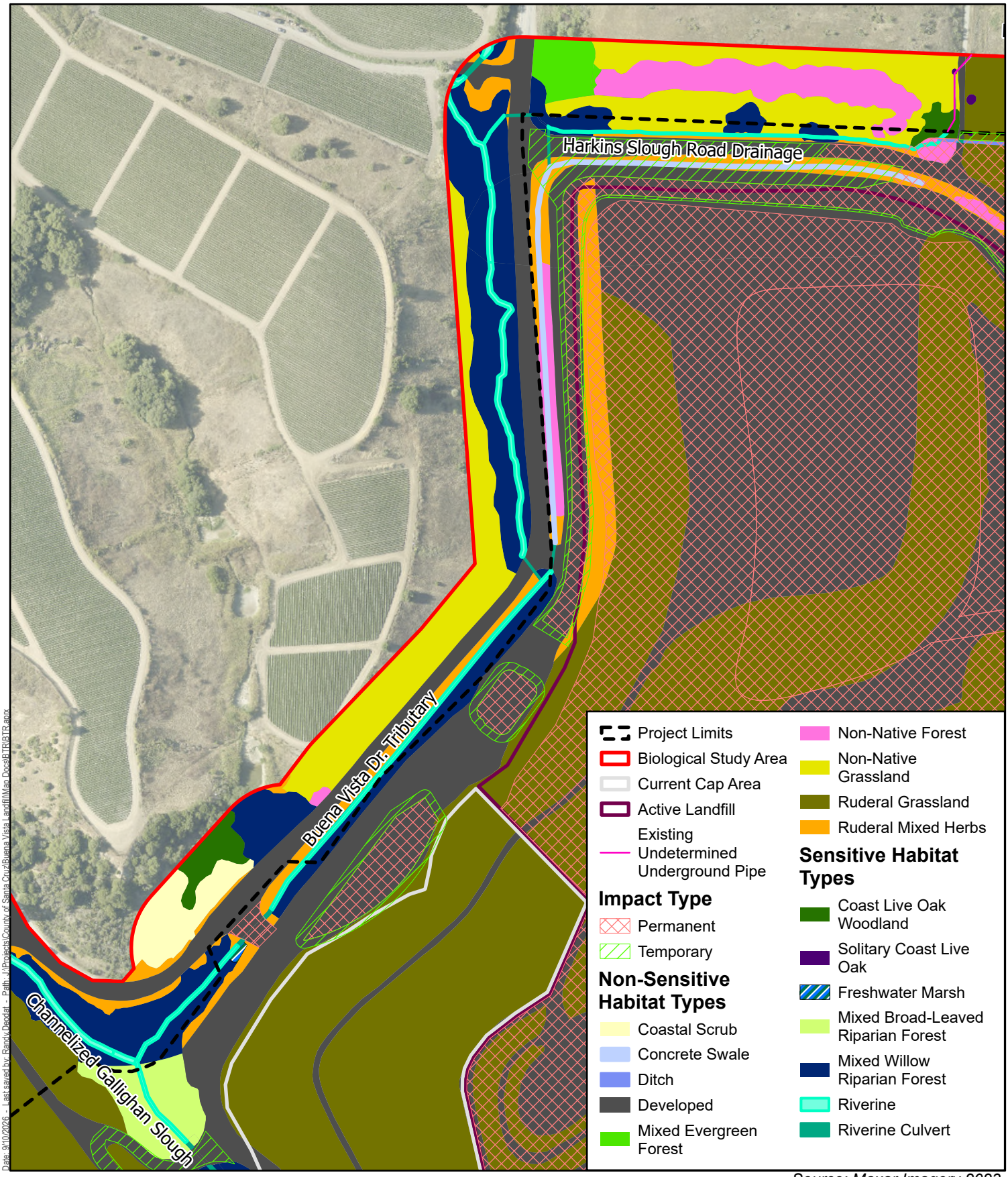
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Figure 3.4-2A

Habitat Type Impacts for Proposed Project

Buena Vista Landfill Redevelopment Project



Source: Maxar Imagery 2023.

Harris & Associates

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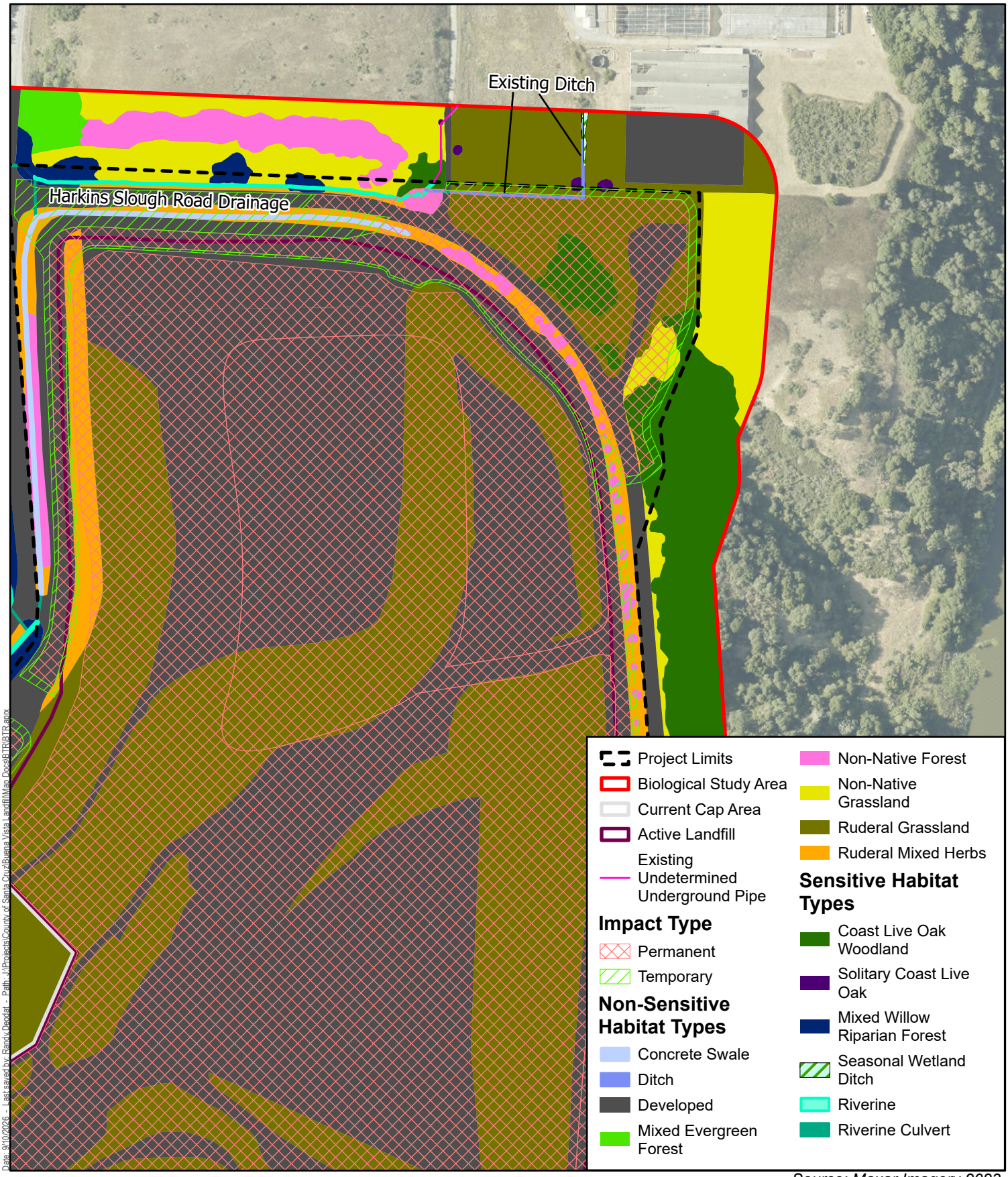
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Figure 3.4-2a

Habitat Type Impacts for Proposed Project

Buena Vista Landfill Redevelopment Project



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Source: Maxar Imagery 2023.

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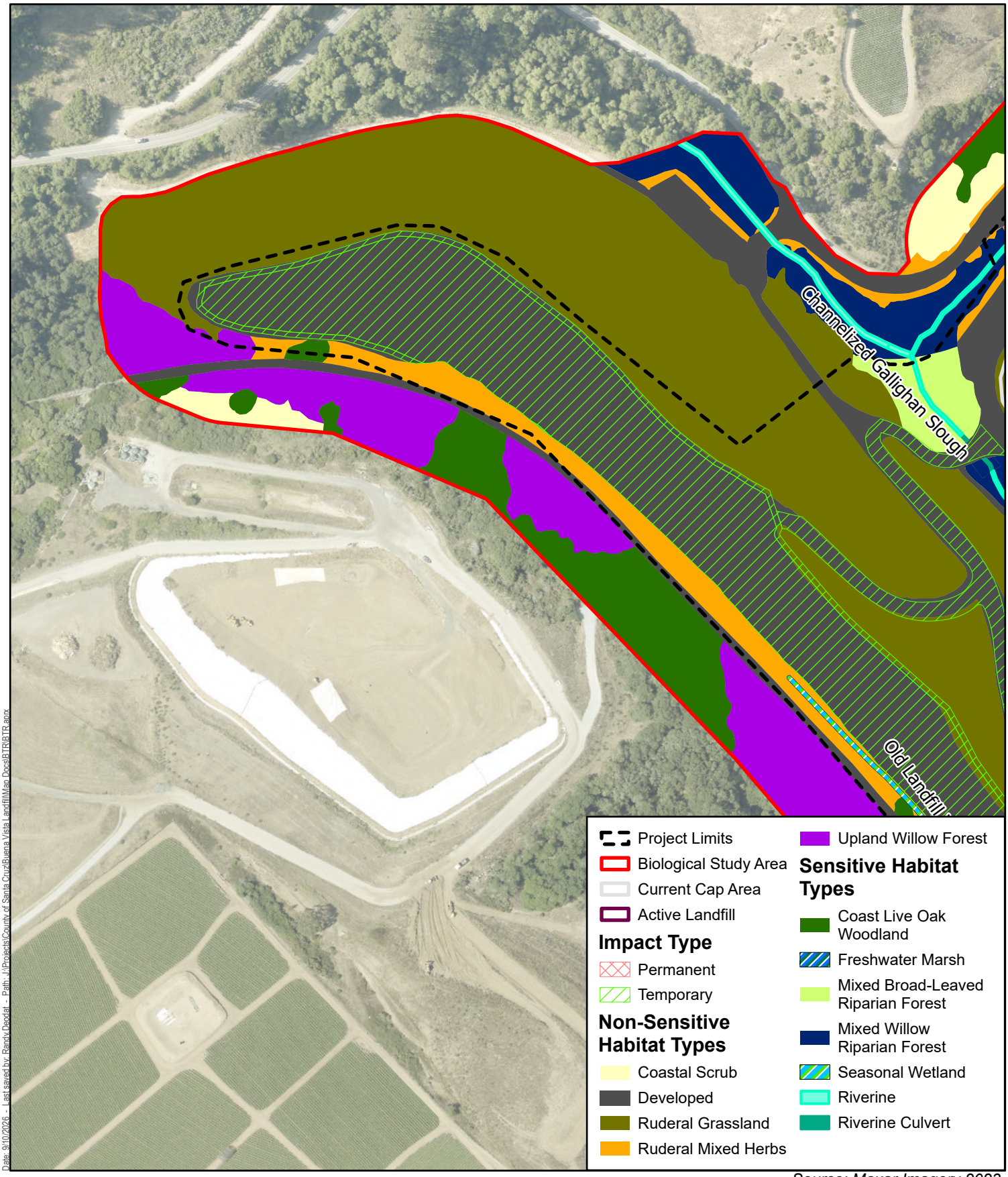
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Figure 3.4-2b

Habitat Type Impacts for Proposed Project

Buena Vista Landfill Redevelopment Project



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Source: Maxar Imagery 2023.

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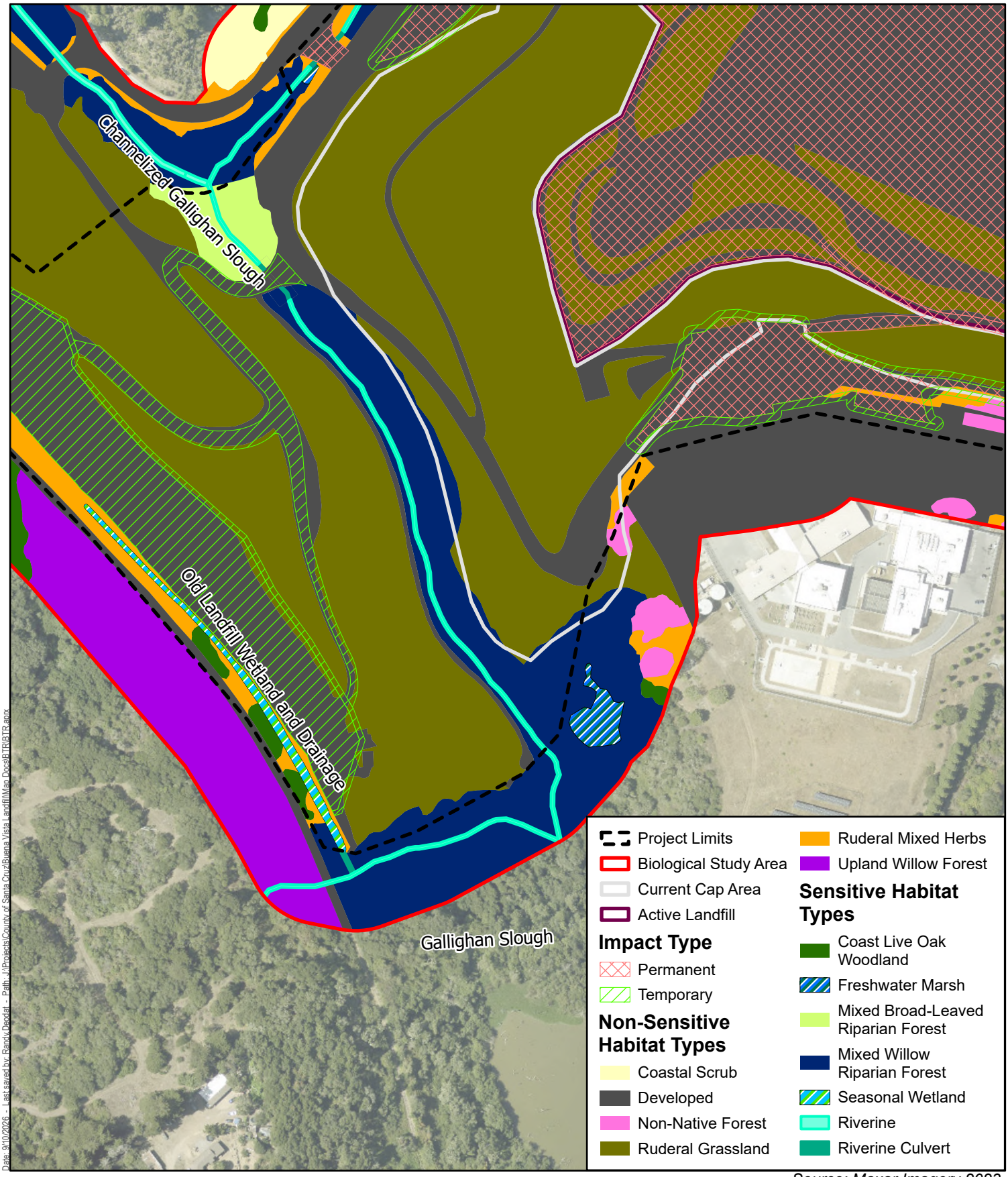
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Figure 3.4-2c

Habitat Type Impacts for Proposed Project

Buena Vista Landfill Redevelopment Project



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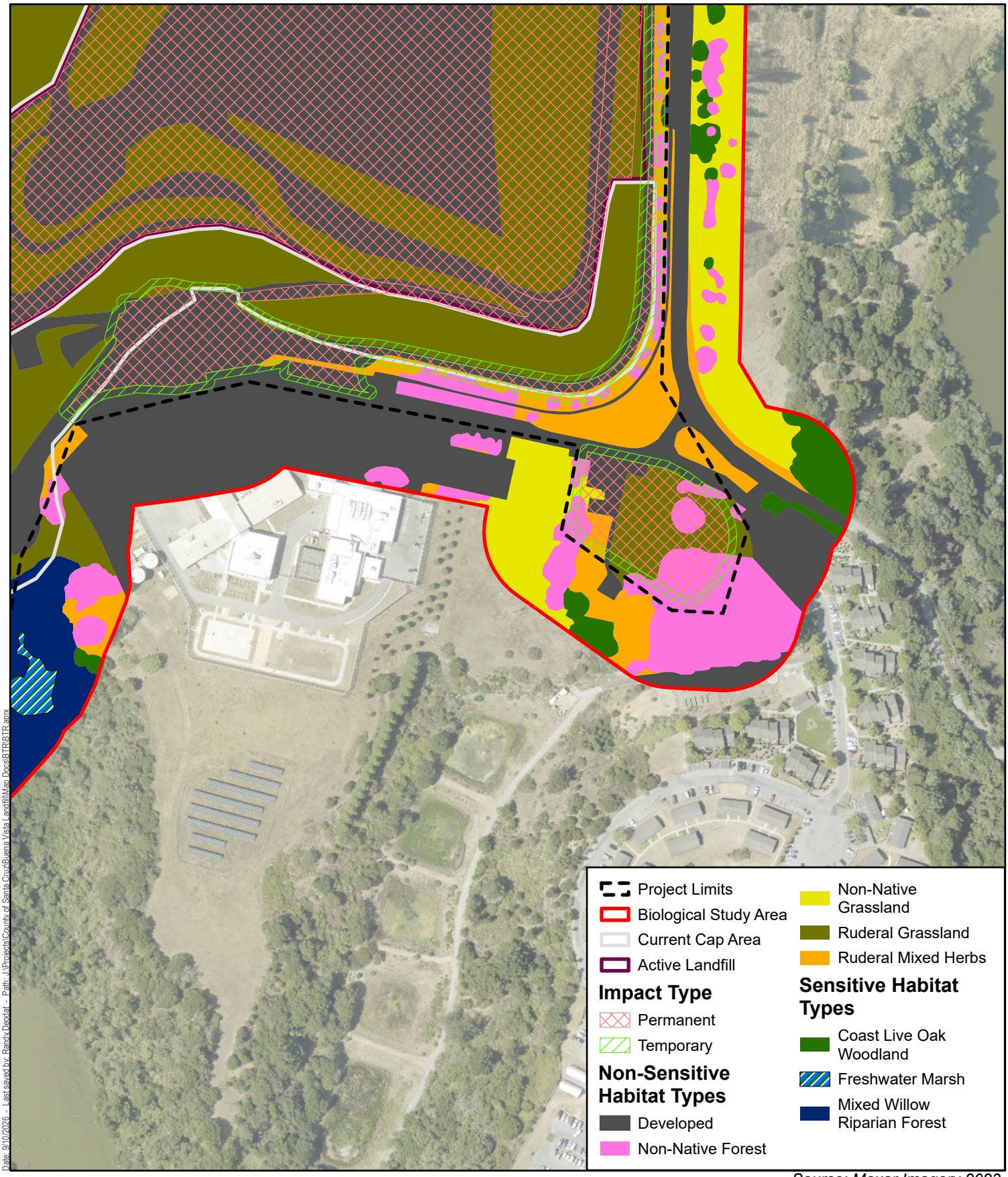
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Figure 3.4-2d

Habitat Type Impacts for Proposed Project

Buena Vista Landfill Redevelopment Project



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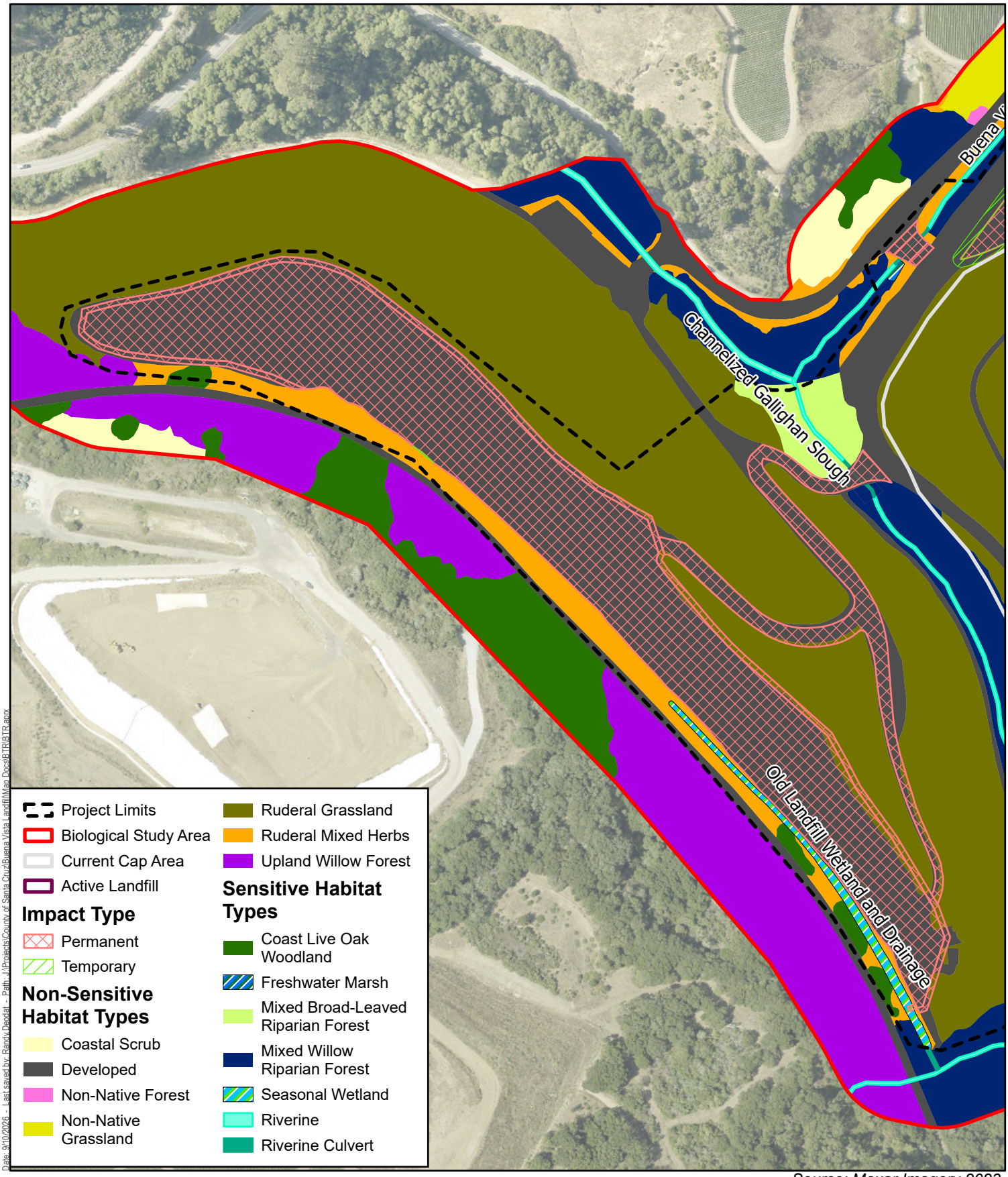
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Figure 3.4-2e

Habitat Type Impacts for Proposed Project

Buena Vista Landfill Redevelopment Project



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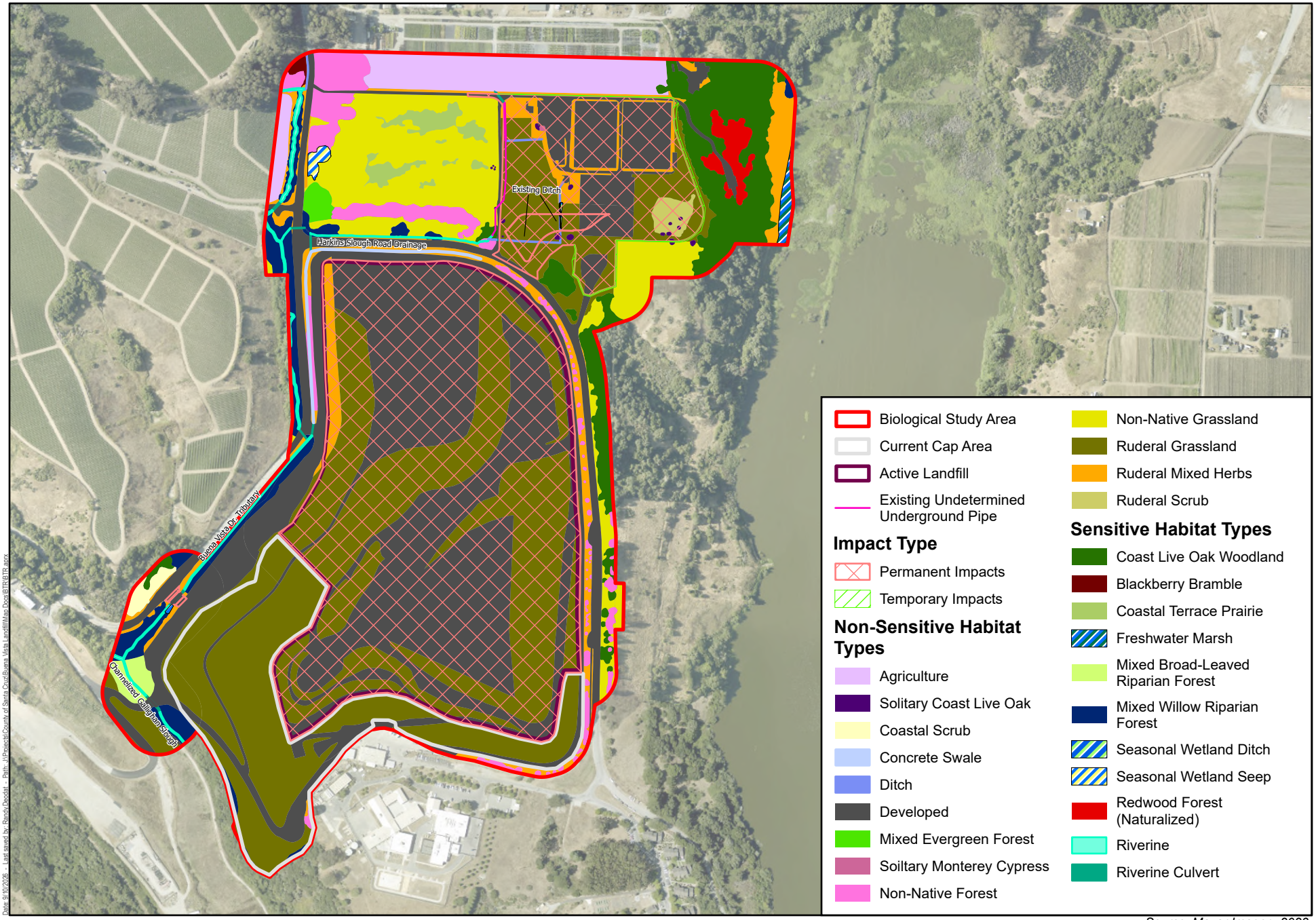
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Figure 3.4-2B

Habitat Type Impacts for ODF Option 2

Buena Vista Landfill Redevelopment Project



Source: Maxar Imagery 2023.

