Appendix F:

Hydrology and Water Quality Supporting Information

THIS PAGE INTENTIONALLY LEFT BLANK

TTM 19343

ALISO VIEJO, CALIFORNIA

PRELIMINARY HYDROLOGY REPORT

PREPARED FOR:

Meritage Homes
230 Progress
Irvine, CA 92618
949-266-3824
Date Prepared: 10/2025

PREPARED BY:

X Engineering & Consulting, Inc.
6 Hutton Centre Drive, Suite 650
Santa Ana, California 92707
949.522.7100
Project Manager: Eric Lissner, P.E.
Project Number: 117-011

ENGINEERING & CONSULTING

This report was prepared by or under the supervision of the undersigned registered civil engineer who attests to the technical information contained herein.

10/22/2025

Eric Lissner

Date

REGISTERED PROFESSIONAL ENGINEER
ERIC LISSNER
No. 84264
CIVIL
STATE OF CALIFORNIA

ENGINEERING & CONSULTING

TABLE OF CONTENTS

I. Introduction 3
  A. Project Site Description 3
  B. Purpose and Scope 3
  C. Project Location Map 4
II. Existing Topographic and Hydrologic Conditions 4
  A. Existing Topography 4
  B. Existing Drainage Pattern 5
  C. Existing Storm Drain Facilities 5
III. Hydrologic Analysis 5
  A. Storm Frequency 5
  B. Methodology 5
  C. Existing Condition 5
  D. Proposed Condition 6
IV. Proposed Onsite Drainage Facilities 8
  A. Proposed stormwater facilities 8
  B. Mitigated Peak Storm Flows 9
V. Conclusion 9
VI. References 10

FIGURES

Figure 1: Existing Condition Rational Method Hydrology Map

Figure 2: Proposed Condition Rational Method Hydrology Map

APPENDICES

Appendix A: Hydrology Exhibits

Appendix B: Hydrology Calculations

Appendix C: Hydraulic Calculations

Appendix D: Geotechnical Report

Appendix E: Supporting Exhibits

I. INTRODUCTION

A. PROJECT SITE DESCRIPTION

The project site is located at 400-700 Freedom Lane in the City of Aliso Viejo, California and covers 7.06 acres with a study area of 4.44 acres. The site is described in the County tax assessor maps as APNs 632-141-12 through 632-141-15. The site is bounded by Freedom Lane to the north and a commercial property owned by Kaiser Foundation to the west. A 45% slope is directly to the south with an above ground water tank at the base of the slope owned by Moulton Niguel Water District. To the east is a commercial property owned by Belmont Village. See Vicinity Map in **Section I.C.**

The existing site is vacant with sparse poor ground cover. Mass grading of the site and general region occurred in the mid-1980s. Development of the site will convert the property into a residential development with a total of 72 dwelling units, consisting of 8 single units and 32 buildings (64 dwelling units) at 16.2 dwelling units per acre. The present zoning and General Plan land use will be changed to accommodate the new use.

Based on the FEMA flood map revised December 3, 2009, FIRM panel 06059C0436J, the site is in Flood Zone X, areas of minimal flood hazard.

B. PURPOSE AND SCOPE

The purpose of this preliminary study is to analyze the pre- and post-development drainage conditions in order to provide adequate drainage facilities for the proposed development project.

The scope of this study includes:

1. Determination of existing and proposed drainage patterns
2. Peak flow analysis of the downstream discharge points for both existing and proposed drainage conditions
3. Validation of the proposed drainage facility design
4. Performance of hydrograph routing calculations

C. PROJECT LOCATION MAP

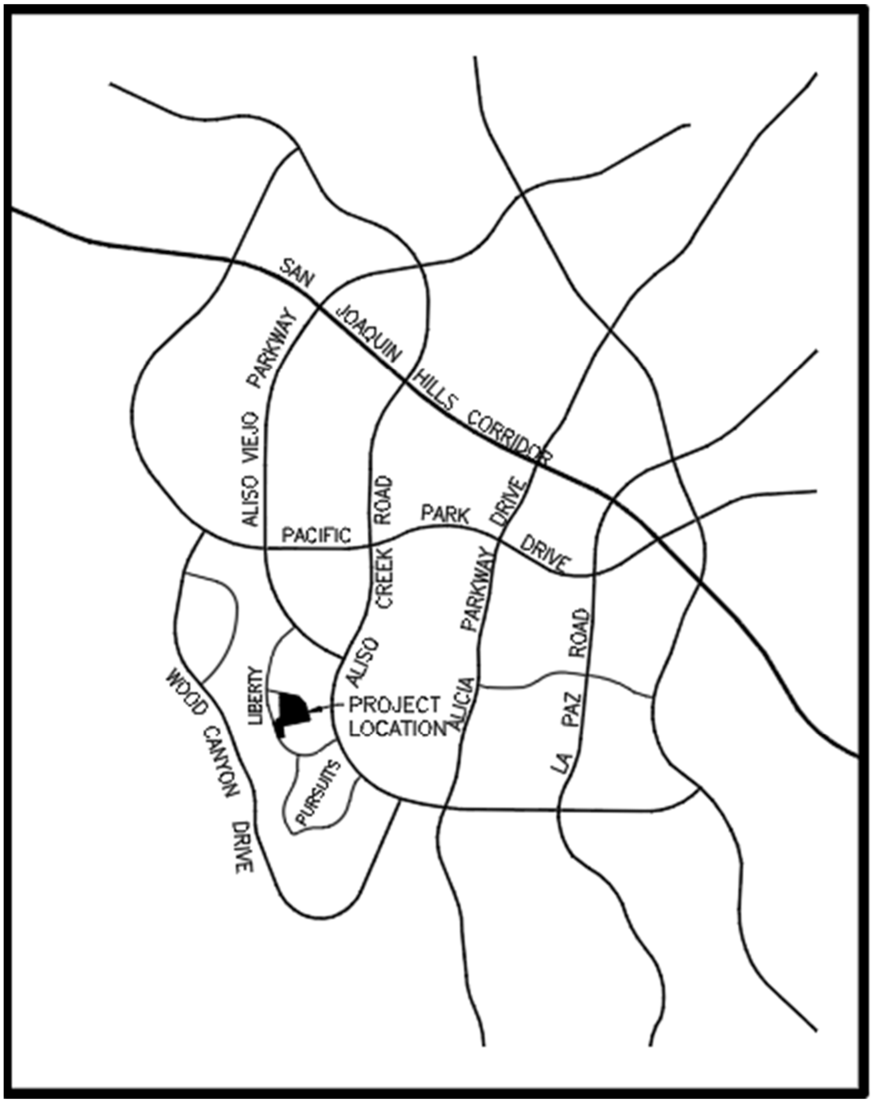

SAN JOAQUIN HILLS CORRIDOR
ALISO VIEJO PARKWAY
PACIFIC PARK DRIVE
ALISO CREEK ROAD
ALICIA PARKWAY
LA PAZ ROAD
WOOD CANYON DRIVE
LIBERTY
PURSUITS
PROJECT LOCATION

Figure I.1: Vicinity Map (N.T.S.)

II. EXISTING TOPOGRAPHIC AND HYDROLOGIC CONDITIONS

A. EXISTING TOPOGRAPHY

The existing topography is sloped at approximately 2.5% from west to east with elevations ranging between 467.5' and 460'. This hydrologic study references the North American Vertical Datum of 1988 (NAVD88). Per the soils report dated June 2024 by SA Geotechnical, the site is underlain primarily by artificial fill from the result of the original mass grading in the 1980s. Artificial fill was found to be up to 22 feet thick (southeast corner of site) consisting of silty fine to medium sand. Bedrock is at or near existing grades. Groundwater was not encountered during exploration. Historic high groundwater has shown depths to be greater than 20 feet below ground surface (bgs). Soils in this region are categorized as Hydrologic Soils Group (HSG) class D (see **Appendix C** for soils map).

B. EXISTING DRAINAGE PATTERN

The project site is located within the Aliso Creek Watershed and is subject to hydromodification mitigation requirements, which are discussed separately in the Project's Water Quality Management Plan.

Site drainage is one main watershed in the existing condition shown in **Figure 1**. Drainage originates from overland flow that sheet flows east into a siltation basin at the east of the site adjacent to the cul-de-sac. Existing catch basins along Freedom Lane intercept street flow and convey stormwater to the existing 18-inch high density polyethylene (HDPE) storm drain within the cul-de-sac. Street flow drainage does not comingle with site stormwater flows.

Project drainage is directed to the 18-inch HDPE existing storm drain that scales up to a 24-inch HDPE storm drain flowing northeast through the Belmont Village property. A 24-inch reinforced concrete pipe (RCP) conveys stormwater to a 30-inch RCP storm drain on Aliso Creek Road that eventually increases up to a 96-inch RCP downstream. The 96-inch RCP terminates at a rip rap energy dissipation structure at Aliso Creek, via which stormwater is conveyed to the Pacific Ocean at South Laguna Beach.

C. EXISTING STORM DRAIN FACILITIES

The existing site is presently vacant with one siltation basin at the east border of the site. One 18-inch corrugated metal pipe (CMP), approximately 80 feet long, drains stormwater from the basin to a catch basin at the Freedom Lane cul-de-sac.

III. HYDROLOGIC ANALYSIS

A. STORM FREQUENCY

This report includes hydrology analysis for the existing and proposed project conditions based on 25-year and 100-year frequency storm events. These storm frequencies are chosen as a more conservative approach than the required 20-year storm frequency by the City of Aliso Viejo. The hydrologic parameters used for the analysis are in accordance with the 1986 County of Orange Hydrology Manual and its 1996 Addendum.

B. METHODOLOGY

The City of Aliso Viejo is an incorporated city within Orange County. Accordingly, the City of Aliso Viejo accepts methodologies and practices as described in the 1986 Orange County Hydrology Manual and its 1996 Addendum.

The rational method, as described in Section D of the County's hydrology manual, is used for determining all peak runoff rates and times of concentration for this study. The rational method is implemented using CivilDesign software, 2018 version, developed by Civil Design Corporation and Joseph E. Bonadiman and Associates, Inc, and is accepted by the County of Orange for hydrologic study purposes.

C. EXISTING CONDITION

As described in Section II.B., drainage areas of the existing project site are depicted in **Figure 1** in **Appendix A**.

Peak flow originates as overland flow from a high point in subarea A-1 (node 101). Stormwater flow from subarea A-2 is conveyed by sheet flow to the siltation basin at node 103. The purpose of the basin is not for detention. **Appendix C** contains a routing analysis of the siltation basin in the existing condition. The maximum water surface elevation is expected to be 1.45 feet above the basin bottom surface. Stormwater flow exits the site and is conveyed to a catch basin on Freedom Lane approximately 80 feet northwest of the basin.

At time of publication, a Kaiser Permanente medical facility is being constructed by others on the adjacent lot to the west (APN 632-141-16). Stormwater flow from this location is directed to the 18-inch HDPE storm drainpipe that parallels Freedom Lane and enters the 24-inch RCP located at the cul-de-sac at node 104, **Figure 1**.

The 25-year and 100-year existing condition peak flow drainage for the project is described in **Table III.C.1**:

Table III.C.1 Existing Onsite Runoff 100-Year Storm

Subarea Designation	Existing Condition		
	25-Year Storm QPEAK (cfs)[1]	100-Year Storm QPEAK (cfs)[2]	Area (AC)
A	9.9	13	4.44
Total Project	**9.9**	**13**	**4.44**

[1]CivilD file name: 117011FreedomEx25v22; [2]CivilD file name:117011FreedomEx100v22

Table III.C.2 Existing Street Runoff 100-Year Storm

Subarea Designation	Existing Condition	
	100-Year Storm QPEAK (cfs)[1]	Area (AC)
E	1.6	0.4
Total Project	**1.6**	**0.4**

[1]CivilD file name: 117011FreedomStreet100v1

III.C.1. Existing Street Runoff

Stormwater flow along Freedom Lane (Area C in **Figure 1, Appendix A**) is conveyed to a catch basin at node 203, with a 100-year peak flow of 1.6 cfs. In the existing condition, flow is directed to the siltation basin and then to the public 24-inch RCP storm drain at node 104. In the proposed condition (Area E in **Figure 2, Appendix A**), street flow is directly conveyed from the catch basin to the 24-inch RCP storm drain, with no change. Therefore, street flow is excluded from this analysis.

D. PROPOSED CONDITION

The proposed drainage patterns are depicted in **Figure 2** in **Appendix A**.

Per the MS4 Permit requirements for redevelopment, this project will also incorporate low impact development (hereafter, LID) elements into the site design as well as implementation of the structural best management practices (BMP). Stormwater for the project will be routed through the BMPs before discharging offsite.

The proposed condition peak flow drainage will mimic the existing condition to the maximum extent possible as described in **Section III.C**. Runoff originating as overland flow along the site boundary and from the proposed buildings will be conveyed into area drains placed throughout the development.

All project drainage will be routed to four proposed modular wetland systems (MWS) for water quality treatment prior to entering a proposed subsurface detention basin in the north portion of the project. The detention system is designed for hydromodification management as well as peak flow mitigation. Peak flows from the site will ultimately discharge through a proposed 18-inch pipe connection into the existing 18-inch HDPE storm drain downstream.

The 25 year and 100 year proposed peak flow drainage for the project is described in **Table III.D.1**:

Table III.D.1 Proposed Project Runoff (Unmitigated)

Subarea	Final Node	Proposed Unmitigated Condition		
		25-Year Storm[1] QPEAK (cfs)	100-Year Storm[2] QPEAK (cfs)	Area (AC)
A-1	101	0.83	1.06	0.2
A-2	102	0.52	0.67	0.16
A-3	102	0.63	0.82	0.17
Area A		**1.98**	**2.55**	**0.53**
B-1	201	0.28	0.36	0.06
B-2	202	0.56	0.72	0.14
B-3	203	0.54	0.70	0.14
B-4	203	0.69	0.89	0.17
B-5	204	0.09	0.11	0.06
B-6	204	0.94	1.22	0.25
B-7	204	0.41	0.54	0.11
B-8	205	0.51	0.66	0.15
B-9	205	0.49	0.63	0.13
Area B		**4.50**	**5.82**	**1.21**
C-1	301	1.2	1.49	0.31
C-2	301	0.68	0.86	0.18
C-3	305	0.85	1.11	0.33
C-4	305	1.05	1.35	0.32
C-5	303	0.60	0.76	0.17
C-6	303	0.84	1.07	0.24
C-7	304	0.36	0.46	0.13
C-8	304	0.43	0.55	0.13
Area C		**5.94**	**7.65**	**1.81**
D-1	401	0.48	0.62	0.13
D-2	402	0.78	1.01	0.26
D-3	403	0.76	0.98	0.29
D-4	403	0.62	0.81	0.21
Area D		**2.64**	**3.42**	**0.89**
Total Project		**14.3**	**18.4**	**4.44**

[1] CivilD file name: 117011FreedomProp25v8; [2] CivilD file name:117011FreedomProp100v8;

Table III.D.2 Proposed Street Runoff 100-Year Storm

Subarea	Final Node	Proposed Unmitigated Condition	
		100-Year Storm[1] QPEAK (cfs)	Area (AC)
E-1	501	0.8	0.16
E-2	502	0.8	0.24
Area E		**1.6**	**0.4**

[1] CivilD file name: 117011FreedomStreet100v1

Area E, street flow, is excluded from the analysis. (See section III.C.1).

Comparing the existing condition peak flows from **Table III.C.1** and the proposed unmitigated condition peak flows in **Table III.D.1**, the unmitigated proposed condition peak flows exceed the existing condition peak flows. Routing calculations are provided in **Appendix B**.

Table III.D.2 Comparison of Existing and Proposed Condition 100-Year Storms

Existing Condition 100-Year Storm (cfs)	Proposed Condition 100-Year Storm (cfs)	Δ QPEAK (cfs)
13	**18.4**	**+5.4**

Because of this condition, the project is proposing a subsurface detention basin to reduce the proposed 25- and 100-year storm flow rates from the project to be below the existing condition flow rates.

IV. PROPOSED ONSITE DRAINAGE FACILITIES

A. PROPOSED STORMWATER FACILITIES

As described in Section III.D, this project will implement structural BMPs that meet water quality and hydromodification management objectives as required by the MS4 Permit.

All existing storm drainage structures within the site will be demolished. Stormwater from the proposed site will be intercepted by roof downspouts, new area drains, gutters, and catch basins and conveyed to the water quality treatment system paired with a downstream detention system. The detention system serves to mitigate hydromodification (HMP), and peak storm flows.

The detention system, manufactured by StormTrap, is 10.5-foot high. The storage system provided by the detention system is 24,801 cubic feet. Additional information on the StormTrap system is available in **Attachment E** and shown on the **Figure 2** profile schematic.

Storm water flows through the subsurface detention system were analyzed in two scenarios:

1. HMP scenario:

This will be the scenario for the more frequent storm events (i.e. 10% of the 2-year through 10-year storms). Stormwater is routed through the four MWS units and enters the subsurface detention vault. Stormwater then flows through a riser, exits through a 3.25-inch low-flow orifice at the bottom of the riser as well as a 1.0 foot wide by 1.0-foot height notch (Section A detail **Figure 2)**, and to the 18-inch HDPE storm drain at the cul-de-sac of Freedom Lane. Placement and sizing of the orifice is designed to meet hydromodification objectives detailed in the project's WQMP.

2. Peak storm:
   During less frequent and more intense storm events (i.e. the 25-year and 100-year storms), stormwater will flow over an internal bypass weir in the MWS units, through the detention vault, through the 3.25-inch orifice at the system invert and over the downstream weir plate. Stormwater then flows underground to the existing 18-inch HDPE storm drain at the cul-de-sac of Freedom Lane.

B. MITIGATED PEAK STORM FLOWS

As described in Section III.D, the proposed drainage patterns are depicted in **Figure 2** in **Appendix A.**

The proposed subsurface detention system has been sized accordingly to accommodate hydromodification management and peak flow attenuation. The proposed condition unmitigated 100-year storm peak flows exceed the existing condition peak flows by 5.4 cfs (**Table III.D.2**). Results from the existing and proposed condition studies are in **Table III.C.1** and **Table III.D.1** respectively.

As described in the project WQMP, the detention facility was sized for hydromodification and peak flow mitigation by routing the 100-year, 24-hour peak storm hydrograph through the detention system. Basin routing was accomplished using Flood Hydrograph routing of the peak storm hydrograph with modified puls routing in CivilDesign software, 2018 version, developed by Civil Design Corporation and Joseph E. Bonadiman and Associates, Inc. All routing calculations are provided in **Appendix B**.

Table IV.1 Proposed Onsite Runoff (Mitigated)

Existing Condition 100-Year Storm	Proposed Unmitigated Condition 100-Year Storm^2	Proposed Mitigated Condition
QPEAK (cfs)	QPEAK (cfs)	QPEAK (cfs)
13	**18.4**	**12.7**

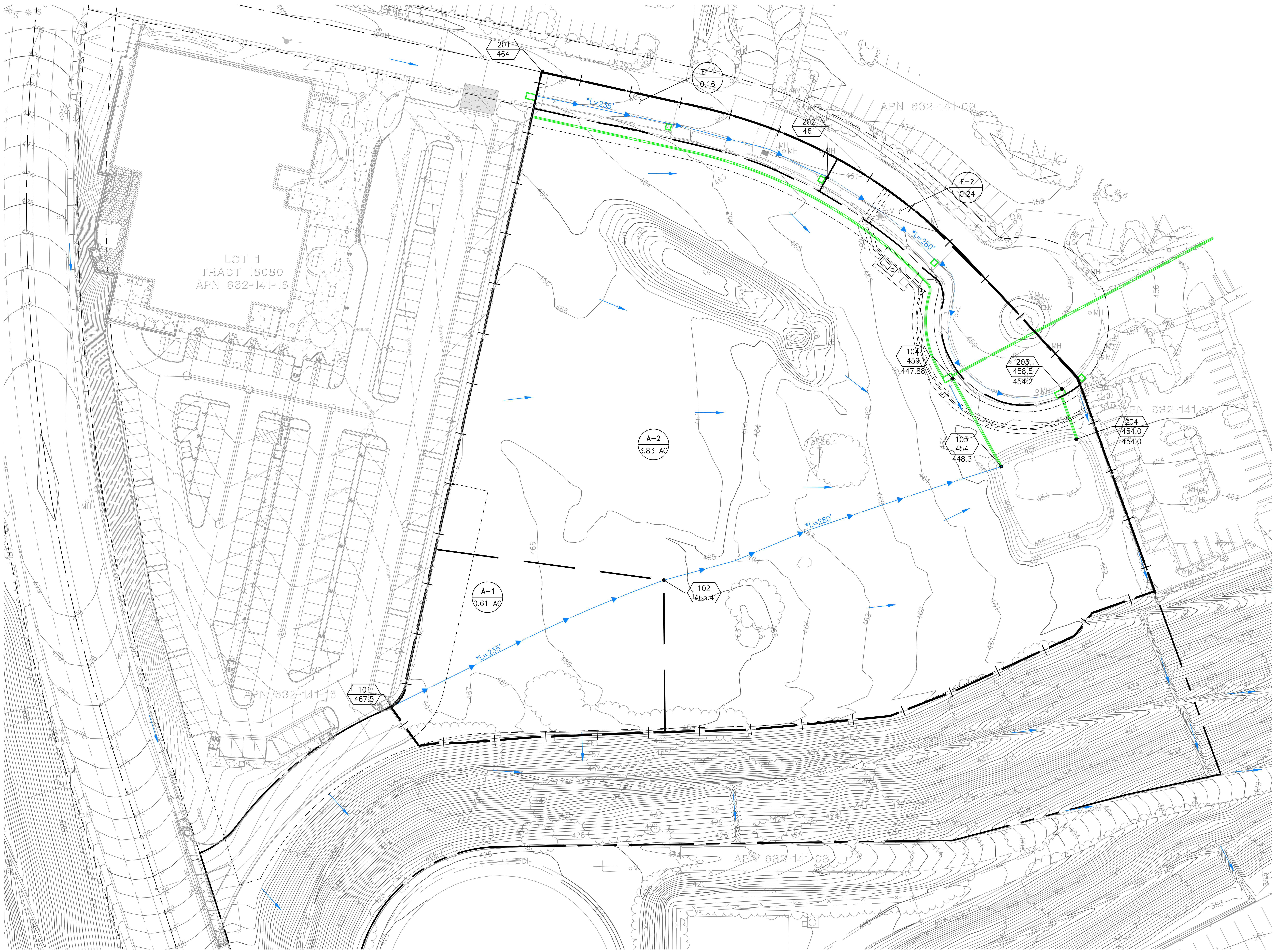
V. CONCLUSION

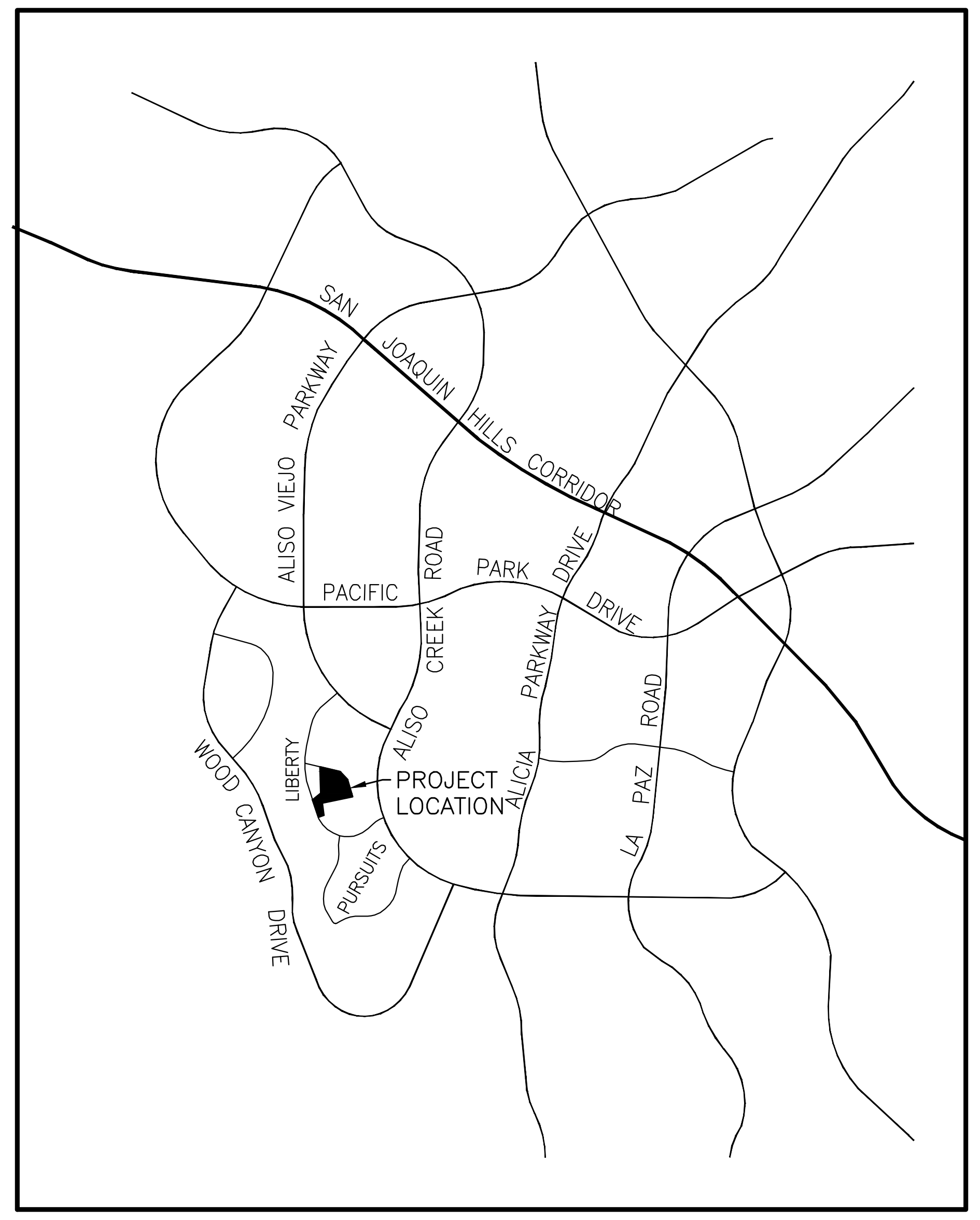
Based upon the analyses completed in this preliminary study, the proposed condition project has been adequately designed to convey the 25-year and 100-year storm flow to ensure flood protection for the onsite areas as well as for the surrounding neighbors, and no adverse impacts to the storm drain system.

VI. REFERENCES

1. Orange County Hydrology Manual (1986)
2. Orange County Hydrology Manual Addendum (1996)
3. Orange County Model Water Quality Management Plan
4. Orange County Technical Guidance Document, South Orange County (2017)
5. SA Geotechnical. Geotechnical Exploration and Preliminary Design Recommendations, Proposed Residential Development Report, 400-700 Freedom Lane, Lots 2 through 5 of Tract No. 18080, City of Aliso Viejo, California. June 2024.
6. VCA Engineers, Inc. Site Hydrology and Hydraulics Report for Kaiser Permanente Aliso Viejo Medical Office Building, 4 Liberty, Aliso Viejo, CA. Project No. 2070-219. August 2024.

APPENDIX A


201
464
E-1
0.16
*L=235'
202
461
APN 632-141-09
E-2
0.24
*L=280'
LOT 1
TRACT 18080
APN 632-141-16
104
459
447.88
203
458.5
454.2
204
454.0
454.0
APN 632-141-10
103
454
448.3
A-2
3.83 AC
A-1
0.61 AC
102
465.4
*L=280'
*L=235'
101
467.5
APN 632-141-16
APN 632-141-03


SAN JOAQUIN HILLS CORRIDOR
ALISO VIEJO PARKWAY
PACIFIC
PARK DRIVE
ALISO CREEK ROAD
PARKWAY
ALICIA
LA PAZ ROAD
WOOD CANYON DRIVE
LIBERTY
PURSUITS
PROJECT LOCATION

LEGEND

━━━ | ━━━	MAJOR WATERSHED BOUNDARY
━━━　━━━	MINOR WATERSHED BOUNDARY
——— – – ———	EXISTING RIGHT OF WAY
━━ ▬ ▬ ━━	PROPERTY BOUNDARY
L=270'	SURFACE FLOW PATH LENGTH
──▶───	SURFACE FLOW PATH
101	NODE NUMBER
781.0	FLOWLINE ELEVATION
*771.0	*INDICATES INVERT ELEVATION
A	SUBAREA DESIGNATION
0.64	SUBAREA ACREAGE
	DIRECTION OF SURFACE FLOW
🟩	EXISTING STORM DRAIN

DRAINAGE SUMMARY

SUBAREA DESIGNATION	SUBAREA ACREAGE	25-YR STORM		100-YR STORM	
		TOTAL RUNOFF (CFS)	T_C (MIN)	TOTAL RUNOFF (CFS)	T_C (MIN)
A	4.44	9.9	14.1	13.0	14.0

EXISTING STREET RUNOFF

SUBAREA DESIGNATION	SUBAREA ACREAGE	100-YR STORM	
		TOTAL RUNOFF (CFS)	T_C (MIN)
E	0.4	1.6	9.0

NOTES

1. ENTIRE PROJECT SITE IS UNDERLAIN BY HYDROLOGIC SOILS GROUP D
2. EXISTING STREET RUNOFF (AREA E) IS EXCLUDED FROM THE ANALYSIS

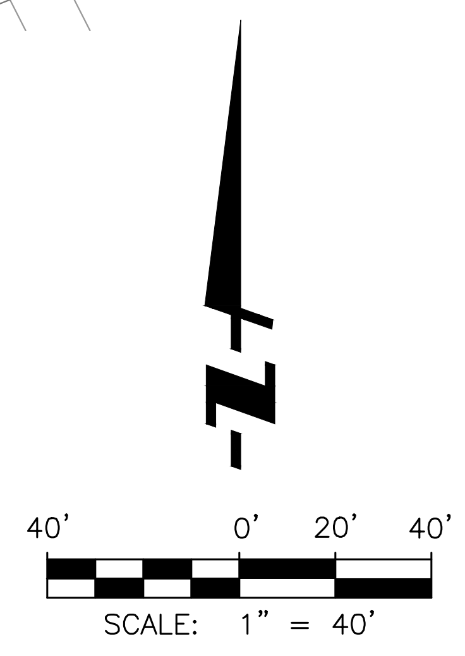
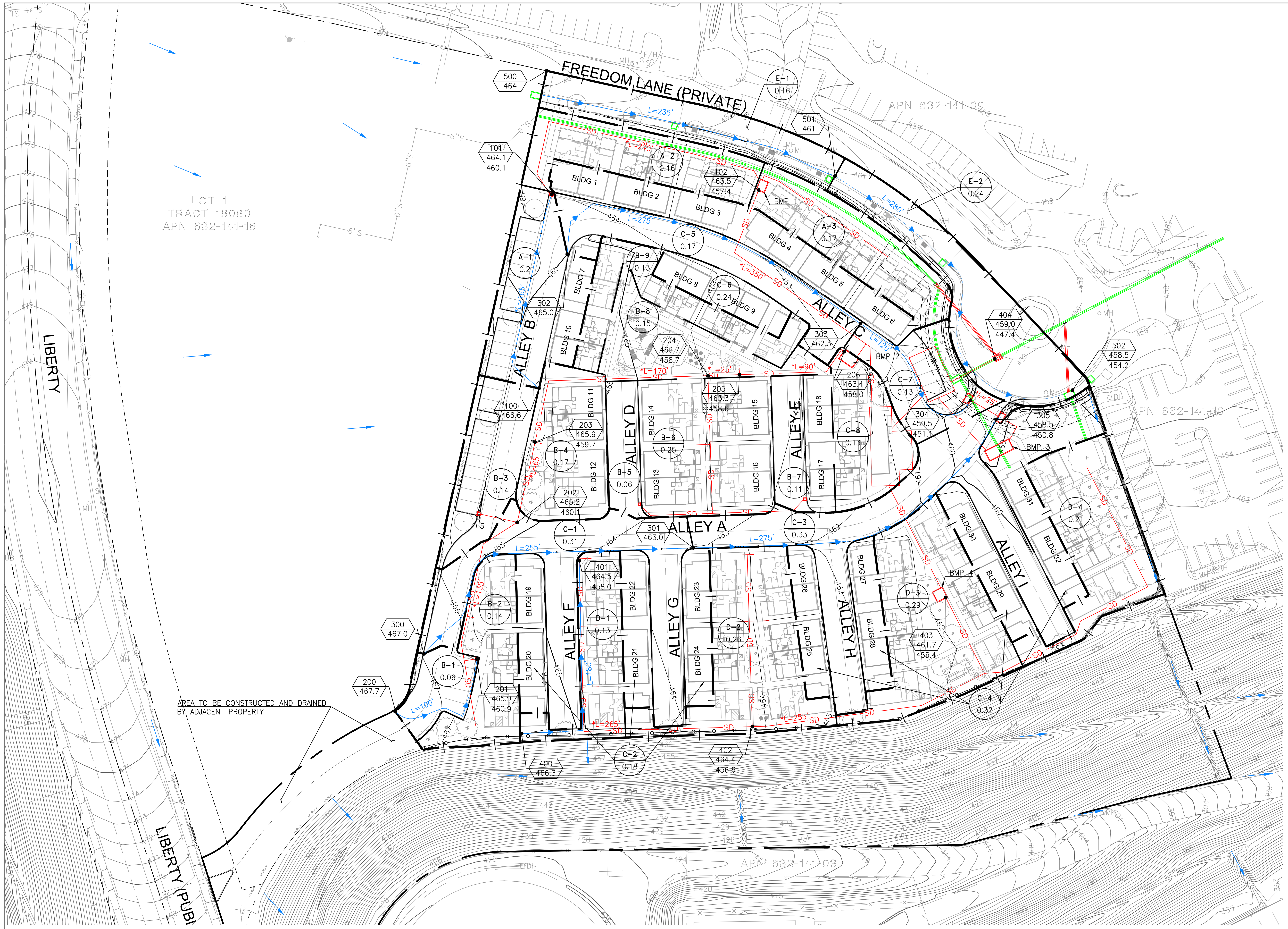

N
40'
0'
20'
40'
SCALE: 1" = 40'

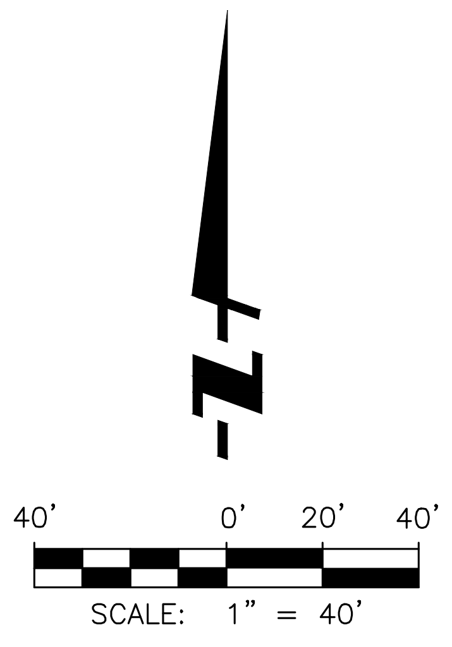
FIGURE 1: EXISTING CONDITION HYDROLOGY

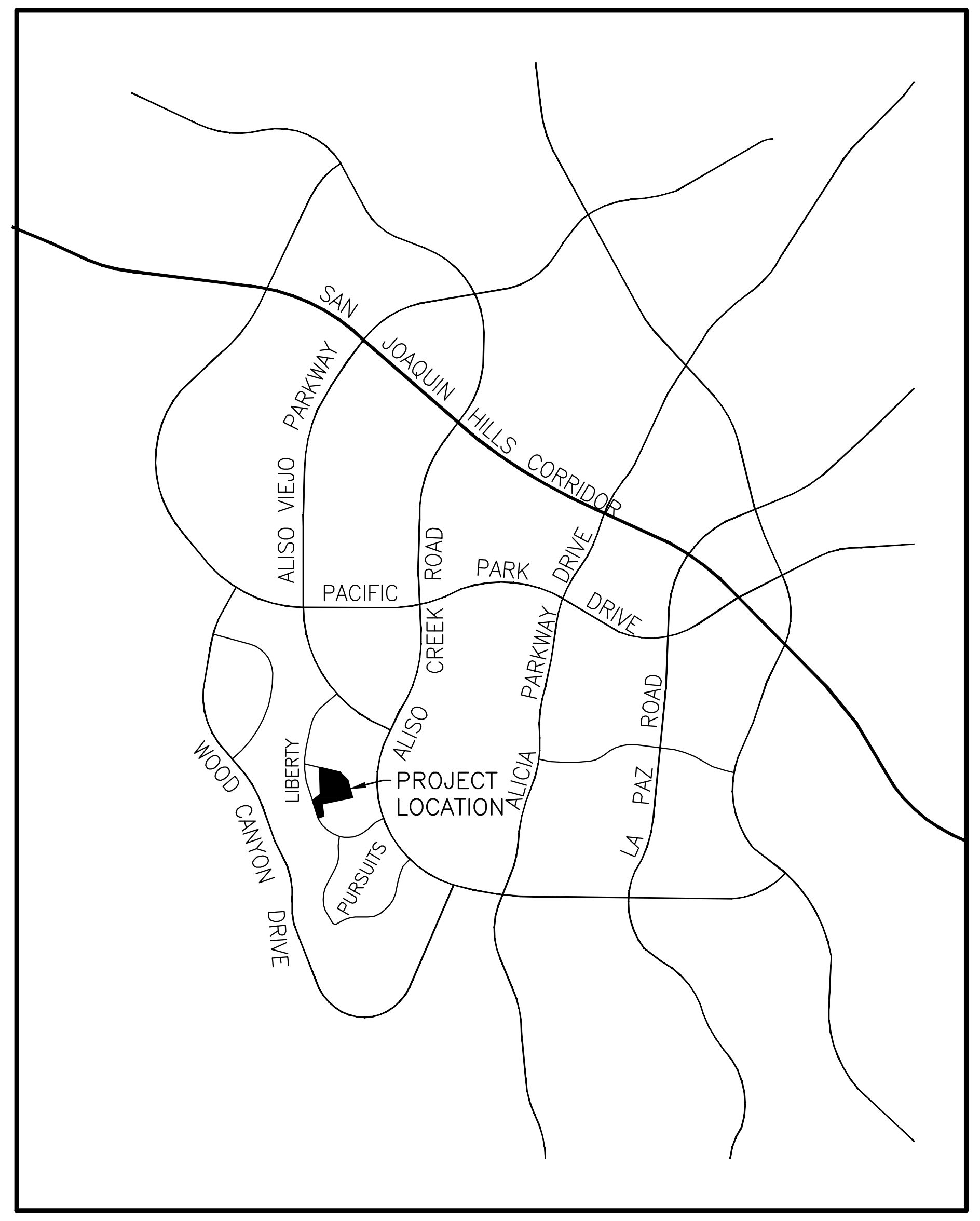
TTM 19343
ALISO VIEJO, CA

X ENGINEERING & CONSULTING, INC.
6 Hutton Centre Drive, Suite 650
Santa Ana, California 92707
949.522.7100 | xengineeringinc.com

P:\117\011\Reports\Entitlement\Hydrology – Preliminary\Exhibits\117-011 Figure 1 Existing Condition Hydrology.dwg Plotted At: October 23, 2025 12:13 PM Last Saved By: hana.aljassim Last Saved At: October 23, 2025 12:12 PM


FREEDOM LANE (PRIVATE)
LIBERTY
LIBERTY (PUBL
LOT 1
TRACT 16080
APN 632-141-16
APN 632-141-09
APN 632-141-10
APN 632-141-03
ALLEY A
ALLEY B
ALLEY C
ALLEY D
ALLEY E
ALLEY F
ALLEY G
ALLEY H
ALLEY I
BLDG 1
BLDG 2
BLDG 3
BLDG 4
BLDG 5
BLDG 6
BLDG 7
BLDG 8
BLDG 9
BLDG 10
BLDG 11
BLDG 12
BLDG 13
BLDG 14
BLDG 15
BLDG 16
BLDG 17
BLDG 18
BLDG 19
BLDG 20
BLDG 21
BLDG 22
BLDG 23
BLDG 24
BLDG 25
BLDG 26
BLDG 27
BLDG 28
BLDG 29
BLDG 30
BLDG 31
BLDG 32
BMP 1
BMP 2
BMP 3
BMP
A-1 0.2
A-2 0.16
A-3 0.17
B-1 0.06
B-2 0.14
B-3 0.14
B-4 0.17
B-5 0.06
B-6 0.25
B-7 0.11
B-8 0.15
B-9 0.13
C-1 0.31
C-2 0.18
C-3 0.33
C-4 0.32
C-5 0.17
C-6 0.24
C-7 0.13
C-8 0.13
D-1 0.13
D-2 0.26
D-3 0.29
D-4 0.21
E-1 0.16
E-2 0.24
100 466.6
101 464.1 460.1
102 463.5 457.4
200 467.7
201 465.9 460.9
202 465.2 460.1
203 465.9 459.7
204 463.7 458.7
205 463.3 458.6
206 463.4 458.0
300 467.0
301 463.0
302 465.0
303 462.3
304 459.5 451.1
305 458.5 450.8
400 466.3
401 464.5 458.0
402 464.4 456.6
403 461.7 455.4
404 459.0 447.4
500 464
501 461
502 458.5 454.2
L=235'
L=275'
L=280'
L=255'
L=275'
L=100'
L=135'
L=150'
*L=240'
*L=350'
*L=170'
*L=25'
*L=90'
*L=120'
*L=45'
*L=165'
*L=180'
*L=265'
*L=255'
SD
AREA TO BE CONSTRUCTED AND DRAINED BY ADJACENT PROPERTY


N
40' 0' 20' 40'
SCALE: 1" = 40'


SAN JOAQUIN HILLS CORRIDOR
ALISO VIEJO PARKWAY
PACIFIC PARK DRIVE
ALISO CREEK ROAD
PARKWAY
ROAD
LA PAZ
ALICIA
LIBERTY
WOOD CANYON DRIVE
PURSUITS
PROJECT LOCATION

LEGEND

	MAJOR WATERSHED BOUNDARY
	MINOR WATERSHED BOUNDARY
	EXISTING RIGHT OF WAY
	PROPERTY BOUNDARY
L=270'	SURFACE FLOW PATH LENGTH
	SURFACE FLOW PATH
101	NODE NUMBER
781.0	FLOWLINE ELEVATION
*771.0	*INDICATES INVERT ELEVATION
A	SUBAREA DESIGNATION
0.64	SUBAREA ACREAGE
	DIRECTION OF SURFACE FLOW
*L=270'	STORM DRAIN LENGTH
	PROPOSED STORM DRAIN
	PROPOSED STORM DRAIN FLOW DIRECTION
	EXISTING STORM DRAIN

DRAINAGE SUMMARY

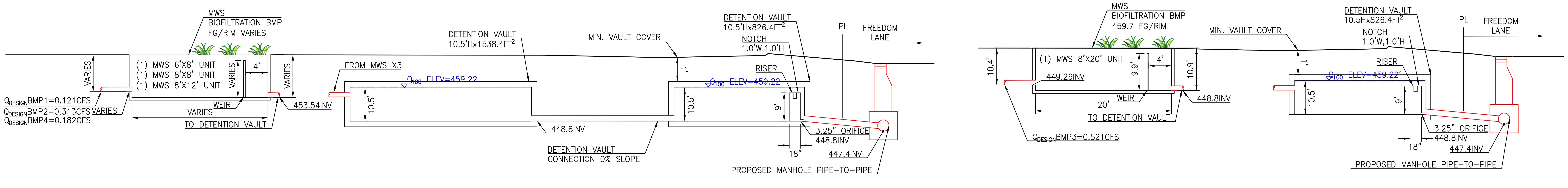
WATERSHED DESIGNATION	ACREAGE	25-YR STORM		100-YR STORM	
		RUNOFF (CFS)	T_C (MIN)	RUNOFF (CFS)	T_C (MIN)
A	0.53	1.98	7.3	2.55	7.2
B	1.21	4.50	7.1	5.82	6.9
C	1.81	5.94	8.4	7.65	8.3
D	0.89	2.64	10.1	3.42	9.9
TOTAL	4.44	13.8	7.3	18.4	7.2

EXISTING STREET RUNOFF

SUBAREA DESIGNATION	SUBAREA ACREAGE	100-YR STORM	
		TOTAL RUNOFF (CFS)	T_C (MIN)
E	0.4	1.6	9.0

NOTES

1. ENTIRE PROJECT SITE IS UNDERLAIN BY HYDROLOGIC SOILS GROUP D
2. EXISTING STREET RUNOFF (AREA E) IS EXCLUDED FROM THE ANALYSIS


MWS
BIOFILTRATION BMP
FG/RIM VARIES
(1) MWS 6'X8' UNIT
(1) MWS 8'X8' UNIT
(1) MWS 8'X12' UNIT
VARIES
4'
Q_{DESIGN}BMP1=0.121CFS
Q_{DESIGN}BMP2=0.313CFS
Q_{DESIGN}BMP4=0.182CFS
WEIR
TO DETENTION VAULT
453.54INV
FROM MWS X3
DETENTION VAULT
10.5'Hx1538.4FT^2
Q_{100} ELEV=459.22
10.5'
448.8INV
DETENTION VAULT CONNECTION 0% SLOPE
MIN. VAULT COVER
1'
DETENTION VAULT
10.5'Hx826.4FT^2
NOTCH
1.0'W,1.0'H
RISER
9'
3.25" ORIFICE
448.8INV
18"
447.4INV
PROPOSED MANHOLE PIPE-TO-PIPE
PL
FREEDOM LANE
MWS
BIOFILTRATION BMP
459.7 FG/RIM
(1) MWS 8'X20' UNIT
10.4'
9.9'
10.9'
449.26INV
20'
Q_{DESIGN}BMP3=0.521CFS
10.5Hx826.4FT^2
Q_{100} ELEV=459.22'

PROPOSED STORMWATER SYSTEM
N.T.S

FIGURE 2: PROPOSED CONDITION HYDROLOGY

TTM 19343
ALISO VIEJO, CA

X ENGINEERING & CONSULTING, INC.
6 Hutton Centre Drive, Suite 650
Santa Ana, California 92707
949.522.7100 | xengineeringinc.com

P:\117\011\Reports\Entitlement\Hydrology - Preliminary\Exhibits\117-011 Figure 2 Proposed Condition Hydrology.dwg Plotted At: October 23, 2025 1:30 PM Last Saved By: hana.aljassim Last Saved At: October 23, 2025 1:30 PM

APPENDIX B

```
                            Orange County Rational Hydrology Program

                        (Hydrology Manual Date(s) October 1986 & November 1996)

         CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2018 Version 9.0
                Rational Hydrology Study, Date: 10/23/25  File Name:
117011FreedomStreet100.roc
        ------------------------------------------------------------------------
        117-011 Freedom Lane
        Frontage Street Flow, 100-year storm
        2025-10-22 HA


        ------------------------------------------------------------------------


        Program License Serial Number 6440

        ------------------------------------------------------------------------
         *********   Hydrology Study Control Information **********

        ------------------------------------------------------------------------

        Rational hydrology study storm event year is   100.0

        Decimal fraction of study above 2000 ft., 600M  =     0.0000
        English Units Used for input data


        ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
        Process from Point/Station      500.000 to Point/Station      501.000
        **** INITIAL AREA EVALUATION ****
        ______________________________________________________________________
        COMMERCIAL subarea type
        Decimal fraction soil group A = 0.000
        Decimal fraction soil group B = 0.000
        Decimal fraction soil group C = 0.000
        Decimal fraction soil group D = 1.000
        SCS curve number for soil(AMC 2)  = 75.00
        Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
        Max Catchment Loss (Fm) =     0.020(In/Hr)
        Initial subarea data:
        Initial area flow distance =   235.000(Ft.)
        Top (of initial area) elevation =   464.000(Ft.)
        Bottom (of initial area) elevation =   461.000(Ft.)
        Difference in elevation =     3.000(Ft.)
        Slope =    0.01277  s(%)=       1.28
        TC = k(0.304)*[(length^3)/(elevation change)]^0.2
        Initial area time of concentration =    6.458 min.
```

```
Rainfall intensity =      5.344(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.897
Subarea runoff =      0.767(CFS)
Total initial stream area =       0.160(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      501.000 to Point/Station      502.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =   461.000(Ft.)
End of street segment elevation =   458.500(Ft.)
Length of street segment  =   280.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  22.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.025
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      1.218(CFS)
Depth of flow =   0.273(Ft.), Average velocity =   1.840(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   7.317(Ft.)
Flow velocity =   1.84(Ft/s)
Travel time =    2.54 min.     TC =    8.99  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Rainfall intensity =      4.420(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.896
Subarea runoff =      0.817(CFS) for    0.240(Ac.)
Total runoff =      1.584(CFS)  Total area =       0.40(Ac.)
Area averaged Fm value =    0.020(In/Hr)
Street flow at end of street =      1.584(CFS)
Half street flow at end of street =      1.584(CFS)
Depth of flow =   0.292(Ft.), Average velocity =   1.946(Ft/s)
```

```
Flow width (from curb towards crown)=   8.291(Ft.)
End of computations, total study area =            0.40 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged SCS curve number (AMC 2) =  75.0
```

```
                            Orange County Rational Hydrology Program

                        (Hydrology Manual Date(s) October 1986 & November 1996)

         CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2018 Version 9.0
                Rational Hydrology Study, Date: 10/14/25  File Name:
117011FreedomProp25v8.roc
        ------------------------------------------------------------------------
        117-007 Freedom Lane
        Proposed Condition
        25-year storm
        2025-10-14 HA
        ------------------------------------------------------------------------


        Program License Serial Number 6440

        ------------------------------------------------------------------------
         *********   Hydrology Study Control Information **********

        ------------------------------------------------------------------------

        Rational hydrology study storm event year is    25.0

        Decimal fraction of study above 2000 ft., 600M  =     0.0000
        English Units Used for input data


        ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
        Process from Point/Station      100.000 to Point/Station      101.000
        **** INITIAL AREA EVALUATION ****
        ______________________________________________________________________
        COMMERCIAL subarea type
        Decimal fraction soil group A = 0.000
        Decimal fraction soil group B = 0.000
        Decimal fraction soil group C = 0.000
        Decimal fraction soil group D = 1.000
        SCS curve number for soil(AMC 2)  = 75.00
        Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
        Max Catchment Loss (Fm) =     0.020(In/Hr)
        Initial subarea data:
        Initial area flow distance =   165.000(Ft.)
        Top (of initial area) elevation =   466.600(Ft.)
        Bottom (of initial area) elevation =   464.100(Ft.)
        Difference in elevation =     2.500(Ft.)
        Slope =    0.01515  s(%)=       1.52
        TC = k(0.304)*[(length^3)/(elevation change)]^0.2
        Initial area time of concentration =    5.417 min.
        Rainfall intensity =      4.610(In/Hr) for a    25.0 year storm
```

```
Effective runoff coefficient used for area (Q=KCIA) is C = 0.896
Subarea runoff =      0.826(CFS)
Total initial stream area =        0.200(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      101.000 to Point/Station      102.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   460.100(Ft.)
Downstream point/station elevation =   457.400(Ft.)
Pipe length  =   240.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.826(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     0.826(CFS)
Normal flow depth in pipe =    4.34(In.)
Flow top width inside pipe =    8.99(In.)
Critical Depth =    4.99(In.)
Pipe flow velocity =      3.91(Ft/s)
Travel time through pipe =    1.02 min.
Time of concentration (TC) =     6.44 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      102.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     6.44 min.
Rainfall intensity =      4.180(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.894
Subarea runoff =      0.519(CFS) for    0.160(Ac.)
Total runoff =      1.345(CFS)  Total area =        0.36(Ac.)
Area averaged Fm value =    0.029(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      102.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     6.44 min.
Rainfall intensity =      4.180(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.893
Subarea runoff =      0.633(CFS) for    0.170(Ac.)
Total runoff =      1.978(CFS)  Total area =        0.53(Ac.)
Area averaged Fm value =    0.032(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      404.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   457.400(Ft.)
Downstream point/station elevation =   447.400(Ft.)
Pipe length  =   350.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.978(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     1.978(CFS)
Normal flow depth in pipe =    5.59(In.)
Flow top width inside pipe =    8.73(In.)
Critical Depth =    7.67(In.)
Pipe flow velocity =      6.86(Ft/s)
Travel time through pipe =    0.85 min.
Time of concentration (TC) =     7.29 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      404.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      0.530(Ac.)
Runoff from this stream =      1.978(CFS)
Time of concentration =    7.29 min.
Rainfall intensity =     3.897(In/Hr)
Area averaged loss rate (Fm) =    0.0325(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1623
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      200.000 to Point/Station      201.000
```

```
**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   100.000(Ft.)
Top (of initial area) elevation =   467.700(Ft.)
Bottom (of initial area) elevation =   465.900(Ft.)
Difference in elevation =     1.800(Ft.)
Slope =    0.01800  s(%)=       1.80
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    4.284 min.
Rainfall intensity =      5.265(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.897
Subarea runoff =      0.283(CFS)
Total initial stream area =        0.060(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      201.000 to Point/Station      202.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation =   460.900(Ft.)
Downstream point/station elevation =   460.100(Ft.)
Pipe length  =   135.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.283(CFS)
Nearest computed pipe diameter  =      6.00(In.)
Calculated individual pipe flow  =     0.283(CFS)
Normal flow depth in pipe =    3.54(In.)
Flow top width inside pipe =    5.90(In.)
Critical Depth =    3.22(In.)
Pipe flow velocity =      2.35(Ft/s)
Travel time through pipe =    0.96 min.
Time of concentration (TC) =     5.24 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      202.000 to Point/Station      202.000
**** SUBAREA FLOW ADDITION ****

RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     5.24 min.
Rainfall intensity =      4.696(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.893
Subarea runoff =      0.556(CFS) for    0.140(Ac.)
Total runoff =      0.839(CFS)  Total area =       0.20(Ac.)
Area averaged Fm value =    0.034(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      202.000 to Point/Station      203.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   460.100(Ft.)
Downstream point/station elevation =   459.700(Ft.)
Pipe length  =    65.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.839(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     0.839(CFS)
Normal flow depth in pipe =    5.27(In.)
Flow top width inside pipe =    8.87(In.)
Critical Depth =    5.03(In.)
Pipe flow velocity =      3.12(Ft/s)
Travel time through pipe =    0.35 min.
Time of concentration (TC) =     5.59 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      203.000 to Point/Station      203.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Time of concentration =     5.59 min.
Rainfall intensity =      4.529(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.894
Subarea runoff =      0.538(CFS) for    0.140(Ac.)
Total runoff =      1.377(CFS)  Total area =       0.34(Ac.)
Area averaged Fm value =    0.028(In/Hr)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      203.000 to Point/Station      203.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     5.59 min.
Rainfall intensity =      4.529(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.894
Subarea runoff =      0.687(CFS) for    0.170(Ac.)
Total runoff =      2.064(CFS)  Total area =        0.51(Ac.)
Area averaged Fm value =    0.032(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      203.000 to Point/Station      204.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   459.700(Ft.)
Downstream point/station elevation =   458.700(Ft.)
Pipe length  =   170.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.064(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     2.064(CFS)
Normal flow depth in pipe =    7.79(In.)
Flow top width inside pipe =   11.45(In.)
Critical Depth =    7.36(In.)
Pipe flow velocity =      3.82(Ft/s)
Travel time through pipe =    0.74 min.
Time of concentration (TC) =     6.33 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      204.000 to Point/Station      204.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
```

```
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Time of concentration =     6.33 min.
Rainfall intensity =      4.221(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.893
Subarea runoff =      0.085(CFS) for    0.060(Ac.)
Total runoff =      2.149(CFS)  Total area =        0.57(Ac.)
Area averaged Fm value =    0.031(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      204.000 to Point/Station      204.000
**** SUBAREA FLOW ADDITION ****

______________________________________________________________________
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     6.33 min.
Rainfall intensity =      4.221(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.893
Subarea runoff =      0.941(CFS) for    0.250(Ac.)
Total runoff =      3.090(CFS)  Total area =        0.82(Ac.)
Area averaged Fm value =    0.034(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      204.000 to Point/Station      204.000
**** SUBAREA FLOW ADDITION ****

______________________________________________________________________
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     6.33 min.
Rainfall intensity =      4.221(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.893
Subarea runoff =      0.414(CFS) for    0.110(Ac.)
```

```
Total runoff =      3.504(CFS)  Total area =        0.93(Ac.)
Area averaged Fm value =    0.034(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      204.000 to Point/Station      205.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   458.700(Ft.)
Downstream point/station elevation =   458.600(Ft.)
Pipe length  =    25.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.504(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     3.504(CFS)
Normal flow depth in pipe =   10.70(In.)
Flow top width inside pipe =   13.57(In.)
Critical Depth =    9.06(In.)
Pipe flow velocity =      3.74(Ft/s)
Travel time through pipe =    0.11 min.
Time of concentration (TC) =     6.44 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      205.000 to Point/Station      205.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
PARK subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.170(In/Hr)
Time of concentration =     6.44 min.
Rainfall intensity =      4.179(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.889
Subarea runoff =      0.507(CFS) for    0.150(Ac.)
Total runoff =      4.011(CFS)  Total area =        1.08(Ac.)
Area averaged Fm value =    0.053(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      205.000 to Point/Station      205.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     6.44 min.
Rainfall intensity =      4.179(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.889
Subarea runoff =      0.484(CFS) for    0.130(Ac.)
Total runoff =      4.495(CFS)  Total area =        1.21(Ac.)
Area averaged Fm value =    0.052(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      205.000 to Point/Station      206.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   458.600(Ft.)
Downstream point/station elevation =   458.000(Ft.)
Pipe length  =    90.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.495(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     4.495(CFS)
Normal flow depth in pipe =   10.64(In.)
Flow top width inside pipe =   13.62(In.)
Critical Depth =   10.30(In.)
Pipe flow velocity =      4.83(Ft/s)
Travel time through pipe =    0.31 min.
Time of concentration (TC) =     6.75 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      206.000 to Point/Station      404.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   458.000(Ft.)
Downstream point/station elevation =   447.400(Ft.)
Pipe length  =   200.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.495(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     4.495(CFS)
Normal flow depth in pipe =    6.34(In.)
Flow top width inside pipe =   11.98(In.)
Critical Depth =   10.64(In.)
Pipe flow velocity =     10.68(Ft/s)
Travel time through pipe =    0.31 min.
Time of concentration (TC) =     7.06 min.
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      200.000 to Point/Station      404.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      1.210(Ac.)
Runoff from this stream =      4.495(CFS)
Time of concentration =    7.06 min.
Rainfall intensity =     3.967(In/Hr)
Area averaged loss rate (Fm) =    0.0518(In/Hr)
Area averaged Pervious ratio (Ap) = 0.2591
Program is now starting with Main Stream No. 3


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      300.000 to Point/Station      301.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   255.000(Ft.)
Top (of initial area) elevation =   467.000(Ft.)
Bottom (of initial area) elevation =   463.000(Ft.)
Difference in elevation =     4.000(Ft.)
Slope =    0.01569  s(%)=       1.57
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.403 min.
Rainfall intensity =      4.194(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.896
Subarea runoff =      1.164(CFS)
Total initial stream area =       0.310(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      301.000 to Point/Station      301.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
```

```
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     6.40 min.
Rainfall intensity =      4.194(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.894
Subarea runoff =      0.673(CFS) for    0.180(Ac.)
Total runoff =      1.837(CFS)  Total area =        0.49(Ac.)
Area averaged Fm value =    0.027(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      301.000 to Point/Station      305.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =   463.000(Ft.)
End of street segment elevation =   458.500(Ft.)
Length of street segment  =   275.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  24.000(Ft.)
Distance from crown to crossfall grade break  =  22.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   3.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      2.312(CFS)
Depth of flow =   0.298(Ft.), Average velocity =   2.678(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   8.584(Ft.)
Flow velocity =   2.68(Ft/s)
Travel time =    1.71 min.     TC =    8.11  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Rainfall intensity =      3.667(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.894
```

```
Subarea runoff =      0.851(CFS) for    0.330(Ac.)
Total runoff =      2.688(CFS)  Total area =        0.82(Ac.)
Area averaged Fm value =    0.024(In/Hr)
Street flow at end of street =      2.688(CFS)
Half street flow at end of street =      2.688(CFS)
Depth of flow =   0.310(Ft.), Average velocity =   2.769(Ft/s)
Flow width (from curb towards crown)=   9.189(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      305.000 to Point/Station      305.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     8.11 min.
Rainfall intensity =      3.667(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.893
Subarea runoff =      1.045(CFS) for    0.320(Ac.)
Total runoff =      3.733(CFS)  Total area =        1.14(Ac.)
Area averaged Fm value =    0.029(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      300.000 to Point/Station      305.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 3 in normal stream number 1
Stream flow area =      1.140(Ac.)
Runoff from this stream =      3.733(CFS)
Time of concentration =    8.11 min.
Rainfall intensity =     3.667(In/Hr)
Area averaged loss rate (Fm) =    0.0288(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1439


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      302.000 to Point/Station      303.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   275.000(Ft.)
Top (of initial area) elevation =   465.000(Ft.)
Bottom (of initial area) elevation =   462.300(Ft.)
Difference in elevation =     2.700(Ft.)
Slope =    0.00982  s(%)=       0.98
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.248 min.
Rainfall intensity =      3.910(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.895
Subarea runoff =      0.595(CFS)
Total initial stream area =       0.170(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      303.000 to Point/Station      303.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     7.25 min.
Rainfall intensity =      3.910(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.893
Subarea runoff =      0.836(CFS) for    0.240(Ac.)
Total runoff =      1.431(CFS)  Total area =       0.41(Ac.)
Area averaged Fm value =    0.032(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      303.000 to Point/Station      304.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =   462.300(Ft.)
End of street segment elevation =   459.500(Ft.)
Length of street segment  =   120.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  24.000(Ft.)
Distance from crown to crossfall grade break  =  22.000(Ft.)
```

```
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   3.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      1.658(CFS)
Depth of flow =   0.261(Ft.), Average velocity =   2.872(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   6.712(Ft.)
Flow velocity =   2.87(Ft/s)
Travel time =    0.70 min.     TC =    7.94  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Rainfall intensity =      3.712(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.893
Subarea runoff =      0.359(CFS) for    0.130(Ac.)
Total runoff =      1.790(CFS)  Total area =        0.54(Ac.)
Area averaged Fm value =    0.029(In/Hr)
Street flow at end of street =      1.790(CFS)
Half street flow at end of street =      1.790(CFS)
Depth of flow =   0.266(Ft.), Average velocity =   2.917(Ft/s)
Flow width (from curb towards crown)=   6.979(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      304.000 to Point/Station      304.000
**** SUBAREA FLOW ADDITION ****

RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     7.94 min.
```

```
Rainfall intensity =      3.712(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.892
Subarea runoff =      0.430(CFS) for    0.130(Ac.)
Total runoff =      2.219(CFS)  Total area =        0.67(Ac.)
Area averaged Fm value =    0.031(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      304.000 to Point/Station      305.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   451.100(Ft.)
Downstream point/station elevation =   450.800(Ft.)
Pipe length  =    25.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.219(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     2.219(CFS)
Normal flow depth in pipe =    6.48(In.)
Flow top width inside pipe =   11.96(In.)
Critical Depth =    7.64(In.)
Pipe flow velocity =      5.13(Ft/s)
Travel time through pipe =    0.08 min.
Time of concentration (TC) =     8.03 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      302.000 to Point/Station      305.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 3 in normal stream number 2
Stream flow area =      0.670(Ac.)
Runoff from this stream =      2.219(CFS)
Time of concentration =    8.03 min.
Rainfall intensity =     3.690(In/Hr)
Area averaged loss rate (Fm) =    0.0310(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1552
Summary of stream data:

Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
 No.    (Ac.)   (CFS)       (min) (In/Hr)     (In/Hr)


1      1.14     3.733      8.11    0.029      3.667
2      0.67     2.219      8.03    0.031      3.690
Qmax(1) =
           1.000 *    1.000 *     3.733) +
           0.994 *    1.000 *     2.219) + =       5.939
Qmax(2) =
           1.006 *    0.989 *     3.733) +
           1.000 *    1.000 *     2.219) + =       5.935

Total of 2 streams to confluence:
Flow rates before confluence point:
       3.733      2.219
Maximum flow rates at confluence using above data:
        5.939       5.935
Area of streams before confluence:
        1.140       0.670
Effective area values after confluence:
        1.810       1.797
Results of confluence:
Total flow rate =      5.939(CFS)
Time of concentration =     8.115 min.
Effective stream area after confluence =      1.810(Ac.)
Study area average Pervious fraction(Ap) =  0.148
Study area average soil loss rate(Fm) =    0.030(In/Hr)
Study area total (this main stream) =      1.81(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      305.000 to Point/Station      404.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   450.800(Ft.)
Downstream point/station elevation =   447.400(Ft.)
Pipe length  =   160.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     5.939(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     5.939(CFS)
Normal flow depth in pipe =    8.64(In.)
Flow top width inside pipe =   14.83(In.)
Critical Depth =   11.82(In.)
Pipe flow velocity =      8.11(Ft/s)
Travel time through pipe =    0.33 min.
Time of concentration (TC) =     8.44 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      300.000 to Point/Station      404.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 3
Stream flow area =      1.810(Ac.)
Runoff from this stream =      5.939(CFS)
Time of concentration =    8.44 min.
Rainfall intensity =     3.586(In/Hr)
Area averaged loss rate (Fm) =    0.0296(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1481
```

```
Program is now starting with Main Stream No. 4


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      400.000 to Point/Station      401.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Initial subarea data:
Initial area flow distance =   180.000(Ft.)
Top (of initial area) elevation =   466.300(Ft.)
Bottom (of initial area) elevation =   464.500(Ft.)
Difference in elevation =     1.800(Ft.)
Slope =    0.01000  s(%)=       1.00
TC = k(0.324)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.496 min.
Rainfall intensity =      4.159(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.891
Subarea runoff =      0.482(CFS)
Total initial stream area =       0.130(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      401.000 to Point/Station      402.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   458.000(Ft.)
Downstream point/station elevation =   456.600(Ft.)
Pipe length  =   265.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.482(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     0.482(CFS)
Normal flow depth in pipe =    3.96(In.)
Flow top width inside pipe =    8.94(In.)
Critical Depth =    3.75(In.)
Pipe flow velocity =      2.57(Ft/s)
Travel time through pipe =    1.72 min.
Time of concentration (TC) =     8.21 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      402.000 to Point/Station      402.000
**** SUBAREA FLOW ADDITION ****
```

```
----------------------------------------------------------------------
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     8.21 min.
Rainfall intensity =      3.642(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.890
Subarea runoff =     0.782(CFS) for    0.260(Ac.)
Total runoff =      1.264(CFS)  Total area =        0.39(Ac.)
Area averaged Fm value =    0.040(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      402.000 to Point/Station      403.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

----------------------------------------------------------------------
Upstream point/station elevation =   456.600(Ft.)
Downstream point/station elevation =   455.400(Ft.)
Pipe length  =   255.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.264(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     1.264(CFS)
Normal flow depth in pipe =    6.12(In.)
Flow top width inside pipe =   12.00(In.)
Critical Depth =    5.69(In.)
Pipe flow velocity =      3.14(Ft/s)
Travel time through pipe =    1.35 min.
Time of concentration (TC) =     9.57 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      403.000 to Point/Station      403.000
**** SUBAREA FLOW ADDITION ****

----------------------------------------------------------------------
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     9.57 min.
Rainfall intensity =      3.341(In/Hr) for a    25.0 year storm
```

```
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.889
Subarea runoff =      0.756(CFS) for    0.290(Ac.)
Total runoff =      2.020(CFS)  Total area =       0.68(Ac.)
Area averaged Fm value =    0.040(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      403.000 to Point/Station      403.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     9.57 min.
Rainfall intensity =      3.341(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.889
Subarea runoff =      0.624(CFS) for    0.210(Ac.)
Total runoff =      2.644(CFS)  Total area =       0.89(Ac.)
Area averaged Fm value =    0.040(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      403.000 to Point/Station      404.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   455.400(Ft.)
Downstream point/station elevation =   447.400(Ft.)
Pipe length  =   245.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.644(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     2.644(CFS)
Normal flow depth in pipe =    6.58(In.)
Flow top width inside pipe =    7.98(In.)
Critical Depth =    8.43(In.)
Pipe flow velocity =      7.64(Ft/s)
Travel time through pipe =    0.53 min.
Time of concentration (TC) =    10.10 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      400.000 to Point/Station      404.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
```

```
The following data inside Main Stream is listed:
In Main Stream number: 4
Stream flow area =      0.890(Ac.)
Runoff from this stream =      2.644(CFS)
Time of concentration =   10.10 min.
Rainfall intensity =     3.240(In/Hr)
Area averaged loss rate (Fm) =    0.0400(In/Hr)
Area averaged Pervious ratio (Ap) = 0.2000
Summary of stream data:

Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
 No.    (Ac.)   (CFS)       (min) (In/Hr)     (In/Hr)


1      0.53     1.978      7.29    0.032      3.897
2      1.21     4.495      7.06    0.052      3.967
3      1.81     5.939      8.44    0.030      3.586
4      0.89     2.644     10.10    0.040      3.240
Qmax(1) =
           1.000 *    1.000 *     1.978) +
           0.982 *    1.000 *     4.495) +
           1.087 *    0.863 *     5.939) +
           1.205 *    0.722 *     2.644) + =      14.268
Qmax(2) =
           1.018 *    0.969 *     1.978) +
           1.000 *    1.000 *     4.495) +
           1.107 *    0.837 *     5.939) +
           1.227 *    0.699 *     2.644) + =      14.217
Qmax(3) =
           0.920 *    1.000 *     1.978) +
           0.903 *    1.000 *     4.495) +
           1.000 *    1.000 *     5.939) +
           1.108 *    0.836 *     2.644) + =      14.264
Qmax(4) =
           0.830 *    1.000 *     1.978) +
           0.814 *    1.000 *     4.495) +
           0.903 *    1.000 *     5.939) +
           1.000 *    1.000 *     2.644) + =      13.307

Total of 4 main streams to confluence:
Flow rates before confluence point:
       2.978       5.495       6.939       3.644
Maximum flow rates at confluence using above data:
       14.268       14.217       14.264       13.307
Area of streams before confluence:
        0.530        1.210        1.810        0.890
Effective area values after confluence:
        3.945        3.860        4.294        4.440
```

```
Results of confluence:
Total flow rate =     14.268(CFS)
Time of concentration =     7.290 min.
Effective stream area after confluence  =      3.945(Ac.)
Study area average Pervious fraction(Ap) =  0.190
Study area average soil loss rate(Fm) =    0.038(In/Hr)
Study area total =       4.44(Ac.)
End of computations, total study area =            4.44 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.190
Area averaged SCS curve number (AMC 2) =  75.0
```

```
                          Orange County Rational Hydrology Program

                      (Hydrology Manual Date(s) October 1986 & November 1996)

         CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2018 Version 9.0
                Rational Hydrology Study, Date: 10/14/25  File Name:
117011FreedomProp100v8.roc
        ------------------------------------------------------------------------
        117-007 Freedom Lane
        Proposed Condition
        100-year storm
        2025-10-14 HA
        ------------------------------------------------------------------------


        Program License Serial Number 6440

        ------------------------------------------------------------------------
         *********   Hydrology Study Control Information **********

        ------------------------------------------------------------------------

        Rational hydrology study storm event year is   100.0

        Decimal fraction of study above 2000 ft., 600M  =     0.0000
        English Units Used for input data


        ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
        Process from Point/Station      100.000 to Point/Station      101.000
        **** INITIAL AREA EVALUATION ****
        ______________________________________________________________________
        COMMERCIAL subarea type
        Decimal fraction soil group A = 0.000
        Decimal fraction soil group B = 0.000
        Decimal fraction soil group C = 0.000
        Decimal fraction soil group D = 1.000
        SCS curve number for soil(AMC 2)  = 75.00
        Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
        Max Catchment Loss (Fm) =     0.020(In/Hr)
        Initial subarea data:
        Initial area flow distance =   165.000(Ft.)
        Top (of initial area) elevation =   466.600(Ft.)
        Bottom (of initial area) elevation =   464.100(Ft.)
        Difference in elevation =     2.500(Ft.)
        Slope =    0.01515  s(%)=       1.52
        TC = k(0.304)*[(length^3)/(elevation change)]^0.2
        Initial area time of concentration =    5.417 min.
        Rainfall intensity =      5.910(In/Hr) for a   100.0 year storm
```

```
Effective runoff coefficient used for area (Q=KCIA) is C = 0.897
Subarea runoff =      1.060(CFS)
Total initial stream area =        0.200(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      101.000 to Point/Station      102.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   460.100(Ft.)
Downstream point/station elevation =   457.400(Ft.)
Pipe length  =   240.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.060(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     1.060(CFS)
Normal flow depth in pipe =    5.05(In.)
Flow top width inside pipe =    8.93(In.)
Critical Depth =    5.67(In.)
Pipe flow velocity =      4.16(Ft/s)
Travel time through pipe =    0.96 min.
Time of concentration (TC) =     6.38 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      102.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     6.38 min.
Rainfall intensity =      5.381(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.895
Subarea runoff =      0.674(CFS) for    0.160(Ac.)
Total runoff =      1.734(CFS)  Total area =        0.36(Ac.)
Area averaged Fm value =    0.029(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      102.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     6.38 min.
Rainfall intensity =      5.381(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.895
Subarea runoff =      0.817(CFS) for    0.170(Ac.)
Total runoff =      2.551(CFS)  Total area =        0.53(Ac.)
Area averaged Fm value =    0.032(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      404.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation =   457.400(Ft.)
Downstream point/station elevation =   447.400(Ft.)
Pipe length  =   350.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.551(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     2.551(CFS)
Normal flow depth in pipe =    6.75(In.)
Flow top width inside pipe =    7.79(In.)
Critical Depth =    8.36(In.)
Pipe flow velocity =      7.17(Ft/s)
Travel time through pipe =    0.81 min.
Time of concentration (TC) =     7.19 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      404.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      0.530(Ac.)
Runoff from this stream =      2.551(CFS)
Time of concentration =    7.19 min.
Rainfall intensity =     5.024(In/Hr)
Area averaged loss rate (Fm) =    0.0325(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1623
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      200.000 to Point/Station      201.000
```

```
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   100.000(Ft.)
Top (of initial area) elevation =   467.700(Ft.)
Bottom (of initial area) elevation =   465.900(Ft.)
Difference in elevation =     1.800(Ft.)
Slope =    0.01800  s(%)=       1.80
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    4.284 min.
Rainfall intensity =      6.760(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.897
Subarea runoff =      0.364(CFS)
Total initial stream area =        0.060(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      201.000 to Point/Station      202.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   460.900(Ft.)
Downstream point/station elevation =   460.100(Ft.)
Pipe length  =   135.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.364(CFS)
Nearest computed pipe diameter  =      6.00(In.)
Calculated individual pipe flow  =     0.364(CFS)
Normal flow depth in pipe =    4.22(In.)
Flow top width inside pipe =    5.48(In.)
Critical Depth =    3.68(In.)
Pipe flow velocity =      2.47(Ft/s)
Travel time through pipe =    0.91 min.
Time of concentration (TC) =     5.20 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      202.000 to Point/Station      202.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     5.20 min.
Rainfall intensity =      6.052(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.895
Subarea runoff =      0.719(CFS) for    0.140(Ac.)
Total runoff =      1.083(CFS)  Total area =        0.20(Ac.)
Area averaged Fm value =    0.034(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      202.000 to Point/Station      203.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   460.100(Ft.)
Downstream point/station elevation =   459.700(Ft.)
Pipe length  =    65.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.083(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     1.083(CFS)
Normal flow depth in pipe =    6.29(In.)
Flow top width inside pipe =    8.26(In.)
Critical Depth =    5.74(In.)
Pipe flow velocity =      3.29(Ft/s)
Travel time through pipe =    0.33 min.
Time of concentration (TC) =     5.53 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      203.000 to Point/Station      203.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Time of concentration =     5.53 min.
Rainfall intensity =      5.843(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.896
Subarea runoff =      0.696(CFS) for    0.140(Ac.)
Total runoff =      1.779(CFS)  Total area =        0.34(Ac.)
Area averaged Fm value =    0.028(In/Hr)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      203.000 to Point/Station      203.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     5.53 min.
Rainfall intensity =      5.843(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.895
Subarea runoff =      0.888(CFS) for    0.170(Ac.)
Total runoff =      2.667(CFS)  Total area =        0.51(Ac.)
Area averaged Fm value =    0.032(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      203.000 to Point/Station      204.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   459.700(Ft.)
Downstream point/station elevation =   458.700(Ft.)
Pipe length  =   170.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.667(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     2.667(CFS)
Normal flow depth in pipe =    9.59(In.)
Flow top width inside pipe =    9.62(In.)
Critical Depth =    8.40(In.)
Pipe flow velocity =      3.97(Ft/s)
Travel time through pipe =    0.71 min.
Time of concentration (TC) =     6.24 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      204.000 to Point/Station      204.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
```

```
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Time of concentration =     6.24 min.
Rainfall intensity =      5.450(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.895
Subarea runoff =      0.113(CFS) for    0.060(Ac.)
Total runoff =      2.780(CFS)  Total area =       0.57(Ac.)
Area averaged Fm value =    0.031(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      204.000 to Point/Station      204.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     6.24 min.
Rainfall intensity =      5.450(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.894
Subarea runoff =      1.217(CFS) for    0.250(Ac.)
Total runoff =      3.997(CFS)  Total area =       0.82(Ac.)
Area averaged Fm value =    0.034(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      204.000 to Point/Station      204.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     6.24 min.
Rainfall intensity =      5.450(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.894
Subarea runoff =      0.536(CFS) for    0.110(Ac.)
```

```
Total runoff =      4.532(CFS)  Total area =        0.93(Ac.)
Area averaged Fm value =    0.034(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      204.000 to Point/Station      205.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   458.700(Ft.)
Downstream point/station elevation =   458.600(Ft.)
Pipe length  =    25.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.532(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     4.532(CFS)
Normal flow depth in pipe =   10.91(In.)
Flow top width inside pipe =   17.59(In.)
Critical Depth =    9.80(In.)
Pipe flow velocity =      4.05(Ft/s)
Travel time through pipe =    0.10 min.
Time of concentration (TC) =     6.34 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      205.000 to Point/Station      205.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
PARK subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.170(In/Hr)
Time of concentration =     6.34 min.
Rainfall intensity =      5.399(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.891
Subarea runoff =      0.663(CFS) for    0.150(Ac.)
Total runoff =      5.196(CFS)  Total area =        1.08(Ac.)
Area averaged Fm value =    0.053(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      205.000 to Point/Station      205.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     6.34 min.
Rainfall intensity =      5.399(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.891
Subarea runoff =      0.627(CFS) for    0.130(Ac.)
Total runoff =      5.823(CFS)  Total area =        1.21(Ac.)
Area averaged Fm value =    0.052(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      205.000 to Point/Station      206.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   458.600(Ft.)
Downstream point/station elevation =   458.000(Ft.)
Pipe length  =    90.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     5.823(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     5.823(CFS)
Normal flow depth in pipe =   10.87(In.)
Flow top width inside pipe =   17.61(In.)
Critical Depth =   11.18(In.)
Pipe flow velocity =      5.22(Ft/s)
Travel time through pipe =    0.29 min.
Time of concentration (TC) =     6.63 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      206.000 to Point/Station      404.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   458.000(Ft.)
Downstream point/station elevation =   447.400(Ft.)
Pipe length  =   200.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     5.823(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     5.823(CFS)
Normal flow depth in pipe =    7.47(In.)
Flow top width inside pipe =   11.64(In.)
Critical depth could not be calculated.
Pipe flow velocity =     11.33(Ft/s)
Travel time through pipe =    0.29 min.
Time of concentration (TC) =     6.92 min.
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      200.000 to Point/Station      404.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      1.210(Ac.)
Runoff from this stream =      5.823(CFS)
Time of concentration =    6.92 min.
Rainfall intensity =     5.134(In/Hr)
Area averaged loss rate (Fm) =    0.0518(In/Hr)
Area averaged Pervious ratio (Ap) = 0.2591
Program is now starting with Main Stream No. 3


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      300.000 to Point/Station      301.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   255.000(Ft.)
Top (of initial area) elevation =   467.000(Ft.)
Bottom (of initial area) elevation =   463.000(Ft.)
Difference in elevation =     4.000(Ft.)
Slope =    0.01569  s(%)=       1.57
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.403 min.
Rainfall intensity =      5.370(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.897
Subarea runoff =      1.493(CFS)
Total initial stream area =       0.310(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      301.000 to Point/Station      301.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
```

```
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     6.40 min.
Rainfall intensity =      5.370(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.895
Subarea runoff =      0.863(CFS) for    0.180(Ac.)
Total runoff =      2.356(CFS)  Total area =        0.49(Ac.)
Area averaged Fm value =    0.027(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      301.000 to Point/Station      305.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =   463.000(Ft.)
End of street segment elevation =   458.500(Ft.)
Length of street segment  =   275.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  24.000(Ft.)
Distance from crown to crossfall grade break  =  22.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   3.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      2.941(CFS)
Depth of flow =   0.318(Ft.), Average velocity =   2.825(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   9.561(Ft.)
Flow velocity =   2.83(Ft/s)
Travel time =    1.62 min.     TC =    8.03  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Rainfall intensity =      4.718(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.895
```

```
Subarea runoff =      1.108(CFS) for    0.330(Ac.)
Total runoff =      3.464(CFS)  Total area =        0.82(Ac.)
Area averaged Fm value =    0.024(In/Hr)
Street flow at end of street =      3.464(CFS)
Half street flow at end of street =      3.464(CFS)
Depth of flow =   0.332(Ft.), Average velocity =   2.933(Ft/s)
Flow width (from curb towards crown)=  10.269(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      305.000 to Point/Station      305.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     8.03 min.
Rainfall intensity =      4.718(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.895
Subarea runoff =      1.347(CFS) for    0.320(Ac.)
Total runoff =      4.811(CFS)  Total area =        1.14(Ac.)
Area averaged Fm value =    0.029(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      300.000 to Point/Station      305.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 3 in normal stream number 1
Stream flow area =      1.140(Ac.)
Runoff from this stream =      4.811(CFS)
Time of concentration =    8.03 min.
Rainfall intensity =     4.718(In/Hr)
Area averaged loss rate (Fm) =    0.0288(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1439


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      302.000 to Point/Station      303.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   275.000(Ft.)
Top (of initial area) elevation =   465.000(Ft.)
Bottom (of initial area) elevation =   462.300(Ft.)
Difference in elevation =     2.700(Ft.)
Slope =    0.00982  s(%)=       0.98
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.248 min.
Rainfall intensity =      5.002(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.896
Subarea runoff =      0.762(CFS)
Total initial stream area =       0.170(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      303.000 to Point/Station      303.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     7.25 min.
Rainfall intensity =      5.002(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.894
Subarea runoff =      1.072(CFS) for    0.240(Ac.)
Total runoff =      1.834(CFS)  Total area =       0.41(Ac.)
Area averaged Fm value =    0.032(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      303.000 to Point/Station      304.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =   462.300(Ft.)
End of street segment elevation =   459.500(Ft.)
Length of street segment  =   120.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  24.000(Ft.)
Distance from crown to crossfall grade break  =  22.000(Ft.)
```

```
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   3.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      2.095(CFS)
Depth of flow =   0.277(Ft.), Average velocity =   3.013(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   7.541(Ft.)
Flow velocity =   3.01(Ft/s)
Travel time =    0.66 min.     TC =    7.91  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Rainfall intensity =      4.757(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.895
Subarea runoff =      0.464(CFS) for    0.130(Ac.)
Total runoff =      2.298(CFS)  Total area =        0.54(Ac.)
Area averaged Fm value =    0.029(In/Hr)
Street flow at end of street =      2.298(CFS)
Half street flow at end of street =      2.298(CFS)
Depth of flow =   0.284(Ft.), Average velocity =   3.073(Ft/s)
Flow width (from curb towards crown)=   7.881(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      304.000 to Point/Station      304.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     7.91 min.
```

```
Rainfall intensity =      4.757(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.894
Subarea runoff =      0.552(CFS) for    0.130(Ac.)
Total runoff =      2.850(CFS)  Total area =       0.67(Ac.)
Area averaged Fm value =    0.031(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      304.000 to Point/Station      305.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   451.100(Ft.)
Downstream point/station elevation =   450.800(Ft.)
Pipe length  =    25.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.850(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     2.850(CFS)
Normal flow depth in pipe =    7.61(In.)
Flow top width inside pipe =   11.56(In.)
Critical Depth =    8.69(In.)
Pipe flow velocity =      5.42(Ft/s)
Travel time through pipe =    0.08 min.
Time of concentration (TC) =     7.99 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      302.000 to Point/Station      305.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 3 in normal stream number 2
Stream flow area =      0.670(Ac.)
Runoff from this stream =      2.850(CFS)
Time of concentration =    7.99 min.
Rainfall intensity =     4.730(In/Hr)
Area averaged loss rate (Fm) =    0.0310(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1552
Summary of stream data:

Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
 No.    (Ac.)   (CFS)       (min) (In/Hr)     (In/Hr)


1      1.14     4.811      8.03    0.029      4.718
2      0.67     2.850      7.99    0.031      4.730
Qmax(1) =
           1.000 *    1.000 *     4.811) +
           0.997 *    1.000 *     2.850) + =       7.653
Qmax(2) =
           1.003 *    0.995 *     4.811) +
           1.000 *    1.000 *     2.850) + =       7.651

Total of 2 streams to confluence:
Flow rates before confluence point:
       4.811       2.850
Maximum flow rates at confluence using above data:
        7.653       7.651
Area of streams before confluence:
        1.140       0.670
Effective area values after confluence:
        1.810       1.805
Results of confluence:
Total flow rate =      7.653(CFS)
Time of concentration =     8.025 min.
Effective stream area after confluence =      1.810(Ac.)
Study area average Pervious fraction(Ap) =  0.148
Study area average soil loss rate(Fm) =    0.030(In/Hr)
Study area total (this main stream) =      1.81(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      305.000 to Point/Station      404.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   450.800(Ft.)
Downstream point/station elevation =   447.400(Ft.)
Pipe length  =   160.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     7.653(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     7.653(CFS)
Normal flow depth in pipe =   10.27(In.)
Flow top width inside pipe =   13.94(In.)
Critical Depth =   13.17(In.)
Pipe flow velocity =      8.55(Ft/s)
Travel time through pipe =    0.31 min.
Time of concentration (TC) =     8.34 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      300.000 to Point/Station      404.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 3
Stream flow area =      1.810(Ac.)
Runoff from this stream =      7.653(CFS)
Time of concentration =    8.34 min.
Rainfall intensity =     4.616(In/Hr)
Area averaged loss rate (Fm) =    0.0296(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1481
```

```
Program is now starting with Main Stream No. 4


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      400.000 to Point/Station      401.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Initial subarea data:
Initial area flow distance =   180.000(Ft.)
Top (of initial area) elevation =   466.300(Ft.)
Bottom (of initial area) elevation =   464.500(Ft.)
Difference in elevation =     1.800(Ft.)
Slope =    0.01000  s(%)=       1.00
TC = k(0.324)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.496 min.
Rainfall intensity =      5.325(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff =      0.618(CFS)
Total initial stream area =       0.130(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      401.000 to Point/Station      402.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   458.000(Ft.)
Downstream point/station elevation =   456.600(Ft.)
Pipe length  =   265.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.618(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     0.618(CFS)
Normal flow depth in pipe =    4.58(In.)
Flow top width inside pipe =    9.00(In.)
Critical Depth =    4.28(In.)
Pipe flow velocity =      2.74(Ft/s)
Travel time through pipe =    1.61 min.
Time of concentration (TC) =     8.11 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      402.000 to Point/Station      402.000
**** SUBAREA FLOW ADDITION ****
```

```
________________________________________________________________________
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     8.11 min.
Rainfall intensity =      4.690(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.892
Subarea runoff =      1.014(CFS) for    0.260(Ac.)
Total runoff =      1.632(CFS)  Total area =       0.39(Ac.)
Area averaged Fm value =    0.040(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      402.000 to Point/Station      403.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   456.600(Ft.)
Downstream point/station elevation =   455.400(Ft.)
Pipe length  =   255.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.632(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     1.632(CFS)
Normal flow depth in pipe =    7.17(In.)
Flow top width inside pipe =   11.77(In.)
Critical Depth =    6.52(In.)
Pipe flow velocity =      3.33(Ft/s)
Travel time through pipe =    1.28 min.
Time of concentration (TC) =     9.38 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      403.000 to Point/Station      403.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     9.38 min.
Rainfall intensity =      4.314(In/Hr) for a   100.0 year storm
```

```
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.892
Subarea runoff =      0.983(CFS) for    0.290(Ac.)
Total runoff =      2.616(CFS)  Total area =       0.68(Ac.)
Area averaged Fm value =    0.040(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      403.000 to Point/Station      403.000
**** SUBAREA FLOW ADDITION ****

RESIDENTIAL(11+ dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.2000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.040(In/Hr)
Time of concentration =     9.38 min.
Rainfall intensity =      4.314(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.892
Subarea runoff =      0.808(CFS) for    0.210(Ac.)
Total runoff =      3.423(CFS)  Total area =       0.89(Ac.)
Area averaged Fm value =    0.040(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      403.000 to Point/Station      404.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation =   455.400(Ft.)
Downstream point/station elevation =   447.400(Ft.)
Pipe length  =   245.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.423(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     3.423(CFS)
Normal flow depth in pipe =    6.22(In.)
Flow top width inside pipe =   11.99(In.)
Critical Depth =    9.50(In.)
Pipe flow velocity =      8.32(Ft/s)
Travel time through pipe =    0.49 min.
Time of concentration (TC) =     9.87 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      400.000 to Point/Station      404.000
**** CONFLUENCE OF MAIN STREAMS ****
```

```
The following data inside Main Stream is listed:
In Main Stream number: 4
Stream flow area =      0.890(Ac.)
Runoff from this stream =      3.423(CFS)
Time of concentration =    9.87 min.
Rainfall intensity =     4.190(In/Hr)
Area averaged loss rate (Fm) =    0.0400(In/Hr)
Area averaged Pervious ratio (Ap) = 0.2000
Summary of stream data:

Stream  Area  Flow rate      TC     Fm       Rainfall Intensity
 No.    (Ac.)   (CFS)       (min) (In/Hr)     (In/Hr)



1      0.53     2.551      7.19    0.032      5.024
2      1.21     5.823      6.92    0.052      5.134
3      1.81     7.653      8.34    0.030      4.616
4      0.89     3.423      9.87    0.040      4.190
Qmax(1) =
           1.000 *    1.000 *     2.551) +
           0.978 *    1.000 *     5.823) +
           1.089 *    0.863 *     7.653) +
           1.201 *    0.728 *     3.423) + =      18.432
Qmax(2) =
           1.022 *    0.963 *     2.551) +
           1.000 *    1.000 *     5.823) +
           1.113 *    0.831 *     7.653) +
           1.228 *    0.701 *     3.423) + =      18.355
Qmax(3) =
           0.918 *    1.000 *     2.551) +
           0.898 *    1.000 *     5.823) +
           1.000 *    1.000 *     7.653) +
           1.103 *    0.844 *     3.423) + =      18.413
Qmax(4) =
           0.833 *    1.000 *     2.551) +
           0.814 *    1.000 *     5.823) +
           0.907 *    1.000 *     7.653) +
           1.000 *    1.000 *     3.423) + =      17.231

Total of 4 main streams to confluence:
Flow rates before confluence point:
       3.551       6.823       8.653       4.423
Maximum flow rates at confluence using above data:
       18.432       18.355       18.413       17.231
Area of streams before confluence:
        0.530        1.210        1.810        0.890
Effective area values after confluence:
        3.950        3.848        4.302        4.440
```

```
Results of confluence:
Total flow rate =     18.432(CFS)
Time of concentration =     7.192 min.
Effective stream area after confluence  =      3.950(Ac.)
Study area average Pervious fraction(Ap) =  0.190
Study area average soil loss rate(Fm) =    0.038(In/Hr)
Study area total =      4.44(Ac.)
End of computations, total study area =           4.44 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.190
Area averaged SCS curve number (AMC 2) =  75.0
```

```
        U n i t   H y d r o g r a p h   A n a l y s i s

Copyright (c) CIVILCADD/CIVILDESIGN, 1989-2018, Version 9.0

        Study date  10/14/25   File Name 117011FreedomUH100yr1.out


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
------------------------------------------------------------------------

Orange County Unit Hydrograph Hydrology Method
Manual Date(s) - October 1986, November 1996


Program License Serial Number 6440

---------------------------------------------------------------------
117-011 Freedom Lane
100-year storm, Unit Hydrograph
Proposed Condition
2025-10-13 HA
--------------------------------------------------------------------

        Storm Event Year = 100

        Antecedent Moisture Condition = 3

 English (in-lb) Input Units Used
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

******** Area-averaged max loss rate, Fm ********


SCS curve  Area       Area       Soil     Fp      Ap      Fm
No.(AMCII) (Ac.)    Fraction     Group  (In/Hr)   (dec.)    (In/Hr)
 75.0       4.4         1.00     D     0.200     0.250    0.050

Area-averaged adjusted loss rate Fm (In/Hr) =  0.050

********* Area-Averaged low loss rate fraction, Yb **********

Area       Area          SCS CN    SCS CN      S     Pervious
 (Ac.)      Fract         (AMC2)    (AMC3)           Yield Fr
    1.11   0.250         75.0      91.0       0.99     0.816
    3.33   0.750         98.0      98.0       0.20     0.958

Area-averaged catchment yield fraction, Y =  0.922
Area-averaged low loss fraction, Yb =  0.078
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Direct entry of lag time by user
Watershed area =       4.44(Ac.)
Catchment Lag time =   0.120 hours
Unit interval =   5.000 minutes
Unit interval percentage of lag time = 69.4444
Hydrograph baseflow =     0.00(CFS)
Average maximum watershed loss rate(Fm) =  0.050(In/Hr)
Average low loss rate fraction (Yb) = 0.078 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall =  0.520(In)
Computed peak 30-minute rainfall =  1.090(In)
Specified peak 1-hour rainfall =  1.450(In)
Computed peak 3-hour rainfall =  2.430(In)
Specified peak 6-hour rainfall =  3.360(In)
Specified peak 24-hour rainfall =  5.630(In)


Rainfall depth area reduction factors:
Using a total area of       4.44(Ac.) (Ref: fig. E-4)

5-minute factor = 1.000     Adjusted rainfall =  0.520(In)
30-minute factor = 1.000    Adjusted rainfall =  1.090(In)
1-hour factor = 1.000       Adjusted rainfall =  1.450(In)
3-hour factor = 1.000       Adjusted rainfall =  2.430(In)
6-hour factor = 1.000       Adjusted rainfall =  3.360(In)
24-hour factor = 1.000  Adjusted rainfall =  5.630(In)
---------------------------------------------------------------------

                        U n i t  H y d r o g r a p h
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Interval          'S' Graph          Unit Hydrograph
Number            Mean values             ((CFS))
---------------------------------------------------------------------
                (K =        53.70 (CFS))

  1               8.644                  4.641
  2              52.860                 23.742
  3              88.970                 19.390
  4              97.834                  4.760
  5              99.420                  0.852
  6             100.000                  0.311
---------------------------------------------------------------------
Peak Unit   Adjusted mass rainfall  Unit rainfall
Number              (In)                (In)
  1             0.5199              0.5199
  2             0.6922              0.1723
  3             0.8185              0.1262
  4             0.9217              0.1033
  5             1.0107              0.0890
  6             1.0898              0.0791
```