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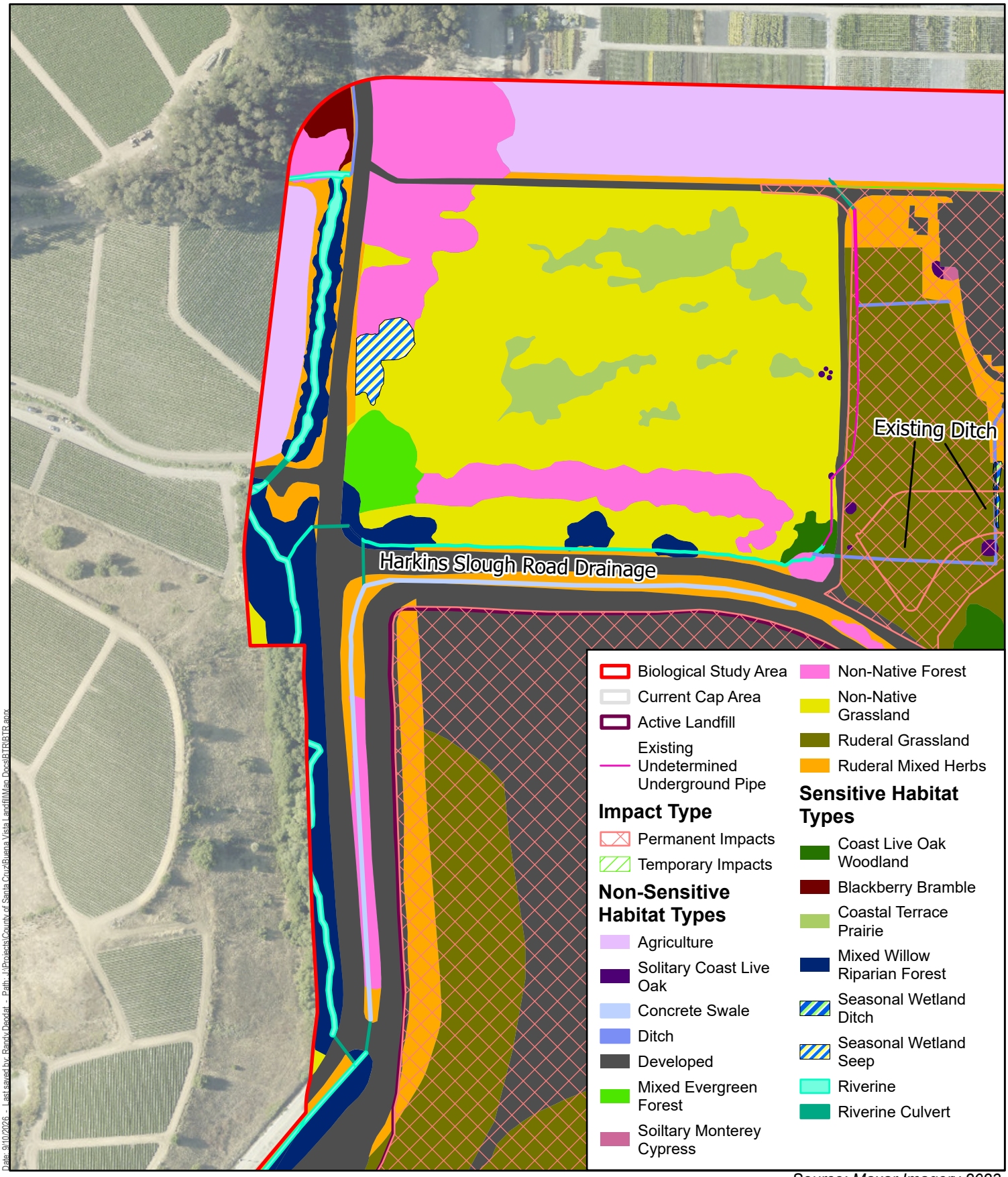
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Figure 6.4-1

Habitat Type Impacts for Alternative 3

Buena Vista Landfill Redevelopment Project



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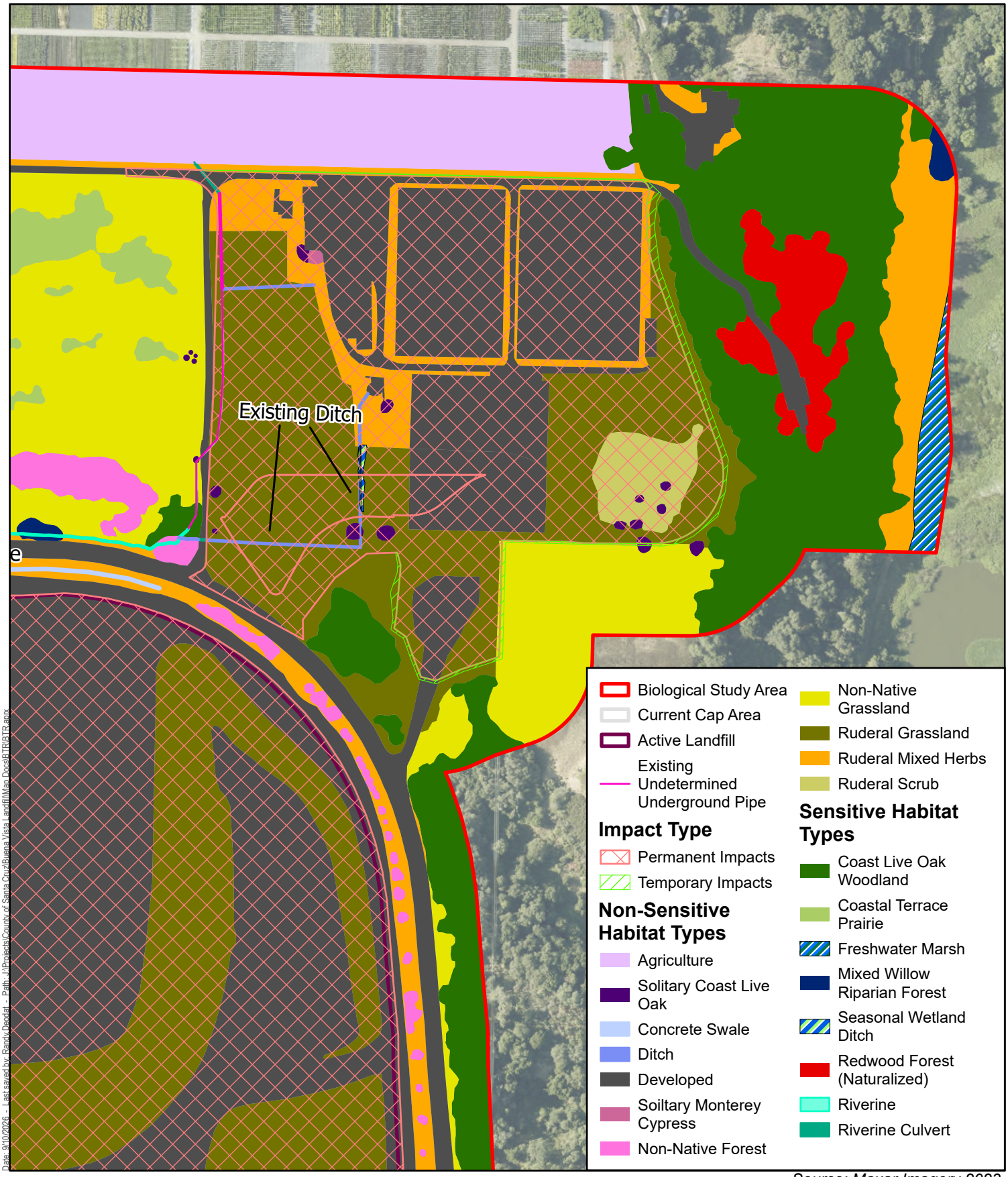
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Figure 6.4-1a

Habitat Type Impacts for Alternative 3

Buena Vista Landfill Redevelopment Project



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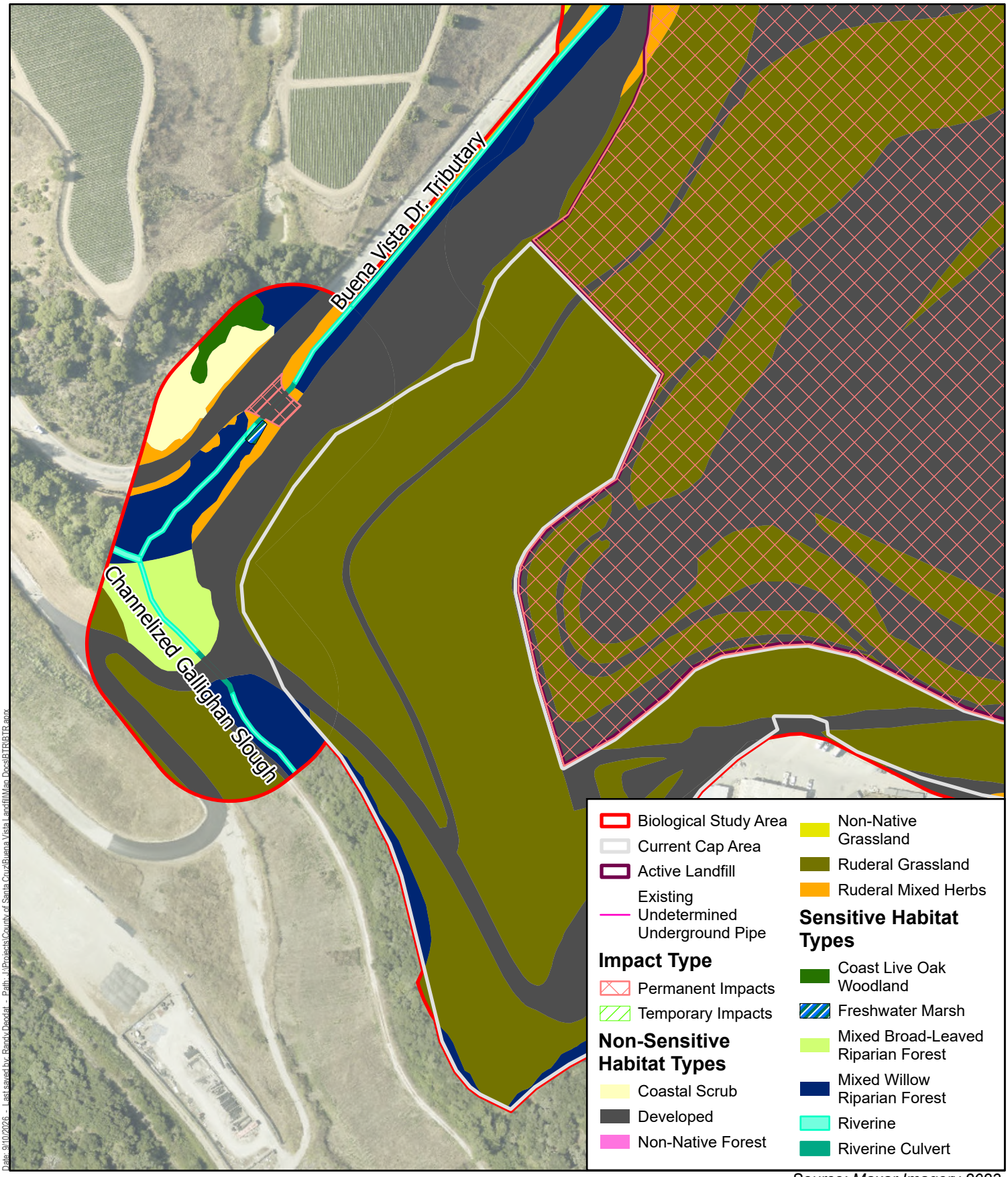
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Figure 6.4-1b

Habitat Type Impacts for Alternative 3

Buena Vista Landfill Redevelopment Project



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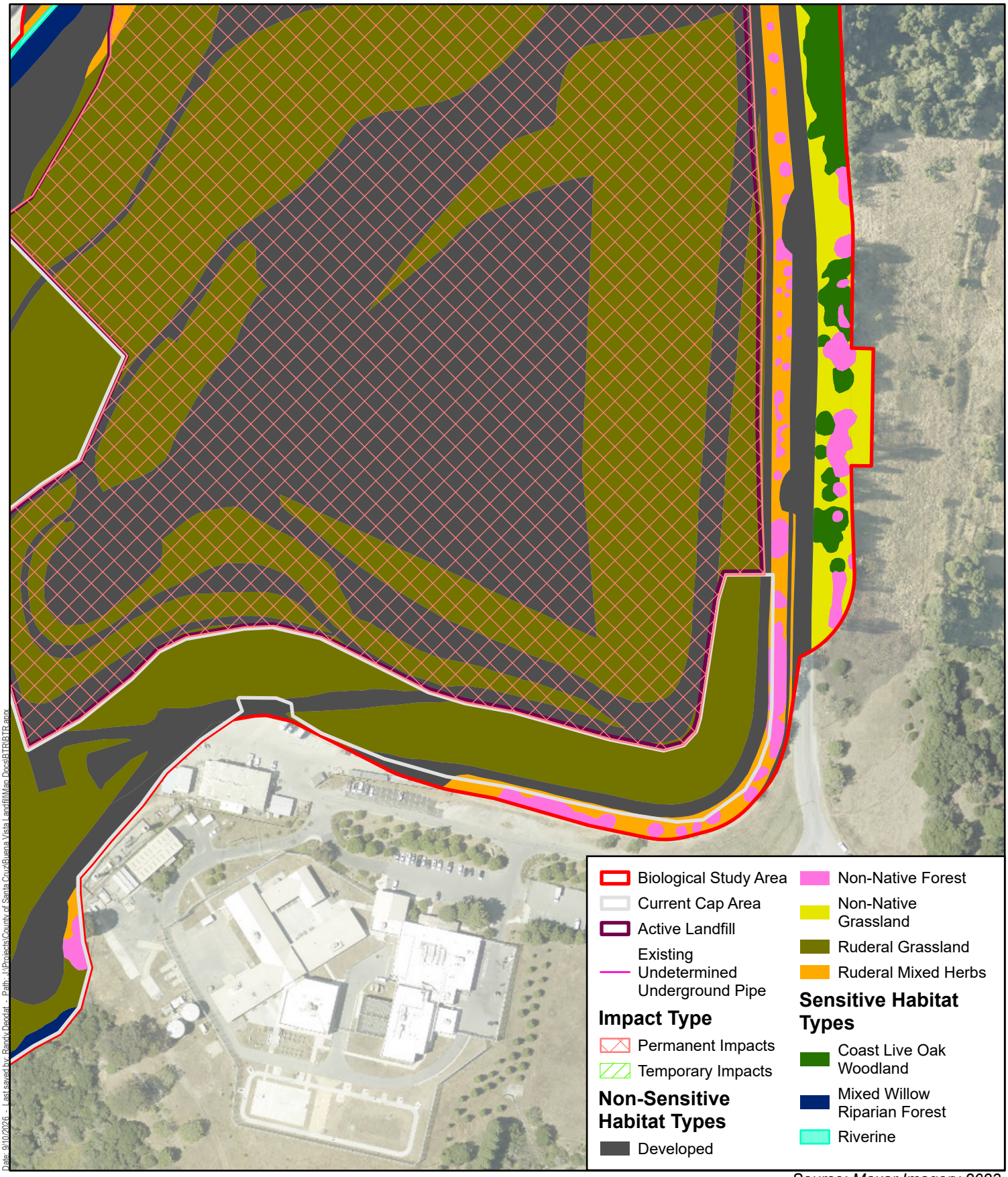
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Figure 6.4-1c

Habitat Type Impacts for Alternative 3

Buena Vista Landfill Redevelopment Project



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Source: Maxar Imagery 2023.

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Feet

Figure 6.4-1d

Habitat Type Impacts for Alternative 3

Buena Vista Landfill Redevelopment Project

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APPENDIX G4 NATIVE SHALLOW-ROOTED SHRUBS, PERENNIAL HERBS, AND VINES PROPOSED THE FOR THE LANDFILL CAP

UPLAND SPECIES

Baldhip rose (*Rosa gymnocarpa*)
Black sage (*Salvia mellifera*)
Blue elderberry (*Sambucus Mexicana*)
Blueblossum (*Ceanothus thyrsiflorus*)
Brittle leaf manzanita (*Arctostaphylos crustacea*)
California buckwheat (*Eriogonum fasciculatum*)
California fuchsia (*Epilobium canum*)
California poppy (*Escholzia californica*)
California sagebrush (*Artemisia californica*)
Chamise (*Adenostoma fasciculatus*)
Chaparral currant (*Ribes malvaceum*)
Coast silk tassel (*Garrya elliptica*)
Coffeeberry (*Frangula californica*)
Columbine (*Aquilegia Formosa*)
Creeping snowberry (*Symphoricarpos mollis*)
Flannel bush (*Fremontodendron californicum*)
Fuchsia flowered gooseberry (*Ribes speciosum*)
Giant vetch (*Vicia gigantea*)
Gooseberry (*Ribes mensiesii*)
Lemonade berry (*Rhus integrifolia*)
Lupine (*Lupinus bicolor*)
Naked buckwheat (*Eriogonum nudum*)
Osoberry (*Oemleria cerasiformis*)
Paintbrush (*Castilleja affinis*)
Pink honeysuckle (*Lonicera hispidula*)
Pitcher sage (*Lepechinia calycina*)
Sticky-monkey flower (*Diplacus aurantiacus*)
Toyon (*Heteromeles arbutifolia*)
Wartleaf ceanothus (*Ceanothus papillosus*)
Wooly leaf manzanita (*Arctostaphylos tomentosa*)
Yarrow (*Achillea millefolium*)

RIPARIAN BUFFER SPECIES

California aster (*Symphyotrichum chilense*)
California blackberry (*Rubus ursinus*)
California wild rose (*Rosa californica*)
Cardinal monkey flower (*Erythranthe cardinalis*)
Coast twinberry (*Lonicera involucrate*)
Spreading gooseberry (*Ribes divaricatum*)
Western goldenrod (*Euthamia occidentalis*)
Western verbena (*Verbena lasiostachys*)

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Appendix F. Air Quality and Greenhouse Gas Modeling Assumptions

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Transfer Station A - Construction Detailed Report

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1. Basic Project Information

1.1. Basic Project Information

Data Field	Value
Project Name	Transfer Station A - Construction
Construction Start Date	1/4/2027
Lead Agency	—
Land Use Scale	Project/site
Analysis Level for Defaults	County
Windspeed (m/s)	1.80
Precipitation (days)	36.6
Location	1231 Buena Vista Dr, Watsonville, CA 95076, USA
County	Santa Cruz
City	Unincorporated
Air District	Monterey Bay ARD
Air Basin	North Central Coast
TAZ	3128
EDFZ	6
Electric Utility	Pacific Gas & Electric Company
Gas Utility	Pacific Gas & Electric
App Version	2022.1.1.29

1.2. Land Use Types

Land Use Subtype	Size	Unit	Lot Acreage	Building Area (sq ft)	Landscape Area (sq ft)	Special Landscape Area (sq ft)	Population	Description
Manufacturing	32.7	1000sqft	2.73	32,700	0.00	0.00	—	—
Other Asphalt Surfaces	99.0	1000sqft	2.27	0.00	0.00	0.00	—	—

1.3. User-Selected Emission Reduction Measures by Emissions Sector

No measures selected

2. Emissions Summary

2.1. Construction Emissions Compared Against Thresholds

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Un/Mit.	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	1.10	9.76	13.7	0.02	0.34	3.00	3.34	0.31	0.32	0.63	—	2,699	2,699	0.12	0.05	0.82	2,719
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	33.0	28.3	29.0	0.13	1.17	40.2	40.9	1.08	5.45	6.10	—	11,941	11,941	0.93	1.44	0.39	12,395
Average Daily (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	2.63	7.78	9.78	0.02	0.26	3.86	4.12	0.24	0.56	0.80	—	2,296	2,296	0.12	0.11	0.56	2,332
Annual (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	0.48	1.42	1.78	< 0.005	0.05	0.70	0.75	0.04	0.10	0.15	—	380	380	0.02	0.02	0.09	386

2.2. Construction Emissions by Year, Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2027	1.10	9.76	13.7	0.02	0.34	3.00	3.34	0.31	0.32	0.63	—	2,699	2,699	0.12	0.05	0.82	2,719

Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2027	33.0	28.3	29.0	0.13	1.17	40.2	40.9	1.08	5.45	6.10	—	11,941	11,941	0.93	1.44	0.39	12,395
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2027	2.63	7.78	9.78	0.02	0.26	3.86	4.12	0.24	0.56	0.80	—	2,296	2,296	0.12	0.11	0.56	2,332
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2027	0.48	1.42	1.78	< 0.005	0.05	0.70	0.75	0.04	0.10	0.15	—	380	380	0.02	0.02	0.09	386

3. Construction Emissions Details

3.1. Site Preparation (2027) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	3.05	28.0	28.3	0.05	1.17	—	1.17	1.08	—	1.08	—	5,298	5,298	0.21	0.04	—	5,316
Dust From Material Movement	—	—	—	—	—	7.67	7.67	—	3.94	3.94	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Off-Road Equipment	0.08	0.77	0.77	< 0.005	0.03	—	0.03	0.03	—	0.03	—	145	145	0.01	< 0.005	—	146
Dust From Material Movement	—	—	—	—	—	0.21	0.21	—	0.11	0.11	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.02	0.14	0.14	< 0.005	0.01	—	0.01	0.01	—	0.01	—	24.0	24.0	< 0.005	< 0.005	—	24.1
Dust From Material Movement	—	—	—	—	—	0.04	0.04	—	0.02	0.02	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.08	0.07	0.75	0.00	0.00	2.62	2.62	0.00	0.28	0.28	—	120	120	0.01	0.01	0.01	121
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.02	0.00	0.00	0.06	0.06	0.00	0.01	0.01	—	3.28	3.28	< 0.005	< 0.005	0.01	3.33
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.00	0.00	0.01	0.01	0.00	< 0.005	< 0.005	—	0.54	0.54	< 0.005	< 0.005	< 0.005	0.55

Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.3. Grading (2027) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.59	14.2	17.3	0.03	0.60	—	0.60	0.55	—	0.55	—	2,960	2,960	0.12	0.02	—	2,970
Dust From Material Movement	—	—	—	—	—	2.77	2.77	—	1.34	1.34	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.09	0.78	0.95	< 0.005	0.03	—	0.03	0.03	—	0.03	—	162	162	0.01	< 0.005	—	163
Dust From Material Movement	—	—	—	—	—	0.15	0.15	—	0.07	0.07	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.02	0.14	0.17	< 0.005	0.01	—	0.01	0.01	—	0.01	—	26.9	26.9	< 0.005	< 0.005	—	26.9

Dust From Material Movement	—	—	—	—	—	0.03	0.03	—	0.01	0.01	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.07	0.06	0.65	0.00	0.00	2.25	2.25	0.00	0.24	0.24	—	103	103	0.01	< 0.005	0.01	104
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.21	14.1	5.67	0.10	0.10	35.2	35.3	0.10	3.87	3.97	—	8,879	8,879	0.80	1.42	0.38	9,321
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.03	0.00	0.00	0.11	0.11	0.00	0.01	0.01	—	5.62	5.62	< 0.005	< 0.005	0.01	5.71
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.01	0.76	0.31	0.01	0.01	1.74	1.75	0.01	0.19	0.20	—	486	486	0.04	0.08	0.34	511
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.01	0.00	0.00	0.02	0.02	0.00	< 0.005	< 0.005	—	0.93	0.93	< 0.005	< 0.005	< 0.005	0.95
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	0.14	0.06	< 0.005	< 0.005	0.32	0.32	< 0.005	0.04	0.04	—	80.5	80.5	0.01	0.01	0.06	84.6

3.5. Building Construction (2027) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.03	9.39	12.9	0.02	0.34	—	0.34	0.31	—	0.31	—	2,397	2,397	0.10	0.02	—	2,405
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.03	9.39	12.9	0.02	0.34	—	0.34	0.31	—	0.31	—	2,397	2,397	0.10	0.02	—	2,405
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.54	4.89	6.73	0.01	0.18	—	0.18	0.16	—	0.16	—	1,248	1,248	0.05	0.01	—	1,252
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.10	0.89	1.23	< 0.005	0.03	—	0.03	0.03	—	0.03	—	207	207	0.01	< 0.005	—	207
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.06	0.04	0.60	0.00	0.00	2.06	2.06	0.00	0.22	0.22	—	98.0	98.0	0.01	< 0.005	0.38	99.8
Vendor	0.01	0.33	0.14	< 0.005	< 0.005	0.94	0.95	< 0.005	0.10	0.11	—	204	204	0.01	0.03	0.44	214
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Worker	0.06	0.05	0.59	0.00	0.00	2.06	2.06	0.00	0.22	0.22	—	93.8	93.8	0.01	< 0.005	0.01	95.3
Vendor	0.01	0.34	0.15	< 0.005	< 0.005	0.94	0.95	< 0.005	0.10	0.11	—	204	204	0.01	0.03	0.01	214
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.03	0.02	0.29	0.00	0.00	0.97	0.97	0.00	0.10	0.10	—	48.9	48.9	< 0.005	< 0.005	0.09	49.7
Vendor	< 0.005	0.17	0.07	< 0.005	< 0.005	0.44	0.45	< 0.005	0.05	0.05	—	106	106	0.01	0.02	0.10	111
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01	< 0.005	0.05	0.00	0.00	0.18	0.18	0.00	0.02	0.02	—	8.09	8.09	< 0.005	< 0.005	0.01	8.22
Vendor	< 0.005	0.03	0.01	< 0.005	< 0.005	0.08	0.08	< 0.005	0.01	0.01	—	17.6	17.6	< 0.005	< 0.005	0.02	18.4
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.7. Paving (2027) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.66	6.09	8.83	0.01	0.24	—	0.24	0.22	—	0.22	—	1,350	1,350	0.05	0.01	—	1,355
Paving	0.30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Off-Road Equipment	0.04	0.33	0.48	< 0.005	0.01	—	0.01	0.01	—	0.01	—	74.0	74.0	< 0.005	< 0.005	—	74.2
Paving	0.02	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01	0.06	0.09	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	12.3	12.3	< 0.005	< 0.005	—	12.3
Paving	< 0.005	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.09	0.08	0.86	0.00	0.00	2.99	2.99	0.00	0.32	0.32	—	137	137	0.01	0.01	0.01	139
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.04	0.00	0.00	0.15	0.15	0.00	0.02	0.02	—	7.49	7.49	< 0.005	< 0.005	0.01	7.61
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.01	0.00	0.00	0.03	0.03	0.00	< 0.005	< 0.005	—	1.24	1.24	< 0.005	< 0.005	< 0.005	1.26
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.9. Architectural Coating (2027) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.11	0.83	1.13	< 0.005	0.02	—	0.02	0.02	—	0.02	—	134	134	0.01	< 0.005	—	134
Architectural Coatings	32.9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01	0.05	0.06	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	7.32	7.32	< 0.005	< 0.005	—	7.34
Architectural Coatings	1.80	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	< 0.005	0.01	0.01	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	1.21	1.21	< 0.005	< 0.005	—	1.22
Architectural Coatings	0.33	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01	0.01	0.12	0.00	0.00	0.41	0.41	0.00	0.04	0.04	—	18.8	18.8	< 0.005	< 0.005	< 0.005	19.1
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.01	0.00	0.00	0.02	0.02	0.00	< 0.005	< 0.005	—	1.03	1.03	< 0.005	< 0.005	< 0.005	1.05
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	0.17	0.17	< 0.005	< 0.005	< 0.005	0.17
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

4. Operations Emissions Details

4.10. Soil Carbon Accumulation By Vegetation Type

4.10.1. Soil Carbon Accumulation By Vegetation Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Vegetation	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.2. Above and Belowground Carbon Accumulation by Land Use Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.3. Avoided and Sequestered Emissions by Species - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Species	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Sequest	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

5. Activity Data

5.1. Construction Schedule

Phase Name	Phase Type	Start Date	End Date	Days Per Week	Work Days per Phase	Phase Description
Site Preparation	Site Preparation	1/4/2027	1/15/2027	5.00	10.0	—
Grading	Grading	1/16/2027	2/12/2027	5.00	20.0	—
Building Construction	Building Construction	2/13/2027	11/5/2027	5.00	190	—
Paving	Paving	11/6/2027	12/3/2027	5.00	20.0	—
Architectural Coating	Architectural Coating	12/4/2027	12/31/2027	5.00	20.0	—

5.2. Off-Road Equipment

5.2.1. Unmitigated

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Site Preparation	Rubber Tired Dozers	Diesel	Average	3.00	8.00	367	0.40
Site Preparation	Tractors/Loaders/Backhoes	Diesel	Average	4.00	8.00	84.0	0.37
Grading	Excavators	Diesel	Average	1.00	8.00	36.0	0.38
Grading	Graders	Diesel	Average	1.00	8.00	148	0.41
Grading	Rubber Tired Dozers	Diesel	Average	1.00	8.00	367	0.40
Grading	Tractors/Loaders/Backhoes	Diesel	Average	3.00	8.00	84.0	0.37
Building Construction	Cranes	Diesel	Average	1.00	7.00	367	0.29
Building Construction	Forklifts	Diesel	Average	3.00	8.00	82.0	0.20
Building Construction	Generator Sets	Diesel	Average	1.00	8.00	14.0	0.74
Building Construction	Tractors/Loaders/Backhoes	Diesel	Average	3.00	7.00	84.0	0.37
Building Construction	Welders	Diesel	Average	1.00	8.00	46.0	0.45
Paving	Cement and Mortar Mixers	Diesel	Average	2.00	6.00	10.0	0.56
Paving	Pavers	Diesel	Average	1.00	8.00	81.0	0.42

Paving	Paving Equipment	Diesel	Average	2.00	6.00	89.0	0.36
Paving	Rollers	Diesel	Average	2.00	6.00	36.0	0.38
Paving	Tractors/Loaders/Backhoes	Diesel	Average	1.00	8.00	84.0	0.37
Architectural Coating	Air Compressors	Diesel	Average	1.00	6.00	37.0	0.48

5.3. Construction Vehicles

5.3.1. Unmitigated

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Site Preparation	—	—	—	—
Site Preparation	Worker	17.5	9.71	LDA,LDT1,LDT2
Site Preparation	Vendor	—	6.06	HHDT,MHDT
Site Preparation	Hauling	0.00	20.0	HHDT
Site Preparation	Onsite truck	—	—	HHDT
Grading	—	—	—	—
Grading	Worker	15.0	9.71	LDA,LDT1,LDT2
Grading	Vendor	—	6.06	HHDT,MHDT
Grading	Hauling	113	20.0	HHDT
Grading	Onsite truck	—	—	HHDT
Building Construction	—	—	—	—
Building Construction	Worker	13.7	9.71	LDA,LDT1,LDT2
Building Construction	Vendor	10.0	6.06	HHDT,MHDT
Building Construction	Hauling	0.00	20.0	HHDT
Building Construction	Onsite truck	—	—	HHDT
Paving	—	—	—	—
Paving	Worker	20.0	9.71	LDA,LDT1,LDT2
Paving	Vendor	—	6.06	HHDT,MHDT
Paving	Hauling	0.00	20.0	HHDT

Paving	Onsite truck	—	—	HHDT
Architectural Coating	—	—	—	—
Architectural Coating	Worker	2.75	9.71	LDA,LDT1,LDT2
Architectural Coating	Vendor	—	6.06	HHDT,MHDT
Architectural Coating	Hauling	0.00	20.0	HHDT
Architectural Coating	Onsite truck	—	—	HHDT

5.4. Vehicles

5.4.1. Construction Vehicle Control Strategies

Control Strategies Applied	PM10 Reduction	PM2.5 Reduction
Water unpaved roads twice daily	55%	55%
Limit vehicle speeds on unpaved roads to 25 mph	44%	44%

5.5. Architectural Coatings

Phase Name	Residential Interior Area Coated (sq ft)	Residential Exterior Area Coated (sq ft)	Non-Residential Interior Area Coated (sq ft)	Non-Residential Exterior Area Coated (sq ft)	Parking Area Coated (sq ft)
Architectural Coating	0.00	0.00	49,050	16,350	5,933

5.6. Dust Mitigation

5.6.1. Construction Earthmoving Activities

Phase Name	Material Imported (Cubic Yards)	Material Exported (Cubic Yards)	Acres Graded (acres)	Material Demolished (sq. ft.)	Acres Paved (acres)
Site Preparation	0.00	0.00	15.0	0.00	—
Grading	0.00	18,000	20.0	0.00	—
Paving	0.00	0.00	0.00	0.00	2.27

5.6.2. Construction Earthmoving Control Strategies

Control Strategies Applied	Frequency (per day)	PM10 Reduction	PM2.5 Reduction
Water Exposed Area	2	61%	61%

5.7. Construction Paving

Land Use	Area Paved (acres)	% Asphalt
Manufacturing	0.00	0%
Other Asphalt Surfaces	2.27	100%

5.8. Construction Electricity Consumption and Emissions Factors

kWh per Year and Emission Factor (lb/MWh)

Year	kWh per Year	CO2	CH4	N2O
2027	0.00	204	0.03	< 0.005

5.18. Vegetation

5.18.1. Land Use Change

5.18.1.1. Unmitigated

Vegetation Land Use Type	Vegetation Soil Type	Initial Acres	Final Acres

5.18.1. Biomass Cover Type

5.18.1.1. Unmitigated

Biomass Cover Type	Initial Acres	Final Acres

5.18.2. Sequestration

5.18.2.1. Unmitigated

Tree Type	Number	Electricity Saved (kWh/year)	Natural Gas Saved (btu/year)

6. Climate Risk Detailed Report

6.1. Climate Risk Summary

Cal-Adapt midcentury 2040–2059 average projections for four hazards are reported below for your project location. These are under Representation Concentration Pathway (RCP) 8.5 which assumes GHG emissions will continue to rise strongly through 2050 and then plateau around 2100.

Climate Hazard	Result for Project Location	Unit
Temperature and Extreme Heat	6.83	annual days of extreme heat
Extreme Precipitation	6.05	annual days with precipitation above 20 mm
Sea Level Rise	—	meters of inundation depth
Wildfire	14.2	annual hectares burned

Temperature and Extreme Heat data are for grid cell in which your project are located. The projection is based on the 98th historical percentile of daily maximum/minimum temperatures from observed historical data (32 climate model ensemble from Cal-Adapt, 2040–2059 average under RCP 8.5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Extreme Precipitation data are for the grid cell in which your project are located. The threshold of 20 mm is equivalent to about ¾ an inch of rain, which would be light to moderate rainfall if received over a full day or heavy rain if received over a period of 2 to 4 hours. Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Sea Level Rise data are for the grid cell in which your project are located. The projections are from Radke et al. (2017), as reported in Cal-Adapt (Radke et al., 2017, CEC-500-2017-008), and consider inundation location and depth for the San Francisco Bay, the Sacramento-San Joaquin River Delta and California coast resulting different increments of sea level rise coupled with extreme storm events. Users may select from four scenarios to view the range in potential inundation depth for the grid cell. The four scenarios are: No rise, 0.5 meter, 1.0 meter, 1.41 meters
Wildfire data are for the grid cell in which your project are located. The projections are from UC Davis, as reported in Cal-Adapt (2040–2059 average under RCP 8.5), and consider historical data of climate, vegetation, population density, and large (> 400 ha) fire history. Users may select from four model simulations to view the range in potential wildfire probabilities for the grid cell. The four simulations make different assumptions about expected rainfall and temperature are: Warmer/drier (HadGEM2-ES), Cooler/wetter (CNRM-CM5), Average conditions (CanESM2), Range of different rainfall and temperature possibilities (MIROC5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.

6.2. Initial Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	N/A	N/A	N/A	N/A
Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	1	0	0	N/A
Wildfire	1	0	0	N/A

Flooding	N/A	N/A	N/A	N/A
Drought	0	0	0	N/A
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.
The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.
The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores do not include implementation of climate risk reduction measures.

6.3. Adjusted Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	N/A	N/A	N/A	N/A
Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	1	1	1	2
Wildfire	1	1	1	2
Flooding	N/A	N/A	N/A	N/A
Drought	1	1	1	2
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.
The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.
The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores include implementation of climate risk reduction measures.

6.4. Climate Risk Reduction Measures

7. Health and Equity Details

7.1. CalEnviroScreen 4.0 Scores

The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Exposure Indicators	—
AQ-Ozone	14.9
AQ-PM	2.71
AQ-DPM	42.7
Drinking Water	70.5
Lead Risk Housing	47.3
Pesticides	99.6
Toxic Releases	8.90
Traffic	69.7
Effect Indicators	—
CleanUp Sites	63.1
Groundwater	64.2
Haz Waste Facilities/Generators	80.2
Impaired Water Bodies	99.5
Solid Waste	97.9
Sensitive Population	—
Asthma	62.7
Cardio-vascular	41.9
Low Birth Weights	52.4
Socioeconomic Factor Indicators	—
Education	58.5
Housing	31.2
Linguistic	52.0
Poverty	37.9
Unemployment	59.4

7.2. Healthy Places Index Scores

The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Economic	—
Above Poverty	68.47170538
Employed	33.54292314
Median HI	77.41562941
Education	—
Bachelor's or higher	74.51559091
High school enrollment	7.327088413
Preschool enrollment	83.90863596
Transportation	—
Auto Access	81.29090209
Active commuting	41.03682792
Social	—
2-parent households	58.82201976
Voting	74.02797382
Neighborhood	—
Alcohol availability	73.69434108
Park access	29.20569742
Retail density	9.303220839
Supermarket access	9.983318363
Tree canopy	92.41627101
Housing	—
Homeownership	74.16912614
Housing habitability	87.37328372
Low-inc homeowner severe housing cost burden	42.5895034
Low-inc renter severe housing cost burden	89.84986526

Uncrowded housing	84.29359682
Health Outcomes	—
Insured adults	42.7691518
Arthritis	0.0
Asthma ER Admissions	30.7
High Blood Pressure	0.0
Cancer (excluding skin)	0.0
Asthma	0.0
Coronary Heart Disease	0.0
Chronic Obstructive Pulmonary Disease	0.0
Diagnosed Diabetes	0.0
Life Expectancy at Birth	66.4
Cognitively Disabled	74.6
Physically Disabled	69.8
Heart Attack ER Admissions	60.9
Mental Health Not Good	0.0
Chronic Kidney Disease	0.0
Obesity	0.0
Pedestrian Injuries	19.6
Physical Health Not Good	0.0
Stroke	0.0
Health Risk Behaviors	—
Binge Drinking	0.0
Current Smoker	0.0
No Leisure Time for Physical Activity	0.0
Climate Change Exposures	—
Wildfire Risk	0.0
SLR Inundation Area	41.6

Children	50.1
Elderly	12.2
English Speaking	45.2
Foreign-born	31.6
Outdoor Workers	7.8
Climate Change Adaptive Capacity	—
Impervious Surface Cover	92.0
Traffic Density	42.1
Traffic Access	0.0
Other Indices	—
Hardship	27.2
Other Decision Support	—
2016 Voting	85.3

7.3. Overall Health & Equity Scores

Metric	Result for Project Census Tract
CalEnviroScreen 4.0 Score for Project Location (a)	69.0
Healthy Places Index Score for Project Location (b)	66.0
Project Located in a Designated Disadvantaged Community (Senate Bill 535)	No
Project Located in a Low-Income Community (Assembly Bill 1550)	No
Project Located in a Community Air Protection Program Community (Assembly Bill 617)	No

a: The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.
b: The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

7.4. Health & Equity Measures

No Health & Equity Measures selected.

7.5. Evaluation Scorecard

Health & Equity Evaluation Scorecard not completed.

7.6. Health & Equity Custom Measures

No Health & Equity Custom Measures created.

8. User Changes to Default Data

Screen	Justification
Land Use	Revised acreage to disturbance area
Construction: Construction Phases	Removed demo and reduced building construction to fit 12 month construction period
Construction: Trips and VMT	Revised vendor trips based on material import estimates
Construction: On-Road Fugitive Dust	Site accessible by paved roads
Construction: Paving	Estimated new paved area

Transfer Station B - Construction Detailed Report

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8. User Changes to Default Data

1. Basic Project Information

1.1. Basic Project Information

Data Field	Value
Project Name	Transfer Station B - Construction
Construction Start Date	1/2/2029
Lead Agency	—
Land Use Scale	Project/site
Analysis Level for Defaults	County
Windspeed (m/s)	1.80
Precipitation (days)	36.6
Location	1231 Buena Vista Dr, Watsonville, CA 95076, USA
County	Santa Cruz
City	Unincorporated
Air District	Monterey Bay ARD
Air Basin	North Central Coast
TAZ	3128
EDFZ	6
Electric Utility	Pacific Gas & Electric Company
Gas Utility	Pacific Gas & Electric
App Version	2022.1.1.29

1.2. Land Use Types

Land Use Subtype	Size	Unit	Lot Acreage	Building Area (sq ft)	Landscape Area (sq ft)	Special Landscape Area (sq ft)	Population	Description
Manufacturing	28.7	1000sqft	4.40	28,700	0.00	0.00	—	—
Other Asphalt Surfaces	25.0	1000sqft	0.60	0.00	0.00	0.00	—	—

1.3. User-Selected Emission Reduction Measures by Emissions Sector

No measures selected

2. Emissions Summary

2.1. Construction Emissions Compared Against Thresholds

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Un/Mit.	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	1.02	8.82	13.5	0.02	0.28	6.06	6.34	0.25	0.62	0.88	—	2,616	2,616	0.11	0.04	0.54	2,632
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	28.6	26.0	28.7	0.05	1.09	13.0	13.9	1.00	4.47	5.47	—	5,412	5,412	0.24	0.26	0.06	5,432
Average Daily (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	2.37	7.00	9.60	0.02	0.24	4.15	4.39	0.22	0.57	0.79	—	1,894	1,894	0.08	0.04	0.20	1,909
Annual (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	0.43	1.28	1.75	< 0.005	0.04	0.76	0.80	0.04	0.10	0.14	—	314	314	0.01	0.01	0.03	316

2.2. Construction Emissions by Year, Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2029	1.02	8.82	13.5	0.02	0.28	6.06	6.34	0.25	0.62	0.88	—	2,616	2,616	0.11	0.04	0.54	2,632

Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2029	28.6	26.0	28.7	0.05	1.09	13.0	13.9	1.00	4.47	5.47	—	5,412	5,412	0.24	0.26	0.06	5,432
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2029	2.37	7.00	9.60	0.02	0.24	4.15	4.39	0.22	0.57	0.79	—	1,894	1,894	0.08	0.04	0.20	1,909
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2029	0.43	1.28	1.75	< 0.005	0.04	0.76	0.80	0.04	0.10	0.14	—	314	314	0.01	0.01	0.03	316

3. Construction Emissions Details

3.1. Demolition (2029) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	2.14	18.6	18.5	0.03	0.74	—	0.74	0.68	—	0.68	—	3,427	3,427	0.14	0.03	—	3,439
Demolition	—	—	—	—	—	0.47	0.47	—	0.07	0.07	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.12	1.02	1.01	< 0.005	0.04	—	0.04	0.04	—	0.04	—	188	188	0.01	< 0.005	—	188

Demoliti	—	—	—	—	—	0.03	0.03	—	< 0.005	< 0.005	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.02	0.19	0.18	< 0.005	0.01	—	0.01	0.01	—	0.01	—	31.1	31.1	< 0.005	< 0.005	—	31.2
Demolition	—	—	—	—	—	< 0.005	< 0.005	—	< 0.005	< 0.005	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.06	0.05	0.57	0.00	0.00	4.39	4.39	0.00	0.45	0.45	—	99.1	99.1	< 0.005	< 0.005	0.01	101
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.01	0.63	0.27	0.01	0.01	1.75	1.76	< 0.005	0.19	0.20	—	420	420	0.03	0.07	0.02	441
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.03	0.00	0.00	0.22	0.22	0.00	0.02	0.02	—	5.43	5.43	< 0.005	< 0.005	0.01	5.52
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	0.03	0.01	< 0.005	< 0.005	0.09	0.09	< 0.005	0.01	0.01	—	23.0	23.0	< 0.005	< 0.005	0.01	24.2
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.01	0.00	0.00	0.04	0.04	0.00	< 0.005	< 0.005	—	0.90	0.90	< 0.005	< 0.005	< 0.005	0.91
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	0.01	< 0.005	< 0.005	< 0.005	0.02	0.02	< 0.005	< 0.005	< 0.005	—	3.81	3.81	< 0.005	< 0.005	< 0.005	4.00