7	1.1612	0.0714
8	1.2268	0.0656
9	1.2878	0.0610
10	1.3449	0.0571
11	1.3987	0.0538
12	1.4497	0.0510
13	1.5053	0.0556
14	1.5587	0.0534
15	1.6101	0.0514
16	1.6597	0.0496
17	1.7076	0.0480
18	1.7541	0.0465
19	1.7993	0.0452
20	1.8432	0.0439
21	1.8860	0.0428
22	1.9277	0.0417
23	1.9684	0.0407
24	2.0082	0.0398
25	2.0471	0.0389
26	2.0852	0.0381
27	2.1225	0.0373
28	2.1591	0.0366
29	2.1951	0.0359
30	2.2303	0.0353
31	2.2650	0.0346
32	2.2990	0.0341
33	2.3325	0.0335
34	2.3655	0.0330
35	2.3980	0.0325
36	2.4299	0.0320
37	2.4613	0.0313
38	2.4921	0.0309
39	2.5226	0.0304
40	2.5526	0.0300
41	2.5823	0.0296
42	2.6115	0.0293
43	2.6404	0.0289
44	2.6689	0.0285
45	2.6971	0.0282
46	2.7250	0.0279
47	2.7525	0.0275
48	2.7798	0.0272
49	2.8067	0.0269
50	2.8333	0.0266
51	2.8597	0.0264
52	2.8857	0.0261
53	2.9116	0.0258
54	2.9371	0.0256
55	2.9624	0.0253
56	2.9875	0.0251

57	3.0123	0.0248
58	3.0369	0.0246
59	3.0613	0.0244
60	3.0854	0.0241
61	3.1094	0.0239
62	3.1331	0.0237
63	3.1566	0.0235
64	3.1799	0.0233
65	3.2031	0.0231
66	3.2260	0.0229
67	3.2488	0.0228
68	3.2714	0.0226
69	3.2938	0.0224
70	3.3160	0.0222
71	3.3381	0.0221
72	3.3600	0.0219
73	3.3773	0.0173
74	3.3944	0.0172
75	3.4114	0.0170
76	3.4283	0.0169
77	3.4450	0.0167
78	3.4616	0.0166
79	3.4781	0.0165
80	3.4944	0.0163
81	3.5106	0.0162
82	3.5267	0.0161
83	3.5426	0.0160
84	3.5584	0.0158
85	3.5742	0.0157
86	3.5898	0.0156
87	3.6052	0.0155
88	3.6206	0.0154
89	3.6359	0.0153
90	3.6510	0.0152
91	3.6661	0.0151
92	3.6810	0.0149
93	3.6959	0.0148
94	3.7106	0.0147
95	3.7253	0.0146
96	3.7398	0.0146
97	3.7543	0.0145
98	3.7687	0.0144
99	3.7829	0.0143
100	3.7971	0.0142
101	3.8112	0.0141
102	3.8252	0.0140
103	3.8391	0.0139
104	3.8530	0.0138
105	3.8667	0.0138
106	3.8804	0.0137

107	3.8940	0.0136
108	3.9075	0.0135
109	3.9209	0.0134
110	3.9343	0.0134
111	3.9476	0.0133
112	3.9608	0.0132
113	3.9739	0.0131
114	3.9870	0.0131
115	4.0000	0.0130
116	4.0129	0.0129
117	4.0257	0.0128
118	4.0385	0.0128
119	4.0512	0.0127
120	4.0638	0.0126
121	4.0764	0.0126
122	4.0889	0.0125
123	4.1014	0.0124
124	4.1138	0.0124
125	4.1261	0.0123
126	4.1383	0.0123
127	4.1505	0.0122
128	4.1627	0.0121
129	4.1748	0.0121
130	4.1868	0.0120
131	4.1987	0.0120
132	4.2107	0.0119
133	4.2225	0.0118
134	4.2343	0.0118
135	4.2460	0.0117
136	4.2577	0.0117
137	4.2693	0.0116
138	4.2809	0.0116
139	4.2924	0.0115
140	4.3039	0.0115
141	4.3153	0.0114
142	4.3267	0.0114
143	4.3380	0.0113
144	4.3493	0.0113
145	4.3605	0.0112
146	4.3717	0.0112
147	4.3828	0.0111
148	4.3939	0.0111
149	4.4049	0.0110
150	4.4159	0.0110
151	4.4269	0.0109
152	4.4377	0.0109
153	4.4486	0.0108
154	4.4594	0.0108
155	4.4702	0.0108
156	4.4809	0.0107

157	4.4916	0.0107
158	4.5022	0.0106
159	4.5128	0.0106
160	4.5233	0.0105
161	4.5338	0.0105
162	4.5443	0.0105
163	4.5547	0.0104
164	4.5651	0.0104
165	4.5754	0.0103
166	4.5857	0.0103
167	4.5960	0.0103
168	4.6062	0.0102
169	4.6164	0.0102
170	4.6266	0.0102
171	4.6367	0.0101
172	4.6468	0.0101
173	4.6568	0.0100
174	4.6668	0.0100
175	4.6768	0.0100
176	4.6867	0.0099
177	4.6966	0.0099
178	4.7065	0.0099
179	4.7163	0.0098
180	4.7261	0.0098
181	4.7359	0.0098
182	4.7456	0.0097
183	4.7553	0.0097
184	4.7649	0.0097
185	4.7746	0.0096
186	4.7842	0.0096
187	4.7937	0.0096
188	4.8032	0.0095
189	4.8127	0.0095
190	4.8222	0.0095
191	4.8316	0.0094
192	4.8411	0.0094
193	4.8504	0.0094
194	4.8598	0.0093
195	4.8691	0.0093
196	4.8784	0.0093
197	4.8876	0.0093
198	4.8968	0.0092
199	4.9060	0.0092
200	4.9152	0.0092
201	4.9243	0.0091
202	4.9334	0.0091
203	4.9425	0.0091
204	4.9516	0.0091
205	4.9606	0.0090
206	4.9696	0.0090

207	4.9786	0.0090
208	4.9875	0.0089
209	4.9964	0.0089
210	5.0053	0.0089
211	5.0142	0.0089
212	5.0230	0.0088
213	5.0318	0.0088
214	5.0406	0.0088
215	5.0494	0.0088
216	5.0581	0.0087
217	5.0668	0.0087
218	5.0755	0.0087
219	5.0841	0.0087
220	5.0928	0.0086
221	5.1014	0.0086
222	5.1099	0.0086
223	5.1185	0.0086
224	5.1270	0.0085
225	5.1356	0.0085
226	5.1440	0.0085
227	5.1525	0.0085
228	5.1609	0.0084
229	5.1694	0.0084
230	5.1778	0.0084
231	5.1861	0.0084
232	5.1945	0.0083
233	5.2028	0.0083
234	5.2111	0.0083
235	5.2194	0.0083
236	5.2276	0.0083
237	5.2359	0.0082
238	5.2441	0.0082
239	5.2523	0.0082
240	5.2605	0.0082
241	5.2686	0.0082
242	5.2767	0.0081
243	5.2848	0.0081
244	5.2929	0.0081
245	5.3010	0.0081
246	5.3090	0.0080
247	5.3171	0.0080
248	5.3251	0.0080
249	5.3331	0.0080
250	5.3410	0.0080
251	5.3490	0.0079
252	5.3569	0.0079
253	5.3648	0.0079
254	5.3727	0.0079
255	5.3806	0.0079
256	5.3884	0.0078

```
257              5.3962         0.0078
258              5.4040         0.0078
259              5.4118         0.0078
260              5.4196         0.0078
261              5.4273         0.0078
262              5.4351         0.0077
263              5.4428         0.0077
264              5.4505         0.0077
265              5.4582         0.0077
266              5.4658         0.0077
267              5.4735         0.0076
268              5.4811         0.0076
269              5.4887         0.0076
270              5.4963         0.0076
271              5.5039         0.0076
272              5.5114         0.0076
273              5.5190         0.0075
274              5.5265         0.0075
275              5.5340         0.0075
276              5.5415         0.0075
277              5.5489         0.0075
278              5.5564         0.0075
279              5.5638         0.0074
280              5.5712         0.0074
281              5.5786         0.0074
282              5.5860         0.0074
283              5.5934         0.0074
284              5.6007         0.0074
285              5.6081         0.0073
286              5.6154         0.0073
287              5.6227         0.0073
288              5.6300         0.0073
----------------------------------------------------------------------
Unit              Unit            Unit              Effective
Period            Rainfall        Soil-Loss         Rainfall
(number)            (In)          (In)                 (In)
----------------------------------------------------------------------
  1              0.0073           0.0006              0.0067
  2              0.0073           0.0006              0.0067
  3              0.0073           0.0006              0.0068
  4              0.0074           0.0006              0.0068
  5              0.0074           0.0006              0.0068
  6              0.0074           0.0006              0.0068
  7              0.0074           0.0006              0.0069
  8              0.0075           0.0006              0.0069
  9              0.0075           0.0006              0.0069
 10              0.0075           0.0006              0.0069
 11              0.0075           0.0006              0.0070
 12              0.0076           0.0006              0.0070
 13              0.0076           0.0006              0.0070
```

14	0.0076	0.0006	0.0070
15	0.0076	0.0006	0.0070
16	0.0077	0.0006	0.0071
17	0.0077	0.0006	0.0071
18	0.0077	0.0006	0.0071
19	0.0078	0.0006	0.0072
20	0.0078	0.0006	0.0072
21	0.0078	0.0006	0.0072
22	0.0078	0.0006	0.0072
23	0.0079	0.0006	0.0073
24	0.0079	0.0006	0.0073
25	0.0079	0.0006	0.0073
26	0.0079	0.0006	0.0073
27	0.0080	0.0006	0.0074
28	0.0080	0.0006	0.0074
29	0.0080	0.0006	0.0074
30	0.0081	0.0006	0.0074
31	0.0081	0.0006	0.0075
32	0.0081	0.0006	0.0075
33	0.0082	0.0006	0.0075
34	0.0082	0.0006	0.0076
35	0.0082	0.0006	0.0076
36	0.0083	0.0006	0.0076
37	0.0083	0.0006	0.0077
38	0.0083	0.0006	0.0077
39	0.0084	0.0006	0.0077
40	0.0084	0.0007	0.0077
41	0.0084	0.0007	0.0078
42	0.0085	0.0007	0.0078
43	0.0085	0.0007	0.0079
44	0.0085	0.0007	0.0079
45	0.0086	0.0007	0.0079
46	0.0086	0.0007	0.0079
47	0.0087	0.0007	0.0080
48	0.0087	0.0007	0.0080
49	0.0087	0.0007	0.0081
50	0.0088	0.0007	0.0081
51	0.0088	0.0007	0.0081
52	0.0088	0.0007	0.0081
53	0.0089	0.0007	0.0082
54	0.0089	0.0007	0.0082
55	0.0090	0.0007	0.0083
56	0.0090	0.0007	0.0083
57	0.0091	0.0007	0.0083
58	0.0091	0.0007	0.0084
59	0.0091	0.0007	0.0084
60	0.0092	0.0007	0.0085
61	0.0092	0.0007	0.0085
62	0.0093	0.0007	0.0085
63	0.0093	0.0007	0.0086

64	0.0093	0.0007	0.0086
65	0.0094	0.0007	0.0087
66	0.0094	0.0007	0.0087
67	0.0095	0.0007	0.0088
68	0.0095	0.0007	0.0088
69	0.0096	0.0007	0.0088
70	0.0096	0.0007	0.0089
71	0.0097	0.0008	0.0089
72	0.0097	0.0008	0.0090
73	0.0098	0.0008	0.0090
74	0.0098	0.0008	0.0091
75	0.0099	0.0008	0.0091
76	0.0099	0.0008	0.0092
77	0.0100	0.0008	0.0092
78	0.0100	0.0008	0.0093
79	0.0101	0.0008	0.0093
80	0.0102	0.0008	0.0094
81	0.0102	0.0008	0.0094
82	0.0103	0.0008	0.0095
83	0.0103	0.0008	0.0095
84	0.0104	0.0008	0.0096
85	0.0105	0.0008	0.0097
86	0.0105	0.0008	0.0097
87	0.0106	0.0008	0.0098
88	0.0106	0.0008	0.0098
89	0.0107	0.0008	0.0099
90	0.0108	0.0008	0.0099
91	0.0108	0.0008	0.0100
92	0.0109	0.0008	0.0100
93	0.0110	0.0009	0.0101
94	0.0110	0.0009	0.0102
95	0.0111	0.0009	0.0103
96	0.0112	0.0009	0.0103
97	0.0113	0.0009	0.0104
98	0.0113	0.0009	0.0104
99	0.0114	0.0009	0.0105
100	0.0115	0.0009	0.0106
101	0.0116	0.0009	0.0107
102	0.0116	0.0009	0.0107
103	0.0117	0.0009	0.0108
104	0.0118	0.0009	0.0109
105	0.0119	0.0009	0.0110
106	0.0120	0.0009	0.0110
107	0.0121	0.0009	0.0111
108	0.0121	0.0009	0.0112
109	0.0123	0.0010	0.0113
110	0.0123	0.0010	0.0114
111	0.0124	0.0010	0.0115
112	0.0125	0.0010	0.0115
113	0.0126	0.0010	0.0117

114	0.0127	0.0010	0.0117
115	0.0128	0.0010	0.0118
116	0.0129	0.0010	0.0119
117	0.0131	0.0010	0.0120
118	0.0131	0.0010	0.0121
119	0.0133	0.0010	0.0122
120	0.0134	0.0010	0.0123
121	0.0135	0.0010	0.0125
122	0.0136	0.0011	0.0125
123	0.0138	0.0011	0.0127
124	0.0138	0.0011	0.0128
125	0.0140	0.0011	0.0129
126	0.0141	0.0011	0.0130
127	0.0143	0.0011	0.0132
128	0.0144	0.0011	0.0133
129	0.0146	0.0011	0.0134
130	0.0146	0.0011	0.0135
131	0.0148	0.0012	0.0137
132	0.0149	0.0012	0.0138
133	0.0152	0.0012	0.0140
134	0.0153	0.0012	0.0141
135	0.0155	0.0012	0.0143
136	0.0156	0.0012	0.0144
137	0.0158	0.0012	0.0146
138	0.0160	0.0012	0.0147
139	0.0162	0.0013	0.0149
140	0.0163	0.0013	0.0151
141	0.0166	0.0013	0.0153
142	0.0167	0.0013	0.0154
143	0.0170	0.0013	0.0157
144	0.0172	0.0013	0.0158
145	0.0219	0.0017	0.0202
146	0.0221	0.0017	0.0204
147	0.0224	0.0017	0.0207
148	0.0226	0.0018	0.0208
149	0.0229	0.0018	0.0212
150	0.0231	0.0018	0.0213
151	0.0235	0.0018	0.0217
152	0.0237	0.0018	0.0219
153	0.0241	0.0019	0.0223
154	0.0244	0.0019	0.0225
155	0.0248	0.0019	0.0229
156	0.0251	0.0019	0.0231
157	0.0256	0.0020	0.0236
158	0.0258	0.0020	0.0238
159	0.0264	0.0020	0.0243
160	0.0266	0.0021	0.0246
161	0.0272	0.0021	0.0251
162	0.0275	0.0021	0.0254
163	0.0282	0.0022	0.0260

164	0.0285	0.0022	0.0263
165	0.0293	0.0023	0.0270
166	0.0296	0.0023	0.0273
167	0.0304	0.0024	0.0281
168	0.0309	0.0024	0.0285
169	0.0320	0.0025	0.0295
170	0.0325	0.0025	0.0299
171	0.0335	0.0026	0.0309
172	0.0341	0.0026	0.0314
173	0.0353	0.0027	0.0325
174	0.0359	0.0028	0.0331
175	0.0373	0.0029	0.0344
176	0.0381	0.0030	0.0351
177	0.0398	0.0031	0.0367
178	0.0407	0.0032	0.0376
179	0.0428	0.0033	0.0395
180	0.0439	0.0034	0.0405
181	0.0465	0.0036	0.0429
182	0.0480	0.0037	0.0443
183	0.0514	0.0040	0.0474
184	0.0534	0.0041	0.0492
185	0.0510	0.0040	0.0471
186	0.0538	0.0042	0.0497
187	0.0610	0.0042	0.0568
188	0.0656	0.0042	0.0615
189	0.0791	0.0042	0.0749
190	0.0890	0.0042	0.0848
191	0.1262	0.0042	0.1220
192	0.1723	0.0042	0.1682
193	0.5199	0.0042	0.5157
194	0.1033	0.0042	0.0991
195	0.0714	0.0042	0.0672
196	0.0571	0.0042	0.0529
197	0.0556	0.0042	0.0514
198	0.0496	0.0038	0.0458
199	0.0452	0.0035	0.0417
200	0.0417	0.0032	0.0385
201	0.0389	0.0030	0.0359
202	0.0366	0.0028	0.0338
203	0.0346	0.0027	0.0320
204	0.0330	0.0026	0.0304
205	0.0313	0.0024	0.0289
206	0.0300	0.0023	0.0277
207	0.0289	0.0022	0.0266
208	0.0279	0.0022	0.0257
209	0.0269	0.0021	0.0248
210	0.0261	0.0020	0.0241
211	0.0253	0.0020	0.0233
212	0.0246	0.0019	0.0227
213	0.0239	0.0019	0.0221

214	0.0233	0.0018	0.0215
215	0.0228	0.0018	0.0210
216	0.0222	0.0017	0.0205
217	0.0173	0.0013	0.0160
218	0.0169	0.0013	0.0156
219	0.0165	0.0013	0.0152
220	0.0161	0.0012	0.0148
221	0.0157	0.0012	0.0145
222	0.0154	0.0012	0.0142
223	0.0151	0.0012	0.0139
224	0.0147	0.0011	0.0136
225	0.0145	0.0011	0.0133
226	0.0142	0.0011	0.0131
227	0.0139	0.0011	0.0128
228	0.0137	0.0011	0.0126
229	0.0134	0.0010	0.0124
230	0.0132	0.0010	0.0122
231	0.0130	0.0010	0.0120
232	0.0128	0.0010	0.0118
233	0.0126	0.0010	0.0116
234	0.0124	0.0010	0.0114
235	0.0122	0.0009	0.0113
236	0.0120	0.0009	0.0111
237	0.0118	0.0009	0.0109
238	0.0117	0.0009	0.0108
239	0.0115	0.0009	0.0106
240	0.0114	0.0009	0.0105
241	0.0112	0.0009	0.0104
242	0.0111	0.0009	0.0102
243	0.0109	0.0008	0.0101
244	0.0108	0.0008	0.0100
245	0.0107	0.0008	0.0098
246	0.0105	0.0008	0.0097
247	0.0104	0.0008	0.0096
248	0.0103	0.0008	0.0095
249	0.0102	0.0008	0.0094
250	0.0101	0.0008	0.0093
251	0.0100	0.0008	0.0092
252	0.0099	0.0008	0.0091
253	0.0098	0.0008	0.0090
254	0.0097	0.0007	0.0089
255	0.0096	0.0007	0.0088
256	0.0095	0.0007	0.0087
257	0.0094	0.0007	0.0086
258	0.0093	0.0007	0.0086
259	0.0092	0.0007	0.0085
260	0.0091	0.0007	0.0084
261	0.0090	0.0007	0.0083
262	0.0089	0.0007	0.0082
263	0.0089	0.0007	0.0082

```
      264              0.0088           0.0007              0.0081
      265              0.0087           0.0007              0.0080
      266              0.0086           0.0007              0.0080
      267              0.0086           0.0007              0.0079
      268              0.0085           0.0007              0.0078
      269              0.0084           0.0007              0.0078
      270              0.0083           0.0006              0.0077
      271              0.0083           0.0006              0.0076
      272              0.0082           0.0006              0.0076
      273              0.0082           0.0006              0.0075
      274              0.0081           0.0006              0.0075
      275              0.0080           0.0006              0.0074
      276              0.0080           0.0006              0.0073
      277              0.0079           0.0006              0.0073
      278              0.0078           0.0006              0.0072
      279              0.0078           0.0006              0.0072
      280              0.0077           0.0006              0.0071
      281              0.0077           0.0006              0.0071
      282              0.0076           0.0006              0.0070
      283              0.0076           0.0006              0.0070
      284              0.0075           0.0006              0.0069
      285              0.0075           0.0006              0.0069
      286              0.0074           0.0006              0.0068
      287              0.0074           0.0006              0.0068
      288              0.0073           0.0006              0.0068
      --------------------------------------------------------------------
      --------------------------------------------------------------------
      Total soil rain loss =      0.37(In)
      Total effective rainfall =      5.26(In)
      Peak flow rate in flood hydrograph =     16.64(CFS)
      ---------------------------------------------------------------------
      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          24 - H O U R    S T O R M
                     R u n o f f      H y d r o g r a p h
      --------------------------------------------------------------------
                  Hydrograph in   5   Minute intervals ((CFS))

      --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        5.0      10.0      15.0      20.0
-----------------------------------------------------------------------
  0+ 5      0.0002      0.03  Q         |         |         |         |
  0+10      0.0015      0.19  Q         |         |         |         |
  0+15      0.0037      0.32  Q         |         |         |         |
  0+20      0.0062      0.35  Q         |         |         |         |
  0+25      0.0087      0.36  Q         |         |         |         |
  0+30      0.0112      0.36  Q         |         |         |         |
  0+35      0.0137      0.37  Q         |         |         |         |
  0+40      0.0162      0.37  Q         |         |         |         |
  0+45      0.0188      0.37  Q         |         |         |         |
  0+50      0.0213      0.37  Q         |         |         |         |
0+55       0.0239      0.37  Q         |         |         |         |
1+ 0       0.0264      0.37  Q         |         |         |         |
1+ 5       0.0290      0.37  Q         |         |         |         |
1+10       0.0316      0.37  Q         |         |         |         |
1+15       0.0342      0.38  Q         |         |         |         |
1+20       0.0368      0.38  Q         |         |         |         |
1+25       0.0394      0.38  Q         |         |         |         |
1+30       0.0420      0.38  Q         |         |         |         |
1+35       0.0447      0.38  Q         |         |         |         |
1+40       0.0473      0.38  Q         |         |         |         |
1+45       0.0499      0.38  QV        |         |         |         |
1+50       0.0526      0.39  QV        |         |         |         |
1+55       0.0553      0.39  QV        |         |         |         |
2+ 0       0.0579      0.39  QV        |         |         |         |
2+ 5       0.0606      0.39  QV        |         |         |         |
2+10       0.0633      0.39  QV        |         |         |         |
2+15       0.0660      0.39  QV        |         |         |         |
2+20       0.0687      0.39  QV        |         |         |         |
2+25       0.0715      0.40  QV        |         |         |         |
2+30       0.0742      0.40  QV        |         |         |         |
2+35       0.0770      0.40  QV        |         |         |         |
2+40       0.0797      0.40  QV        |         |         |         |
2+45       0.0825      0.40  QV        |         |         |         |
2+50       0.0853      0.40  QV        |         |         |         |
2+55       0.0881      0.41  QV        |         |         |         |
3+ 0       0.0909      0.41  QV        |         |         |         |
3+ 5       0.0937      0.41  QV        |         |         |         |
3+10       0.0965      0.41  QV        |         |         |         |
3+15       0.0993      0.41  Q V       |         |         |         |
3+20       0.1022      0.41  Q V       |         |         |         |
3+25       0.1050      0.42  Q V       |         |         |         |
3+30       0.1079      0.42  Q V       |         |         |         |
3+35       0.1108      0.42  Q V       |         |         |         |
3+40       0.1137      0.42  Q V       |         |         |         |
3+45       0.1166      0.42  Q V       |         |         |         |
3+50       0.1195      0.42  Q V       |         |         |         |
3+55       0.1224      0.43  Q V       |         |         |         |
4+ 0       0.1254      0.43  Q V       |         |         |         |
4+ 5       0.1283      0.43  Q V       |         |         |         |
4+10       0.1313      0.43  Q V       |         |         |         |
4+15       0.1343      0.43  Q V       |         |         |         |
4+20       0.1373      0.44  Q V       |         |         |         |
4+25       0.1403      0.44  Q V       |         |         |         |
4+30       0.1433      0.44  Q V       |         |         |         |
4+35       0.1464      0.44  Q  V      |         |         |         |
4+40       0.1494      0.44  Q  V      |         |         |         |
4+45       0.1525      0.44  Q  V      |         |         |         |
4+50       0.1555      0.45  Q  V      |         |         |         |
4+55       0.1586      0.45  Q  V      |         |         |         |
5+ 0       0.1617      0.45  Q  V      |         |         |         |
5+ 5       0.1649      0.45  Q  V      |         |         |         |
5+10       0.1680      0.46  Q  V      |         |         |         |
5+15       0.1712      0.46  Q  V      |         |         |         |
5+20       0.1743      0.46  Q  V      |         |         |         |
5+25       0.1775      0.46  Q  V      |         |         |         |
5+30       0.1807      0.46  Q  V      |         |         |         |
5+35       0.1839      0.47  Q  V      |         |         |         |
5+40       0.1871      0.47  Q  V      |         |         |         |
5+45       0.1904      0.47  Q  V      |         |         |         |
5+50       0.1936      0.47  Q  V      |         |         |         |
5+55       0.1969      0.48  Q   V     |         |         |         |
6+ 0       0.2002      0.48  Q   V     |         |         |         |
6+ 5       0.2035      0.48  Q   V     |         |         |         |
6+10       0.2069      0.48  Q   V     |         |         |         |
6+15       0.2102      0.49  Q   V     |         |         |         |
6+20       0.2136      0.49  Q   V     |         |         |         |
6+25       0.2170      0.49  Q   V     |         |         |         |
6+30       0.2204      0.49  Q   V     |         |         |         |
6+35       0.2238      0.50  Q   V     |         |         |         |
6+40       0.2272      0.50  Q   V     |         |         |         |
6+45       0.2307      0.50  |Q  V     |         |         |         |
6+50       0.2341      0.50  |Q  V     |         |         |         |
6+55       0.2376      0.51  |Q  V     |         |         |         |
7+ 0       0.2411      0.51  |Q  V     |         |         |         |
7+ 5       0.2447      0.51  |Q   V    |         |         |         |
7+10       0.2482      0.52  |Q   V    |         |         |         |
7+15       0.2518      0.52  |Q   V    |         |         |         |
7+20       0.2554      0.52  |Q   V    |         |         |         |
7+25       0.2590      0.53  |Q   V    |         |         |         |
7+30       0.2627      0.53  |Q   V    |         |         |         |
7+35       0.2663      0.53  |Q   V    |         |         |         |
7+40       0.2700      0.54  |Q   V    |         |         |         |
7+45       0.2737      0.54  |Q   V    |         |         |         |
7+50       0.2775      0.54  |Q   V    |         |         |         |
7+55       0.2812      0.55  |Q   V    |         |         |         |
8+ 0       0.2850      0.55  |Q   V    |         |         |         |
8+ 5       0.2888      0.55  |Q   V    |         |         |         |
8+10       0.2926      0.56  |Q    V   |         |         |         |
8+15       0.2965      0.56  |Q    V   |         |         |         |
8+20       0.3004      0.56  |Q    V   |         |         |         |
8+25       0.3043      0.57  |Q    V   |         |         |         |
8+30       0.3082      0.57  |Q    V   |         |         |         |
8+35       0.3121      0.57  |Q    V   |         |         |         |
8+40       0.3161      0.58  |Q    V   |         |         |         |
8+45       0.3201      0.58  |Q    V   |         |         |         |
8+50       0.3242      0.59  |Q    V   |         |         |         |
8+55       0.3283      0.59  |Q    V   |         |         |         |
9+ 0       0.3324      0.60  |Q    V   |         |         |         |
9+ 5       0.3365      0.60  |Q    V   |         |         |         |
9+10       0.3406      0.60  |Q      V |         |         |         |
 9+15       0.3448      0.61  |Q     V  |         |         |         |
 9+20       0.3491      0.61  |Q     V  |         |         |         |
 9+25       0.3533      0.62  |Q     V  |         |         |         |
 9+30       0.3576      0.62  |Q     V  |         |         |         |
 9+35       0.3619      0.63  |Q     V  |         |         |         |
 9+40       0.3663      0.63  |Q     V  |         |         |         |
 9+45       0.3707      0.64  |Q     V  |         |         |         |
 9+50       0.3751      0.64  |Q     V  |         |         |         |
 9+55       0.3796      0.65  |Q     V  |         |         |         |
10+ 0       0.3841      0.65  |Q     V  |         |         |         |
10+ 5       0.3886      0.66  |Q     V  |         |         |         |
10+10       0.3932      0.67  |Q      V |         |         |         |
10+15       0.3978      0.67  |Q      V |         |         |         |
10+20       0.4025      0.68  |Q      V |         |         |         |
10+25       0.4072      0.68  |Q      V |         |         |         |
10+30       0.4119      0.69  |Q      V |         |         |         |
10+35       0.4167      0.70  |Q      V |         |         |         |
10+40       0.4216      0.70  |Q      V |         |         |         |
10+45       0.4265      0.71  |Q      V |         |         |         |
10+50       0.4314      0.72  |Q      V |         |         |         |
10+55       0.4364      0.72  |Q      V |         |         |         |
11+ 0       0.4414      0.73  |Q       V|         |         |         |
11+ 5       0.4465      0.74  |Q       V|         |         |         |
11+10       0.4516      0.75  |Q       V|         |         |         |
11+15       0.4568      0.75  |Q       V|         |         |         |
11+20       0.4620      0.76  |Q       V|         |         |         |
11+25       0.4673      0.77  |Q       V|         |         |         |
11+30       0.4727      0.78  |Q       V|         |         |         |
11+35       0.4781      0.79  |Q       V|         |         |         |
11+40       0.4836      0.80  |Q       V|         |         |         |
11+45       0.4892      0.81  |Q        V         |         |         |
11+50       0.4948      0.82  |Q        V         |         |         |
11+55       0.5004      0.82  |Q        V         |         |         |
12+ 0       0.5062      0.84  |Q        V         |         |         |
12+ 5       0.5122      0.86  |Q        V         |         |         |
12+10       0.5189      0.97  |Q        V         |         |         |
12+15       0.5262      1.06  | Q       V         |         |         |
12+20       0.5337      1.10  | Q       V         |         |         |
12+25       0.5414      1.11  | Q       |V        |         |         |
12+30       0.5492      1.13  | Q       |V        |         |         |
12+35       0.5570      1.14  | Q       |V        |         |         |
12+40       0.5650      1.16  | Q       |V        |         |         |
12+45       0.5730      1.17  | Q       |V        |         |         |
12+50       0.5812      1.19  | Q       |V        |         |         |
12+55       0.5895      1.20  | Q       | V       |         |         |
13+ 0       0.5979      1.22  | Q       | V       |         |         |
13+ 5       0.6064      1.23  | Q       | V       |         |         |
13+10       0.6150      1.25  | Q       | V       |         |         |
13+15       0.6238      1.27  | Q       | V       |         |         |
13+20       0.6327      1.29  | Q       |  V      |         |         |
13+25       0.6417      1.31  | Q       |  V      |         |         |
13+30       0.6509      1.33  | Q       |  V      |         |         |
13+35       0.6602      1.36  | Q       |  V      |         |         |
13+40       0.6697      1.38  | Q       |  V      |         |         |
13+45       0.6794      1.40  | Q       |  V      |         |         |
13+50       0.6893      1.43  | Q       |   V     |         |         |
13+55       0.6993      1.46  | Q       |   V     |         |         |
14+ 0       0.7095      1.49  | Q       |   V     |         |         |
14+ 5       0.7200      1.52  |  Q      |   V     |         |         |
14+10       0.7307      1.56  |  Q      |    V    |         |         |
14+15       0.7417      1.59  |  Q      |    V    |         |         |
14+20       0.7530      1.63  |  Q      |    V    |         |         |
14+25       0.7645      1.67  |  Q      |    V    |         |         |
14+30       0.7763      1.72  |  Q      |    V    |         |         |
14+35       0.7884      1.76  |  Q      |     V   |         |         |
14+40       0.8009      1.81  |  Q      |     V   |         |         |
14+45       0.8138      1.87  |  Q      |     V   |         |         |
14+50       0.8271      1.93  |  Q      |      V  |         |         |
14+55       0.8408      1.99  |  Q      |      V  |         |         |
15+ 0       0.8550      2.07  |   Q     |      V  |         |         |
15+ 5       0.8698      2.15  |   Q     |      V  |         |         |
15+10       0.8853      2.24  |   Q     |       V |         |         |
15+15       0.9014      2.34  |   Q     |       V |         |         |
15+20       0.9183      2.46  |   Q     |       V |         |         |
15+25       0.9360      2.57  |    Q    |        V|         |         |
15+30       0.9538      2.58  |    Q    |        V|         |         |
15+35       0.9720      2.64  |    Q    |         V         |         |
15+40       0.9918      2.88  |    Q    |         V         |         |
15+45       1.0138      3.20  |     Q   |         V         |         |
15+50       1.0393      3.69  |      Q  |         |V        |         |
15+55       1.0695      4.39  |       Q |         | V       |         |
16+ 0       1.1091      5.75  |         |Q        | V       |         |
16+ 5       1.1727      9.24  |         |       Q |   V     |         |
16+10       1.2873     16.64  |         |         |     V   |  Q      |
16+15       1.3810     13.60  |         |         |      QV |         |
16+20       1.4250      6.40  |         | Q       |        V|         |
16+25       1.4510      3.76  |      Q  |         |        V|         |
16+30       1.4718      3.02  |     Q   |         |         V         |
16+35       1.4898      2.62  |    Q    |         |         V         |
16+40       1.5061      2.37  |   Q     |         |         V         |
16+45       1.5210      2.17  |   Q     |         |         |V        |
16+50       1.5348      2.01  |   Q     |         |         |V        |
16+55       1.5478      1.88  |  Q      |         |         |V        |
17+ 0       1.5600      1.77  |  Q      |         |         | V       |
17+ 5       1.5715      1.68  |  Q      |         |         | V       |
17+10       1.5825      1.60  |  Q      |         |         | V       |
17+15       1.5930      1.52  |  Q      |         |         | V       |
17+20       1.6031      1.46  | Q       |         |         | V       |
17+25       1.6128      1.41  | Q       |         |         |  V      |
17+30       1.6222      1.36  | Q       |         |         |  V      |
17+35       1.6312      1.31  | Q       |         |         |  V      |
17+40       1.6400      1.27  | Q       |         |         |  V      |
17+45       1.6485      1.24  | Q       |         |         |  V      |
17+50       1.6568      1.20  | Q       |         |         |   V     |
17+55       1.6649      1.17  | Q       |         |         |   V     |
18+ 0       1.6727      1.14  | Q       |         |         |   V     |
18+ 5       1.6803      1.10  | Q       |         |         |   V     |
18+10       1.6870      0.97  |Q        |         |         |   V     |
18+15       1.6930      0.87  |Q        |         |         |   V     |
18+20       1.6987      0.83  |Q        |         |         |   V     |
18+25       1.7043      0.81  |Q        |         |         |    V    |
18+30       1.7097      0.79  |Q        |         |         |    V    |
18+35       1.7150      0.77  |Q        |         |         |    V    |
18+40       1.7202      0.75  |Q        |         |         |    V    |
18+45       1.7253      0.74  |Q        |         |         |    V    |
18+50       1.7303      0.72  |Q        |         |         |    V    |
18+55       1.7352      0.71  |Q        |         |         |    V    |
19+ 0       1.7400      0.70  |Q        |         |         |    V    |
19+ 5       1.7447      0.68  |Q        |         |         |    V    |
19+10       1.7493      0.67  |Q        |         |         |    V    |
19+15       1.7538      0.66  |Q        |         |         |     V   |
19+20       1.7583      0.65  |Q        |         |         |     V   |
19+25       1.7627      0.64  |Q        |         |         |     V   |
19+30       1.7670      0.63  |Q        |         |         |     V   |
19+35       1.7713      0.62  |Q        |         |         |     V   |
19+40       1.7755      0.61  |Q        |         |         |     V   |
19+45       1.7796      0.60  |Q        |         |         |     V   |
19+50       1.7837      0.59  |Q        |         |         |     V   |
19+55       1.7877      0.58  |Q        |         |         |     V   |
20+ 0       1.7917      0.57  |Q        |         |         |     V   |
20+ 5       1.7956      0.57  |Q        |         |         |     V   |
20+10       1.7994      0.56  |Q        |         |         |      V  |
20+15       1.8032      0.55  |Q        |         |         |      V  |
20+20       1.8070      0.55  |Q        |         |         |      V  |
20+25       1.8107      0.54  |Q        |         |         |      V  |
20+30       1.8144      0.53  |Q        |         |         |      V  |
20+35       1.8180      0.53  |Q        |         |         |      V  |
20+40       1.8216      0.52  |Q        |         |         |      V  |
20+45       1.8251      0.51  |Q        |         |         |      V  |
20+50       1.8286      0.51  |Q        |         |         |      V  |
20+55       1.8321      0.50  |Q        |         |         |      V  |
21+ 0       1.8355      0.50  Q         |         |         |      V  |
21+ 5       1.8389      0.49  Q         |         |         |      V  |
21+10       1.8422      0.49  Q         |         |         |      V  |
21+15       1.8455      0.48  Q         |         |         |      V  |
21+20       1.8488      0.48  Q         |         |         |       V |
21+25       1.8520      0.47  Q         |         |         |       V |
21+30       1.8553      0.47  Q         |         |         |       V |
21+35       1.8584      0.46  Q         |         |         |       V |
21+40       1.8616      0.46  Q         |         |         |       V |
            21+45       1.8647      0.45  Q         |         |         |       V |
            21+50       1.8678      0.45  Q         |         |         |       V |
            21+55       1.8709      0.45  Q         |         |         |       V |
            22+ 0       1.8739      0.44  Q         |         |         |       V |
            22+ 5       1.8769      0.44  Q         |         |         |       V |
            22+10       1.8799      0.43  Q         |         |         |       V |
            22+15       1.8829      0.43  Q         |         |         |       V |
            22+20       1.8858      0.43  Q         |         |         |       V |
            22+25       1.8887      0.42  Q         |         |         |       V |
            22+30       1.8916      0.42  Q         |         |         |       V |
            22+35       1.8945      0.42  Q         |         |         |       V |
            22+40       1.8973      0.41  Q         |         |         |        V|
            22+45       1.9001      0.41  Q         |         |         |        V|
            22+50       1.9029      0.41  Q         |         |         |        V|
            22+55       1.9057      0.40  Q         |         |         |        V|
            23+ 0       1.9084      0.40  Q         |         |         |        V|
            23+ 5       1.9111      0.40  Q         |         |         |        V|
            23+10       1.9138      0.39  Q         |         |         |        V|
            23+15       1.9165      0.39  Q         |         |         |        V|
            23+20       1.9192      0.39  Q         |         |         |        V|
            23+25       1.9219      0.38  Q         |         |         |        V|
            23+30       1.9245      0.38  Q         |         |         |        V|
            23+35       1.9271      0.38  Q         |         |         |        V|
            23+40       1.9297      0.38  Q         |         |         |        V|
            23+45       1.9323      0.37  Q         |         |         |        V|
            23+50       1.9348      0.37  Q         |         |         |        V|
            23+55       1.9374      0.37  Q         |         |         |        V|
            24+ 0       1.9399      0.37  Q         |         |         |        V|
            24+ 5       1.9422      0.33  Q         |         |         |        V|
            24+10       1.9433      0.17  Q         |         |         |        V|
            24+15       1.9436      0.04  Q         |         |         |        V|
            24+20       1.9437      0.01  Q         |         |         |        V|
            24+25       1.9437      0.00  Q         |         |         |         V
         -----------------------------------------------------------------------
```

APPENDIX C

```
                     FLOOD HYDROGRAPH ROUTING PROGRAM
            Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2018
                        Study date: 10/14/25


--------------------------------------------------------------------


117-011 Freedom Lane
Basin Routing, Proposed Condition
100-year storm
2025-10-14 HA
-------------------------------------------------------------------


Program License Serial Number 6440

-------------------------------------------------------------------
********************* HYDROGRAPH INFORMATION **********************

                From study/file name: 117011FreedomUH100yr1.rte
****************************HYDROGRAPH DATA****************************
                Number of intervals =   293
                Time interval =    5.0 (Min.)
                Maximum/Peak flow rate =      16.642 (CFS)
                Total volume =       1.944 (Ac.Ft)
        Status of hydrographs being held in storage
                   Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
        Peak (CFS)      0.000     0.000     0.000     0.000     0.000
        Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
**********************************************************************




++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      101.000
**** RETARDING BASIN ROUTING ****
______________________________________________________________________

User entry of depth-outflow-storage data
-------------------------------------------------------------------
Total number of inflow hydrograph intervals = 293
Hydrograph time unit =  5.000 (Min.)
Initial depth in storage basin =   0.00(Ft.)
-------------------------------------------------------------------
-------------------------------------------------------------------
Initial basin depth =   0.00 (Ft.)
Initial basin storage =      0.00 (Ac.Ft)
Initial basin outflow =   0.00 (CFS)
```

```
       ---------------------------------------------------------------------
       --------------------------------------------------------------------
       Depth vs. Storage and Depth vs. Discharge data:
        Basin Depth  Storage    Outflow   (S-O*dt/2)   (S+O*dt/2)
            (Ft.)    (Ac.Ft)    (CFS)     (Ac.Ft)    (Ac.Ft)
       ---------------------------------------------------------------------
         0.000      0.000      0.000      0.000        0.000
         0.117      0.005      0.097      0.005        0.005
         0.350      0.016      0.169      0.015        0.017
         1.050      0.048      0.293      0.047        0.049
         2.100      0.096      0.415      0.095        0.097
         3.033      0.139      0.499      0.137        0.141
         4.083      0.188      0.579      0.186        0.190
         5.017      0.231      0.642      0.229        0.233
         6.067      0.280      0.706      0.278        0.282
         7.000      0.322      0.758      0.319        0.325
         7.933      0.366      0.807      0.363        0.369
         8.050      0.371      0.850      0.368        0.374
         8.517      0.392      2.073      0.385        0.399
         9.100      0.419      4.696      0.403        0.435
         9.800      0.451     10.560      0.415        0.487
        10.500      0.484     12.930      0.439        0.529
       --------------------------------------------------------------------
                       Hydrograph Detention Basin Routing
       ---------------------------------------------------------------------

       Graph values: 'I'= unit inflow; 'O'=outflow at time shown
       ---------------------------------------------------------------------
 Time   Inflow  Outflow    Storage                                     Depth
(Hours)  (CFS)   (CFS)     (Ac.Ft) .0       4.2    8.32   12.48   16.64 (Ft.)
 0.083    0.03    0.00      0.000  O        |       |       |       |    0.00
 0.167    0.19    0.02      0.001  O        |       |       |       |    0.02
 0.250    0.32    0.05      0.002  O        |       |       |       |    0.06
 0.333    0.35    0.08      0.004  O        |       |       |       |    0.10
 0.417    0.36    0.10      0.006  O        |       |       |       |    0.14
 0.500    0.36    0.12      0.008  O        |       |       |       |    0.18
 0.583    0.37    0.13      0.010  O        |       |       |       |    0.21
 0.667    0.37    0.14      0.011  O        |       |       |       |    0.25
 0.750    0.37    0.15      0.013  O        |       |       |       |    0.28
 0.833    0.37    0.16      0.014  O        |       |       |       |    0.31
 0.917    0.37    0.17      0.016  O        |       |       |       |    0.34
 1.000    0.37    0.17      0.017  O        |       |       |       |    0.37
 1.083    0.37    0.18      0.018  O        |       |       |       |    0.40
 1.167    0.37    0.18      0.020  O        |       |       |       |    0.43
 1.250    0.38    0.19      0.021  O        |       |       |       |    0.46
 1.333    0.38    0.19      0.022  O        |       |       |       |    0.49
 1.417    0.38    0.20      0.024  O        |       |       |       |    0.51
 1.500    0.38    0.20      0.025  O        |       |       |       |    0.54
 1.583    0.38    0.21      0.026  O        |       |       |       |    0.57
 1.667    0.38    0.21      0.027  O        |       |       |       |    0.59
```

```
1.750    0.38    0.22      0.028  O       |         |         |         |        0.62
1.833    0.39    0.22      0.029  O       |         |         |         |        0.64
1.917    0.39    0.23      0.031  O       |         |         |         |        0.67
2.000    0.39    0.23      0.032  O       |         |         |         |        0.69
2.083    0.39    0.23      0.033  O       |         |         |         |        0.72
2.167    0.39    0.24      0.034  O       |         |         |         |        0.74
2.250    0.39    0.24      0.035  O       |         |         |         |        0.76
2.333    0.39    0.25      0.036  O       |         |         |         |        0.79
2.417    0.40    0.25      0.037  O       |         |         |         |        0.81
2.500    0.40    0.25      0.038  O       |         |         |         |        0.83
2.583    0.40    0.26      0.039  O       |         |         |         |        0.85
2.667    0.40    0.26      0.040  O       |         |         |         |        0.87
2.750    0.40    0.27      0.041  O       |         |         |         |        0.89
2.833    0.40    0.27      0.042  O       |         |         |         |        0.91
2.917    0.41    0.27      0.043  O       |         |         |         |        0.93
3.000    0.41    0.28      0.044  O       |         |         |         |        0.95
3.083    0.41    0.28      0.044  O       |         |         |         |        0.97
3.167    0.41    0.28      0.045  O       |         |         |         |        0.99
3.250    0.41    0.29      0.046  O       |         |         |         |        1.01
3.333    0.41    0.29      0.047  O       |         |         |         |        1.03
3.417    0.42    0.29      0.048  O       |         |         |         |        1.05
3.500    0.42    0.30      0.049  O       |         |         |         |        1.07
3.583    0.42    0.30      0.050  O       |         |         |         |        1.09
3.667    0.42    0.30      0.050  O       |         |         |         |        1.10
3.750    0.42    0.30      0.051  O       |         |         |         |        1.12
3.833    0.42    0.30      0.052  O       |         |         |         |        1.14
3.917    0.43    0.31      0.053  O       |         |         |         |        1.16
4.000    0.43    0.31      0.054  O       |         |         |         |        1.18
4.083    0.43    0.31      0.055  O       |         |         |         |        1.19
4.167    0.43    0.31      0.055  O       |         |         |         |        1.21
4.250    0.43    0.31      0.056  O       |         |         |         |        1.23
4.333    0.44    0.32      0.057  O       |         |         |         |        1.25
4.417    0.44    0.32      0.058  O       |         |         |         |        1.27
4.500    0.44    0.32      0.059  O       |         |         |         |        1.28
4.583    0.44    0.32      0.060  O       |         |         |         |        1.30
4.667    0.44    0.32      0.060  O       |         |         |         |        1.32
4.750    0.44    0.33      0.061  O       |         |         |         |        1.34
4.833    0.45    0.33      0.062  O       |         |         |         |        1.36
4.917    0.45    0.33      0.063  O       |         |         |         |        1.37
5.000    0.45    0.33      0.064  O       |         |         |         |        1.39
5.083    0.45    0.33      0.064  O       |         |         |         |        1.41
5.167    0.46    0.34      0.065  O       |         |         |         |        1.43
5.250    0.46    0.34      0.066  O       |         |         |         |        1.44
5.333    0.46    0.34      0.067  O       |         |         |         |        1.46
5.417    0.46    0.34      0.068  O       |         |         |         |        1.48
5.500    0.46    0.35      0.069  O       |         |         |         |        1.50
5.583    0.47    0.35      0.069  O       |         |         |         |        1.52
5.667    0.47    0.35      0.070  O       |         |         |         |        1.53
5.750    0.47    0.35      0.071  O       |         |         |         |        1.55
5.833    0.47    0.35      0.072  O       |         |         |         |        1.57
```

```
  5.917    0.48    0.36      0.073  O           |         |         |         |        1.59
  6.000    0.48    0.36      0.073  O           |         |         |         |        1.61
  6.083    0.48    0.36      0.074  O           |         |         |         |        1.63
  6.167    0.48    0.36      0.075  O           |         |         |         |        1.64
  6.250    0.49    0.36      0.076  O           |         |         |         |        1.66
  6.333    0.49    0.37      0.077  O           |         |         |         |        1.68
  6.417    0.49    0.37      0.078  O           |         |         |         |        1.70
  6.500    0.49    0.37      0.078  O           |         |         |         |        1.72
  6.583    0.50    0.37      0.079  O           |         |         |         |        1.74
  6.667    0.50    0.37      0.080  O           |         |         |         |        1.75
  6.750    0.50    0.38      0.081  O           |         |         |         |        1.77
  6.833    0.50    0.38      0.082  O           |         |         |         |        1.79
  6.917    0.51    0.38      0.083  O           |         |         |         |        1.81
  7.000    0.51    0.38      0.084  O           |         |         |         |        1.83
  7.083    0.51    0.39      0.085  O           |         |         |         |        1.85
  7.167    0.52    0.39      0.085  O           |         |         |         |        1.87
  7.250    0.52    0.39      0.086  O           |         |         |         |        1.89
  7.333    0.52    0.39      0.087  OI          |         |         |         |        1.91
  7.417    0.53    0.39      0.088  OI          |         |         |         |        1.93
  7.500    0.53    0.40      0.089  OI          |         |         |         |        1.95
  7.583    0.53    0.40      0.090  OI          |         |         |         |        1.97
  7.667    0.54    0.40      0.091  OI          |         |         |         |        1.99
  7.750    0.54    0.40      0.092  OI          |         |         |         |        2.01
  7.833    0.54    0.41      0.093  OI          |         |         |         |        2.03
  7.917    0.55    0.41      0.094  OI          |         |         |         |        2.05
  8.000    0.55    0.41      0.095  OI          |         |         |         |        2.07
  8.083    0.55    0.41      0.095  OI          |         |         |         |        2.09
  8.167    0.56    0.42      0.096  OI          |         |         |         |        2.11
  8.250    0.56    0.42      0.097  OI          |         |         |         |        2.13
  8.333    0.56    0.42      0.098  OI          |         |         |         |        2.15
  8.417    0.57    0.42      0.099  OI          |         |         |         |        2.17
  8.500    0.57    0.42      0.100  OI          |         |         |         |        2.20
  8.583    0.57    0.43      0.101  OI          |         |         |         |        2.22
  8.667    0.58    0.43      0.102  OI          |         |         |         |        2.24
  8.750    0.58    0.43      0.103  OI          |         |         |         |        2.26
  8.833    0.59    0.43      0.105  OI          |         |         |         |        2.29
  8.917    0.59    0.43      0.106  OI          |         |         |         |        2.31
  9.000    0.60    0.44      0.107  OI          |         |         |         |        2.33
  9.083    0.60    0.44      0.108  OI          |         |         |         |        2.36
  9.167    0.60    0.44      0.109  OI          |         |         |         |        2.38
  9.250    0.61    0.44      0.110  OI          |         |         |         |        2.41
  9.333    0.61    0.44      0.111  OI          |         |         |         |        2.43
  9.417    0.62    0.45      0.112  OI          |         |         |         |        2.46
  9.500    0.62    0.45      0.114  OI          |         |         |         |        2.48
  9.583    0.63    0.45      0.115  OI          |         |         |         |        2.51
  9.667    0.63    0.45      0.116  OI          |         |         |         |        2.53
  9.750    0.64    0.46      0.117  OI          |         |         |         |        2.56
  9.833    0.64    0.46      0.119  OI          |         |         |         |        2.59
  9.917    0.65    0.46      0.120  OI          |         |         |         |        2.62
 10.000    0.65    0.46      0.121  OI          |         |         |         |        2.64
```

```
10.083    0.66    0.47      0.122  OI      |       |       |       |     2.67
10.167    0.67    0.47      0.124  OI      |       |       |       |     2.70
10.250    0.67    0.47      0.125  OI      |       |       |       |     2.73
10.333    0.68    0.47      0.126  OI      |       |       |       |     2.76
10.417    0.68    0.48      0.128  OI      |       |       |       |     2.79
10.500    0.69    0.48      0.129  OI      |       |       |       |     2.82
10.583    0.70    0.48      0.131  OI      |       |       |       |     2.85
10.667    0.70    0.49      0.132  OI      |       |       |       |     2.89
10.750    0.71    0.49      0.134  OI      |       |       |       |     2.92
10.833    0.72    0.49      0.135  OI      |       |       |       |     2.95
10.917    0.72    0.49      0.137  OI      |       |       |       |     2.99
11.000    0.73    0.50      0.138  OI      |       |       |       |     3.02
11.083    0.74    0.50      0.140  OI      |       |       |       |     3.06
11.167    0.75    0.50      0.142  OI      |       |       |       |     3.09
11.250    0.75    0.51      0.143  OI      |       |       |       |     3.13
11.333    0.76    0.51      0.145  OI      |       |       |       |     3.16
11.417    0.77    0.51      0.147  OI      |       |       |       |     3.20
11.500    0.78    0.51      0.149  OI      |       |       |       |     3.24
11.583    0.79    0.52      0.150  OI      |       |       |       |     3.28
11.667    0.80    0.52      0.152  |O      |       |       |       |     3.32
11.750    0.81    0.52      0.154  |O      |       |       |       |     3.36
11.833    0.82    0.53      0.156  |O      |       |       |       |     3.40
11.917    0.82    0.53      0.158  |O      |       |       |       |     3.45
12.000    0.84    0.53      0.160  |O      |       |       |       |     3.49
12.083    0.86    0.54      0.162  |O      |       |       |       |     3.54
12.167    0.97    0.54      0.165  |O      |       |       |       |     3.59
12.250    1.06    0.55      0.168  |OI     |       |       |       |     3.66
12.333    1.10    0.55      0.172  |OI     |       |       |       |     3.74
12.417    1.11    0.56      0.176  |OI     |       |       |       |     3.82
12.500    1.13    0.57      0.180  |OI     |       |       |       |     3.90
12.583    1.14    0.57      0.184  |OI     |       |       |       |     3.99
12.667    1.16    0.58      0.187  |OI     |       |       |       |     4.07
12.750    1.17    0.58      0.191  |OI     |       |       |       |     4.16
12.833    1.19    0.59      0.196  |OI     |       |       |       |     4.25
12.917    1.20    0.60      0.200  |OI     |       |       |       |     4.34
13.000    1.22    0.60      0.204  |OI     |       |       |       |     4.43
13.083    1.23    0.61      0.208  |OI     |       |       |       |     4.52
13.167    1.25    0.61      0.213  |OI     |       |       |       |     4.62
13.250    1.27    0.62      0.217  |OI     |       |       |       |     4.71
13.333    1.29    0.63      0.221  |OI     |       |       |       |     4.81
13.417    1.31    0.63      0.226  |OI     |       |       |       |     4.91
13.500    1.33    0.64      0.231  |OI     |       |       |       |     5.01
13.583    1.36    0.65      0.236  |OI     |       |       |       |     5.12
13.667    1.38    0.65      0.241  |OI     |       |       |       |     5.22
13.750    1.40    0.66      0.246  |OI     |       |       |       |     5.33
13.833    1.43    0.67      0.251  |OI     |       |       |       |     5.44
13.917    1.46    0.67      0.256  |OI     |       |       |       |     5.56
14.000    1.49    0.68      0.262  |OI     |       |       |       |     5.67
14.083    1.52    0.69      0.267  |OI     |       |       |       |     5.79
14.167    1.56    0.70      0.273  |OI     |       |       |       |     5.92
```

```
14.250    1.59    0.70      0.279  |O I    |       |       |       |     6.05
14.333    1.63    0.71      0.285  |O I    |       |       |       |     6.19
14.417    1.67    0.72      0.292  |O I    |       |       |       |     6.33
14.500    1.72    0.73      0.298  |O I    |       |       |       |     6.48
14.583    1.76    0.74      0.305  |O I    |       |       |       |     6.63
14.667    1.81    0.75      0.313  |O I    |       |       |       |     6.79
14.750    1.87    0.76      0.320  |O I    |       |       |       |     6.96
14.833    1.93    0.76      0.328  |O I    |       |       |       |     7.13
14.917    1.99    0.77      0.336  |O I    |       |       |       |     7.30
15.000    2.07    0.78      0.345  |O I    |       |       |       |     7.48
15.083    2.15    0.79      0.354  |O  I   |       |       |       |     7.68
15.167    2.24    0.80      0.363  |O  I   |       |       |       |     7.88
15.250    2.34    0.97      0.373  |O  I   |       |       |       |     8.10
15.333    2.46    1.45      0.381  | O I   |       |       |       |     8.28
15.417    2.57    1.81      0.387  |  OI   |       |       |       |     8.42
15.500    2.58    2.06      0.392  |  OI   |       |       |       |     8.51
15.583    2.64    2.33      0.395  |   OI  |       |       |       |     8.57
15.667    2.88    2.55      0.397  |   OI  |       |       |       |     8.62
15.750    3.20    2.79      0.399  |    OI |       |       |       |     8.68
15.833    3.69    3.12      0.403  |    O I|       |       |       |     8.75
15.917    4.39    3.58      0.408  |     O I       |       |       |     8.85
16.000    5.75    4.33      0.415  |       O  I    |       |       |     9.02
16.083    9.24    6.58      0.429  |       |   O   |I      |       |     9.32
16.167   16.64   11.04      0.458  |       |       |    O  |       I     9.94
16.250   13.60   12.66      0.480  |       |       |       O I     |    10.42
16.333    6.40   11.60      0.466  |       |   I   |     O |       |    10.11
16.417    3.76    7.55      0.435  |      I|     O |       |       |     9.44
16.500    3.02    4.46      0.417  |    I  O       |       |       |     9.05
16.583    2.62    3.64      0.408  |    IO |       |       |       |     8.87
16.667    2.37    3.06      0.402  |   IO  |       |       |       |     8.74
16.750    2.17    2.66      0.398  |   IO  |       |       |       |     8.65
16.833    2.01    2.37      0.395  |  IO   |       |       |       |     8.58
16.917    1.88    2.16      0.393  |  IO   |       |       |       |     8.54
17.000    1.77    2.02      0.391  |  O    |       |       |       |     8.50
17.083    1.68    1.92      0.389  |  O    |       |       |       |     8.46
17.167    1.60    1.83      0.388  |  O    |       |       |       |     8.42
17.250    1.52    1.74      0.386  | IO    |       |       |       |     8.39
17.333    1.46    1.66      0.385  | IO    |       |       |       |     8.36
17.417    1.41    1.58      0.384  | IO    |       |       |       |     8.33
17.500    1.36    1.52      0.382  | O     |       |       |       |     8.30
17.583    1.31    1.46      0.381  | O     |       |       |       |     8.28
17.667    1.27    1.40      0.380  | O     |       |       |       |     8.26
17.750    1.24    1.35      0.380  | O     |       |       |       |     8.24
17.833    1.20    1.31      0.379  | O     |       |       |       |     8.23
17.917    1.17    1.27      0.378  | O     |       |       |       |     8.21
18.000    1.14    1.23      0.378  | O     |       |       |       |     8.20
18.083    1.10    1.19      0.377  | O     |       |       |       |     8.18
18.167    0.97    1.14      0.376  |IO     |       |       |       |     8.16
18.250    0.87    1.07      0.375  |IO     |       |       |       |     8.13
18.333    0.83    1.00      0.373  |O      |       |       |       |     8.11
```

MAX
WSE

```
18.417     0.81     0.94      0.372  |O        |        |        |        |      8.08
18.500     0.79     0.89      0.372  |O        |        |        |        |      8.07
18.583     0.77     0.85      0.371  |O        |        |        |        |      8.05
18.667     0.75     0.85      0.370  |O        |        |        |        |      8.04
18.750     0.74     0.84      0.370  |O        |        |        |        |      8.02
18.833     0.72     0.83      0.369  |O        |        |        |        |      8.00
18.917     0.71     0.83      0.368  |O        |        |        |        |      7.99
19.000     0.70     0.82      0.367  |O        |        |        |        |      7.97
19.083     0.68     0.81      0.367  |O        |        |        |        |      7.95
19.167     0.67     0.81      0.366  |O        |        |        |        |      7.93
19.250     0.66     0.81      0.365  |O        |        |        |        |      7.91
19.333     0.65     0.80      0.364  |O        |        |        |        |      7.88
19.417     0.64     0.80      0.363  |O        |        |        |        |      7.86
19.500     0.63     0.80      0.361  |O        |        |        |        |      7.84
19.583     0.62     0.80      0.360  |O        |        |        |        |      7.81
19.667     0.61     0.80      0.359  |O        |        |        |        |      7.78
19.750     0.60     0.80      0.358  |O        |        |        |        |      7.75
19.833     0.59     0.80      0.356  |O        |        |        |        |      7.73
19.917     0.58     0.79      0.355  |O        |        |        |        |      7.69
20.000     0.57     0.79      0.353  |O        |        |        |        |      7.66
20.083     0.57     0.79      0.352  |O        |        |        |        |      7.63
20.167     0.56     0.79      0.350  |O        |        |        |        |      7.60
20.250     0.55     0.79      0.349  |O        |        |        |        |      7.56
20.333     0.55     0.79      0.347  |O        |        |        |        |      7.53
20.417     0.54     0.78      0.345  |O        |        |        |        |      7.49
20.500     0.53     0.78      0.344  |O        |        |        |        |      7.46
20.583     0.53     0.78      0.342  |O        |        |        |        |      7.42
20.667     0.52     0.78      0.340  IO       |        |        |        |      7.38
20.750     0.51     0.78      0.338  IO       |        |        |        |      7.35
20.833     0.51     0.77      0.336  IO       |        |        |        |      7.31
20.917     0.50     0.77      0.335  IO       |        |        |        |      7.27
21.000     0.50     0.77      0.333  IO       |        |        |        |      7.23
21.083     0.49     0.77      0.331  IO       |        |        |        |      7.19
21.167     0.49     0.77      0.329  IO       |        |        |        |      7.15
21.250     0.48     0.76      0.327  IO       |        |        |        |      7.11
21.333     0.48     0.76      0.325  IO       |        |        |        |      7.06
21.417     0.47     0.76      0.323  IO       |        |        |        |      7.02
21.500     0.47     0.76      0.321  IO       |        |        |        |      6.98
21.583     0.46     0.75      0.319  IO       |        |        |        |      6.94
21.667     0.46     0.75      0.317  IO       |        |        |        |      6.89
21.750     0.45     0.75      0.315  IO       |        |        |        |      6.85
21.833     0.45     0.75      0.313  IO       |        |        |        |      6.80
21.917     0.45     0.74      0.311  IO       |        |        |        |      6.75
22.000     0.44     0.74      0.309  IO       |        |        |        |      6.71
22.083     0.44     0.74      0.307  IO       |        |        |        |      6.66
22.167     0.43     0.74      0.305  IO       |        |        |        |      6.62
22.250     0.43     0.73      0.303  IO       |        |        |        |      6.57
22.333     0.43     0.73      0.301  IO       |        |        |        |      6.52
22.417     0.42     0.73      0.298  IO       |        |        |        |      6.48
22.500     0.42     0.73      0.296  IO       |        |        |        |      6.43
```

```
22.583    0.42    0.72      0.294  IO      |       |       |       |    6.38
22.667    0.41    0.72      0.292  IO      |       |       |       |    6.33
22.750    0.41    0.72      0.290  IO      |       |       |       |    6.29
22.833    0.41    0.72      0.288  IO      |       |       |       |    6.24
22.917    0.40    0.71      0.286  IO      |       |       |       |    6.19
23.000    0.40    0.71      0.283  IO      |       |       |       |    6.14
23.083    0.40    0.71      0.281  IO      |       |       |       |    6.10
23.167    0.39    0.70      0.279  IO      |       |       |       |    6.05
23.250    0.39    0.70      0.277  IO      |       |       |       |    6.00
23.333    0.39    0.70      0.275  IO      |       |       |       |    5.96
23.417    0.38    0.70      0.273  IO      |       |       |       |    5.91
23.500    0.38    0.69      0.271  IO      |       |       |       |    5.87
23.583    0.38    0.69      0.268  IO      |       |       |       |    5.82
23.667    0.38    0.69      0.266  IO      |       |       |       |    5.77
23.750    0.37    0.69      0.264  IO      |       |       |       |    5.73
23.833    0.37    0.68      0.262  IO      |       |       |       |    5.68
23.917    0.37    0.68      0.260  IO      |       |       |       |    5.64
24.000    0.37    0.68      0.258  IO      |       |       |       |    5.59
24.083    0.33    0.67      0.255  IO      |       |       |       |    5.54
24.167    0.17    0.67      0.253  IO      |       |       |       |    5.48
24.250    0.04    0.67      0.249  IO      |       |       |       |    5.40
24.333    0.01    0.66      0.244  IO      |       |       |       |    5.30
24.417    0.00    0.65      0.240  IO      |       |       |       |    5.21
24.500    0.00    0.65      0.235  IO      |       |       |       |    5.11
24.583    0.00    0.64      0.231  IO      |       |       |       |    5.02
24.667    0.00    0.64      0.227  IO      |       |       |       |    4.92
24.750    0.00    0.63      0.222  IO      |       |       |       |    4.83
24.833    0.00    0.62      0.218  IO      |       |       |       |    4.73
24.917    0.00    0.62      0.214  IO      |       |       |       |    4.64
25.000    0.00    0.61      0.209  IO      |       |       |       |    4.55
25.083    0.00    0.60      0.205  IO      |       |       |       |    4.46
25.167    0.00    0.60      0.201  IO      |       |       |       |    4.37
25.250    0.00    0.59      0.197  IO      |       |       |       |    4.28
25.333    0.00    0.59      0.193  IO      |       |       |       |    4.19
25.417    0.00    0.58      0.189  IO      |       |       |       |    4.10
25.500    0.00    0.57      0.185  IO      |       |       |       |    4.02
25.583    0.00    0.57      0.181  IO      |       |       |       |    3.93
25.667    0.00    0.56      0.177  IO      |       |       |       |    3.85
25.750    0.00    0.55      0.173  IO      |       |       |       |    3.77
25.833    0.00    0.55      0.169  IO      |       |       |       |    3.69
25.917    0.00    0.54      0.166  IO      |       |       |       |    3.60
26.000    0.00    0.54      0.162  IO      |       |       |       |    3.53
26.083    0.00    0.53      0.158  IO      |       |       |       |    3.45
26.167    0.00    0.52      0.155  IO      |       |       |       |    3.37
26.250    0.00    0.52      0.151  O       |       |       |       |    3.29
26.333    0.00    0.51      0.148  O       |       |       |       |    3.22
26.417    0.00    0.51      0.144  O       |       |       |       |    3.14
26.500    0.00    0.50      0.141  O       |       |       |       |    3.07
26.583    0.00    0.50      0.137  O       |       |       |       |    2.99
26.667    0.00    0.49      0.134  O       |       |       |       |    2.92
```

```
26.750    0.00    0.48      0.130  O       |       |       |       |     2.85
26.833    0.00    0.48      0.127  O       |       |       |       |     2.77
26.917    0.00    0.47      0.124  O       |       |       |       |     2.70
27.000    0.00    0.46      0.121  O       |       |       |       |     2.63
27.083    0.00    0.46      0.117  O       |       |       |       |     2.57
27.167    0.00    0.45      0.114  O       |       |       |       |     2.50
27.250    0.00    0.44      0.111  O       |       |       |       |     2.43
27.333    0.00    0.44      0.108  O       |       |       |       |     2.36
27.417    0.00    0.43      0.105  O       |       |       |       |     2.30
27.500    0.00    0.43      0.102  O       |       |       |       |     2.23
27.583    0.00    0.42      0.099  O       |       |       |       |     2.17
27.667    0.00    0.42      0.096  O       |       |       |       |     2.11
27.750    0.00    0.41      0.094  O       |       |       |       |     2.05
27.833    0.00    0.40      0.091  O       |       |       |       |     1.99
27.917    0.00    0.39      0.088  O       |       |       |       |     1.93
28.000    0.00    0.39      0.085  O       |       |       |       |     1.87
28.083    0.00    0.38      0.083  O       |       |       |       |     1.81
28.167    0.00    0.37      0.080  O       |       |       |       |     1.75
28.250    0.00    0.37      0.078  O       |       |       |       |     1.70
28.333    0.00    0.36      0.075  O       |       |       |       |     1.64
28.417    0.00    0.36      0.073  O       |       |       |       |     1.59
28.500    0.00    0.35      0.070  O       |       |       |       |     1.53
28.583    0.00    0.34      0.068  O       |       |       |       |     1.48
28.667    0.00    0.34      0.065  O       |       |       |       |     1.43
28.750    0.00    0.33      0.063  O       |       |       |       |     1.38
28.833    0.00    0.33      0.061  O       |       |       |       |     1.33
28.917    0.00    0.32      0.059  O       |       |       |       |     1.28
29.000    0.00    0.31      0.056  O       |       |       |       |     1.23
29.083    0.00    0.31      0.054  O       |       |       |       |     1.19
29.167    0.00    0.30      0.052  O       |       |       |       |     1.14
29.250    0.00    0.30      0.050  O       |       |       |       |     1.10
29.333    0.00    0.29      0.048  O       |       |       |       |     1.05
29.417    0.00    0.29      0.046  O       |       |       |       |     1.01
29.500    0.00    0.28      0.044  O       |       |       |       |     0.97
29.583    0.00    0.27      0.042  O       |       |       |       |     0.92
29.667    0.00    0.26      0.040  O       |       |       |       |     0.88
29.750    0.00    0.26      0.039  O       |       |       |       |     0.84
29.833    0.00    0.25      0.037  O       |       |       |       |     0.81
29.917    0.00    0.24      0.035  O       |       |       |       |     0.77
30.000    0.00    0.24      0.034  O       |       |       |       |     0.73
30.083    0.00    0.23      0.032  O       |       |       |       |     0.70
30.167    0.00    0.22      0.030  O       |       |       |       |     0.66
30.250    0.00    0.22      0.029  O       |       |       |       |     0.63
30.333    0.00    0.21      0.027  O       |       |       |       |     0.60
30.417    0.00    0.21      0.026  O       |       |       |       |     0.57
30.500    0.00    0.20      0.024  O       |       |       |       |     0.54
30.583    0.00    0.20      0.023  O       |       |       |       |     0.51
30.667    0.00    0.19      0.022  O       |       |       |       |     0.48
30.750    0.00    0.19      0.020  O       |       |       |       |     0.45
30.833    0.00    0.18      0.019  O       |       |       |       |     0.42
```

```
30.917     0.00     0.18      0.018  O       |        |        |        |      0.39
31.000     0.00     0.17      0.017  O       |        |        |        |      0.37
31.083     0.00     0.17      0.016  O       |        |        |        |      0.34
31.167     0.00     0.16      0.014  O       |        |        |        |      0.32
31.250     0.00     0.15      0.013  O       |        |        |        |      0.30
31.333     0.00     0.15      0.012  O       |        |        |        |      0.27
31.417     0.00     0.14      0.011  O       |        |        |        |      0.25
31.500     0.00     0.13      0.010  O       |        |        |        |      0.23
31.583     0.00     0.13      0.010  O       |        |        |        |      0.21
31.667     0.00     0.12      0.009  O       |        |        |        |      0.20
31.750     0.00     0.12      0.008  O       |        |        |        |      0.18
31.833     0.00     0.11      0.007  O       |        |        |        |      0.16
31.917     0.00     0.11      0.006  O       |        |        |        |      0.15
32.000     0.00     0.10      0.006  O       |        |        |        |      0.13
32.083     0.00     0.10      0.005  O       |        |        |        |      0.12
32.167     0.00     0.08      0.004  O       |        |        |        |      0.10
32.250     0.00     0.07      0.004  O       |        |        |        |      0.09
32.333     0.00     0.06      0.003  O       |        |        |        |      0.08
32.417     0.00     0.06      0.003  O       |        |        |        |      0.07
32.500     0.00     0.05      0.003  O       |        |        |        |      0.06
32.583     0.00     0.04      0.002  O       |        |        |        |      0.05
32.667     0.00     0.04      0.002  O       |        |        |        |      0.05
32.750     0.00     0.03      0.002  O       |        |        |        |      0.04
32.833     0.00     0.03      0.001  O       |        |        |        |      0.03
32.917     0.00     0.03      0.001  O       |        |        |        |      0.03
33.000     0.00     0.02      0.001  O       |        |        |        |      0.03
33.083     0.00     0.02      0.001  O       |        |        |        |      0.02
33.167     0.00     0.02      0.001  O       |        |        |        |      0.02
33.250     0.00     0.01      0.001  O       |        |        |        |      0.02
33.333     0.00     0.01      0.001  O       |        |        |        |      0.02
33.417     0.00     0.01      0.001  O       |        |        |        |      0.01
33.500     0.00     0.01      0.001  O       |        |        |        |      0.01
33.583     0.00     0.01      0.000  O       |        |        |        |      0.01
33.667     0.00     0.01      0.000  O       |        |        |        |      0.01
33.750     0.00     0.01      0.000  O       |        |        |        |      0.01
33.833     0.00     0.01      0.000  O       |        |        |        |      0.01
33.917     0.00     0.01      0.000  O       |        |        |        |      0.01
34.000     0.00     0.00      0.000  O       |        |        |        |      0.01
34.083     0.00     0.00      0.000  O       |        |        |        |      0.00
34.167     0.00     0.00      0.000  O       |        |        |        |      0.00
34.250     0.00     0.00      0.000  O       |        |        |        |      0.00
34.333     0.00     0.00      0.000  O       |        |        |        |      0.00
34.417     0.00     0.00      0.000  O       |        |        |        |      0.00
34.500     0.00     0.00      0.000  O       |        |        |        |      0.00
34.583     0.00     0.00      0.000  O       |        |        |        |      0.00
34.667     0.00     0.00      0.000  O       |        |        |        |      0.00
34.750     0.00     0.00      0.000  O       |        |        |        |      0.00
34.833     0.00     0.00      0.000  O       |        |        |        |      0.00
34.917     0.00     0.00      0.000  O       |        |        |        |      0.00
35.000     0.00     0.00      0.000  O       |        |        |        |      0.00
```

WSE = 0

```
****************************HYDROGRAPH DATA****************************
                Number of intervals =   420
                Time interval =    5.0 (Min.)
                Maximum/Peak flow rate =       12.659 (CFS)
                Total volume =       1.944 (Ac.Ft)
        Status of hydrographs being held in storage
                   Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
        Peak (CFS)      0.000     0.000     0.000     0.000     0.000
        Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
***********************************************************************

--------------------------------------------------------------------
```

SOHM

PROJECT REPORT

General Model Information

Project Name:	117-011 Freedom Lane SOHM
Site Name:	
Site Address:	
City:	
Report Date:	10/14/2025
Gage:	Laguna Beach
Data Start:	10/01/1949
Data End:	09/30/2006
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2021/05/25

POC Thresholds

Low Flow Threshold for POC1:	10 Percent of the 2 Year
High Flow Threshold for POC1:	10 Year

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
D,Open Brush,Steep	0.53
Pervious Total	0.53
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.53

Element Flows To:

Surface	Interflow	Groundwater

Basin 2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
D,Open Brush,Steep	1.21
Pervious Total	1.21
Impervious Land Use	acre
Impervious Total	0
Basin Total	1.21

Element Flows To:

Surface	Interflow	Groundwater

Basin 3

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
D,Open Brush,Steep	1.81
Pervious Total	1.81
Impervious Land Use	acre
Impervious Total	0
Basin Total	1.81

Element Flows To:

Surface	Interflow	Groundwater

Basin 4

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
D,Open Brush,Steep	0.89
Pervious Total	0.89
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.89

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
D,Urban,Flat(0-5%)	0.15
Pervious Total	0.15
Impervious Land Use	acre
Impervious,Flat(0-5)	0.38
Impervious Total	0.38
Basin Total	0.53

Element Flows To:

Surface	Interflow	Groundwater
MWS 1	MWS 1	

Basin 2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
D,Urban,Flat(0-5%)	0.3
Pervious Total	0.3
Impervious Land Use	acre
Impervious,Flat(0-5)	0.91
Impervious Total	0.91
Basin Total	1.21

Element Flows To:

Surface	Interflow	Groundwater
MWS 2	MWS 2	

Basin 3

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
D,Urban,Flat(0-5%)	0.26
Pervious Total	0.26

Impervious Land Use	acre
Impervious,Flat(0-5)	1.55
Impervious Total	1.55

Basin Total	1.81

Element Flows To:

Surface	Interflow	Groundwater
MWS 3	MWS 3	

Basin 4

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
D,Urban,Flat(0-5%)	0.38
Pervious Total	0.38
Impervious Land Use	acre
Impervious,Flat(0-5)	0.51
Impervious Total	0.51
Basin Total	0.89

Element Flows To:

Surface	Interflow	Groundwater
MWS 4	MWS 4	

Routing Elements

Predeveloped Routing

Mitigated Routing

MWS 1

MWS Model Number:	MWS-L-6-8
Media Filter Rate (in/hr):	25

Element Flows To:

Outlet 1	Outlet 2
Vault 2	Vault 2

MWS Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
9.0000	0.000551	0.000000	0.000	0.000
9.0000	0.000551	0.000067	0.000	0.004
9.0000	0.000551	0.000202	0.000	0.008
9.0000	0.000551	0.000404	0.000	0.012
9.0000	0.000551	0.000673	0.000	0.016
9.0000	0.000551	0.001010	0.000	0.020
9.0000	0.000551	0.001413	0.000	0.025
9.0000	0.000551	0.001884	0.000	0.029
9.0000	0.000551	0.002423	0.000	0.033
9.0000	0.000551	0.003029	0.000	0.037
9.0000	0.000551	0.003702	0.000	0.041
9.0000	0.000551	0.004442	0.000	0.045
9.0000	0.000551	0.005249	0.000	0.049
9.0000	0.000551	0.006124	0.000	0.054
9.0000	0.000551	0.007067	0.000	0.058
9.0000	0.000551	0.008076	0.000	0.062
9.0000	0.000551	0.009153	0.000	0.066
9.0000	0.000551	0.010297	0.000	0.070
9.0000	0.000551	0.011508	0.000	0.074
9.0000	0.000551	0.012787	0.000	0.079
9.0000	0.000551	0.014133	0.000	0.083
9.0000	0.000551	0.015546	0.000	0.087
9.0000	0.000551	0.017027	0.000	0.091
9.0000	0.000551	0.018575	0.000	0.095
9.0000	0.000551	0.020190	0.000	0.099
9.0000	0.000551	0.021873	0.000	0.104
9.0000	0.000551	0.023622	0.000	0.108
9.0000	0.000551	0.025440	0.000	0.112
9.0000	0.000551	0.027324	0.000	0.116
9.0000	0.000551	0.029276	0.000	0.120
9.0000	0.000551	0.031295	0.000	0.124
9.0000	0.000551	0.033381	0.000	0.129
9.0000	0.000551	0.035535	0.000	0.133
9.0000	0.000551	0.037755	0.000	0.137
9.0000	0.000551	0.040044	0.000	0.141
9.0000	0.000551	0.042399	6.000	0.141

MWS 2

MWS Model Number: MWS-L-8-12
Media Filter Rate (in/hr): 25

Element Flows To:

Outlet 1	Outlet 2
Vault 2	Vault 2

MWS Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
11.000	0.001102	0.000000	0.000	0.000
11.000	0.001102	0.000130	0.000	0.009
11.000	0.001102	0.000391	0.000	0.019
11.000	0.001102	0.000782	0.000	0.029
11.000	0.001102	0.001303	0.000	0.039
11.000	0.001102	0.001954	0.000	0.049
11.000	0.001102	0.002736	0.000	0.058
11.000	0.001102	0.003648	0.000	0.068
11.000	0.001102	0.004690	0.000	0.078
11.000	0.001102	0.005863	0.000	0.088
11.000	0.001102	0.007166	0.000	0.098
11.000	0.001102	0.008599	0.000	0.107
11.000	0.001102	0.010163	0.000	0.117
11.000	0.001102	0.011856	0.000	0.127
11.000	0.001102	0.013680	0.000	0.137
11.000	0.001102	0.015635	0.000	0.147
11.000	0.001102	0.017719	0.000	0.157
11.000	0.001102	0.019934	0.000	0.166
11.000	0.001102	0.022279	0.000	0.176
11.000	0.001102	0.024755	0.000	0.186
11.000	0.001102	0.027361	0.000	0.196
11.000	0.001102	0.030097	0.000	0.206
11.000	0.001102	0.032963	0.000	0.215
11.000	0.001102	0.035960	0.000	0.225
11.000	0.001102	0.039087	0.000	0.235
11.000	0.001102	0.042344	0.000	0.245
11.000	0.001102	0.045732	0.000	0.255
11.000	0.001102	0.049249	0.000	0.264
11.000	0.001102	0.052897	0.000	0.274
11.000	0.001102	0.056676	0.000	0.284
11.000	0.001102	0.060585	0.000	0.294
11.000	0.001102	0.064623	0.000	0.304
11.000	0.001102	0.068793	0.000	0.314
11.000	0.001102	0.073092	0.000	0.323
11.000	0.001102	0.077522	0.000	0.333
11.000	0.001102	0.082082	6.000	0.333

MWS 3

MWS Model Number: MWS-L-8-20
Media Filter Rate (in/hr): 25

Element Flows To:

Outlet 1	Outlet 2
Vault 2	Vault 2

MWS Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
13.000	0.001837	0.000000	0.000	0.000
13.000	0.001837	0.000218	0.000	0.016
13.000	0.001837	0.000653	0.000	0.032
13.000	0.001837	0.001305	0.000	0.049
13.000	0.001837	0.002175	0.000	0.065
13.000	0.001837	0.003263	0.000	0.081
13.000	0.001837	0.004568	0.000	0.098
13.000	0.001837	0.006091	0.000	0.114
13.000	0.001837	0.007831	0.000	0.130
13.000	0.001837	0.009789	0.000	0.147
13.000	0.001837	0.011965	0.000	0.163
13.000	0.001837	0.014358	0.000	0.179
13.000	0.001837	0.016968	0.000	0.196
13.000	0.001837	0.019796	0.000	0.212
13.000	0.001837	0.022842	0.000	0.228
13.000	0.001837	0.026105	0.000	0.245
13.000	0.001837	0.029586	0.000	0.261
13.000	0.001837	0.033284	0.000	0.278
13.000	0.001837	0.037200	0.000	0.294
13.000	0.001837	0.041333	0.000	0.310
13.000	0.001837	0.045684	0.000	0.327
13.000	0.001837	0.050252	0.000	0.343
13.000	0.001837	0.055038	0.000	0.359
13.000	0.001837	0.060041	0.000	0.376
13.000	0.001837	0.065262	0.000	0.392
13.000	0.001837	0.070701	0.000	0.408
13.000	0.001837	0.076357	0.000	0.425
13.000	0.001837	0.082231	0.000	0.441
13.000	0.001837	0.088322	0.000	0.457
13.000	0.001837	0.094630	0.000	0.474
13.000	0.001837	0.101157	0.000	0.490
13.000	0.001837	0.107900	0.000	0.507
13.000	0.001837	0.114862	0.000	0.523
13.000	0.001837	0.122041	0.000	0.539
13.000	0.001837	0.129437	0.000	0.556
13.000	0.001837	0.137051	6.000	0.556

MWS 4

MWS Model Number: MWS-L-8-8
Media Filter Rate (in/hr): 25

Element Flows To:

Outlet 1	Outlet 2
Vault 2	Vault 2

MWS Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
10.000	0.000735	0.000000	0.000	0.000
10.000	0.000735	0.000086	0.000	0.006
10.000	0.000735	0.000258	0.000	0.013
10.000	0.000735	0.000515	0.000	0.019
10.000	0.000735	0.000859	0.000	0.026
10.000	0.000735	0.001289	0.000	0.032
10.000	0.000735	0.001804	0.000	0.039
10.000	0.000735	0.002405	0.000	0.045
10.000	0.000735	0.003093	0.000	0.052
10.000	0.000735	0.003866	0.000	0.058
10.000	0.000735	0.004725	0.000	0.065
10.000	0.000735	0.005670	0.000	0.072
10.000	0.000735	0.006701	0.000	0.078
10.000	0.000735	0.007817	0.000	0.085
10.000	0.000735	0.009020	0.000	0.091
10.000	0.000735	0.010309	0.000	0.098
10.000	0.000735	0.011683	0.000	0.104
10.000	0.000735	0.013143	0.000	0.111
10.000	0.000735	0.014690	0.000	0.117
10.000	0.000735	0.016322	0.000	0.124
10.000	0.000735	0.018040	0.000	0.130
10.000	0.000735	0.019844	0.000	0.137
10.000	0.000735	0.021734	0.000	0.143
10.000	0.000735	0.023710	0.000	0.150
10.000	0.000735	0.025771	0.000	0.157
10.000	0.000735	0.027919	0.000	0.163
10.000	0.000735	0.030152	0.000	0.170
10.000	0.000735	0.032472	0.000	0.176
10.000	0.000735	0.034877	0.000	0.183
10.000	0.000735	0.037368	0.000	0.189
10.000	0.000735	0.039946	0.000	0.196
10.000	0.000735	0.042609	0.000	0.202
10.000	0.000735	0.045358	0.000	0.209
10.000	0.000735	0.048192	0.000	0.215
10.000	0.000735	0.051113	0.000	0.222
10.000	0.000735	0.054120	6.000	0.222

Vault 2

Width:	48.6 ft.
Length:	48.6 ft.
Depth:	10.5 ft.
Discharge Structure	
Riser Height:	9 ft.
Riser Diameter:	18 in.
Notch Type:	Rectangular
Notch Width:	1.000 ft.
Notch Height:	1.000 ft.
Orifice 1 Diameter:	3.25 in. Elevation:0 ft.
Element Flows To:	
Outlet 1	Outlet 2

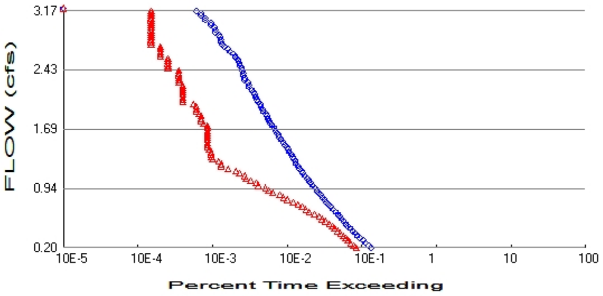
Vault Hydraulic Table

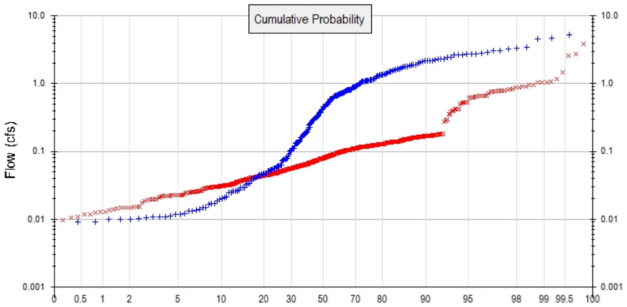
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.054	0.000	0.000	0.000
0.1167	0.054	0.006	0.097	0.000
0.2333	0.054	0.012	0.138	0.000
0.3500	0.054	0.019	0.169	0.000
0.4667	0.054	0.025	0.195	0.000
0.5833	0.054	0.031	0.218	0.000
0.7000	0.054	0.038	0.239	0.000
0.8167	0.054	0.044	0.259	0.000
0.9333	0.054	0.050	0.276	0.000
1.0500	0.054	0.056	0.293	0.000
1.1667	0.054	0.063	0.309	0.000
1.2833	0.054	0.069	0.324	0.000
1.4000	0.054	0.075	0.339	0.000
1.5167	0.054	0.082	0.353	0.000
1.6333	0.054	0.088	0.366	0.000
1.7500	0.054	0.094	0.379	0.000
1.8667	0.054	0.101	0.391	0.000
1.9833	0.054	0.107	0.403	0.000
2.1000	0.054	0.113	0.415	0.000
2.2167	0.054	0.120	0.426	0.000
2.3333	0.054	0.126	0.437	0.000
2.4500	0.054	0.132	0.448	0.000
2.5667	0.054	0.139	0.459	0.000
2.6833	0.054	0.145	0.469	0.000
2.8000	0.054	0.151	0.479	0.000
2.9167	0.054	0.158	0.489	0.000
3.0333	0.054	0.164	0.499	0.000
3.1500	0.054	0.170	0.508	0.000
3.2667	0.054	0.177	0.518	0.000
3.3833	0.054	0.183	0.527	0.000
3.5000	0.054	0.189	0.536	0.000
3.6167	0.054	0.196	0.545	0.000
3.7333	0.054	0.202	0.553	0.000
3.8500	0.054	0.208	0.562	0.000
3.9667	0.054	0.215	0.570	0.000
4.0833	0.054	0.221	0.579	0.000
4.2000	0.054	0.227	0.587	0.000
4.3167	0.054	0.234	0.595	0.000
4.4333	0.054	0.240	0.603	0.000

4.5500	0.054	0.246	0.611	0.000
4.6667	0.054	0.253	0.619	0.000
4.7833	0.054	0.259	0.626	0.000
4.9000	0.054	0.265	0.634	0.000
5.0167	0.054	0.272	0.642	0.000
5.1333	0.054	0.278	0.649	0.000
5.2500	0.054	0.284	0.656	0.000
5.3667	0.054	0.291	0.664	0.000
5.4833	0.054	0.297	0.671	0.000
5.6000	0.054	0.303	0.678	0.000
5.7167	0.054	0.310	0.685	0.000
5.8333	0.054	0.316	0.692	0.000
5.9500	0.054	0.322	0.699	0.000
6.0667	0.054	0.329	0.706	0.000
6.1833	0.054	0.335	0.712	0.000
6.3000	0.054	0.341	0.719	0.000
6.4167	0.054	0.347	0.726	0.000
6.5333	0.054	0.354	0.732	0.000
6.6500	0.054	0.360	0.739	0.000
6.7667	0.054	0.366	0.745	0.000
6.8833	0.054	0.373	0.752	0.000
7.0000	0.054	0.379	0.758	0.000
7.1167	0.054	0.385	0.764	0.000
7.2333	0.054	0.392	0.770	0.000
7.3500	0.054	0.398	0.777	0.000
7.4667	0.054	0.404	0.783	0.000
7.5833	0.054	0.411	0.789	0.000
7.7000	0.054	0.417	0.795	0.000
7.8167	0.054	0.423	0.801	0.000
7.9333	0.054	0.430	0.807	0.000
8.0500	0.054	0.436	0.850	0.000
8.1667	0.054	0.442	1.045	0.000
8.2833	0.054	0.449	1.327	0.000
8.4000	0.054	0.455	1.673	0.000
8.5167	0.054	0.461	2.073	0.000
8.6333	0.054	0.468	2.520	0.000
8.7500	0.054	0.474	3.010	0.000
8.8667	0.054	0.480	3.540	0.000
8.9833	0.054	0.487	4.106	0.000
9.1000	0.054	0.493	4.696	0.000
9.2167	0.054	0.499	5.778	0.000
9.3333	0.054	0.506	7.088	0.000
9.4500	0.054	0.512	8.371	0.000
9.5667	0.054	0.518	9.395	0.000
9.6833	0.054	0.525	10.04	0.000
9.8000	0.054	0.531	10.56	0.000
9.9167	0.054	0.537	11.01	0.000
10.033	0.054	0.544	11.44	0.000
10.150	0.054	0.550	11.84	0.000
10.267	0.054	0.556	12.22	0.000
10.383	0.054	0.563	12.58	0.000
10.500	0.054	0.569	12.93	0.000
10.617	0.054	0.575	13.27	0.000
10.733	0.000	0.000	13.59	0.000

Analysis Results

POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1

Total Pervious Area:	4.44
Total Impervious Area:	0

Mitigated Landuse Totals for POC #1

Total Pervious Area:	1.09
Total Impervious Area:	3.35

Flow Frequency Method: Cunnane

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	2.009035
5 year	2.71755
10 year	3.170826
25 year	4.622614

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.657276
5 year	0.920666
10 year	1.06427
25 year	2.608271

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.2009	2666	1688	63	Pass
0.2309	2450	1544	63	Pass
0.2609	2250	1416	62	Pass
0.2909	2063	1298	62	Pass
0.3209	1882	1212	64	Pass
0.3509	1729	1121	64	Pass
0.3809	1618	1039	64	Pass
0.4109	1505	949	63	Pass
0.4409	1401	866	61	Pass
0.4709	1294	804	62	Pass
0.5009	1216	731	60	Pass
0.5309	1138	655	57	Pass
0.5609	1072	580	54	Pass
0.5909	1010	535	52	Pass
0.6209	952	461	48	Pass
0.6509	890	392	44	Pass
0.6809	820	354	43	Pass
0.7109	762	316	41	Pass
0.7409	712	280	39	Pass
0.7709	663	239	36	Pass
0.8009	630	202	32	Pass
0.8309	589	179	30	Pass
0.8609	559	158	28	Pass
0.8909	527	128	24	Pass
0.9209	498	113	22	Pass
0.9509	473	102	21	Pass
0.9809	438	82	18	Pass
1.0109	414	77	18	Pass
1.0409	389	65	16	Pass
1.0709	372	56	15	Pass
1.1009	348	54	15	Pass
1.1309	326	46	14	Pass
1.1609	311	41	13	Pass
1.1909	293	32	10	Pass
1.2209	283	26	9	Pass
1.2509	262	26	9	Pass
1.2809	256	24	9	Pass
1.3109	245	20	8	Pass
1.3409	234	19	8	Pass
1.3709	226	19	8	Pass
1.4009	214	19	8	Pass
1.4309	205	18	8	Pass
1.4609	200	17	8	Pass
1.4909	186	17	9	Pass
1.5209	176	17	9	Pass
1.5509	165	17	10	Pass
1.5809	157	17	10	Pass
1.6109	153	17	11	Pass
1.6409	145	17	11	Pass
1.6709	139	17	12	Pass
1.7009	134	17	12	Pass
1.7309	125	17	13	Pass
1.7609	119	15	12	Pass

1.7909	114	14	12	Pass
1.8209	110	14	12	Pass
1.8509	106	14	13	Pass
1.8809	102	13	12	Pass
1.9109	95	12	12	Pass
1.9409	92	12	13	Pass
1.9709	88	12	13	Pass
2.0009	86	11	12	Pass
2.0309	81	8	9	Pass
2.0609	78	8	10	Pass
2.0909	75	8	10	Pass
2.1209	73	8	10	Pass
2.1509	71	8	11	Pass
2.1809	67	8	11	Pass
2.2109	62	8	12	Pass
2.2409	61	8	13	Pass
2.2708	60	7	11	Pass
2.3008	54	7	12	Pass
2.3308	53	7	13	Pass
2.3608	52	7	13	Pass
2.3908	52	7	13	Pass
2.4208	50	7	14	Pass
2.4508	49	5	10	Pass
2.4808	47	5	10	Pass
2.5108	46	5	10	Pass
2.5408	44	5	11	Pass
2.5708	42	5	11	Pass
2.6008	40	4	10	Pass
2.6308	38	4	10	Pass
2.6608	34	4	11	Pass
2.6908	32	4	12	Pass
2.7208	29	4	13	Pass
2.7508	27	3	11	Pass
2.7808	26	3	11	Pass
2.8108	26	3	11	Pass
2.8408	25	3	12	Pass
2.8708	24	3	12	Pass
2.9008	22	3	13	Pass
2.9308	22	3	13	Pass
2.9608	21	3	14	Pass
2.9908	19	3	15	Pass
3.0208	19	3	15	Pass
3.0508	16	3	18	Pass
3.0808	16	3	18	Pass
3.1108	14	3	21	Pass
3.1408	14	3	21	Pass
3.1708	12	3	25	Pass

Water Quality

POC 2

POC #2 was not reported because POC must exist in both scenarios and both scenarios must have been run.

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

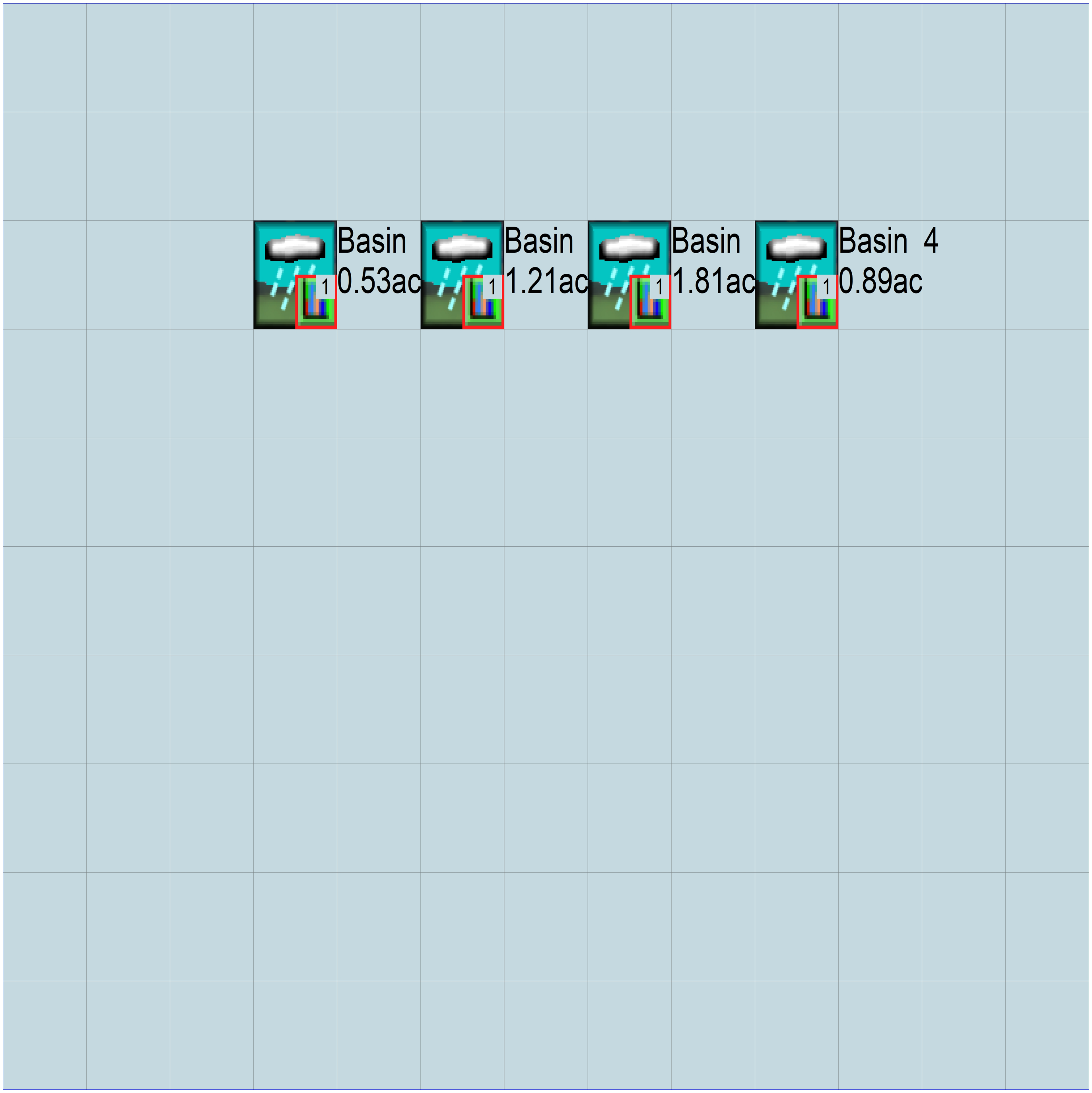
No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

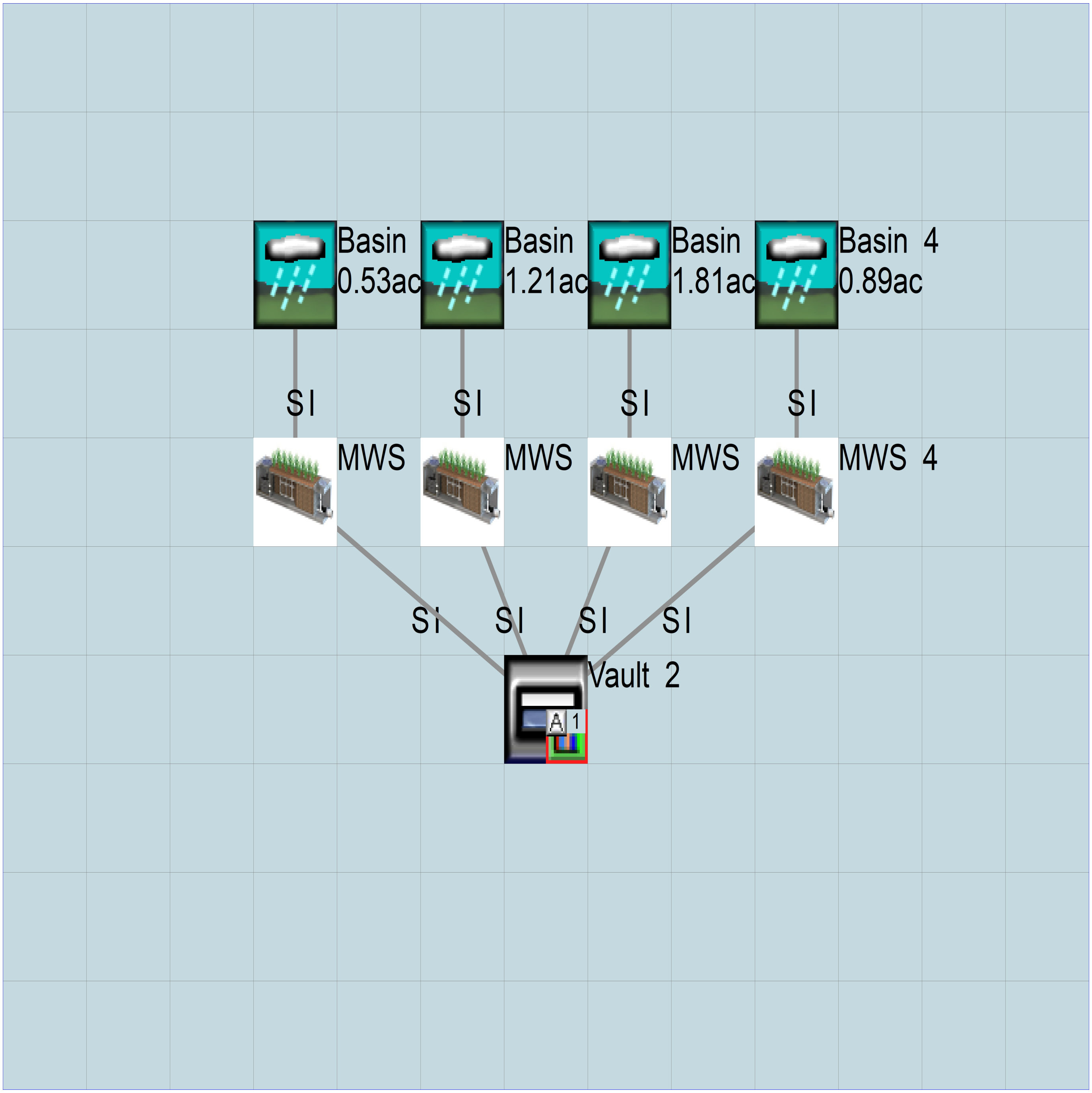
Appendix

Predeveloped Schematic



Basin
0.53ac
1
Basin
1.21ac
1
Basin
1.81ac
1
Basin 4
0.89ac
1

Mitigated Schematic


Basin
0.53ac
Basin
1.21ac
Basin
1.81ac
Basin 4
0.89ac
SI
SI
SI
SI
MWS
MWS
MWS
MWS 4
SI
SI
SI
SI
Vault 2
A
1

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1949 10 01        END    2006 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                             ***
WDM        26   117-011 Freedom Lane SOHM.wdm
MESSU      25   Pre117-011 Freedom Lane SOHM.MES
           27   Pre117-011 Freedom Lane SOHM.L61
           28   Pre117-011 Freedom Lane SOHM.L62
           30   POC117-011 Freedom Lane SOHM1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      43
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                    MAX                   1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                            User  t-series Engl Metr ***
                                             in  out           ***
   43     D,Open Brush,Steep      1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   43         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   43         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   43         0    0    0    1    0    0    0    0    1    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   43              0         4     0.025       300      0.15       0.8     0.955
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   43             40        35         4         2         0      0.03         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   43              0      0.45      0.25       0.6       0.4         0
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   43       0.4  0.4  0.4  0.5 0.55 0.55 0.55 0.55 0.55 0.55 0.45  0.4
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   43      0.12 0.12 0.12 0.12 0.12 0.12 0.12 0.12 0.12 0.12 0.12 0.12
  END MON-INTERCEP

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   43              0         0     0.045         0       0.8       0.3      0.01
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2
  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  43                        0.53     COPY   501     12
PERLND  43                        0.53     COPY   501     13
Basin  2***
PERLND  43                        1.21     COPY   501     12
PERLND  43                        1.21     COPY   501     13
Basin  3***
PERLND  43                        1.81     COPY   501     12
PERLND  43                        1.81     COPY   501     13
Basin  4***
PERLND  43                        0.89     COPY   501     12
PERLND  43                        0.89     COPY   501     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                           in  out                           ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1949 10 01        END    2006 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM        26   117-011 Freedom Lane SOHM.wdm
MESSU      25   Mit117-011 Freedom Lane SOHM.MES
           27   Mit117-011 Freedom Lane SOHM.L61
           28   Mit117-011 Freedom Lane SOHM.L62
           30   POC117-011 Freedom Lane SOHM1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      61
      IMPLND       1
      RCHRES       1
      RCHRES       2
      RCHRES       3
      RCHRES       4
      RCHRES       5
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Vault  2                     MAX                     1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   61      D,Urban,Flat(0-5%)      1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   61         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   61         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   61         0    0    0    1    0    0    0    0    1    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   61             0       4.4      0.04       400      0.05       0.8     0.955
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   61            40        35         4         2         0      0.03         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   61             0       0.7      0.25         3       0.7         0
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   61       0.5  0.5  0.5  0.6 0.65 0.65 0.65 0.65 0.65 0.65 0.55  0.5
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   61      0.12 0.12 0.12 0.12 0.12 0.12 0.12 0.12 0.12 0.12 0.12 0.12
  END MON-INTERCEP

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   61             0         0      0.07         0      0.88       0.3      0.01
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
    1     Impervious,Flat(0-5)    1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
  END PRINT-INFO
  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            100      0.05       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  61                        0.15     RCHRES   1      2
PERLND  61                        0.15     RCHRES   1      3
IMPLND   1                        0.38     RCHRES   1      5
Basin  2***
PERLND  61                         0.3     RCHRES   2      2
PERLND  61                         0.3     RCHRES   2      3
IMPLND   1                        0.91     RCHRES   2      5
Basin  3***
PERLND  61                        0.26     RCHRES   3      2
PERLND  61                        0.26     RCHRES   3      3
IMPLND   1                        1.55     RCHRES   3      5
Basin  4***
PERLND  61                        0.38     RCHRES   4      2
PERLND  61                        0.38     RCHRES   4      3
IMPLND   1                        0.51     RCHRES   4      5

******Routing******
RCHRES   1                           1     RCHRES   5      7
RCHRES   1                                 COPY     1     17
RCHRES   1                           1     RCHRES   5      8
RCHRES   1                                 COPY     1     18
RCHRES   2                           1     RCHRES   5      7
RCHRES   2                                 COPY     1     17
RCHRES   2                           1     RCHRES   5      8
RCHRES   2                                 COPY     1     18
RCHRES   3                           1     RCHRES   5      7
RCHRES   3                                 COPY     1     17
RCHRES   3                           1     RCHRES   5      8
RCHRES   3                                 COPY     1     18
RCHRES   4                           1     RCHRES   5      7
RCHRES   4                                 COPY     1     17
RCHRES   4                           1     RCHRES   5      8
RCHRES   4                                 COPY     1     18
RCHRES   5                           1     COPY   501     16
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
```

```
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                           in  out                           ***
    1     MWS  1                  2    1    1    1   28    0    1
    2     MWS  2                  2    1    1    1   28    0    1
    3     MWS  3                  2    1    1    1   28    0    1
    4     MWS  4                  2    1    1    1   28    0    1
    5     Vault  2                1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
    3         1    0    0    0    0    0    0    0    0    0
    4         1    0    0    0    0    0    0    0    0    0
    5         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
    3         4    0    0    0    0    0    0    0    0    0    1    9
    4         4    0    0    0    0    0    0    0    0    0    1    9
    5         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
    1        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    2        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    3        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    4        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    5        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1             1      0.01       0.0       9.0       0.5       0.0
    2             2      0.01       0.0      11.0       0.5       0.0
    3             3      0.01       0.0      13.0       0.5       0.0
    4             4      0.01       0.0      10.0       0.5       0.0
    5             5      0.01       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    3            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    4            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    5            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   36    5
     Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
      (ft)   (acres) (acre-ft)    (cfs)     (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.000551  0.000000  0.000000  0.000000
  0.100000  0.000551  0.000067  0.000000  0.004162
  0.200000  0.000551  0.000202  0.000000  0.008324
  0.300000  0.000551  0.000404  0.000000  0.012486
  0.400000  0.000551  0.000673  0.000000  0.016648
  0.500000  0.000551  0.001010  0.000000  0.020810
  0.600000  0.000551  0.001413  0.000000  0.024971
  0.700000  0.000551  0.001884  0.000000  0.029133
  0.800000  0.000551  0.002423  0.000000  0.033295
  0.900000  0.000551  0.003029  0.000000  0.037457
  1.000000  0.000551  0.003702  0.000000  0.041619
  1.100000  0.000551  0.004442  0.000000  0.045781
  1.200000  0.000551  0.005249  0.000000  0.049943
  1.300000  0.000551  0.006124  0.000000  0.054105
  1.400000  0.000551  0.007067  0.000000  0.058267
  1.500000  0.000551  0.008076  0.000000  0.062429
  1.600000  0.000551  0.009153  0.000000  0.066590
  1.700000  0.000551  0.010297  0.000000  0.070752
  1.800000  0.000551  0.011508  0.000000  0.074914
  1.900000  0.000551  0.012787  0.000000  0.079076
  2.000000  0.000551  0.014133  0.000000  0.083238
  2.100000  0.000551  0.015546  0.000000  0.087400
  2.200000  0.000551  0.017027  0.000000  0.091562
  2.300000  0.000551  0.018575  0.000000  0.095724
  2.400000  0.000551  0.020190  0.000000  0.099886
  2.500000  0.000551  0.021873  0.000000  0.104048
  2.600000  0.000551  0.023622  0.000000  0.108210
  2.700000  0.000551  0.025440  0.000000  0.112371
  2.800000  0.000551  0.027324  0.000000  0.116533
  2.900000  0.000551  0.029276  0.000000  0.120695
  3.000000  0.000551  0.031295  0.000000  0.124857
  3.100000  0.000551  0.033381  0.000000  0.129019
  3.200000  0.000551  0.035535  0.000000  0.133181
  3.300000  0.000551  0.037755  0.000000  0.137343
  3.400000  0.000551  0.040044  0.000000  0.141505
  4.400000  0.000551  0.042399  6.000000  0.141505
  END FTABLE  1
  FTABLE      2
   36    5
     Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
      (ft)   (acres) (acre-ft)    (cfs)     (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.001102  0.000000  0.000000  0.000000
  0.100000  0.001102  0.000130  0.000000  0.009812
  0.200000  0.001102  0.000391  0.000000  0.019624
  0.300000  0.001102  0.000782  0.000000  0.029436
  0.400000  0.001102  0.001303  0.000000  0.039248
  0.500000  0.001102  0.001954  0.000000  0.049061
  0.600000  0.001102  0.002736  0.000000  0.058873
  0.700000  0.001102  0.003648  0.000000  0.068685
  0.800000  0.001102  0.004690  0.000000  0.078497
  0.900000  0.001102  0.005863  0.000000  0.088309
  1.000000  0.001102  0.007166  0.000000  0.098121
  1.100000  0.001102  0.008599  0.000000  0.107933
  1.200000  0.001102  0.010163  0.000000  0.117745
  1.300000  0.001102  0.011856  0.000000  0.127557
  1.400000  0.001102  0.013680  0.000000  0.137370
  1.500000  0.001102  0.015635  0.000000  0.147182
  1.600000  0.001102  0.017719  0.000000  0.156994
  1.700000  0.001102  0.019934  0.000000  0.166806
```

```
1.800000  0.001102  0.022279  0.000000  0.176618
1.900000  0.001102  0.024755  0.000000  0.186430
2.000000  0.001102  0.027361  0.000000  0.196242
2.100000  0.001102  0.030097  0.000000  0.206054
2.200000  0.001102  0.032963  0.000000  0.215866
2.300000  0.001102  0.035960  0.000000  0.225679
2.400000  0.001102  0.039087  0.000000  0.235491
2.500000  0.001102  0.042344  0.000000  0.245303
2.600000  0.001102  0.045732  0.000000  0.255115
2.700000  0.001102  0.049249  0.000000  0.264927
2.800000  0.001102  0.052897  0.000000  0.274739
2.900000  0.001102  0.056676  0.000000  0.284551
3.000000  0.001102  0.060585  0.000000  0.294363
3.100000  0.001102  0.064623  0.000000  0.304175
3.200000  0.001102  0.068793  0.000000  0.313988
3.300000  0.001102  0.073092  0.000000  0.323800
3.400000  0.001102  0.077522  0.000000  0.333612
4.400000  0.001102  0.082082  6.000000  0.333612
END FTABLE  2
FTABLE      3
 36    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)     (cfs)   (ft/sec)    (Minutes)***
0.000000  0.001837  0.000000  0.000000  0.000000
0.100000  0.001837  0.000218  0.000000  0.016354
0.200000  0.001837  0.000653  0.000000  0.032707
0.300000  0.001837  0.001305  0.000000  0.049061
0.400000  0.001837  0.002175  0.000000  0.065414
0.500000  0.001837  0.003263  0.000000  0.081768
0.600000  0.001837  0.004568  0.000000  0.098121
0.700000  0.001837  0.006091  0.000000  0.114475
0.800000  0.001837  0.007831  0.000000  0.130828
0.900000  0.001837  0.009789  0.000000  0.147182
1.000000  0.001837  0.011965  0.000000  0.163535
1.100000  0.001837  0.014358  0.000000  0.179889
1.200000  0.001837  0.016968  0.000000  0.196242
1.300000  0.001837  0.019796  0.000000  0.212596
1.400000  0.001837  0.022842  0.000000  0.228949
1.500000  0.001837  0.026105  0.000000  0.245303
1.600000  0.001837  0.029586  0.000000  0.261656
1.700000  0.001837  0.033284  0.000000  0.278010
1.800000  0.001837  0.037200  0.000000  0.294363
1.900000  0.001837  0.041333  0.000000  0.310717
2.000000  0.001837  0.045684  0.000000  0.327070
2.100000  0.001837  0.050252  0.000000  0.343424
2.200000  0.001837  0.055038  0.000000  0.359777
2.300000  0.001837  0.060041  0.000000  0.376131
2.400000  0.001837  0.065262  0.000000  0.392484
2.500000  0.001837  0.070701  0.000000  0.408838
2.600000  0.001837  0.076357  0.000000  0.425192
2.700000  0.001837  0.082231  0.000000  0.441545
2.800000  0.001837  0.088322  0.000000  0.457899
2.900000  0.001837  0.094630  0.000000  0.474252
3.000000  0.001837  0.101157  0.000000  0.490606
3.100000  0.001837  0.107900  0.000000  0.506959
3.200000  0.001837  0.114862  0.000000  0.523313
3.300000  0.001837  0.122041  0.000000  0.539666
3.400000  0.001837  0.129437  0.000000  0.556020
4.400000  0.001837  0.137051  6.000000  0.556020
END FTABLE  3
FTABLE      4
 36    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)     (cfs)   (ft/sec)    (Minutes)***
0.000000  0.000735  0.000000  0.000000  0.000000
0.100000  0.000735  0.000086  0.000000  0.006541
0.200000  0.000735  0.000258  0.000000  0.013083
0.300000  0.000735  0.000515  0.000000  0.019624
0.400000  0.000735  0.000859  0.000000  0.026166
0.500000  0.000735  0.001289  0.000000  0.032707
```

```
0.600000  0.000735  0.001804  0.000000  0.039248
0.700000  0.000735  0.002405  0.000000  0.045790
0.800000  0.000735  0.003093  0.000000  0.052331
0.900000  0.000735  0.003866  0.000000  0.058873
1.000000  0.000735  0.004725  0.000000  0.065414
1.100000  0.000735  0.005670  0.000000  0.071955
1.200000  0.000735  0.006701  0.000000  0.078497
1.300000  0.000735  0.007817  0.000000  0.085038
1.400000  0.000735  0.009020  0.000000  0.091580
1.500000  0.000735  0.010309  0.000000  0.098121
1.600000  0.000735  0.011683  0.000000  0.104663
1.700000  0.000735  0.013143  0.000000  0.111204
1.800000  0.000735  0.014690  0.000000  0.117745
1.900000  0.000735  0.016322  0.000000  0.124287
2.000000  0.000735  0.018040  0.000000  0.130828
2.100000  0.000735  0.019844  0.000000  0.137370
2.200000  0.000735  0.021734  0.000000  0.143911
2.300000  0.000735  0.023710  0.000000  0.150452
2.400000  0.000735  0.025771  0.000000  0.156994
2.500000  0.000735  0.027919  0.000000  0.163535
2.600000  0.000735  0.030152  0.000000  0.170077
2.700000  0.000735  0.032472  0.000000  0.176618
2.800000  0.000735  0.034877  0.000000  0.183159
2.900000  0.000735  0.037368  0.000000  0.189701
3.000000  0.000735  0.039946  0.000000  0.196242
3.100000  0.000735  0.042609  0.000000  0.202784
3.200000  0.000735  0.045358  0.000000  0.209325
3.300000  0.000735  0.048192  0.000000  0.215866
3.400000  0.000735  0.051113  0.000000  0.222408
4.400000  0.000735  0.054120  6.000000  0.222408
END FTABLE  4
FTABLE      5
 92    4
   Depth      Area    Volume  Outflow1 Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
0.000000  0.050712  0.000000  0.000000
0.100000  0.050712  0.005071  0.021968
0.200000  0.050712  0.010142  0.031068
0.300000  0.050712  0.015213  0.038050
0.400000  0.050712  0.020285  0.043937
0.500000  0.050712  0.025356  0.049123
0.600000  0.050712  0.030427  0.053811
0.700000  0.050712  0.035498  0.058123
0.800000  0.050712  0.040569  0.062136
0.900000  0.050712  0.045640  0.065905
1.000000  0.050712  0.050712  0.069470
1.100000  0.050712  0.055783  0.072861
1.200000  0.050712  0.060854  0.076101
1.300000  0.050712  0.065925  0.079208
1.400000  0.050712  0.070996  0.082198
1.500000  0.050712  0.076067  0.085083
1.600000  0.050712  0.081139  0.087874
1.700000  0.050712  0.086210  0.090578
1.800000  0.050712  0.091281  0.093204
1.900000  0.050712  0.096352  0.095758
2.000000  0.050712  0.101423  0.098246
2.100000  0.050712  0.106494  0.100672
2.200000  0.050712  0.111566  0.103041
2.300000  0.050712  0.116637  0.105357
2.400000  0.050712  0.121708  0.107623
2.500000  0.050712  0.126779  0.109842
2.600000  0.050712  0.131850  0.112017
2.700000  0.050712  0.136921  0.114151
2.800000  0.050712  0.141993  0.116246
2.900000  0.050712  0.147064  0.118304
3.000000  0.050712  0.152135  0.120326
3.100000  0.050712  0.157206  0.122315
3.200000  0.050712  0.162277  0.124272
3.300000  0.050712  0.167348  0.126199
3.400000  0.050712  0.172420  0.128097
```

```
  3.500000  0.050712  0.177491  0.129967
  3.600000  0.050712  0.182562  0.131810
  3.700000  0.050712  0.187633  0.133629
  3.800000  0.050712  0.192704  0.135422
  3.900000  0.050712  0.197775  0.137193
  4.000000  0.050712  0.202847  0.138940
  4.100000  0.050712  0.207918  0.140666
  4.200000  0.050712  0.212989  0.142372
  4.300000  0.050712  0.218060  0.144057
  4.400000  0.050712  0.223131  0.145722
  4.500000  0.050712  0.228202  0.147369
  4.600000  0.050712  0.233274  0.148997
  4.700000  0.050712  0.238345  0.150608
  4.800000  0.050712  0.243416  0.152202
  4.900000  0.050712  0.248487  0.153779
  5.000000  0.050712  0.253558  0.155340
  5.100000  0.050712  0.258629  0.156886
  5.200000  0.050712  0.263701  0.158416
  5.300000  0.050712  0.268772  0.159932
  5.400000  0.050712  0.273843  0.161434
  5.500000  0.050712  0.278914  0.162922
  5.600000  0.050712  0.283985  0.164397
  5.700000  0.050712  0.289056  0.165858
  5.800000  0.050712  0.294128  0.167306
  5.900000  0.050712  0.299199  0.168743
  6.000000  0.050712  0.304270  0.170167
  6.100000  0.050712  0.309341  0.171579
  6.200000  0.050712  0.314412  0.172979
  6.300000  0.050712  0.319483  0.174369
  6.400000  0.050712  0.324555  0.175747
  6.500000  0.050712  0.329626  0.177115
  6.600000  0.050712  0.334697  0.178472
  6.700000  0.050712  0.339768  0.179819
  6.800000  0.050712  0.344839  0.181156
  6.900000  0.050712  0.349910  0.182483
  7.000000  0.050712  0.354982  0.183801
  7.100000  0.050712  0.360053  0.290413
  7.200000  0.050712  0.365124  0.484252
  7.300000  0.050712  0.370195  0.734873
  7.400000  0.050712  0.375266  1.031410
  7.500000  0.050712  0.380337  1.367585
  7.600000  0.050712  0.385409  1.739160
  7.700000  0.050712  0.390480  2.143027
  7.800000  0.050712  0.395551  2.576774
  7.900000  0.050712  0.400622  3.038463
  8.000000  0.050712  0.405693  3.526491
  8.100000  0.050712  0.410764  4.197957
  8.200000  0.050712  0.415836  5.415609
  8.300000  0.050712  0.420907  6.951329
  8.400000  0.050712  0.425978  8.665936
  8.500000  0.050712  0.431049  10.42007
  8.600000  0.050712  0.436120  12.07372
  8.700000  0.050712  0.441191  13.50272
  8.800000  0.050712  0.446263  14.62371
  8.900000  0.050712  0.451334  15.42506
  9.000000  0.050712  0.456405  16.00235
  9.100000  0.050712  0.461476  16.75300
  END FTABLE  5
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP
WDM     22 IRRG     ENGL    0.7       SAME PERLND  61     EXTNL  SURLI
WDM      2 PREC     ENGL    1              RCHRES   1     EXTNL  PREC
WDM      2 PREC     ENGL    1              RCHRES   2     EXTNL  PREC
WDM      2 PREC     ENGL    1              RCHRES   3     EXTNL  PREC
WDM      2 PREC     ENGL    1              RCHRES   4     EXTNL  PREC
WDM      1 EVAP     ENGL    1              RCHRES   1     EXTNL  POTEV
WDM      1 EVAP     ENGL    1              RCHRES   2     EXTNL  POTEV
WDM      1 EVAP     ENGL    1              RCHRES   3     EXTNL  POTEV
WDM      1 EVAP     ENGL    1              RCHRES   4     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   5 HYDR   RO      1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   5 HYDR   STAGE   1 1        1      WDM   1001 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN    1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN    1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        7
RCHRES     OFLOW  OVOL   1                  RCHRES         INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                  RCHRES         INFLOW IVOL
  END MASS-LINK    8

  MASS-LINK       16
RCHRES     ROFLOW                           COPY           INPUT  MEAN
  END MASS-LINK   16

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                  COPY           INPUT  MEAN
  END MASS-LINK   17

  MASS-LINK       18
RCHRES     OFLOW  OVOL   2                  COPY           INPUT  MEAN
  END MASS-LINK   18


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

Legal Notice

This program and accompanying documentation are provided 'as-is' without warranty of any kind. The entire risk regarding the performance and results of this program is assumed by End User. Clear Creek Solutions Inc. and the governmental licensee or sublicensees disclaim all warranties, either expressed or implied, including but not limited to implied warranties of program and accompanying documentation. In no event shall Clear Creek Solutions Inc. be liable for any damages whatsoever (including without limitation to damages for loss of business profits, loss of business information, business interruption, and the like) arising out of the use of, or inability to use this program even if Clear Creek Solutions Inc. or their authorized representatives have been advised of the possibility of such damages. Software Copyright © by : Clear Creek Solutions, Inc. 2005-2025; All Rights Reserved.