3.3. Site Preparation (2029) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	2.97	25.9	28.1	0.05	1.09	—	1.09	1.00	—	1.00	—	5,296	5,296	0.21	0.04	—	5,314
Dust From Material Movement	—	—	—	—	—	7.67	7.67	—	3.94	3.94	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.08	0.71	0.77	< 0.005	0.03	—	0.03	0.03	—	0.03	—	145	145	0.01	< 0.005	—	146
Dust From Material Movement	—	—	—	—	—	0.21	0.21	—	0.11	0.11	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01	0.13	0.14	< 0.005	0.01	—	0.01	0.01	—	0.01	—	24.0	24.0	< 0.005	< 0.005	—	24.1
Dust From Material Movement	—	—	—	—	—	0.04	0.04	—	0.02	0.02	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.07	0.06	0.67	0.00	0.00	5.12	5.12	0.00	0.53	0.53	—	116	116	< 0.005	0.01	0.01	117
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.02	0.00	0.00	0.13	0.13	0.00	0.01	0.01	—	3.17	3.17	< 0.005	< 0.005	< 0.005	3.22
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.00	0.00	0.02	0.02	0.00	< 0.005	< 0.005	—	0.52	0.52	< 0.005	< 0.005	< 0.005	0.53
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.5. Grading (2029) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.52	13.0	17.2	0.03	0.53	—	0.53	0.49	—	0.49	—	2,959	2,959	0.12	0.02	—	2,969

Dust From Material Movement	—	—	—	—	—	2.76	2.76	—	1.34	1.34	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.08	0.71	0.94	< 0.005	0.03	—	0.03	0.03	—	0.03	—	162	162	0.01	< 0.005	—	163
Dust From Material Movement	—	—	—	—	—	0.15	0.15	—	0.07	0.07	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.02	0.13	0.17	< 0.005	0.01	—	0.01	< 0.005	—	< 0.005	—	26.8	26.8	< 0.005	< 0.005	—	26.9
Dust From Material Movement	—	—	—	—	—	0.03	0.03	—	0.01	0.01	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.06	0.05	0.57	0.00	0.00	4.39	4.39	0.00	0.45	0.45	—	99.1	99.1	< 0.005	< 0.005	0.01	101
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.03	2.10	0.89	0.02	0.02	5.86	5.88	0.02	0.65	0.66	—	1,406	1,406	0.12	0.23	0.05	1,476

Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.03	0.00	0.00	0.22	0.22	0.00	0.02	0.02	—	5.43	5.43	< 0.005	< 0.005	0.01	5.52
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	0.11	0.05	< 0.005	< 0.005	0.29	0.29	< 0.005	0.03	0.03	—	77.0	77.0	0.01	0.01	0.05	80.9
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.01	0.00	0.00	0.04	0.04	0.00	< 0.005	< 0.005	—	0.90	0.90	< 0.005	< 0.005	< 0.005	0.91
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	0.02	0.01	< 0.005	< 0.005	0.05	0.05	< 0.005	0.01	0.01	—	12.8	12.8	< 0.005	< 0.005	0.01	13.4

3.7. Building Construction (2029) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.97	8.58	12.9	0.02	0.28	—	0.28	0.25	—	0.25	—	2,397	2,397	0.10	0.02	—	2,405
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.97	8.58	12.9	0.02	0.28	—	0.28	0.25	—	0.25	—	2,397	2,397	0.10	0.02	—	2,405
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.44	3.93	5.90	0.01	0.13	—	0.13	0.12	—	0.12	—	1,097	1,097	0.04	0.01	—	1,100

Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.08	0.72	1.08	< 0.005	0.02	—	0.02	0.02	—	0.02	—	182	182	0.01	< 0.005	—	182
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.05	0.03	0.47	0.00	0.00	3.53	3.53	0.00	0.36	0.36	—	83.2	83.2	< 0.005	< 0.005	0.28	84.6
Vendor	< 0.005	0.20	0.09	< 0.005	< 0.005	2.53	2.53	< 0.005	0.26	0.26	—	136	136	0.01	0.02	0.25	143
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.05	0.04	0.46	0.00	0.00	3.53	3.53	0.00	0.36	0.36	—	79.7	79.7	< 0.005	< 0.005	0.01	80.8
Vendor	< 0.005	0.21	0.09	< 0.005	< 0.005	2.53	2.53	< 0.005	0.26	0.26	—	136	136	0.01	0.02	0.01	142
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.02	0.02	0.20	0.00	0.00	1.45	1.45	0.00	0.15	0.15	—	36.5	36.5	< 0.005	< 0.005	0.06	37.1
Vendor	< 0.005	0.10	0.04	< 0.005	< 0.005	1.04	1.04	< 0.005	0.11	0.11	—	62.2	62.2	< 0.005	0.01	0.05	65.2
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.04	0.00	0.00	0.27	0.27	0.00	0.03	0.03	—	6.04	6.04	< 0.005	< 0.005	0.01	6.14
Vendor	< 0.005	0.02	0.01	< 0.005	< 0.005	0.19	0.19	< 0.005	0.02	0.02	—	10.3	10.3	< 0.005	< 0.005	0.01	10.8
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.9. Paving (2029) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.62	5.73	8.81	0.01	0.20	—	0.20	0.18	—	0.18	—	1,350	1,350	0.05	0.01	—	1,354
Paving	0.08	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.03	0.31	0.48	< 0.005	0.01	—	0.01	0.01	—	0.01	—	74.0	74.0	< 0.005	< 0.005	—	74.2
Paving	< 0.005	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01	0.06	0.09	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	12.2	12.2	< 0.005	< 0.005	—	12.3
Paving	< 0.005	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Worker	0.08	0.06	0.76	0.00	0.00	5.85	5.85	0.00	0.60	0.60	—	132	132	< 0.005	0.01	0.01	134
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.04	0.00	0.00	0.29	0.29	0.00	0.03	0.03	—	7.24	7.24	< 0.005	< 0.005	0.01	7.36
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.01	0.00	0.00	0.05	0.05	0.00	0.01	0.01	—	1.20	1.20	< 0.005	< 0.005	< 0.005	1.22
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.11. Architectural Coating (2029) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.10	0.79	1.11	< 0.005	0.01	—	0.01	0.01	—	0.01	—	134	134	0.01	< 0.005	—	134
Architectural Coatings	28.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Off-Road Equipment	0.01	0.04	0.06	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	7.32	7.32	< 0.005	< 0.005	—	7.34
Architectural Coatings	1.56	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	< 0.005	0.01	0.01	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	1.21	1.21	< 0.005	< 0.005	—	1.22
Architectural Coatings	0.28	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01	0.01	0.09	0.00	0.00	0.71	0.71	0.00	0.07	0.07	—	15.9	15.9	< 0.005	< 0.005	< 0.005	16.2
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.00	0.00	0.03	0.03	0.00	< 0.005	< 0.005	—	0.87	0.87	< 0.005	< 0.005	< 0.005	0.89
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.00	0.00	0.01	0.01	0.00	< 0.005	< 0.005	—	0.14	0.14	< 0.005	< 0.005	< 0.005	0.15
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

4. Operations Emissions Details

4.10. Soil Carbon Accumulation By Vegetation Type

4.10.1. Soil Carbon Accumulation By Vegetation Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Vegetation	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.2. Above and Belowground Carbon Accumulation by Land Use Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.3. Avoided and Sequestered Emissions by Species - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Species	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

5. Activity Data

5.1. Construction Schedule

Phase Name	Phase Type	Start Date	End Date	Days Per Week	Work Days per Phase	Phase Description
Demolition	Demolition	1/2/2029	1/30/2029	5.00	20.0	—
Site Preparation	Site Preparation	1/31/2029	2/14/2029	5.00	10.0	—
Grading	Grading	2/15/2029	3/15/2029	5.00	20.0	—
Building Construction	Building Construction	3/16/2029	11/5/2029	5.00	167	—
Paving	Paving	11/6/2029	12/3/2029	5.00	20.0	—
Architectural Coating	Architectural Coating	12/4/2029	12/31/2029	5.00	20.0	—

5.2. Off-Road Equipment

5.2.1. Unmitigated

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Demolition	Concrete/Industrial Saws	Diesel	Average	1.00	8.00	33.0	0.73
Demolition	Excavators	Diesel	Average	3.00	8.00	36.0	0.38

Demolition	Rubber Tired Dozers	Diesel	Average	2.00	8.00	367	0.40
Site Preparation	Rubber Tired Dozers	Diesel	Average	3.00	8.00	367	0.40
Site Preparation	Tractors/Loaders/Backhoes	Diesel	Average	4.00	8.00	84.0	0.37
Grading	Excavators	Diesel	Average	1.00	8.00	36.0	0.38
Grading	Graders	Diesel	Average	1.00	8.00	148	0.41
Grading	Rubber Tired Dozers	Diesel	Average	1.00	8.00	367	0.40
Grading	Tractors/Loaders/Backhoes	Diesel	Average	3.00	8.00	84.0	0.37
Building Construction	Cranes	Diesel	Average	1.00	7.00	367	0.29
Building Construction	Forklifts	Diesel	Average	3.00	8.00	82.0	0.20
Building Construction	Generator Sets	Diesel	Average	1.00	8.00	14.0	0.74
Building Construction	Tractors/Loaders/Backhoes	Diesel	Average	3.00	7.00	84.0	0.37
Building Construction	Welders	Diesel	Average	1.00	8.00	46.0	0.45
Paving	Cement and Mortar Mixers	Diesel	Average	2.00	6.00	10.0	0.56
Paving	Pavers	Diesel	Average	1.00	8.00	81.0	0.42
Paving	Paving Equipment	Diesel	Average	2.00	6.00	89.0	0.36
Paving	Rollers	Diesel	Average	2.00	6.00	36.0	0.38
Paving	Tractors/Loaders/Backhoes	Diesel	Average	1.00	8.00	84.0	0.37
Architectural Coating	Air Compressors	Diesel	Average	1.00	6.00	37.0	0.48

5.3. Construction Vehicles

5.3.1. Unmitigated

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Demolition	—	—	—	—
Demolition	Worker	15.0	9.71	LDA,LDT1,LDT2

Demolition	Vendor	—	6.06	HHDT,MHDT
Demolition	Hauling	5.60	20.0	HHDT
Demolition	Onsite truck	—	—	HHDT
Site Preparation	—	—	—	—
Site Preparation	Worker	17.5	9.71	LDA,LDT1,LDT2
Site Preparation	Vendor	—	6.06	HHDT,MHDT
Site Preparation	Hauling	0.00	20.0	HHDT
Site Preparation	Onsite truck	—	—	HHDT
Grading	—	—	—	—
Grading	Worker	15.0	9.71	LDA,LDT1,LDT2
Grading	Vendor	—	6.06	HHDT,MHDT
Grading	Hauling	18.8	20.0	HHDT
Grading	Onsite truck	—	—	HHDT
Building Construction	—	—	—	—
Building Construction	Worker	12.1	9.71	LDA,LDT1,LDT2
Building Construction	Vendor	7.00	6.06	HHDT,MHDT
Building Construction	Hauling	0.00	20.0	HHDT
Building Construction	Onsite truck	—	—	HHDT
Paving	—	—	—	—
Paving	Worker	20.0	9.71	LDA,LDT1,LDT2
Paving	Vendor	—	6.06	HHDT,MHDT
Paving	Hauling	0.00	20.0	HHDT
Paving	Onsite truck	—	—	HHDT
Architectural Coating	—	—	—	—
Architectural Coating	Worker	2.41	9.71	LDA,LDT1,LDT2
Architectural Coating	Vendor	—	6.06	HHDT,MHDT
Architectural Coating	Hauling	0.00	20.0	HHDT
Architectural Coating	Onsite truck	—	—	HHDT

5.4. Vehicles

5.4.1. Construction Vehicle Control Strategies

Control Strategies Applied	PM10 Reduction	PM2.5 Reduction
Water unpaved roads twice daily	55%	55%
Limit vehicle speeds on unpaved roads to 25 mph	44%	44%

5.5. Architectural Coatings

Phase Name	Residential Interior Area Coated (sq ft)	Residential Exterior Area Coated (sq ft)	Non-Residential Interior Area Coated (sq ft)	Non-Residential Exterior Area Coated (sq ft)	Parking Area Coated (sq ft)
Architectural Coating	0.00	0.00	43,050	14,350	1,568

5.6. Dust Mitigation

5.6.1. Construction Earthmoving Activities

Phase Name	Material Imported (Cubic Yards)	Material Exported (Cubic Yards)	Acres Graded (acres)	Material Demolished (Building Square Footage)	Acres Paved (acres)
Demolition	0.00	0.00	0.00	9,700	—
Site Preparation	0.00	0.00	15.0	0.00	—
Grading	0.00	3,000	20.0	0.00	—
Paving	0.00	0.00	0.00	0.00	0.60

5.6.2. Construction Earthmoving Control Strategies

Control Strategies Applied	Frequency (per day)	PM10 Reduction	PM2.5 Reduction
Water Exposed Area	2	61%	61%

5.7. Construction Paving

Land Use	Area Paved (acres)	% Asphalt
Manufacturing	0.00	0%
Other Asphalt Surfaces	0.60	100%

5.8. Construction Electricity Consumption and Emissions Factors

kWh per Year and Emission Factor (lb/MWh)

Year	kWh per Year	CO2	CH4	N2O
2029	0.00	204	0.03	< 0.005

5.18. Vegetation

5.18.1. Land Use Change

5.18.1.1. Unmitigated

Vegetation Land Use Type	Vegetation Soil Type	Initial Acres	Final Acres

5.18.1. Biomass Cover Type

5.18.1.1. Unmitigated

Biomass Cover Type	Initial Acres	Final Acres

5.18.2. Sequestration

5.18.2.1. Unmitigated

Tree Type	Number	Electricity Saved (kWh/year)	Natural Gas Saved (btu/year)

6. Climate Risk Detailed Report

6.1. Climate Risk Summary

Cal-Adapt midcentury 2040–2059 average projections for four hazards are reported below for your project location. These are under Representation Concentration Pathway (RCP) 8.5 which assumes GHG emissions will continue to rise strongly through 2050 and then plateau around 2100.

Climate Hazard	Result for Project Location	Unit
Temperature and Extreme Heat	6.83	annual days of extreme heat
Extreme Precipitation	6.05	annual days with precipitation above 20 mm
Sea Level Rise	—	meters of inundation depth
Wildfire	14.2	annual hectares burned

Temperature and Extreme Heat data are for grid cell in which your project are located. The projection is based on the 98th historical percentile of daily maximum/minimum temperatures from observed historical data (32 climate model ensemble from Cal-Adapt, 2040–2059 average under RCP 8.5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Extreme Precipitation data are for the grid cell in which your project are located. The threshold of 20 mm is equivalent to about ¾ an inch of rain, which would be light to moderate rainfall if received over a full day or heavy rain if received over a period of 2 to 4 hours. Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Sea Level Rise data are for the grid cell in which your project are located. The projections are from Radke et al. (2017), as reported in Cal-Adapt (Radke et al., 2017, CEC-500-2017-008), and consider inundation location and depth for the San Francisco Bay, the Sacramento-San Joaquin River Delta and California coast resulting different increments of sea level rise coupled with extreme storm events. Users may select from four scenarios to view the range in potential inundation depth for the grid cell. The four scenarios are: No rise, 0.5 meter, 1.0 meter, 1.41 meters
Wildfire data are for the grid cell in which your project are located. The projections are from UC Davis, as reported in Cal-Adapt (2040–2059 average under RCP 8.5), and consider historical data of climate, vegetation, population density, and large (> 400 ha) fire history. Users may select from four model simulations to view the range in potential wildfire probabilities for the grid cell. The four simulations make different assumptions about expected rainfall and temperature are: Warmer/drier (HadGEM2-ES), Cooler/wetter (CNRM-CM5), Average conditions (CanESM2), Range of different rainfall and temperature possibilities (MIROC5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.

6.2. Initial Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	N/A	N/A	N/A	N/A
Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	0	0	0	N/A
Wildfire	0	0	0	N/A
Flooding	N/A	N/A	N/A	N/A
Drought	0	0	0	N/A
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.

The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.
The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores do not include implementation of climate risk reduction measures.

6.3. Adjusted Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	N/A	N/A	N/A	N/A
Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	1	1	1	2
Wildfire	1	1	1	2
Flooding	N/A	N/A	N/A	N/A
Drought	1	1	1	2
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.
The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.
The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores include implementation of climate risk reduction measures.

6.4. Climate Risk Reduction Measures

7. Health and Equity Details

7.1. CalEnviroScreen 4.0 Scores

The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Exposure Indicators	—
AQ-Ozone	14.9
AQ-PM	2.71

AQ-DPM	42.7
Drinking Water	70.5
Lead Risk Housing	47.3
Pesticides	99.6
Toxic Releases	8.90
Traffic	69.7
Effect Indicators	—
CleanUp Sites	63.1
Groundwater	64.2
Haz Waste Facilities/Generators	80.2
Impaired Water Bodies	99.5
Solid Waste	97.9
Sensitive Population	—
Asthma	62.7
Cardio-vascular	41.9
Low Birth Weights	52.4
Socioeconomic Factor Indicators	—
Education	58.5
Housing	31.2
Linguistic	52.0
Poverty	37.9
Unemployment	59.4

7.2. Healthy Places Index Scores

The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Economic	—
Above Poverty	68.47170538

Employed	33.54292314
Median HI	77.41562941
Education	—
Bachelor's or higher	74.51559091
High school enrollment	7.327088413
Preschool enrollment	83.90863596
Transportation	—
Auto Access	81.29090209
Active commuting	41.03682792
Social	—
2-parent households	58.82201976
Voting	74.02797382
Neighborhood	—
Alcohol availability	73.69434108
Park access	29.20569742
Retail density	9.303220839
Supermarket access	9.983318363
Tree canopy	92.41627101
Housing	—
Homeownership	74.16912614
Housing habitability	87.37328372
Low-inc homeowner severe housing cost burden	42.5895034
Low-inc renter severe housing cost burden	89.84986526
Uncrowded housing	84.29359682
Health Outcomes	—
Insured adults	42.7691518
Arthritis	0.0
Asthma ER Admissions	30.7

High Blood Pressure	0.0
Cancer (excluding skin)	0.0
Asthma	0.0
Coronary Heart Disease	0.0
Chronic Obstructive Pulmonary Disease	0.0
Diagnosed Diabetes	0.0
Life Expectancy at Birth	66.4
Cognitively Disabled	74.6
Physically Disabled	69.8
Heart Attack ER Admissions	60.9
Mental Health Not Good	0.0
Chronic Kidney Disease	0.0
Obesity	0.0
Pedestrian Injuries	19.6
Physical Health Not Good	0.0
Stroke	0.0
Health Risk Behaviors	—
Binge Drinking	0.0
Current Smoker	0.0
No Leisure Time for Physical Activity	0.0
Climate Change Exposures	—
Wildfire Risk	0.0
SLR Inundation Area	41.6
Children	50.1
Elderly	12.2
English Speaking	45.2
Foreign-born	31.6
Outdoor Workers	7.8

Climate Change Adaptive Capacity	—
Impervious Surface Cover	92.0
Traffic Density	42.1
Traffic Access	0.0
Other Indices	—
Hardship	27.2
Other Decision Support	—
2016 Voting	85.3

7.3. Overall Health & Equity Scores

Metric	Result for Project Census Tract
CalEnviroScreen 4.0 Score for Project Location (a)	69.0
Healthy Places Index Score for Project Location (b)	66.0
Project Located in a Designated Disadvantaged Community (Senate Bill 535)	No
Project Located in a Low-Income Community (Assembly Bill 1550)	No
Project Located in a Community Air Protection Program Community (Assembly Bill 617)	No

a: The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.
b: The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

7.4. Health & Equity Measures

No Health & Equity Measures selected.

7.5. Evaluation Scorecard

Health & Equity Evaluation Scorecard not completed.

7.6. Health & Equity Custom Measures

No Health & Equity Custom Measures created.

8. User Changes to Default Data

Screen	Justification

Land Use	Revised lot acreage to disturbance area
Construction: Construction Phases	Reduced to 12 mo construction period
Construction: Trips and VMT	Revised based on material import quantities
Construction: On-Road Fugitive Dust	Mostly accessible by paved roads. Last approx. 1250 feet unpaved

ODF Option 2 - Construction Detailed Report

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8. User Changes to Default Data

1. Basic Project Information

1.1. Basic Project Information

Data Field	Value
Project Name	ODF Option 2 - Construction
Construction Start Date	1/4/2027
Lead Agency	—
Land Use Scale	Project/site
Analysis Level for Defaults	County
Windspeed (m/s)	1.80
Precipitation (days)	36.6
Location	1231 Buena Vista Dr, Watsonville, CA 95076, USA
County	Santa Cruz
City	Unincorporated
Air District	Monterey Bay ARD
Air Basin	North Central Coast
TAZ	3128
EDFZ	6
Electric Utility	Pacific Gas & Electric Company
Gas Utility	Pacific Gas & Electric
App Version	2022.1.1.29

1.2. Land Use Types

Land Use Subtype	Size	Unit	Lot Acreage	Building Area (sq ft)	Landscape Area (sq ft)	Special Landscape Area (sq ft)	Population	Description
Manufacturing	7.50	1000sqft	0.81	7,500	0.00	0.00	—	—
Other Asphalt Surfaces	400	1000sqft	9.19	0.00	0.00	0.00	—	—

1.3. User-Selected Emission Reduction Measures by Emissions Sector

No measures selected

2. Emissions Summary

2.1. Construction Emissions Compared Against Thresholds

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Un/Mit.	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	1.06	10.2	13.4	0.03	0.34	2.64	2.98	0.32	0.29	0.60	—	2,889	2,889	0.13	0.09	1.10	2,921
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	10.3	28.0	29.0	0.05	1.17	10.3	11.5	1.08	4.22	5.30	—	5,417	5,417	0.22	0.19	0.05	5,437
Average Daily (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	1.42	7.51	9.56	0.02	0.27	2.25	2.52	0.25	0.42	0.66	—	2,002	2,002	0.09	0.06	0.32	2,023
Annual (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	0.26	1.37	1.75	< 0.005	0.05	0.41	0.46	0.05	0.08	0.12	—	331	331	0.02	0.01	0.05	335

2.2. Construction Emissions by Year, Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2027	1.06	10.2	13.4	0.03	0.34	2.64	2.98	0.32	0.29	0.60	—	2,889	2,889	0.13	0.09	1.10	2,921

Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2027	10.3	28.0	29.0	0.05	1.17	10.3	11.5	1.08	4.22	5.30	—	5,417	5,417	0.22	0.19	0.05	5,437
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2027	1.42	7.51	9.56	0.02	0.27	2.25	2.52	0.25	0.42	0.66	—	2,002	2,002	0.09	0.06	0.32	2,023
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2027	0.26	1.37	1.75	< 0.005	0.05	0.41	0.46	0.05	0.08	0.12	—	331	331	0.02	0.01	0.05	335

3. Construction Emissions Details

3.1. Site Preparation (2027) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	3.05	28.0	28.3	0.05	1.17	—	1.17	1.08	—	1.08	—	5,298	5,298	0.21	0.04	—	5,316
Dust From Material Movement	—	—	—	—	—	7.67	7.67	—	3.94	3.94	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Off-Road Equipment	0.08	0.77	0.77	< 0.005	0.03	—	0.03	0.03	—	0.03	—	145	145	0.01	< 0.005	—	146
Dust From Material Movement	—	—	—	—	—	0.21	0.21	—	0.11	0.11	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.02	0.14	0.14	< 0.005	0.01	—	0.01	0.01	—	0.01	—	24.0	24.0	< 0.005	< 0.005	—	24.1
Dust From Material Movement	—	—	—	—	—	0.04	0.04	—	0.02	0.02	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.08	0.07	0.75	0.00	0.00	2.62	2.62	0.00	0.28	0.28	—	120	120	0.01	0.01	0.01	121
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.02	0.00	0.00	0.06	0.06	0.00	0.01	0.01	—	3.28	3.28	< 0.005	< 0.005	0.01	3.33
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.00	0.00	0.01	0.01	0.00	< 0.005	< 0.005	—	0.54	0.54	< 0.005	< 0.005	< 0.005	0.55

Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.3. Grading (2027) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.59	14.2	17.3	0.03	0.60	—	0.60	0.55	—	0.55	—	2,960	2,960	0.12	0.02	—	2,970
Dust From Material Movement	—	—	—	—	—	2.76	2.76	—	1.34	1.34	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.13	1.17	1.42	< 0.005	0.05	—	0.05	0.05	—	0.05	—	243	243	0.01	< 0.005	—	244
Dust From Material Movement	—	—	—	—	—	0.23	0.23	—	0.11	0.11	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.02	0.21	0.26	< 0.005	0.01	—	0.01	0.01	—	0.01	—	40.3	40.3	< 0.005	< 0.005	—	40.4

Dust From Material Movement	—	—	—	—	—	0.04	0.04	—	0.02	0.02	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.07	0.06	0.65	0.00	0.00	2.25	2.25	0.00	0.24	0.24	—	103	103	0.01	< 0.005	0.01	104
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.02	1.56	0.63	0.01	0.01	3.91	3.92	0.01	0.43	0.44	—	987	987	0.09	0.16	0.04	1,036
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01	< 0.005	0.05	0.00	0.00	0.17	0.17	0.00	0.02	0.02	—	8.43	8.43	< 0.005	< 0.005	0.01	8.57
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	0.13	0.05	< 0.005	< 0.005	0.29	0.29	< 0.005	0.03	0.03	—	81.1	81.1	0.01	0.01	0.06	85.2
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.01	0.00	0.00	0.03	0.03	0.00	< 0.005	< 0.005	—	1.39	1.39	< 0.005	< 0.005	< 0.005	1.42
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	0.02	0.01	< 0.005	< 0.005	0.05	0.05	< 0.005	0.01	0.01	—	13.4	13.4	< 0.005	< 0.005	0.01	14.1

3.5. Building Construction (2027) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.03	9.39	12.9	0.02	0.34	—	0.34	0.31	—	0.31	—	2,397	2,397	0.10	0.02	—	2,405
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.03	9.39	12.9	0.02	0.34	—	0.34	0.31	—	0.31	—	2,397	2,397	0.10	0.02	—	2,405
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.51	4.63	6.38	0.01	0.17	—	0.17	0.15	—	0.15	—	1,182	1,182	0.05	0.01	—	1,186
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.09	0.85	1.16	< 0.005	0.03	—	0.03	0.03	—	0.03	—	196	196	0.01	< 0.005	—	196
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01	0.01	0.14	0.00	0.00	0.47	0.47	0.00	0.05	0.05	—	22.5	22.5	< 0.005	< 0.005	0.09	22.9
Vendor	0.02	0.75	0.32	< 0.005	0.01	2.17	2.18	0.01	0.24	0.24	—	470	470	0.03	0.07	1.02	493
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Worker	0.01	0.01	0.14	0.00	0.00	0.47	0.47	0.00	0.05	0.05	—	21.5	21.5	< 0.005	< 0.005	< 0.005	21.8
Vendor	0.02	0.78	0.33	< 0.005	0.01	2.17	2.18	0.01	0.24	0.24	—	470	470	0.03	0.07	0.03	492
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01	0.01	0.06	0.00	0.00	0.21	0.21	0.00	0.02	0.02	—	10.6	10.6	< 0.005	< 0.005	0.02	10.8
Vendor	0.01	0.38	0.16	< 0.005	< 0.005	0.97	0.97	< 0.005	0.11	0.11	—	232	232	0.02	0.04	0.22	243
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.01	0.00	0.00	0.04	0.04	0.00	< 0.005	< 0.005	—	1.76	1.76	< 0.005	< 0.005	< 0.005	1.79
Vendor	< 0.005	0.07	0.03	< 0.005	< 0.005	0.18	0.18	< 0.005	0.02	0.02	—	38.4	38.4	< 0.005	0.01	0.04	40.2
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.7. Paving (2027) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.74	6.94	9.95	0.01	0.30	—	0.30	0.27	—	0.27	—	1,511	1,511	0.06	0.01	—	1,516
Paving	1.20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Off-Road Equipment	0.04	0.38	0.55	< 0.005	0.02	—	0.02	0.02	—	0.02	—	82.8	82.8	< 0.005	< 0.005	—	83.1
Paving	0.07	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01	0.07	0.10	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	13.7	13.7	< 0.005	< 0.005	—	13.8
Paving	0.01	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.07	0.06	0.65	0.00	0.00	2.25	2.25	0.00	0.24	0.24	—	103	103	0.01	< 0.005	0.01	104
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.03	0.00	0.00	0.11	0.11	0.00	0.01	0.01	—	5.62	5.62	< 0.005	< 0.005	0.01	5.71
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.01	0.00	0.00	0.02	0.02	0.00	< 0.005	< 0.005	—	0.93	0.93	< 0.005	< 0.005	< 0.005	0.95
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.9. Architectural Coating (2027) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.11	0.83	1.13	< 0.005	0.02	—	0.02	0.02	—	0.02	—	134	134	0.01	< 0.005	—	134
Architectural Coatings	10.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01	0.05	0.06	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	7.32	7.32	< 0.005	< 0.005	—	7.34
Architectural Coatings	0.56	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	< 0.005	0.01	0.01	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	1.21	1.21	< 0.005	< 0.005	—	1.22
Architectural Coatings	0.10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.03	0.00	0.00	0.09	0.09	0.00	0.01	0.01	—	4.31	4.31	< 0.005	< 0.005	< 0.005	4.37
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	0.24	0.24	< 0.005	< 0.005	< 0.005	0.24
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	0.04	0.04	< 0.005	< 0.005	< 0.005	0.04
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

4. Operations Emissions Details

4.10. Soil Carbon Accumulation By Vegetation Type

4.10.1. Soil Carbon Accumulation By Vegetation Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Vegetation	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.2. Above and Belowground Carbon Accumulation by Land Use Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.3. Avoided and Sequestered Emissions by Species - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Species	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Sequest	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

5. Activity Data

5.1. Construction Schedule

Phase Name	Phase Type	Start Date	End Date	Days Per Week	Work Days per Phase	Phase Description
Site Preparation	Site Preparation	1/4/2027	1/15/2027	5.00	10.0	—
Grading	Grading	1/16/2027	2/26/2027	5.00	30.0	—
Building Construction	Building Construction	2/27/2027	11/5/2027	5.00	180	—
Paving	Paving	11/6/2027	12/3/2027	5.00	20.0	—
Architectural Coating	Architectural Coating	12/4/2027	12/31/2027	5.00	20.0	—

5.2. Off-Road Equipment

5.2.1. Unmitigated

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Site Preparation	Rubber Tired Dozers	Diesel	Average	3.00	8.00	367	0.40
Site Preparation	Tractors/Loaders/Backhoes	Diesel	Average	4.00	8.00	84.0	0.37
Grading	Excavators	Diesel	Average	1.00	8.00	36.0	0.38
Grading	Graders	Diesel	Average	1.00	8.00	148	0.41
Grading	Rubber Tired Dozers	Diesel	Average	1.00	8.00	367	0.40
Grading	Tractors/Loaders/Backhoes	Diesel	Average	3.00	8.00	84.0	0.37
Building Construction	Cranes	Diesel	Average	1.00	7.00	367	0.29
Building Construction	Forklifts	Diesel	Average	3.00	8.00	82.0	0.20
Building Construction	Generator Sets	Diesel	Average	1.00	8.00	14.0	0.74
Building Construction	Tractors/Loaders/Backhoes	Diesel	Average	3.00	7.00	84.0	0.37
Building Construction	Welders	Diesel	Average	1.00	8.00	46.0	0.45
Paving	Pavers	Diesel	Average	2.00	8.00	81.0	0.42
Paving	Paving Equipment	Diesel	Average	2.00	8.00	89.0	0.36
Paving	Rollers	Diesel	Average	2.00	8.00	36.0	0.38

Architectural Coating	Air Compressors	Diesel	Average	1.00	6.00	37.0	0.48

5.3. Construction Vehicles

5.3.1. Unmitigated

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Site Preparation	—	—	—	—
Site Preparation	Worker	17.5	9.71	LDA,LDT1,LDT2
Site Preparation	Vendor	—	6.06	HHDT,MHDT
Site Preparation	Hauling	0.00	20.0	HHDT
Site Preparation	Onsite truck	—	—	HHDT
Grading	—	—	—	—
Grading	Worker	15.0	9.71	LDA,LDT1,LDT2
Grading	Vendor	—	6.06	HHDT,MHDT
Grading	Hauling	12.5	20.0	HHDT
Grading	Onsite truck	—	—	HHDT
Building Construction	—	—	—	—
Building Construction	Worker	3.15	9.71	LDA,LDT1,LDT2
Building Construction	Vendor	23.0	6.06	HHDT,MHDT
Building Construction	Hauling	0.00	20.0	HHDT
Building Construction	Onsite truck	—	—	HHDT
Paving	—	—	—	—
Paving	Worker	15.0	9.71	LDA,LDT1,LDT2
Paving	Vendor	—	6.06	HHDT,MHDT
Paving	Hauling	0.00	20.0	HHDT
Paving	Onsite truck	—	—	HHDT
Architectural Coating	—	—	—	—
Architectural Coating	Worker	0.63	9.71	LDA,LDT1,LDT2

Architectural Coating	Vendor	—	6.06	HHDT,MHDT
Architectural Coating	Hauling	0.00	20.0	HHDT
Architectural Coating	Onsite truck	—	—	HHDT

5.4. Vehicles

5.4.1. Construction Vehicle Control Strategies

Non-applicable. No control strategies activated by user.

5.5. Architectural Coatings

Phase Name	Residential Interior Area Coated (sq ft)	Residential Exterior Area Coated (sq ft)	Non-Residential Interior Area Coated (sq ft)	Non-Residential Exterior Area Coated (sq ft)	Parking Area Coated (sq ft)
Architectural Coating	0.00	0.00	11,250	3,750	24,019

5.6. Dust Mitigation

5.6.1. Construction Earthmoving Activities

Phase Name	Material Imported (Cubic Yards)	Material Exported (Cubic Yards)	Acres Graded (acres)	Material Demolished (sq. ft.)	Acres Paved (acres)
Site Preparation	0.00	0.00	15.0	0.00	—
Grading	0.00	3,000	30.0	0.00	—
Paving	0.00	0.00	0.00	0.00	9.19

5.6.2. Construction Earthmoving Control Strategies

Control Strategies Applied	Frequency (per day)	PM10 Reduction	PM2.5 Reduction
Water Exposed Area	2	61%	61%

5.7. Construction Paving

Land Use	Area Paved (acres)	% Asphalt

Manufacturing	0.00	0%
Other Asphalt Surfaces	9.19	100%

5.8. Construction Electricity Consumption and Emissions Factors

kWh per Year and Emission Factor (lb/MWh)

Year	kWh per Year	CO2	CH4	N2O
2027	0.00	204	0.03	< 0.005

5.18. Vegetation

5.18.1. Land Use Change

5.18.1.1. Unmitigated

Vegetation Land Use Type	Vegetation Soil Type	Initial Acres	Final Acres

5.18.1. Biomass Cover Type

5.18.1.1. Unmitigated

Biomass Cover Type	Initial Acres	Final Acres

5.18.2. Sequestration

5.18.2.1. Unmitigated

Tree Type	Number	Electricity Saved (kWh/year)	Natural Gas Saved (btu/year)

6. Climate Risk Detailed Report

6.1. Climate Risk Summary

Cal-Adapt midcentury 2040–2059 average projections for four hazards are reported below for your project location. These are under Representation Concentration Pathway (RCP) 8.5 which assumes GHG emissions will continue to rise strongly through 2050 and then plateau around 2100.

Climate Hazard	Result for Project Location	Unit
Temperature and Extreme Heat	6.83	annual days of extreme heat
Extreme Precipitation	6.05	annual days with precipitation above 20 mm
Sea Level Rise	—	meters of inundation depth
Wildfire	14.2	annual hectares burned

Temperature and Extreme Heat data are for grid cell in which your project are located. The projection is based on the 98th historical percentile of daily maximum/minimum temperatures from observed historical data (32 climate model ensemble from Cal-Adapt, 2040–2059 average under RCP 8.5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Extreme Precipitation data are for the grid cell in which your project are located. The threshold of 20 mm is equivalent to about ¾ an inch of rain, which would be light to moderate rainfall if received over a full day or heavy rain if received over a period of 2 to 4 hours. Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Sea Level Rise data are for the grid cell in which your project are located. The projections are from Radke et al. (2017), as reported in Cal-Adapt (Radke et al., 2017, CEC-500-2017-008), and consider inundation location and depth for the San Francisco Bay, the Sacramento-San Joaquin River Delta and California coast resulting different increments of sea level rise coupled with extreme storm events. Users may select from four scenarios to view the range in potential inundation depth for the grid cell. The four scenarios are: No rise, 0.5 meter, 1.0 meter, 1.41 meters
Wildfire data are for the grid cell in which your project are located. The projections are from UC Davis, as reported in Cal-Adapt (2040–2059 average under RCP 8.5), and consider historical data of climate, vegetation, population density, and large (> 400 ha) fire history. Users may select from four model simulations to view the range in potential wildfire probabilities for the grid cell. The four simulations make different assumptions about expected rainfall and temperature are: Warmer/drier (HadGEM2-ES), Cooler/wetter (CNRM-CM5), Average conditions (CanESM2), Range of different rainfall and temperature possibilities (MIROC5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.

6.2. Initial Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	N/A	N/A	N/A	N/A
Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	1	0	0	N/A
Wildfire	1	0	0	N/A
Flooding	N/A	N/A	N/A	N/A
Drought	0	0	0	N/A
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.
The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.

The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores do not include implementation of climate risk reduction measures.

6.3. Adjusted Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	N/A	N/A	N/A	N/A
Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	1	1	1	2
Wildfire	1	1	1	2
Flooding	N/A	N/A	N/A	N/A
Drought	1	1	1	2
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.
The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.
The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores include implementation of climate risk reduction measures.

6.4. Climate Risk Reduction Measures

7. Health and Equity Details

7.1. CalEnviroScreen 4.0 Scores

The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Exposure Indicators	—
AQ-Ozone	14.9
AQ-PM	2.71
AQ-DPM	42.7
Drinking Water	70.5

Lead Risk Housing	47.3
Pesticides	99.6
Toxic Releases	8.90
Traffic	69.7
Effect Indicators	—
CleanUp Sites	63.1
Groundwater	64.2
Haz Waste Facilities/Generators	80.2
Impaired Water Bodies	99.5
Solid Waste	97.9
Sensitive Population	—
Asthma	62.7
Cardio-vascular	41.9
Low Birth Weights	52.4
Socioeconomic Factor Indicators	—
Education	58.5
Housing	31.2
Linguistic	52.0
Poverty	37.9
Unemployment	59.4

7.2. Healthy Places Index Scores

The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Economic	—
Above Poverty	68.47170538
Employed	33.54292314
Median HI	77.41562941

Education	—
Bachelor's or higher	74.51559091
High school enrollment	7.327088413
Preschool enrollment	83.90863596
Transportation	—
Auto Access	81.29090209
Active commuting	41.03682792
Social	—
2-parent households	58.82201976
Voting	74.02797382
Neighborhood	—
Alcohol availability	73.69434108
Park access	29.20569742
Retail density	9.303220839
Supermarket access	9.983318363
Tree canopy	92.41627101
Housing	—
Homeownership	74.16912614
Housing habitability	87.37328372
Low-inc homeowner severe housing cost burden	42.5895034
Low-inc renter severe housing cost burden	89.84986526
Uncrowded housing	84.29359682
Health Outcomes	—
Insured adults	42.7691518
Arthritis	0.0
Asthma ER Admissions	30.7
High Blood Pressure	0.0
Cancer (excluding skin)	0.0

Asthma	0.0
Coronary Heart Disease	0.0
Chronic Obstructive Pulmonary Disease	0.0
Diagnosed Diabetes	0.0
Life Expectancy at Birth	66.4
Cognitively Disabled	74.6
Physically Disabled	69.8
Heart Attack ER Admissions	60.9
Mental Health Not Good	0.0
Chronic Kidney Disease	0.0
Obesity	0.0
Pedestrian Injuries	19.6
Physical Health Not Good	0.0
Stroke	0.0
Health Risk Behaviors	—
Binge Drinking	0.0
Current Smoker	0.0
No Leisure Time for Physical Activity	0.0
Climate Change Exposures	—
Wildfire Risk	0.0
SLR Inundation Area	41.6
Children	50.1
Elderly	12.2
English Speaking	45.2
Foreign-born	31.6
Outdoor Workers	7.8
Climate Change Adaptive Capacity	—
Impervious Surface Cover	92.0

Traffic Density	42.1
Traffic Access	0.0
Other Indices	—
Hardship	27.2
Other Decision Support	—
2016 Voting	85.3

7.3. Overall Health & Equity Scores

Metric	Result for Project Census Tract
CalEnviroScreen 4.0 Score for Project Location (a)	69.0
Healthy Places Index Score for Project Location (b)	66.0
Project Located in a Designated Disadvantaged Community (Senate Bill 535)	No
Project Located in a Low-Income Community (Assembly Bill 1550)	No
Project Located in a Community Air Protection Program Community (Assembly Bill 617)	No

a: The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.
b: The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

7.4. Health & Equity Measures

No Health & Equity Measures selected.

7.5. Evaluation Scorecard

Health & Equity Evaluation Scorecard not completed.

7.6. Health & Equity Custom Measures

No Health & Equity Custom Measures created.

8. User Changes to Default Data

Screen	Justification
Land Use	Adjusted acreage to disturbance area
Construction: Construction Phases	Revised building construction to 12 month construction period. No demo phase.

Construction: Trips and VMT	Adjusted based on material import estimate
Construction: On-Road Fugitive Dust	Accessible from existing paved road except last approx. 300 feet

Landfill Closure - Construction Detailed Report

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8. User Changes to Default Data

1. Basic Project Information

1.1. Basic Project Information

Data Field	Value
Project Name	Landfill Closure - Construction
Construction Start Date	1/3/2028
Lead Agency	—
Land Use Scale	Project/site
Analysis Level for Defaults	County
Windspeed (m/s)	1.80
Precipitation (days)	36.6
Location	1231 Buena Vista Dr, Watsonville, CA 95076, USA
County	Santa Cruz
City	Unincorporated
Air District	Monterey Bay ARD
Air Basin	North Central Coast
TAZ	3128
EDFZ	6
Electric Utility	Pacific Gas & Electric Company
Gas Utility	Pacific Gas & Electric
App Version	2022.1.1.29

1.2. Land Use Types

Land Use Subtype	Size	Unit	Lot Acreage	Building Area (sq ft)	Landscape Area (sq ft)	Special Landscape Area (sq ft)	Population	Description
Other Asphalt Surfaces	251	1000sqft	5.76	0.00	0.00	0.00	—	—

Other Non-Asphalt Surfaces	45.0	Acre	45.0	0.00	0.00	0.00	—	—

1.3. User-Selected Emission Reduction Measures by Emissions Sector

No measures selected

2. Emissions Summary

2.1. Construction Emissions Compared Against Thresholds

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Un/Mit.	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	3.11	32.8	31.6	0.13	1.14	39.9	41.0	1.05	5.31	6.28	—	12,462	12,462	0.77	0.96	9.37	12,777
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	3.11	33.2	31.6	0.13	1.14	39.9	41.0	1.05	5.31	6.28	—	12,456	12,456	0.77	0.96	0.24	12,763
Average Daily (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	2.22	22.2	21.9	0.07	0.78	20.1	20.9	0.72	3.46	4.18	—	6,993	6,993	0.40	0.44	1.84	7,136
Annual (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	0.41	4.04	4.00	0.01	0.14	3.67	3.81	0.13	0.63	0.76	—	1,158	1,158	0.07	0.07	0.31	1,181

2.2. Construction Emissions by Year, Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e

Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2028	3.11	32.8	31.6	0.13	1.14	39.9	41.0	1.05	5.31	6.28	—	12,462	12,462	0.77	0.96	9.37	12,777
2029	3.01	30.8	31.1	0.13	0.98	39.9	40.9	0.91	5.31	6.22	—	12,306	12,306	0.74	0.96	8.58	12,620
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2028	3.11	33.2	31.6	0.13	1.14	39.9	41.0	1.05	5.31	6.28	—	12,456	12,456	0.77	0.96	0.24	12,763
2029	3.01	31.1	31.2	0.13	0.98	39.9	40.9	0.91	5.31	6.22	—	12,301	12,301	0.73	0.96	0.22	12,606
2030	0.79	6.61	10.6	0.02	0.22	10.1	10.4	0.20	1.03	1.24	—	1,797	1,797	0.08	0.05	0.02	1,812
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2028	2.22	22.2	21.9	0.07	0.78	20.1	20.9	0.72	3.46	4.18	—	6,993	6,993	0.40	0.44	1.84	7,136
2029	1.27	12.4	13.9	0.05	0.40	15.0	15.4	0.37	1.92	2.29	—	4,555	4,555	0.26	0.32	1.28	4,657
2030	0.09	0.75	1.20	< 0.005	0.03	1.04	1.06	0.02	0.11	0.13	—	204	204	0.01	0.01	0.03	206
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2028	0.41	4.04	4.00	0.01	0.14	3.67	3.81	0.13	0.63	0.76	—	1,158	1,158	0.07	0.07	0.31	1,181
2029	0.23	2.26	2.54	0.01	0.07	2.74	2.81	0.07	0.35	0.42	—	754	754	0.04	0.05	0.21	771
2030	0.02	0.14	0.22	< 0.005	< 0.005	0.19	0.19	< 0.005	0.02	0.02	—	33.8	33.8	< 0.005	< 0.005	0.01	34.1

3. Construction Emissions Details

3.1. Site Preparation (2028) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Off-Road Equipment	3.04	27.5	28.4	0.05	1.14	—	1.14	1.05	—	1.05	—	5,300	5,300	0.21	0.04	—	5,318
Dust From Material Movement	—	—	—	—	—	7.67	7.67	—	3.94	3.94	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	3.04	27.5	28.4	0.05	1.14	—	1.14	1.05	—	1.05	—	5,300	5,300	0.21	0.04	—	5,318
Dust From Material Movement	—	—	—	—	—	7.67	7.67	—	3.94	3.94	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.83	7.52	7.77	0.01	0.31	—	0.31	0.29	—	0.29	—	1,452	1,452	0.06	0.01	—	1,457
Dust From Material Movement	—	—	—	—	—	2.10	2.10	—	1.08	1.08	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.15	1.37	1.42	< 0.005	0.06	—	0.06	0.05	—	0.05	—	240	240	0.01	< 0.005	—	241
Dust From Material Movement	—	—	—	—	—	0.38	0.38	—	0.20	0.20	—	—	—	—	—	—	—

Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.08	0.05	0.72	0.00	0.00	7.62	7.62	0.00	0.78	0.78	—	123	123	0.01	< 0.005	0.45	125
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.07	0.06	0.71	0.00	0.00	7.62	7.62	0.00	0.78	0.78	—	118	118	0.01	0.01	0.01	119
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.02	0.02	0.18	0.00	0.00	1.88	1.88	0.00	0.19	0.19	—	32.2	32.2	< 0.005	< 0.005	0.05	32.8
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.03	0.00	0.00	0.34	0.34	0.00	0.04	0.04	—	5.33	5.33	< 0.005	< 0.005	0.01	5.42
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.3. Grading (2028) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	2.88	24.3	27.2	0.06	0.99	—	0.99	0.91	—	0.91	—	6,598	6,598	0.27	0.05	—	6,621
Dust From Material Movement	—	—	—	—	—	3.60	3.60	—	1.43	1.43	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	2.88	24.3	27.2	0.06	0.99	—	0.99	0.91	—	0.91	—	6,598	6,598	0.27	0.05	—	6,621
Dust From Material Movement	—	—	—	—	—	3.60	3.60	—	1.43	1.43	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.27	10.8	12.0	0.03	0.44	—	0.44	0.40	—	0.40	—	2,918	2,918	0.12	0.02	—	2,928
Dust From Material Movement	—	—	—	—	—	1.59	1.59	—	0.63	0.63	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.23	1.96	2.19	< 0.005	0.08	—	0.08	0.07	—	0.07	—	483	483	0.02	< 0.005	—	485

Dust From Material Movement	—	—	—	—	—	0.29	0.29	—	0.12	0.12	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.09	0.06	0.82	0.00	0.00	8.71	8.71	0.00	0.89	0.89	—	140	140	0.01	0.01	0.51	143
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.14	8.39	3.62	0.07	0.07	27.6	27.7	0.07	2.99	3.06	—	5,723	5,723	0.49	0.90	8.86	6,014
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.08	0.07	0.81	0.00	0.00	8.71	8.71	0.00	0.89	0.89	—	134	134	0.01	0.01	0.01	136
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.14	8.78	3.65	0.07	0.07	27.6	27.7	0.07	2.99	3.06	—	5,724	5,724	0.49	0.90	0.23	6,006
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.04	0.03	0.34	0.00	0.00	3.47	3.47	0.00	0.35	0.35	—	59.4	59.4	< 0.005	< 0.005	0.10	60.4
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.06	3.83	1.61	0.03	0.03	11.0	11.1	0.03	1.21	1.23	—	2,531	2,531	0.22	0.40	1.69	2,658
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01	0.01	0.06	0.00	0.00	0.63	0.63	0.00	0.06	0.06	—	9.84	9.84	< 0.005	< 0.005	0.02	10.0
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.01	0.70	0.29	0.01	0.01	2.02	2.02	0.01	0.22	0.23	—	419	419	0.04	0.07	0.28	440

3.5. Grading (2029) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	2.79	22.7	26.9	0.06	0.92	—	0.92	0.84	—	0.84	—	6,596	6,596	0.27	0.05	—	6,619
Dust From Material Movement	—	—	—	—	—	3.60	3.60	—	1.43	1.43	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	2.79	22.7	26.9	0.06	0.92	—	0.92	0.84	—	0.84	—	6,596	6,596	0.27	0.05	—	6,619
Dust From Material Movement	—	—	—	—	—	3.60	3.60	—	1.43	1.43	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.87	7.07	8.36	0.02	0.29	—	0.29	0.26	—	0.26	—	2,052	2,052	0.08	0.02	—	2,059
Dust From Material Movement	—	—	—	—	—	1.12	1.12	—	0.44	0.44	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Off-Road Equipment	0.16	1.29	1.53	< 0.005	0.05	—	0.05	0.05	—	0.05	—	340	340	0.01	< 0.005	—	341
Dust From Material Movement	—	—	—	—	—	0.20	0.20	—	0.08	0.08	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.08	0.05	0.77	0.00	0.00	8.71	8.71	0.00	0.89	0.89	—	138	138	0.01	0.01	0.47	140
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.14	8.00	3.49	0.07	0.07	27.6	27.7	0.07	2.99	3.06	—	5,572	5,572	0.46	0.90	8.11	5,861
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.08	0.06	0.76	0.00	0.00	8.71	8.71	0.00	0.89	0.89	—	132	132	< 0.005	0.01	0.01	134
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.14	8.33	3.52	0.07	0.07	27.6	27.7	0.07	2.99	3.06	—	5,572	5,572	0.46	0.90	0.21	5,853
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.02	0.02	0.22	0.00	0.00	2.44	2.44	0.00	0.25	0.25	—	41.1	41.1	< 0.005	< 0.005	0.06	41.8
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.04	2.57	1.09	0.02	0.02	7.77	7.79	0.02	0.85	0.87	—	1,734	1,734	0.14	0.28	1.09	1,822
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.04	0.00	0.00	0.45	0.45	0.00	0.05	0.05	—	6.81	6.81	< 0.005	< 0.005	0.01	6.92
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.01	0.47	0.20	< 0.005	< 0.005	1.42	1.42	< 0.005	0.15	0.16	—	287	287	0.02	0.05	0.18	302

3.7. Paving (2029) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.67	6.46	9.92	0.01	0.24	—	0.24	0.22	—	0.22	—	1,511	1,511	0.06	0.01	—	1,516
Paving	0.08	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.67	6.46	9.92	0.01	0.24	—	0.24	0.22	—	0.22	—	1,511	1,511	0.06	0.01	—	1,516
Paving	0.08	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.27	2.60	4.00	0.01	0.10	—	0.10	0.09	—	0.09	—	609	609	0.02	< 0.005	—	611
Paving	0.03	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.05	0.48	0.73	< 0.005	0.02	—	0.02	0.02	—	0.02	—	101	101	< 0.005	< 0.005	—	101
Paving	0.01	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.06	0.04	0.58	0.00	0.00	6.53	6.53	0.00	0.67	0.67	—	104	104	0.01	< 0.005	0.35	105
Vendor	0.01	0.29	0.13	< 0.005	< 0.005	3.62	3.62	< 0.005	0.37	0.37	—	194	194	0.01	0.03	0.36	204
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.06	0.05	0.57	0.00	0.00	6.53	6.53	0.00	0.67	0.67	—	99.1	99.1	< 0.005	< 0.005	0.01	101
Vendor	0.01	0.30	0.13	< 0.005	< 0.005	3.62	3.62	< 0.005	0.37	0.37	—	194	194	0.01	0.03	0.01	203
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.02	0.02	0.22	0.00	0.00	2.37	2.37	0.00	0.24	0.24	—	40.0	40.0	< 0.005	< 0.005	0.06	40.6
Vendor	< 0.005	0.12	0.05	< 0.005	< 0.005	1.31	1.32	< 0.005	0.13	0.14	—	78.3	78.3	< 0.005	0.01	0.06	82.0
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.04	0.00	0.00	0.43	0.43	0.00	0.04	0.04	—	6.62	6.62	< 0.005	< 0.005	0.01	6.73
Vendor	< 0.005	0.02	0.01	< 0.005	< 0.005	0.24	0.24	< 0.005	0.02	0.02	—	13.0	13.0	< 0.005	< 0.005	0.01	13.6
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.9. Paving (2030) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.64	6.28	9.90	0.01	0.22	—	0.22	0.20	—	0.20	—	1,511	1,511	0.06	0.01	—	1,516
Paving	0.08	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.07	0.71	1.12	< 0.005	0.03	—	0.03	0.02	—	0.02	—	171	171	0.01	< 0.005	—	172
Paving	0.01	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01	0.13	0.20	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	28.4	28.4	< 0.005	< 0.005	—	28.5
Paving	< 0.005	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.06	0.04	0.54	0.00	0.00	6.53	6.53	0.00	0.67	0.67	—	97.5	97.5	< 0.005	< 0.005	0.01	99.0
Vendor	0.01	0.29	0.13	< 0.005	< 0.005	3.62	3.62	< 0.005	0.37	0.37	—	188	188	0.01	0.03	0.01	197
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01	< 0.005	0.06	0.00	0.00	0.67	0.67	0.00	0.07	0.07	—	11.1	11.1	< 0.005	< 0.005	0.02	11.2

Vendor	< 0.005	0.03	0.01	< 0.005	< 0.005	0.37	0.37	< 0.005	0.04	0.04	—	21.4	21.4	< 0.005	< 0.005	0.02	22.4
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.01	0.00	0.00	0.12	0.12	0.00	0.01	0.01	—	1.83	1.83	< 0.005	< 0.005	< 0.005	1.86
Vendor	< 0.005	0.01	< 0.005	< 0.005	< 0.005	0.07	0.07	< 0.005	0.01	0.01	—	3.54	3.54	< 0.005	< 0.005	< 0.005	3.71
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

4. Operations Emissions Details

4.10. Soil Carbon Accumulation By Vegetation Type

4.10.1. Soil Carbon Accumulation By Vegetation Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Vegetation	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.2. Above and Belowground Carbon Accumulation by Land Use Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e

Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.3. Avoided and Sequestered Emissions by Species - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Species	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

5. Activity Data

5.1. Construction Schedule

Phase Name	Phase Type	Start Date	End Date	Days Per Week	Work Days per Phase	Phase Description
Site Preparation	Site Preparation	1/3/2028	5/19/2028	5.00	100	—
Grading	Grading	5/20/2028	6/8/2029	5.00	275	—
Paving	Paving	6/9/2029	2/27/2030	5.00	188	—

5.2. Off-Road Equipment

5.2.1. Unmitigated

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Site Preparation	Rubber Tired Dozers	Diesel	Average	3.00	8.00	367	0.40
Site Preparation	Tractors/Loaders/Backhoes	Diesel	Average	4.00	8.00	84.0	0.37
Grading	Excavators	Diesel	Average	2.00	8.00	36.0	0.38
Grading	Graders	Diesel	Average	1.00	8.00	148	0.41
Grading	Rubber Tired Dozers	Diesel	Average	1.00	8.00	367	0.40
Grading	Scrapers	Diesel	Average	2.00	8.00	423	0.48
Grading	Tractors/Loaders/Backhoes	Diesel	Average	2.00	8.00	84.0	0.37
Paving	Pavers	Diesel	Average	2.00	8.00	81.0	0.42
Paving	Paving Equipment	Diesel	Average	2.00	8.00	89.0	0.36
Paving	Rollers	Diesel	Average	2.00	8.00	36.0	0.38

5.3. Construction Vehicles

5.3.1. Unmitigated

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Site Preparation	—	—	—	—
Site Preparation	Worker	17.5	9.71	LDA,LDT1,LDT2
Site Preparation	Vendor	—	6.06	HHDT,MHDT
Site Preparation	Hauling	0.00	20.0	HHDT
Site Preparation	Onsite truck	—	—	HHDT
Grading	—	—	—	—
Grading	Worker	20.0	9.71	LDA,LDT1,LDT2
Grading	Vendor	—	6.06	HHDT,MHDT
Grading	Hauling	74.3	20.0	HHDT
Grading	Onsite truck	—	—	HHDT
Paving	—	—	—	—

Paving	Worker	15.0	9.71	LDA,LDT1,LDT2
Paving	Vendor	10.0	6.06	HHDT,MHDT
Paving	Hauling	0.00	20.0	HHDT
Paving	Onsite truck	—	—	HHDT

5.4. Vehicles

5.4.1. Construction Vehicle Control Strategies

Control Strategies Applied	PM10 Reduction	PM2.5 Reduction
Water unpaved roads twice daily	55%	55%
Limit vehicle speeds on unpaved roads to 25 mph	44%	44%

5.5. Architectural Coatings

Phase Name	Residential Interior Area Coated (sq ft)	Residential Exterior Area Coated (sq ft)	Non-Residential Interior Area Coated (sq ft)	Non-Residential Exterior Area Coated (sq ft)	Parking Area Coated (sq ft)

5.6. Dust Mitigation

5.6.1. Construction Earthmoving Activities

Phase Name	Material Imported (Cubic Yards)	Material Exported (Cubic Yards)	Acres Graded (acres)	Material Demolished (sq. ft.)	Acres Paved (acres)
Site Preparation	0.00	0.00	150	0.00	—
Grading	163,529	0.00	825	0.00	—
Paving	0.00	0.00	0.00	0.00	50.8

5.6.2. Construction Earthmoving Control Strategies

Control Strategies Applied	Frequency (per day)	PM10 Reduction	PM2.5 Reduction
Water Exposed Area	2	61%	61%

5.7. Construction Paving

Land Use	Area Paved (acres)	% Asphalt
Other Asphalt Surfaces	5.76	100%
Other Non-Asphalt Surfaces	45.0	0%

5.8. Construction Electricity Consumption and Emissions Factors

kWh per Year and Emission Factor (lb/MWh)

Year	kWh per Year	CO2	CH4	N2O
2028	0.00	204	0.03	< 0.005
2029	0.00	204	0.03	< 0.005
2030	0.00	204	0.03	< 0.005

5.18. Vegetation

5.18.1. Land Use Change

5.18.1.1. Unmitigated

Vegetation Land Use Type	Vegetation Soil Type	Initial Acres	Final Acres

5.18.1. Biomass Cover Type

5.18.1.1. Unmitigated

Biomass Cover Type	Initial Acres	Final Acres

5.18.2. Sequestration

5.18.2.1. Unmitigated

Tree Type	Number	Electricity Saved (kWh/year)	Natural Gas Saved (btu/year)

6. Climate Risk Detailed Report

6.1. Climate Risk Summary

Cal-Adapt midcentury 2040–2059 average projections for four hazards are reported below for your project location. These are under Representation Concentration Pathway (RCP) 8.5 which assumes GHG emissions will continue to rise strongly through 2050 and then plateau around 2100.

Climate Hazard	Result for Project Location	Unit
Temperature and Extreme Heat	6.83	annual days of extreme heat
Extreme Precipitation	6.05	annual days with precipitation above 20 mm
Sea Level Rise	—	meters of inundation depth
Wildfire	14.2	annual hectares burned

Temperature and Extreme Heat data are for grid cell in which your project are located. The projection is based on the 98th historical percentile of daily maximum/minimum temperatures from observed historical data (32 climate model ensemble from Cal-Adapt, 2040–2059 average under RCP 8.5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Extreme Precipitation data are for the grid cell in which your project are located. The threshold of 20 mm is equivalent to about ¾ an inch of rain, which would be light to moderate rainfall if received over a full day or heavy rain if received over a period of 2 to 4 hours. Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Sea Level Rise data are for the grid cell in which your project are located. The projections are from Radke et al. (2017), as reported in Cal-Adapt (Radke et al., 2017, CEC-500-2017-008), and consider inundation location and depth for the San Francisco Bay, the Sacramento-San Joaquin River Delta and California coast resulting different increments of sea level rise coupled with extreme storm events. Users may select from four scenarios to view the range in potential inundation depth for the grid cell. The four scenarios are: No rise, 0.5 meter, 1.0 meter, 1.41 meters
Wildfire data are for the grid cell in which your project are located. The projections are from UC Davis, as reported in Cal-Adapt (2040–2059 average under RCP 8.5), and consider historical data of climate, vegetation, population density, and large (> 400 ha) fire history. Users may select from four model simulations to view the range in potential wildfire probabilities for the grid cell. The four simulations make different assumptions about expected rainfall and temperature are: Warmer/drier (HadGEM2-ES), Cooler/wetter (CNRM-CM5), Average conditions (CanESM2), Range of different rainfall and temperature possibilities (MIROC5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.

6.2. Initial Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	N/A	N/A	N/A	N/A
Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	0	0	0	N/A
Wildfire	0	0	0	N/A
Flooding	N/A	N/A	N/A	N/A
Drought	0	0	0	N/A

Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.
The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.
The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores do not include implementation of climate risk reduction measures.

6.3. Adjusted Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	N/A	N/A	N/A	N/A
Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	1	1	1	2
Wildfire	1	1	1	2
Flooding	N/A	N/A	N/A	N/A
Drought	1	1	1	2
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.
The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.
The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores include implementation of climate risk reduction measures.

6.4. Climate Risk Reduction Measures

7. Health and Equity Details

7.1. CalEnviroScreen 4.0 Scores

The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Exposure Indicators	—
AQ-Ozone	14.9
AQ-PM	2.71
AQ-DPM	42.7
Drinking Water	70.5
Lead Risk Housing	47.3
Pesticides	99.6
Toxic Releases	8.90
Traffic	69.7
Effect Indicators	—
CleanUp Sites	63.1
Groundwater	64.2
Haz Waste Facilities/Generators	80.2
Impaired Water Bodies	99.5
Solid Waste	97.9
Sensitive Population	—
Asthma	62.7
Cardio-vascular	41.9
Low Birth Weights	52.4
Socioeconomic Factor Indicators	—
Education	58.5
Housing	31.2
Linguistic	52.0
Poverty	37.9
Unemployment	59.4

7.2. Healthy Places Index Scores

The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Economic	—
Above Poverty	68.47170538
Employed	33.54292314
Median HI	77.41562941
Education	—
Bachelor's or higher	74.51559091
High school enrollment	7.327088413
Preschool enrollment	83.90863596
Transportation	—
Auto Access	81.29090209
Active commuting	41.03682792
Social	—
2-parent households	58.82201976
Voting	74.02797382
Neighborhood	—
Alcohol availability	73.69434108
Park access	29.20569742
Retail density	9.303220839
Supermarket access	9.983318363
Tree canopy	92.41627101
Housing	—
Homeownership	74.16912614
Housing habitability	87.37328372
Low-inc homeowner severe housing cost burden	42.5895034
Low-inc renter severe housing cost burden	89.84986526
Uncrowded housing	84.29359682
Health Outcomes	—

Insured adults	42.7691518
Arthritis	0.0
Asthma ER Admissions	30.7
High Blood Pressure	0.0
Cancer (excluding skin)	0.0
Asthma	0.0
Coronary Heart Disease	0.0
Chronic Obstructive Pulmonary Disease	0.0
Diagnosed Diabetes	0.0
Life Expectancy at Birth	66.4
Cognitively Disabled	74.6
Physically Disabled	69.8
Heart Attack ER Admissions	60.9
Mental Health Not Good	0.0
Chronic Kidney Disease	0.0
Obesity	0.0
Pedestrian Injuries	19.6
Physical Health Not Good	0.0
Stroke	0.0
Health Risk Behaviors	—
Binge Drinking	0.0
Current Smoker	0.0
No Leisure Time for Physical Activity	0.0
Climate Change Exposures	—
Wildfire Risk	0.0
SLR Inundation Area	41.6
Children	50.1
Elderly	12.2

English Speaking	45.2
Foreign-born	31.6
Outdoor Workers	7.8
Climate Change Adaptive Capacity	—
Impervious Surface Cover	92.0
Traffic Density	42.1
Traffic Access	0.0
Other Indices	—
Hardship	27.2
Other Decision Support	—
2016 Voting	85.3

7.3. Overall Health & Equity Scores

Metric	Result for Project Census Tract
CalEnviroScreen 4.0 Score for Project Location (a)	69.0
Healthy Places Index Score for Project Location (b)	66.0
Project Located in a Designated Disadvantaged Community (Senate Bill 535)	No
Project Located in a Low-Income Community (Assembly Bill 1550)	No
Project Located in a Community Air Protection Program Community (Assembly Bill 617)	No

a: The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.
b: The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

7.4. Health & Equity Measures

No Health & Equity Measures selected.

7.5. Evaluation Scorecard

Health & Equity Evaluation Scorecard not completed.

7.6. Health & Equity Custom Measures

No Health & Equity Custom Measures created.

8. User Changes to Default Data

Screen	Justification
Construction: Construction Phases	No building construction. revised to 26 month construction period. Site prep assumed for non-pavement material placement.
Construction: On-Road Fugitive Dust	Assume approx. 0.25 mile each trip not paved

Storage Area - Construction Detailed Report

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8. User Changes to Default Data

1. Basic Project Information

1.1. Basic Project Information

Data Field	Value
Project Name	Storage Area - Construction
Construction Start Date	1/4/2027
Lead Agency	—
Land Use Scale	Project/site
Analysis Level for Defaults	County
Windspeed (m/s)	1.80
Precipitation (days)	36.6
Location	1231 Buena Vista Dr, Watsonville, CA 95076, USA
County	Santa Cruz
City	Unincorporated
Air District	Monterey Bay ARD
Air Basin	North Central Coast
TAZ	3128
EDFZ	6
Electric Utility	Pacific Gas & Electric Company
Gas Utility	Pacific Gas & Electric
App Version	2022.1.1.29

1.2. Land Use Types

Land Use Subtype	Size	Unit	Lot Acreage	Building Area (sq ft)	Landscape Area (sq ft)	Special Landscape Area (sq ft)	Population	Description
Gasoline/Service Station	4.00	Pump	0.90	565	0.00	0.00	—	—

Other Asphalt Surfaces	44.4	1000sqft	1.10	0.00	0.00	0.00	—	—

1.3. User-Selected Emission Reduction Measures by Emissions Sector

No measures selected

2. Emissions Summary

2.1. Construction Emissions Compared Against Thresholds

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Un/Mit.	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	1.89	0.83	1.13	< 0.005	0.02	0.01	0.02	0.02	< 0.005	0.02	—	134	134	0.01	< 0.005	< 0.005	134
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	1.89	12.9	14.6	0.03	0.54	5.93	6.47	0.50	1.68	2.18	—	2,945	2,945	0.14	0.09	0.03	2,975
Average Daily (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	0.20	1.28	1.53	< 0.005	0.04	0.29	0.34	0.04	0.06	0.10	—	301	301	0.01	0.01	0.04	304
Annual (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	0.04	0.23	0.28	< 0.005	0.01	0.05	0.06	0.01	0.01	0.02	—	49.9	49.9	< 0.005	< 0.005	0.01	50.3

2.2. Construction Emissions by Year, Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e

Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2027	1.89	0.83	1.13	< 0.005	0.02	0.01	0.02	0.02	< 0.005	0.02	—	134	134	0.01	< 0.005	< 0.005	134
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2027	1.89	12.9	14.6	0.03	0.54	5.93	6.47	0.50	1.68	2.18	—	2,945	2,945	0.14	0.09	0.03	2,975
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2027	0.20	1.28	1.53	< 0.005	0.04	0.29	0.34	0.04	0.06	0.10	—	301	301	0.01	0.01	0.04	304
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2027	0.04	0.23	0.28	< 0.005	0.01	0.05	0.06	0.01	0.01	0.02	—	49.9	49.9	< 0.005	< 0.005	0.01	50.3

3. Construction Emissions Details

3.1. Site Preparation (2027) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.19	10.4	11.6	0.02	0.47	—	0.47	0.43	—	0.43	—	2,065	2,065	0.08	0.02	—	2,072
Dust From Material Movement	—	—	—	—	—	2.44	2.44	—	1.17	1.17	—	—	—	—	—	—	—

Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01	0.09	0.10	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	17.0	17.0	< 0.005	< 0.005	—	17.0
Dust From Material Movement	—	—	—	—	—	0.02	0.02	—	0.01	0.01	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	< 0.005	0.02	0.02	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	2.81	2.81	< 0.005	< 0.005	—	2.82
Dust From Material Movement	—	—	—	—	—	< 0.005	< 0.005	—	< 0.005	< 0.005	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.03	0.03	0.32	0.00	0.00	1.12	1.12	0.00	0.12	0.12	—	51.3	51.3	< 0.005	< 0.005	0.01	52.0
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.00	0.00	0.01	0.01	0.00	< 0.005	< 0.005	—	0.42	0.42	< 0.005	< 0.005	< 0.005	0.43
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	0.07	0.07	< 0.005	< 0.005	< 0.005	0.07
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.3. Grading (2027) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.37	12.2	13.9	0.02	0.54	—	0.54	0.50	—	0.50	—	2,455	2,455	0.10	0.02	—	2,464
Dust From Material Movement	—	—	—	—	—	2.76	2.76	—	1.34	1.34	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.02	0.20	0.23	< 0.005	0.01	—	0.01	0.01	—	0.01	—	40.4	40.4	< 0.005	< 0.005	—	40.5
Dust From Material Movement	—	—	—	—	—	0.05	0.05	—	0.02	0.02	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	< 0.005	0.04	0.04	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	6.68	6.68	< 0.005	< 0.005	—	6.71
Dust From Material Movement	—	—	—	—	—	0.01	0.01	—	< 0.005	< 0.005	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.05	0.04	0.43	0.00	0.00	1.50	1.50	0.00	0.16	0.16	—	68.3	68.3	< 0.005	< 0.005	0.01	69.4
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.01	0.67	0.27	< 0.005	< 0.005	1.67	1.67	< 0.005	0.18	0.19	—	421	421	0.04	0.07	0.02	442
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.01	0.00	0.00	0.02	0.02	0.00	< 0.005	< 0.005	—	1.12	1.12	< 0.005	< 0.005	< 0.005	1.14
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	0.01	< 0.005	< 0.005	< 0.005	0.02	0.02	< 0.005	< 0.005	< 0.005	—	6.92	6.92	< 0.005	< 0.005	< 0.005	7.27
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	0.19	0.19	< 0.005	< 0.005	< 0.005	0.19
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	1.15	1.15	< 0.005	< 0.005	< 0.005	1.20