Clear Creek Solutions, Inc.
6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
Local (360)943-0304

www.clearcreeksolutions.com

APPENDIX D

SA GEOTECHNICAL
OPTIMIZED SOIL ENGINEERING

June 3, 2024

Project No. 24064-01

To:	Meritage Homes 5 Peters Canyon Road, Suite 310 Irvine, California 92606
Attention:	Ms. Johanna Crooker
Subject:	Geotechnical Exploration and Preliminary Design Recommendations, Proposed Residential Development, 400 - 700 Freedom Lane, Lots 2 through 5 of Tract No. 18080, City of Aliso Viejo, California

At your request, SA Geotechnical, Inc. (SA GEO) has conducted a geotechnical subsurface exploration and due diligence study for the subject proposed residential development at 400 - 700 Freedom Lane in the City of Aliso Viejo, California (Figure 1), legally described as Lots 2 through 5 of Tract No. 18080, Assessor's Parcel Numbers (APNs) 632-141-12, -13, -14, and -15. The purpose of this study was to evaluate the geotechnical site conditions considering the proposed grading and improvements in order to provide a geotechnical summary and preliminary geotechnical recommendations for project design, grading, and construction. Our evaluation included review of background geologic and geotechnical engineering maps and reports for the subject site; a site-specific subsurface exploration; laboratory testing; geotechnical analysis and preparation of this report.

The subject site was previously mass graded during the 1980s but has remained undeveloped since that time. No documentation of this grading was recovered during our archive search of City records. Based on our exploration, the mass grading resulted in bedrock at or near existing grades throughout a majority of the site, while the southeastern corner of the site and southerly slope was filled to current grades. The primary geotechnical constraints include the presence of friable sands prone to caving in steep-sided excavations (Niguel Formation), presence of highly expansive earth materials (Monterey Formation) within the northern portion of the site, existing onsite utilities that must be protected in place during grading, and the potential for seismic shaking during a strong seismic event. Groundwater was not encountered during this or prior subsurface exploration to a maximum depth of 75 feet. Seepage was encountered at depths ranging from 18.5 to 27 feet below ground surface in one boring (B-2).

This report presents our findings, conclusions, and preliminary design recommendations for the proposed residential development. Based on our review, the proposed grading and development is considered geotechnically feasible provided the recommendations in this report are implemented during design, grading, and construction. Additional geotechnical evaluation and analysis will need to be performed once the project plans for grading, utility improvements and foundations are developed. Stormwater infiltration at the subject site is not considered feasible from a geotechnical viewpoint.

References pertinent to the site are included in Appendix A. Boring and test pit logs are included in Appendix B. Laboratory test data is included in Appendix C. Seismic design parameters are presented in Appendix D. Slope stability analysis is attached as Appendix E. General earthwork and grading specifications are presented in Appendix F.

If you have any questions regarding this report, please contact our office. We appreciate the opportunity to provide our services.

Respectfully submitted,

SA GEOTECHNICAL, INC.

Anthony Zepeda, CEG 2681
Project Geologist

Reza Saberi, GE 3071
Principal Engineer

Peter

Peter Anderson, CEG 2596
Principal Engineering Geologist

CERTIFIED ENGINEERING GEOLOGIST
ANTHONY L. ZEPEDA
CEG No. 2681
STATE OF CALIFORNIA

CERTIFIED ENGINEERING GEOLOGIST
PETER G. ANDERSON
No. 2596
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER
MOHAMMAD REZA SABERI
No. 3071
GEOTECHNICAL
STATE OF CALIFORNIA

TABLE OF CONTENTS

EXECUTIVE SUMMARY 1
1.0 INTRODUCTION 2
1.1 Introduction and Scope of Services 2
1.2 Site Condition and History 2
1.3 Proposed Grading and Improvements 4
1.4 Prior Geotechnical Studies 4
1.5 Subsurface Exploration 4
1.6 Laboratory Testing 5
2.0 GEOTECHNICAL FINDINGS 6
2.1 Geologic Setting and Earth Units 6
2.2 Geotechnical Conditions 7
2.3 Groundwater and Surface Water 8
2.4 Regional Faulting and Seismicity 8
2.5 Slope Stability 9
2.6 Settlement and Foundation Considerations 9
2.7 Stormwater Infiltration Feasibility 10
2.8 Shrinkage and Bulking 10
2.9 Existing Utilities 10
3.0 CONCLUSION AND PRELIMINARY RECOMMENDATIONS 11
3.1 General Conclusion and Recommendation 11
3.2 Site Preparation and Earthwork 11
3.2.1 Site Demolition and Clearing 11
3.2.2 Protection of Existing Improvements and Utilities 11
3.2.3 Remedial Grading Measures 12
3.2.4 Placement of Oversize Material 12
3.2.5 Fill Placement 13
3.2.6 Import 13
3.3 Settlement Potential 13
3.4 Foundation Design 14
3.5 Caisson Design 15
3.6 Retaining Wall Design and Lateral Earth Pressures 16
3.7 Seismic Design Parameters 17
3.8 Slope Stability and Slope Setback 18
3.9 Corrosivity 18
3.10 Expansion Potential 19
3.11 Interior Slab Moisture Mitigation 19
3.12 Exterior Concrete 20
3.13 Preliminary Asphalt Concrete Pavement Design 20
3.14 Vehicular PCC Pavements 21
3.15 Concrete Paver Section 21
3.16 Trench Excavation and Backfill 22
3.17 Groundwater 23
3.18 Stormwater Infiltration Feasibility 23
3.19 Surface Drainage and Irrigation 23
3.20 Slope Maintenance, Lot Drainage, and Erosion Control 24
3.21 Additional Subsurface Exploration and Laboratory Testing 24
3.22 Review of Future Plans 24
3.23 Observation and Testing during Grading and Construction 24
4.0 LIMITATIONS 26

TABLE OF CONTENTS (Continued)

List of Illustrations

Figure 1 – Site Location Map – Rear of Text
Figure 2 – Regional Geologic Map – Rear of Text
Figure 3 – Regional Fault Map – Rear of Text
Figure 4 – Retaining Wall Drainage Detail – Rear of Text

Appendices

Appendix A – References
Appendix B – Boring and Test Pit Logs
Appendix C – Laboratory Test Results,
Appendix D – Seismicity Data
Appendix E – Slope Stability Analysis
Appendix F – General Earthwork and Grading Specifications

Plates

Plate 1 – Geotechnical Map – Rear of Appendices
Plate 2 – Remedial Measures Map – Rear of Appendices
Plates 3 and 4 – Geotechnical Cross Sections A-A' and B-B' – Rear of Appendices

EXECUTIVE SUMMARY

The subject site is underlain by bedrock of the Niguel and Monterey Formations and partially by artificial fill material as a result of mass grading in the 1980s. The majority of the site is underlain by bedrock at or near existing grades. The southerly perimeter and southeastern corner of the site were brought to current grades with compacted artificial fill. The artificial fill materials generally consisted of yellowish brown, brown, olive brown, and grayish brown fine to medium-grained, sand that was damp to very moist, and medium dense. Bedrock of the Niguel and Monterey Formations were encountered during our exploration. The Niguel Formation generally consisted of silty to clean sandstone with minor amounts of siltstone; the Monterey Formation consisted of diatomaceous clayey siltstone with minor amounts of silty sandstone.

The primary geotechnical constraints for the proposed site redevelopment include the following:

- Presence of highly expansive earth materials (Monterey Formation) within the northern portion of the site;
- Presence of friable sands prone to caving in steep-sided excavations;
- Existing onsite utilities that must be protected in place; and,
- Potential for strong seismic shaking during an earthquake event.

Remedial grading for the site should consist of the removal and recompaction of all undocumented fill materials and near-surface weathered/disturbed or highly faulted bedrock. In general, remedial removals are anticipated to range from 1 to 7 feet below existing grades. Remedial removal/overexcavation within the building pads is recommended 3 to 5 feet below design grades or existing grades, whichever is lower. For areas underlain by faulted, highly expansive diatomaceous bedrock (Monterey Formation), we recommended a 7-foot removal/overexcavation. Remedial grading within the proposed drive areas may be limited to removal and recompaction of the upper 1 to 2 feet (see Plate 2).

Static groundwater was not encountered during our exploration. Seepage was encountered in Boring B-2 at depths between 18.5 and 27 feet below ground surface. In general, groundwater is anticipated to remain more than 20 feet below design grades upon the completion of grading. However, seepage/groundwater may be present at shallow depth locally and fluctuates on an annual and seasonal basis.

Building foundations and slabs should be designed to tolerate a total settlement of 1-inch and differential settlement of ½-inch over a span of 40 feet. The site is categorized as Site Class "C" for seismic design. Onsite soils are anticipated to have "Medium" expansion potential at the completion of grading. Onsite soils are not anticipated to be corrosive to concrete but are anticipated to be corrosive to metals.

Based on our findings, we conclude that the proposed residential development is feasible from a geotechnical viewpoint, provided it is designed and constructed in accordance with the recommendations presented in this report and any future design/plan review reports. The site is not considered suitable for infiltration of stormwater.

1.0 INTRODUCTION

1.1 Introduction and Scope of Services

At your request, SA Geotechnical, Inc. (SA GEO) has conducted geotechnical exploration and due diligence study for the subject proposed residential development at 400-700 Freedom Lane in the city of Aliso Viejo, California (Figure 1). The purpose of our review was to assess the onsite geologic and geotechnical conditions and provide preliminary recommendations for design, grading, and construction of the proposed improvements. We have reviewed the Conceptual Site Plan, dated May 2024, and the site topographic survey prepared by X Engineering & Consulting, Inc., received on May 15, 2024, which was used as the base for our Geotechnical Map and Remedial Measures Map (Plates 1 and 2). The Conceptual Site Plan was also used as the base for our Remedial Measures Map (Plate 2).

Our scope of services for this study included the following tasks:

- Review of available geologic and geotechnical maps, reports, and data for the subject site and surrounding area, including an archive search of City of Aliso Viejo records. A list of references is included in Appendix A.
- Review of available historic aerial photographs dating back to 1931.
- Subsurface exploration consisting of two bucker auger borings (B-1 and B-2) to depths of 65 and 75 feet bgs, twelve test pits (TP-1 through TP-3, TP-3a, TP-3b, and TP-4 through TP-10) to depths ranging from 4 to 14 feet bgs, and three hand auger borings (HA-1 through HA-3) to depths ranging from 10 to 13 feet below ground surface (bgs).
- Laboratory testing of selected samples to determine engineering properties of onsite soils, including in-situ moisture and density, grain size distribution, Atterberg limits, consolidation, shear strength, maximum density and optimum moisture content, expansion potential, and soluble sulfate content.
- Geotechnical evaluation and analysis of the compiled data regarding the proposed grading and development.
- Evaluation of faulting, seismicity, and seismic and static settlement in accordance with the 2022 California Building Code (CBC).
- Preparation of this report including our findings, conclusions, preliminary recommendations, and accompanying illustrations.
- Consultations with the project team.

SA GEO's expertise and scope of services do not include assessment of potential subsurface environmental contaminants or environmental health hazards.

1.2 Site Condition and History

The approximately 7.1-acre (4.3 net acres), roughly triangular-shaped site is located in Aliso Viejo, California (Figure 1), and is legally described as Lots 2 through 5 of Tract No. 18080, Assessor's Parcel Numbers (APNs) 632-141-12, -13, -14, and -15. The site is bound to the north by Freedom Lane, Belmont Village Senior Living to the east, undeveloped land to the west, and to the south by a Moulton Niguel Water District reservoir tank.

Overall site topography is relatively flat, with grade changes on the order of 5 feet, aside from an approximately 12-foot-high stockpile in the northern portion of the site. An approximately 5- to 6-foot-deep temporary desilting basin is present in the eastern portion of the site. A descending slope is present along the entire southern portion of the property approximately 40 to 70 feet in height, extending beyond the property boundary. The slope is generally 2H:1V (horizontal:vertical) or flatter, and includes terrace drains (v-ditches) every 30 vertical feet. During our site reconnaissance we observed the presence of scattered 2- to 4- foot-diameter boulders at the ground surface, presumed to have been placed concurrent with the onsite undocumented fill stockpile. The site is variably vegetated with large, mature trees on the southern slope, and scrubs, grasses, and bushes in the flat portion of the landscape.

The subject site was mass graded in the 1980s, resulting in the current topography but has remained undeveloped since that time. Based on our review of historic and current topography, during mass grading the flat portion of the site was cut on the order of 40 to 100 feet below original grades, while the southeastern corner of the site and southerly slope was filled to current grades. Following grading, dry utilities and a 12-inch domestic water pipeline were installed in the northern and central portions of the site, respectively. An existing temporary 18-inch storm drain pipe/riser is present draining the desilting basin to a junction structure adjacent to Freedom Lane.

Based on our review of available historic aerial photographs dating back to 1931, the following summarizes our understanding of the site history:

- **1931-1987:** The site and surrounding area were undeveloped natural scrubland. A natural descending slope and drainage were present in the southernmost portion of the site, in approximate alignment with the present-day slope. A northeast trending ridgeline is present just north of the site. The site remained undeveloped during this period except for various dirt access roads traversing the site and surrounding area.
- **1988-1995:** Mass grading began for the site and the surrounding area to the north, east, and south, encompassing a large portion of the City of Aliso Viejo. Grading onsite was completed by 1990. The water reservoir tank and light industrial facilities to the south were constructed by 1990. The existing southerly slope was landscaped with trees around 1993.
- **1996-2015:** No changes were observed onsite.
- **2016-2018:** Grading and construction of Freedom Lane began in late 2016; grading/paving was completed in 2017. The construction of the senior living development (Liberty at Aliso and Belmont Village) and Aliso Ridge Behavioral Health Center, north and east of the subject site began in 2017. Beginning in 2016, the subject site was utilized as an equipment/materials storage yard and staging area for the adjacent construction. It was during this time that the onsite artificial fill stockpile was placed, likely generated from excavations associated with the adjacent developments. The onsite desilting basin and storm drain improvements were constructed by late 2017.
- **2019-Present:** The adjacent senior living developments were completed by 2019 and the health center by 2021. The subject site was utilized as a storage yard/staging area through 2019. Temporary fencing associated with the storage yard was removed by 2020. The site has remained largely unchanged since 2020.

1.3 Proposed Grading and Improvements

Based on our review of the Conceptual Site Plan, the site is proposed to be developed for residential use. The Conceptual Site Plan shows 12 multifamily residential buildings with approximately 124 total units proposed. The project will also include stormwater quality/filtration devices, paved drive aisles and parking, and utility infrastructure improvements to support the development. We anticipate that the proposed attached units will be 3- to 4-story and consist of wood-framed construction.

The planned earthwork/grading is currently unknown; however, considering the relatively flat topographic relief across the site, we anticipate design cuts and fills generally on the order of 1 to 3 feet will be required to create a relatively level site and building pads. Locally deeper cuts/fills (i.e., stockpile area, temporary desilting basin) on the order of 4 to 12 feet will be required.

1.4 Prior Geotechnical Studies

Southern California Geotechnical, Inc. (SCG) performed a geotechnical exploration at the subject site in 2021. The subsurface exploration program included four hollow-stem auger borings (SB-1 through SB-4) to depths ranging from 20 to 40 feet below ground surface (bgs), and two bucket auger borings (SBA-1 and SBA-2), to depths of 31 and 66 feet. An additional boring (SB-3) was also included in the report from a prior 2014 study that was performed by SCG; however, the report associated with that boring was not available for our review. The boring and laboratory data included in the 2021 exploration report were reviewed as part of study.

The approximate boring locations are shown on the Boring Location Map (Plate 1). The associated boring logs are provided in Appendix B. Laboratory testing included in-situ moisture content and dry density, maximum density and optimum moisture content, consolidation, and direct shear. The associated laboratory test data is provided in Appendix C.

1.5 Subsurface Exploration

Our field exploration was performed between May 3 and May 9, 2024, and included excavation of two bucker auger borings (B-1 and B-2) to depths of 65 and 75 feet bgs, twelve test pits (TP-1 through TP-3, TP-3a, TP-3b, and TP-4 through TP-10) to depths ranging from 4 to 14 feet bgs, and three hand auger borings (HA-1 through HA-3) to depths ranging from 10 to 13 feet bgs. The borings and trenches were geologically logged, and samples were obtained at selected intervals. After completion of boring and test pit logging, the excavations were backfilled with soil cuttings. The approximate boring and test pit locations are shown on the Geotechnical Map (Plate 1). Boring and trench logs are included in Appendix B.

Soil sampling was performed using a Modified California ring sampler. Relatively undisturbed ring samples were obtained from the borings at various depths with a 2.5-inch inside-diameter, split-barrel sampler. The sampler was driven using the kelly bar, free falling 12 inches. The hammer weights varied with depth due to the telescoping kelly bar, with drive weights of 2500 pounds (lbs) from 0-25 feet bgs, 1500 lbs from 25 to 45 feet bgs, 750 lbs from 45 to 65 feet bgs, and 1500 lbs from 65 to 90 feet bgs. The sampling was used to assess the soil beneath the site as well as to obtain a measure of resistance of the soil to penetration (recorded as blows-per-foot on the geotechnical boring logs). Representative bulk samples of onsite soils were also collected from soil cuttings and used for additional soil identification purposes and laboratory testing.

1.6 Laboratory Testing

Representative samples of onsite soils collected during our field exploration were tested to characterize the engineering properties. Laboratory tests performed on selected relatively undisturbed and bulk soil samples included:

- Moisture content and dry density;
- Sieve analysis;
- Atterberg limits;
- Direct shear;
- Consolidation;
- Maximum density and optimum moisture content;
- Expansion potential; and
- Soluble sulfate.

Laboratory tests were conducted in general conformance with applicable ASTM International standards. The laboratory test results for this and prior studies are provided in Appendix C.

2.0 GEOTECHNICAL FINDINGS

2.1 Geologic Setting and Earth Units

The subject site is located on the eastern foothills of the San Joaquin Hills range, within the Peninsular Ranges geomorphic province of Southern California. The site is mapped by the United States Geologic Survey (2006) as underlain by Tertiary-age sedimentary bedrock of the Niguel Formation. Based on our subsurface exploration and understanding of the site history, the subject site was mass graded in the 1980's resulting in a relatively flat lot with bedrock at or near existing grades. The southeastern corner of the site and southerly slope were constructed with compacted fill materials overlying bedrock. No alluvium/colluvium was encountered in any of our borings and is assumed to have been removed during mass grading. The earth unit distribution and our interpretation of the subsurface conditions are shown on the Geotechnical Map (Plate 1) and Geotechnical Cross-Sections A-A' and B-B' (Plates 3 and 4).

Within the southern portion of the site, the bedrock is overlain by compacted **Artificial Fill (Af)** associated with prior mass grading. The artificial fill was found to be up to 22 feet thick and generally consisted of pale brown, yellowish brown, dark brown, and olive brown silty fine to medium sand that was damp to very moist and medium dense. The stockpile in the northern portion of the site is composed of **Undocumented Artificial Fill (Afu)** presumed to have been placed during grading and construction of the neighboring developments. The undocumented artificial fill (stockpile) encountered was up to 12.5 feet thick and generally consisted of pale brown, yellowish brown, and pale yellowish gray silty to clean fine to coarse sand and sandy silt that was damp to moist and loose to medium dense. The limits of artificial fill and undocumented artificial fill are shown on the Geotechnical Map (Plate 1).

The **Niguel Formation (Tn)** is mapped throughout the majority of the site. The bedrock was found to consist of pale olive brown, yellowish brown, pale gray, and white fine to coarse-grained sandstone that was massive to poorly bedded. Crossbedding and variable structure (strike/dip) was observed throughout the site with dips at generally low inclination. The sandstone is weakly indurated and friable, resulting in minor caving in Boring B-1 and some test pits. A minor siltstone package (with clay beds) was encountered in Boring B-2 and was olive brown to gray and massive to thinly laminated. The siltstone package was found to be hard and moderately indurated/cemented. Seepage was also encountered at varying depths within the siltstone package.

The **Monterey Formation (Tm)** is not mapped onsite per published geologic mapping by the United States Geological Survey (USGS, 2006), nor was the formation encountered during the prior onsite exploration by others (SCG, 2021). We encountered Monterey Formation in three test pits (TP-3, TP-3a, and TP-3b) which consisted of pale brownish gray, bluish gray, and white diatomaceous siltstone with minor claystone and silty sandstone. The bedrock was generally damp to very moist and locally wet. Bedding was observed to be laminated/thinly bedded with variable structure, similar to the Niguel Formation. The contact between Monterey and Niguel Formations was found to be fault controlled, with several faults/fault zones observed in Test Pits TP-3a and TP-3b. The Monterey Formation exhibits very different engineering properties ("high" expansion) compared to Niguel Formation ("very low" expansion) and will require additional remedial grading (see Section 3.2).

2.2 Geotechnical Conditions

Based on our geotechnical exploration and laboratory testing data (Appendix C), the geotechnical conditions are generally as follows:

Soil Moisture Content and Dry Density: The collected samples show that dry densities of the Niguel Formation bedrock generally vary from 87.5 to 120.5 pcf with moisture contents in the range of 2.0 to 30.6 percent. Dry densities of the artificial fill material varied from 106.1 to 117.3 pcf with moisture contents in the range of 8.8 to 14.8 percent.

Soil Properties: A grain-size distribution test was conducted on three samples, representative of the Niguel Formation, Monterey Formation, and existing artificial fill material. The Niguel Formation sample had a fines content (passing Sieve No. 200) of 14 percent, the Monterey Formation sample had a fines content of 72 percent, and the artificial fill sample had a fines content of 26 percent. The samples were classified as silty sand (SM), highly plastic silt (MH), and clayey sand (SC), respectively, per the Unified Soil Classification System (USCS).

Soil plasticity testing was performed on the bulk sample representative of Monterey Formation and was classified as highly plastic silt (MH) with a Plasticity Index of 30 and Liquid Limit of 75 percent. Plasticity testing was also performed on the fines portion of the sample representative of the Niguel Formation and indicated the fines were highly plastic silt (MH); however, considering the fines content of less than 50 percent, the sample was classified as SM.

Maximum density testing was performed on a bulk sample representative of the existing artificial fill materials and indicates a maximum dry density of 117.4 pcf at an optimum moisture content of 12.1 percent. Testing by Southern California Geotechnical (SCG, 2021) conducted on one sample taken from the uppermost 5 feet (Boring SB-2), representative of the Niguel Formation, shows a maximum dry density of 114 pcf at an optimum moisture content of 12 percent.

Shear Strength: Direct shear testing was conducted on four relatively undisturbed samples representative of the existing fill materials along the southerly slope and of the Niguel Formation. Direct shear testing was also performed by SCG during their prior study, generally representing the Niguel Formation. The following table includes the direct shear test results for various earth units and soil types:

Earth Unit	**Soil Type**	**Ultimate Strengths**		**Peak Strengths**		**Residual Strengths**	
		φ	**C (psf)**	**φ**	**C (psf)**	**φ**	**C (psf)**
Fill (Af)	Silty/Clayey Sand (SM)	31	170	34	450	--	--
	Silty/Clayey Sand (SM)	31	300	33	825	--	--
Niguel Formation (Tn)	Sandstone	36	800	40	1265	--	--
	Sandstone	37	100	41	300	--	--
	Siltstone (Silt Beds)	31	405	43	240	--	--
	Fine Grained Sandstone	34	200	39	335	31	200

Expansion Potential: Two samples were tested to determine the expansion potential of the onsite artificial fill materials and Monterey Formation. The artificial fill sample had an Expansion Index of 10, indicating "Very Low" expansion potential. The Monterey Formation sample had an Expansion Index of 106, indicating "High" expansion potential.

Chemical Properties: Soluble sulfate content of the soil was measured in two samples, one representative of the artificial fill materials and one of the Monterey Formation. Soluble sulfate content testing indicates the samples may be classified as "S0" per Table 19.3.1.1 of ACI-318-14.

Consolidation: Tests were performed on two samples at depths of 5 and 10 feet bgs, representative of existing fill materials. The testing shows that the fill materials have low compressibility. The samples had minor collapse upon the addition of water at a load of 0.8 ksf which is most likely related to sandy/disturbed nature of the soil.

Consolidation tests were performed on four samples collected by SCG (2021), from depths of 1, 3, 5, and 7 feet bgs, representative of the Niguel Formation. The testing showed that the materials have low compressibility. The tests show minor collapse (less than one-quarter percent) upon the addition of water at a load of 1.6 ksf.

2.3 Groundwater and Surface Water

Groundwater was not encountered in any of our onsite borings to a maximum depth of 75 feet bgs. Seepage was encountered in Boring B-2 at depths between 18.5 to 27 feet. Historic high groundwater mapping by the State shows high groundwater depths greater than 20 feet bgs (CDMG, 2001a).

Groundwater levels may fluctuate on an annual and seasonal basis based on rainfall and variations in future residential irrigation and/or adjacent land use. Perched water may be encountered during grading for deepened foundation elements or deep utility lines.

2.4 Regional Faulting and Seismicity

Regional Faults: The site is not located within a fault-rupture hazard zone as defined by the Alquist-Priolo Special Studies Zones Act (CGS, 2018). Also, based on mapping by the State (Jennings and Bryant, 2010), there are no active faults mapped at the site. Regional faults are presented on Figure 3. Several inactive (Pre-Quaternary-age) faults were observed during our subsurface exploration as shown on Plate 1 and the boring/test pit logs.

Seismicity: Properties in southern California are subject to seismic hazards of varying degrees depending upon the proximity, degree of activity, and capability of nearby faults. These hazards can be primary (i.e., directly related to the energy release of an earthquake) or secondary (i.e., related to the effect of earthquake energy on the physical world). Since there are no active faults at the site, the potential for primary ground rupture is considered very low. The primary seismic hazard for this site is ground shaking during a future earthquake. The maximum moment magnitude for the controlling fault is 7.1 Mw, which would be generated from the San Joaquin Hills Fault. Using the site coordinates of 33.56181 degrees latitude and -117.72862 degrees longitude, the San Joaquin Hills Fault is the closest fault to the site, approximately 2.7 miles to the west.

The site is not located within a mapped potential liquefaction hazard zone per the State's Seismic Hazard Mapping (CDMG, 2001b). A portion of the southerly slope is located adjacent to a potential earthquake-induced landslide zone; however, this potential hazard has been mitigated during mass grading as the original slope inclination was flattened to the current 2H:1V configuration. Slope stability was reviewed as part of our study and is discussed in the following section (Section 2.5). The attached Site Location and Seismic Hazards Map (Figure 1) depicts the site relative to County mapped potential seismic hazard zones. Other secondary seismic hazards, such as tsunami and seiche are considered nil due to site elevation and distance from the ocean or other confined bodies of water (CGS, 2022).

2.5 Slope Stability

The site geologic/geotechnical conditions are generally favorable for overall stability of the existing slope along the southerly portion of the site. The existing fill/stabilization fill slope ranges in height from approximately 40 to 70 feet at an inclination of 2H:1V or flatter. We prepared two cross-sections (Plates 3 and 4) depicting the existing descending slope at the site. Slope stability analysis was performed on cross-section B-B', which represents the highest portion of the perimeter slope at the site. The soil strength parameters were developed during this study per the direct shear test results and our experience with the earth units. The following table includes the strength parameters used for slope stability analysis:

Earth Unit	**Soil Type**	**Ultimate Strength**		**Peak Strength**	
		ϕ	**C (psf)**	**ϕ**	**C (psf)**
Fill (Af)	Silty/Clayey Sand (SM)	31	200	33	350
Niguel Formation (Tn)	Sandstone	34	200	39	350
	Siltstone with Along Bedding Strength	28	200	32	240

For pseudo-static analysis, we applied a seismic horizontal coefficient (k_h) of 0.22 in accordance with Special Publication 117A, Guidelines for Evaluation and Mitigating Seismic Hazards in California (CGS, 2008).

The results of the slope stability analysis are presented in Appendix E. The existing slope at the site was found to be grossly stable with a factor of safety of more than 1.5 under static conditions and a factor of safety of 1.1 or greater for pseudo-static conditions.

2.6 Settlement and Foundation Considerations

In general, the anticipated settlements depend upon the building loads, type of foundations, and the geotechnical properties of the supporting subgrade. Considering the subsurface soil conditions, laboratory test data, and anticipated lightly loaded residential structures, we estimate total settlement (combined static and seismic) to be on the order of 1-inch with differential settlement of ½-inch over a 40-foot span. The settlement estimate assumes remedial grading measures recommended in Section 3.2 of this report are implemented during grading.

2.7 Stormwater Infiltration Feasibility

The southern portion of the site is underlain by variably thick artificial fill overlying bedrock. The remainder of the site is generally underlain by shallow bedrock. County of Orange guidelines prohibit stormwater infiltration in compacted fill (OCPW, 2013). Additionally, infiltration of stormwater in bedrock can result in migration of subsurface water along bedding, faults, or lithologic contacts, resulting in seepage or springs in where previously none existed, potentially impacting offsite properties and slopes. Stormwater infiltration is not considered feasible from a geotechnical viewpoint.

2.8 Shrinkage and Bulking

The shrinkage and bulking (reduction or increase in volume of excavated materials upon recompaction and replacement as fill) varies by soil type, earth unit, and location. The volume change primarily depends on in-situ density and the maximum dry density of the soil type. We anticipate that shrinkage/bulking of the bedrock and compacted artificial fill (Af) will be relatively minor, and shrinkage of the undocumented fill/stockpile materials will be on the order of 5 to 15 percent. Ground subsidence at the site is estimated to be on the order of 0.1 foot.

2.9 Existing Utilities

Based on our review of the ALTA Survey and the DigAlert markings provided during the utility clearance procedure, there are several dry utility services present along the northern property boundary, adjacent to Freedom Lane. An exiting 12-inch water pipeline transects the site from east to west. Within the temporary desilting basin at the southeastern corner of the site, an 18-inch storm drain/tin whistle drains the basin to a junction structure located adjacent to Freedom Lane.

3.0 CONCLUSION AND PRELIMINARY RECOMMENDATIONS

3.1 General Conclusion and Recommendation

Construction of the proposed residential development, as described herein, is considered geotechnically feasible provided the preliminary recommendations in this report are implemented during design, grading, and construction. Additional geotechnical exploration is not considered necessary provided there are no significant plan changes. Grading, foundation, utility/street improvements, structural and wall plans for the project should be reviewed by the geotechnical consultant during the design phase. Updated recommendations may be provided once the project plans are finalized and as needed.

The recommendations in this report should be considered minimum and may be superseded by more restrictive requirements of others. In addition to the following recommendations, General Earthwork and Grading Specifications are provided in Appendix F.

3.2 Site Preparation and Earthwork

Site preparation and grading should be performed in accordance with the recommendations herein and the requirements of the City of Aliso Viejo.

3.2.1 Site Demolition and Clearing

Prior to remedial grading, any existing structures and utilities to be abandoned should be demolished. Deleterious materials and debris should be cleared and disposed of offsite. Excavations for the removal of existing utilities (i.e. temporary storm drain line, etc.) and vegetation, including any onsite trees, should be observed by the geotechnical consultant. Large roots, highly organic soils, and utility/pipeline debris should be removed and should not be incorporated into new fills.

Soil that is disturbed as part of excavations or during removal of trees or underground utilities should be evaluated by the geotechnical consultant. Excavations that require backfill should be properly documented and compacted under the observation and testing of the geotechnical consultant in accordance with the recommendations provided in Section 3.2.5.

3.2.2 Protection of Existing Improvements and Utilities

Existing buildings, improvements, and utilities adjacent to the site that are to be protected in place should be located and visually marked prior to grading operations. Excavations adjacent to improvements to be protected in-place or any utility easement should be performed with care, so as not to undermine existing foundations or destabilize the adjacent ground.

Stockpiling of soils more than 5 feet in height at or near existing structures and over utility lines should not be allowed. If deep excavation/removals are required, shoring or other special measures (i.e., setback or laybacks) to provide safety and mitigate the potential for lateral/vertical movements may be required.

3.2.3 Remedial Grading Measures

Remedial grading at the site should consist of removal of highly weathered/disturbed/faulted bedrock and all undocumented fill materials. Remedial removals are anticipated to range from 1 to 7 feet below existing grades. In general, remedial removal/overexcavation within the building pads is recommended to extend 3 to 5 feet below design grades or existing grades, whichever is lower. For areas underlain by faulted, highly expansive diatomaceous bedrock (Monterey Formation), we recommended a 7-foot removal/overexcavation. Remedial grading within the proposed drive areas may be limited to removal and recompaction of the upper 1 to 2 feet. The recommended remedial grading is shown on the Remedial Measures Map (Plate 2).

Considering the very different geotechnical conditions between the bedrock of Monterey Formation (northern portion of the site) and Niguel Formation, we recommend that the grading contractor attempt to mix the materials during the remedial grading/fill placement to achieve a more uniform subsurface soil conditions across the site. If that is not achieved, the geotechnical design parameters provided herein will be re-evaluated at the completion of grading and more stringent recommendations will need to be provided for the building pads underlain by highly expansive soils.

The geotechnical consultant should review and approve the removal bottoms prior to fill placement and should provide specific recommendations based on actual conditions, as necessary.

Excavations deeper than 4 feet will need to be laid back a minimum inclination of 1H:1V (horizontal to vertical) or provided with shoring. Shallow, unconfined excavations (4 feet or less) may consist of near-vertical excavation. In general, the excavation within the existing bedrock and fill materials should be in accordance with Cal/OSHA requirements for Soil Type "C". Friable sands prone to caving should be anticipated throughout the site. The contractor’s qualified person should verify compliance with Cal/OSHA requirements. Excavations near existing structures (within a 1:1 projection) should be provided with shoring that is designed to support the surcharge load of the existing structure. Otherwise, excavations may be performed in sections (A/B/C slot cuts). The conditions should be reviewed in the field by the project geotechnical consultant. Additional recommendations will be provided based on the actual conditions encountered during excavation and grading, as needed.

3.2.4 Placement of Oversize Material

In general, bedrock at the site is friable and can be broken down. However, as discussed previously, boulders on the order of 2 to 4 feet in diameter are present at the ground surface (approximately two truckloads). If grading equipment cannot break down the material into smaller pieces, oversize rock will need to be disposed of in deeper fill areas, if any, or disposed offsite. Oversize rocks may be placed in fills deeper than 10 feet below design grades. The grading contractor should consider performing deeper remedial removals within design fill areas to facilitate placement of oversize rocks. Rocks larger than 6 inches and smaller than 12 inches in the largest dimension may be placed at depth between 4 and 10 feet below design finish grades or 1 foot below the deepest utility line, whichever is deeper. Rocks greater than 3 inches in dimension are typically not suitable for backfill of utility trench excavations (unless accepted by the agency/utility owner). Thus, we recommend that the grading contractor consider placement of rocks larger than 3 inches in dimension, if any, outside of proposed utility alignments.

The Grading and Earthwork Specifications in Appendix F include details for placement of oversize rock.

3.2.5 Fill Placement

Upon the completion of remedial grading measures, the approved removal/overexcavation bottoms should be scarified a minimum of 6 inches. The removal bottoms and fill materials should be compacted to at least 90 percent of maximum dry density, as determined by ASTM Test Method D1557. Fill materials should be placed in loose lifts no thicker than 8 inches.

Considering the very different geotechnical conditions between the bedrock of Monterey Formation (northern portion of the site) and Niguel Formation, we recommend that the grading contractor attempt to mix the materials during the remedial grading/fill placement to achieve a more uniform subsurface soil conditions across the site. If that is not achieved, the geotechnical design parameters provided herein will be re-evaluated at the completion of grading and more stringent recommendations will need to be provided for the building pads underlain by highly expansive soils.

Fill materials should be relatively free of deleterious material. The onsite artificial fill and bedrock materials are considered suitable for re-use as compacted fill provided any deleterious material is removed.

We recommend that the moisture content of new compacted fill soils be above the optimum moisture content but should be within the compactable moisture range. Appropriate equipment should be used and other measures (e.g., mixing, stockpiling, drying) may be needed to achieve the uniform and correct moisture content for fill placement. If the soils become extremely wet, special measures for mixing and drying may be required that will need to be determined based on the actual field conditions.

3.2.6 Import

The geotechnical consultant should evaluate and accept any import soils prior to transportation to the subject site. We recommend that import soils have similar engineering properties as onsite soils. At minimum, the import materials should have Expansion Index of less than 50, Plasticity Index of less than 15, fines content (passing Sieve 200) of less than 50 percent, and negligible soluble sulfate content.

3.3 Settlement Potential

The amount of settlement will depend upon the type of foundation(s) selected and future loading by additional fill and structures. Based on the subsurface exploration and laboratory data, our review and analysis, considering the remedial grading recommendations provided in this report are implemented during grading, and the anticipated structural loads typically associated with the proposed structures, we estimate that total and differential settlement (combined static and seismic) will be less than 1-inch and ½-inch over a span of 40 feet, respectively.

SA GEO should be provided with the foundation plans and structural loads, once available, to further evaluate the potential for post-construction settlement of the proposed buildings and associated improvements. The parameters provided herein will then be confirmed/updated based on the planned foundation layout and loads and any additional testing/analysis.

3.4 Foundation Design

The slab and foundations should be designed by the project structural engineer based on the proposed structure type and the anticipated loading conditions. Onsite soils are anticipated to have "Medium" expansion potential at the completion of grading. However, this will need to be confirmed upon the completion of grading as the northern portion of the site is underlain by highly expansive bedrock of the Monterey Formation. The following foundation recommendations are provided with the assumption that the recommendations included in Section 3.2 of this report are implemented during grading.

The recommended net allowable bearing capacity for continuous and isolated footings may be calculated based on the following equation:

$q_{all} = 800\ D + 300\ B + 700$ (but not to exceed 4,000 psf)

where:
D = embedment depth of footing, in feet
B = width of footing, in feet

Also, the following parameters may be used for design of foundation and slabs:

- Soil unit weight = 120 pcf
- Soil internal friction angle = 30 degrees
- Coefficient of Friction = 0.38
- Subgrade modulus (k) of 100 pci (corrected for large slabs)
- Soil elastic modulus (Es) of 1,500 psi

The dead load of concrete below adjacent grades (buried concrete foundations) may be neglected. The allowable bearing pressure and friction coefficient may be increased by one-third for wind and seismic loading.

We recommend that strip and isolated footings for the buildings have a minimum embedment depth of 18 inches below the lowest adjacent grade. Continuous footings should be at least 12 inches wide and isolated column footings should be at least 24 inches wide. The footings of freestanding and isolated structures, such as walls and pilasters, should have a minimum embedment depth of 18 inches into approved soils.

The following table provides our general guidelines and preliminary recommendations for design of post-tensioned foundations and slabs on expansive soil in accordance with the 2022 CBC and Post-Tension Institute (PTI) DC 10.5 Edition provisions.

GEOTECHNICAL GUIDELINES FOR DESIGN OF POST-TENSIONED SLABS*

Parameter	***Recommendation***
Center Lift	
* Edge Moisture Variation Distance, e_m	9.00 feet
* Center Lift, y_m	0.70 inches
Edge Lift	
* Edge Moisture Variation Distance, e_m	4.5 feet
* Edge Lift, y_m	0.80 inch
Presaturation, as needed, to obtain the minimum moisture down to the minimum depth	1.2 x optimum down to 12 inches
***Based on method in CBC 2022**	

For post-tensioned slabs, we recommend that the slabs have a thickened edge such that the slab is embedded a minimum of 12 inches below the lowest adjacent grade. The thickened edge should be tapered and have a minimum width of 12 inches.

In addition, as indicated in the DC 10.5 Edition of PTI, shape factor calculations should be performed by the project structural engineer in order to determine if strengthening/modification of foundations are necessary. Per PTI guidelines, the modifications to the foundations design should be considered if the shape factor (ratio of square of foundation perimeter over foundation area) exceeds 24.

If non-post-tensioned slabs-on-grade and foundations are considered at the site in accordance with Wire Reinforcement Institute (WRI) method (per the 2022 CBC), an effective Plasticity Index of 25 is considered appropriate for the upper 15 feet of soil materials. For non-post-tensioned slabs, we recommend a minimum embedment of 12 inches below the lowest adjacent grade for the perimeter footings. Also, the upper 12 inches of subgrade soil should be moisture conditioned to 120 percent of optimum moisture content prior to placement of moisture barrier and concrete.

The foundations and slabs should be designed to tolerate the total and differential settlements discussed in Section 3.3 of these recommendations.

For the design of pole-type foundations (i.e., light poles, shade structures, etc.), an allowable soil-bearing pressure (s_1) of 360 psf/ft may be used for Equation 18-1 (the "pole" equation) of the 2022 CBC Section 1807.3.2.1 to determine the depth of embedment for the footings, considering level ground conditions. The equation is applicable for designed embedment depths of less than 12 feet for the purpose of computing lateral pressure. Also, for vertical loads on pole-type foundations, an allowable skin friction of 300 pounds per square foot may be used. For cast-in-place pole-type foundations, the vertical end bearing pressure should be neglected.

3.5 Caisson Design

All caissons, if any, should have a minimum embedment of 5 feet into competent fill or bedrock materials. An average skin friction value of 300 pounds per square foot may be utilized to calculate the axial capacity of caissons. The lateral capacity of caissons may be computed using a value of 360 psf/ft but should not exceed 5,400 psf/ft for level conditions. For caissons near the existing descending slope with passive envelope impacted by the slope, the passive pressure should be limited to 180 psf/ft. Passive resistance may be doubled for isolated piles/caissons spaced a minimum of 3 diameters apart center-to-center. The allowable bearing pressure (both axial and lateral) may be increased by one-third for wind or seismic loading. Other minimum footing dimensions should be provided by the Structural Engineer and should comply with Table 1809.7 of the 2022 CBC.

Caissons should be designed in accordance with ACI recommendations and applicable building code requirements. The accepted criteria for caisson installation are detailed below:

- Caissons should be constructed as pre-drilled cast-in-place elements. A representative of the geotechnical consultant should be present during drilling of all caisson excavations in order to verify proper embedment and to geotechnically review appropriate drilling methods.
- Caisson excavations should be cleaned of loose soil, cuttings and groundwater and should be reviewed by the project geologist prior to placement of steel or concrete.
- No caisson boring shall be excavated within 6 feet from the nearest edge of a completed caisson unless the completed caisson has been filled with concrete for more than 24 hours.

3.6 Retaining Wall Design and Lateral Earth Pressures

Recommendations for lateral earth pressures for permanent retaining walls and structures with approved onsite drained soils and above groundwater table (drained condition) are as follows:

Conditions	***Level (pcf)***	***2:1 Sloping***
Active	40	65
At-Rest	60	85
Passive	360	180 (sloping down)

parameters provided above are based on a soil internal friction angle of 30 degrees and soil unit weight of 120 pcf.

To design an unrestrained retaining wall, such as a cantilever wall, the active earth pressure may be used. For a restrained retaining wall, the at-rest pressure should be used. Passive pressure is used to compute lateral soils resistance developed against lateral structural movement. The passive pressures provided above may be increased by one-third for wind and seismic loads. The passive resistance is taken into account only if it is ensured that the soil against embedded structure will remain intact with time. Future landscaping/planting and improvements adjacent to the retaining walls should also be taken into account in the design of the retaining walls. Excessive soil disturbance, trenches (excavation and backfill), future landscaping adjacent to footings and over-saturation can adversely impact retaining structures and result in reduced lateral resistance.

For sliding resistance, the friction coefficient of 0.38 may be used at the concrete and soil interface. The coefficient of friction may be increased by one-third for wind and seismic loading. The retaining walls may also need to be designed for additional lateral loads if other structures or walls are planned within a 1H:1V projection.

The seismic lateral earth pressure for walls retaining more than 6 feet of soil may be estimated to be an additional 18 pcf for active and at-rest conditions. The earthquake soil pressure has a triangular distribution and is added to the static pressures. For the active and at-rest conditions, the additional earthquake loading is zero at the top and maximum at the base. The seismic lateral earth pressure does not apply to walls retaining less than, or equal to, 6 feet of soil (2022 CBC Section 1803.5.12).

Drainage behind retaining walls (retaining more than 30 inches of soil) should also be provided in accordance with the attached Figure 4. Specific drainage connections, outlets and avoiding open joints should be considered for the retaining wall design.

3.7 Seismic Design Parameters

The following table summarizes the seismic design criteria for the subject site. The seismic design parameters are developed in accordance with ASCE 7-16 and 2022 CBC. Considering shallow bedrock across the site, the site is classified as Site Class "C". Please note that, considering the proposed structures and anticipated structural periods, site-specific ground-motion hazard analysis was not performed for the site. The seismic response coefficient, Cs, should be determined per the parameters provided below and using equation 12.8-2 of ASCE 7-16.

Selected Seismic Design Parameters from 2022 CBC/ASCE 7-16	*Seismic Design Values*	*Reference*
Latitude	33.56181 North	
Longitude	-117.72862 West	
Controlling Seismic Source	San Joaquin Hills	USGS, 2024
Site Class per Table 20.3-1 of ASCE 7-16	C	
Spectral Acceleration for Short Periods (Ss)	1.244 g	SEA/OSHPD, 2024
Spectral Accelerations for 1-Second Periods (S_1)	0.444 g	SEA/OSHPD, 2024
Site Coefficient F_a, Table 11.4-1 of ASCE 7-16	1.2	SEA/OSHPD, 2024
Site Coefficient F_v, Table 11.4-2 of ASCE 7-16	1.5	SEA/OSHPD, 2024
Design Spectral Response Acceleration at Short Periods (S_{DS}) from Equation 11.4-4 of ASCE 7-16	0.995 g	SEA/OSHPD, 2024
Design Spectral Response Acceleration at 1-Second Period (S_{D1}) from Equation 11.4-4 of ASCE 7-16	0.444 g	SEA/OSHPD, 2024
T_S, S_{D1} /S_{DS} 11.4.6 of ASCE 7-16	0.446 sec	
T_L, Long-Period Transition Period	8 sec	SEA/OSHPD, 2024
Peak Ground Acceleration Corrected for Site Class Effects (PGA_M) from Equation 11.8-1 of ASCE 7-16	0.639 g	SEA/OSHPD, 2024
Seismic Design Category Section 11.6 of ASCE 7-16	D	SEA/OSHPD, 2024

3.8 Slope Stability and Slope Setback

No significant modifications to the existing slope are planned as part of this project. The existing slope generally consists of artificial fill and Niguel Formation bedrock. The proposed improvements are not anticipated to adversely impact the slope. Based on our slope stability analysis (Appendix E), the existing slope was found to be grossly stable. In general, slopes are considered susceptible to surficial instability in the form of erosion, raveling, and slumping. Special care should be taken to ensure that onsite runoff is controlled and directed offsite in a non-erosive manner and that site drainage, and slopes are maintained over the life of the project.

Footings for structures located above descending slopes should be set back from the slope face in accordance with the minimum requirements of the City of Aliso Viejo and section 1808.7.1 of the 2022 CBC, whichever is greater. The setback distance is measured from the outside edge of the footing bottom along a horizontal line to the face of the slope.

The tables below summarize the minimum setback criteria for structures above descending slopes:

Case A – Building and Retaining Wall Footings Above Descending Slopes

Slope Height [H] (feet)	*Minimum Setback from Slope face (feet)*
Less than 10	5
10 to 20	½ * H
20 to 30	10
Greater than 30	⅓ * H (maximum of 40')

Case B – Freestanding Wall Footings Above Descending Slopes

Slope Height [H] (feet)	*Minimum Setback from Slope face (feet)*
Less than 10	5
10 to 20	½ * H
Greater than 20	Maximum of 10

For freestanding walls and other structures that are sensitive to lateral movement (e.g., smooth stucco finish, glass screens, etc.), SA GEO recommends that the structural setback requirements in accordance with Case A above be followed or that additional design measures be used to help control the potential for cracking and displacements. Otherwise, typical freestanding walls may have a setback in accordance with Case B.

3.9 Corrosivity

Based on laboratory testing, soluble sulfate exposure in the onsite soils may be classified as "S0" per Table 19.3.1.1 of ACI-318-14. Structural concrete elements in contact with soil include footings and building slabs-on-grade. The flatwork and sidewalk concrete are typically not considered structural elements. Concrete mix for structural elements should be based on the "S0" soluble sulfate exposure class of Table 19.3.2.1 in ACI-318-14. Other ACI guidelines for structural concrete are recommended. Also, onsite soils are anticipated to be corrosive to metals.

3.10 Expansion Potential

At the completion of grading, we anticipate that onsite soils will have "Medium" expansion potential. The geotechnical recommendations provided in this report including the design parameters for foundations, slab-on-grade and flatwork improvement should be implemented during design and construction. Updated recommendations will be provided upon additional testing at the completion of grading at the site and as needed.

3.11 Interior Slab Moisture Mitigation

In addition to geotechnical and structural considerations, the project owner should also consider interior moisture mitigation when designing and constructing slabs-on-grade.

The intended use of the interior space, type of flooring, and type of goods in contact with the floor may dictate the need for, and design of, measures to mitigate potential effects of moisture emission from and/or moisture vapor transmission through the slab. Typically, for human occupied structures, a vapor retarder or barrier is recommended under the slab to help mitigate moisture transmission through slabs. The most recent guidelines by the American Concrete Institute (ACI 302.1R-04) suggest that the vapor retarder be placed directly under the slab (no sand layer). However, the location of the vapor retarder may also be subject to the builder's past successful practice. Placement of 1 or 2 inches of sand over the moisture retardant has been common practice by builders in southern California. Specifying the strength of the retarder to resist puncture and its permeance rating is important. These qualities are not necessarily a function of the retarder thickness. A minimum of 10-mil is typical but some materials, such as 10-mil polyethylene ("Visqueen"), may not meet the desired standards for toughness and permeance.

Vapor retarders, when used, should be installed in accordance with standards such as ASTM E 1643 and/or those specified by the manufacturer.

Concrete mix design and curing are also significant factors in mitigating slab moisture problems. Concrete with lower water/cement ratios results in denser, less permeable slabs that also "dry" faster with regard to when flooring can be installed (reduced moisture emissions quantities and rates). Rewetting of the slab following curing should be avoided since it can result in additional drying time required prior to flooring installation. Proper concrete slab testing prior to flooring installation is also important.

Concrete mix design, the type and location of the vapor retarder should be determined in coordination with all parties involved in the finished product, including the project owner, architect, structural engineer, geotechnical consultant, concrete subcontractors, and flooring subcontractors.

3.12 Exterior Concrete

The driveway, patio slabs and other flatwork elements should be at least 4 inches thick. We recommend that the concrete be reinforced with No. 3 rebars placed at 24 inches on center both ways. Equivalent wire mesh reinforcement may also be used. Concrete slabs should be provided with construction or weakened plane control joints at a maximum spacing of 8 feet. The control joints should have a thickness that is ¼ of the total concrete thickness. The subgrade soils in the upper 12 inches should be pre-saturated to 120 percent of optimum moisture content.

For exterior slabs, the use of a granular sublayer is primarily intended to facilitate presaturation and subsequent construction by providing a better working surface over the saturated soil. It also helps retain the added moisture in the native soil in the event that the slab is not placed immediately. Where these factors are not significant, the layer may be omitted. If used, we recommend placement of 2 to 4 inches of granular material over subgrade soils.

Exterior concrete elements such as curb and gutter, driveways, sidewalks and patios are susceptible to lifting and cracking when constructed over expansive soils. With expansive soils, the impacts to flatwork/hardscape can be significant, generally requiring removal and replacement of the affected improvements. Please also note that reducing concrete problems is often a function of proper slab design, concrete mix design, placement, and curing/finishing practices. Adherence to guidelines of the American Concrete Institute (ACI) is recommended. Also, the amount of post-construction watering, or lack thereof, can have a very significant impact on the adjacent concrete flatwork.

On projects with expansive soils, additional measures such as thickened concrete edges/footings, subdrains and/or moisture barriers should be considered where planter or natural areas with irrigation are located adjacent to the concrete improvements. Design and maintenance of proper surface drainage is also very important. If the concrete will be subject to heavy loading from cars/trucks or other heavy objects, thicker pavement section will be required the design of which should be performed by the geotechnical consultant, as needed.

3.13 Preliminary Asphalt Concrete Pavement Design

Final structural pavement sections should be based on R-value testing after the completion of grading and in accordance with City of Aliso Viejo/County of Orange requirements. Using a design R-value of 15 and estimated traffic indices (TIs), we recommend the following preliminary pavement sections:

Street Location	*Estimated TIs*	*Pavement Section*
Parking Stalls	TI – 4.0	3 inches of AC / 6 inches of AB
General Drives	TI – 5.5	4 inches of AC / 9 inches of AB
AC = Asphalt Concrete, AB = Aggregate Base		

Please note that for two-stage paving operations, we recommend that the final AC cap be a minimum of 0.10 foot thick and the base AC course have a minimum thickness of 0.25 foot.

If pavement repair is needed within the adjacent streets, the section should match the existing section and follow standard City/County guidelines for trench/pavement repair. The new pavement section should at minimum consist of 4 inches of AC over 9 inches of AB unless approved otherwise by the geotechnical consultant and based on evaluation of subgrade soils.

Asphalt concrete pavement should be placed in accordance with the requirements of Sections 301 and 302 of the Standard Specifications of Public Works Construction (the Greenbook). Prior to construction of pavement sections, the subgrade soils should be scarified to a minimum depth of 6 inches, moisture-conditioned as needed, and recompacted in-place to a minimum of 90 percent relative compaction (per ASTM D1557). Subgrade should be firm prior to AB placement.

AB materials can be crushed aggregate base or crushed miscellaneous base in accordance with the Greenbook (Section 200-2). The materials should be free of any deleterious materials. Aggregate base materials should be placed in 6- to 8-inch-thick loose lifts, moisture-conditioned as necessary, and compacted to a minimum of 95 percent relative compaction (per ASTM D1557). Asphalt concrete should also be compacted to a minimum relative compaction of 95 percent.

Unpaved median and parkway areas should be provided with vertical moisture barriers.

3.14 Vehicular PCC Pavements

If trash enclosures or truck loading areas are to be constructed at the site, we recommend 6 inches of PCC reinforced with No. 4 rebar at 18 inches on-center, both ways, over compacted subgrade. For parking stalls, the section may consist of 4 inches of PCC reinforced with No. 4 rebar at 18 inches on-center, both ways, over compacted subgrade.

The subgrade soils should be scarified to a minimum depth of 6 inches, moisture-conditioned as needed, and recompacted in place to a minimum of 90 percent relative compaction (per ASTM D1557).

Aggregate base materials can be crushed aggregate base or crushed miscellaneous base in accordance with the Greenbook (Section 200-2). The materials should be free of any deleterious materials. Aggregate base materials should be placed in 6- to 8-inch-thick loose lifts, moisture-conditioned as necessary, and compacted to a minimum of 95 percent relative compaction (per ASTM D1557).

3.15 Concrete Paver Section

For concrete pavers within **pedestrian** walkways, we recommend 60-millimeter-thick concrete pavers over approximately 1 inch of sand, over a minimum of 6 inches of AB, over compacted subgrade. This should also accommodate the rare maintenance cart or light truck that might drive up on these areas.

For concrete pavers within **vehicular** drive areas, if any, we recommend 80-millimeter-thick concrete pavers over 6 inches of concrete reinforced with No. 3 rebar at 24 inches on-center, over compacted subgrade. Alternatively, the concrete low pour slab may be replaced with a minimum of 13 inches of AB over compacted subgrade; or 10 inches of AB over a layer of geotextile (e.g., Mirafi 600X or equivalent), over compacted subgrade.

A concrete band along the perimeter of the pavers should be provided for lateral restraint. The concrete band should, at minimum, be 12 inches deep and deepened to below the depth of disturbed soil, if adjacent to landscape/planter areas.

Also, a drainage system consisting of a 2-inch PVC drainage pipe should be installed at the low end of the concrete low pour at 10-foot intervals through the slab and filled with pea gravel. The PVC drainage pipe should drain to a minimum of 6-inch-diameter by 12-inch-deep drain pit filled with pea gravel below the pipe. The paver surfaces should slope away from structures a minimum of 2 percent. The concrete underlayment for the drive areas should be provided with weakened plane joints at maximum 8-foot intervals. If the pavers are to be set in mortar or are underlain with AB, this drainage system is not required.

Prior to construction of the paver sections, the subgrade soils should be scarified to a minimum depth of 6 inches, moisture conditioned as needed, and recompacted in place to a minimum of 90 percent relative compaction (per ASTM D1557). The upper 12 inches of subgrade for pedestrian walkway and patio areas should then be presaturated to 120 percent of optimum moisture content. Subgrade for vehicular pavers need not be pre-saturated.

Aggregate base materials can be crushed aggregate base or crushed miscellaneous base in accordance with the Greenbook (Section 200-2). The materials should be free of deleterious materials. Aggregate base materials should be placed in 6- to 8-inch-thick loose lifts, moisture-conditioned as necessary, and compacted to a minimum of 95 percent relative compaction (per ASTM D1557).

3.16 Trench Excavation and Backfill

Excavations should be performed in accordance with the requirements set forth by Cal/OSHA Excavation Safety Regulations (Construction Safety Orders, Section 1504, 1539 through 1547, Title 8, California Code of Regulations). In general, onsite soils may be classified as Type "C" soils for excavations into compacted fill and/or bedrock. Cal/OSHA regulations indicate that, for workmen in confined conditions, the steepest allowable slopes in Type "C" soils is 1.5H:1V (horizontal to vertical), respectively, for excavations less than 20 feet deep. Where there is no room for these layback slopes, we anticipate that shoring will be necessary. The subsurface soils are generally sandy and may be friable, locally loose, and prone to caving. This condition should also be anticipated for excavations within the streets adjacent to the site. Adequate shoring/shield should be provided, as deemed necessary. Backfilling may require sand-cement slurry in order to reduce the potential of caving during the removal of shoring. Excavations should be reviewed periodically by the contractor's qualified person to confirm compliance with Cal/OSHA requirements.

Onsite soils should be suitable for use as trench backfill. Utility trench backfill should be in accordance with City of Aliso Viejo and/or the governing jurisdiction's specifications. Backfill materials should be compacted to a minimum of 90 percent relative compaction (per ASTM D1557). Rocks greater than 3 inches in largest diameter should generally not be used as trench backfill unless approved by the agency and geotechnical consultant of record. Excavation and backfilling of HDPE pipes (if any) should be in accordance with the manufacturer's requirement and the Greenbook. Select granular backfill (i.e., clean sand with SE 30 or better) may be used in lieu of native soils but should also be compacted or densified with water jetting and flooding.

Trenches excavated next to structures and foundations should also be properly backfilled and compacted to provide full lateral support and reduce settlement potential.

3.17 Groundwater

In general, groundwater is anticipated to remain more than 20 feet below design grades upon the completion of grading. However, shallow, perched groundwater/seepage may occur on an annual and seasonal basis as a result of rainfall, irrigation and/or seepage from adjacent properties, and along earth unit contacts (i.e., artificial fill and bedrock). Groundwater is not expected to be encountered during grading or utility construction; however, the presence of locally saturated soils and/or perched water cannot be ruled out, especially during rainy seasons.

3.18 Stormwater Infiltration Feasibility

Considering that the site is underlain by very dense bedrock and artificial fill, and the presence of a relatively large perimeter slope along the southern property boundary, infiltration of stormwater is not feasible at the site from a geotechnical viewpoint and is considered a geotechnical hazard per County of Orange's guidelines (OCPW, 2013). Other methods of stormwater treatment, such as detention and biofiltration basins, should be evaluated by the project civil engineer.

3.19 Surface Drainage and Irrigation

Maintaining adequate surface drainage, proper disposal of run-off water, and control of irrigation will help reduce the potential for future moisture-related problems and differential movements from soil heave/settlement.

Surface drainage should be carefully taken into consideration during grading, landscaping, and building construction. Positive surface drainage should be provided to direct surface water away from structures and slopes and toward the street or suitable drainage devices. Ponding of water adjacent to the structures should not be allowed. Buildings should have roof gutter systems and the run-off should be directed to parking lot/street gutters by area drainpipes or by sheet flow over paved areas. Paved areas should be provided with adequate drainage devices, gradients, and curbing to prevent run-off flowing from paved areas onto adjacent unpaved areas.

Considering the climatic conditions in southern California and provided that the recommendations included in this report are implemented during grading and construction, a minimum two-percent slope away from structures is considered acceptable and in substantial compliance with the 2022 CBC. Also, swales with one-percent slopes are acceptable from a geotechnical standpoint and are common practice in this locale.

Construction of planter areas immediately adjacent to structures should be avoided if possible. If planter boxes are constructed adjacent to or near buildings, the planters should be provided with controls to prevent excessive penetration of the irrigation water into the foundation and flatwork subgrades. Provisions should be made to drain excess irrigation water from the planters without saturating the subgrade below or adjacent to the planters. Raised planter boxes may be drained with weepholes. Deep planters (such as palm tree planters) should be drained with below-ground, water-tight drainage lines connected to a suitable outlet. Moisture barriers should also be considered.

It is also important to maintain a consistent level of soil moisture, not allowing the subgrade soils to become overly dry or overly wet. Properly designed landscaping and irrigation systems can help in that regard.

3.20 Slope Maintenance, Lot Drainage, and Erosion Control

Maintenance of proper pad drainage, the design and construction of property improvements in accordance with sound engineering practices, and proper maintenance of landscaping, including regular pad and slope irrigation, should be performed. Irrigation should not be excessive or sporadic; maintaining a relatively constant level of soil moisture around structures and improvements is important. Oversteepening of slopes should be avoided.

Planters and landscape areas adjacent to structures should be avoided or provided with measures to mitigate the potential for water getting under the foundations and slabs. Water should not be allowed to pond and drainage should be maintained away from structures and tops of slopes.

Establishing and maintaining a rodent-control program is also recommended to reduce surficial slope deterioration often associated with rodent burrowing. The improvements at or near the tops of slopes may be subject to varying degrees of slope-creep related movements and should be designed with that in mind.

3.21 Additional Subsurface Exploration and Laboratory Testing

Additional subsurface exploration during the design phase of the project is not anticipated provided no significant plan changes occur. Additional laboratory testing should be performed during and upon completion of the grading to confirm/update the design parameters provided herein.

3.22 Review of Future Plans

The project grading, foundation, street improvement, wall, and landscape plans should be reviewed and accepted by the geotechnical consultant prior to grading and construction. Additional recommendations should be provided upon the review of the project plans and as needed.

3.23 Observation and Testing during Grading and Construction

Geotechnical observation and testing should be performed by SA GEO during the following phases of grading and construction:

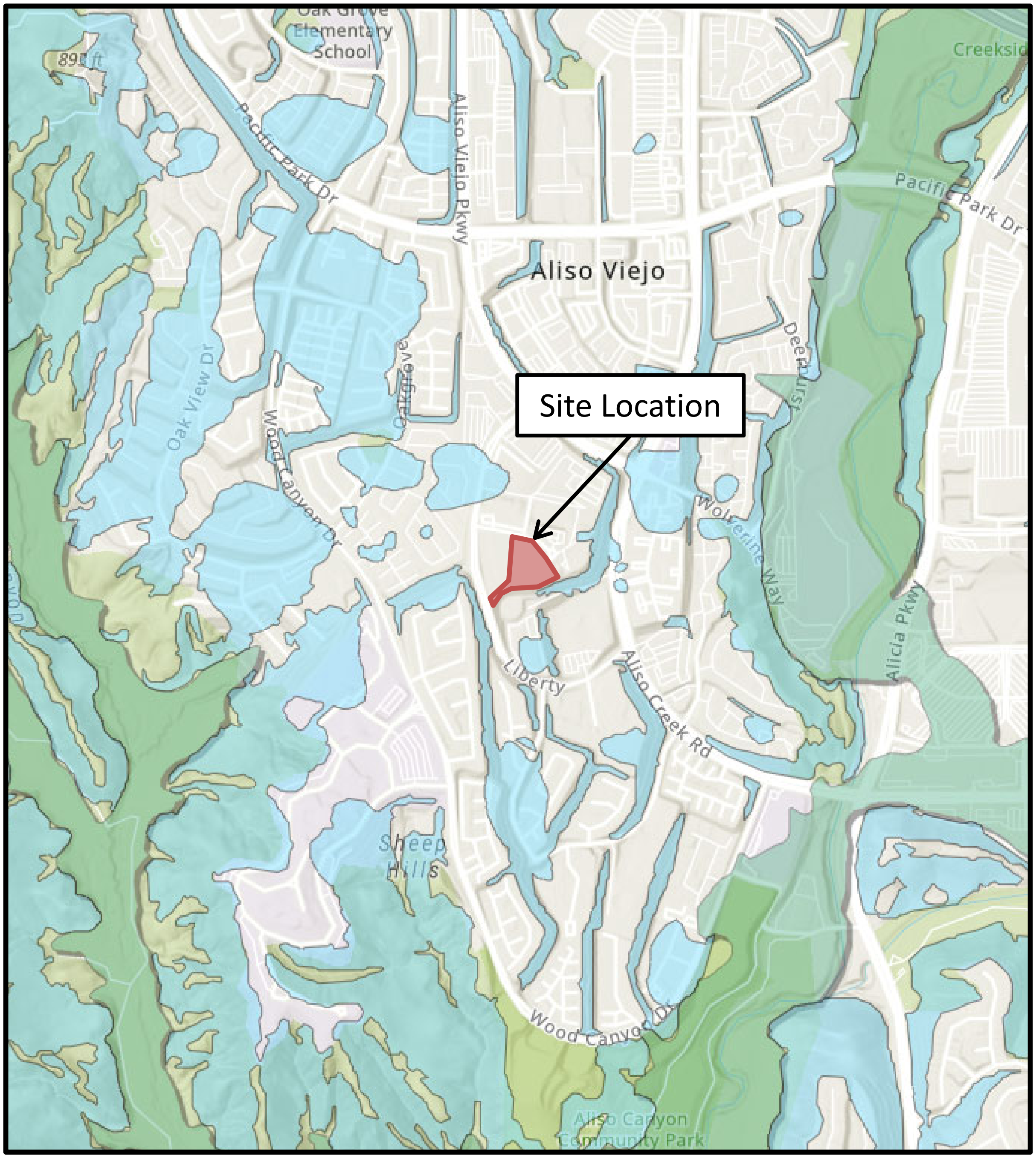
- During site demolition, preparation and clearing;
- During excavations performed for remedial grading and to relocate or remove existing underground improvements and structures;

- During earthwork, including observation and acceptance of remedial removal/overexcavation bottoms and fill placement, including import material (if any);
- Following the completion of grading, in order to verify soil properties for foundations, slab-on-grade and pavement areas;
- Upon completion of any foundation or structural excavation, prior to pouring concrete;
- During slab and flatwork subgrade preparation including pre-saturation, prior to pouring of concrete;
- During placement of backfill for utility trenches;
- During construction of the stormwater filtration devices/basins;
- During placement of backfill for retaining structures, if any;
- During installation and backfill of subdrainage systems; and
- When any unusual soil conditions are encountered.

4.0 LIMITATIONS

This report has been prepared for the exclusive use of our client, Meritage Homes, within the scope of services requested for the subject property described herein. This report or its contents should not be used or relied upon for other projects or purposes, or by other parties without the acknowledgement of SA GEO and the consultation of a geotechnical professional. The means and methods used by SA GEO for this study are based on local geotechnical standards of practice, care, and requirements of governing agencies. No warranty or guarantee, expressed or implied, is given.

Our findings, conclusions, and recommendations are professional opinions based on interpretations and inferences made from geologic and engineering data from specific locations and depths, observed or collected at a given time. By nature, geologic conditions can vary from point to point, can be very different in-between exploration points, and can also change over time. Our conclusions and recommendations are, by nature, preliminary and subject to verification and/or modification during grading and construction when more subsurface data is exposed.


Oak Grove
Elementary
School
890 ft
Pacific Park Dr
Aliso Viejo Pkwy
Aliso Viejo
Creeksid
Pacific Park Dr
Deerhurst
Oak View Dr
Wood Canyon Dr
Oakgrove
Wolverine Way
Alicia Pkwy
Liberty
Aliso Creek Rd
Sheep
Hills
Wood Canyon Dr
Aliso Canyon
Community Park

Site Location

Source: Seismic Hazard Zones, San Juan Capistrano Quadrangle (CDMG, 2001b)

🟩 **Liquefaction**
Areas where historic occurrence of liquefaction, or local geological, geotechnical and groundwater conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resource Code Section 2693(c) would be required.

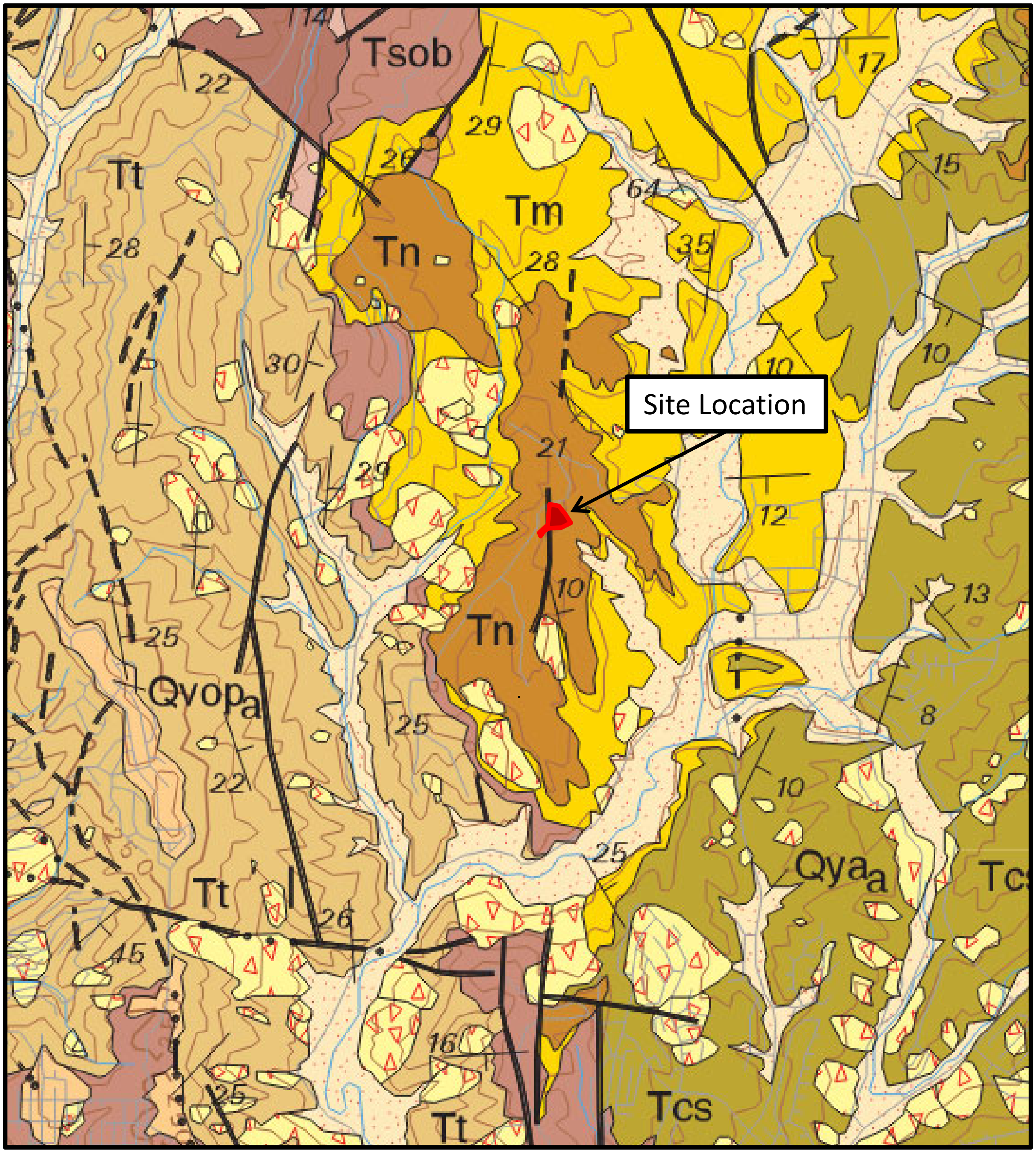
🟦 **Earthquake-Induced Landslides**
Areas where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resource Code Section 2693(c) would be required.

Site Location and Seismic Hazard Map

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01
Date: June 3, 2024
Figure 1

S/A


Tsob
14
22
17
29
26
Tt
Tm
64
15
Tn
28
35
28
30
10
10
Site Location
21
29
12
10
13
25
Tn
Qvopa
25
8
22
10
25
Qyaa
Tcs
Tt
26
45
16
25
Tcs
Tt

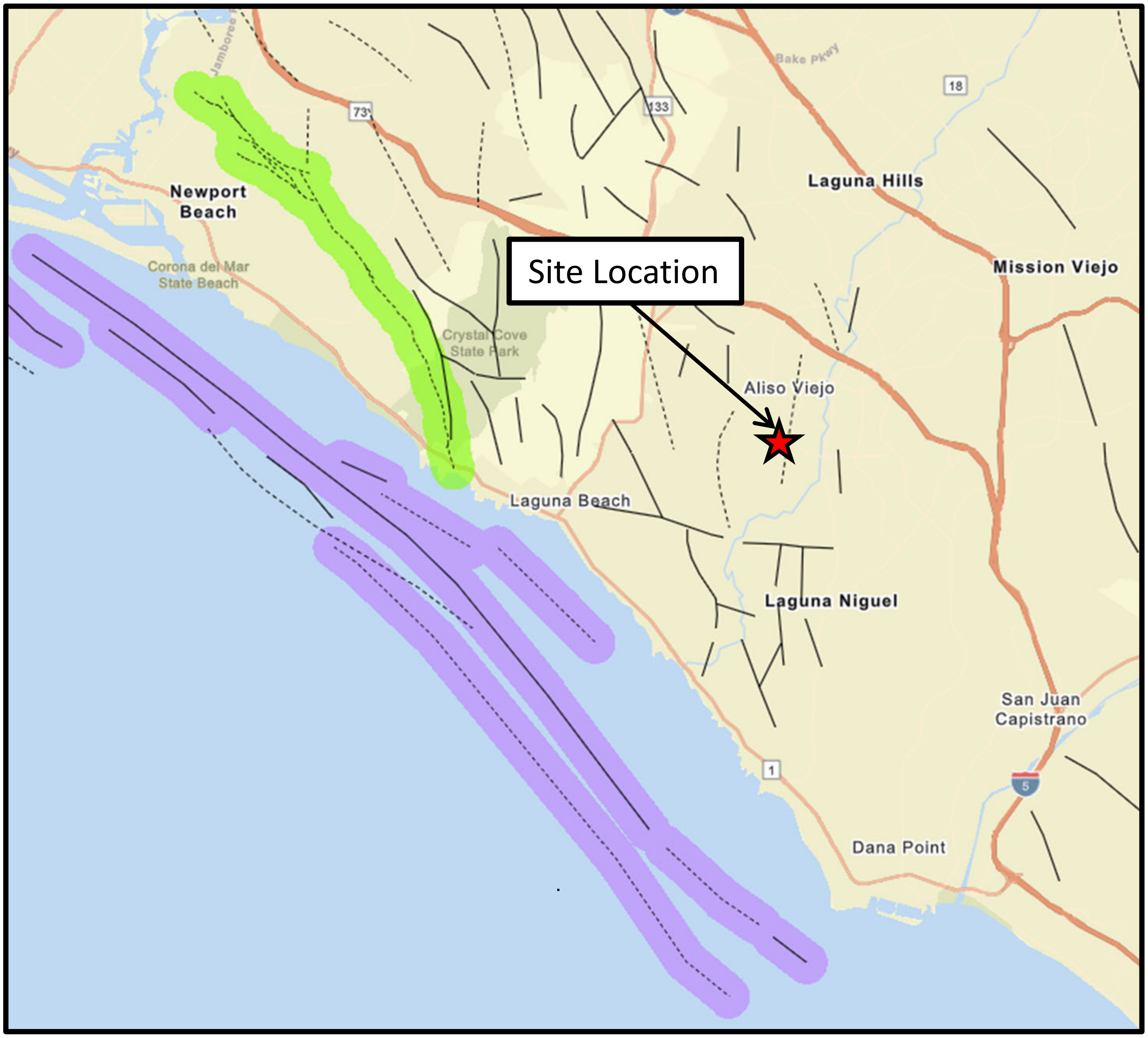
Source: Geologic Map of the San Bernardino and Santa Ana 30' X 60' Quadrangles (USGS, 2006)

Regional Geologic Map

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01
Date: June 3, 2024
Figure 2

S/A


Site Location
Newport Beach
Corona del Mar State Beach
Crystal Cove State Park
Laguna Beach
Laguna Hills
Mission Viejo
Aliso Viejo
Laguna Niguel
San Juan Capistrano
Dana Point
Bake Pkwy
Jamboree
73
133
18
1
5

Source: Fault Activity Map of California (Jennings and Bryant, 2010)

———— — — — ·········?	Holocene fault displacement (during past 11,700 years) without historic record. Geomorphic evidence for Holocene faulting includes sag ponds, scarps showing little erosion, or the following features in Holocene age deposits: offset stream courses, linear scarps, shutter ridges, and triangular faceted spurs. Recency of faulting offshore is based on the interpreted age of the youngest strata displaced by faulting.
———— — — — ·········?	Late Quaternary fault displacement (during past 700,000 years). Geomorphic evidence similar to that described for Holocene faults except features are less distinct. Faulting may be younger, but lack of younger overlying deposits precludes more accurate age classification.
———— — — — ·········?	Quaternary fault (age undifferentiated). Most faults of this category show evidence of displacement sometime during the past 1.6 million years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age. Unnumbered Quaternary faults were based on Fault Map of California, 1975. See Bulletin 201, Appendix D for source data.
———— — — — ·········?	Pre-Quaternary fault (older that 1.6 million years) or fault without recognized Quaternary displacement. Some faults are shown in this category because the source of mapping used was of reconnaissnce nature, or was not done with the object of dating fault displacements. Faults in this category are not necessarily inactive.

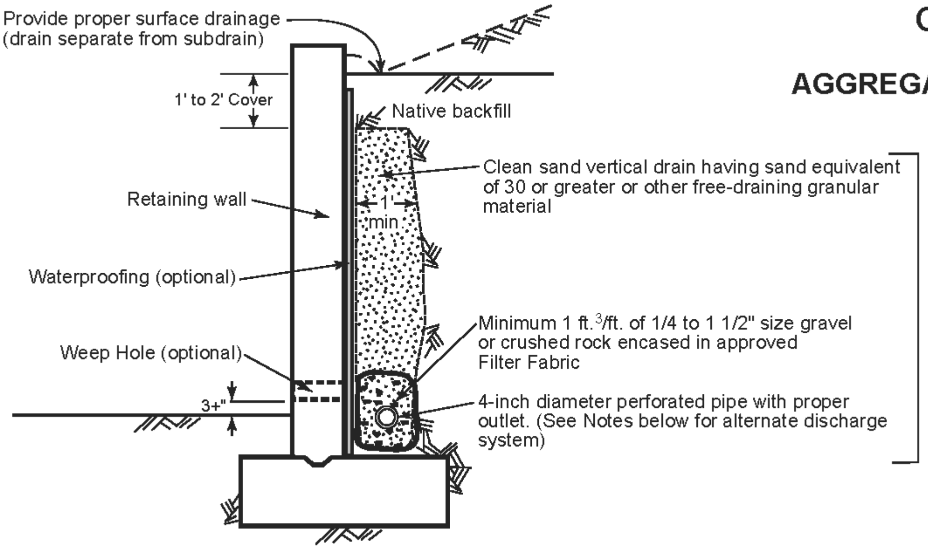
Regional Fault Map

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01
Date: June 3, 2024
Figure 3

OPTION 1:

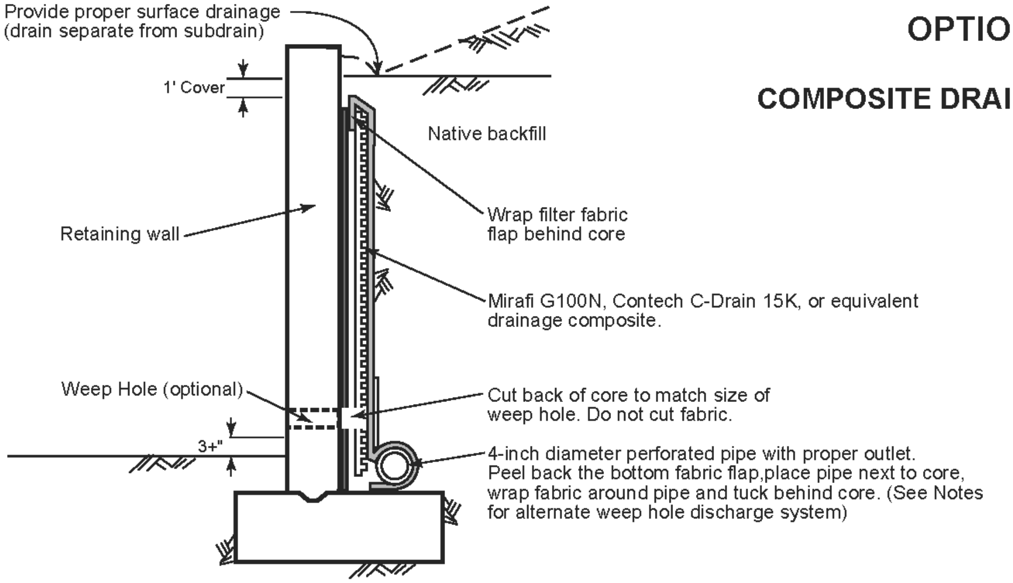
AGGREGATE SYSTEM DRAIN


Provide proper surface drainage (drain separate from subdrain)
1' to 2' Cover
Native backfill
Retaining wall
Clean sand vertical drain having sand equivalent of 30 or greater or other free-draining granular material
1' min
Waterproofing (optional)
Minimum 1 ft.^{3}/ft. of 1/4 to 1 1/2" size gravel or crushed rock encased in approved Filter Fabric
Weep Hole (optional)
3+"
4-inch diameter perforated pipe with proper outlet. (See Notes below for alternate discharge system)

Alternative: Class 2 permeable filter material (Per Caltrans specifications) may be used for vertical drain and around perforated pipe (without filter fabric)

OPTION 2:

COMPOSITE DRAINAGE SYSTEM


Provide proper surface drainage (drain separate from subdrain)
1' Cover
Native backfill
Retaining wall
Wrap filter fabric flap behind core
Mirafi G100N, Contech C-Drain 15K, or equivalent drainage composite.
Weep Hole (optional)
Cut back of core to match size of weep hole. Do not cut fabric.
3+"
4-inch diameter perforated pipe with proper outlet. Peel back the bottom fabric flap,place pipe next to core, wrap fabric around pipe and tuck behind core. (See Notes for alternate weep hole discharge system)

NOTES:

1. PIPE TYPE SHOULD BE PVC OR ABS, SCHEDULE 40 OR SDR35 SATISFYING THE REQUIREMENTS OF ASTM TEST STANDARD D1527, D1785, D2751 , OR D3034.
2. FILTER FABRIC SHALL BE APPROVED PERMEABLE NON-WOVEN POLYESTER, NYLON, OR POLYPROPYLENE MATERIAL.
3. DRAIN PIPE SHOULD HAVE A GRADIENT OF 1 PERCENT MINIMUM.
4. WATERPROOFING MEMBRANE MAY BE REQUIRED FOR A SPECIFIC RETAINING WALL (SUCH AS A STUCCO OR BASEMENT WALL).
5. WEEP HOLES MAY BE PROVIDED FOR LOW RETAINING WALLS (LESS THAN 3 FEET IN HEIGHT) IN LIEU OF A VERTICAL DRAIN AND PIPE AND WHERE POTENTIAL WATER FROM BEHIND THE RETAINING WALL WILL NOT CREATE A NUISANCE WATER CONDITION. IF EXPOSURE IS NOT PERMITTED, A PROPER SUBDRAIN OUTLET SYSTEM SHOULD BE PROVIDED.
6. IF EXPOSURE IS PERMITTED, WEEP HOLES SHOULD BE 2-INCH MINIMUM DIAMETER AND PROVIDED AT 25-FOOT MAXIMUM SPACING ALONG WALL. WEEP HOLES SHOULD BE LOCATED 3+ INCHES ABOVE FINISHED GRADE.
7. SCREENING SUCH AS WITH A FILTER FABRIC SHOULD BE PROVIDED FOR WEEP HOLES/OPEN JOINTS TO PREVENT EARTH MATERIALS FROM ENTERING THE HOLES/JOINTS.
8. OPEN VERTICAL MASONRY JOINTS (I.E., OMIT MORTAR FROM JOINTS OF FIRST COURSE ABOVE FINISHED GRADE) AT 32-INCH MAXIMUM INTERVALS MAY BE SUBSTITUTED FOR WEEP HOLES.
9 THE GEOTECHNICAL CONSULTANT MAY PROVIDE ADDITIONAL RECOMMENDATIONS FOR RETAINING WALLS DESIGNED FOR SELECT SAND BACKFILL.

Retaining Wall Drainage Detail

S/A

Appendix A

APPENDIX A

REFERENCES

California Division of Mines and Geology (CDMG), 2001a, Seismic Hazard Zone Report for the San Juan Capistrano 7.5-Minute Quadrangle, Orange County, California, Seismic Hazard Zone Report 053.

California Division of Mines and Geology (CDMG), 2001b, Seismic Hazard Zones, San Juan Capistrano Quadrangle, Official Map dated December 21, 2001.

California Geological Survey (CGS), 2008, Guidelines for Evaluation and Mitigating Seismic Hazards in California, Special Publication 117A.

California Geological Survey (CGS), 2018, Earthquake Fault Zones, A Guide for Government Agencies, Property Owners / Developers, and Geoscience Practitioners for Assessing Fault Rupture Hazards in California, Special Publication 42, Revised 2018.

California Geological Survey (CGS), 2021, Tsunami Hazard Area Map, County of Orange, California, Official Map dated July 8, 2021.

Jennings, Charles W. and Bryant W.A., 2010, Fault Activity Map of California, Department of Conservation, California Geological Survey, Geologic Data Map No. 6.

Nationwide Environmental Title Research, LLC (NETR), 2024, Historic Aerials by NETR Online, Date Accessed: May 24, 2024; website address: http://historicaerials.com

Orange County Public Works (OCPW), 2013, Orange County Watersheds Water Quality Management Plan (WQMP) Technical Guidance Document for the Preparation of Conceptual/Preliminary and/or Project Water Quality Management Plans, Exhibit 7.III, Dated December 20, 2013.

Orange County Public Works (OCPW), 2024, County of Orange, Historic Aerial Imagery, Date Accessed: May 24, 2024; website address: https://www.ocgis.com/ocpw/historicalimagery/

Southern California Geotechnical, Inc., 2021, Geotechnical Investigation, Proposed Commercial/Industrial Development, 400-700 Freedom Lane, Aliso Viejo, California, Project No.: 21G167-1, dated July 2, 2021.

Structural Engineers Association/Office of Statewide Health Planning and Development (SEA/OSHPD), 2024, U.S. Seismic Design Maps, web site address: https://seismicmaps.org/; Date Accessed: May 31, 2024.

APPENDIX A (Cont'd)

REFERENCES

U.S. Geological Survey, 2006, Geologic Map of the San Bernardino and Santa Ana 30' X 60' Quadrangles, California, dated 2006, Open File Report 2006-1217.

U.S. Geological Survey, 2024, Unified Hazard Tool, NSHM 2014 Dynamic Deaggregation Program; web site address: https://earthquake.usgs.gov/hazards/interactive/; Date Accessed: May 31, 2024.

Appendix B

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	*GRAVEL AND GRAVELLY SOILS* MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	*CLEAN GRAVELS* (LITTLE OR NO FINES)	**GW**	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	**GM**	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	*CLEAN SANDS* (LITTLE OR NO FINES)	**SW**	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	**SM**	SILTY SANDS, SAND - SILT MIXTURES
			SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	*SILTS AND CLAYS*	LIQUID LIMIT LESS THAN 50	**ML**	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50	**MH**	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			**PT**	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: Dual symbols are used to indicate gravels or sand with 5-12% fines and soils with fines classifying as CL-ML. Symbols separated by a slash indicate borderline soil classifications.

Sampler and Symbol Descriptions

■ Modified California sample (D-#)
◪ Standard Penetration Test (S-#)
◫ Shelby tube sample (T-#)
▩ Large bulk sample (B-#)
☒ Small bulk sample (SB-#)
▽ Approximate depth of groundwater during drilling
▼ Approximate depth of static groundwater

Note: Number of blows required to advance driven sample 12 inches (or length noted).

Laboratory and Field Test Abbreviations

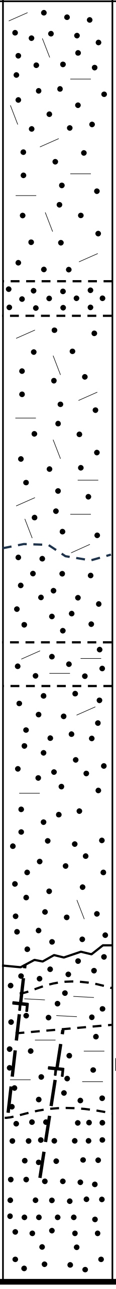
AL	Atterberg limits (plasticity)
CC	Chemical Testing incl. Soluble Sulfate
CN	Consolidation
DS	Direct Shear
EI	Expansion Index
GS	Grain Size Analysis (Sieve, Hydro. and/or -No. 200)
MD	Maximum Density and Optimum Moisture
RV	Resistance Value (R-Value)
SE	Sand Equivalent
UU	Unconsolidated Undrained Shear Strength

Notes:

1. Soil classifications are based on the Unified Soil Classification System and include color, moisture, and relative density or consistency. Field descriptions have been modified to reflect results of laboratory tests where deemed appropriate. Bedrock descriptions are based on visual classification and include rock type, moisture, color, grain size, strength, and weathering.
2. Descriptions on these boring logs apply only at the specific boring locations and at the time the borings were drilled. They are not warranted to be representative of subsurface conditions at other locations or times.

KEY TO LOG OF BORING

Date(s) Drilled: 05-07/08-2024	**Logged By:** AC/PA/AZ	**B-1** Page 1 of 3
Drilling Method: Bucket Auger	**Drill Bit Size/Type:** 24”	
Drill Rig Type: Cal Weld	**Hammer Drive Drop (in.):** 12”	
Drive Weight (lbs.): 0-25’: 2500, 25-45’: 1500, 45-65’: 750, 65-90’: 1300		**Total Depth Drilled (ft):** 75
Drilling Company: Big Johnny’s		**Approximate Ground Surface Elevation (ft):** 460.5
Comments:		

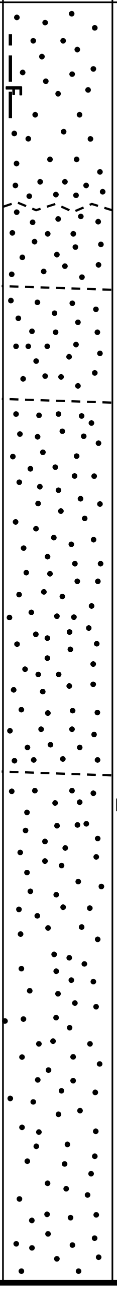
Depth (ft)	SAMPLES Type and Number	SAMPLES Blows Per Foot	Graphic Log S N	Attitudes	USCS	DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Remarks
						**Artificial Fill (Af)** @0’: Yellowish brown silty fine to medium SAND, moist, medium dense. Visible fill lifts 4 to 6 inches thick. Roots in the upper 1.5’. Trace bedrock fragments 2 to 4 inches in diameter.			
5	D-1	3			SM	@5’ SAMPLE: Yellowish brown silty fine to medium SAND, moist, medium dense, clean sand stringers, iron staining.	14.8	112.5	DS, CN
						@6.5’: 8-inch-thick clean sand layer, damp.			
10	D-2	9			SM	@10’ SAMPLE: Dark brown to pale gray silty fine to coarse SAND, moist, medium dense.	10.3	117.3	DS, CN
						@10.7’: Dark brown silty clayey SAND, moist, medium dense.			
						@12.9’:Undulatory fill lift/contact, friable sand below.			
						@14.8’: Brown silty SAND, about 1’ thick.			
15	D-3	4			SM	@15’ SAMPLE: Pale olive brown to pale brown silty fine to medium SAND with gravel, damp, medium dense.	14.6	108.7	
						@15.7’: Pale yellowish brown SAND, slightly friable.			
20	D-4	3			SP-SM	@20’ SAMPLE: Pale brownish gray to olive brown fine to coarse SAND with silt, moist to very moist, medium dense, trace bedrock fragments.	8.8	106.1	
				@22.5 B: N6E, 12E @23.6 B: N45W, 4N @24.1 F: N40E, 85SE @24.5 F: N66E, 74S @26.0 B: N2E, 11E		@ 22.0’-22.5’: Undulatory contact with bedrock below (Tn).			
						Niguel Formation (Tn) @22.5’: Pale yellow fine to medium SANDSTONE, slightly friable, damp, about 16” thick, jarosite staining.			
25						@23.8’: Olive yellow silty fine to medium SANDSTONE, damp, dense, weakly cemented, flame structure/soft-sediment deformation.			
						@24.1’: Pale yellow to white silty fine to medium SAND, slightly friable.			
						@25’: Open joint/fracture, ½-inch thick, steeply dipping, iron staining.			
						@24.3-28.3’: Fault set, massive on hanging wall, iron stained bedding on foot wall.			
30						@29’: Fine to medium SANDSTONE, trace silt, massive, friable, damp.			

Geotechnical Log Of Boring

Project Number: 24064-01
Project Name: Meritage Homes
400-700 Freedom Lane

S/A

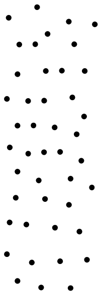
Date(s) Drilled: 05-08-2024	**Logged By:** AC/AZ	**B-1** Page 2 of 3
Drilling Method: Bucket Auger	**Drill Bit Size/Type:** 24”	
Drill Rig Type: Cal Weld	**Hammer Drive Drop (in.):** 12”	
Drive Weight (lbs.): 0-25’: 2500, 25-45’: 1500, 45-65’: 750, 65-90’: 1300		**Total Depth Drilled (ft):** 75
Drilling Company: Big Johnny’s		**Approximate Ground Surface Elevation (ft):** 460.5
Comments:		

Depth (ft)	SAMPLES		Graphic Log	Attitudes	USCS	DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Remarks
	Type and Number	Blows Per Foot							
	D-5	6		@30.2 B: N13W, 19W @31.8 B: Flat	SP	@30’ SAMPLE: White to pale yellowish gray fine to coarse SANDSTONE, damp, medium dense, iron staining, slightly micaceous, friable. @30.2’: Iron staining along bedding, cross bedded.	2.0	103.0	
						@30.6-32.9’: Vertical fault on southeast wall, 1-inch of apparent offset on sand/iron stained beds.			
35				@34.8 B: Flat		@34.8’: Yellow fine to medium SANDSTONE, little to no silt, damp, friable, erosional/undulatory contact with SANDSTONE below.			
				@36.6 B: N77E, 3N		@37’: Color change to pale yellow, dense, friable SANDSTONE, very massive.			
				@39.2 B: N88W, 4N		@39.2’: Color change to olive yellow.			
40	D-6	10		@39.0 B: N84W, 4N	SP	@40’ SAMPLE: Pale yellowish brown to white fine to medium SANDSTONE, moist to very moist, dense, iron staining, friable. @40’: Interbedded pale yellow, olive yellow, reddish yellow clean fine to medium SANDSTONE, moist to very moist, friable.	4.7	108.4	DS
						@43’: Interbedded pale yellow and reddish yellow SANDSTONE, very moist to wet.			
45						@46’: Fine to coarse SANDSTONE, moist, massive, shells.			
				@48.0 B: N65W, 6NE		@48’: Pale yellow to white SANDSTONE, moist, mostly massive, no iron staining.			
50	D-7	13		@51.1 B: Flat	SP	@50’ SAMPLE: Pale yellowish gray to white fine to coarse SANDSTONE with fine gravel, moist, very dense, trace iron staining, trace shell fragments, slightly friable. @51.1: 8-inch-thick SANDSTONE bed highlighted by iron staining along bedding, damp. Horizontal/flat bedding.	3.8	105.8	
				@53.5 B: N31W, 2N					
55									
						@58: Very massive, no iron staining.			
60									

Geotechnical Log Of Boring

Project Number: 24064-01
Project Name: Meritage Homes
400-700 Freedom Lane

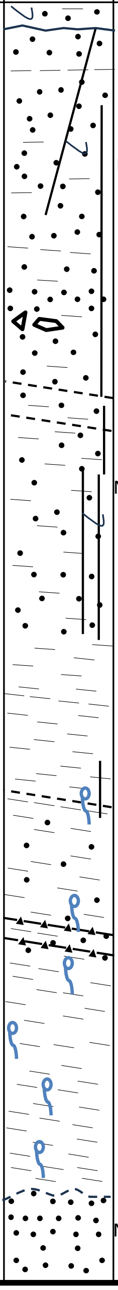
Date(s) Drilled: 05-08-2024	**Logged By:** AC/AZ	**B-1** Page 3 of 3
Drilling Method: Bucket Auger	**Drill Bit Size/Type:** 24”	
Drill Rig Type: Cal Weld	**Hammer Drive Drop (in.):** 12”	
Drive Weight (lbs.): 0-25’: 2500, 25-45’: 1500, 45-65’: 750, 65-90’: 1300		**Total Depth Drilled (ft):** 75
Drilling Company: Big Johnny’s		**Approximate Ground Surface Elevation (ft):** 460.5
Comments:		

Depth (ft)	SAMPLES Type and Number	 Blows Per Foot	Graphic Log S N	Attitudes	USCS	DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Remarks
	■ D-8	17			SP	@60’ SAMPLE: Pale olive brown to white fine to coarse SANDSTONE, very moist, very dense, trace iron staining, trace fine gravel, friable.	3.3	108.5	
65									
						@68’: Heavily iron stained.			
70	■ D-9	19			SP	@70’ SAMPLE: Yellowish brown to pale yellowish gray medium to coarse SANDSTONE, very moist, very dense, trace iron staining, friable.	5.9	120.5	
75						Notes: Total Depth: 75’ (Caved in to 71’). Downhole Logged to 67’. No Groundwater. Backfilled With Cuttings And Tamped.			
80									
85									
90									

Geotechnical Log Of Boring

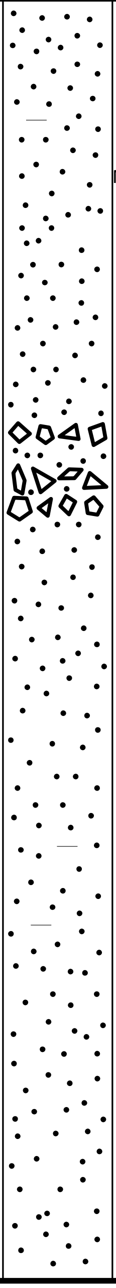
Project Number: 24064-01
Project Name: Meritage Homes
400-700 Freedom Lane

Date(s) Drilled: 05-09-2024	**Logged By:** AC/PA	**B-2** Page 1 of 3
Drilling Method: Bucket Auger	**Drill Bit Size/Type:** 24”	
Drill Rig Type: Cal Weld	**Hammer Drive Drop (in.):** 12”	
Drive Weight (lbs.): 0-25’: 2500, 25-45’: 1500, 45-65’: 750, 65-90’: 1300		**Total Depth Drilled (ft):** 65
Drilling Company: Big Johnny’s		**Approximate Ground Surface Elevation (ft):** 468
Comments: Seepage at 18.4, 19.6-28.4.		

Depth (ft)	SAMPLES Type and Number	 Blows Per Foot	Graphic Log S N	Attitudes	USCS	DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Remarks
				@1.5 B: N22W, 2W @3.0 J: N34E, 82W		**Niguel Formation (Tn)** @0-0.7’: Top soil. @0.7’-5’: Pale olive brown silty SANDSTONE, moist, medium dense, iron staining, scattered roots, jointed.			
5	D-1	3		@5.0 J: N8E, 90 @6.4 B: N66W, 4N @7.0 B: N67E, 9N @9.3 C: N66W, 6N @9.5 J: N7E, 87E	SP	@5’: SAMPLE: Pale olive brown fine to medium SANDSTONE, moist to very moist, medium dense, iron staining, trace silt, massive. @7’: Iron stained layer/bedding, siltstone ripup clasts, wet. @8’: Pale olive brown silty SANDSTONE, moist, iron and manganese staining. @8.8-9.3’: Contact with SILTSTONE below, slight seepage on downdip side, manganese staining, cemented along bedding.	11.6	107.6	
10	D-2	7		@10.0 C: N74W, 22N	SM/ ML	@10’ SAMPLE: Yellowish brown to pale gray silty fine SANDSTONE/ sandy SILTSTONE, very moist, dense, iron staining, fractured. @9.7’: Iron stained contact with pale gray silty fine SANDSTONE, moist, massive. @11’: Near-vertical parallel joints, manganese stained, roots. @14.5’: Gradational contact with gray massive siltstone.	19.3	106.6	
15				@16.0 B: N76E, 8N @18.5 J: N28W, 90E @19.6 B: E-W, 9N		@18.5’: Near-vertical joint, light seepage. @19.4’: Contact, laminated SILTSTONE below, well bedded.			
20	D-3	6		@21.5 CB: N78W, 9N @22.0 CB: N65W, 6N	ML	@20’ SAMPLE: Olive brown to yellowish brown sandy SILTSTONE, very moist to wet, hard, thinly laminated, well bedded. @21.5’: Clay bed 1/8” thick, slightly sheared. @22’: Clay bed 1/8” thick, gray, slightly sheared, plastic.	30.6	87.5	GS, AL, DS
25				@28.0 C: N30W, 15N		@22’: Pale gray massive iron stained SILTSTONE, seepage. @27’: Seepage. @27.8’: Undulatory contact, pale gray to brown SANDSTONE, clean, massive.			
30									

Geotechnical Log Of Boring	Project Number: 24064-01 Project Name: Meritage Homes 400-700 Freedom Lane

Date(s) Drilled: 05-09-2024	**Logged By:** AC/PA	**B-2** Page 2 of 3
Drilling Method: Bucket Auger	**Drill Bit Size/Type:** 24”	
Drill Rig Type: Cal Weld	**Hammer Drive Drop (in.):** 12”	
Drive Weight (lbs.): 0-25’: 2500, 25-45’: 1500, 45-65’: 750, 65-90’: 1300		**Total Depth Drilled (ft):** 65
Drilling Company: Big Johnny’s		**Approximate Ground Surface Elevation (ft):** 468
Comments:		

Depth (ft)	SAMPLES Type and Number	SAMPLES Blows Per Foot	Graphic Log S N	Attitudes	USCS	DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Remarks
	D-4	12			SP	@30’ SAMPLE: Pale gray to white fine to medium SANDSTONE, damp, dense, iron staining, massive, slightly friable. – Sample Disturbed - @30.5’: Iron stained cross bedding. @32’: Pale gray SANDSTONE, damp, dense, slightly friable, trace silt, little to no iron staining, massive.	2.3	81.5	
				@33.5 B: N58W, 10N					
35									
				@38.0 B: N67W, 7N		@38’: Iron staining along bedding.			
40	D-5	9			SP	@40’-42’: Siltstone rip-up clasts along bedding. @40’ SAMPLE: Pale gray to white fine to medium SANDSTONE, damp, dense, some iron staining, slightly friable. @41’: Scattered shell fragments.	5.3	107.8	
				@41.0 B: N86E, 9N					
45									
50	D-6	20		@50.0 B: Flat	SP	@50’ SAMPLE: Pale yellowish gray to white SANDSTONE, damp to moist, dense to very dense, trace iron staining, slightly friable. @50’: Pale gray slightly silty SANDSTONE, moist, dense, slightly friable, massive, iron staining along bedding.	6.6	106.5	
55									
				@58.0 B: N48E, 3N		@58’: Increasingly friable, banded iron staining.			
60									

Date(s) Drilled: 05-09-2024	**Logged By:** AC/PA	**B-2**
Drilling Method: Bucket Auger	**Drill Bit Size/Type:** 24”	
Drill Rig Type: Cal Weld	**Hammer Drive Drop (in.):** 12”	Page 3 of 3
Drive Weight (lbs.): 0-25’: 2500, 25-45’: 1500, 45-65’: 750, 65-90’: 1300		**Total Depth Drilled (ft):** 65
Drilling Company: Big Johnny’s		**Approximate Ground Surface Elevation (ft):** 468
Comments:		

Depth (ft)	SAMPLES Type and Number	 Blows Per Foot	Graphic Log S N	Attitudes	USCS	DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Remarks
	▮ D-7	18	⁘		SP	@60’ SAMPLE: Pale olive brown fine to coarse SANDSTONE, damp to moist, dense to very dense, some iron staining, micaceous, trace shell fragments. @60’: Pale gray SANDSTONE, moist, trace silt, banded iron staining.	6.9	111.5	
65						Notes: Total Depth: 65’. Downhole Logged to 63’. No Groundwater. Backfilled With Cuttings And Tamped.			
70									
75									
80									
85									
90									

Geotechnical Log Of Boring

Project Number: 24064-01
Project Name: Meritage Homes
400-700 Freedom Lane

Date(s)Excavated: 05-03-2024	**Logged By:** AC/AZ
Excavation Method: Backhoe	
Equipment Type: Deere 310 SL	
Sampling Method(s): Bulk	
Approximate Groundwater Depth: Groundwater Not Encountered.	
Comments:	

TP-1

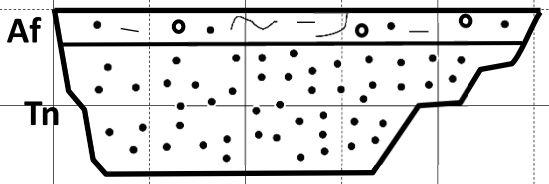
Total Depth (ft): 4

Approximate Ground Surface Elevation (ft): 464.5

Log Of Test Pit

Sample Depth (ft)	SAMPLES Type Number	SAMPLES Blows Per Foot	USCS	Surface: Weeds	Moisture Content (%)	Dry Density (pcf)	REMARKS
0	B-1		SM	**Artificial Fill (Af)** @ 0-0.6': Pale olive gray to pale brown silty fine SAND with coarse gravel, dry, loose, vegetation and roots.			Bulk Bag @ 1-4'
			SM	**Niguel Formation (Tn)** @ 0.6'-4': Yellowish gray to reddish yellow fine to coarse SANDSTONE, damp, medium dense, banded iron staining, friable, slight caving, massive.			
5				Notes: Total Depth: 4 Feet. Groundwater Not Encountered. Backfilled with Cuttings and Rolled.			
10							
15							

Graphic Orientation: North Wall **Trend:** E-W **Scale:** 1"=5'



Log Of Test Pit

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01

Appendix B

Date(s)Excavated: 05-03-2024	**Logged By:** AC/AZ
Excavation Method: Backhoe	
Equipment Type: Deere 310 SL	
Sampling Method(s):	
Approximate Groundwater Depth: Groundwater Not Encountered.	
Comments:	

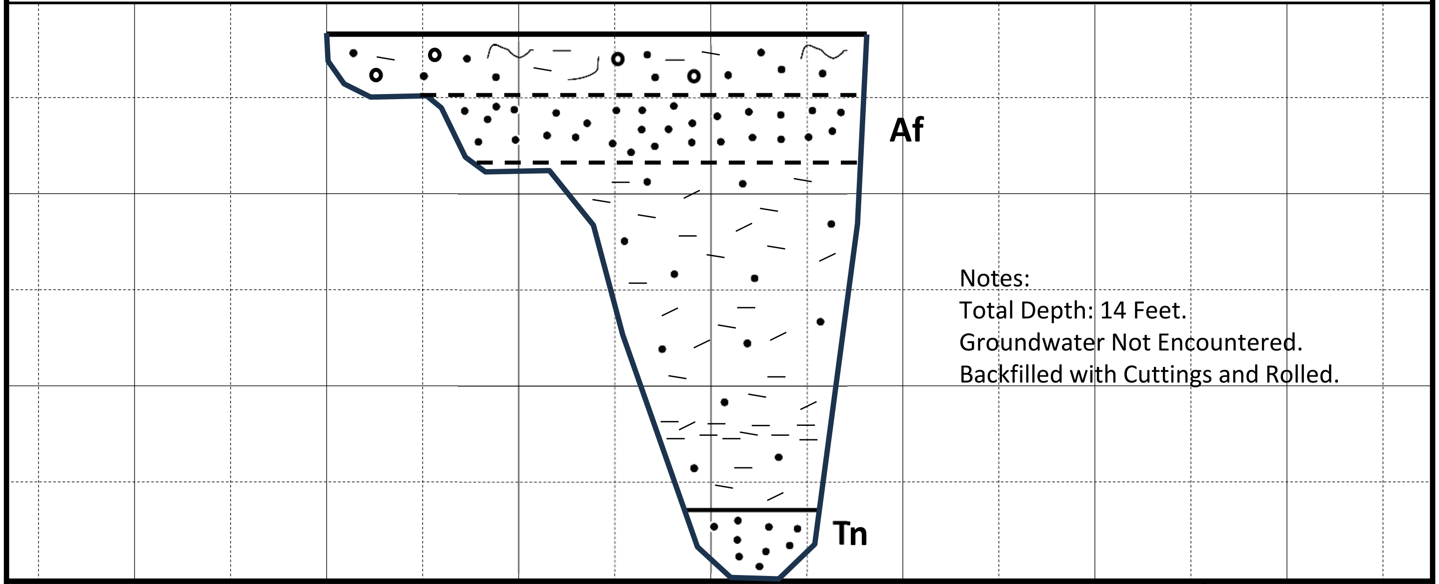
TP-2

Total Depth (ft): 14

Approximate Ground Surface Elevation (ft): 475

Sample Depth (ft)	SAMPLES		USCS	Log Of Test Pit	Moisture Content (%)	Dry Density (pcf)	REMARKS
	Type Number	Blows Per Foot		Surface: Weeds			
0				**Undocumented Artificial Fill (Afu)**			
			SM	@ 0-1.5’: Yellowish gray to pale brown silty fine SAND dry, loose, little coarse gravel, roots, scattered vegetation.			
			SP	@ 1.5-3’: Pale yellowish gray to white fine to coarse SAND, damp, loose, friable/caving.			
			SM	@ 3-12.5’: Pale brown to yellowish brown silty fine to coarse SAND, damp to moist, medium dense, trace clay and asphalt debris.			
5							
10			SM/ ML	@ 10’: Moist to very moist. @ 11’: Brown sandy SILT.			
				Niguel Formation (Tn)			
			SM	@ 12.5-14’: Pale yellowish gray to white fine to coarse SANDSTONE, moist, dense, iron staining, friable, caving, massive.			
15							

Graphic Orientation: North Wall **Trend:** <-N69W- **Scale:** 1”=5’



Notes:
Total Depth: 14 Feet.
Groundwater Not Encountered.
Backfilled with Cuttings and Rolled.

Log Of Test Pit

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

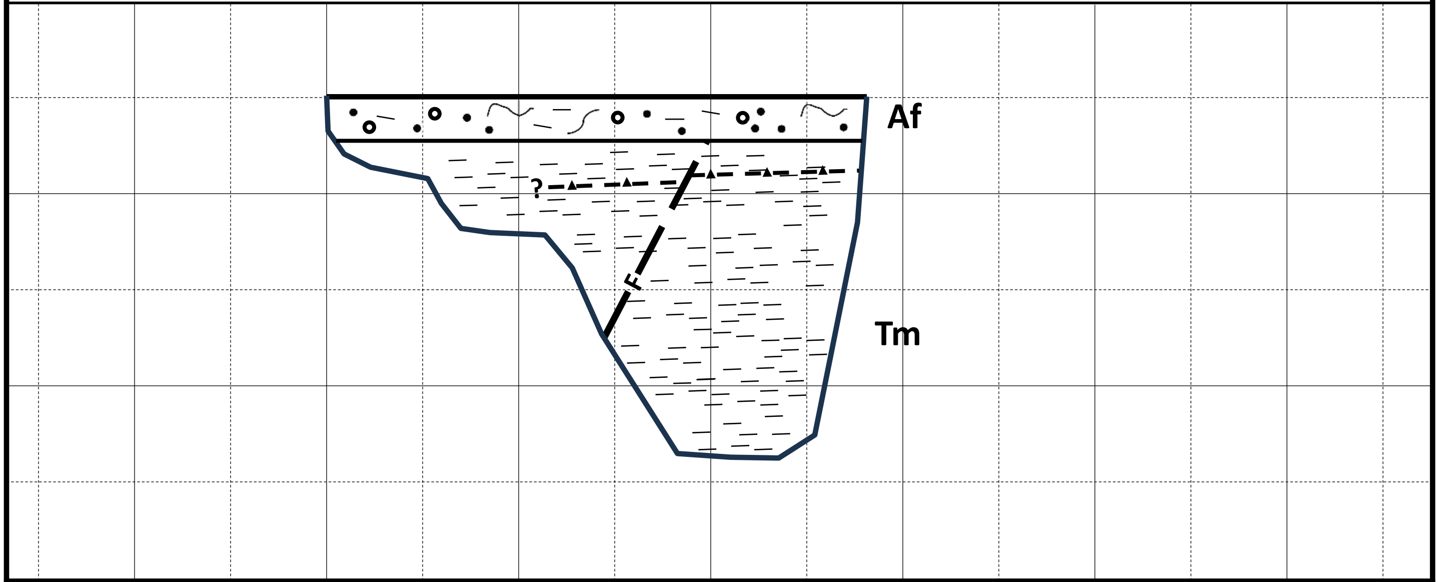
Project Number: 24064-01

Appendix B

Date(s)Excavated: 05-03-2024	**Logged By:** AC/AZ	**TP-3**
Excavation Method: Backhoe		
Equipment Type: Deere 310 SL		
Sampling Method(s): Bulk		**Total Depth (ft)**: 9
Approximate Groundwater Depth: Groundwater Not Encountered.		**Approximate Ground Surface Elevation (ft):** 461.5
Comments:		

Sample Depth (ft)	SAMPLES Type Number	SAMPLES Blows Per Foot	USCS	Log Of Test Pit Surface: Weeds	Moisture Content (%)	Dry Density (pcf)	REMARKS
0				**Artificial Fill (Af)**			
			SM	@ 0-1': Pale brown silty fine SAND with gravel, dry, loose.			Bulk Bag @ 1-4' GS, AL, EI, CC
				Monterey Formation (Tm)			
	B-1		MH	@ 1-9': Pale brown to white SILTSTONE, moist, medium dense, well laminated, diatomaceous. @2': 0.25-inch-thick olive gray CLAY, very moist, slightly plastic, offset by fault 1 to 2 inches, pinches out north of fault.			@2' CB: N62E, 4W @2.5' F: N40W, 78SW @4' J: N44E, 82E
5							
10				Notes: Total Depth: 9 Feet. Groundwater Not Encountered. Backfilled with Cuttings and Rolled.			
15							

Graphic Orientation: North Wall **Trend:** <-N45W- **Scale:** 1"=5'



Log Of Test Pit

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

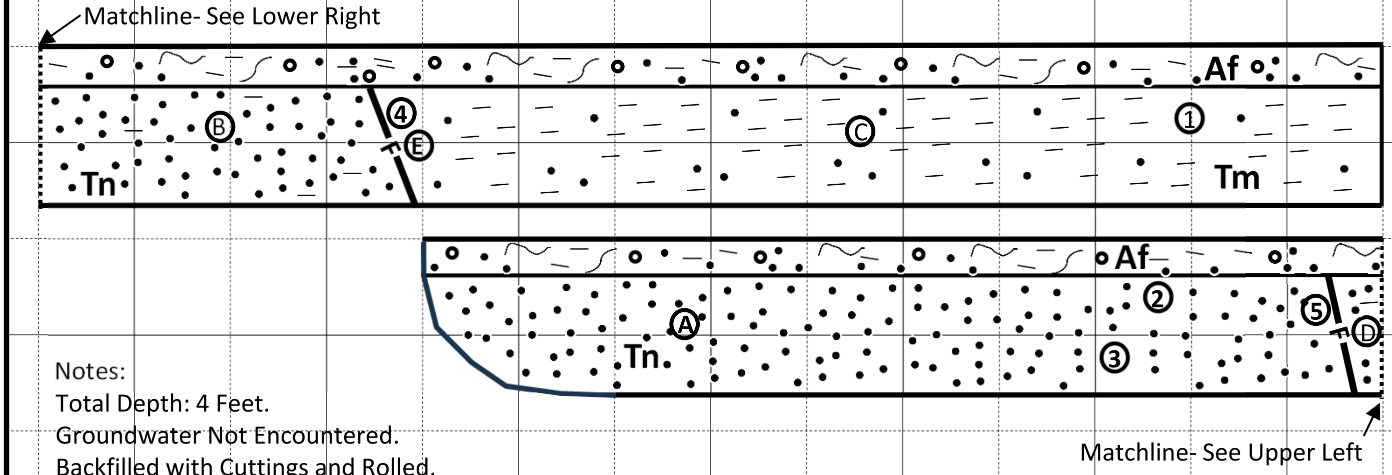
Project Number: 24064-01

Appendix B

Date(s)Excavated: 05-07-2024	**Logged By:** AC/AZ	**TP-3a**
Excavation Method: Backhoe		
Equipment Type: Deere 310 SL		
Sampling Method(s):		**Total Depth (ft)**: 4
Approximate Groundwater Depth: Groundwater Not Encountered.		**Approximate Ground Surface Elevation (ft):** 464
Comments:		

Sample Depth (ft)	SAMPLES Type Number	SAMPLES Blows Per Foot	USCS	**Log Of Test Pit** Surface: Weeds	Moisture Content (%)	Dry Density (pcf)	REMARKS
0			SM	**Artificial Fill (Af)** Pale brown silty fine SAND with coarse gravel, dry, loose, vegetation and roots.			(1) B: N88W, 14N (2) B: N46E, 18S (3) B: N24E, 12NE (4) F: N8W, 63E (5) F: N4E, 60E
			SP	**Niguel Formation (Tn)** (A) Pale brownish gray to white fine to coarse SANDSTONE, damp to moist, medium dense, iron staining, friable, caving, locally crossbedded.			
5			SM-SP	(B) Pale brownish gray to pale brown slightly silty fine to coarse SANDSTONE, moist, medium dense, friable, caving, massive.			
			SM/ML	**Monterey Formation (Tm)** (C) Pale brown to reddish brown silty fine to medium SANDSTONE/ SILTSTONE, moist to very moist, medium dense, well bedded.			
10				(D) Fault: olive brown, clay-filled, roots, very plastic, 0.25" thick			
				(E) Fault: dark brown-olive brown, clay-filled, roots, very plastic, 0.25" thick, soft			
15							

Graphic Orientation: North Wall **Trend:** <-N70W- **Scale:** 1"=5'



Notes:
Total Depth: 4 Feet.
Groundwater Not Encountered.
Backfilled with Cuttings and Rolled.

Log Of Test Pit

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01

Appendix B

Date(s)Excavated: 05-07-2024

Logged By: AC/AZ

Excavation Method: Backhoe

Equipment Type: Deere 310 SL

Sampling Method(s): None

Approximate Groundwater Depth: Groundwater Not Encountered.

Comments:

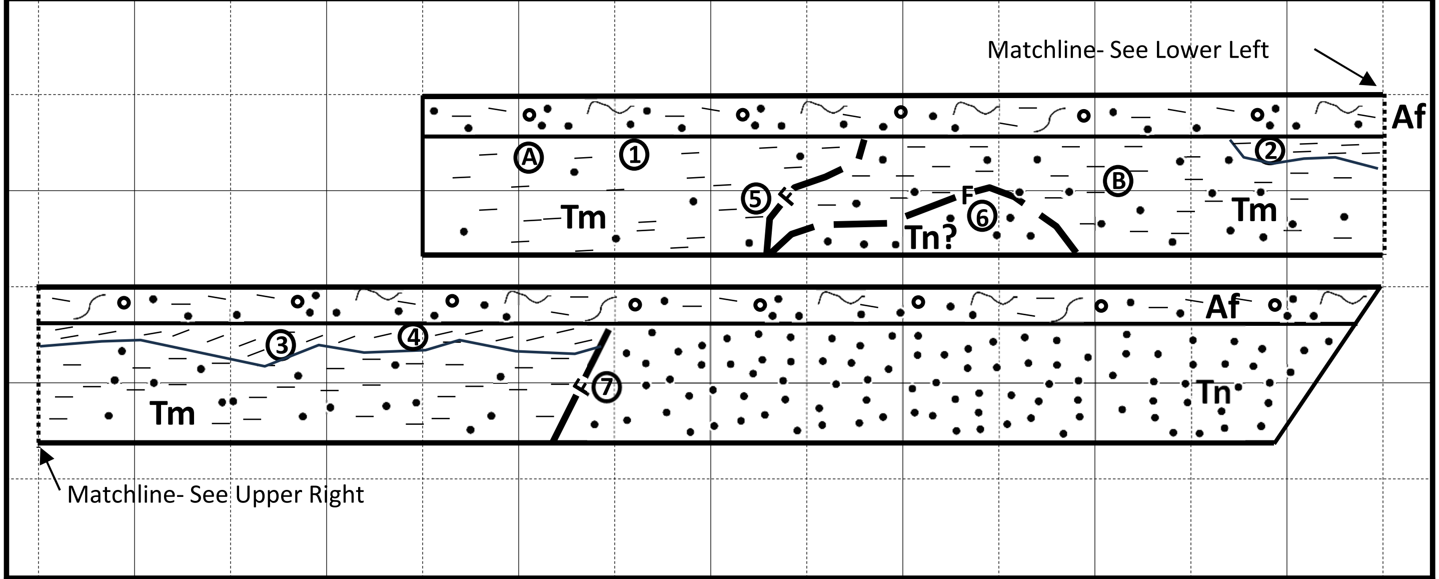
TP-3b

Total Depth (ft): 4

Approximate Ground Surface Elevation (ft): 461.5

Sample Depth (ft)	SAMPLES Type Number	SAMPLES Blows Per Foot	USCS	Log Of Test Pit Surface: Weeds	Moisture Content (%)	Dry Density (pcf)	REMARKS
0			SM	**Artificial Fill (Af)** Pale brown silty fine to coarse SAND with gravel, dry to damp, loose, entrained vegetation and debris.			(1) B: N60W, 6NE (2) B: N18W, 7E (3) B: N12W, 36W (4) B: N3W, 32W (5) F: N2W, 82W (6) F: N3W, 52E (7) F: N5W, 72W
5			SP	**Niguel Formation (Tn)** Pale brown to white fine to coarse SANDSTONE, very moist to wet, medium dense, iron staining, friable, micaceous, caving, mild crossbedding. In fault contact with Monterey. Fault is clay-lined with abundant roots, planar. Bedrock on either side of fault is broken/weathered.			
10			ML	**Monterey Formation (Tm)** (A) Pale bluish gray clayey SILTSTONE, moist, dense, thinly bedded, well bedded.			
			SM	(B) Reddish brown silty SANDSTONE, very moist to wet, medium dense to dense, massive.			
15				Notes: Total Depth: 4 Feet. Groundwater Not Encountered. Backfilled with Cuttings and Rolled.			

Graphic Orientation: North Wall **Trend:** <-N34W- **Scale:** 1"=5'



Log Of Test Pit

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01

Appendix B

Date(s)Excavated: 05-03-2024	**Logged By:** AZ
Excavation Method: Backhoe	
Equipment Type: Deere 310 SL	
Sampling Method(s):	
Approximate Groundwater Depth: Groundwater Not Encountered.	
Comments:	

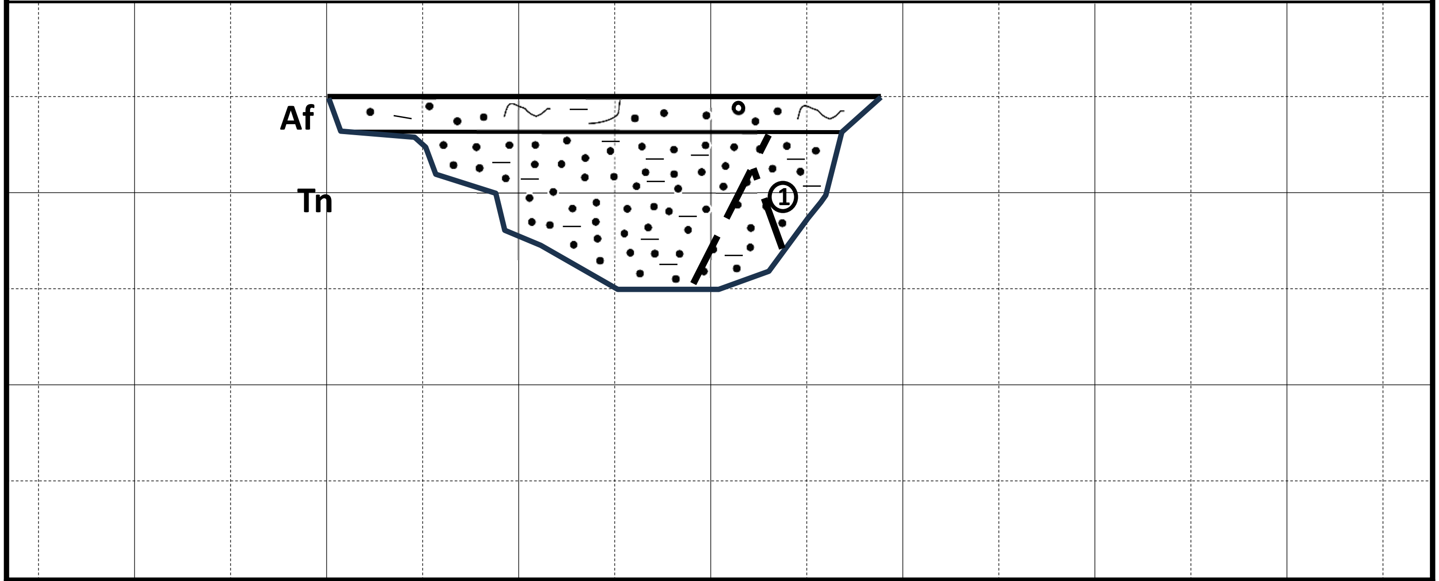
TP-4

Total Depth (ft): 5

Approximate Ground Surface Elevation (ft): 466.5

Sample Depth (ft)	SAMPLES Type Number	SAMPLES Blows Per Foot	USCS	**Log Of Test Pit** Surface: Weeds	Moisture Content (%)	Dry Density (pcf)	REMARKS
0			SP-SM	**Artificial Fill (Af)** @ 0-1’: Yellowish brown fine to medium SAND with silt, moist, medium dense, some roots, trace coarse gravel.			(1) J: N34E, 83W
			SM	**Niguel Formation (Tn)** @ 1’-5’: Gray and pale yellow silty fine to medium SANDSTONE, damp to moist, medium dense, trace root hairs, iron staining, fractured/conjugate joints, massive.			
5				Notes: Total Depth: 5 Feet. Groundwater Not Encountered. Backfilled with Cuttings and Rolled.			
10							
15							

Graphic Orientation: East Wall **Trend:** N-S **Scale:** 1”=5’



Log Of Test Pit

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01

Appendix B

Date(s)Excavated: 05-03-2024	**Logged By:** AZ
Excavation Method: Backhoe	
Equipment Type: Deere 310 SL	
Sampling Method(s):	
Approximate Groundwater Depth: Groundwater Not Encountered.	
Comments:	

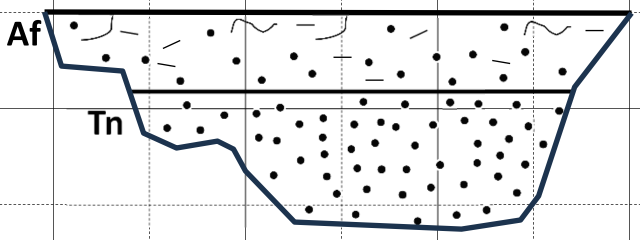
TP-5

Total Depth (ft): 5.5

Approximate Ground Surface Elevation (ft): 466.5

Sample Depth (ft)	SAMPLES		USCS	Log Of Test Pit	Moisture Content (%)	Dry Density (pcf)	REMARKS
	Type Number	Blows Per Foot		Surface: Weeds			
0			SM	**Artificial Fill (Af)** @ 0-2.5’: Yellowish brown silty fine to medium SAND, moist, medium dense, roots in upper 6 inches.			
			SP	**Niguel Formation (Tn)** @ 2.5-5.5’: Light gray fine to medium SANDSTONE, damp to moist, medium dense, friable, massive.			
5				Notes: Total Depth: 5.5 Feet. Groundwater Not Encountered. Backfilled with Cuttings and Rolled.			
10							
15							

Graphic Orientation: East Wall **Trend:** <-N50W- **Scale:** 1”=5’



Log Of Test Pit

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01

Appendix B

Date(s)Excavated: 05-03-2024 **Logged By:** AC/AZ

Excavation Method: Backhoe

Equipment Type: Deere 310 SL

Sampling Method(s): Bulk

Approximate Groundwater Depth: Groundwater Not Encountered.

Comments:

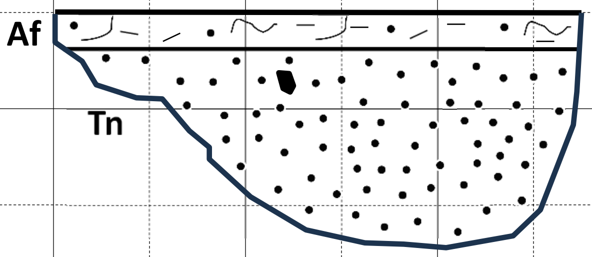
TP-6

Total Depth (ft): 6

Approximate Ground Surface Elevation (ft): 461.5

Sample Depth (ft)	SAMPLES		USCS	Log Of Test Pit	Moisture Content (%)	Dry Density (pcf)	REMARKS
	Type Number	Blows Per Foot		Surface: Weeds			
0	B-1		SM	**Artificial Fill (Af)** @ 0-1’: Pale brown silty fine SAND with gravel, dry, loose, vegetation/debris.			Bulk Bag @ 0-5' @2.5’ B: N5E, 8W
			SP	**Niguel Formation (Tn)** @ 1-6’: Pale yellowish gray and pale reddish brown fine to coarse SANDSTONE, moist to very moist, medium dense, iron staining along bedding. Krotovina @ 1.5’.			
5							
				Notes: Total Depth: 6 Feet. Groundwater Not Encountered. Backfilled with Cuttings and Rolled.			
10							
15							

Graphic Orientation: North Wall **Trend:** <-N16W- **Scale:** 1”=5’



Log Of Test Pit

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

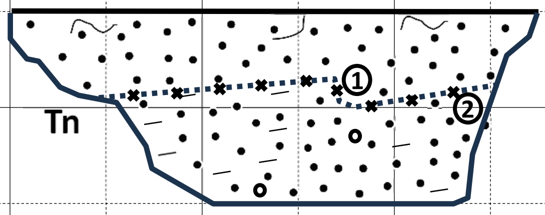
Project Number: 24064-01

Appendix B

Date(s)Excavated: 05-03-2024	**Logged By:** AC/AZ	**TP-7**
Excavation Method: Backhoe		
Equipment Type: Deere 310 SL		
Sampling Method(s):		**Total Depth (ft)**: 5
Approximate Groundwater Depth: Groundwater Not Encountered.		**Approximate Ground Surface Elevation (ft):** 454
Comments:		

Sample Depth (ft)	SAMPLES Type Number	SAMPLES Blows Per Foot	USCS	Log Of Test Pit Surface: Weeds/Vegetation.	Moisture Content (%)	Dry Density (pcf)	REMARKS
0			SP	**Niguel Formation (Tn)** @ 0-2': Pale yellow fine to medium SANDSTONE, damp to moist, medium dense to dense, friable, massive, root hairs in upper 6".			(1) B: N68E, 10NW (2) B: N40E, 2NW
			SM	@ 2-2.5': Dark reddish brown to dark brown weakly cemented SANDSTONE, iron staining.			
5			SM	@ 2.5-5': Grayish yellow silty fine SANDSTONE, moist, dense, trace iron staining and jarosite, trace rounded fine gravel.			
10				Notes: Total Depth: 5 Feet. Groundwater Not Encountered. Backfilled with Cuttings and Rolled.			
15							

Graphic Orientation: East Wall **Trend:** <-N9E- **Scale:** 1"=5'



Log Of Test Pit

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

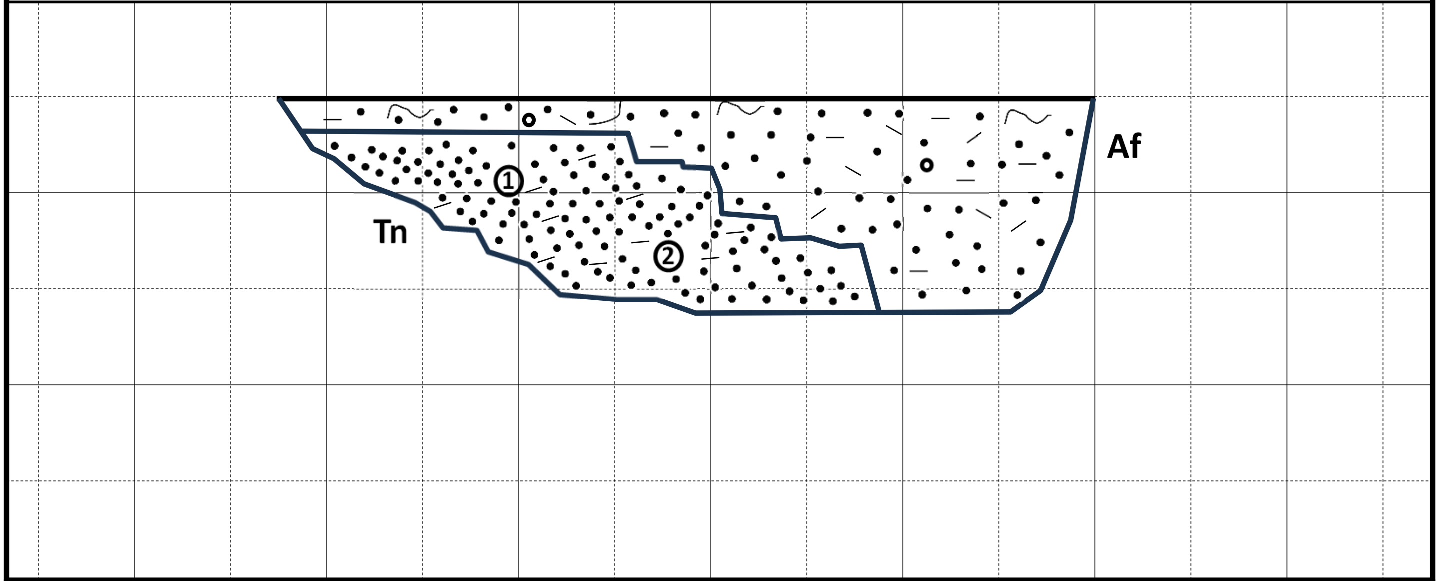
Project Number: 24064-01

Appendix B

Date(s)Excavated: 05-03-2024	**Logged By:** AC/AZ	**TP-8**
Excavation Method: Backhoe		
Equipment Type: Deere 310 SL		
Sampling Method(s):		**Total Depth (ft)**: 5.5
Approximate Groundwater Depth: Groundwater Not Encountered.		**Approximate Ground Surface Elevation (ft):** 467
Comments:		

Sample Depth (ft)	SAMPLES Type Number	 Blows Per Foot	USCS	**Log Of Test Pit** Surface: Weeds/sand	Moisture Content (%)	Dry Density (pcf)	REMARKS
0			SM	**Artificial Fill (Af)** Mottled yellowish brown, brown, and grayish brown silty fine to medium SAND, moist to very moist, medium dense, probes firm, trace fine gravel.			(1) B: N80E, 19N (2) B: N28E, 7NW
			SP	**Niguel Formation (Tn)** Pale yellow to reddish yellow SANDSTONE, damp, medium dense to dense, friable, iron staining, cross bedded.			
5							
				Notes: Total Depth: 5.5 Feet. Groundwater Not Encountered. Backfilled with Cuttings and Rolled.			
10							
15							

Graphic Orientation: North Wall **Trend:** <-N20W- **Scale:** 1”=5’



Log Of Test Pit

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

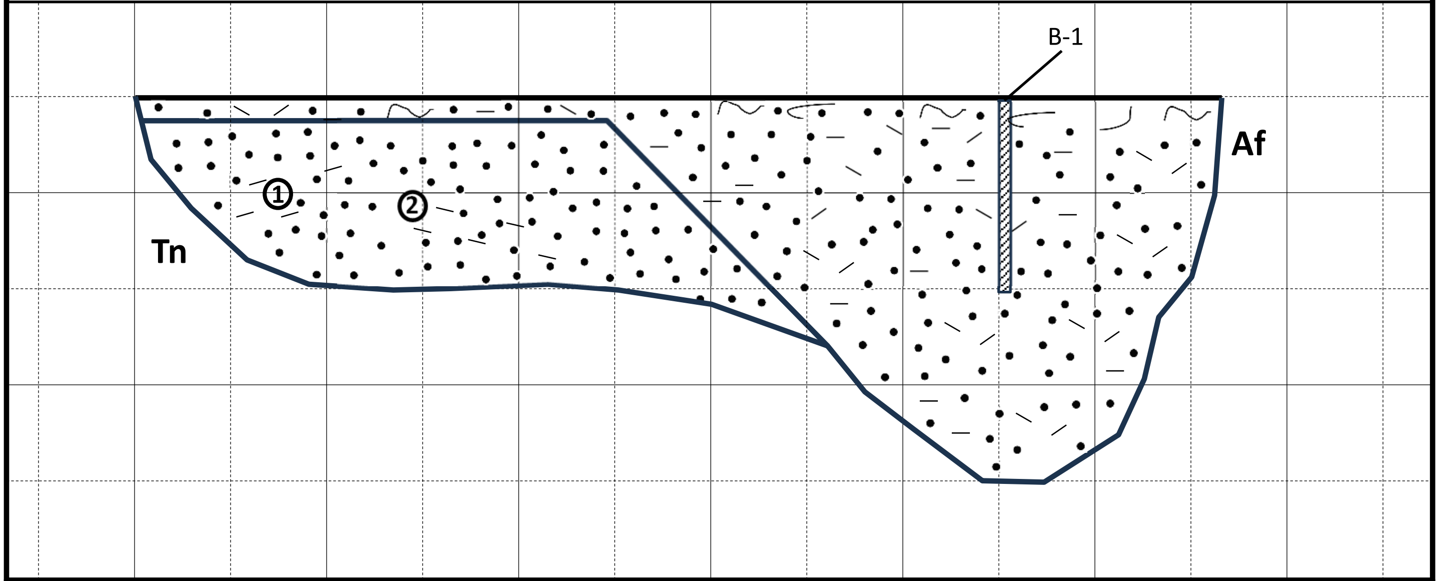
Project Number: 24064-01

Appendix B

Date(s)Excavated: 05-03-2024	**Logged By:** AC/AZ	**TP-9**
Excavation Method: Backhoe		
Equipment Type: Deere 310 SL		
Sampling Method(s): Bulk		**Total Depth (ft)**: 10
Approximate Groundwater Depth: Groundwater Not Encountered.		**Approximate Ground Surface Elevation (ft):** 465
Comments:		

Sample Depth (ft)	SAMPLES Type Number	SAMPLES Blows Per Foot	USCS	Log Of Test Pit	Moisture Content (%)	Dry Density (pcf)	REMARKS
0	B-1		SM	**Artificial Fill (Af)** Mottled dark brown and yellowish gray silty fine to medium SAND, damp to moist, medium dense, abundant roots in upper 12”.			Bulk Bag @ 0-5’ GS, MD, EI, CC (1) B: N43E, 18W (2) B: E-W, 13S
5			SP	**Niguel Formation (Tn)** Pale yellowish gray to white fine to coarse SANDSTONE, moist to very moist, dense, iron staining, friable, caving, cross bedded.			
				Notes: Total Depth: 10 Feet. Groundwater Not Encountered. Backfilled with Cuttings and Rolled.			
10							
15							

Graphic Orientation: North Wall **Trend:** <-N20W- **Scale:** 1”=5’



Log Of Test Pit

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01

Appendix B

Date(s)Excavated: 05-03-2024 | **Logged By:** AC/AZ

Excavation Method: Backhoe

Equipment Type: Deere 310 SL

Sampling Method(s):

Approximate Groundwater Depth: Groundwater Not Encountered.