3.5. Building Construction (2027) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e

Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.97	8.25	9.91	0.02	0.26	—	0.26	0.24	—	0.24	—	1,801	1,801	0.07	0.01	—	1,807
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.09	0.79	0.95	< 0.005	0.03	—	0.03	0.02	—	0.02	—	173	173	0.01	< 0.005	—	173
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.02	0.14	0.17	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	28.6	28.6	< 0.005	< 0.005	—	28.7
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.01	0.00	0.00	0.03	0.03	0.00	< 0.005	< 0.005	—	1.24	1.24	< 0.005	< 0.005	< 0.005	1.25
Vendor	0.01	0.51	0.22	< 0.005	< 0.005	1.42	1.42	< 0.005	0.15	0.16	—	306	306	0.02	0.05	0.02	321
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Worker	< 0.005	< 0.005	< 0.005	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	0.12	0.12	< 0.005	< 0.005	< 0.005	0.12
Vendor	< 0.005	0.05	0.02	< 0.005	< 0.005	0.12	0.12	< 0.005	0.01	0.01	—	29.4	29.4	< 0.005	< 0.005	0.03	30.8
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	0.02	0.02	< 0.005	< 0.005	< 0.005	0.02
Vendor	< 0.005	0.01	< 0.005	< 0.005	< 0.005	0.02	0.02	< 0.005	< 0.005	< 0.005	—	4.87	4.87	< 0.005	< 0.005	< 0.005	5.10
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.7. Paving (2027) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.46	4.30	6.49	0.01	0.17	—	0.17	0.16	—	0.16	—	992	992	0.04	0.01	—	995
Paving	0.29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01	0.12	0.18	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	27.2	27.2	< 0.005	< 0.005	—	27.3
Paving	0.01	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Off-Road Equipment	< 0.005	0.02	0.03	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	4.50	4.50	< 0.005	< 0.005	—	4.51
Paving	< 0.005	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.06	0.05	0.54	0.00	0.00	1.87	1.87	0.00	0.20	0.20	—	85.4	85.4	0.01	< 0.005	0.01	86.7
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.01	0.00	0.00	0.05	0.05	0.00	< 0.005	< 0.005	—	2.34	2.34	< 0.005	< 0.005	< 0.005	2.38
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.00	0.00	0.01	0.01	0.00	< 0.005	< 0.005	—	0.39	0.39	< 0.005	< 0.005	< 0.005	0.39
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.9. Architectural Coating (2027) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.11	0.83	1.13	< 0.005	0.02	—	0.02	0.02	—	0.02	—	134	134	0.01	< 0.005	—	134
Architectural Coatings	1.78	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.11	0.83	1.13	< 0.005	0.02	—	0.02	0.02	—	0.02	—	134	134	0.01	< 0.005	—	134
Architectural Coatings	1.78	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	< 0.005	0.02	0.03	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	3.66	3.66	< 0.005	< 0.005	—	3.67
Architectural Coatings	0.05	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	< 0.005	< 0.005	0.01	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	0.61	0.61	< 0.005	< 0.005	—	0.61
Architectural Coatings	0.01	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.00	0.00	0.01	0.01	0.00	< 0.005	< 0.005	—	0.26	0.26	< 0.005	< 0.005	< 0.005	0.26
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.00	0.00	0.01	0.01	0.00	< 0.005	< 0.005	—	0.25	0.25	< 0.005	< 0.005	< 0.005	0.25
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	0.01	0.01	< 0.005	< 0.005	< 0.005	0.01
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

4. Operations Emissions Details

4.10. Soil Carbon Accumulation By Vegetation Type

4.10.1. Soil Carbon Accumulation By Vegetation Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Vegetatio	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.2. Above and Belowground Carbon Accumulation by Land Use Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.3. Avoided and Sequestered Emissions by Species - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Species	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e

Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

5. Activity Data

5.1. Construction Schedule

Phase Name	Phase Type	Start Date	End Date	Days Per Week	Work Days per Phase	Phase Description
Site Preparation	Site Preparation	1/4/2027	1/6/2027	5.00	3.00	—
Grading	Grading	1/7/2027	1/14/2027	5.00	6.00	—
Building Construction	Building Construction	1/15/2027	3/4/2027	5.00	35.0	—
Paving	Paving	3/5/2027	3/18/2027	5.00	10.0	—
Architectural Coating	Architectural Coating	3/19/2027	4/1/2027	5.00	10.0	—

5.2. Off-Road Equipment

5.2.1. Unmitigated

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Site Preparation	Graders	Diesel	Average	1.00	8.00	148	0.41
Site Preparation	Rubber Tired Dozers	Diesel	Average	1.00	7.00	367	0.40
Site Preparation	Tractors/Loaders/Backhoes	Diesel	Average	1.00	8.00	84.0	0.37
Grading	Graders	Diesel	Average	1.00	8.00	148	0.41
Grading	Rubber Tired Dozers	Diesel	Average	1.00	8.00	367	0.40
Grading	Tractors/Loaders/Backhoes	Diesel	Average	2.00	7.00	84.0	0.37
Building Construction	Cranes	Diesel	Average	1.00	6.00	367	0.29
Building Construction	Forklifts	Diesel	Average	1.00	6.00	82.0	0.20
Building Construction	Generator Sets	Diesel	Average	1.00	8.00	14.0	0.74

Building Construction	Tractors/Loaders/Back	Diesel	Average	1.00	6.00	84.0	0.37
Building Construction	Welders	Diesel	Average	3.00	8.00	46.0	0.45
Paving	Cement and Mortar Mixers	Diesel	Average	1.00	6.00	10.0	0.56
Paving	Pavers	Diesel	Average	1.00	6.00	81.0	0.42
Paving	Paving Equipment	Diesel	Average	1.00	8.00	89.0	0.36
Paving	Rollers	Diesel	Average	1.00	7.00	36.0	0.38
Paving	Tractors/Loaders/Backhoes	Diesel	Average	1.00	8.00	84.0	0.37
Architectural Coating	Air Compressors	Diesel	Average	1.00	6.00	37.0	0.48

5.3. Construction Vehicles

5.3.1. Unmitigated

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Site Preparation	—	—	—	—
Site Preparation	Worker	7.50	9.71	LDA,LDT1,LDT2
Site Preparation	Vendor	—	6.06	HHDT,MHDT
Site Preparation	Hauling	0.00	20.0	HHDT
Site Preparation	Onsite truck	—	—	HHDT
Grading	—	—	—	—
Grading	Worker	10.0	9.71	LDA,LDT1,LDT2
Grading	Vendor	—	6.06	HHDT,MHDT
Grading	Hauling	5.33	20.0	HHDT
Grading	Onsite truck	—	—	HHDT
Building Construction	—	—	—	—
Building Construction	Worker	0.18	9.71	LDA,LDT1,LDT2
Building Construction	Vendor	15.0	6.06	HHDT,MHDT
Building Construction	Hauling	0.00	20.0	HHDT

Building Construction	Onsite truck	—	—	HHDT
Paving	—	—	—	—
Paving	Worker	12.5	9.71	LDA,LDT1,LDT2
Paving	Vendor	—	6.06	HHDT,MHDT
Paving	Hauling	0.00	20.0	HHDT
Paving	Onsite truck	—	—	HHDT
Architectural Coating	—	—	—	—
Architectural Coating	Worker	0.04	9.71	LDA,LDT1,LDT2
Architectural Coating	Vendor	—	6.06	HHDT,MHDT
Architectural Coating	Hauling	0.00	20.0	HHDT
Architectural Coating	Onsite truck	—	—	HHDT

5.4. Vehicles

5.4.1. Construction Vehicle Control Strategies

Control Strategies Applied	PM10 Reduction	PM2.5 Reduction
Water unpaved roads twice daily	55%	55%
Limit vehicle speeds on unpaved roads to 25 mph	44%	44%

5.5. Architectural Coatings

Phase Name	Residential Interior Area Coated (sq ft)	Residential Exterior Area Coated (sq ft)	Non-Residential Interior Area Coated (sq ft)	Non-Residential Exterior Area Coated (sq ft)	Parking Area Coated (sq ft)
Architectural Coating	0.00	0.00	848	283	2,875

5.6. Dust Mitigation

5.6.1. Construction Earthmoving Activities

Phase Name	Material Imported (Cubic Yards)	Material Exported (Cubic Yards)	Acres Graded (acres)	Material Demolished (sq. ft.)	Acres Paved (acres)
Site Preparation	0.00	0.00	2.81	0.00	—
Grading	250	0.00	6.00	0.00	—
Paving	0.00	0.00	0.00	0.00	1.10

5.6.2. Construction Earthmoving Control Strategies

Control Strategies Applied	Frequency (per day)	PM10 Reduction	PM2.5 Reduction
Water Exposed Area	2	61%	61%

5.7. Construction Paving

Land Use	Area Paved (acres)	% Asphalt
Gasoline/Service Station	0.00	0%
Other Asphalt Surfaces	1.10	100%

5.8. Construction Electricity Consumption and Emissions Factors

kWh per Year and Emission Factor (lb/MWh)

Year	kWh per Year	CO2	CH4	N2O
2027	0.00	204	0.03	< 0.005

5.18. Vegetation

5.18.1. Land Use Change

5.18.1.1. Unmitigated

Vegetation Land Use Type	Vegetation Soil Type	Initial Acres	Final Acres

5.18.1. Biomass Cover Type

5.18.1.1. Unmitigated

Biomass Cover Type	Initial Acres	Final Acres

5.18.2. Sequestration

5.18.2.1. Unmitigated

Tree Type	Number	Electricity Saved (kWh/year)	Natural Gas Saved (btu/year)

6. Climate Risk Detailed Report

6.1. Climate Risk Summary

Cal-Adapt midcentury 2040–2059 average projections for four hazards are reported below for your project location. These are under Representation Concentration Pathway (RCP) 8.5 which assumes GHG emissions will continue to rise strongly through 2050 and then plateau around 2100.

Climate Hazard	Result for Project Location	Unit
Temperature and Extreme Heat	6.83	annual days of extreme heat
Extreme Precipitation	6.05	annual days with precipitation above 20 mm
Sea Level Rise	—	meters of inundation depth
Wildfire	14.2	annual hectares burned

Temperature and Extreme Heat data are for grid cell in which your project are located. The projection is based on the 98th historical percentile of daily maximum/minimum temperatures from observed historical data (32 climate model ensemble from Cal-Adapt, 2040–2059 average under RCP 8.5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Extreme Precipitation data are for the grid cell in which your project are located. The threshold of 20 mm is equivalent to about ¾ an inch of rain, which would be light to moderate rainfall if received over a full day or heavy rain if received over a period of 2 to 4 hours. Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Sea Level Rise data are for the grid cell in which your project are located. The projections are from Radke et al. (2017), as reported in Cal-Adapt (Radke et al., 2017, CEC-500-2017-008), and consider inundation location and depth for the San Francisco Bay, the Sacramento-San Joaquin River Delta and California coast resulting different increments of sea level rise coupled with extreme storm events. Users may select from four scenarios to view the range in potential inundation depth for the grid cell. The four scenarios are: No rise, 0.5 meter, 1.0 meter, 1.41 meters
Wildfire data are for the grid cell in which your project are located. The projections are from UC Davis, as reported in Cal-Adapt (2040–2059 average under RCP 8.5), and consider historical data of climate, vegetation, population density, and large (> 400 ha) fire history. Users may select from four model simulations to view the range in potential wildfire probabilities for the grid cell. The four simulations make different assumptions about expected rainfall and temperature are: Warmer/drier (HadGEM2-ES), Cooler/wetter (CNRM-CM5), Average conditions (CanESM2), Range of different rainfall and temperature possibilities (MIROC5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.

6.2. Initial Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	N/A	N/A	N/A	N/A
Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	0	0	0	N/A
Wildfire	0	0	0	N/A
Flooding	N/A	N/A	N/A	N/A
Drought	0	0	0	N/A
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.
The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.
The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores do not include implementation of climate risk reduction measures.

6.3. Adjusted Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	N/A	N/A	N/A	N/A
Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	1	1	1	2
Wildfire	1	1	1	2
Flooding	N/A	N/A	N/A	N/A
Drought	1	1	1	2
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.

The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.
The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores include implementation of climate risk reduction measures.

6.4. Climate Risk Reduction Measures

7. Health and Equity Details

7.1. CalEnviroScreen 4.0 Scores

The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Exposure Indicators	—
AQ-Ozone	14.9
AQ-PM	2.71
AQ-DPM	42.7
Drinking Water	70.5
Lead Risk Housing	47.3
Pesticides	99.6
Toxic Releases	8.90
Traffic	69.7
Effect Indicators	—
CleanUp Sites	63.1
Groundwater	64.2
Haz Waste Facilities/Generators	80.2
Impaired Water Bodies	99.5
Solid Waste	97.9
Sensitive Population	—
Asthma	62.7
Cardio-vascular	41.9
Low Birth Weights	52.4

Socioeconomic Factor Indicators	—
Education	58.5
Housing	31.2
Linguistic	52.0
Poverty	37.9
Unemployment	59.4

7.2. Healthy Places Index Scores

The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Economic	—
Above Poverty	68.47170538
Employed	33.54292314
Median HI	77.41562941
Education	—
Bachelor's or higher	74.51559091
High school enrollment	7.327088413
Preschool enrollment	83.90863596
Transportation	—
Auto Access	81.29090209
Active commuting	41.03682792
Social	—
2-parent households	58.82201976
Voting	74.02797382
Neighborhood	—
Alcohol availability	73.69434108
Park access	29.20569742
Retail density	9.303220839

Supermarket access	9.983318363
Tree canopy	92.41627101
Housing	—
Homeownership	74.16912614
Housing habitability	87.37328372
Low-inc homeowner severe housing cost burden	42.5895034
Low-inc renter severe housing cost burden	89.84986526
Uncrowded housing	84.29359682
Health Outcomes	—
Insured adults	42.7691518
Arthritis	0.0
Asthma ER Admissions	30.7
High Blood Pressure	0.0
Cancer (excluding skin)	0.0
Asthma	0.0
Coronary Heart Disease	0.0
Chronic Obstructive Pulmonary Disease	0.0
Diagnosed Diabetes	0.0
Life Expectancy at Birth	66.4
Cognitively Disabled	74.6
Physically Disabled	69.8
Heart Attack ER Admissions	60.9
Mental Health Not Good	0.0
Chronic Kidney Disease	0.0
Obesity	0.0
Pedestrian Injuries	19.6
Physical Health Not Good	0.0
Stroke	0.0

Health Risk Behaviors	—
Binge Drinking	0.0
Current Smoker	0.0
No Leisure Time for Physical Activity	0.0
Climate Change Exposures	—
Wildfire Risk	0.0
SLR Inundation Area	41.6
Children	50.1
Elderly	12.2
English Speaking	45.2
Foreign-born	31.6
Outdoor Workers	7.8
Climate Change Adaptive Capacity	—
Impervious Surface Cover	92.0
Traffic Density	42.1
Traffic Access	0.0
Other Indices	—
Hardship	27.2
Other Decision Support	—
2016 Voting	85.3

7.3. Overall Health & Equity Scores

Metric	Result for Project Census Tract
CalEnviroScreen 4.0 Score for Project Location (a)	69.0
Healthy Places Index Score for Project Location (b)	66.0
Project Located in a Designated Disadvantaged Community (Senate Bill 535)	No
Project Located in a Low-Income Community (Assembly Bill 1550)	No
Project Located in a Community Air Protection Program Community (Assembly Bill 617)	No

a: The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.
b: The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

7.4. Health & Equity Measures

No Health & Equity Measures selected.

7.5. Evaluation Scorecard

Health & Equity Evaluation Scorecard not completed.

7.6. Health & Equity Custom Measures

No Health & Equity Custom Measures created.

8. User Changes to Default Data

Screen	Justification
Land Use	Revised acreage to disturbance area
Construction: Construction Phases	No demo, revised building construction to 3 month period
Construction: Trips and VMT	Vendor trips based on imported material estimate
Construction: On-Road Fugitive Dust	Accessible from Harkins Slough Rd

BV Landfill Operation Detailed Report

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8. User Changes to Default Data

1. Basic Project Information

1.1. Basic Project Information

Data Field	Value
Project Name	BV Landfill Operation
Operational Year	2028
Lead Agency	—
Land Use Scale	Project/site
Analysis Level for Defaults	County
Windspeed (m/s)	1.80
Precipitation (days)	36.6
Location	1231 Buena Vista Dr, Watsonville, CA 95076, USA
County	Santa Cruz
City	Unincorporated
Air District	Monterey Bay ARD
Air Basin	North Central Coast
TAZ	3128
EDFZ	6
Electric Utility	Central Coast Community Energy
Gas Utility	Pacific Gas & Electric
App Version	2022.1.1.29

1.2. Land Use Types

Land Use Subtype	Size	Unit	Lot Acreage	Building Area (sq ft)	Landscape Area (sq ft)	Special Landscape Area (sq ft)	Population	Description
Manufacturing	32.7	1000sqft	3.00	32,700	0.00	0.00	—	Transfer Station A
Manufacturing	28.7	1000sqft	4.40	28,700	0.00	0.00	—	Transfer Station B

Manufacturing	7.50	1000sqft	0.20	7,500	0.00	0.00	—	ODF 2 Canopy
Gasoline/Service Station	4.00	Pump	1.00	565	0.00	0.00	—	Storage/Fuel Facility
Parking Lot	535	1000sqft	12.2	0.00	0.00	0.00	—	—
Other Asphalt Surfaces	52.5	1000sqft	1.20	0.00	0.00	0.00	—	—

1.3. User-Selected Emission Reduction Measures by Emissions Sector

No measures selected

2. Emissions Summary

2.4. Operations Emissions Compared Against Thresholds

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Un/Mit.	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	2.86	4.29	12.5	0.02	0.18	0.97	1.15	0.17	0.10	0.27	77.8	2,614	2,692	8.08	0.11	16.1	2,944
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	2.36	4.27	9.44	0.02	0.18	0.97	1.15	0.16	0.10	0.26	77.8	2,601	2,679	8.08	0.11	16.0	2,931
Average Daily (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	2.50	3.06	8.80	0.01	0.13	0.75	0.88	0.12	0.08	0.20	77.8	2,058	2,136	8.06	0.11	16.0	2,385
Annual (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	0.46	0.56	1.61	< 0.005	0.02	0.14	0.16	0.02	0.01	0.04	12.9	341	354	1.33	0.02	2.65	395

2.5. Operations Emissions by Sector, Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Sector	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mobile	0.01	0.06	0.11	< 0.005	< 0.005	0.97	0.97	< 0.005	0.10	0.10	—	48.0	48.0	< 0.005	0.01	0.11	50.1
Area	2.16	0.03	3.02	< 0.005	0.01	—	0.01	< 0.005	—	< 0.005	—	12.4	12.4	< 0.005	< 0.005	—	12.5
Energy	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	622	622	0.13	0.02	—	630
Water	—	—	—	—	—	—	—	—	—	—	30.6	37.4	68.0	3.15	0.08	—	169
Waste	—	—	—	—	—	—	—	—	—	—	47.2	0.00	47.2	4.72	0.00	—	165
Refrig.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	16.0	16.0
Off-Road	0.69	4.20	9.33	0.02	0.18	—	0.18	0.16	—	0.16	—	1,894	1,894	0.08	0.02	—	1,901
Total	2.86	4.29	12.5	0.02	0.18	0.97	1.15	0.17	0.10	0.27	77.8	2,614	2,692	8.08	0.11	16.1	2,944
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mobile	0.01	0.06	0.10	< 0.005	< 0.005	0.97	0.97	< 0.005	0.10	0.10	—	47.5	47.5	< 0.005	0.01	< 0.005	49.4
Area	1.66	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Energy	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	622	622	0.13	0.02	—	630
Water	—	—	—	—	—	—	—	—	—	—	30.6	37.4	68.0	3.15	0.08	—	169
Waste	—	—	—	—	—	—	—	—	—	—	47.2	0.00	47.2	4.72	0.00	—	165
Refrig.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	16.0	16.0
Off-Road	0.69	4.20	9.33	0.02	0.18	—	0.18	0.16	—	0.16	—	1,894	1,894	0.08	0.02	—	1,901
Total	2.36	4.27	9.44	0.02	0.18	0.97	1.15	0.16	0.10	0.26	77.8	2,601	2,679	8.08	0.11	16.0	2,931
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mobile	0.01	0.05	0.09	< 0.005	< 0.005	0.75	0.75	< 0.005	0.08	0.08	—	40.7	40.7	< 0.005	0.01	0.04	42.4
Area	2.00	0.02	2.07	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	8.51	8.51	< 0.005	< 0.005	—	8.54
Energy	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	622	622	0.13	0.02	—	630

Water	—	—	—	—	—	—	—	—	—	—	30.6	37.4	68.0	3.15	0.08	—	169
Waste	—	—	—	—	—	—	—	—	—	—	47.2	0.00	47.2	4.72	0.00	—	165
Refrig.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	16.0	16.0
Off-Road	0.49	2.99	6.65	0.01	0.13	—	0.13	0.12	—	0.12	—	1,349	1,349	0.05	0.01	—	1,354
Total	2.50	3.06	8.80	0.01	0.13	0.75	0.88	0.12	0.08	0.20	77.8	2,058	2,136	8.06	0.11	16.0	2,385
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mobile	< 0.005	0.01	0.02	< 0.005	< 0.005	0.14	0.14	< 0.005	0.01	0.01	—	6.74	6.74	< 0.005	< 0.005	0.01	7.02
Area	0.37	< 0.005	0.38	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	1.41	1.41	< 0.005	< 0.005	—	1.41
Energy	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	103	103	0.02	< 0.005	—	104
Water	—	—	—	—	—	—	—	—	—	—	5.07	6.19	11.3	0.52	0.01	—	28.0
Waste	—	—	—	—	—	—	—	—	—	—	7.82	0.00	7.82	0.78	0.00	—	27.3
Refrig.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2.65	2.65
Off-Road	0.09	0.55	1.21	< 0.005	0.02	—	0.02	0.02	—	0.02	—	223	223	0.01	< 0.005	—	224
Total	0.46	0.56	1.61	< 0.005	0.02	0.14	0.16	0.02	0.01	0.04	12.9	341	354	1.33	0.02	2.65	395

4. Operations Emissions Details

4.1. Mobile Emissions by Land Use

4.1.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Manufacturing	0.01	0.06	0.11	< 0.005	< 0.005	0.97	0.97	< 0.005	0.10	0.10	—	48.0	48.0	< 0.005	0.01	0.11	50.1
Gasoline /Service Station	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Parking Lot	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Other Asphalt Surfaces	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.01	0.06	0.11	< 0.005	< 0.005	0.97	0.97	< 0.005	0.10	0.10	—	48.0	48.0	< 0.005	0.01	0.11	50.1
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Manufacturing	0.01	0.06	0.10	< 0.005	< 0.005	0.97	0.97	< 0.005	0.10	0.10	—	47.5	47.5	< 0.005	0.01	< 0.005	49.4
Gasoline /Service Station	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Parking Lot	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Other Asphalt Surfaces	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.01	0.06	0.10	< 0.005	< 0.005	0.97	0.97	< 0.005	0.10	0.10	—	47.5	47.5	< 0.005	0.01	< 0.005	49.4
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Manufacturing	< 0.005	0.01	0.02	< 0.005	< 0.005	0.14	0.14	< 0.005	0.01	0.01	—	6.74	6.74	< 0.005	< 0.005	0.01	7.02
Gasoline /Service Station	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Parking Lot	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Other Asphalt Surfaces	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Total	< 0.005	0.01	0.02	< 0.005	< 0.005	0.14	0.14	< 0.005	0.01	0.01	—	6.74	6.74	< 0.005	< 0.005	0.01	7.02