Comments:

TP-10

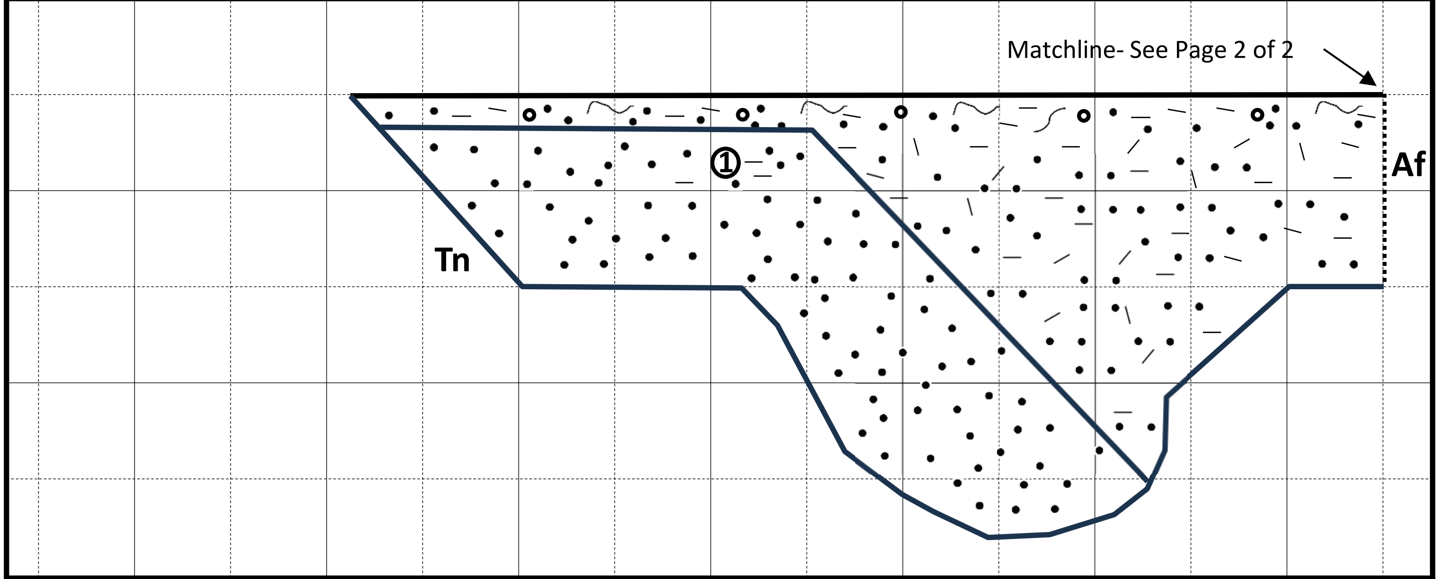
Page 1 of 2

Total Depth (ft): 12

Approximate Ground Surface Elevation (ft): 461

Sample Depth (ft)	SAMPLES Type Number	SAMPLES Blows Per Foot	USCS	Log Of Test Pit Surface: Weeds	Moisture Content (%)	Dry Density (pcf)	REMARKS
0			SM	**Artificial Fill (Af)** Mottled olive brown and dark brown silty fine to medium SAND, moist to very moist, medium dense, predominantly bedrock derived with local lifts of topsoil, lift thickness 2-7”, probes firm throughout, upper 1-1.5’ weathered, roots, damp.			(1) B: N9W, 6NE
5			SP	**Niguel Formation (Tn)** Pale gray and pale reddish brown fine to coarse SANDSTONE, moist to wet, dense, banded iron staining, friable, locally cross bedded, caving.			
				*Continued on Page 2 of 2.			
10				Notes: Total Depth: 12 Feet. Groundwater Not Encountered. Backfilled with Cuttings and Rolled.			
15							

Graphic Orientation: East Wall **Trend:** <-N27W- **Scale:** 1”=5’



Log Of Test Pit

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01

Appendix B

Date(s)Excavated: 05-03-2024 **Logged By:** AC/AZ

Excavation Method: Backhoe

Equipment Type: Deere 310 SL

Sampling Method(s):

Approximate Groundwater Depth: Groundwater Not Encountered.

Comments:

TP-10

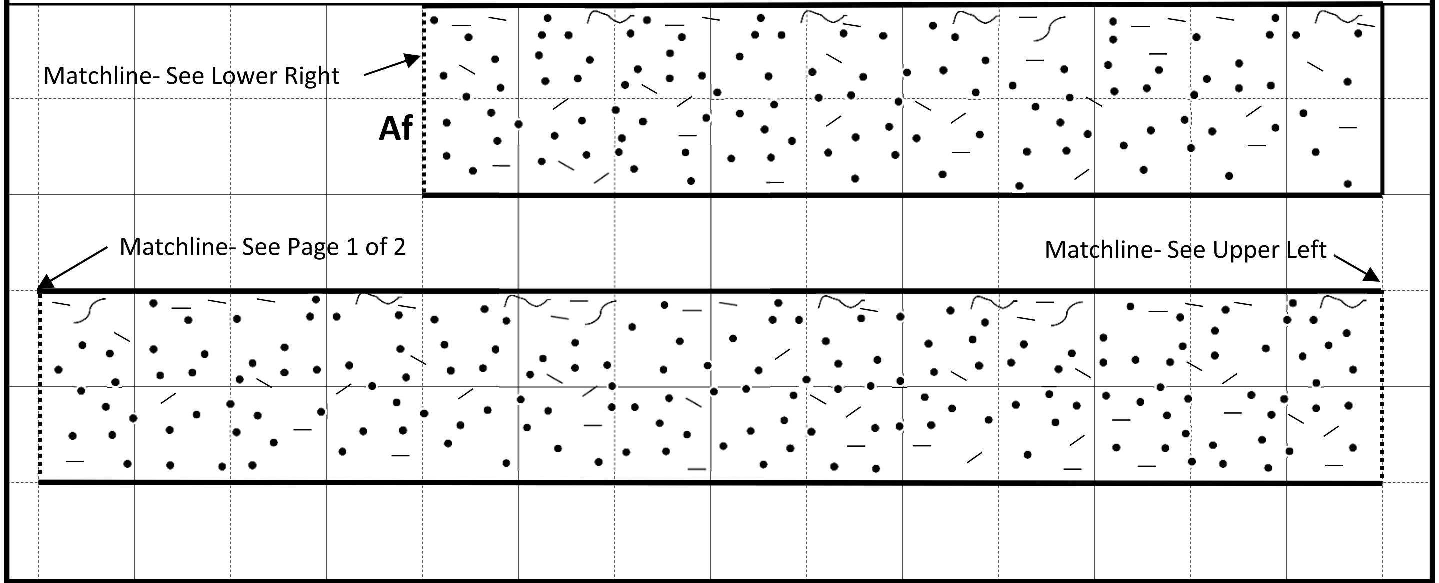
Page 2 of 2

Total Depth (ft): 12

Approximate Ground Surface Elevation (ft): 461

Sample Depth (ft)	SAMPLES		USCS	Log Of Test Pit	Moisture Content (%)	Dry Density (pcf)	REMARKS
	Type Number	Blows Per Foot		Surface: Weeds/Vegetation.			
0			SM	**Artificial Fill (Af)** Mottled olive brown and dark brown silty fine to medium SAND, moist to very moist, medium dense, predominantly bedrock (Tn) derived with local lifts topsoil derived, lift thickness 2-7”, probes firm throughout. Upper 1-1.5’ weathered, roots, damp.			
5							
10							
15							

Graphic Orientation: East Wall **Trend:** <-N27W- **Scale:** 1”=5’


Matchline- See Lower Right
Af
Matchline- See Page 1 of 2
Matchline- See Upper Left

Log Of Test Pit

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01

Appendix B

Date(s) Drilled: 05-14-2024	**Logged By:** AC/PA	**HA-1** Page 1 of 1
Drilling Method: Hand Auger	**Drill Bit Size/Type:** 3” Hand Auger	
Drill Rig Type: Manual	**Hammer Type:**	
Sampling Method(s):		**Total Depth Drilled (ft)** 11.5
Approximate Groundwater Depth: Groundwater Not Encountered		**Approximate Ground Surface Elevation (ft)** 445
Comments:		

Depth (ft)	SAMPLES Type Number	SAMPLES Blows Per Foot	USCS	MATERIAL DESCRIPTION Surface: Grass/weeds.	Moisture Content (%)	Dry Density (pcf)	REMARKS
0			SM	**Artificial Fill (Af)** @ 0-4.5’: Dark brown to brownish black silty fine to medium SAND, moist to very moist, medium dense, trace organics/ vegetation. @ 3.5’: Bedrock fragments.			
5			SM-SP	@ 4.5-8’: Mottled yellowish brown and olive gray fine to coarse SAND with silt, moist to very moist, medium dense, bedrock fragments, trace iron staining.			
			SC	@ 8-9’: Reddish brown clayey fine to coarse SAND, moist to very moist, medium dense.			
			SM	@ 9-10’: Mottled yellowish gray and olive brown silty fine to coarse SAND, moist, medium dense, trace clay.			
10			SP	**Niguel Formation (Tn)** @ 10-11.5’: Pale yellow and yellowish orange fine to medium SAND, damp to moist, dense, banded iron staining.			
				Notes: Total Depth: 11.5 Feet. Groundwater Not Encountered. Backfilled With Cuttings.			
15							
20							

Log Of Boring

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01

Appendix B

Date(s) Drilled: 05-14-2024	**Logged By:** AC/PA	**HA-2** Page 1 of 1
Drilling Method: Hand Auger	**Drill Bit Size/Type:** 3” Hand Auger	
Drill Rig Type: Manual	**Hammer Type:**	
Sampling Method(s):		**Total Depth Drilled (ft)** 13
Approximate Groundwater Depth: Groundwater Not Encountered		**Approximate Ground Surface Elevation (ft)** 426
Comments:		

Depth (ft)	**SAMPLES** Type Number	**SAMPLES** Blows Per Foot	**USCS**	**MATERIAL DESCRIPTION** Surface: Grass/weeds	**Moisture Content (%)**	**Dry Density (pcf)**	**REMARKS**
0			SM	**Artificial Fill (Af)** @ 0-1.5’: Brown silty fine to medium SAND, dry, loose, weathered in upper 6”, trace gravel, slight caving, roots.			
			SP-SM	@ 1.5-5’: Mottled yellowish brown and brown slightly silty fine to coarse SAND, moist, medium dense, trace iron staining.			
5			SM	@ 5-13’: Mottled yellowish gray and olive brown silty fine to medium SAND, moist, medium dense, trace clay and coarse gravel, trace bedrock fragments. @ 8.5’: Clean sand layer, 4 inches thick. @ 10.3’: Pale olive grey siltstone fragment. @ 11-12’: Clean sand, very moist.			
10							
15				Notes: Total Depth: 13 Feet. Groundwater Not Encountered. Backfilled With Cuttings.			
20							

Log Of Boring

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01

Appendix B

Date(s) Drilled: 05-14-2024	**Logged By:** AC/PA	**HA-3** Page 1 of 1
Drilling Method: Hand Auger	**Drill Bit Size/Type:** 3” Hand Auger	
Drill Rig Type: Manual	**Hammer Type:**	
Sampling Method(s):		**Total Depth Drilled (ft)** 10
Approximate Groundwater Depth: Groundwater Not Encountered		**Approximate Ground Surface Elevation (ft)** 429
Comments:		

Depth (ft)	**SAMPLES** Type Number	**SAMPLES** Blows Per Foot	**USCS**	**MATERIAL DESCRIPTION** Surface: Mulch/pine needles.	**Moisture Content (%)**	**Dry Density (pcf)**	**REMARKS**
0			SM	**Artificial Fill (Af)** @ 0-5.5: Yellowish brown to brown silty fine to medium SAND, damp to moist, medium dense, some coarse gravel and bedrock fragments, roots/vegetation in upper 2’.			
5			SM	@ 5.5-10’: Mottled yellowish brown, reddish brown, and white silty fine to coarse SAND, moist, medium dense, trace fine gravel, micaceous.			
10				Notes: Total Depth: 10 Feet. Groundwater Not Encountered. Backfilled With Cuttings.			
15							
20							

Log Of Boring

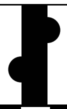
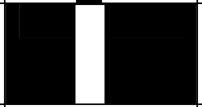
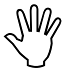
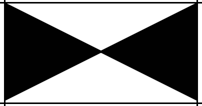
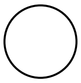
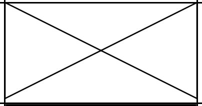
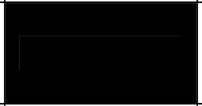
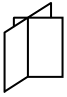
Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01

Appendix B

Boring Logs by Southern California Geotechnical (2021)

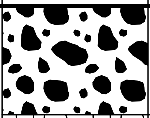
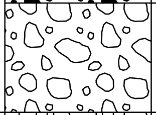
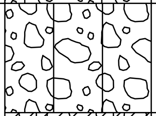
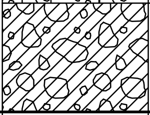
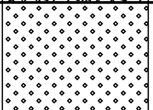
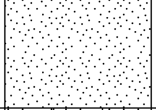
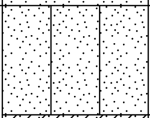
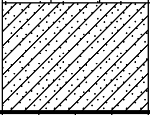
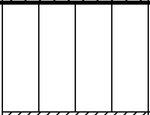
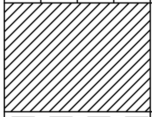
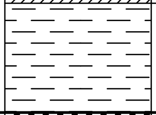
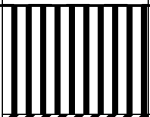
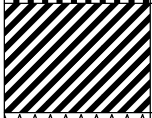
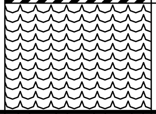
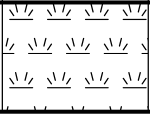
BORING LOG LEGEND

SAMPLE TYPE	GRAPHICAL SYMBOL	SAMPLE DESCRIPTION
AUGER		SAMPLE COLLECTED FROM AUGER CUTTINGS, NO FIELD MEASUREMENT OF SOIL STRENGTH. (DISTURBED)
CORE		ROCK CORE SAMPLE: TYPICALLY TAKEN WITH A DIAMOND-TIPPED CORE BARREL. TYPICALLY USED ONLY IN HIGHLY CONSOLIDATED BEDROCK.
GRAB		SOIL SAMPLE TAKEN WITH NO SPECIALIZED EQUIPMENT, SUCH AS FROM A STOCKPILE OR THE GROUND SURFACE. (DISTURBED)
CS		CALIFORNIA SAMPLER: 2-1/2 INCH I.D. SPLIT BARREL SAMPLER, LINED WITH 1-INCH HIGH BRASS RINGS. DRIVEN WITH SPT HAMMER. (RELATIVELY UNDISTURBED)
NSR		NO RECOVERY: THE SAMPLING ATTEMPT DID NOT RESULT IN RECOVERY OF ANY SIGNIFICANT SOIL OR ROCK MATERIAL.
SPT		STANDARD PENETRATION TEST: SAMPLER IS A 1.4 INCH INSIDE DIAMETER SPLIT BARREL, DRIVEN 18 INCHES WITH THE SPT HAMMER. (DISTURBED)
SH		SHELBY TUBE: TAKEN WITH A THIN WALL SAMPLE TUBE, PUSHED INTO THE SOIL AND THEN EXTRACTED. (UNDISTURBED)
VANE		VANE SHEAR TEST: SOIL STRENGTH OBTAINED USING A 4 BLADED SHEAR DEVICE. TYPICALLY USED IN SOFT CLAYS-NO SAMPLE RECOVERED.

COLUMN DESCRIPTIONS

DEPTH:	Distance in feet below the ground surface.
SAMPLE:	Sample Type as depicted above.
BLOW COUNT:	Number of blows required to advance the sampler 12 inches using a 140 lb hammer with a 30-inch drop. 50/3" indicates penetration refusal (>50 blows) at 3 inches. WH indicates that the weight of the hammer was sufficient to push the sampler 6 inches or more.
POCKET PEN.:	Approximate shear strength of a cohesive soil sample as measured by pocket penetrometer.
GRAPHIC LOG:	Graphic Soil Symbol as depicted on the following page.
DRY DENSITY:	Dry density of an undisturbed or relatively undisturbed sample in lbs/ft^3.
MOISTURE CONTENT:	Moisture content of a soil sample, expressed as a percentage of the dry weight.
LIQUID LIMIT:	The moisture content above which a soil behaves as a liquid.
PLASTIC LIMIT:	The moisture content above which a soil behaves as a plastic.
PASSING #200 SIEVE:	The percentage of the sample finer than the #200 standard sieve.
UNCONFINED SHEAR:	The shear strength of a cohesive soil sample, as measured in the unconfined state.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

SOUTHERN
CALIFORNIA
GEOTECHNICAL
A California Corporation

BORING NO.
B-1

JOB NO.: 21G167-1	DRILLING DATE: 5/13/21	WATER DEPTH: Dry
PROJECT: Proposed C/I Development	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 37 feet
LOCATION: Aliso Viejo, California	LOGGED BY: Daryl Kas	READING TAKEN: At Completion

SURFACE ELEVATION: 463 feet MSL

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
					FILL: Brown Silty fine Sand, mottled, dense to very dense-damp							
	⧗	78				122	3					EI = 0 0 to 5 feet
					NIGUEL FORMATION (Tn): Light Gray fine grained Sandstone, trace Silt, trace Iron oxide staining, weakly cemented, medium dense-dry to damp							
	⧗	28				99	2					
5	⧗	32				102	2					
	⧗	25				82	2					
10	⧗	26				102	3					
					Light Brown fine grained Sandstone, trace to little Silt, trace Iron oxide staining, weakly cemented, dense-damp							
15	⧗	56				101	5					
20	⧗	65				113	6					
					Brown fine grained Sandstone, trace medium Sand, trace Silt, trace Iron oxide staining, weakly cemented, dense-damp to moist							
25	⧗	48				110	6					
					Gray Brown fine to medium grained Sandstone, trace Iron oxide staining, weakly cemented, very dense-damp							
30	⧗	78/11"				111	6					
	⧗	98/11"				112	6					

TEST BORING LOG

JOB NO.: 21G167-1	DRILLING DATE: 5/13/21	WATER DEPTH: Dry
PROJECT: Proposed C/I Development	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 37 feet
LOCATION: Aliso Viejo, California	LOGGED BY: Daryl Kas	READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION (Continued)	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
				▨	Gray Brown fine to medium grained Sandstone, trace Iron oxide staining, weakly cemented, very dense-damp							
	⧗	79		▨		114	6					
40					Boring Terminated at 40'							

BORING NO.
B-2

JOB NO.: 21G167-1
PROJECT: Proposed C/I Development
LOCATION: Aliso Viejo, California
DRILLING DATE: 5/13/21
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Daryl Kas
WATER DEPTH: Dry
CAVE DEPTH: 18 feet
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: 466 feet MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
					NIGUEL FORMATION (Tn): Light Brown fine grained Sandstone, trace Iron oxide staining, weakly cemented, medium dense to dense-damp							
	⧗	33				101	5					EI = 0 0 to 5 feet
	⧗	28				103	6					
5	⧗	34				102	4					
	⧗	67			@ 7 to 8 feet, dense	110	5					
	⧗	41				105	7					
10												
					Light Gray fine grained Sandy Siltstone, abundant Iron oxide staining, weakly cemented, dense-very moist							
	⧗	53				100	23					
15												
					Light Gray fine grained Sandstone, trace Iron oxide staining, weakly cemented, very dense-moist							
	⧗	91/10"				102	13					
20												
					Boring Terminated at 20'							

**BORING NO.
B-3**

JOB NO.: 21G167-1
PROJECT: Proposed C/I Development
LOCATION: Aliso Viejo, California

DRILLING DATE: 5/13/21
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Daryl Kas

WATER DEPTH: Dry
CAVE DEPTH: 17 feet
READING TAKEN: At Completion

FIELD RESULTS					DESCRIPTION	LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	SURFACE ELEVATION: 461 feet MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
				▨	NIGUEL FORMATION (Tn): Light Gray fine grained Sandstone, weakly cemented, medium dense to dense-damp							
	☒	23		▨			3					
	☒	30		▨			5					
5				▨								
	☒	35		▨	Light Gray Silty fine grained Sandstone, trace Iron oxide staining, weakly cemented, dense-moist to very moist		15					
	☒	30		▨	Light Gray fine grained Sandstone, trace Iron oxide staining, weakly cemented, dense to very dense-damp		6					
10				▨								
	☒	46		▨			4					
15				▨								
	☒	70/11"		▨			5					
20					Boring Terminated at 20'							

SOUTHERN
CALIFORNIA
GEOTECHNICAL
A California Corporation

BORING NO. B-4

JOB NO.: 21G167-1
PROJECT: Proposed C/I Development
LOCATION: Aliso Viejo, California

DRILLING DATE: 5/13/21
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Daryl Kas

WATER DEPTH: Dry
CAVE DEPTH: 20 feet
READING TAKEN: At Completion

SURFACE ELEVATION: 466 feet MSL

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
	⧓	27		░	FILL: Brown Silty fine Sand, trace medium Sand, medium dense-damp	105	6					
	⧓	64		▨	NIGUEL FORMATIOM (Tn): Light Gray to Light Brown fine grained Sandstone, trace Silt, trace Iron oxide staining, weakly cemented, dense-damp to moist	97	8					
5	⧓	55		▨		99	9					
	⧓	55		▨		100	11					
10	⧓	67		▨		111	9					
				▨	Brown Silty fine grained Sandstone, weakly cemented, dense-damp							
15	⧓	53		▨	Light Gray fine grained Sandstone, trace Iron oxide staining, weakly cemented, dense-damp	104	8					
20	⧓	95/9"		▨	Brown Silty fine grained Sandstone, weakly cemented, very dense-damp	113	7					
				▨	Light Gray fine grained Sandstone, weakly cemented, dense-damp							
25	⧓	63		▨	Gray Brown fine grained Sandy Siltstone, trace Iron oxide staining, weakly cemented, dense-damp	106	5					

Boring Terminated at 25'

TBL 21G167-1.GPJ SOCALGEO.GDT 7/2/21

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. BA-1

JOB NO.: 21G167-1	DRILLING DATE: 5/13/21	WATER DEPTH: Dry
PROJECT: Proposed C/I Development	DRILLING METHOD: Bucket Auger	CAVE DEPTH: 60 feet
LOCATION: Aliso Viejo, California	LOGGED BY: Daryl Kas	READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: 465.5 feet MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
					NIGUEL FORMATION (Tn): Light Gray fine grained Sandstone, weakly cemented, dense-damp							Kelly Bar Weight @ 0 to 29' = 4,800 lbs
5	☒	7				98	5					
					@ 8 feet, very moist							
10	☒	4			@ 10 feet, little Iron oxide staining, moderately cemented, moist	111	12					
	☒	2										
15					@ 15 feet, no sample recovery							
					Light Gray Silty Claystone, little Iron oxide staining, stiff-moist Bedding: S03W, 30E							
20	☒	11			Light Gray fine grained Sandstone, moderately cemented, dense-damp	110	7					
25	☒	12			@ 25 feet, little Iron oxide staining	110	6					
30	☒	13			@ 29 feet, (4) 2- to 7- inch Light Gray Silty fine grained Sandstone lenses with Iron oxide staining @ 30 to 40 feet, coarsening downward	111	4						Kelly Bar Weight @ 30 to 58' = 3,350 lbs
					@ 32 feet 3 inches, trace Iron oxide staining Bedding: N60E, 5E							

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. BA-1

JOB NO.: 21G167-1	DRILLING DATE: 5/13/21	WATER DEPTH: Dry
PROJECT: Proposed C/I Development	DRILLING METHOD: Bucket Auger	CAVE DEPTH: 60 feet
LOCATION: Aliso Viejo, California	LOGGED BY: Daryl Kas	READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION (Continued)	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
	☒	11			Light Gray fine grained Sandstone, trace coarse Sand, dense-damp	106	3					
					Light Gray fine grained Sandstone, trace medium Sand, weakly cemented, dense-damp							
					@ 39 feet, Iron oxide layering, Bedding: S0W, 3W							
40	☒	11				114	6					
					@ 42 feet, gradual color change to Orange Brown							
					@ 43 feet, ¼- inch thick Green Silty fine grained Sandstone lense, Bedding: N40W, 5W							
45	☒	15				108	6					
50	☒	20			Light Yellow Brown fine grained Sandstone, weakly cemented, very dense-moist, Bedding: N20W, 4W	105	7					
					Light Orange Brown fine grained Sandstone, weakly cemented, very dense-damp, Bedding: N12W, 6W							
					Light Gray fine grained Sandstone, very dense-damp							
					Yellow fine grained Sandstone, moist, Bedding: N10W, 4W							
55	☒	21			Interbedded Yellow fine grained Sandstone, and ½- inch Claystone lenses with Iron oxide staining, damp	92	6					
					Light Gray Silty fine grained Sandstone, little Iron oxide staining, very dense-damp							
					Brown to Orange Brown Silty fine grained Sandstone, little Clay, very dense-very moist, Bedding: S40W, 8W							
60	☒	23				99	21					Kelly Bar Weight @ 59 to 71' = 2,045 lbs
					Light Gray fine grained Sandy Claystone, weakly cemented, dense-very moist							
65	☒	13				114	25					
					Boring Terminated at 66'							

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. BA-2

JOB NO.: 21G167-1
PROJECT: Proposed C/I Development
LOCATION: Aliso Viejo, California

DRILLING DATE: 5/13/21
DRILLING METHOD: Bucket Auger
LOGGED BY: Daryl Kas

WATER DEPTH: Dry
CAVE DEPTH: 28 feet
READING TAKEN: At Completion

SURFACE ELEVATION: 466.5 feet MSL

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
					FILL: Gray Brown fine to medium Sand, trace coarse Sand, little fine root fibers, trace Asphaltic concrete fragments, trace Brick fragments, mottled, loose to medium dense-dry							Kelly Bar Weight @ 0 to 29' = 4,800 lbs
					NIGUEL FORMATION (Tn): Light Gray fine grained Sandstone, trace Silt, trace to little Iron oxide staining dense-dry, Bedding: S20W, 11E							
					Light Brown fine grained Sandstone, trace medium Sand, trace Iron oxide staining, dense-dry							
5												
	☒	9			Light Gray fine to medium grained Sandstone, little Iron oxide staining, weakly cemented, dense-dry to damp, undulated contact, Bedding: N25W, 4W	104	2					
10	☒	8			@ 10 feet, damp	106	3					
					@ 11 feet 10 inches, Iron oxide staining lense, Bedding: N10E, 5W							
					@ 13 feet, Iron oxide staining lense, Bedding: S35W, 6W							
15	☒	7			@ 15 feet, Light Orange to Light Gray	109	3					
					Orange fine to medium Sandstone, dense-dry to damp Bedding Contact: Horizontal							
20	☒	7			Light Gray fine grained Sandstone, dense-damp	105	3					
25	☒	8			@ 25 to 31 feet, trace medium Sand, trace Iron oxide staining	106	4					
30	☒	10				105	4					Kelly Bar Weight @ 30 - 58' = 3,350 lbs
					Boring Terminated at 31'							

TEST BORING LOG

Boring Log by Southern California Geotechnical

(2014)

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-3

JOB NO.: 14G176
PROJECT: C/I Development
LOCATION: Aliso Viejo, California

DRILLING DATE: 8/1/14
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Eric Torres

WATER DEPTH: Dry
CAVE DEPTH: 18 feet
READING TAKEN: At Completion

SURFACE ELEVATION: --- MSL

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					NIGUEL FORMATION BEDROCK: Light Brown to White Silty fine grained Sandstone, highly weathered, weakly cemented, Iron oxide staining, dense to very dense-damp							
	☒	51					4					
	☒	51					4					
5												
	☒	56					3					
					Light Brown fine grained Sandstone, trace Silt, highly weathered, weakly cemented, trace Iron oxide staining, dense-damp							
	☒	44					3					
10												
	☒	45					3					
15												
					Orange Brown Silty fine grained Sandstone, highly weathered, weakly cemented, abundant Iron oxide staining, very dense-moist							
	☒	79/11"					15 4					
					Light Gray fine grained Sandstone, weathered, weakly cemented, very dense-damp							
20												
					Brown fine to medium grained Sandstone, weakly cemented, weathered, very dense-damp							
	☒	55					3					
25												
					Boring Terminated at 25'							

TEST BORING LOG

Appendix C

HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

MATERIALS FINER THAN 75-µm (No. 200) SIEVE by WASHING

ASTM D1140

Client:	SA Geotechnical, Inc	*HAI Project No.:*	SAG-24-022
Project:	Freedom Lane	*Performed by:*	GA
Project No.:	24064-01	*Checked by:*	KL
		Date:	5/14/2024

Boring No.	Sample No.	Depth (ft)	Sample Description (USCS)	Dry Soil before Wash + $W_{Container}$	Dry Soil after #200 Wash + $W_{Container}$	$W_{Container}$	Wt of soil retained on # 200 sieve	Initial wt of dry soil	**Soil % passing 200 sieve**
				g	g	g	g	g	**%**
TP-3	B-1	1-4	Olive, Elastic Silt with Sand (MH)	504.87	303.55	223.46	80.09	281.41	**71.54**
TP-9	B-1	0-5	Olive, Clayey Sand (SC)	591.94	494.11	221.45	272.66	370.49	**26.41**
B-2	D-3	20	Olive, Silty Sand (SM)	403.62	377.34	221.13	156.21	182.49	**14.40**

Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM D4318

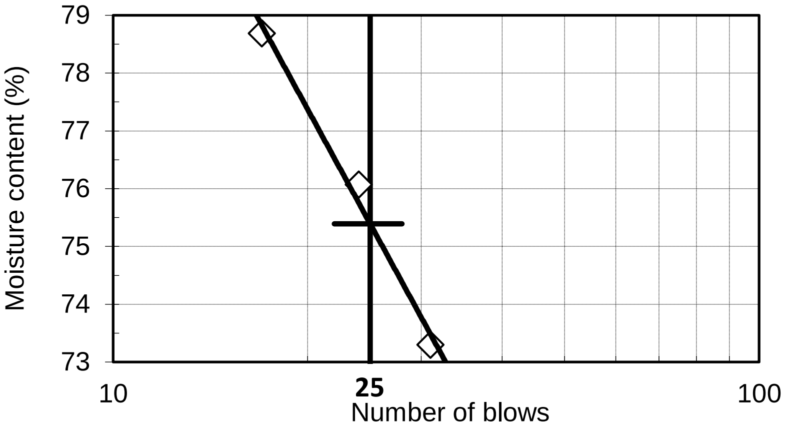
Client: SA Geotechnical, Inc
Project Name: Freedom Lane
Project No.: 24064-01
Boring No.: TP-3
Sample No.: B-1
Depth (ft): 1-4
Soil Description: Olive, Elastic Silt with Sand (MH)

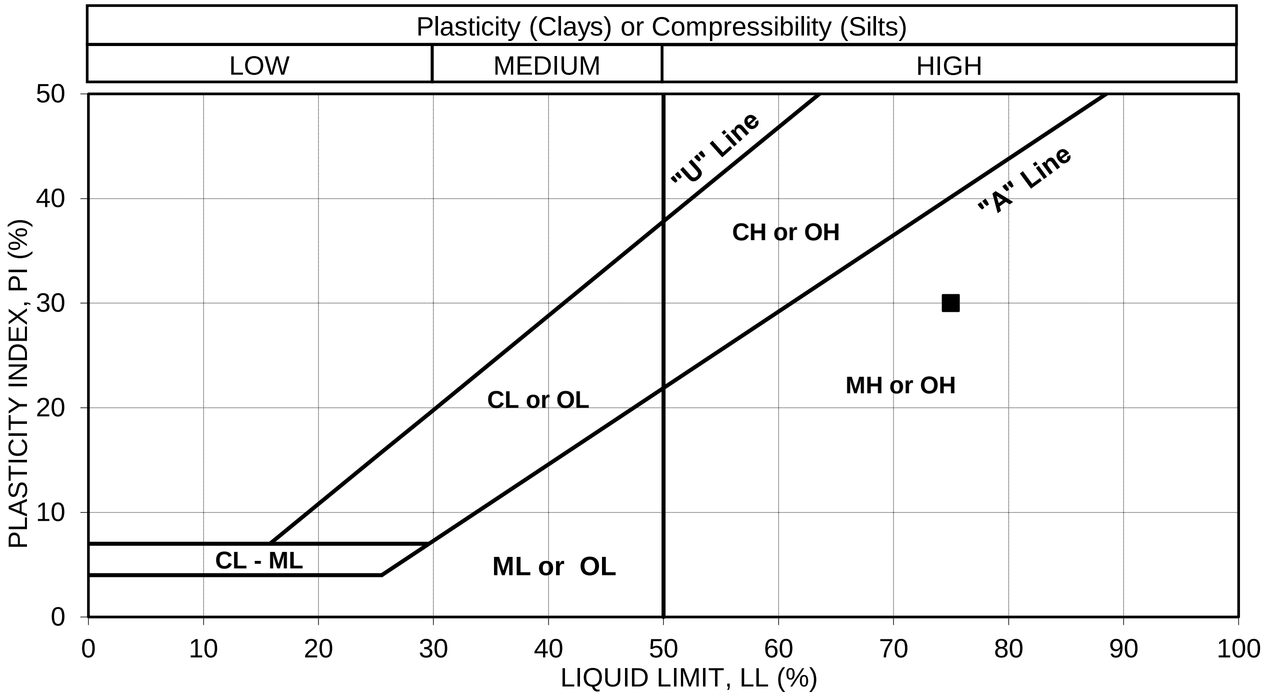
HAI Project No.: SAG-24-022
Tested by: GA
Checked by: KL
Date: 05/14/24

Test		**LL**	**LL**	**LL**	**PL**	**PL**
No. of blows	**-**	**31**	**24**	**17**	**-**	**-**
Wt. of Wet Soil + Container	(g)	24.16	24.38	24.6	9.62	9.34
Wt. of Dry soil + Container	(g)	18.67	18.69	18.73	7.02	6.78
Wt. of Container	(g)	11.18	11.21	11.27	1.16	1.1
Water content	**(%)**	**73.3**	**76.1**	**78.7**	**44.4**	**45.1**

Liquid Limit (LL)	**75**
Plastic Limit (PL)	**45**
Plasticity Index (PI)	**30**
USCS	**MH**

Remarks:





Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM D4318

Client: SA Geotechnical, Inc
Project Name: Freedom Lane
Project No.: 24064-01
Boring No.: B-2
Sample No.: D-3
Depth (ft): 20.0
Soil Description: Olive, Silty Sand (SM)

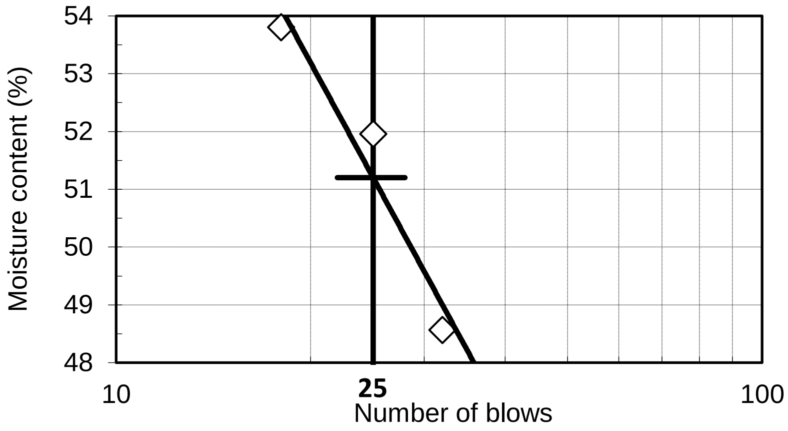
HAI Project No.: SAG-24-022
Tested by: GA
Checked by: KL
Date: 05/14/24

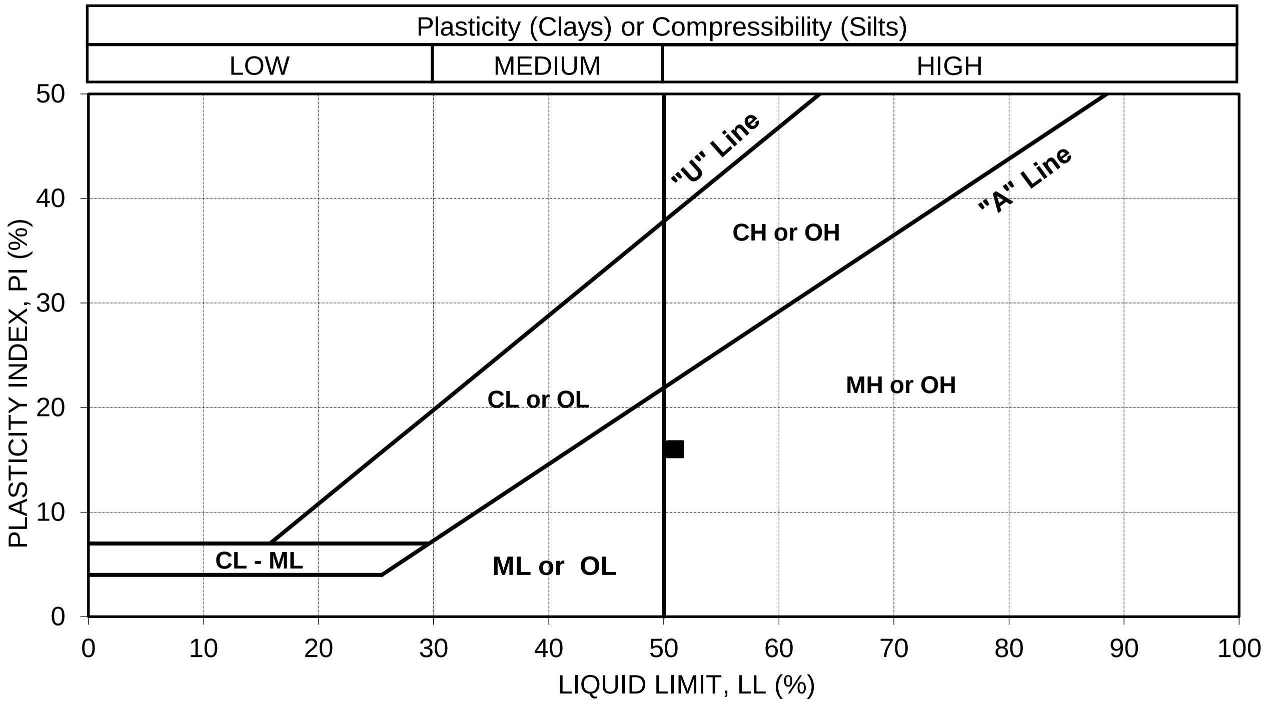
Test		**LL**	**LL**	**LL**	**PL**	**PL**
No. of blows	**-**	**32**	**25**	**18**	**-**	**-**
Wt. of Wet Soil + Container	(g)	25.56	25.68	25.52	9.49	9.6
Wt. of Dry soil + Container	(g)	20.81	20.77	20.36	7.29	7.41
Wt. of Container	(g)	11.03	11.32	10.77	1.09	1.11
Water content	**(%)**	**48.6**	**52.0**	**53.8**	**35.5**	**34.8**

Liquid Limit (LL)	**51**
Plastic Limit (PL)	**35**
Plasticity Index (PI)	**16**
USCS	**MH**

Remarks:

- Fine Sample is Less than 50% of Passing #200)





HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

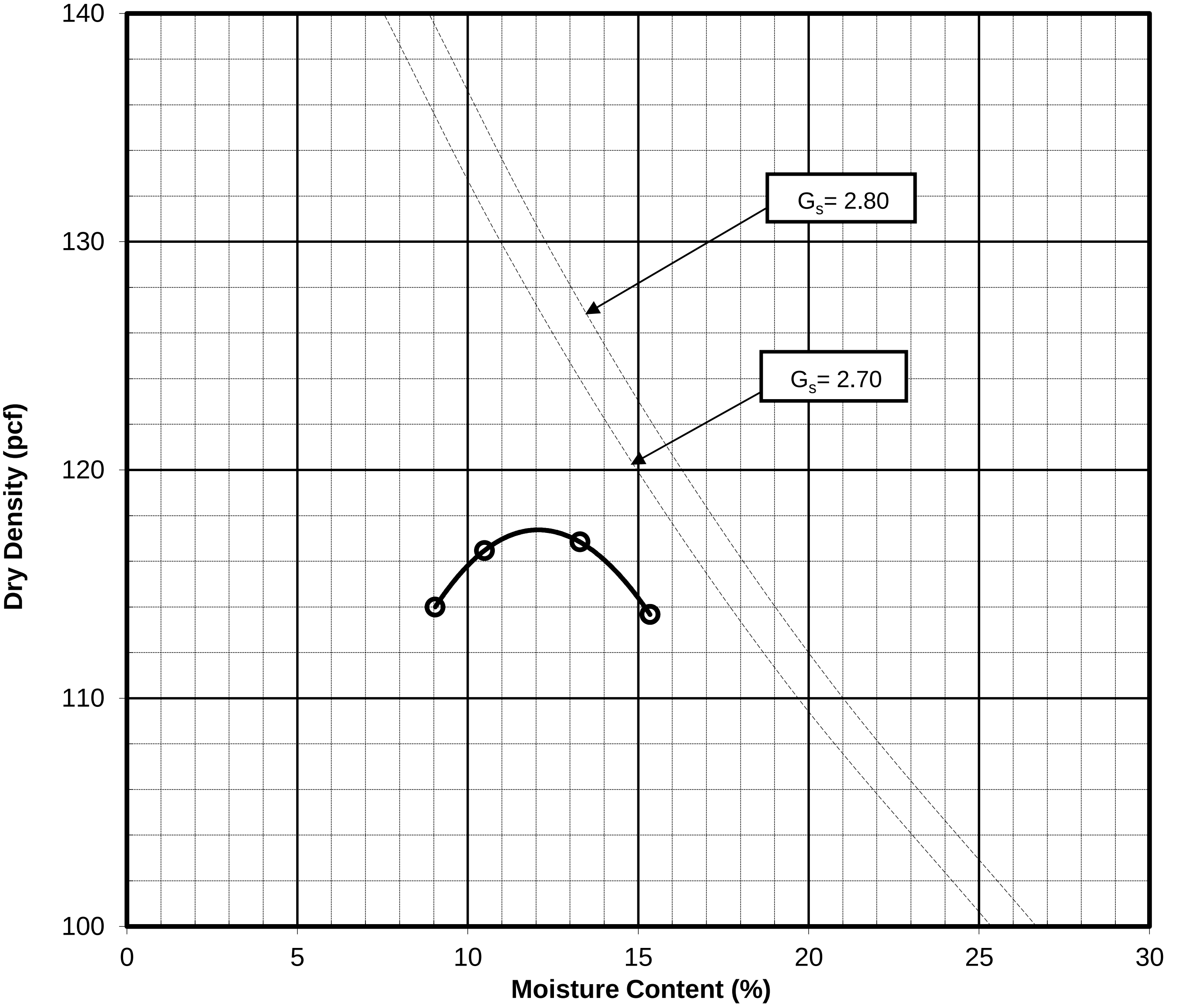
Compaction Characteristics of Soils Using Modified Effort

ASTM D1557

Client:	SA Geotechnical, Inc	*HAI Project No.:*	SAG-24-022
Project:	Freedom Lane	*Tested by:*	GA
Project No.:	24064-01	*Checked by:*	KL
Boring Number:	TP-9	*Date:*	05/14/24
Sample Number:	B-1		
Depth (ft) :	0-5		
Soil Description:	Olive Brown, Clayey Sand (SC)		

Mold size (in)	4"
Procedure	B
Weight Retained on:	0.0
Remarks:	

Maximum Dry Density (pcf)	**117.4**
Optimum Moisture Content (%)	**12.1**
Corrected Maximum Dry Density (pcf)	**-**
Corrected Optimum Moisture Content (%)	**-**



HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

EXPANSION INDEX

ASTM D4829

Client:	SA Geotechnical, Inc	*HAI Project No.:*	SAG-24-022
Project Name:	Freedom Lane	*Tested by:*	GA
Project No.:	24064-01	*Checked by:*	KL
Boring No.:	TP-3	*Date:*	5/14/2024
Sample No.:	B-1		
Depth (ft):	1-4	*Apparatus No.:*	1
Soil Description:	Olive, Sandy Silt (MH)		

Initial Specimen Info		
Wt. of wet soil + cont.	154.03	g
Wt. of dry soil + cont.	125.48	g
Wt. of container	11.89	g
Wt. of water	28.55	g
Wt. of dry soil	113.59	g
Moisture Content	**25.1**	**%**

Final Specimen Info		
Wt. of wet soil + cont.	580.39	g
Wt. of dry soil + cont.	433.48	g
Wt. of container	206.33	g
Wt. of water	146.91	g
Wt. of dry soil	227.15	g
Moisture Content	**64.7**	**%**

Wt. of wet soil + ring	497.58	g
Wt. of ring	206.33	g
Wt. of wet soil	291.25	g
Wet density of soil	90.7	pcf
Dry density of soil	72.5	pcf
Specific gravity of soil	2.68	-
Saturation	**51.5**	**%**

Date & Time	**Elapsed Time (min)**	**Dial Reading**	**∆h, Expansion**
5/21/2024 9:30	0	0	0
5/21/2024 9:40	10	0.0000	0
Add Distilled Water to Sample			
5/22/2024 9:30	1440	0.1059	0.1059

Expansion Index = **106** **High**

HAI
HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

EXPANSION INDEX

ASTM D4829

Client: SA Geotechnical, Inc
HAI Project No.: SAG-24-022
Project Name: Freedom Lane
Tested by: GA
Project No.: 24064-01
Checked by: KL
Boring No.: TP-9
Date: 5/14/2024
Sample No.: B-1
Depth (ft): 0-5
Apparatus No.: 2
Soil Description: Olive Brown, Clayey Sand (SC)

Initial Specimen Info		
Wt. of wet soil + cont.	205.59	g
Wt. of dry soil + cont.	188.15	g
Wt. of container	11.96	g
Wt. of water	17.44	g
Wt. of dry soil	176.19	g
Moisture Content	**9.9**	**%**

Final Specimen Info		
Wt. of wet soil + cont.	629.84	g
Wt. of dry soil + cont.	565.21	g
Wt. of container	206.53	g
Wt. of water	64.63	g
Wt. of dry soil	358.68	g
Moisture Content	**18.0**	**%**

Wt. of wet soil + ring	603.05	g
Wt. of ring	206.53	g
Wt. of wet soil	396.52	g
Wet density of soil	121.6	pcf
Dry density of soil	110.6	pcf
Specific gravity of soil	2.68	-
Saturation	**51.9**	**%**

Date & Time	Elapsed Time (min)	Dial Reading	Δh, Expansion
5/21/2024 10:00	0	0	0
5/21/2024 10:10	10	0.0000	0
Add Distilled Water to Sample			
5/22/2024 10:00	1440	0.0099	0.0099

Expansion Index = 10 Very Low

HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

DIRECT SHEAR TEST

ASTM D3080

HAI Project No.: SAG-24-022

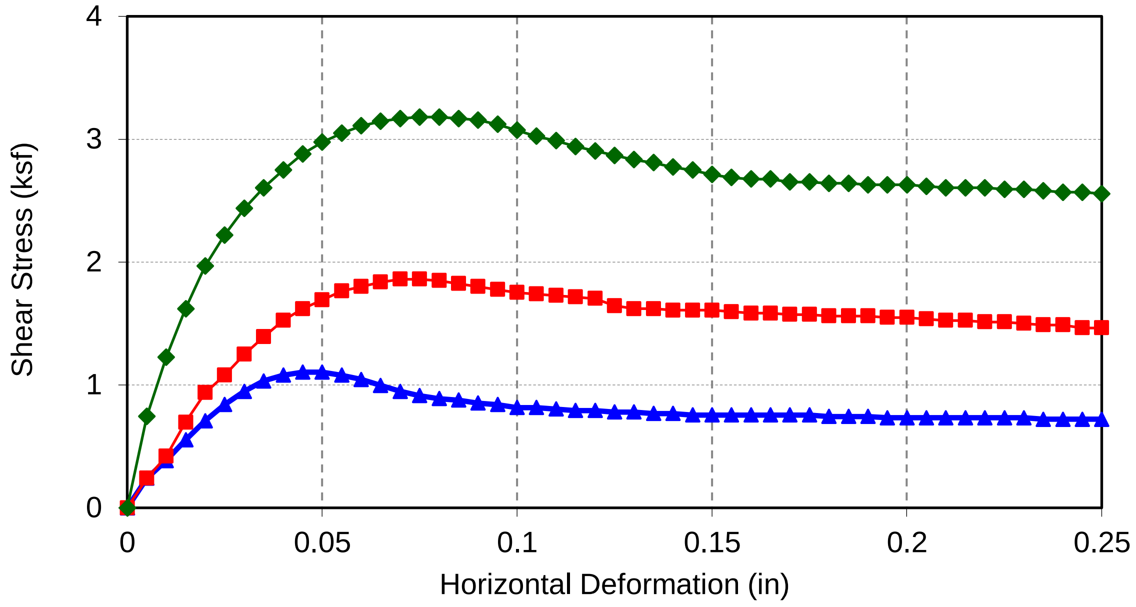
Client:	SA Geotechnical, Inc	***Tested by:***	GA
Project Name:	Freedom Lane	***Checked by:***	KL
Project Number:	24064-01	***Date:***	5/14/2024
Boring No.:	B-1		
Sample No.:	D-1		
Sample Type:	Undisturbed Ring		
Depth (ft):	5		
Soil Description:	Olive Brown, Silty Sand (SM)		

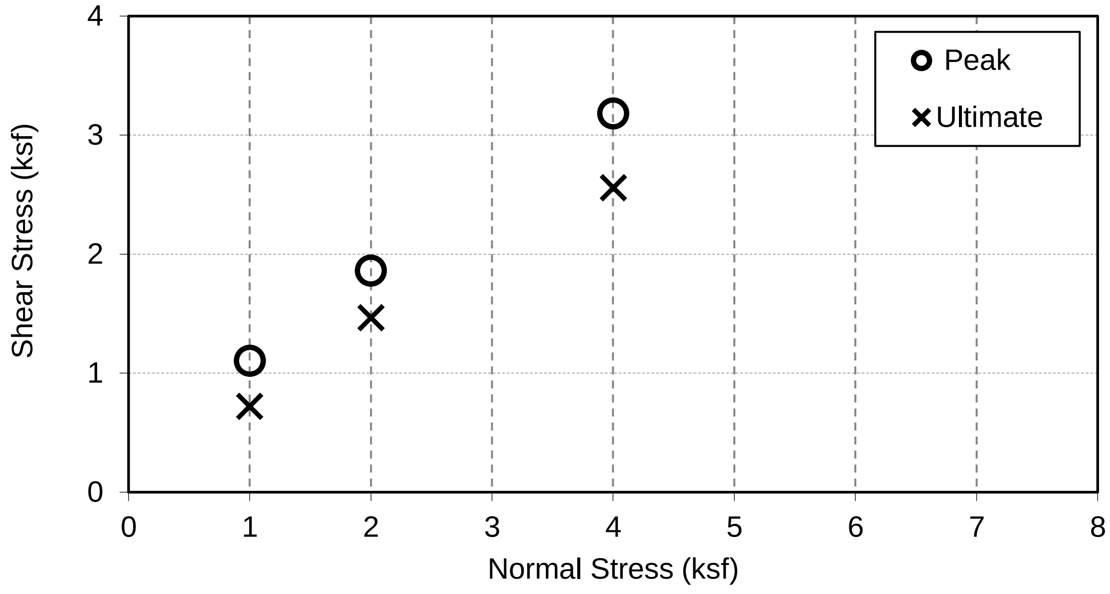
Type of test: **Consolidated, Drained**

Test No.	1	2	3
Symbol	▲	■	◆
Normal Stress (ksf)	**1**	**2**	**4**
Deformation Rate (in/min)	**0.002**	**0.002**	**0.002**

Peak Shear Stress (ksf)	**O**	**1.10**	**1.86**	**3.18**
Shear Stress @ End of Test (ksf)	**X**	**0.72**	**1.46**	**2.56**

Initial Height of Sample (in)	1.000	1.000	1.000
Height of Sample before Shear (in)	0.9967	0.9953	0.9867
Diameter of Sample (in)	2.416	2.416	2.416
Initial Moisture Content (%)	**14.8**	**14.8**	**14.8**
Final Moisture Content (%)	**21.5**	**19.2**	**20.3**
Dry Density (pcf)	**109.6**	**110.6**	**111.3**





HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

DIRECT SHEAR TEST

ASTM D3080

HAI Project No.: SAG-24-022

Tested by: GA
Checked by: KL
Date: 5/14/2024

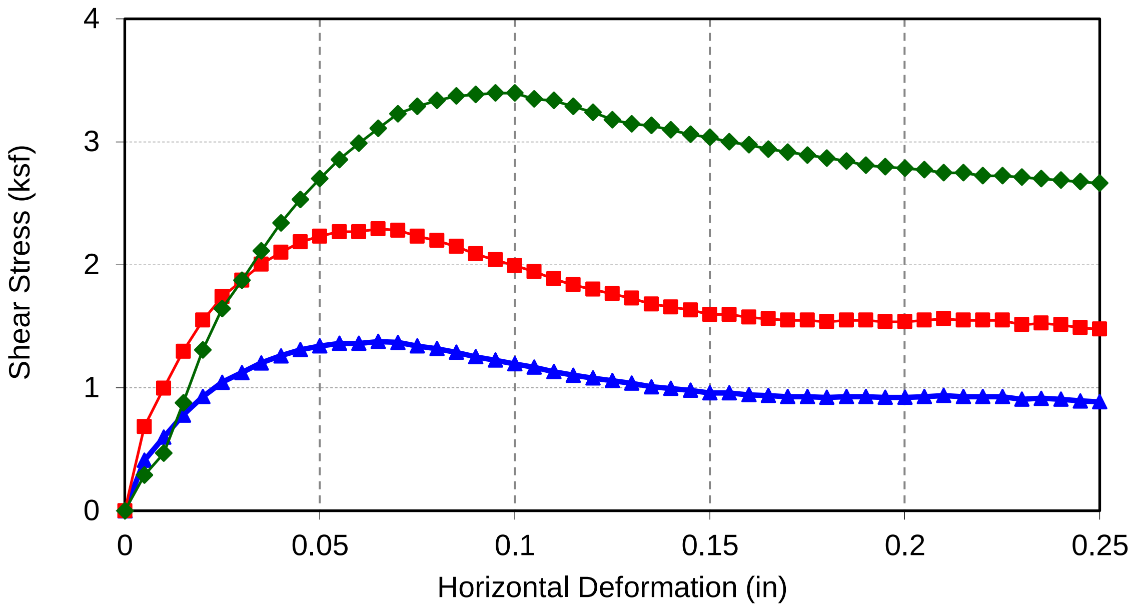
Client: SA Geotechnical, Inc
Project Name: Freedom Lane
Project Number: 24064-01
Boring No.: B-1
Sample No.: D-2
Sample Type: Undisturbed Ring
Depth (ft): 10
Soil Description: Brown, Clayey Sand (SC)

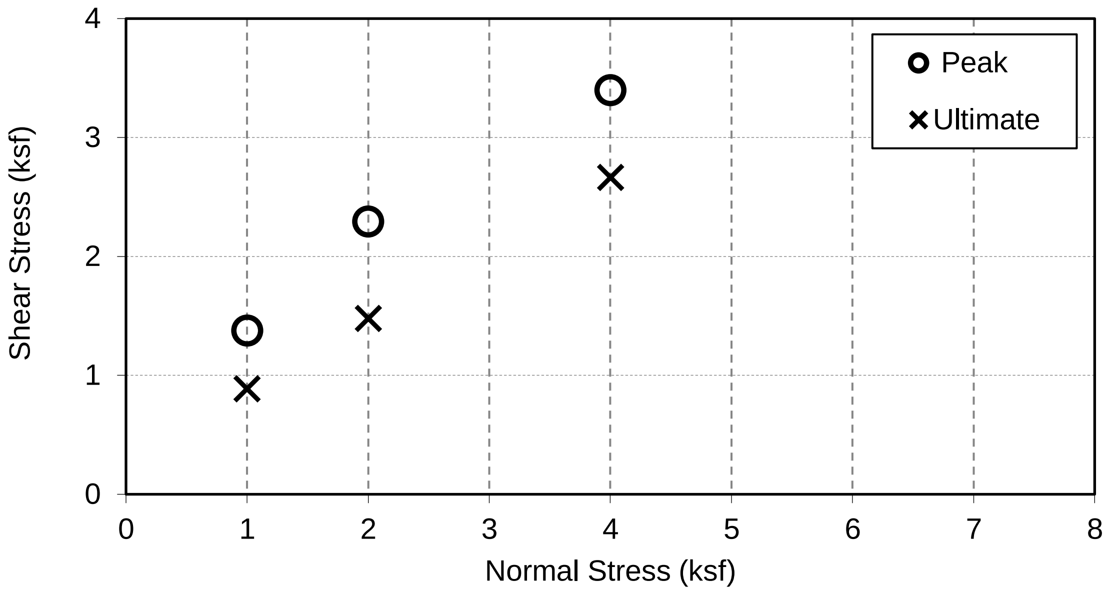
Type of test: **Consolidated, Drained**

Test No.	1	2	3
Symbol	▲	■	◆
Normal Stress (ksf)	**1**	**2**	**4**
Deformation Rate (in/min)	**0.002**	**0.002**	**0.002**

Peak Shear Stress (ksf)	**O**	**1.38**	**2.29**	**3.40**
Shear Stress @ End of Test (ksf)	**X**	**0.89**	**1.48**	**2.66**

Initial Height of Sample (in)	1.000	1.000	1.000
Height of Sample before Shear (in)	0.9916	0.9969	0.9893
Diameter of Sample (in)	2.416	2.416	2.416
Initial Moisture Content (%)	**10.3**	**10.3**	**10.3**
Final Moisture Content (%)	**21.8**	**18.3**	**13.3**
Dry Density (pcf)	**107.8**	**114.2**	**116.9**





HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

DIRECT SHEAR TEST

ASTM D3080

HAI Project No.: SAG-24-022

Client: SA Geotechnical, Inc
Project Name: Freedom Lane
Project Number: 24064-01
Boring No.: B-1
Sample No.: D-6
Sample Type: Undisturbed Ring
Depth (ft): 40
Soil Description: Light Brown, Silty Sand (SM)

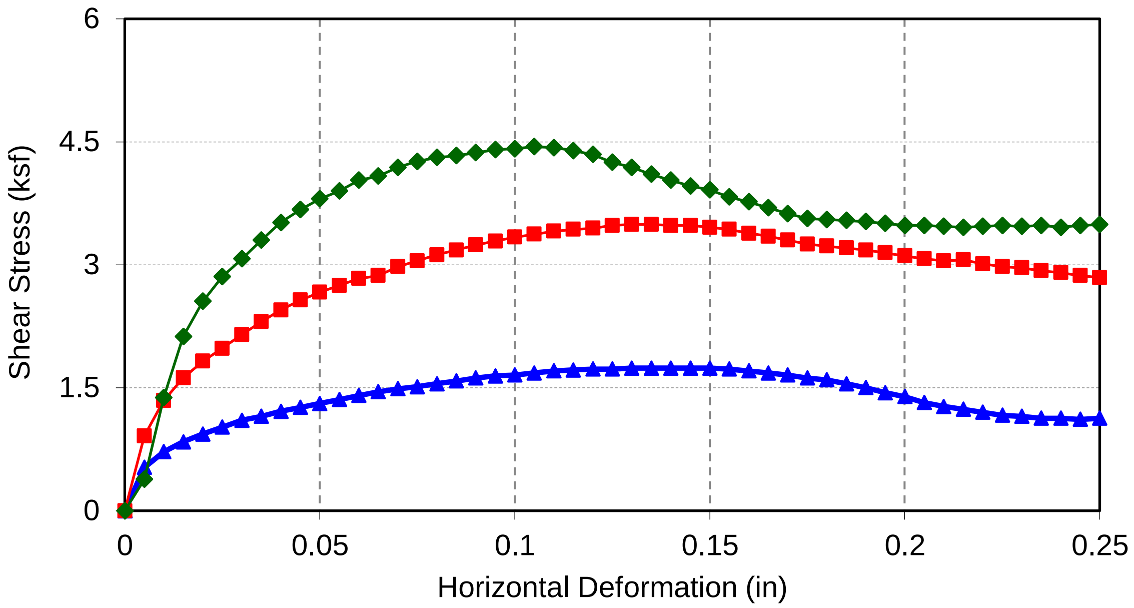
Tested by: GA
Checked by: KL
Date: 5/14/2024

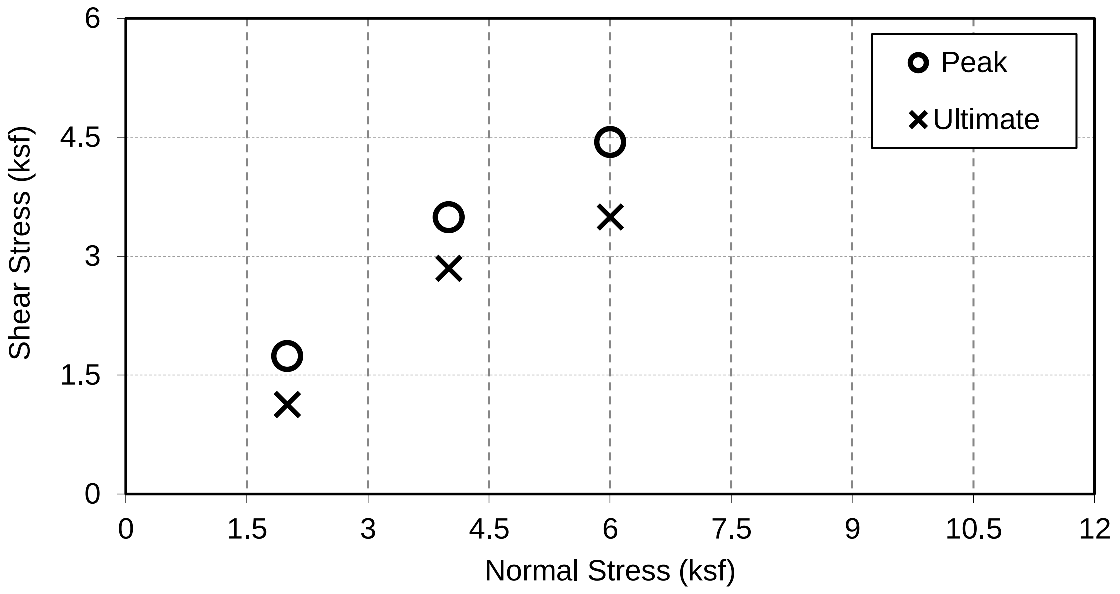
Type of test: **Consolidated, Drained**

Test No.	1	2	3
Symbol	▲	■	◆
Normal Stress (ksf)	**2**	**4**	**6**
Deformation Rate (in/min)	**0.002**	**0.002**	**0.002**

Peak Shear Stress (ksf)	**O**	**1.74**	**3.49**	**4.44**
Shear Stress @ End of Test (ksf)	**X**	**1.13**	**2.84**	**3.49**

Initial Height of Sample (in)	1.000	1.000	1.000
Height of Sample before Shear (in)	0.9919	0.9969	0.9856
Diameter of Sample (in)	2.416	2.416	2.416
Initial Moisture Content (%)	**4.7**	**4.7**	**4.7**
Final Moisture Content (%)	**21.4**	**19.6**	**18.7**
Dry Density (pcf)	**104.4**	**107.2**	**110.9**





HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

DIRECT SHEAR TEST

ASTM D3080

HAI Project No.: SAG-24-022

Tested by: GA
Checked by: KL
Date: 5/14/2024

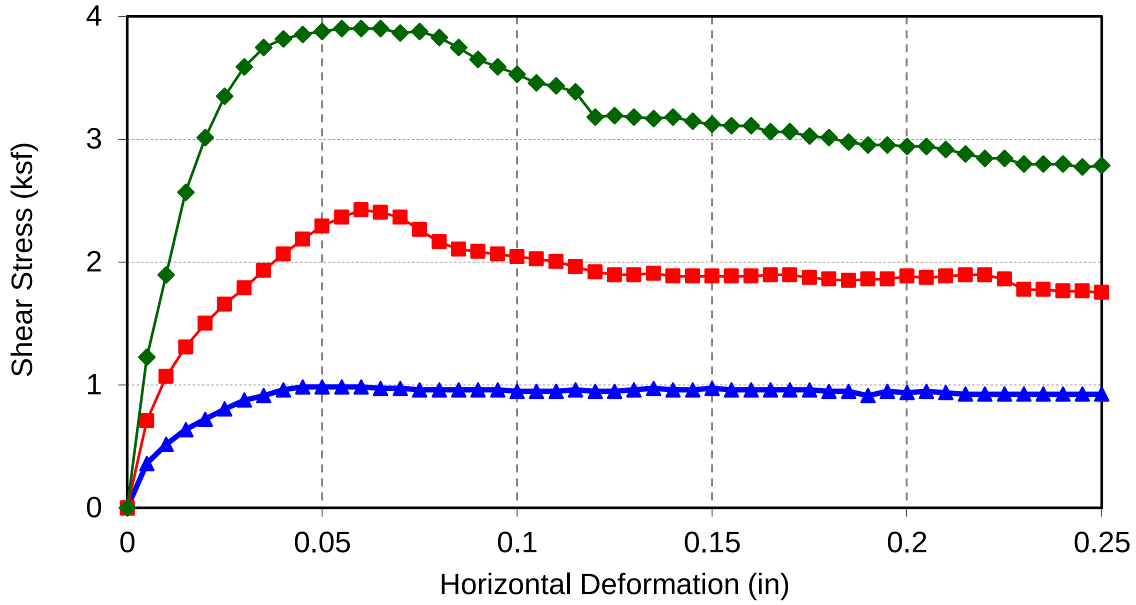
Client: SA Geotechnical, Inc
Project Name: Freedom Lane
Project Number: 24064-01
Boring No.: B-2
Sample No.: D-3
Sample Type: Undisturbed Ring
Depth (ft): 20
Soil Description: Olive, Silty Sand (SM)

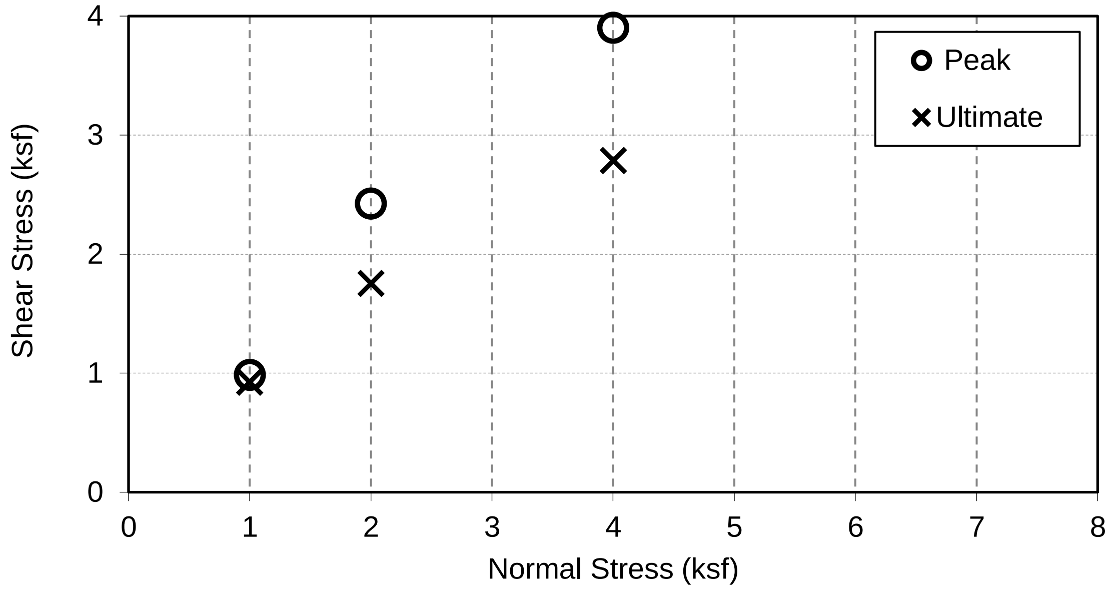
Type of test: **Consolidated, Drained**

Test No.	1	2	3
Symbol	▲	■	◆
Normal Stress (ksf)	**1**	**2**	**4**
Deformation Rate (in/min)	**0.002**	**0.002**	**0.002**

Peak Shear Stress (ksf)	**O**	**0.98**	**2.42**	**3.90**
Shear Stress @ End of Test (ksf)	**X**	**0.92**	**1.75**	**2.78**

Initial Height of Sample (in)	1.000	1.000	1.000
Height of Sample before Shear (in)	0.9976	1.0056	0.9981
Diameter of Sample (in)	2.416	2.416	2.416
Initial Moisture Content (%)	**30.6**	**30.6**	**30.6**
Final Moisture Content (%)	**40.1**	**37.2**	**27.6**
Dry Density (pcf)	**83.6**	**85.6**	**88.8**





HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

CONSOLIDATION TEST

ASTM D2435

Client :	SA Geotechnical, Inc	*HAI Project No.:*	SAG-24-022
Project Name:	Freedom Lane	*Tested by:*	GA
Project Number:	24064-01	*Checked by:*	KL
Boring No.:	B-1	*Date:*	05/14/24
Sample No.:	D-1		
Type of Sample:	Undisturbed ring		
Depth (ft):	5		
Soil Description:	Yellowish Brown, Clayey Sand (SC)		

Initial Total Weight (g)	Final Total Weight (g)	Final Dry Weight (g)
148.19	149.81	125.11

			Initial Conditions	**Final Conditions**
Height	H	(in)	1.000	0.952
Height of Solids	H_s	(in)	0.608	0.608
Height of Water	H_w	(in)	0.307	0.329
Height of Air	H_a	(in)	0.085	0.015
Dry Density		**(pcf)**	**103.9**	**114.8**
Water Content		**(%)**	**18.4**	**19.7**
Saturation		**(%)**	**78.3**	**95.6**

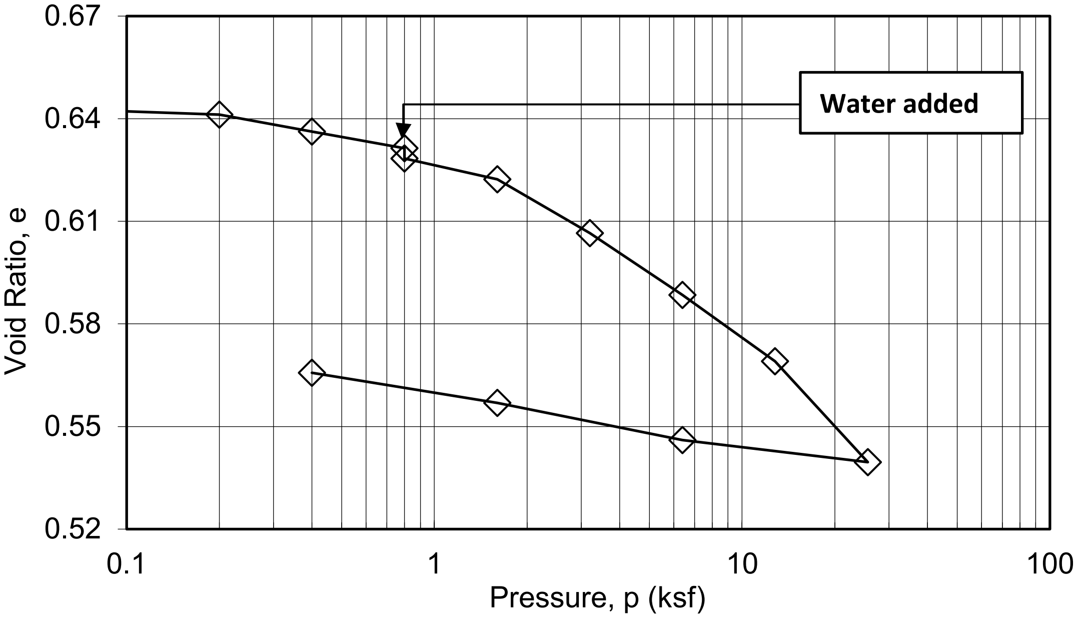
* Saturation is calculated based on Gs= 2.74

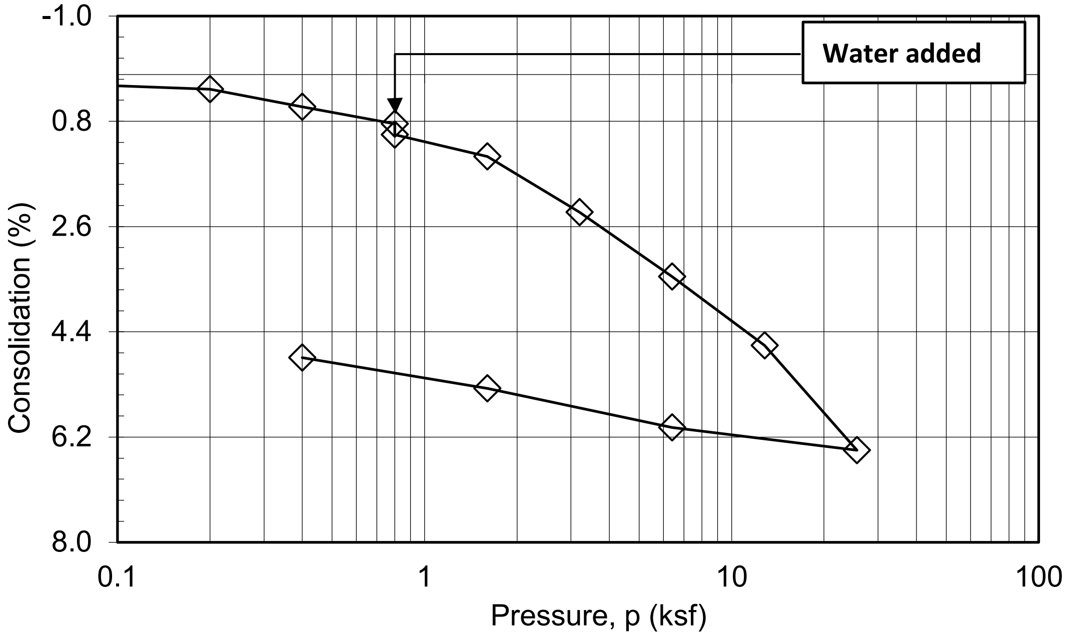
Load (ksf)	**δH (in)**	**H (in)**	**Voids (in)**	**e**	**Consol. (%)**	**a_v (ksf^{-1})**	**M_v (ksf^{-1})**	**Comment**
0.01	-------	1.0000	0.392	0.645	0			
0.2	0.0025	0.9975	0.390	0.641	0.3	2.2E-02	1.3E-02	
0.4	0.0055	0.9945	0.387	0.636	0.6	2.5E-02	1.5E-02	
0.8	0.0084	0.9916	0.384	0.631	0.8	1.2E-02	7.4E-03	
0.8	0.0103	0.9897	0.382	0.628	1.0	Water Added		
1.6	0.0140	0.9860	0.378	0.622	1.4	7.6E-03	4.7E-03	
3.2	0.0236	0.9765	0.369	0.607	2.4	9.8E-03	6.1E-03	
6.4	0.0346	0.9655	0.358	0.588	3.5	5.7E-03	3.6E-03	
12.8	0.0464	0.9537	0.346	0.569	4.6	3.0E-03	1.9E-03	
25.6	0.0643	0.9358	0.328	0.540	6.4	2.3E-03	1.5E-03	
6.4	0.0604	0.9397	0.332	0.546	6.0	Unloaded		
1.6	0.0537	0.9463	0.339	0.557	5.4			
0.4	0.0484	0.9516	0.344	0.566	4.8			

CONSOLIDATION TEST

ASTM D2435

Client :	SA Geotechnical, Inc	*HAI Project No.:*	SAG-24-022
Project Name:	Freedom Lane	*Tested by:*	GA
Project Number:	24064-01	*Checked by:*	KL
Boring No.:	B-1	*Date:*	05/14/24
Sample No.:	D-1		
Type of Sample:	Undisturbed ring		
Depth (ft):	5		
Soil Description:	Yellowish Brown, Clayey Sand (SC)		





HAI
HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

CONSOLIDATION TEST

ASTM D2435

Client : SA Geotechnical, Inc
Project Name: Freedom Lane
Project Number: 24064-01
Boring No.: B-1
Sample No.: D-2
Type of Sample: Undisturbed ring
Depth (ft): 10
Soil Description: Yellowish Brown, Clayey Sand (SC)

HAI Project No.: SAG-24-022
Tested by: GA
Checked by: KL
Date: 05/14/24

Initial Total Weight	Final Total Weight	Final Dry Weight
(g)	(g)	(g)
163.25	167.80	150.89

			Initial Conditions	Final Conditions
Height	H	(in)	1.000	0.959
Height of Solids	H_s	(in)	0.733	0.733
Height of Water	H_w	(in)	0.165	0.225
Height of Air	H_a	(in)	0.102	0.001
Dry Density		**(pcf)**	**125.3**	**136.3**
Water Content		**(%)**	**8.2**	**11.2**
Saturation		**(%)**	**61.6**	**99.6**

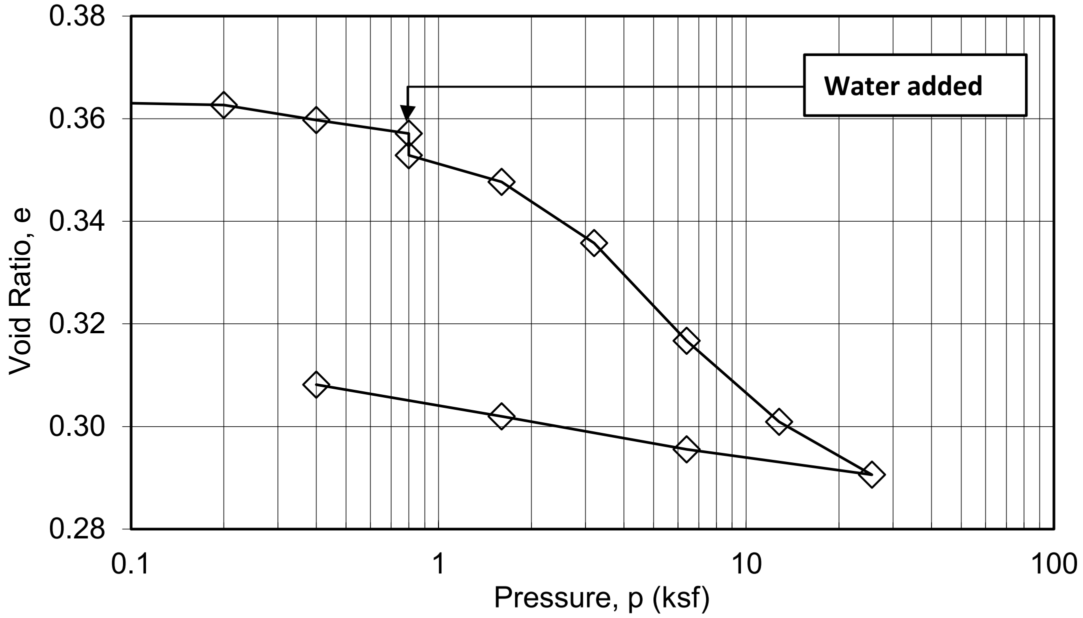
* Saturation is calculated based on Gs= 2.74

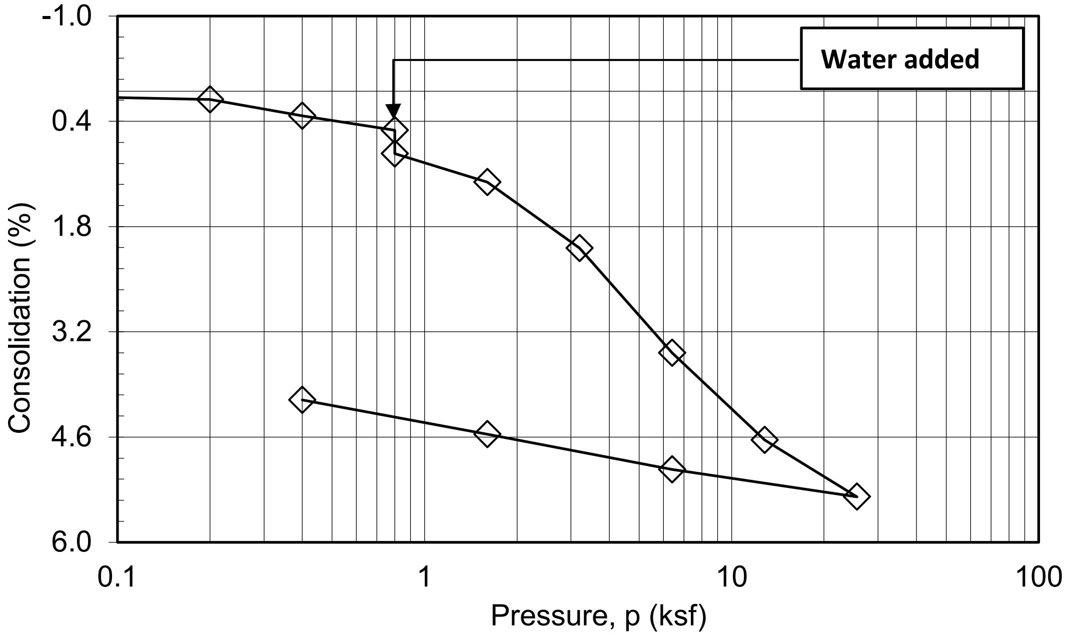
Load (ksf)	**δH (in)**	**H (in)**	**Voids (in)**	**e**	**Consol. (%)**	**a_v (ksf^{-1})**	**M_v (ksf^{-1})**	**Comment**
0.01	-------	1.0000	0.267	0.364	0			
0.2	0.0011	0.9989	0.266	0.363	0.1	7.9E-03	5.8E-03	
0.4	0.0033	0.9968	0.264	0.360	0.3	1.5E-02	1.1E-02	
0.8	0.0052	0.9948	0.262	0.357	0.5	6.7E-03	4.9E-03	
0.8	0.0083	0.9917	0.259	0.353	0.8	Water Added		
1.6	0.0121	0.9879	0.255	0.348	1.2	6.5E-03	4.8E-03	
3.2	0.0209	0.9792	0.246	0.336	2.1	7.5E-03	5.6E-03	
6.4	0.0348	0.9652	0.232	0.317	3.5	5.9E-03	4.5E-03	
12.8	0.0464	0.9536	0.221	0.301	4.6	2.5E-03	1.9E-03	
25.6	0.0540	0.9461	0.213	0.291	5.4	8.0E-04	6.2E-04	
6.4	0.0503	0.9497	0.217	0.296	5.0	Unloaded		
1.6	0.0456	0.9544	0.221	0.302	4.6			
0.4	0.0411	0.9590	0.226	0.308	4.1			

CONSOLIDATION TEST

ASTM D2435

Client :	SA Geotechnical, Inc	*HAI Project No.:*	SAG-24-022
Project Name:	Freedom Lane	*Tested by:*	GA
Project Number:	24064-01	*Checked by:*	KL
Boring No.:	B-1	*Date:*	05/14/24
Sample No.:	D-2		
Type of Sample:	Undisturbed ring		
Depth (ft):	10		
Soil Description:	Yellowish Brown, Clayey Sand (SC)		





Soil Analysis Lab Results

Client: HAI
Job Name: Freedom Lane
Client Job Number: SAG-24-022 / 24064-01
Project X Job Number: S240517E
May 20, 2024

	Method	**ASTM D4327**		**ASTM D4327**	
Bore# / Description	**Depth**	**Sulfates** SO_4^{2-}		**Chlorides** Cl^-	
	(ft)	**(mg/kg)**	**(wt%)**	**(mg/kg)**	**(wt%)**
TP-3 B-1	1-4	107.5	0.0108	199.4	0.0199
TP-9 B-1	0-5	51.3	0.0051	25.2	0.0025

Cations and Anions, except Sulfide and Bicarbonate, tested with Ion Chromatography
mg/kg = milligrams per kilogram (parts per million) of dry soil weight
ND = 0 = Not Detected | NT = Not Tested | Unk = Unknown
Chemical Analysis performed on 1:3 Soil-To-Water extract
PPM = mg/kg (soil) = mg/L (Liquid)

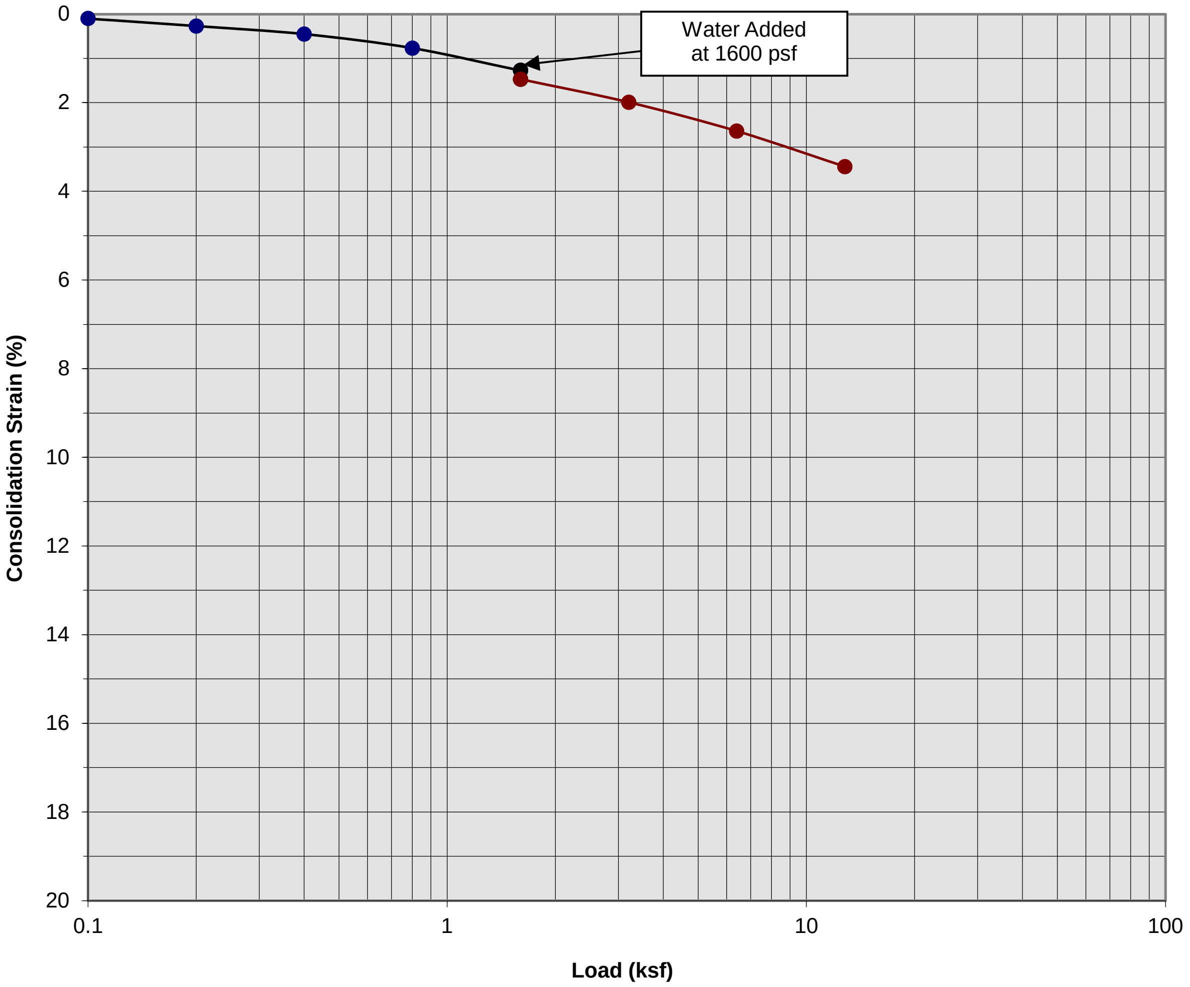
Note: Sometimes a bad sulfate hit is a contaminated spot. Typical fertilizers are Potassium chloride, ammonium sulfate or ammonium sulfate nitrate (ASN). So this is another reason why testing full corrosion series is good because we then have the data to see if those other ingredients are present meaning the soil sample is just fertilizer-contaminated soil. This can happen often when the soil samples collected are simply surface scoops. This is why it's best to dig in a foot, throw away the top and test the deeper stuff. Dairy farms are also notorious for these items.

If one sample pops up much more corrosive than all others, we would recommend collecting more samples surrounding the problem sample location to determine if the peak is isolated to it. This allows us to conclude it was a contaminated sample and able to declare it an outlier.

Try out our new online forms: SOIL CORROSIVITY & THERMAL RESISTIVITY LAB REQUEST FORM & IN-SITU WENNER 4 PIN QUOTE REQUEST FORM

Laboratory Test Results by Southern California Geotechnical (2021)

Consolidation/Collapse Test Results



Classification: BEDROCK: Light Brown fine-grained Sandstone

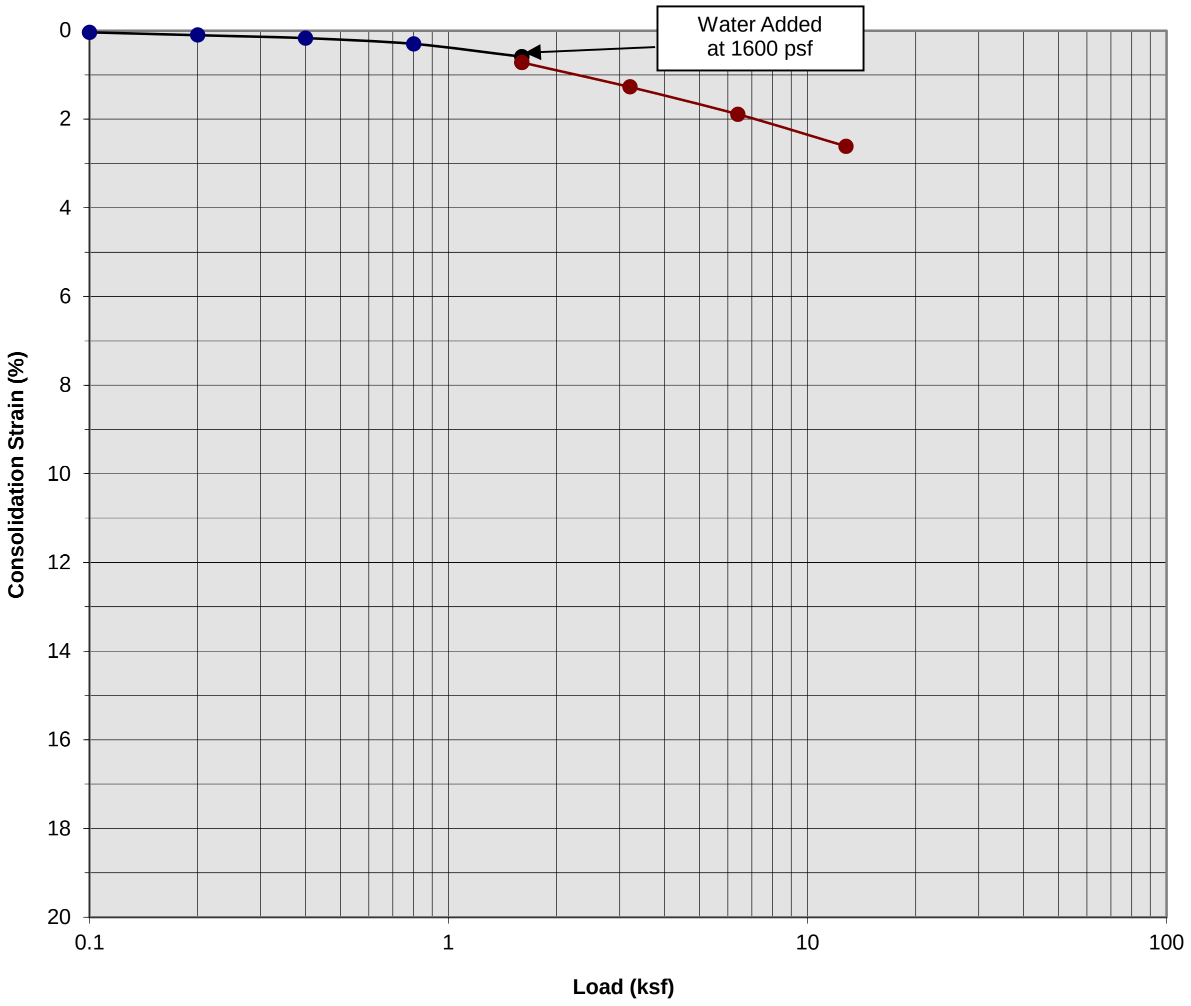
Boring Number:	B-2	Initial Moisture Content (%)	4
Sample Number:	---	Final Moisture Content (%)	20
Depth (ft)	1 to 2	Initial Dry Density (pcf)	102.4
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	104.7
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.20

Proposed Commercial/Industrial Development
Aliso Viejo, California
Project No. 21G167-1

PLATE C- 1

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Consolidation/Collapse Test Results



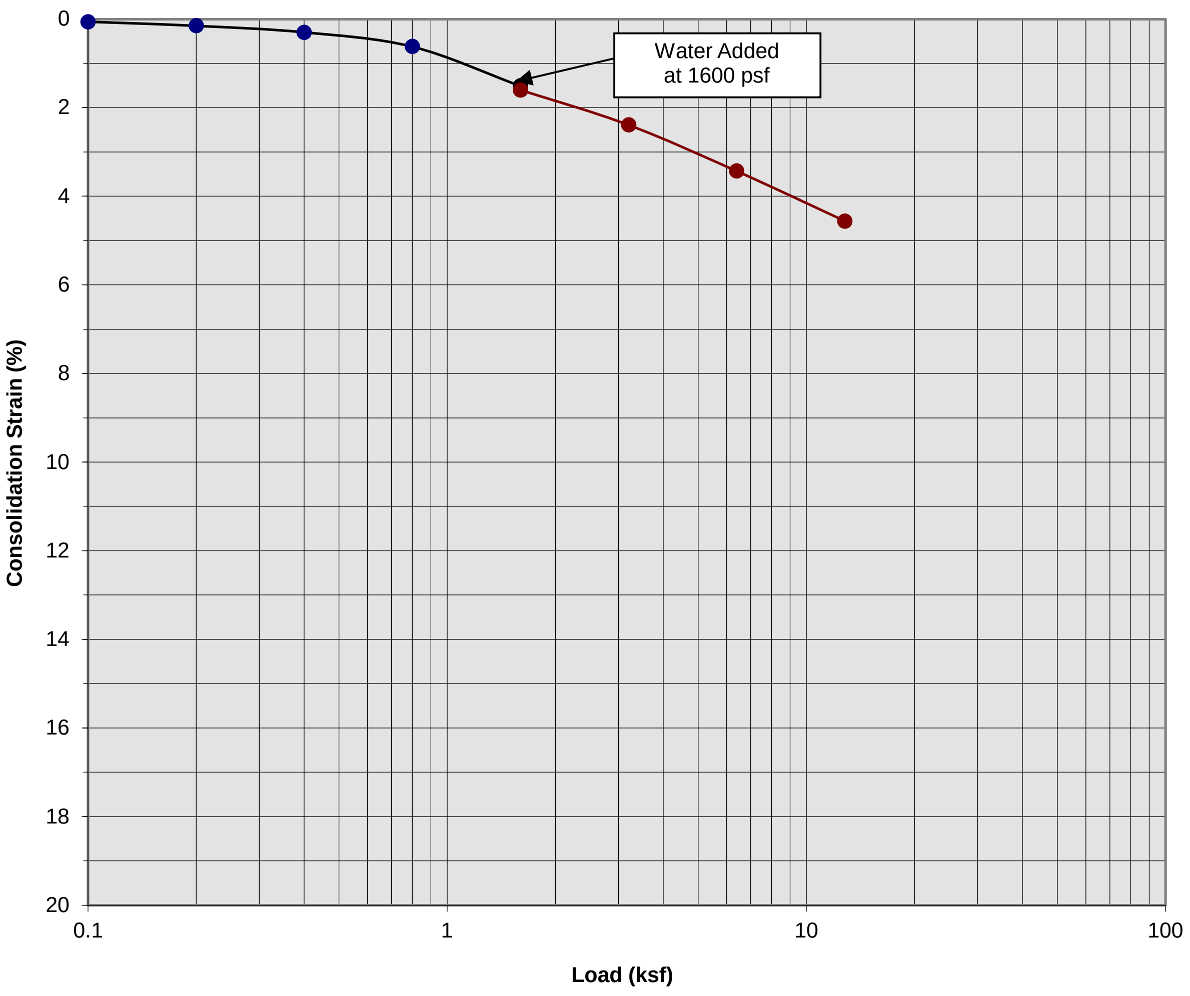
Classification: BEDROCK: Light Brown fine-grained Sandstone

Boring Number:	B-2	Initial Moisture Content (%)	6
Sample Number:	---	Final Moisture Content (%)	21
Depth (ft)	3 to 4	Initial Dry Density (pcf)	103.0
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	101.7
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.13

Proposed Commercial/Industrial Development
Aliso Viejo, California
Project No. 21G167-1
PLATE C- 2

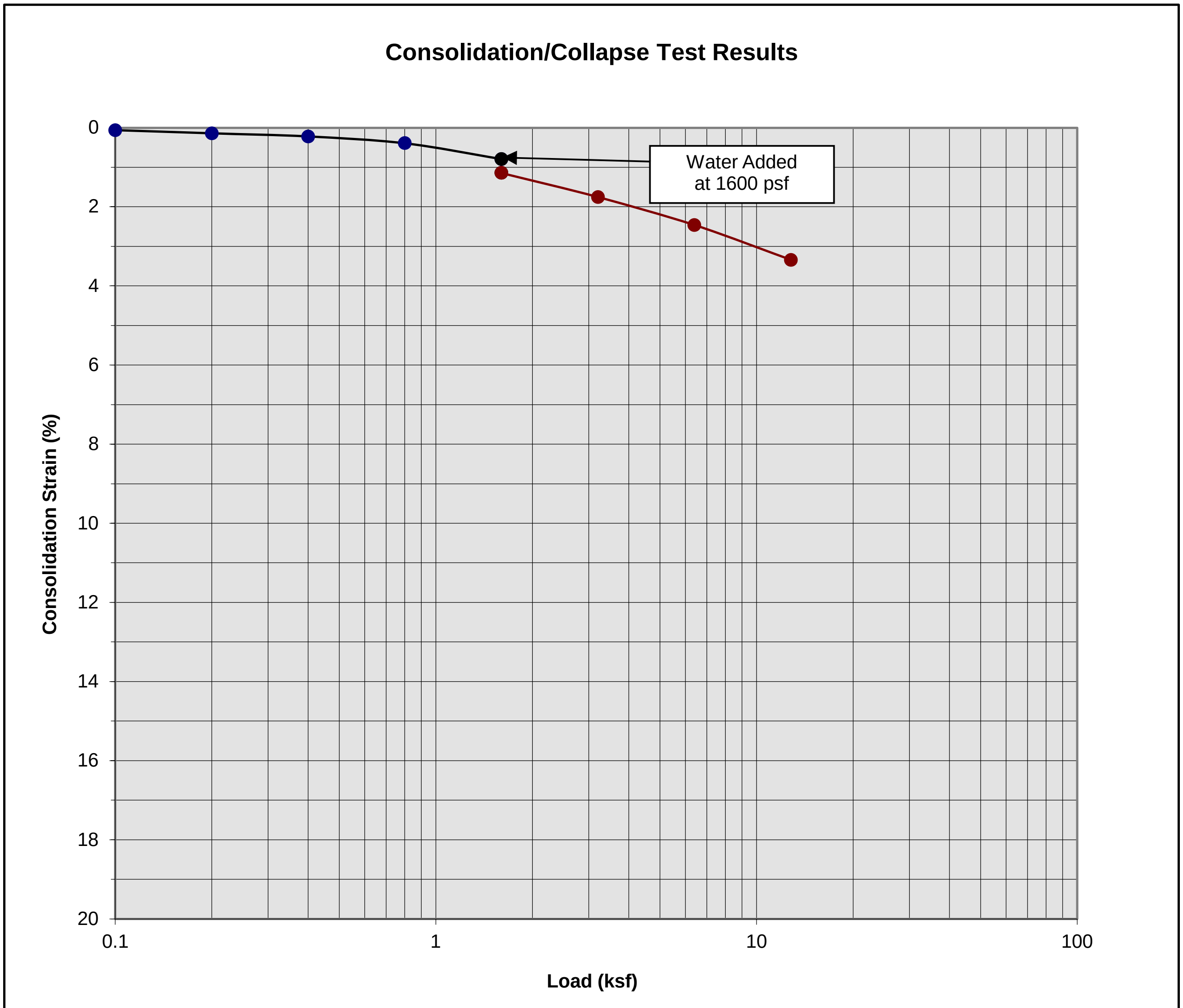
SoCalGeo
SOUTHERN
CALIFORNIA
GEOTECHNICAL
A California Corporation

Consolidation/Collapse Test Results



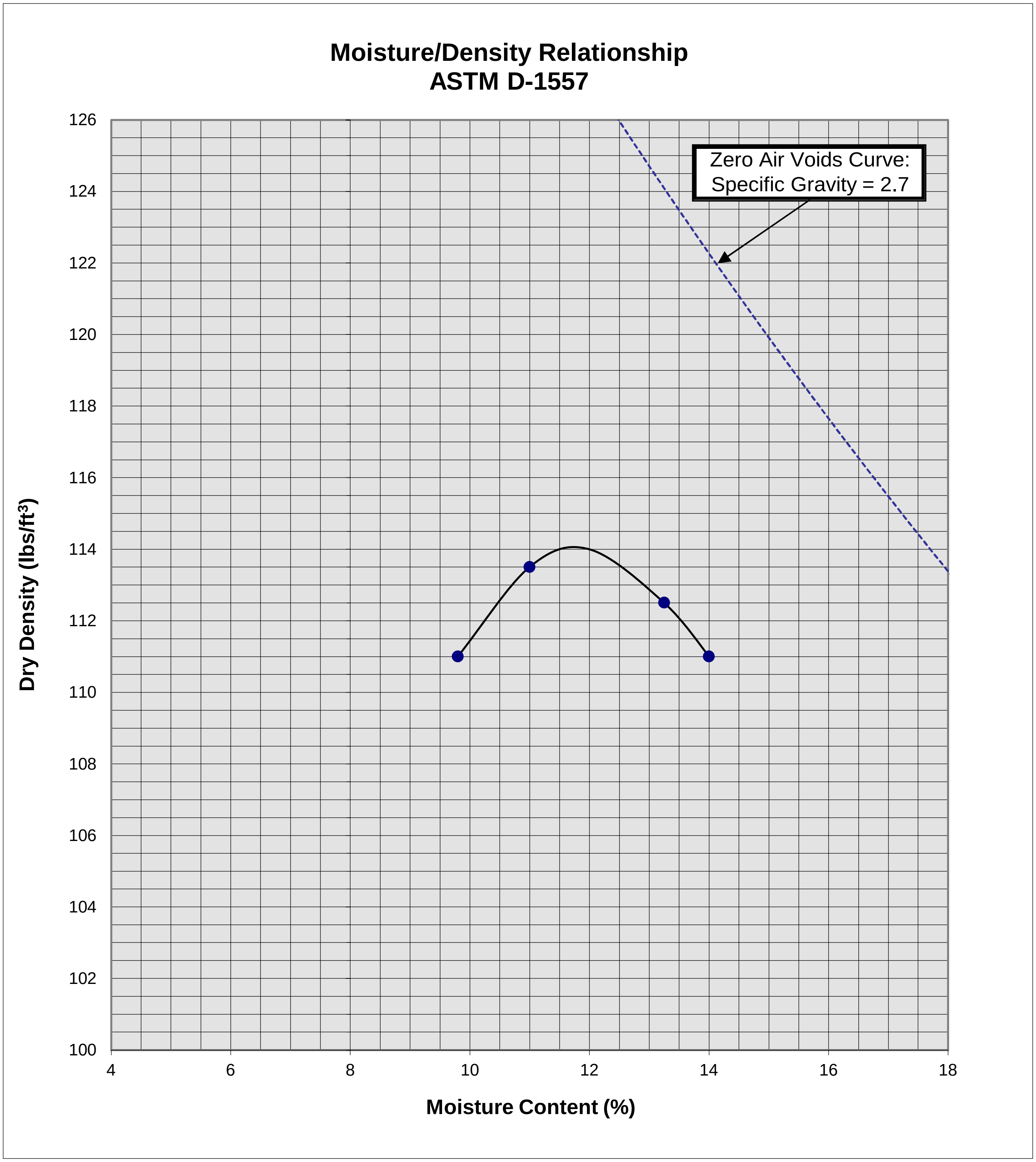
Classification: BEDROCK: Light Brown fine-grained Sandstone

Boring Number:	B-2	Initial Moisture Content (%)	4
Sample Number:	---	Final Moisture Content (%)	19
Depth (ft)	5 to 6	Initial Dry Density (pcf)	102.2
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	106.6
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.09



Classification: BEDROCK: Light Brown fine-grained Sandstone

Boring Number:	B-2	Initial Moisture Content (%)	5
Sample Number:	---	Final Moisture Content (%)	16
Depth (ft)	7 to 8	Initial Dry Density (pcf)	106.6
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	110.6
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.35

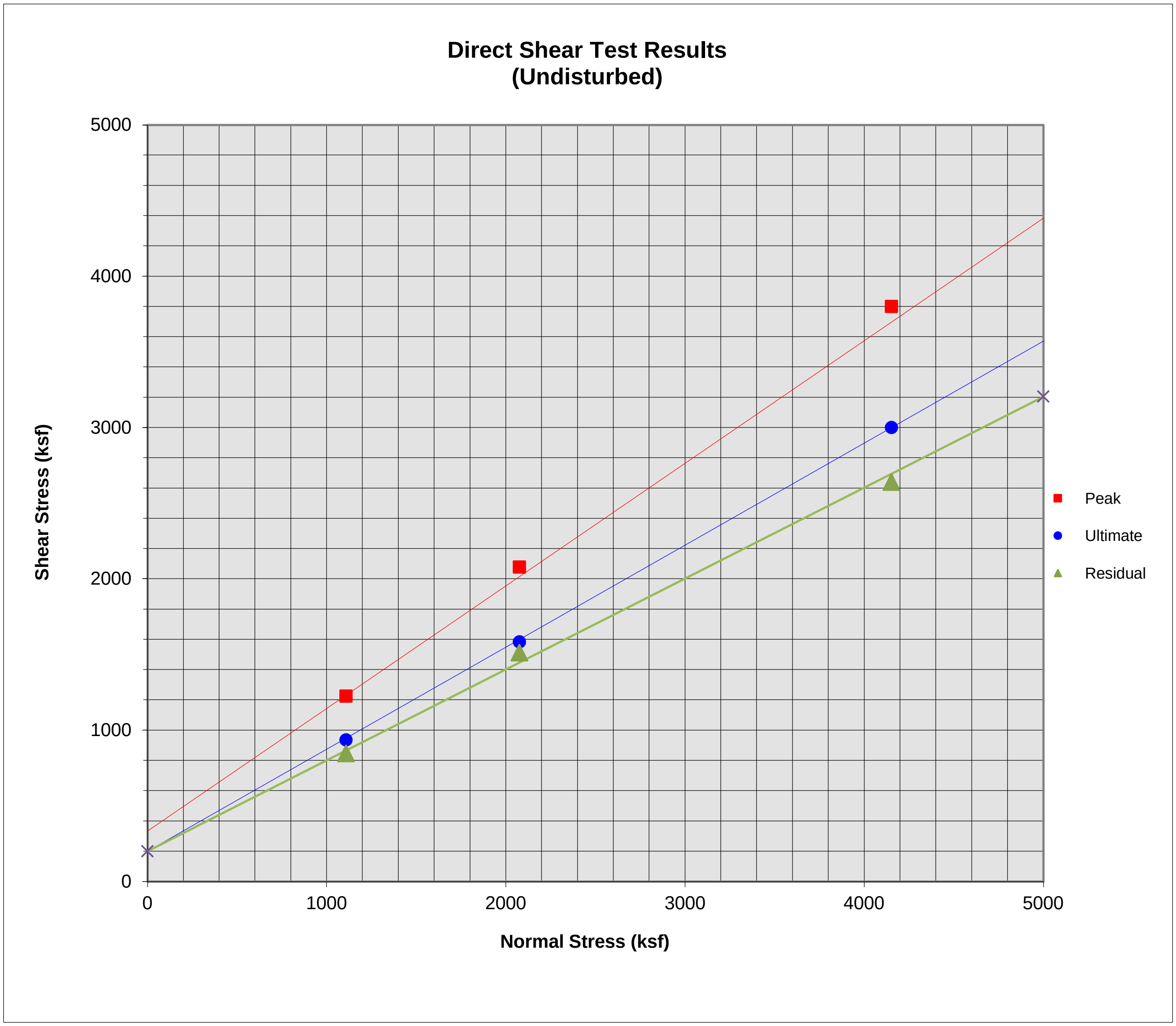


Soil ID Number	B-2 @ 0-5'
Optimum Moisture (%)	12
Maximum Dry Density (pcf)	114
Soil Classification	BEDROCK: Light Brown fine-grained Sandstone

Proposed Commercial/Industrial Development
Aliso Viejo, California
Project No. 21G167-1

PLATE C-5

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation



Sample Description: BA-1 @ 10'

Classification: Bedrock: Light Gray fine grained Sandstone

Sample Data	
Initial Moisture Content	12.0
Final Moisture Content	20.0
Initial Dry Density	111.0
Final Dry Density	--
Specimen Diameter (in)	2.4
Specimen Thickness (in)	1.0

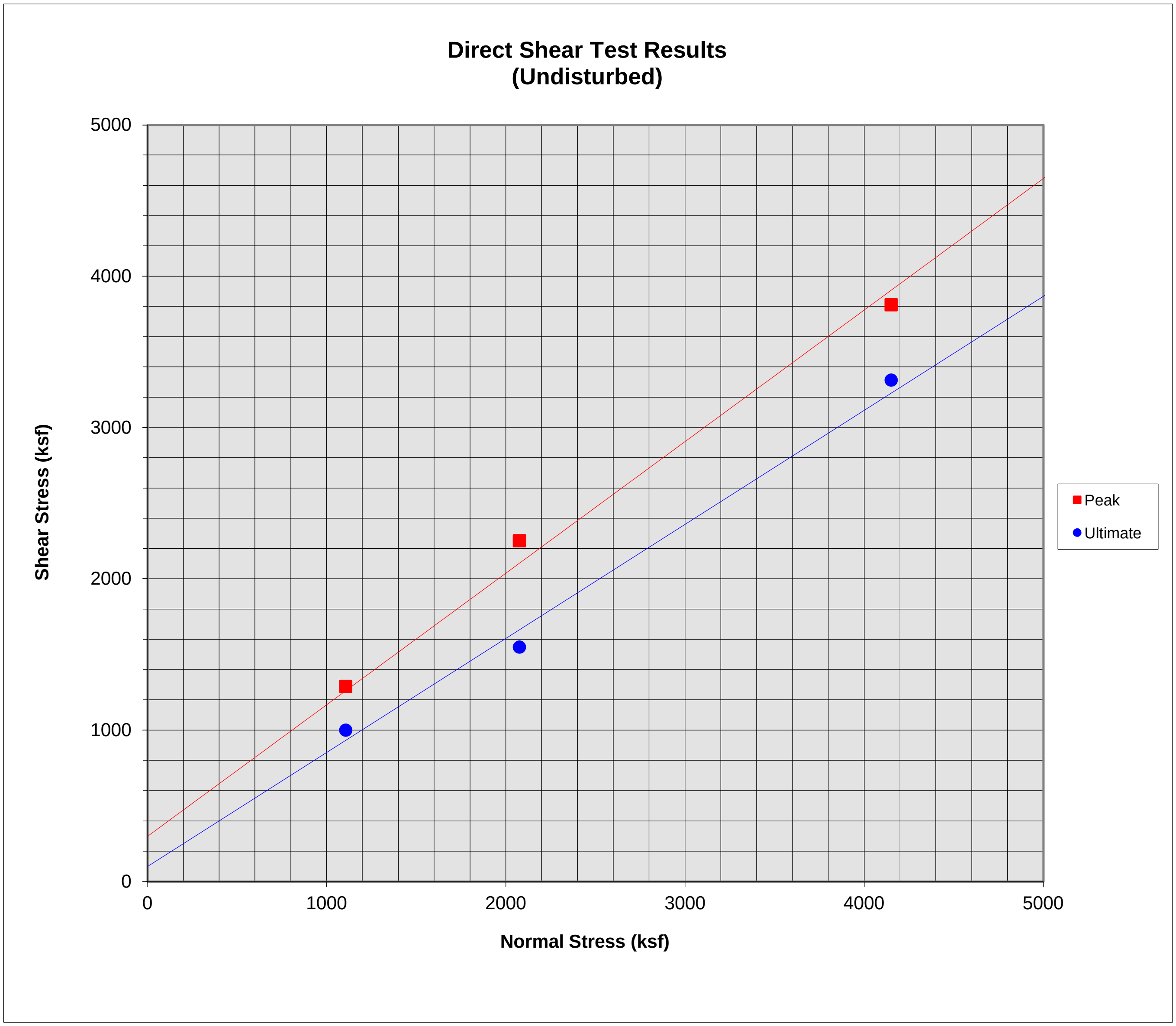
Test Results

	Peak	Ultimate	Residual
ϕ (°)	39.0	34.0	31.0
C (psf)	335	200	200

Proposed Commercial/Industrial Development
Aliso Viejo, California
Project No. 21G167

PLATE C- 6

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation



Sample Description: B-1 @ 24 to 25 feet

Classification: BEDROCK: Brown fine-grained Sandstone

Sample Data		Test Results		
Initial Moisture Content	6.0			
Final Moisture Content	19.0		Peak	Ultimate
Initial Dry Density	110.0	ϕ (°)	41.0	37.0
Final Dry Density	---	C (psf)	300	100
Specimen Diameter (in)	2.4			
Specimen Thickness (in)	1.0			

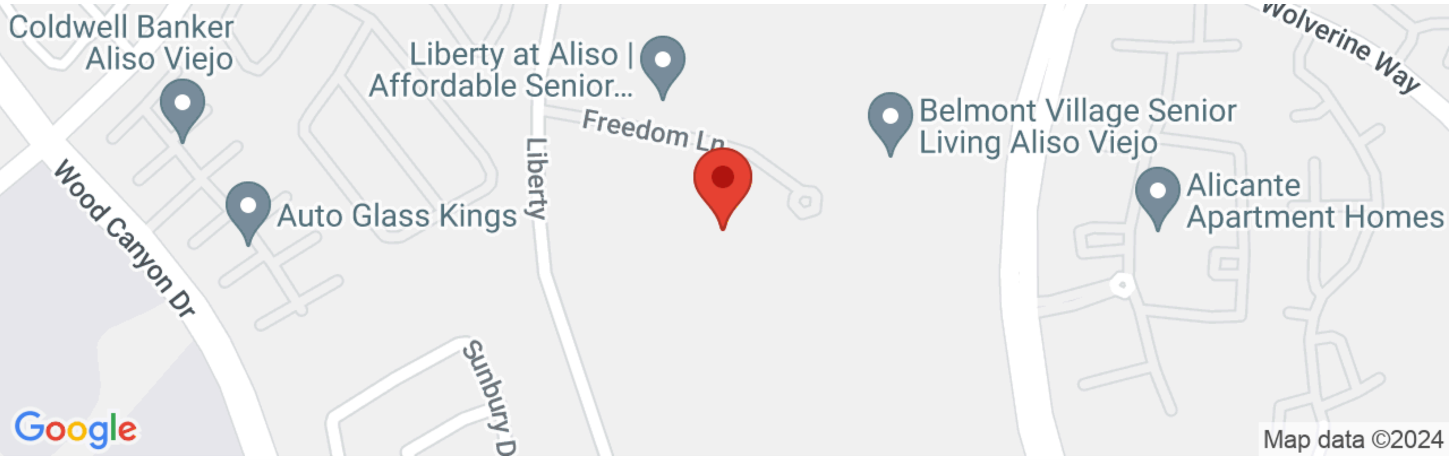
Proposed Commercial/Industrial Development
Aliso Viejo, California
Project No. 21G167
PLATE C-7

SoCalGeo
SOUTHERN
CALIFORNIA
GEOTECHNICAL
A California Corporation

Appendix D

USGS web services were down for some period of time and as a result this tool wasn't operational, resulting in *timeout* error.
USGS web services are now operational so this tool should work as expected.

Latitude, Longitude: 33.56181, -117.72862


Coldwell Banker Aliso Viejo
Liberty at Aliso | Affordable Senior...
Wolverine Way
Freedom Ln
Belmont Village Senior Living Aliso Viejo
Liberty
Auto Glass Kings
Alicante Apartment Homes
Wood Canyon Dr
Sunbury D
Google
Map data ©2024

Date	5/31/2024, 4:29:32 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	C - Very Dense Soil and Soft Rock

Type	Value	Description
S_S	1.244	MCE_R ground motion. (for 0.2 second period)
S_1	0.444	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.493	Site-modified spectral acceleration value
S_{M1}	0.667	Site-modified spectral acceleration value
S_{DS}	0.995	Numeric seismic design value at 0.2 second SA
S_{D1}	0.444	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	1.5	Site amplification factor at 1.0 second
PGA	0.533	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.639	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.244	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.342	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	2.6	Factored deterministic acceleration value. (0.2 second)
S1RT	0.444	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.477	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.869	Factored deterministic acceleration value. (1.0 second)
PGAd	1.061	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.533	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.927	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.932	Mapped value of the risk coefficient at a period of 1 s
C_V	1.149	Vertical coefficient

DISCLAIMER

While the information presented on this website is believed to be correct, SEAOC /OSHPD and its sponsors and contributors assume no responsibility or liability for its accuracy. The material presented in this web application should not be used or relied upon for any specific application without competent examination and verification of its accuracy, suitability and applicability by engineers or other licensed professionals. SEAOC / OSHPD do not intend that the use of this information replace the sound judgment of such competent professionals, having experience and knowledge in the field of practice, nor to substitute for the standard of care required of such professionals in interpreting and applying the results of the seismic data provided by this website. Users of the information from this website assume all liability arising from such use. Use of the output of this website does not imply approval by the governing building code bodies responsible for building code approval and interpretation for the building site described by latitude/longitude location in the search results of this website.

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Please also see the new USGS Earthquake Hazard Toolbox for access to the most recent NSHMs for the conterminous U.S. and Hawaii.

Input

Edition

Dynamic: Conterminous U.S. 2014 (u…

Spectral Period

Peak Ground Acceleration

Latitude

Decimal degrees

33.56181

Time Horizon

Return period in years

2475

Longitude

Decimal degrees, negative values for western longitudes

-117.72862

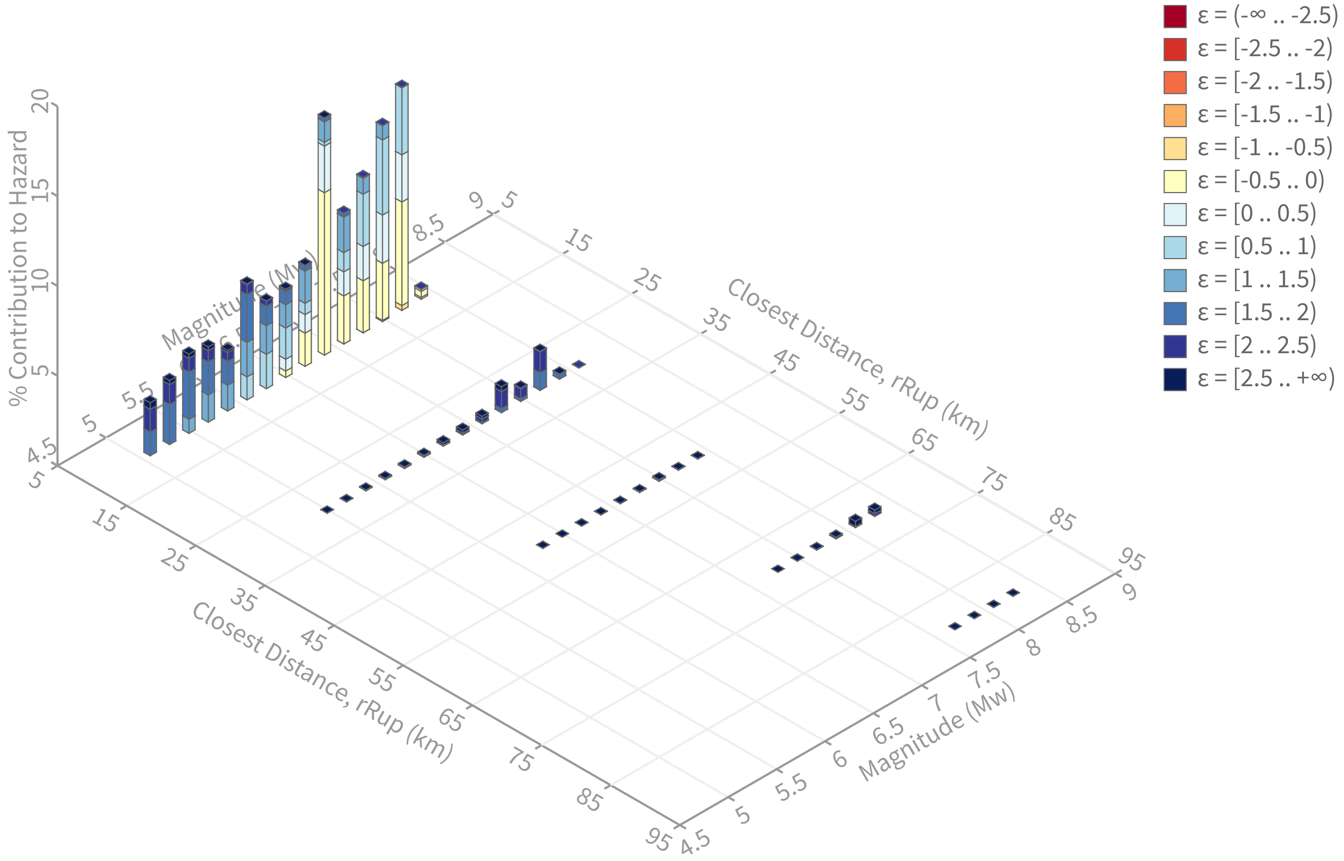
Site Class

537 m/s (Site class C)

Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.59756496 g

Recovered targets

Return period: 2750.0871 yrs
Exceedance rate: 0.00036362485 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.07 %

Mean (over all sources)

m: 6.79
r: 9.39 km
ε_0: 0.85 σ

Mode (largest m-r bin)

m: 6.89
r: 5.23 km
ε_0: 0.06 σ
Contribution: 13.2 %

Mode (largest m-r-ε_0 bin)

m: 6.89
r: 4.51 km
ε_0: -0.19 σ
Contribution: 9.04 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	**Type**	**r**	**m**	**ε_0**	**lon**	**lat**	**az**	**%**
UC33brAvg_FM32	System							34.37
San Joaquin Hills [2]		4.45	7.11	-0.11	117.699°W	33.588°N	42.77	19.34
Newport-Inglewood (Offshore) [3]		8.90	7.29	0.92	117.798°W	33.507°N	226.82	8.25
Oceanside alt2 [12]		5.38	7.53	-0.18	117.802°W	33.515°N	232.65	1.51
Elsinore (Glen Ivy) rev [1]		31.74	7.65	2.07	117.488°W	33.765°N	44.60	1.07
UC33brAvg_FM31	System							31.13
San Joaquin Hills [2]		4.45	7.52	-0.08	117.699°W	33.588°N	42.77	11.47
Newport-Inglewood (Offshore) [3]		8.90	7.29	0.91	117.798°W	33.507°N	226.82	8.56
Oceanside alt1 [6]		5.52	6.98	-0.01	117.802°W	33.514°N	232.26	5.92
Elsinore (Glen Ivy) rev [1]		31.74	7.62	2.10	117.488°W	33.765°N	44.60	1.03
UC33brAvg_FM31 (opt)	Grid							17.31
PointSourceFinite: -117.729, 33.629		8.73	5.73	1.57	117.729°W	33.629°N	0.00	2.88
PointSourceFinite: -117.729, 33.629		8.73	5.73	1.57	117.729°W	33.629°N	0.00	2.88
PointSourceFinite: -117.729, 33.611		7.14	5.83	1.25	117.729°W	33.611°N	0.00	2.41
PointSourceFinite: -117.729, 33.611		7.14	5.83	1.25	117.729°W	33.611°N	0.00	2.41
PointSourceFinite: -117.729, 33.647		10.02	5.82	1.69	117.729°W	33.647°N	0.00	1.05
PointSourceFinite: -117.729, 33.647		10.02	5.82	1.69	117.729°W	33.647°N	0.00	1.05
UC33brAvg_FM32 (opt)	Grid							17.18
PointSourceFinite: -117.729, 33.629		8.73	5.73	1.57	117.729°W	33.629°N	0.00	2.85
PointSourceFinite: -117.729, 33.629		8.73	5.73	1.57	117.729°W	33.629°N	0.00	2.85
PointSourceFinite: -117.729, 33.611		7.15	5.82	1.25	117.729°W	33.611°N	0.00	2.39
PointSourceFinite: -117.729, 33.611		7.15	5.82	1.25	117.729°W	33.611°N	0.00	2.39
PointSourceFinite: -117.729, 33.647		10.02	5.82	1.69	117.729°W	33.647°N	0.00	1.05
PointSourceFinite: -117.729, 33.647		10.02	5.82	1.69	117.729°W	33.647°N	0.00	1.05

Appendix E

Summary of Slope Stability Analysis
Cross-Section B-B'

Filename	Description	Factor of Safety (FS)	
		Static	*Pseudostatic*
01, 01p	Global Stability of the Existing Slope, Block Search through Bedrock with along-bedding strengths	1.88	1.22
02, 02p	Global Stability of the Existing Slope, Circular Search through Bedrock with along-bedding strengths	1.59	1.11

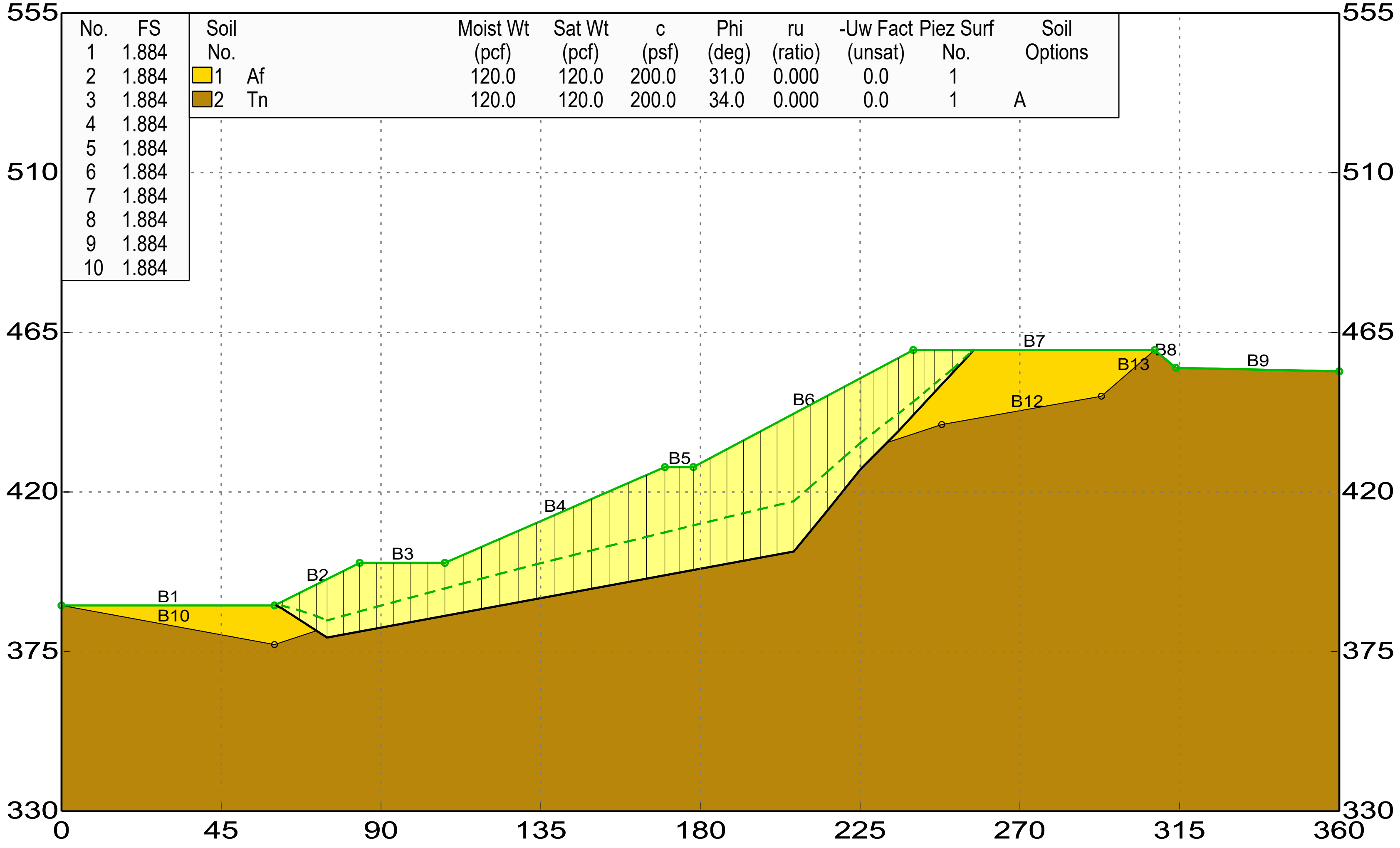
Project No.: 24064-01

Project Name: Meritage/ Freedom Lane, Aliso Viejo

X-Section B-B' - Freedom Lane
Global Stability of Existing Slope

SA Geotechnical, Inc., RS

\01.gsd



No.	FS
1	1.884
2	1.884
3	1.884
4	1.884
5	1.884
6	1.884
7	1.884
8	1.884
9	1.884
10	1.884

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	-Uw Fact (unsat)	Piez Surf No.	Soil Options
🟨 1	Af	120.0	120.0	200.0	31.0	0.000	0.0	1	
🟫 2	Tn	120.0	120.0	200.0	34.0	0.000	0.0	1	A

GEOSTASE FS = 1.884

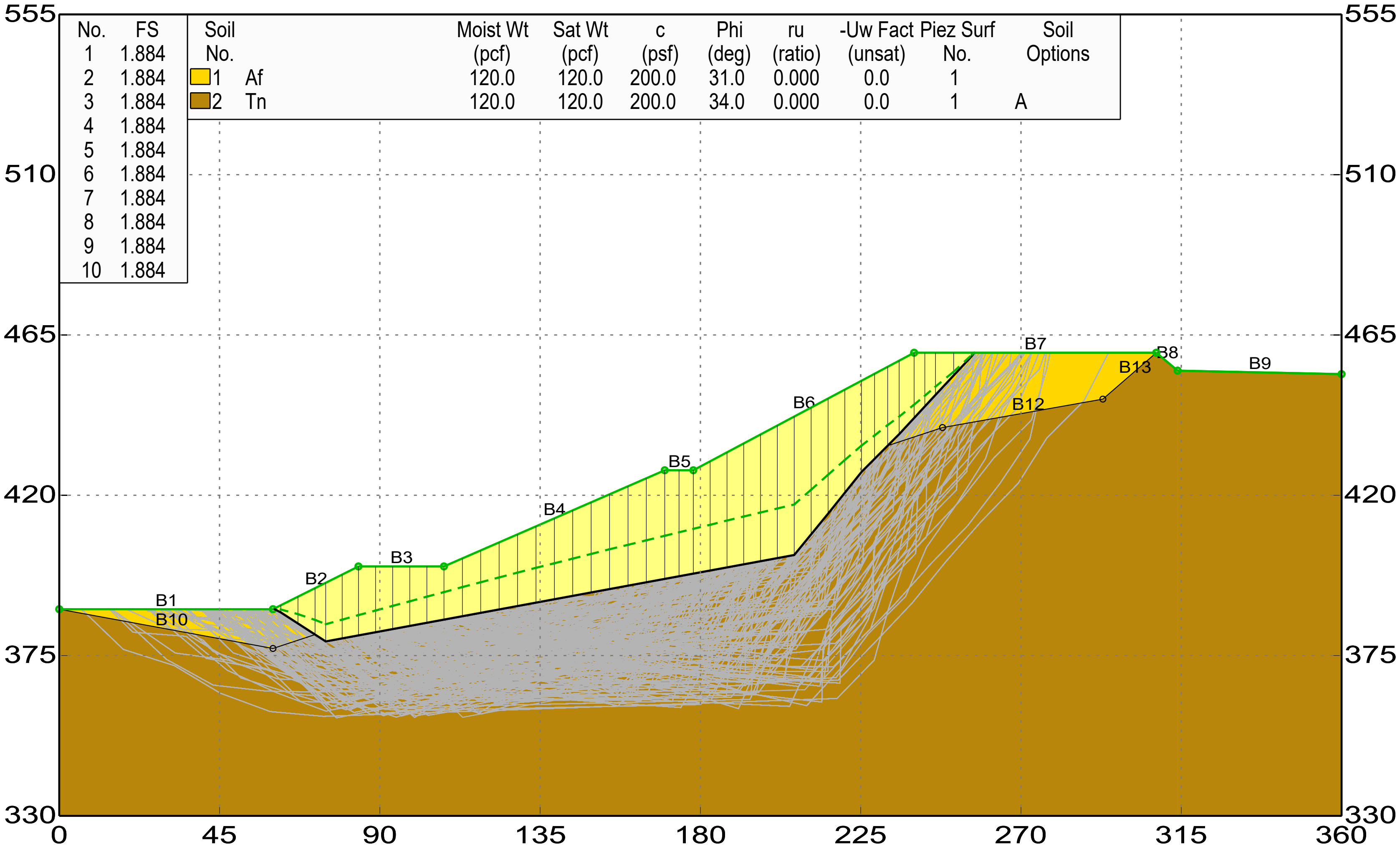
Spencer Method

GEOSTASE
Slope Stability
Analysis

X-Section B-B' - Freedom Lane
Global Stability of Existing Slope

SA Geotechnical, Inc., RS

\01.gsd



No.	FS
1	1.884
2	1.884
3	1.884
4	1.884
5	1.884
6	1.884
7	1.884
8	1.884
9	1.884
10	1.884

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	-Uw Fact (unsat)	Piez Surf No.	Soil Options
🟨 1	Af	120.0	120.0	200.0	31.0	0.000	0.0	1	
🟫 2	Tn	120.0	120.0	200.0	34.0	0.000	0.0	1	A

GEOSTASE FS = 1.884

Spencer Method

GEOSTASE
Slope Stability
Analysis

GEOSTASE® v4.30.32 by GREGORY GEOTECHNICAL SOFTWARE

PLATE C.2

```
                              ***  GEOSTASE(R)  ***

           ** GEOSTASE(R) (c)Copyright by Garry H. Gregory, Ph.D.,P.E.,S.E.,BC.GE **

                  ** Current Version 4.30.32-Double Precision, Sept 2023 **
                      (All Rights Reserved-Unauthorized Use Prohibited)


          *********************************************************************************
                         SLOPE STABILITY ANALYSIS SOFTWARE (2D & 3D)
              Simplified Bishop, Simplified Janbu, or General Equilibrium (GE) Options.
                 (Spencer, Morgenstern-Price, USACE, and Lowe & Karafiath)
                 Including Pier/Pile, Planar Reinf,  Nail, Tieback, Line Loads
                 Applied Forces, Fiber-Reinforced Soil (FRS), Distributed Loads
                 Nonlinear Undrained Shear Strength, Curved Strength Envelope,
                 Anisotropic Strengths, Water Surfaces, 3-Stage Rapid Drawdown
                 2- or 3-Stage Pseudo-Static & Simplified Newmark Seismic Analyses.
          *********************************************************************************


          Analysis Date:              6/  3/ 2024
          Analysis Time:
          Analysis By:               SA Geotechnical, Inc., RS


          Input File Name:           C:\Users\Reza Saberi\SA Geotechnical, Inc\SA Geotechnical -
Projects\2024\24064-01 Meritage - 400-700 Freedom Ln, Aliso Viejo\Engineering\Sted\B-B'\01.gsd

          Output File Name:          C:\Users\Reza Saberi\SA Geotechnical, Inc\SA Geotechnical -
Projects\2024\24064-01 Meritage - 400-700 Freedom Ln, Aliso Viejo\Engineering\Sted\B-B'\01.OUT

          Unit System:               English


          PROJECT: X-Section B-B' - Freedom Lane

          DESCRIPTION: Global Stability of Existing Slope
```

```
 PROFILE BOUNDARY DATA

     9 Surface Boundaries
    13 Total   Boundaries


 Boundary      X - 1       Y - 1       X - 2       Y - 2      Soil Type
    No.        (ft)        (ft)        (ft)        (ft)       Below Bnd

     1          0.000     388.000      60.000     388.000        1
     2         60.000     388.000      84.000     400.000        1
     3         84.000     400.000     108.000     400.000        1
     4        108.000     400.000     170.000     427.000        1
     5        170.000     427.000     178.000     427.000        1
     6        178.000     427.000     240.000     460.000        1
     7        240.000     460.000     308.000     460.000        1
     8        308.000     460.000     314.000     455.000        2
     9        314.000     455.000     360.000     454.000        2
    10          0.000     388.000      60.000     377.000        2
    11         60.000     377.000     248.000     439.000        2
    12        248.000     439.000     293.000     447.000        2
    13        293.000     447.000     308.000     460.000        2

 User Specified X-Origin =         0.000(ft)

 User Specified Y-Origin =       330.000(ft)

 SURFACE BOUNDARY POINT COORDINATES
(Information Only-Not Used Directly)
 Point No.       X-COORD             Y-COORD
    1               0.000               388.000
    2              60.000               388.000
    3              84.000               400.000
    4             108.000               400.000
    5             170.000               427.000
    6             178.000               427.000
    7             240.000               460.000
    8             308.000               460.000
    9             314.000               455.000
```

```
      10             360.000            454.000

    SUBSURFACE BOUNDARY POINT COORDINATES
     (Information Only-Not Used Directly)
    Point No.       X-COORD            Y-COORD
    Surface boundary point    1 and Subsurface boundary point   11 are duplicate points.
      11               0.000            388.000
      12              60.000            377.000
      13             248.000            439.000
      14             293.000            447.000
    Surface boundary point    8 and Subsurface boundary point   15 are duplicate points.
      15             308.000            460.000

 PROFILE BOUNDARY SLOPES AND ANGLES
    BND No.  Slope    Angle(Deg.)
       1      0.000     0.000
       2      0.500    26.565
       3      0.000     0.000
       4      0.435    23.532
       5      0.000     0.000
       6      0.532    28.025
       7      0.000     0.000
       8     -0.833   -39.806
       9     -0.022    -1.245
      10     -0.183   -10.389
      11      0.330    18.252
      12      0.178    10.081
      13      0.867    40.914


   MOHR-COULOMB SOIL PARAMETERS

     2 Type(s) of Soil Defined

 Soil Number           Moist  Saturated  Cohesion Friction   Pore      (-Uw)   Water   Water
     and             Unit Wt. Unit Wt. Intercept   Angle  Pressure    Fact.  Surface  Option
 Description           (pcf)    (pcf)     (psf)     (deg)  Ratio(ru)           No.

1 Af                   120.0    120.0     200.00    31.00    0.000      0.0      1       0
```

```
2 Tn                       120.0    120.0     200.00    34.00    0.000      0.0      1       0


       ANISOTROPIC STRENGTH PARAMETERS

            1 soil type(s)

        Soil Type  2 Is Anisotropic

        Number Of Direction Ranges Specified =  3


        Direction    Counterclockwise     Cohesion     Friction
          Range       Direction Limit    Intercept       Angle
           No.            (deg)            (psf)         (deg)

            1              -5.0             200.00         34.00
            2               8.0             200.00         28.00
            3              90.0             200.00         24.00

        A Non-Circular Zone Search Has Been Selected For Analysis
        Using Random Generation Within Specified Zones.

        2 Zones Defined For Generation Of Non-Circular Surfaces


          4000 Trial Surfaces Have Been Generated.


        Length Of Line Segments For Active And Passive Portions Of
        Non-Circular Zone Search =   15.00(ft)

        Zone       X - 1      Y - 1      X - 2      Y - 2       Height
        No.         (ft)       (ft)       (ft)       (ft)        (ft)

         1          70.00     375.00     125.00     375.00      35.00
         2         140.00     385.00     220.00     385.00      50.00
        The Spencer Method Was Selected for FS Analysis.
```

```
Selected fx function = Constant (1.0)

SELECTED CONVERGENCE PARAMETERS FOR SPENCER METHOD:
Initial estimate of FS =  1.500
FS tolerance =  0.000001000
Initial estimate of theta(deg) =  15.00
Theta tolerance(radians) =  0.0001000
Minimum theta(deg) = -45.00 ; Maximum theta(deg) =  45.00
Theta convergence Step Factor = 5000.00
Maximum number of iterations = 50
Allowable negative side force = -1000.0(lbs)
Maximum force imbalance  = 100.000000(lbs)
Maximum moment imbalance = 100.000000 (ft/lbs)

Selected Lambda Coefficient =  1.00

Specified Tension Crack Water Depth Factor =   0.000

Total Number of Trial Surfaces Attempted = 4000

WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
Did Not Converge in 50 Iterations.


Number of Trial Surfaces with Non-Converged FS = 386

Number of Trial Surfaces With Valid FS = 3614


Percentage of Trial Surfaces With Non-Converged and/or
Non-Valid FS Solutions of the Total Attempted =   9.7 %

Statistical Data On All Valid FS Values:
   FS Max =   9.496   FS Min =   1.884   FS Ave =   3.964
   Standard Deviation =    1.407   Coefficient of Variation =   35.51 %


Critical Surface is Sequence Number     231 of Those Analyzed.
```

```
*****BEGINNING OF DETAILED GEOSTASE OUTPUT FOR CRITICAL SURFACE FROM A SEARCH*****


  Iter.     Theta         FS         FS
   No.      (deg)      (Moment)   (Force)
           (fx=1.0)                           Lambda        Delta FS

    1        15.0000    1.947195   1.841694     0.268      0.1055008E+00
    2        19.9500    1.746420   1.951656     0.363      0.2052360E+00
    3        16.6803    1.898327   1.875861     0.300      0.2246659E-01
    4        17.0035    1.887104   1.882767     0.306      0.4336580E-02
    5        17.0808    1.884320   1.884436     0.307      0.1153620E-03
    6        17.0788    1.884393   1.884393     0.307      0.5047168E-06


Factor Of Safety For The Preceding Specified Surface =  1.884
Theta (fx = 1.0) =  17.08 Deg    Lambda =   0.307


The Spencer Method Has Been Selected For Analysis.

Selected fx function = Constant (1.0)

SELECTED CONVERGENCE PARAMETERS FOR ANALYSIS METHOD:
Initial estimate of FS =  1.500
FS tolerance =  0.000001000
Initial estimate of theta(deg) =  15.00
Theta tolerance(radians) =  0.0001000
Minimum theta(deg) = -45.00 ; Maximum theta(deg) =  45.00
Theta convergence Step Factor = 5000.00
Maximum number of iterations = 50
Maximum force imbalance = 100.000000(lbs)
Maximum moment imbalance(if Applicable) = 100.000000 (ft/lbs)


Selected Lambda Coefficient =  1.00

Tension Crack Water Force =        0.00(lbs)
```

```
Specified Tension Crack Water Depth Factor =  0.000 (  0.00% Filled )

Depth of Tension Crack (zo) at Side of Last Slice =   0.000(ft)

Depth of Water in Tension Crack =   0.000(ft)

Theoretical Tension Crack Depth =   5.892(ft)


NOTE: In Table 1 following, when a tension crack with water is present on the
first slice (right facing slope) or on the last slice (left facing slope), the
"side force" in the tension crack is set equal to the water pressure resultant.


        *** Table 1 - Line of Thrust(if applicable) and Slice Force Data ***

Slice      X         Y               Side Force     fx    Force Angle  Vert. Shear
 No.     Coord.    Coord.    h/H       (lbs)                 (Deg)      Force(lbs)

  1      62.21    387.91    0.406     854.72     1.000       17.08         251.0
  2      67.01    386.62    0.349    7925.95     1.000       17.08        2327.7
  3      71.82    385.00    0.315   21412.46     1.000       17.08        6288.5
  4      74.82    383.82    0.296   34501.64     1.000       17.08       10132.7
  5      79.41    385.09    0.295   35512.75     1.000       17.08       10429.6
  6      84.00    386.34    0.294   36565.89     1.000       17.08       10738.9
  7      88.80    387.64    0.330   37675.41     1.000       17.08       11064.7
  8      93.60    388.93    0.370   38758.07     1.000       17.08       11382.7
  9      98.40    390.23    0.414   39813.85     1.000       17.08       11692.8
 10     103.20    391.52    0.463   40842.77     1.000       17.08       11995.0
 11     108.00    392.81    0.518   41844.81     1.000       17.08       12289.2
 12     113.17    394.20    0.503   42930.11     1.000       17.08       12608.0
 13     118.33    395.57    0.490   44057.75     1.000       17.08       12939.1
 14     123.50    396.93    0.478   45227.71     1.000       17.08       13282.8
 15     128.67    398.27    0.466   46440.00     1.000       17.08       13638.8
 16     133.83    399.60    0.456   47694.63     1.000       17.08       14007.3
 17     139.00    400.92    0.446   48991.59     1.000       17.08       14388.2
 18     144.17    402.23    0.437   50330.88     1.000       17.08       14781.5
 19     149.33    403.53    0.428   51712.50     1.000       17.08       15187.2
```

```
          20     154.50    404.82    0.420    53136.45     1.000        17.08       15605.4
          21     159.67    406.10    0.412    54602.74     1.000        17.08       16036.1
          22     164.83    407.37    0.404    56111.36     1.000        17.08       16479.1
          23     170.00    408.63    0.397    57662.31     1.000        17.08       16934.6
          24     174.00    409.61    0.415    58870.10     1.000        17.08       17289.3
          25     178.00    410.59    0.434    60059.23     1.000        17.08       17638.6
          26     182.72    411.74    0.420    61477.04     1.000        17.08       18055.0
          27     187.45    412.89    0.407    62943.87     1.000        17.08       18485.7
          28     192.17    414.02    0.395    64459.74     1.000        17.08       18930.9
          29     196.90    415.15    0.384    66024.64     1.000        17.08       19390.5
          30     201.62    416.27    0.374    67638.57     1.000        17.08       19864.5
          31     206.34    417.38    0.364    69301.54     1.000        17.08       20352.9
          32     211.09    421.58    0.353    56385.44     1.000        17.08       16559.6
          33     215.84    425.76    0.338    44678.85     1.000        17.08       13121.6
          34     220.53    429.88    0.317    34147.61     1.000        17.08       10028.7
          35     225.22    433.93    0.288    24862.88     1.000        17.08        7301.9
          36     228.89    436.74    0.273    19490.75     1.000        17.08        5724.2
          37     232.56    439.65    0.260    14532.06     1.000        17.08        4267.9
          38     235.82    442.07    0.238    11109.58     1.000        17.08        3262.7
          39     240.00    445.44    0.204     6805.32     1.000        17.08        1998.6
          40     242.99    447.92    0.198     4229.29     1.000        17.08        1242.1
          41     245.99    450.45    0.192     2243.42     1.000        17.08         658.9
          42     251.11    454.69    0.162      233.37     1.000        17.08          68.5
          43     256.24    459.48    0.390      -94.45     1.000        17.08         -27.7
          44     256.90    460.00    0.000        0.02     1.000        17.08          -0.0

         NOTE: A value of 0.000- for h/H indicates that the line of thrust is at or below
         the lower boundary of the sliding mass. A value of 1.000+ for h/H indicates that
         the line of thrust is at or above the upper boundary of the sliding mass.



              ***Table 2 - Geometry Data on the   44 Slices***


  Slice    Width    Height    X-Cntr     Y-Cntr-Base  Y-Cntr-Top    Alpha   Beta    Base Length
   No.      (ft)     (ft)      (ft)         (ft)         (ft)       (deg)   (deg)       (ft)

   1        1.95      1.01     61.23       387.61       388.62     -27.92   26.57       2.21
```