4.2. Energy

4.2.1. Electricity Emissions By Land Use - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Manufacturing	—	—	—	—	—	—	—	—	—	—	—	418	418	0.09	0.01	—	424
Gasoline /Service Station	—	—	—	—	—	—	—	—	—	—	—	2.46	2.46	< 0.005	< 0.005	—	2.49
Parking Lot	—	—	—	—	—	—	—	—	—	—	—	201	201	0.04	0.01	—	204
Other Asphalt Surfaces	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	—	0.00
Total	—	—	—	—	—	—	—	—	—	—	—	622	622	0.13	0.02	—	630
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Manufacturing	—	—	—	—	—	—	—	—	—	—	—	418	418	0.09	0.01	—	424
Gasoline /Service Station	—	—	—	—	—	—	—	—	—	—	—	2.46	2.46	< 0.005	< 0.005	—	2.49
Parking Lot	—	—	—	—	—	—	—	—	—	—	—	201	201	0.04	0.01	—	204
Other Asphalt Surfaces	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	—	0.00
Total	—	—	—	—	—	—	—	—	—	—	—	622	622	0.13	0.02	—	630
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Manufacturing	—	—	—	—	—	—	—	—	—	—	—	69.3	69.3	0.01	< 0.005	—	70.2

Gasoline Station	—	—	—	—	—	—	—	—	—	—	—	0.41	0.41	< 0.005	< 0.005	—	0.41
Parking Lot	—	—	—	—	—	—	—	—	—	—	—	33.3	33.3	0.01	< 0.005	—	33.7
Other Asphalt Surfaces	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	—	0.00
Total	—	—	—	—	—	—	—	—	—	—	—	103	103	0.02	< 0.005	—	104

4.2.3. Natural Gas Emissions By Land Use - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Manufacturing	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00
Gasoline /Service Station	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00
Parking Lot	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00
Other Asphalt Surfaces	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00
Total	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Manufacturing	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00
Gasoline /Service Station	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00

Parking Lot	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00
Other Asphalt Surfaces	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00
Total	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Manufacturing	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00
Gasoline /Service Station	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00
Parking Lot	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00
Other Asphalt Surfaces	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00
Total	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00

4.3. Area Emissions by Source

4.3.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Source	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Consumer Products	1.53	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Architectural Coatings	0.13	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Landscape	0.50	0.03	3.02	< 0.005	0.01	—	0.01	< 0.005	—	< 0.005	—	12.4	12.4	< 0.005	< 0.005	—	12.5
Total	2.16	0.03	3.02	< 0.005	0.01	—	0.01	< 0.005	—	< 0.005	—	12.4	12.4	< 0.005	< 0.005	—	12.5
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Consumer Products	1.53	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Architectural Coatings	0.13	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	1.66	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Consumer Products	0.28	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Architectural Coatings	0.02	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Landscape Equipment	0.06	< 0.005	0.38	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	1.41	1.41	< 0.005	< 0.005	—	1.41
Total	0.37	< 0.005	0.38	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	1.41	1.41	< 0.005	< 0.005	—	1.41

4.4. Water Emissions by Land Use

4.4.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Manufact	—	—	—	—	—	—	—	—	—	—	30.5	37.3	67.8	3.14	0.08	—	169
Gasoline /Service Station	—	—	—	—	—	—	—	—	—	—	0.10	0.12	0.23	0.01	< 0.005	—	0.56
Parking Lot	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	—	0.00
Other Asphalt Surfaces	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	—	0.00
Total	—	—	—	—	—	—	—	—	—	—	30.6	37.4	68.0	3.15	0.08	—	169
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Manufact uring	—	—	—	—	—	—	—	—	—	—	30.5	37.3	67.8	3.14	0.08	—	169
Gasoline /Service Station	—	—	—	—	—	—	—	—	—	—	0.10	0.12	0.23	0.01	< 0.005	—	0.56
Parking Lot	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	—	0.00
Other Asphalt Surfaces	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	—	0.00
Total	—	—	—	—	—	—	—	—	—	—	30.6	37.4	68.0	3.15	0.08	—	169
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Manufact uring	—	—	—	—	—	—	—	—	—	—	5.05	6.17	11.2	0.52	0.01	—	27.9
Gasoline /Service Station	—	—	—	—	—	—	—	—	—	—	0.02	0.02	0.04	< 0.005	< 0.005	—	0.09
Parking Lot	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	—	0.00
Other Asphalt Surfaces	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	—	0.00

Total	—	—	—	—	—	—	—	—	—	—	5.07	6.19	11.3	0.52	0.01	—	28.0

4.5. Waste Emissions by Land Use

4.5.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Manufacturing	—	—	—	—	—	—	—	—	—	—	46.0	0.00	46.0	4.60	0.00	—	161
Gasoline /Service Station	—	—	—	—	—	—	—	—	—	—	1.16	0.00	1.16	0.12	0.00	—	4.06
Parking Lot	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	—	0.00
Other Asphalt Surfaces	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	—	0.00
Total	—	—	—	—	—	—	—	—	—	—	47.2	0.00	47.2	4.72	0.00	—	165
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Manufacturing	—	—	—	—	—	—	—	—	—	—	46.0	0.00	46.0	4.60	0.00	—	161
Gasoline /Service Station	—	—	—	—	—	—	—	—	—	—	1.16	0.00	1.16	0.12	0.00	—	4.06
Parking Lot	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	—	0.00
Other Asphalt Surfaces	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	—	0.00

Total	—	—	—	—	—	—	—	—	—	—	47.2	0.00	47.2	4.72	0.00	—	165
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Manufacturing	—	—	—	—	—	—	—	—	—	—	7.62	0.00	7.62	0.76	0.00	—	26.7
Gasoline/Service Station	—	—	—	—	—	—	—	—	—	—	0.19	0.00	0.19	0.02	0.00	—	0.67
Parking Lot	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	—	0.00
Other Asphalt Surfaces	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	—	0.00
Total	—	—	—	—	—	—	—	—	—	—	7.82	0.00	7.82	0.78	0.00	—	27.3

4.6. Refrigerant Emissions by Land Use

4.6.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Manufacturing	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	16.0	16.0
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	16.0	16.0
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Manufacturing	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	16.0	16.0
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	16.0	16.0
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Manufact	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2.65	2.65
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2.65	2.65

4.7. Offroad Emissions By Equipment Type

4.7.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Equipment Type	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Forklifts	0.06	0.59	1.03	< 0.005	0.02	—	0.02	0.02	—	0.02	—	152	152	0.01	< 0.005	—	153
Rubber Tired Loaders	0.36	2.09	6.32	0.01	0.10	—	0.10	0.10	—	0.10	—	1,004	1,004	0.04	0.01	—	1,007
Excavators	0.04	0.40	0.51	< 0.005	0.01	—	0.01	0.01	—	0.01	—	70.9	70.9	< 0.005	< 0.005	—	71.1
Off-Highway Trucks	0.22	1.12	1.47	0.01	0.04	—	0.04	0.04	—	0.04	—	667	667	0.03	0.01	—	669
Total	0.69	4.20	9.33	0.02	0.18	—	0.18	0.16	—	0.16	—	1,894	1,894	0.08	0.02	—	1,901
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Forklifts	0.06	0.59	1.03	< 0.005	0.02	—	0.02	0.02	—	0.02	—	152	152	0.01	< 0.005	—	153
Rubber Tired Loaders	0.36	2.09	6.32	0.01	0.10	—	0.10	0.10	—	0.10	—	1,004	1,004	0.04	0.01	—	1,007
Excavators	0.04	0.40	0.51	< 0.005	0.01	—	0.01	0.01	—	0.01	—	70.9	70.9	< 0.005	< 0.005	—	71.1

Off-Highway Trucks	0.22	1.12	1.47	0.01	0.04	—	0.04	0.04	—	0.04	—	667	667	0.03	0.01	—	669
Total	0.69	4.20	9.33	0.02	0.18	—	0.18	0.16	—	0.16	—	1,894	1,894	0.08	0.02	—	1,901
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Forklifts	0.01	0.08	0.13	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	18.0	18.0	< 0.005	< 0.005	—	18.0
Rubber Tired Loaders	0.05	0.27	0.82	< 0.005	0.01	—	0.01	0.01	—	0.01	—	118	118	< 0.005	< 0.005	—	119
Excavators	0.01	0.05	0.07	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	8.36	8.36	< 0.005	< 0.005	—	8.39
Off-Highway Trucks	0.03	0.15	0.19	< 0.005	0.01	—	0.01	< 0.005	—	< 0.005	—	78.7	78.7	< 0.005	< 0.005	—	78.9
Total	0.09	0.55	1.21	< 0.005	0.02	—	0.02	0.02	—	0.02	—	223	223	0.01	< 0.005	—	224

4.8. Stationary Emissions By Equipment Type

4.8.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Equipment Type	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.9. User Defined Emissions By Equipment Type

4.9.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Equipment Type	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10. Soil Carbon Accumulation By Vegetation Type

4.10.1. Soil Carbon Accumulation By Vegetation Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Vegetation	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.2. Above and Belowground Carbon Accumulation by Land Use Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.3. Avoided and Sequestered Emissions by Species - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Species	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

5. Activity Data

5.9. Operational Mobile Sources

5.9.1. Unmitigated

Land Use Type	Trips/Weekday	Trips/Saturday	Trips/Sunday	Trips/Year	VMT/Weekday	VMT/Saturday	VMT/Sunday	VMT/Year
Manufacturing	134	134	0.00	41,924	2,559	2,559	0.00	800,754
Manufacturing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Manufacturing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gasoline/Service Station	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Parking Lot	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Asphalt Surfaces	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

5.10. Operational Area Sources

5.10.1. Hearths

5.10.1.1. Unmitigated

5.10.2. Architectural Coatings

Residential Interior Area Coated (sq ft)	Residential Exterior Area Coated (sq ft)	Non-Residential Interior Area Coated (sq ft)	Non-Residential Exterior Area Coated (sq ft)	Parking Area Coated (sq ft)
0	0.00	104,198	34,733	35,022

5.10.3. Landscape Equipment

Season	Unit	Value
Snow Days	day/yr	0.00
Summer Days	day/yr	250

5.11. Operational Energy Consumption

5.11.1. Unmitigated

Electricity (kWh/yr) and CO2 and CH4 and N2O and Natural Gas (kBTU/yr)

Land Use	Electricity (kWh/yr)	CO2	CH4	N2O	Natural Gas (kBTU/yr)
Manufacturing	329,817	158	0.0330	0.0040	0.00
Manufacturing	289,473	158	0.0330	0.0040	0.00
Manufacturing	348,840	158	0.0330	0.0040	0.00
Gasoline/Service Station	5,699	158	0.0330	0.0040	0.00
Parking Lot	465,534	158	0.0330	0.0040	0.00
Other Asphalt Surfaces	0.00	158	0.0330	0.0040	0.00

5.12. Operational Water and Wastewater Consumption

5.12.1. Unmitigated

Land Use	Indoor Water (gal/year)	Outdoor Water (gal/year)
Manufacturing	7,561,875	0.00
Manufacturing	6,636,875	0.00
Manufacturing	1,734,375	0.00
Gasoline/Service Station	53,128	0.00
Parking Lot	0.00	0.00
Other Asphalt Surfaces	0.00	0.00

5.13. Operational Waste Generation

5.13.1. Unmitigated

Land Use	Waste (ton/year)	Cogeneration (kWh/year)
Manufacturing	40.5	—
Manufacturing	35.6	—
Manufacturing	9.30	—
Gasoline/Service Station	2.16	—
Parking Lot	0.00	—

Other Asphalt Surfaces	0.00	—

5.14. Operational Refrigeration and Air Conditioning Equipment

5.14.1. Unmitigated

Land Use Type	Equipment Type	Refrigerant	GWP	Quantity (kg)	Operations Leak Rate	Service Leak Rate	Times Serviced
Manufacturing	Other commercial A/C and heat pumps	R-410A	2,088	0.30	4.00	4.00	18.0
Manufacturing	Other commercial A/C and heat pumps	R-410A	2,088	0.30	4.00	4.00	18.0

5.15. Operational Off-Road Equipment

5.15.1. Unmitigated

Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Forklifts	Diesel	Average	2.00	4.00	82.0	0.20
Rubber Tired Loaders	Diesel	Average	4.00	4.00	150	0.36
Excavators	Diesel	Average	1.00	4.00	36.0	0.38
Off-Highway Trucks	Diesel	Average	1.00	4.00	376	0.38

5.16. Stationary Sources

5.16.1. Emergency Generators and Fire Pumps

Equipment Type	Fuel Type	Number per Day	Hours per Day	Hours per Year	Horsepower	Load Factor

5.16.2. Process Boilers

Equipment Type	Fuel Type	Number	Boiler Rating (MMBtu/hr)	Daily Heat Input (MMBtu/day)	Annual Heat Input (MMBtu/yr)

5.17. User Defined

Equipment Type	Fuel Type

5.18. Vegetation

5.18.1. Land Use Change

5.18.1.1. Unmitigated

Vegetation Land Use Type	Vegetation Soil Type	Initial Acres	Final Acres

5.18.1. Biomass Cover Type

5.18.1.1. Unmitigated

Biomass Cover Type	Initial Acres	Final Acres

5.18.2. Sequestration

5.18.2.1. Unmitigated

Tree Type	Number	Electricity Saved (kWh/year)	Natural Gas Saved (btu/year)

6. Climate Risk Detailed Report

6.1. Climate Risk Summary

Cal-Adapt midcentury 2040–2059 average projections for four hazards are reported below for your project location. These are under Representation Concentration Pathway (RCP) 8.5 which assumes GHG emissions will continue to rise strongly through 2050 and then plateau around 2100.

Climate Hazard	Result for Project Location	Unit
Temperature and Extreme Heat	6.83	annual days of extreme heat
Extreme Precipitation	6.05	annual days with precipitation above 20 mm

Sea Level Rise	—	meters of inundation depth
Wildfire	14.2	annual hectares burned

Temperature and Extreme Heat data are for grid cell in which your project are located. The projection is based on the 98th historical percentile of daily maximum/minimum temperatures from observed historical data (32 climate model ensemble from Cal-Adapt, 2040–2059 average under RCP 8.5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Extreme Precipitation data are for the grid cell in which your project are located. The threshold of 20 mm is equivalent to about ¾ an inch of rain, which would be light to moderate rainfall if received over a full day or heavy rain if received over a period of 2 to 4 hours. Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Sea Level Rise data are for the grid cell in which your project are located. The projections are from Radke et al. (2017), as reported in Cal-Adapt (Radke et al., 2017, CEC-500-2017-008), and consider inundation location and depth for the San Francisco Bay, the Sacramento-San Joaquin River Delta and California coast resulting different increments of sea level rise coupled with extreme storm events. Users may select from four scenarios to view the range in potential inundation depth for the grid cell. The four scenarios are: No rise, 0.5 meter, 1.0 meter, 1.41 meters
Wildfire data are for the grid cell in which your project are located. The projections are from UC Davis, as reported in Cal-Adapt (2040–2059 average under RCP 8.5), and consider historical data of climate, vegetation, population density, and large (> 400 ha) fire history. Users may select from four model simulations to view the range in potential wildfire probabilities for the grid cell. The four simulations make different assumptions about expected rainfall and temperature are: Warmer/drier (HadGEM2-ES), Cooler/wetter (CNRM-CM5), Average conditions (CanESM2), Range of different rainfall and temperature possibilities (MIROC5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.

6.2. Initial Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	N/A	N/A	N/A	N/A
Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	1	0	0	N/A
Wildfire	1	0	0	N/A
Flooding	N/A	N/A	N/A	N/A
Drought	0	0	0	N/A
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.
The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.
The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores do not include implementation of climate risk reduction measures.

6.3. Adjusted Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	N/A	N/A	N/A	N/A

Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	1	1	1	2
Wildfire	1	1	1	2
Flooding	N/A	N/A	N/A	N/A
Drought	1	1	1	2
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.
The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.
The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores include implementation of climate risk reduction measures.

6.4. Climate Risk Reduction Measures

7. Health and Equity Details

7.1. CalEnviroScreen 4.0 Scores

The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Exposure Indicators	—
AQ-Ozone	14.9
AQ-PM	2.71
AQ-DPM	42.7
Drinking Water	70.5
Lead Risk Housing	47.3
Pesticides	99.6
Toxic Releases	8.90
Traffic	69.7
Effect Indicators	—

CleanUp Sites	63.1
Groundwater	64.2
Haz Waste Facilities/Generators	80.2
Impaired Water Bodies	99.5
Solid Waste	97.9
Sensitive Population	—
Asthma	62.7
Cardio-vascular	41.9
Low Birth Weights	52.4
Socioeconomic Factor Indicators	—
Education	58.5
Housing	31.2
Linguistic	52.0
Poverty	37.9
Unemployment	59.4

7.2. Healthy Places Index Scores

The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Economic	—
Above Poverty	68.47170538
Employed	33.54292314
Median HI	77.41562941
Education	—
Bachelor's or higher	74.51559091
High school enrollment	7.327088413
Preschool enrollment	83.90863596
Transportation	—

Auto Access	81.29090209
Active commuting	41.03682792
Social	—
2-parent households	58.82201976
Voting	74.02797382
Neighborhood	—
Alcohol availability	73.69434108
Park access	29.20569742
Retail density	9.303220839
Supermarket access	9.983318363
Tree canopy	92.41627101
Housing	—
Homeownership	74.16912614
Housing habitability	87.37328372
Low-inc homeowner severe housing cost burden	42.5895034
Low-inc renter severe housing cost burden	89.84986526
Uncrowded housing	84.29359682
Health Outcomes	—
Insured adults	42.7691518
Arthritis	0.0
Asthma ER Admissions	30.7
High Blood Pressure	0.0
Cancer (excluding skin)	0.0
Asthma	0.0
Coronary Heart Disease	0.0
Chronic Obstructive Pulmonary Disease	0.0
Diagnosed Diabetes	0.0
Life Expectancy at Birth	66.4

Cognitively Disabled	74.6
Physically Disabled	69.8
Heart Attack ER Admissions	60.9
Mental Health Not Good	0.0
Chronic Kidney Disease	0.0
Obesity	0.0
Pedestrian Injuries	19.6
Physical Health Not Good	0.0
Stroke	0.0
Health Risk Behaviors	—
Binge Drinking	0.0
Current Smoker	0.0
No Leisure Time for Physical Activity	0.0
Climate Change Exposures	—
Wildfire Risk	0.0
SLR Inundation Area	41.6
Children	50.1
Elderly	12.2
English Speaking	45.2
Foreign-born	31.6
Outdoor Workers	7.8
Climate Change Adaptive Capacity	—
Impervious Surface Cover	92.0
Traffic Density	42.1
Traffic Access	0.0
Other Indices	—
Hardship	27.2
Other Decision Support	—

2016 Voting	85.3

7.3. Overall Health & Equity Scores

Metric	Result for Project Census Tract
CalEnviroScreen 4.0 Score for Project Location (a)	69.0
Healthy Places Index Score for Project Location (b)	66.0
Project Located in a Designated Disadvantaged Community (Senate Bill 535)	No
Project Located in a Low-Income Community (Assembly Bill 1550)	No
Project Located in a Community Air Protection Program Community (Assembly Bill 617)	No

a: The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.
b: The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

7.4. Health & Equity Measures

No Health & Equity Measures selected.

7.5. Evaluation Scorecard

Health & Equity Evaluation Scorecard not completed.

7.6. Health & Equity Custom Measures

No Health & Equity Custom Measures created.

8. User Changes to Default Data

Screen	Justification
Land Use	Revised acreages based on total construction area
Operations: Vehicle Data	Revised to include all trips in Transfer Station A line. Landfill not open on Sunday. Assume distance from BV Landfill to ReGen
Operations: Fleet Mix	Assume HDD for all transfer vehicles and LDT for other vehicles
Operations: Road Dust	Assumes one mile of 19 mile average trip length is unpaved
Operations: Refrigerants	No HVAC for ODF
Operations: Off-Road Equipment	Based on anticipated project equipment, assume intermittent daily use

Operations: Energy Use	ODF based on energy demand data from SCS, no new natural gas use at any new building.
Characteristics: Utility Information	Landfill served by 3CE

Gas Pump Daily Fuel Estimate

Equipment	Existing Use	Future Use	Existing fuel use/day	Future gallons/day	Fuel Type	VOC EF (lb/1,000 gallon)	Future VOC Emissions (lbs/day)
Fleet Vehicles	Maintenance, inspections, etc.	Same, to include trips associated with landfill monitoring	42.2	42.2	Gasoline	0.894	0.0377268
Off-Road equipment	Landfilling	Operation for landfilling would cease. Assumed to represent new equiment and proposed components, including ODF	76.3	76.3	Diesel	0.028	0.0021364
On-Road vehicles	Landfilling	Would move to transfer station	15.3	15.3	Gasoline	0.894	0.0136782
Off-Road equipment	Large industrial claw at transfer station	To be replaced by electric equipment.	24.7	0	Diesel	0.028	0
On-Road Trucks	Transfer truck use	Transfer Truck use - See below for net increase from 24 trucks	12556.9	12885.9	Diesel	0.028	0.360805249
						Total	**0.414346649**

Gasoline EF assumes Phase II EVR system similar to Healy vacuum assisted system used at Ben Lomond. Source: CARB. 2022. Gasoline Service Station Industrywide Risk Assessment Technical Guidance. February 18.
Diesel EF assumes no VOC emissions control. Source: South Coast Air Quality Management District. 2022. Guidelines for Fuel Dispensing Operations. December.

Truck Use Calculation				
New Trucks	BV Fuel Use	Existing Trucks in Fuel Use	Fuel/Truck	Net icrease in Gallons
24	12556.9	916	13.70840611	329.0017467

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Appendix G1.1. Special-Status Plants with Potential to Occur

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Appendix G1.2. Plant Species Narratives

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Appendix G1.3. Observed Plant Lists

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Appendix G2.1. Sensitive Wildlife Species with Potential to Occur

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Appendix G2.2. Sensitive Wildlife Species Narratives

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Appendix G2.3. Santa Cruz Long-Toed Salamander and California Tiger Salamander Site Assessment

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Appendix G2.4. Wildlife Species Observed

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Appendix G3.1. U.S. Fish and Wildlife Service Official Species List

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Appendix G3.2. Wildlife Species Excluded from Consideration

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Appendix G4. Native Shallow-Rooted Shrubs, Perennial Herbs, and Vines Proposed for the Landfill Cap

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Appendix G5. Arborist Report

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Appendix H1. Field Investigation, Laboratory Testing, and Subsurface Conditions County Property Northeast of Buena Vista Landfill Memo

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Appendix H2. Subsurface Conditions for Proposed Transfer Station in Current Maintenance Building Area at Buena Vista Landfill Memo

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Appendix H3. Subsurface Conditions for Proposed CASP at Old Landfill at Buena Vista Landfill Memo

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Appendix H4. Subsurface Conditions for Proposed Transfer Station on County Property Northeast of Buena Vista Landfill

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Appendix I. FAA No Hazard Determination

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Appendix J. Drainage Report

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Appendix K. Noise

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Appendix L. Traffic Analysis

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Appendix M. CAG Siting Study

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Appendix N. Agriculture Viability Study for Alternative 3

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Appendix O. Air Quality for Alternative 3

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Appendix P. Intentionally omitted

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Appendix Q. Geotech Memo for Alternative 3

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Appendix R. Hydro Drainage Memo for Alternative 3

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Appendix S. Noise Modeling for Alternative 3

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Appendix T. Traffic Analysis for Alternatives

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