2	4.80	4.76	64.61	385.54	390.31	-32.82	26.57	5.72
3	4.80	10.26	69.42	382.45	392.71	-32.82	26.57	5.72
4	3.00	14.73	73.32	379.93	394.66	-32.82	26.57	3.57
5	4.59	17.17	77.11	379.39	396.56	10.46	26.57	4.67
6	4.59	18.62	81.70	380.23	398.85	10.46	26.57	4.67
7	4.80	18.90	86.40	381.10	400.00	10.46	0.00	4.88
8	4.80	18.01	91.20	381.99	400.00	10.46	0.00	4.88
9	4.80	17.13	96.00	382.87	400.00	10.46	0.00	4.88
10	4.80	16.24	100.80	383.76	400.00	10.46	0.00	4.88
11	4.80	15.36	105.60	384.64	400.00	10.46	0.00	4.88
12	5.17	15.56	110.58	385.56	401.12	10.46	23.53	5.25
13	5.17	16.86	115.75	386.52	403.38	10.46	23.53	5.25
14	5.17	18.16	120.92	387.47	405.62	10.46	23.53	5.25
15	5.17	19.45	126.08	388.42	407.88	10.46	23.53	5.25
16	5.17	20.75	131.25	389.38	410.12	10.46	23.53	5.25
17	5.17	22.04	136.42	390.33	412.38	10.46	23.53	5.25
18	5.17	23.34	141.58	391.28	414.62	10.46	23.53	5.25
19	5.17	24.64	146.75	392.24	416.88	10.46	23.53	5.25
20	5.17	25.93	151.92	393.19	419.12	10.46	23.53	5.25
21	5.17	27.23	157.08	394.14	421.38	10.46	23.53	5.25
22	5.17	28.53	162.25	395.10	423.62	10.46	23.53	5.25
23	5.17	29.82	167.42	396.05	425.88	10.46	23.53	5.25
24	4.00	30.10	172.00	396.90	427.00	10.46	0.00	4.07
25	4.00	29.37	176.00	397.63	427.00	10.46	0.00	4.07
26	4.72	29.82	180.36	398.44	428.26	10.46	28.02	4.80
27	4.72	31.46	185.09	399.31	430.77	10.46	28.02	4.80
28	4.72	33.10	189.81	400.18	433.29	10.46	28.02	4.80
29	4.72	34.75	194.53	401.05	435.80	10.46	28.02	4.80
30	4.72	36.39	199.26	401.93	438.31	10.46	28.02	4.80
31	4.72	38.03	203.98	402.80	440.83	10.46	28.02	4.80
32	4.75	37.21	208.72	406.14	443.35	50.70	28.02	7.50
33	4.75	33.94	213.47	411.94	445.88	50.70	28.02	7.50
34	4.69	30.62	218.19	417.77	448.39	51.32	28.02	7.50
35	4.69	27.26	222.87	423.62	450.88	51.32	28.02	7.50
36	3.67	24.72	227.05	428.39	453.11	45.05	28.02	5.20
37	3.67	22.99	230.73	432.07	455.06	45.05	28.02	5.20
38	3.25	21.37	234.19	435.54	456.91	45.05	28.02	4.60
39	4.18	19.45	237.91	439.43	458.89	47.29	28.02	6.17
40	2.99	16.68	241.50	443.32	460.00	47.29	0.00	4.42

```
  41      2.99    13.43    244.49      446.57      460.00      47.29    0.00       4.42
  42      5.12     9.07    248.55      450.93      460.00      46.92    0.00       7.50
  43      5.12     3.59    253.67      456.41      460.00      46.92    0.00       7.50
  44      0.66     0.43    256.57      459.57      460.00      52.24    0.00       1.08
↑


 ***Table 2A - Coordinates of Slice Points Defining the Slip Surface***


 Point           X-Pt            Y-Pt
  No.            (ft)            (ft)

   1          60.257545       388.128772
   2          62.211895       387.093284
   3          67.014846       383.995322
   4          71.817798       380.897359
   5          74.817200       378.962708
   6          79.408600       379.809998
   7          84.000000       380.657289
   8          88.800000       381.543074
   9          93.600000       382.428859
  10          98.400000       383.314645
  11         103.200000       384.200430
  12         108.000000       385.086215
  13         113.166667       386.039665
  14         118.333333       386.993114
  15         123.500000       387.946563
  16         128.666667       388.900013
  17         133.833333       389.853462
  18         139.000000       390.806912
  19         144.166667       391.760361
  20         149.333333       392.713811
  21         154.500000       393.667260
  22         159.666667       394.620709
  23         164.833333       395.574159
  24         170.000000       396.527608
  25         174.000000       397.265763
  26         178.000000       398.003917
  27           182.723796        398.875640
  28           187.447591        399.747362
  29           192.171387        400.619085
  30           196.895182        401.490808
  31           201.618978        402.362530
  32           206.342773        403.234253
  33           211.093152        409.038037
  34           215.843530        414.841821
  35           220.531029        420.696508
  36           225.218527        426.551195
  37           228.891303        430.230313
  38           232.564078        433.909430
  39           235.815976        437.166943
  40           240.000000        441.700130
  41           242.994790        444.944839
  42           245.989579        448.189548
  43           251.112358        453.667426
  44           256.235137        459.145303
  45           256.897193        460.000000
↑

  ***Table 3 - Force and Pore Pressure Data On The   44 Slices (Excluding Reinforcement)***

                          Ubeta   Ubeta      Ualpha                                  Earthquake
                          Force   Stress     Force      Pore                           Force        Distributed
 Slice      Weight         Top     Top        Bot     Pressure        -Uw      Horiz       Vert         Load
   No.      (lbs)         (lbs)   (psf)      (lbs)      (psf)        (psf)    (lbs)      (lbs)        (psf)
   1          236.0         0.0     0.0        0.0       0.00         0.00     0.0        0.0         0.00
   2         2744.8         0.0     0.0        0.0       0.00         0.00     0.0        0.0         0.00
   3         5914.4         0.0     0.0        0.0       0.00         0.00     0.0        0.0         0.00
   4         5301.3         0.0     0.0        0.0       0.00         0.00     0.0        0.0         0.00
   5         9460.2         0.0     0.0        0.0       0.00         0.00     0.0        0.0         0.00
   6        10258.2         0.0     0.0        0.0       0.00         0.00     0.0        0.0         0.00
   7        10886.3         0.0     0.0        0.0       0.00         0.00     0.0        0.0         0.00
   8        10376.1         0.0     0.0        0.0       0.00         0.00     0.0        0.0         0.00
   9         9865.9         0.0     0.0        0.0       0.00         0.00     0.0        0.0         0.00
  10         9355.7         0.0     0.0        0.0       0.00         0.00     0.0        0.0         0.00
  11         8845.4         0.0     0.0        0.0       0.00         0.00     0.0        0.0         0.00
```

```
12        9648.5       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
13       10452.3       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
14       11256.2       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
15       12060.1       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
16       12863.9       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
17       13667.8       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
18       14471.6       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
19       15275.5       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
20       16079.4       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
21       16883.2       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
22       17687.1       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
23       18491.0       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
24       14449.6       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
25       14095.3       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
26       16902.1       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
27       17833.2       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
28       18764.3       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
29       19695.4       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
30       20626.5       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
31       21557.6       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
32       21213.5       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
33       19346.4       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
34       17224.2       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
35       15334.4       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
36       10894.5       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
37       10134.6       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
38        8338.9       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
39        9767.0       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
40        5993.5       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
41        4827.4       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
42        5576.6       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
43        2209.1       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
44          34.0       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00

        TOTAL WEIGHT OF SLIDING MASS =  526899.03(lbs)

        EFFECTIVE WEIGHT OF SLIDING MASS =  526899.03(lbs)

        TOTAL AREA OF SLIDING MASS =  4390.83(ft2)
```

```
 ***TABLE 4 - SOIL STRENGTH & SOIL OPTIONS DATA ON THE   44 SLICES***

 Slice  Soil   Cohesion   Phi(Deg)   Options
  No.   Type     (psf)
   1      1     200.00     31.00
   2      1     200.00     31.00
   3      1     200.00     31.00
   4      2     200.00     34.00     A
   5      2     200.00     24.00     A
   6      2     200.00     24.00     A
   7      2     200.00     24.00     A
   8      2     200.00     24.00     A
   9      2     200.00     24.00     A
  10      2     200.00     24.00     A
  11      2     200.00     24.00     A
  12      2     200.00     24.00     A
  13      2     200.00     24.00     A
  14      2     200.00     24.00     A
  15      2     200.00     24.00     A
  16      2     200.00     24.00     A
  17      2     200.00     24.00     A
  18      2     200.00     24.00     A
  19      2     200.00     24.00     A
  20      2     200.00     24.00     A
  21      2     200.00     24.00     A
  22      2     200.00     24.00     A
  23      2     200.00     24.00     A
  24      2     200.00     24.00     A
  25      2     200.00     24.00     A
  26      2     200.00     24.00     A
  27      2     200.00     24.00     A
  28      2     200.00     24.00     A
  29      2     200.00     24.00     A
  30      2     200.00     24.00     A
  31      2     200.00     24.00     A
  32      2     200.00     24.00     A
  33       2     200.00     24.00     A
  34       2     200.00     24.00     A
  35       2     200.00     24.00     A
  36       2     200.00     24.00     A
  37       2     200.00     24.00     A
  38       1     200.00     31.00
  39       1     200.00     31.00
  40       1     200.00     31.00
  41       1     200.00     31.00
  42       1     200.00     31.00
  43       1     200.00     31.00
  44       1     200.00     31.00

  SOIL OPTIONS:
  A = ANISOTROPIC SHEAR STRENGTH
  C = CURVED STRENGTH ENVELOPE (TANGENT PHI & C)
  F = FIBER-REINFORCED SOIL (FRS)
  M = INDEPENDENT MULTI-STAGE SHEAR STRENGTH
  N = NONLINEAR UNDRAINED SHEAR STRENGTH
  R = RAPID DRAWDOWN OR RAPID LOADING (SEISMIC) SHEAR STRENGTH
  S = SHANSEP UNDRAINED SHEAR STRENGTH
  NOTE: Phi and C in Table 4 are modified values based on specified
  Soil Options (if any).

↑


        ***TABLE 5 - Total Base Stress Data on the   44 Slices***

 Slice   Alpha     X-Coord.       Base         Total          Total          Total
  No.    (deg)    Slice Cntr     Leng.     Normal Stress   Vert. Stress   Normal/Vert.
   *                 (ft)        (ft)         (psf)          (psf)        Stress Ratio

   1    -27.92      61.23        2.21         367.53         120.76          3.043
   2    -32.82      64.61        5.72        1349.98         571.49          2.362
   3    -32.82      69.42        5.72        2674.63        1231.42          2.172
   4    -32.82      73.32        3.57        4053.37        1767.45          2.293
   5     10.46      77.11        4.67        2017.53        2060.41          0.979
   6     10.46      81.70        4.67        2186.66        2234.22          0.979
  7     10.46    86.40        4.88        2219.50       2267.98        0.979
  8     10.46    91.20        4.88        2116.08       2161.68        0.979
  9     10.46    96.00        4.88        2012.65       2055.39        0.979
 10     10.46   100.80        4.88        1909.22       1949.10        0.980
 11     10.46   105.60        4.88        1805.79       1842.80        0.980
 12     10.46   110.58        5.25        1829.77       1867.45        0.980
 13     10.46   115.75        5.25        1981.16       2023.03        0.979
 14     10.46   120.92        5.25        2132.55       2178.62        0.979
 15     10.46   126.08        5.25        2283.95       2334.21        0.978
 16     10.46   131.25        5.25        2435.34       2489.79        0.978
 17     10.46   136.42        5.25        2586.73       2645.38        0.978
 18     10.46   141.58        5.25        2738.12       2800.96        0.978
 19     10.46   146.75        5.25        2889.51       2956.55        0.977
 20     10.46   151.92        5.25        3040.90       3112.14        0.977
 21     10.46   157.08        5.25        3192.30       3267.72        0.977
 22     10.46   162.25        5.25        3343.69       3423.31        0.977
 23     10.46   167.42        5.25        3495.08       3578.89        0.977
 24     10.46   172.00        4.07        3527.68       3612.40        0.977
 25     10.46   176.00        4.07        3441.49       3523.82        0.977
 26     10.46   180.36        4.80        3494.29       3578.08        0.977
 27     10.46   185.09        4.80        3686.08       3775.19        0.976
 28     10.46   189.81        4.80        3877.87       3972.30        0.976
 29     10.46   194.53        4.80        4069.67       4169.40        0.976
 30     10.46   199.26        4.80        4261.46       4366.51        0.976
 31     10.46   203.98        4.80        4453.25       4563.62        0.976
 32     50.70   208.72        7.50        2745.05       4465.65        0.615
 33     50.70   213.47        7.50        2498.08       4072.61        0.613
 34     51.32   218.19        7.50        2225.40       3674.50        0.606
 35     51.32   222.87        7.50        1974.40       3271.33        0.604
 36     45.05   227.05        5.20        1965.27       2966.29        0.663
 37     45.05   230.73        5.20        1824.69       2759.38        0.661
 38     45.05   234.19        4.60        1628.69       2564.33        0.635
 39     47.29   237.91        6.17        1424.96       2334.36        0.610
 40     47.29   241.50        4.42        1214.21       2001.30        0.607
 41     47.29   244.49        4.42         967.84       1611.94        0.600
 42     46.92   248.55        7.50         641.22       1088.58        0.589
 43     46.92   253.67        7.50         222.94        431.24        0.517
 44     52.24   256.57        1.08         -31.06         51.28       -0.606
```

```
        ***TABLE 5A - Total Base Force Data on the   44 Slices***

Slice   Alpha     X-Coord.      Base         Total            Total           Total
 No.    (deg)    Slice Cntr     Leng.     Normal Force    Vert. Force      Normal/Vert.
  *                 (ft)        (ft)          (lbs)           (lbs)        Force Ratio

  1    -27.92      61.23        2.21          812.87          236.01           3.444
  2    -32.82      64.61        5.72         7715.66         2744.82           2.811
  3    -32.82      69.42        5.72        15286.54         5914.44           2.585
  4    -32.82      73.32        3.57        14467.33         5301.28           2.729
  5     10.46      77.11        4.67         9419.71         9460.17           0.996
  6     10.46      81.70        4.67        10209.34        10258.20           0.995
  7     10.46      86.40        4.88        10833.51        10886.30           0.995
  8     10.46      91.20        4.88        10328.67        10376.08           0.995
  9     10.46      96.00        4.88         9823.83         9865.87           0.996
 10     10.46     100.80        4.88         9318.99         9355.66           0.996
 11     10.46     105.60        4.88         8814.15         8845.45           0.996
 12     10.46     110.58        5.25         9613.45         9648.48           0.996
 13     10.46     115.75        5.25        10408.84        10452.34           0.996
 14     10.46     120.92        5.25        11204.24        11256.20           0.995
 15     10.46     126.08        5.25        11999.64        12060.06           0.995
 16     10.46     131.25        5.25        12795.03        12863.92           0.995
 17     10.46     136.42        5.25        13590.43        13667.78           0.994
 18     10.46     141.58        5.25        14385.82        14471.65           0.994
 19     10.46     146.75        5.25        15181.22        15275.51           0.994
 20     10.46     151.92        5.25        15976.62        16079.37           0.994
 21     10.46     157.08        5.25        16772.01        16883.23           0.993
 22     10.46     162.25        5.25        17567.41        17687.09           0.993
 23     10.46     167.42        5.25        18362.81        18490.95           0.993
 24     10.46     172.00        4.07        14348.97        14449.59           0.993
 25     10.46     176.00        4.07        13998.39        14095.28           0.993
 26     10.46     180.36        4.80        16785.01        16902.13           0.993
 27     10.46     185.09        4.80        17706.30        17833.23           0.993
 28     10.46     189.81        4.80        18627.59        18764.32           0.993
 29     10.46     194.53        4.80        19548.87        19695.41           0.993
 30     10.46     199.26        4.80        20470.16        20626.50           0.992
 31     10.46     203.98        4.80        21391.45        21557.59           0.992
```

```
  32     50.70    208.72          7.50        20587.91        21213.52           0.971
  33     50.70    213.47          7.50        18735.61        19346.42           0.968
  34     51.32    218.19          7.50        16690.50        17224.22           0.969
  35     51.32    222.87          7.50        14808.01        15334.37           0.966
  36     45.05    227.05          5.20        10216.58        10894.53           0.938
  37     45.05    230.73          5.20         9485.78        10134.60           0.936
  38     45.05    234.19          4.60         7496.64         8338.94           0.899
  39     47.29    237.91          6.17         8790.48         9767.00           0.900
  40     47.29    241.50          4.42         5361.40         5993.48           0.895
  41     47.29    244.49          4.42         4273.52         4827.41           0.885
  42     46.92    248.55          7.50         4809.16         5576.56           0.862
  43     46.92    253.67          7.50         1672.03         2209.13           0.757
  44     52.24    256.57          1.08          -33.58           33.95          -0.989
↑


         ***TABLE 6 - Effective and Base Shear Stress Data on the   44 Slices***

 Slice    Alpha    X-Coord.       Base        Effective       Available        Mobilized
  No.     (deg)   Slice Cntr      Leng.     Normal Stress   Shear Strength   Shear Stress
   *                 (ft)         (ft)          (psf)           (psf)            (psf)

   1     -27.92     61.23         2.21          367.53          420.83           223.33
   2     -32.82     64.61         5.72         1349.98         1011.15           536.59
   3     -32.82     69.42         5.72         2674.63         1807.08           958.97
   4     -32.82     73.32         3.57         4053.37         2934.03          1557.02
   5      10.46     77.11         4.67         2017.53         1098.26           582.82
   6      10.46     81.70         4.67         2186.66         1173.56           622.78
   7      10.46     86.40         4.88         2219.50         1188.19           630.54
   8      10.46     91.20         4.88         2116.08         1142.14           606.10
   9      10.46     96.00         4.88         2012.65         1096.09           581.67
  10      10.46    100.80         4.88         1909.22         1050.04           557.23
  11      10.46    105.60         4.88         1805.79         1003.99           532.79
  12      10.46    110.58         5.25         1829.77         1014.67           538.46
  13      10.46    115.75         5.25         1981.16         1082.07           574.23
  14      10.46    120.92         5.25         2132.55         1149.47           610.00
  15      10.46    126.08         5.25         2283.95         1216.88           645.77
  16      10.46    131.25         5.25         2435.34         1284.28           681.54
  17      10.46    136.42         5.25         2586.73         1351.69           717.31
  18      10.46     141.58       5.25         2738.12         1419.09          753.08
  19      10.46     146.75       5.25         2889.51         1486.49          788.84
  20      10.46     151.92       5.25         3040.90         1553.90          824.61
  21      10.46     157.08       5.25         3192.30         1621.30          860.38
  22      10.46     162.25       5.25         3343.69         1688.71          896.15
  23      10.46     167.42       5.25         3495.08         1756.11          931.92
  24      10.46     172.00       4.07         3527.68         1770.62          939.63
  25      10.46     176.00       4.07         3441.49         1732.25          919.26
  26      10.46     180.36       4.80         3494.29         1755.76          931.74
  27      10.46     185.09       4.80         3686.08         1841.15          977.05
  28      10.46     189.81       4.80         3877.87         1926.54         1022.37
  29      10.46     194.53       4.80         4069.67         2011.93         1067.68
  30      10.46     199.26       4.80         4261.46         2097.32         1113.00
  31      10.46     203.98       4.80         4453.25         2182.72         1158.31
  32      50.70     208.72       7.50         2745.05         1422.18          754.71
  33      50.70     213.47       7.50         2498.08         1312.22          696.36
  34      51.32     218.19       7.50         2225.40         1190.81          631.93
  35      51.32     222.87       7.50         1974.40         1079.06          572.63
  36      45.05     227.05       5.20         1965.27         1074.99          570.47
  37      45.05     230.73       5.20         1824.69         1012.40          537.26
  38      45.05     234.19       4.60         1628.69         1178.62          625.46
  39      47.29     237.91       6.17         1424.96         1056.20          560.50
  40      47.29     241.50       4.42         1214.21          929.57          493.30
  41      47.29     244.49       4.42          967.84          781.54          414.74
  42      46.92     248.55       7.50          641.22          585.28          310.60
  43      46.92     253.67       7.50          222.94          333.95          177.22
  44      52.24     256.57       1.08          -31.06          181.34           96.23


         ***TABLE 6A - Effective and Base Shear Force Data on the   44 Slices***

 Slice    Alpha     X-Coord.     Base       Effective       Available         Mobilized
  No.     (deg)    Slice Cntr    Leng.    Normal Force     Shear Force       Shear Force
   *                  (ft)        (ft)        (lbs)           (lbs)             (lbs)

   1     -27.92      61.23       2.21          812.87          930.76          493.93
   2     -32.82      64.61       5.72         7715.66         5779.11         3066.83
   3     -32.82      69.42       5.72        15286.54        10328.16         5480.90
```

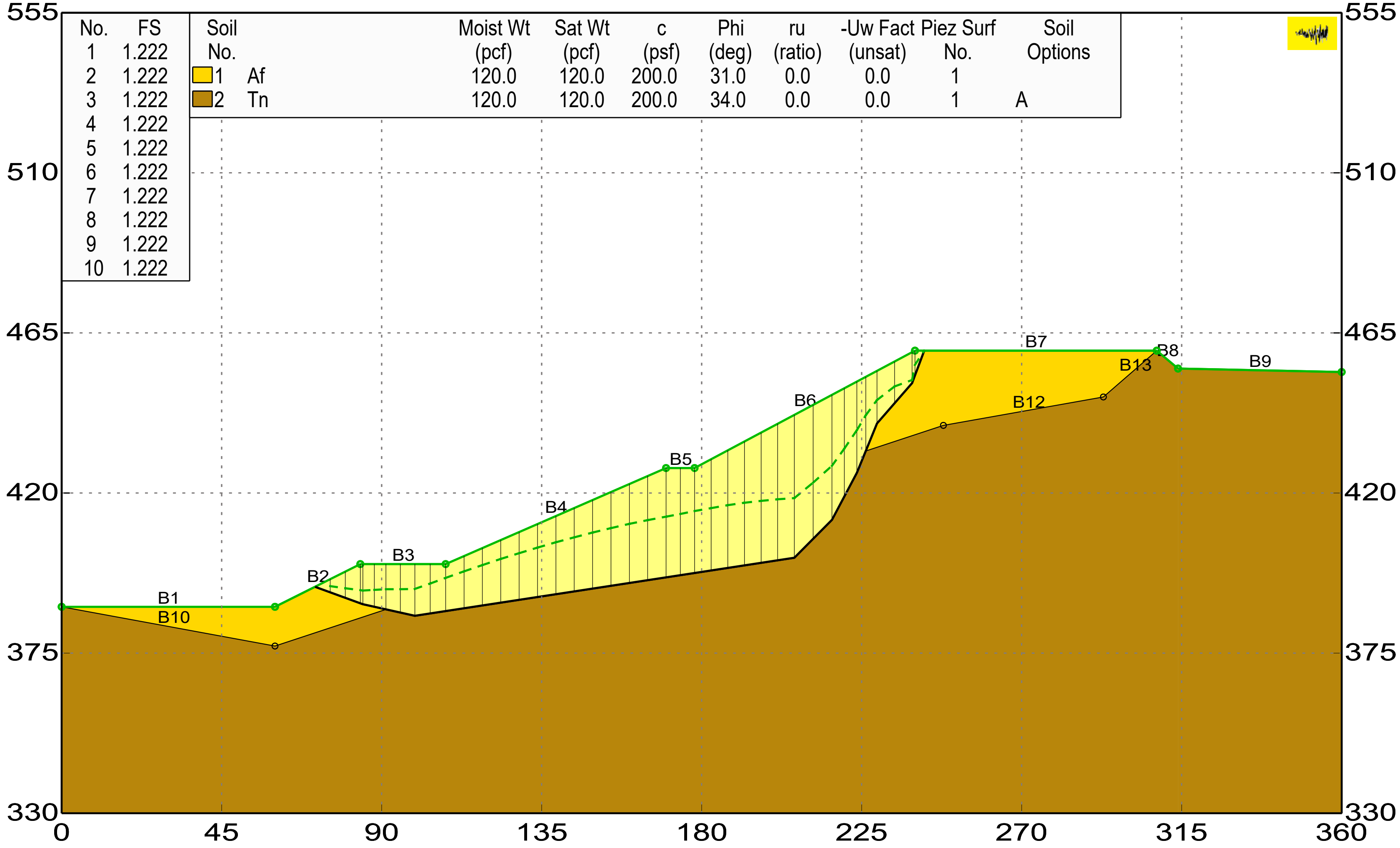
4	-32.82	73.32	3.57	14467.33	10472.18	5557.32
5	10.46	77.11	4.67	9419.71	5127.71	2721.15
6	10.46	81.70	4.67	10209.34	5479.27	2907.71
7	10.46	86.40	4.88	10833.51	5799.60	3077.70
8	10.46	91.20	4.88	10328.67	5574.83	2958.42
9	10.46	96.00	4.88	9823.83	5350.06	2839.14
10	10.46	100.80	4.88	9318.99	5125.29	2719.86
11	10.46	105.60	4.88	8814.15	4900.52	2600.58
12	10.46	110.58	5.25	9613.45	5330.96	2829.01
13	10.46	115.75	5.25	10408.84	5685.10	3016.94
14	10.46	120.92	5.25	11204.24	6039.23	3204.87
15	10.46	126.08	5.25	11999.64	6393.36	3392.80
16	10.46	131.25	5.25	12795.03	6747.50	3580.73
17	10.46	136.42	5.25	13590.43	7101.63	3768.66
18	10.46	141.58	5.25	14385.82	7455.76	3956.59
19	10.46	146.75	5.25	15181.22	7809.90	4144.52
20	10.46	151.92	5.25	15976.62	8164.03	4332.45
21	10.46	157.08	5.25	16772.01	8518.16	4520.37
22	10.46	162.25	5.25	17567.41	8872.30	4708.30
23	10.46	167.42	5.25	18362.81	9226.43	4896.23
24	10.46	172.00	4.07	14348.97	7202.08	3821.96
25	10.46	176.00	4.07	13998.39	7045.99	3739.13
26	10.46	180.36	4.80	16785.01	8433.88	4475.65
27	10.46	185.09	4.80	17706.30	8844.06	4693.32
28	10.46	189.81	4.80	18627.59	9254.25	4911.00
29	10.46	194.53	4.80	19548.87	9664.43	5128.67
30	10.46	199.26	4.80	20470.16	10074.61	5346.34
31	10.46	203.98	4.80	21391.45	10484.80	5564.02
32	50.70	208.72	7.50	20587.91	10666.33	5660.35
33	50.70	213.47	7.50	18735.61	9841.63	5222.71
34	51.32	218.19	7.50	16690.50	8931.09	4739.51
35	51.32	222.87	7.50	14808.01	8092.95	4294.73
36	45.05	227.05	5.20	10216.58	5588.43	2965.64
37	45.05	230.73	5.20	9485.78	5263.05	2792.97
38	45.05	234.19	4.60	7496.64	5425.00	2878.91
39	47.29	237.91	6.17	8790.48	6515.64	3457.69
40	47.29	241.50	4.42	5361.40	4104.56	2178.19
41	47.29	244.49	4.42	4273.52	3450.90	1831.30
42	46.92	248.55	7.50	4809.16	4389.63	2329.47

```
43      46.92     253.67       7.50          1672.03          2504.66          1329.16
44      52.24     256.57       1.08           -33.58           196.05           104.04

   Average Effective Normal Stress = 2381.3459(psf)
   Average Available Shear Strength = 1313.3673(psf)
   Total Length of Failure Surface = 227.0392(ft)


   INPUT PARAMETERS FOR SIMPLIFIED 3D ANALYSIS

        Composite Phi (deg)=  28.878
        3D Depth (Vertical difference between ends of Slip Surface) =   71.87(ft)
        L/D(1): L = 71.87(ft) L/D(2): L = 143.74(ft) L/D(3): L = 215.61(ft)
        L/D(4): L = 287.48(ft) L/D(5): L = 359.36(ft) L/D(6): L = 431.23(ft)

   SUM OF MOMENTS =  -0.709305E-01 (ft/lbs);Imbalance (Fraction of Total Weight) =  -0.1346188E-06
   SUM OF FORCES = -.138636E-03 (lbs);Imbalance (Fraction of Total Weight) =   -0.2631160E-09

   Sum of Available Shear Forces =  298185.85(lbs)

   Sum of Mobilized Shear Forces =  158239.76(lbs)

   FS Balance Check: FS =  1.884393

                     **** END OF GEOSTASE OUTPUT ****
```

X-Section B-B' - Freedom Lane
Global Stability of Existing Slope - Pseudo Static

SA Geotechnical, Inc., RS

\01p.gsd



No.	FS
1	1.222
2	1.222
3	1.222
4	1.222
5	1.222
6	1.222
7	1.222
8	1.222
9	1.222
10	1.222

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	-Uw Fact (unsat)	Piez Surf No.	Soil Options
1	Af	120.0	120.0	200.0	31.0	0.0	0.0	1	
2	Tn	120.0	120.0	200.0	34.0	0.0	0.0	1	A

GEOSTASE FS = 1.222

Spencer Method

kh = 0.22000

GEOSTASE Slope Stability Analysis

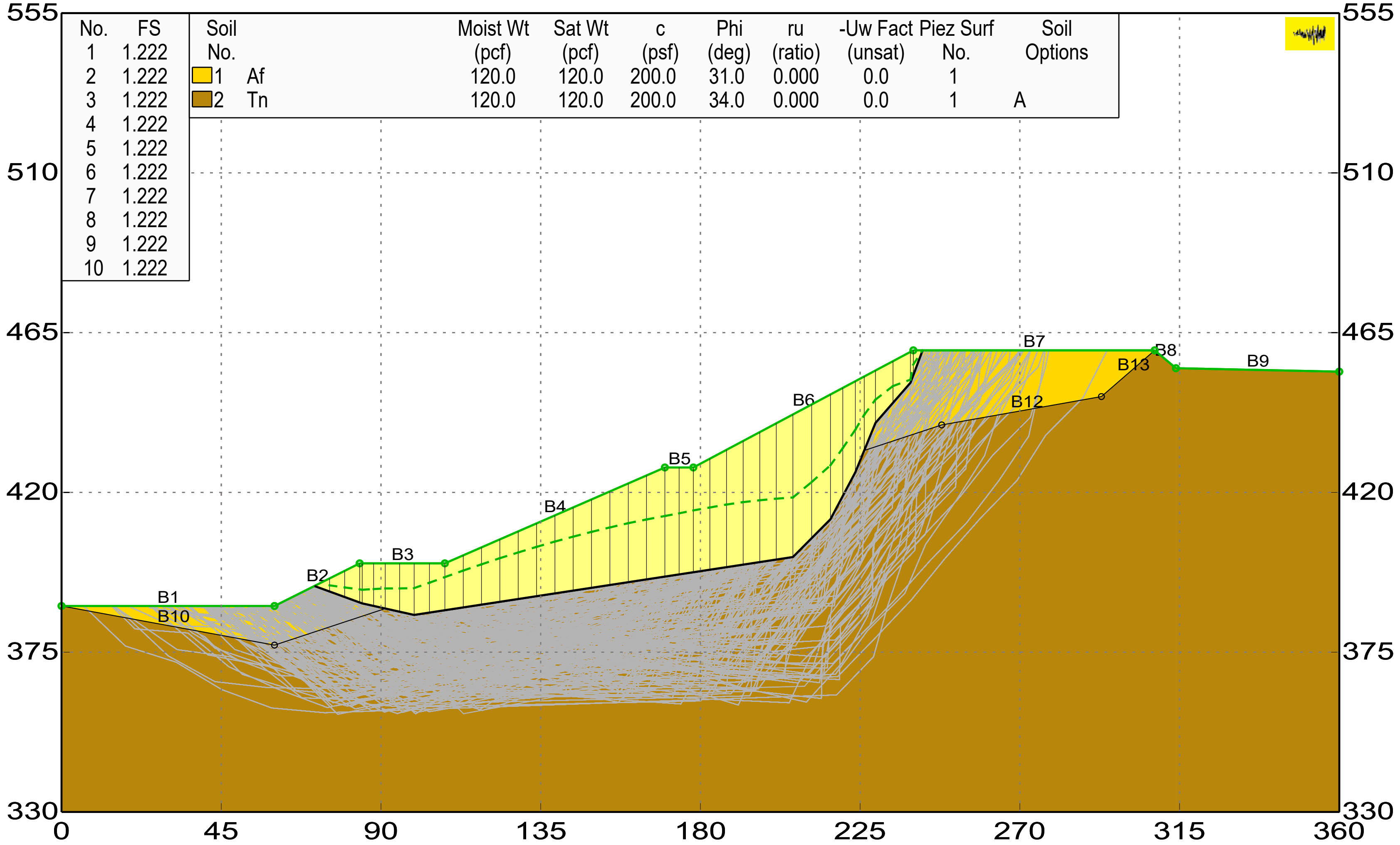
GEOSTASE® v4.30.32 by GREGORY GEOTECHNICAL SOFTWARE

PLATE C.1

X-Section B-B' - Freedom Lane
Global Stability of Existing Slope - Pseudo Static

SA Geotechnical, Inc., RS

\01p.gsd



No.	FS
1	1.222
2	1.222
3	1.222
4	1.222
5	1.222
6	1.222
7	1.222
8	1.222
9	1.222
10	1.222

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	-Uw Fact (unsat)	Piez Surf No.	Soil Options
🟨 1	Af	120.0	120.0	200.0	31.0	0.000	0.0	1	
🟫 2	Tn	120.0	120.0	200.0	34.0	0.000	0.0	1	A

GEOSTASE FS = 1.222

Spencer Method

kh = 0.22000

GEOSTASE
Slope Stability
Analysis

GEOSTASE® v4.30.32 by GREGORY GEOTECHNICAL SOFTWARE

PLATE C.2

```
                     ***  GEOSTASE(R)  ***

  ** GEOSTASE(R) (c)Copyright by Garry H. Gregory, Ph.D.,P.E.,S.E.,BC.GE **

         ** Current Version 4.30.32-Double Precision, Sept 2023 **
             (All Rights Reserved-Unauthorized Use Prohibited)


 *********************************************************************************
               SLOPE STABILITY ANALYSIS SOFTWARE (2D & 3D)
     Simplified Bishop, Simplified Janbu, or General Equilibrium (GE) Options.
        (Spencer, Morgenstern-Price, USACE, and Lowe & Karafiath)
        Including Pier/Pile, Planar Reinf,  Nail, Tieback, Line Loads
        Applied Forces, Fiber-Reinforced Soil (FRS), Distributed Loads
        Nonlinear Undrained Shear Strength, Curved Strength Envelope,
        Anisotropic Strengths, Water Surfaces, 3-Stage Rapid Drawdown
        2- or 3-Stage Pseudo-Static & Simplified Newmark Seismic Analyses.
 *********************************************************************************


 Analysis Date:             6/  3/ 2024
 Analysis Time:
 Analysis By:              SA Geotechnical, Inc., RS


 Input File Name:          C:\Users\Reza Saberi\SA Geotechnical, Inc\SA Geotechnical -
Projects\2024\24064-01 Meritage - 400-700 Freedom Ln, Aliso Viejo\Engineering\Sted\B-B'\01p.gsd

 Output File Name:         C:\Users\Reza Saberi\SA Geotechnical, Inc\SA Geotechnical -
Projects\2024\24064-01 Meritage - 400-700 Freedom Ln, Aliso Viejo\Engineering\Sted\B-B'\01p.OUT

 Unit System:              English


 PROJECT: X-Section B-B' - Freedom Lane

 DESCRIPTION: Global Stability of Existing Slope - Pseudo Static
 PROFILE BOUNDARY DATA

     9 Surface Boundaries
    13 Total   Boundaries


 Boundary      X - 1       Y - 1       X - 2       Y - 2      Soil Type
    No.         (ft)        (ft)        (ft)        (ft)       Below Bnd

     1          0.000     388.000      60.000     388.000        1
     2         60.000     388.000      84.000     400.000        1
     3         84.000     400.000     108.000     400.000        1
     4        108.000     400.000     170.000     427.000        1
     5        170.000     427.000     178.000     427.000        1
     6        178.000     427.000     240.000     460.000        1
     7        240.000     460.000     308.000     460.000        1
     8        308.000     460.000     314.000     455.000        2
     9        314.000     455.000     360.000     454.000        2
    10          0.000     388.000      60.000     377.000        2
    11         60.000     377.000     248.000     439.000        2
    12        248.000     439.000     293.000     447.000        2
    13        293.000     447.000     308.000     460.000        2

 User Specified X-Origin =         0.000(ft)

 User Specified Y-Origin =       330.000(ft)

 SURFACE BOUNDARY POINT COORDINATES
(Information Only-Not Used Directly)
 Point No.       X-COORD             Y-COORD
    1               0.000             388.000
    2              60.000             388.000
    3              84.000             400.000
    4             108.000             400.000
    5             170.000             427.000
    6             178.000             427.000
    7             240.000             460.000
    8             308.000             460.000
    9             314.000             455.000
```

```
          10             360.000             454.000

        SUBSURFACE BOUNDARY POINT COORDINATES
         (Information Only-Not Used Directly)
        Point No.       X-COORD             Y-COORD
        Surface boundary point    1 and Subsurface boundary point   11 are duplicate points.
          11               0.000             388.000
          12              60.000             377.000
          13             248.000             439.000
          14             293.000             447.000
        Surface boundary point    8 and Subsurface boundary point   15 are duplicate points.
          15             308.000             460.000

     PROFILE BOUNDARY SLOPES AND ANGLES
        BND No.  Slope    Angle(Deg.)
           1      0.000     0.000
           2      0.500    26.565
           3      0.000     0.000
           4      0.435    23.532
           5      0.000     0.000
           6      0.532    28.025
           7      0.000     0.000
           8     -0.833   -39.806
           9     -0.022    -1.245
          10     -0.183   -10.389
          11      0.330    18.252
          12      0.178    10.081
          13      0.867    40.914


       MOHR-COULOMB SOIL PARAMETERS

         2 Type(s) of Soil Defined

     Soil Number           Moist  Saturated  Cohesion Friction   Pore      (-Uw)   Water   Water
         and              Unit Wt. Unit Wt. Intercept   Angle  Pressure    Fact.  Surface  Option
     Description           (pcf)    (pcf)     (psf)     (deg)  Ratio(ru)            No.

1 Af                       120.0    120.0     200.00    31.00    0.000      0.0      1       0
```

```
2 Tn                       120.0    120.0     200.00    34.00    0.000      0.0      1       0


       ANISOTROPIC STRENGTH PARAMETERS

            1 soil type(s)

        Soil Type  2 Is Anisotropic

        Number Of Direction Ranges Specified =  3


        Direction    Counterclockwise     Cohesion     Friction
          Range       Direction Limit    Intercept       Angle
           No.             (deg)           (psf)         (deg)

            1               -5.0             200.00         34.00
            2                8.0             200.00         28.00
            3               90.0             200.00         24.00

       SEISMIC (EARTHQUAKE) DATA

        Specified Peak Ground Acceleration Coefficient (PGA) =   0.220(g)
        Default Velocity =   1.100(ft) per second
        Specified Horizontal Earthquake Coefficient (kh) =  0.22000(g)
        Specified Vertical Earthquake Coefficient (kv) =   0.000(g)
        (NOTE:Input Velocity = 0.0 will result in default Peak
        Velocity = 2 times(PGA) times 2.5 fps or 0.762 mps)
        Specified Seismic Pore-Pressure Factor =   0.000
        Horizontal Seismic Force is Applied at Center of Gravity of Slices

        A Non-Circular Zone Search Has Been Selected For Analysis
        Using Random Generation Within Specified Zones.

        2 Zones Defined For Generation Of Non-Circular Surfaces


          4000 Trial Surfaces Have Been Generated.
```

```
Length Of Line Segments For Active And Passive Portions Of
Non-Circular Zone Search =   15.00(ft)

Zone       X - 1      Y - 1      X - 2      Y - 2       Height
No.         (ft)       (ft)       (ft)       (ft)        (ft)

 1          70.00     375.00     125.00     375.00      35.00
 2         140.00     385.00     220.00     385.00      50.00
The Spencer Method Was Selected for FS Analysis.

Selected fx function = Constant (1.0)

SELECTED CONVERGENCE PARAMETERS FOR SPENCER METHOD:
Initial estimate of FS =  1.500
FS tolerance =  0.000001000
Initial estimate of theta(deg) =  15.00
Theta tolerance(radians) =  0.0001000
Minimum theta(deg) = -45.00 ; Maximum theta(deg) =  45.00
Theta convergence Step Factor = 5000.00
Maximum number of iterations = 50
Allowable negative side force = -1000.0(lbs)
Maximum force imbalance  = 100.000000(lbs)
Maximum moment imbalance = 100.000000 (ft/lbs)

Selected Lambda Coefficient =  1.00

Specified Tension Crack Water Depth Factor =   0.000

Total Number of Trial Surfaces Attempted = 4000

WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
Did Not Converge in 50 Iterations.


Number of Trial Surfaces with Non-Converged FS = 957

Number of Trial Surfaces With Valid FS = 3043
```

```
Percentage of Trial Surfaces With Non-Converged and/or
Non-Valid FS Solutions of the Total Attempted =  23.9 %

Statistical Data On All Valid FS Values:
   FS Max =   7.305   FS Min =   1.222   FS Ave =   2.338
   Standard Deviation =    0.719   Coefficient of Variation =   30.74 %


Critical Surface is Sequence Number     148 of Those Analyzed.


*****BEGINNING OF DETAILED GEOSTASE OUTPUT FOR CRITICAL SURFACE FROM A SEARCH*****


  Iter.     Theta         FS         FS
   No.      (deg)      (Moment)   (Force)
           (fx=1.0)                            Lambda        Delta FS

    1        15.0000    1.348413   1.141704     0.268      0.2067092E+00
    2        19.9500    1.304609   1.185213     0.363      0.1193963E+00
    3        26.7175    1.017047   1.258643     0.503      0.2415957E+00
    4        22.1879    1.261483   1.207332     0.408      0.5415105E-01
    5        23.0180    1.238678   1.216021     0.425      0.2265762E-01
    6        23.6151    1.218998   1.222450     0.437      0.3452577E-02
    7        23.5362    1.221783   1.221591     0.436      0.1919497E-03
    8        23.5403    1.221638   1.221637     0.436      0.9067323E-06


Factor Of Safety For The Preceding Specified Surface =  1.222
Theta (fx = 1.0) =  23.54 Deg    Lambda =   0.436


The Spencer Method Has Been Selected For Analysis.

Selected fx function = Constant (1.0)

SELECTED CONVERGENCE PARAMETERS FOR ANALYSIS METHOD:
Initial estimate of FS =  1.500
```

```
FS tolerance =  0.000001000
Initial estimate of theta(deg) =  15.00
Theta tolerance(radians) =  0.0001000
Minimum theta(deg) = -45.00 ; Maximum theta(deg) =  45.00
Theta convergence Step Factor = 5000.00
Maximum number of iterations = 50
Maximum force imbalance = 100.000000(lbs)
Maximum moment imbalance(if Applicable) = 100.000000 (ft/lbs)


Selected Lambda Coefficient =  1.00

Tension Crack Water Force =        0.00(lbs)

Specified Tension Crack Water Depth Factor =  0.000 (  0.00% Filled )

Depth of Tension Crack (zo) at Side of Last Slice =   0.000(ft)

Depth of Water in Tension Crack =   0.000(ft)

Theoretical Tension Crack Depth =   5.892(ft)


NOTE: In Table 1 following, when a tension crack with water is present on the
first slice (right facing slope) or on the last slice (left facing slope), the
"side force" in the tension crack is set equal to the water pressure resultant.


        *** Table 1 - Line of Thrust(if applicable) and Slice Force Data ***

Slice      X         Y               Side Force     fx    Force Angle  Vert. Shear
 No.     Coord.    Coord.    h/H        (lbs)                (Deg)      Force(lbs)

  1      75.53    393.80    0.463    3467.86     1.000       23.54        1385.0
  2      79.77    393.23    0.366   10025.50     1.000       23.54        4004.1
  3      84.00    392.67    0.334   19672.93     1.000       23.54        7857.3
  4      84.70    392.57    0.340   21530.95     1.000       23.54        8599.3
  5      87.95    392.76    0.396   27021.23     1.000       23.54       10792.1
  6      91.20    392.94    0.444   32788.51     1.000       23.54       13095.6
  7      95.27    392.96    0.483    41776.30     1.000        23.54       16685.2
  8      99.34    393.04    0.521    51286.26     1.000        23.54       20483.5
  9     103.67    394.58    0.609    51934.85     1.000        23.54       20742.5
 10     108.00    396.14    0.708    52591.52     1.000        23.54       21004.8
 11     113.17    397.97    0.708    53368.93     1.000        23.54       21315.3
 12     118.33    399.74    0.705    54125.11     1.000        23.54       21617.3
 13     123.50    401.45    0.698    54860.08     1.000        23.54       21910.8
 14     128.67    403.08    0.689    55573.82     1.000        23.54       22195.9
 15     133.83    404.64    0.678    56266.34     1.000        23.54       22472.5
 16     139.00    406.13    0.665    56937.64     1.000        23.54       22740.6
 17     144.17    407.55    0.650    57587.71     1.000        23.54       23000.2
 18     149.33    408.88    0.633    58216.56     1.000        23.54       23251.4
 19     154.50    410.13    0.616    58824.19     1.000        23.54       23494.1
 20     159.67    411.30    0.597    59410.60     1.000        23.54       23728.3
 21     164.83    412.37    0.577    59975.78     1.000        23.54       23954.0
 22     170.00    413.36    0.556    60519.74     1.000        23.54       24171.3
 23     174.00    414.11    0.572    60936.10     1.000        23.54       24337.5
 24     178.00    414.90    0.590    61359.34     1.000        23.54       24506.6
 25     182.68    415.79    0.562    61846.69     1.000        23.54       24701.2
 26     187.36    416.57    0.534    62310.68     1.000        23.54       24886.5
 27     192.03    417.24    0.505    62751.32     1.000        23.54       25062.5
 28     196.71    417.80    0.476    63168.59     1.000        23.54       25229.2
 29     201.39    418.24    0.447    63562.50     1.000        23.54       25386.5
 30     206.07    418.55    0.417    63933.06     1.000        23.54       25534.5
 31     211.35    422.91    0.420    49676.74     1.000        23.54       19840.6
 32     216.63    427.65    0.433    36416.11     1.000        23.54       14544.4
 33     220.15    432.46    0.441    25509.51     1.000        23.54       10188.4
 34     223.66    437.63    0.466    16364.77     1.000        23.54        6536.0
 35     226.15    441.89    0.485    10711.62     1.000        23.54        4278.2
 36     229.33    446.13    0.444     6091.67     1.000        23.54        2433.0
 37     234.26    449.98    0.405     2583.29     1.000        23.54        1031.8
 38     239.18    451.77    0.100      134.16     1.000        23.54          53.6
 39     240.00    455.99    0.420     -189.13     1.000        23.54         -75.5
 40     242.58    460.00    0.000        0.09     1.000        23.54          -0.0

NOTE: A value of 0.000- for h/H indicates that the line of thrust is at or below
the lower boundary of the sliding mass. A value of 1.000+ for h/H indicates that
the line of thrust is at or above the upper boundary of the sliding mass.
```

```
                 ***Table 2 - Geometry Data on the   40 Slices***


 Slice    Width    Height    X-Cntr    Y-Cntr-Base  Y-Cntr-Top    Alpha   Beta    Base Length
  No.      (ft)     (ft)      (ft)        (ft)        (ft)        (deg)   (deg)      (ft)

   1       4.23      1.83     73.41      392.87      394.71      -20.12   26.57      4.51
   2       4.23      5.50     77.65      391.32      396.82      -20.12   26.57      4.51
   3       4.23      9.17     81.88      389.77      398.94      -20.12   26.57      4.51
   4       0.70     11.13     84.35      388.87      400.00      -20.12    0.00      0.74
   5       3.25     11.62     86.32      388.38      400.00      -12.58    0.00      3.33
   6       3.25     12.35     89.57      387.65      400.00      -12.58    0.00      3.33
   7       4.07     13.16     93.23      386.84      400.00      -12.58    0.00      4.17
   8       4.07     14.07     97.30      385.93      400.00      -12.58    0.00      4.17
   9       4.33     14.19    101.50      385.81      400.00        8.69    0.00      4.38
  10       4.33     13.53    105.83      386.47      400.00        8.69    0.00      4.38
  11       5.17     13.93    110.58      387.19      401.12        8.69   23.53      5.23
  12       5.17     15.39    115.75      387.98      403.38        8.69   23.53      5.23
  13       5.17     16.85    120.92      388.77      405.62        8.69   23.53      5.23
  14       5.17     18.31    126.08      389.56      407.88        8.69   23.53      5.23
  15       5.17     19.77    131.25      390.35      410.12        8.69   23.53      5.23
  16       5.17     21.23    136.42      391.14      412.38        8.69   23.53      5.23
  17       5.17     22.69    141.58      391.93      414.62        8.69   23.53      5.23
  18       5.17     24.15    146.75      392.72      416.88        8.69   23.53      5.23
  19       5.17     25.61    151.92      393.51      419.12        8.69   23.53      5.23
  20       5.17     27.07    157.08      394.30      421.38        8.69   23.53      5.23
  21       5.17     28.53    162.25      395.09      423.62        8.69   23.53      5.23
  22       5.17     29.99    167.42      395.88      425.88        8.69   23.53      5.23
  23       4.00     30.42    172.00      396.58      427.00        8.69    0.00      4.05
  24       4.00     29.80    176.00      397.20      427.00        8.69    0.00      4.05
  25       4.68     30.39    180.34      397.86      428.25        8.69   28.02      4.73
  26       4.68     32.16    185.02      398.57      430.74        8.69   28.02      4.73
  27       4.68     33.93    189.70      399.29      433.23        8.69   28.02      4.73
  28       4.68     35.71    194.37      400.01      435.72        8.69   28.02      4.73
  29       4.68     37.48    199.05      400.72      438.21        8.69   28.02      4.73
  30       4.68     39.26    203.73      401.44      440.70        8.69   28.02      4.73
  31       5.28     38.89    208.71      404.46      443.35       45.23   28.02      7.50
  32      5.28    36.38    213.99      409.78      446.16      45.23   28.02      7.50
  33      3.51    32.74    218.39      415.76      448.50      62.08   28.02      7.50
  34      3.51    27.98    221.90      422.38      450.37      62.08   28.02      7.50
  35      2.49    23.22    224.90      428.75      451.96      67.76   28.02      6.59
  36      3.18    17.79    227.74      435.69      453.48      67.76   28.02      8.41
  37      4.92    13.22    231.80      442.41      455.63      48.98   28.02      7.50
  38      4.92    10.19    236.72      448.07      458.25      48.98   28.02      7.50
  39      0.82     7.79    239.59      451.99      459.78      69.51   28.02      2.34
  40      2.58     3.45    241.29      456.55      460.00      69.51    0.00      7.38


 ***Table 2A - Coordinates of Slice Points Defining the Slip Surface***


 Point           X-Pt            Y-Pt
  No.            (ft)            (ft)

   1          71.297267       393.648634
   2          75.531512       392.097592
   3          79.765756       390.546550
   4          84.000000       388.995508
   5          84.696237       388.740470
   6          87.948087       388.014906
   7          91.199937       387.289341
   8          95.268090       386.381639
   9          99.336243       385.473938
  10         103.668121       386.136298
  11         108.000000       386.798659
  12         113.166667       387.588661
  13         118.333333       388.378664
  14         123.500000       389.168666
  15         128.666667       389.958668
  16         133.833333       390.748671
  17         139.000000       391.538673
  18         144.166667       392.328676
  19         149.333333       393.118678
  20         154.500000       393.908681
  21         159.666667       394.698683
  22           164.833333        395.488686
  23           170.000000        396.278688
  24           174.000000        396.890303
  25           178.000000        397.501918
  26           182.678223        398.217235
  27           187.356445        398.932553
  28           192.034668        399.647871
  29           196.712891        400.363188
  30           201.391113        401.078506
  31           206.069336        401.793823
  32           211.351608        407.118070
  33           216.633881        412.442317
  34           220.145225        419.069568
  35           223.656570        425.696820
  36           226.150332        431.794259
  37           229.334806        439.580538
  38           234.257473        445.238927
  39           239.180140        450.897315
  40           240.000000        453.090994
  41           242.582156        460.000000
↑


  ***Table 3 - Force and Pore Pressure Data On The   40 Slices (Excluding Reinforcement)***

                          Ubeta   Ubeta      Ualpha                           Earthquake
                          Force   Stress     Force      Pore                    Force        Distributed
 Slice       Weight        Top     Top        Bot     Pressure        -Uw    Horiz      Vert         Load
   No.       (lbs)        (lbs)   (psf)      (lbs)     (psf)         (psf)   (lbs)      (lbs)        (psf)
   1          931.9         0.0     0.0        0.0      0.00          0.00   205.0        0.0         0.00
   2         2795.7         0.0     0.0        0.0      0.00          0.00   615.1        0.0         0.00
   3         4659.6         0.0     0.0        0.0      0.00          0.00  1025.1        0.0         0.00
   4          930.1         0.0     0.0        0.0      0.00          0.00   204.6        0.0         0.00
   5         4535.3         0.0     0.0        0.0      0.00          0.00   997.8        0.0         0.00
   6         4818.4         0.0     0.0        0.0      0.00          0.00  1060.1        0.0         0.00
   7         6426.6         0.0     0.0        0.0      0.00          0.00  1413.9        0.0         0.00
   8         6869.7         0.0     0.0        0.0      0.00          0.00  1511.3        0.0         0.00
   9         7378.9         0.0     0.0        0.0      0.00          0.00  1623.3        0.0         0.00
  10         7034.5         0.0     0.0        0.0      0.00          0.00  1547.6        0.0         0.00
 11        8637.4       0.0     0.0        0.0       0.00         0.00  1900.2       0.0       0.00
 12        9542.6       0.0     0.0        0.0       0.00         0.00  2099.4       0.0       0.00
 13       10447.8       0.0     0.0        0.0       0.00         0.00  2298.5       0.0       0.00
 14       11353.0       0.0     0.0        0.0       0.00         0.00  2497.7       0.0       0.00
 15       12258.2       0.0     0.0        0.0       0.00         0.00  2696.8       0.0       0.00
 16       13163.4       0.0     0.0        0.0       0.00         0.00  2896.0       0.0       0.00
 17       14068.6       0.0     0.0        0.0       0.00         0.00  3095.1       0.0       0.00
 18       14973.8       0.0     0.0        0.0       0.00         0.00  3294.2       0.0       0.00
 19       15879.0       0.0     0.0        0.0       0.00         0.00  3493.4       0.0       0.00
 20       16784.2       0.0     0.0        0.0       0.00         0.00  3692.5       0.0       0.00
 21       17689.4       0.0     0.0        0.0       0.00         0.00  3891.7       0.0       0.00
 22       18594.6       0.0     0.0        0.0       0.00         0.00  4090.8       0.0       0.00
 23       14599.4       0.0     0.0        0.0       0.00         0.00  3211.9       0.0       0.00
 24       14305.9       0.0     0.0        0.0       0.00         0.00  3147.3       0.0       0.00
 25       17058.0       0.0     0.0        0.0       0.00         0.00  3752.8       0.0       0.00
 26       18054.3       0.0     0.0        0.0       0.00         0.00  3971.9       0.0       0.00
 27       19050.6       0.0     0.0        0.0       0.00         0.00  4191.1       0.0       0.00
 28       20046.9       0.0     0.0        0.0       0.00         0.00  4410.3       0.0       0.00
 29       21043.2       0.0     0.0        0.0       0.00         0.00  4629.5       0.0       0.00
 30       22039.5       0.0     0.0        0.0       0.00         0.00  4848.7       0.0       0.00
 31       24651.3       0.0     0.0        0.0       0.00         0.00  5423.3       0.0       0.00
 32       23058.5       0.0     0.0        0.0       0.00         0.00  5072.9       0.0       0.00
 33       13796.1       0.0     0.0        0.0       0.00         0.00  3035.1       0.0       0.00
 34       11791.1       0.0     0.0        0.0       0.00         0.00  2594.0       0.0       0.00
 35        6948.4       0.0     0.0        0.0       0.00         0.00  1528.6       0.0       0.00
 36        6797.6       0.0     0.0        0.0       0.00         0.00  1495.5       0.0       0.00
 37        7811.5       0.0     0.0        0.0       0.00         0.00  1718.5       0.0       0.00
 38        6016.7       0.0     0.0        0.0       0.00         0.00  1323.7       0.0       0.00
 39         766.2       0.0     0.0        0.0       0.00         0.00   168.6       0.0       0.00
 40        1070.4       0.0     0.0        0.0       0.00         0.00   235.5       0.0       0.00

         TOTAL WEIGHT OF SLIDING MASS =  458678.54(lbs)

         EFFECTIVE WEIGHT OF SLIDING MASS =  458678.54(lbs)

         TOTAL AREA OF SLIDING MASS =  3822.32(ft2)
```

```
***TABLE 4 - SOIL STRENGTH & SOIL OPTIONS DATA ON THE   40 SLICES***

Slice  Soil   Cohesion   Phi(Deg)   Options
 No.   Type     (psf)
  1      1     200.00     31.00
  2      1     200.00     31.00
  3      1     200.00     31.00
  4      1     200.00     31.00
  5      1     200.00     31.00
  6      1     200.00     31.00
  7      2     200.00     34.00     A
  8      2     200.00     34.00     A
  9      2     200.00     24.00     A
 10      2     200.00     24.00     A
 11      2     200.00     24.00     A
 12      2     200.00     24.00     A
 13      2     200.00     24.00     A
 14      2     200.00     24.00     A
 15      2     200.00     24.00     A
 16      2     200.00     24.00     A
 17      2     200.00     24.00     A
 18      2     200.00     24.00     A
 19      2     200.00     24.00     A
 20      2     200.00     24.00     A
 21      2     200.00     24.00     A
 22      2     200.00     24.00     A
 23      2     200.00     24.00     A
 24      2     200.00     24.00     A
 25      2     200.00     24.00     A
 26      2     200.00     24.00     A
 27      2     200.00     24.00     A
 28      2     200.00     24.00     A
 29      2     200.00     24.00     A
 30      2     200.00     24.00     A
 31      2     200.00     24.00     A
 32      2     200.00     24.00     A
 33      2     200.00     24.00     A
 34      2     200.00     24.00     A
 35      2     200.00     24.00     A
```

```
  36      1     200.00     31.00
  37      1     200.00     31.00
  38      1     200.00     31.00
  39      1     200.00     31.00
  40      1     200.00     31.00

  SOIL OPTIONS:
  A = ANISOTROPIC SHEAR STRENGTH
  C = CURVED STRENGTH ENVELOPE (TANGENT PHI & C)
  F = FIBER-REINFORCED SOIL (FRS)
  M = INDEPENDENT MULTI-STAGE SHEAR STRENGTH
  N = NONLINEAR UNDRAINED SHEAR STRENGTH
  R = RAPID DRAWDOWN OR RAPID LOADING (SEISMIC) SHEAR STRENGTH
  S = SHANSEP UNDRAINED SHEAR STRENGTH
  NOTE: Phi and C in Table 4 are modified values based on specified
  Soil Options (if any).

↑


         ***TABLE 5 - Total Base Stress Data on the   40 Slices***

 Slice   Alpha     X-Coord.      Base        Total          Total          Total
  No.    (deg)    Slice Cntr     Leng.    Normal Stress   Vert. Stress    Normal/Vert.
   *                 (ft)        (ft)         (psf)          (psf)        Stress Ratio

   1    -20.12      73.41        4.51          740.60         220.09          3.365
   2    -20.12      77.65        4.51         1633.00         660.27          2.473
   3    -20.12      81.88        4.51         2525.41        1100.45          2.295
   4    -20.12      84.35        0.74         3002.64        1335.84          2.248
   5    -12.58      86.32        3.33         2365.08        1394.68          1.696
   6    -12.58      89.57        3.33         2501.09        1481.75          1.688
   7    -12.58      93.23        4.17         2849.72        1579.74          1.804
   8    -12.58      97.30        4.17         3032.42        1688.67          1.796
   9      8.69     101.50        4.38         1646.40        1703.39          0.967
  10      8.69     105.83        4.38         1571.82        1623.90          0.968
  11      8.69     110.58        5.23         1616.73        1671.76          0.967
  12      8.69     115.75        5.23         1781.13        1846.96          0.964
  13      8.69     120.92        5.23         1945.53        2022.16          0.962
 14      8.69     126.08        5.23         2109.92         2197.36           0.960
 15      8.69     131.25        5.23         2274.32         2372.56           0.959
 16      8.69     136.42        5.23         2438.72         2547.76           0.957
 17      8.69     141.58        5.23         2603.12         2722.96           0.956
 18      8.69     146.75        5.23         2767.51         2898.16           0.955
 19      8.69     151.92        5.23         2931.91         3073.36           0.954
 20      8.69     157.08        5.23         3096.31         3248.56           0.953
 21      8.69     162.25        5.23         3260.71         3423.76           0.952
 22      8.69     167.42        5.23         3425.11         3598.96           0.952
 23      8.69     172.00        4.05         3472.87         3649.86           0.952
 24      8.69     176.00        4.05         3404.00         3576.47           0.952
 25      8.69     180.34        4.73         3469.49         3646.25           0.952
 26      8.69     185.02        4.73         3669.32         3859.22           0.951
 27      8.69     189.70        4.73         3869.15         4072.18           0.950
 28      8.69     194.37        4.73         4068.99         4285.15           0.950
 29      8.69     199.05        4.73         4268.82         4498.11           0.949
 30      8.69     203.73        4.73         4468.66         4711.07           0.949
 31     45.23     208.71        7.50         2504.01         4666.79           0.537
 32     45.23     213.99        7.50         2338.55         4365.27           0.536
 33     62.08     218.39        7.50         1409.74         3929.01           0.359
 34     62.08     221.90        7.50         1190.18         3358.01           0.354
 35     67.76     224.90        6.59          782.93         2786.30           0.281
 36     67.76     227.74        8.41          524.33         2134.62           0.246
 37     48.98     231.80        7.50          711.67         1586.84           0.448
 38     48.98     236.72        7.50          533.66         1222.25           0.437
 39     69.51     239.59        2.34          146.36          934.52           0.157
 40     69.51     241.29        7.38            2.47          414.54           0.006


        ***TABLE 5A - Total Base Force Data on the   40 Slices***

Slice   Alpha     X-Coord.      Base         Total            Total           Total
 No.    (deg)    Slice Cntr     Leng.     Normal Force    Vert. Force      Normal/Vert.
  *                 (ft)        (ft)          (lbs)           (lbs)        Force Ratio

  1    -20.12      73.41        4.51         3339.64          931.91           3.584
  2    -20.12      77.65        4.51         7363.85         2795.74           2.634
  3    -20.12      81.88        4.51        11388.05         4659.57           2.444
```

```
   4    -20.12      84.35        0.74         2226.39          930.06           2.394
   5    -12.58      86.32        3.33         7879.99         4535.28           1.737
   6    -12.58      89.57        3.33         8333.17         4818.41           1.729
   7    -12.58      93.23        4.17        11878.19         6426.63           1.848
   8    -12.58      97.30        4.17        12639.69         6869.75           1.840
   9      8.69     101.50        4.38         7214.92         7378.86           0.978
  10      8.69     105.83        4.38         6888.08         7034.55           0.979
  11      8.69     110.58        5.23         8450.18         8637.43           0.978
  12      8.69     115.75        5.23         9309.45         9542.63           0.976
  13      8.69     120.92        5.23        10168.71        10447.83           0.973
  14      8.69     126.08        5.23        11027.97        11353.03           0.971
  15      8.69     131.25        5.23        11887.23        12258.22           0.970
  16      8.69     136.42        5.23        12746.49        13163.42           0.968
  17      8.69     141.58        5.23        13605.75        14068.62           0.967
  18      8.69     146.75        5.23        14465.01        14973.82           0.966
  19      8.69     151.92        5.23        15324.27        15879.02           0.965
  20      8.69     157.08        5.23        16183.53        16784.22           0.964
  21      8.69     162.25        5.23        17042.79        17689.42           0.963
  22      8.69     167.42        5.23        17902.05        18594.61           0.963
  23      8.69     172.00        4.05        14052.93        14599.44           0.963
  24      8.69     176.00        4.05        13774.26        14305.87           0.963
  25      8.69     180.34        4.73        16419.66        17057.98           0.963
  26      8.69     185.02        4.73        17365.40        18054.27           0.962
  27      8.69     189.70        4.73        18311.13        19050.57           0.961
  28      8.69     194.37        4.73        19256.87        20046.87           0.961
  29      8.69     199.05        4.73        20202.60        21043.16           0.960
  30      8.69     203.73        4.73        21148.34        22039.46           0.960
  31     45.23     208.71        7.50        18780.07        24651.28           0.762
  32     45.23     213.99        7.50        17539.12        23058.54           0.761
  33     62.08     218.39        7.50        10573.09        13796.10           0.766
  34     62.08     221.90        7.50         8926.34        11791.13           0.757
  35     67.76     224.90        6.59         5157.72         6948.38           0.742
  36     67.76     227.74        8.41         4410.83         6797.64           0.649
  37     48.98     231.80        7.50         5337.50         7811.50           0.683
  38     48.98     236.72        7.50         4002.42         6016.74           0.665
  39     69.51     239.59        2.34          342.76          766.17           0.447
  40     69.51     241.29        7.38           18.25         1070.41           0.017
```

```
        ***TABLE 6 - Effective and Base Shear Stress Data on the   40 Slices***

 Slice    Alpha    X-Coord.      Base      Effective       Available        Mobilized
  No.     (deg)   Slice Cntr     Leng.   Normal Stress   Shear Strength   Shear Stress
   *                 (ft)        (ft)        (psf)           (psf)            (psf)

   1     -20.12     73.41        4.51        740.60          645.00          527.98
   2     -20.12     77.65        4.51       1633.00         1181.21          966.91
   3     -20.12     81.88        4.51       2525.41         1717.42         1405.84
   4     -20.12     84.35        0.74       3002.64         2004.17         1640.56
   5     -12.58     86.32        3.33       2365.08         1621.08         1326.98
   6     -12.58     89.57        3.33       2501.09         1702.81         1393.87
   7     -12.58     93.23        4.17       2849.72         2122.16         1737.15
   8     -12.58     97.30        4.17       3032.42         2245.39         1838.02
   9       8.69    101.50        4.38       1646.40          933.03          763.75
  10       8.69    105.83        4.38       1571.82          899.82          736.57
  11       8.69    110.58        5.23       1616.73          919.81          752.94
  12       8.69    115.75        5.23       1781.13          993.01          812.85
  13       8.69    120.92        5.23       1945.53         1066.20          872.77
  14       8.69    126.08        5.23       2109.92         1139.40          932.68
  15       8.69    131.25        5.23       2274.32         1212.59          992.60
  16       8.69    136.42        5.23       2438.72         1285.79         1052.51
  17       8.69    141.58        5.23       2603.12         1358.98         1112.43
  18       8.69    146.75        5.23       2767.51         1432.18         1172.34
  19       8.69    151.92        5.23       2931.91         1505.37         1232.26
  20       8.69    157.08        5.23       3096.31         1578.57         1292.17
  21       8.69    162.25        5.23       3260.71         1651.76         1352.09
  22       8.69    167.42        5.23       3425.11         1724.96         1412.00
  23       8.69    172.00        4.05       3472.87         1746.22         1429.41
  24       8.69    176.00        4.05       3404.00         1715.56         1404.31
  25       8.69    180.34        4.73       3469.49         1744.71         1428.18
  26       8.69    185.02        4.73       3669.32         1833.69         1501.01
  27       8.69    189.70        4.73       3869.15         1922.66         1573.84
  28       8.69    194.37        4.73       4068.99         2011.63         1646.67
  29       8.69    199.05        4.73       4268.82         2100.60         1719.50
  30       8.69    203.73        4.73       4468.66         2189.57         1792.33
  31      45.23    208.71        7.50       2504.01         1314.86         1076.31
  32      45.23    213.99        7.50       2338.55         1241.19         1016.00
```

```
   33      62.08     218.39       7.50         1409.74          827.66          677.50
   34      62.08     221.90       7.50         1190.18          729.90          597.48
   35      67.76     224.90       6.59          782.93          548.58          449.06
   36      67.76     227.74       8.41          524.33          515.05          421.61
   37      48.98     231.80       7.50          711.67          627.61          513.75
   38      48.98     236.72       7.50          533.66          520.65          426.19
   39      69.51     239.59       2.34          146.36          287.94          235.70
   40      69.51     241.29       7.38            2.47          201.49          164.93


          ***TABLE 6A - Effective and Base Shear Force Data on the   40 Slices***

  Slice    Alpha     X-Coord.     Base       Effective       Available         Mobilized
   No.     (deg)   Slice Cntr     Leng.     Normal Force    Shear Force       Shear Force
    *                 (ft)         (ft)        (lbs)           (lbs)             (lbs)

    1     -20.12      73.41       4.51         3339.64         2908.53         2380.85
    2     -20.12      77.65       4.51         7363.85         5326.52         4360.15
    3     -20.12      81.88       4.51        11388.05         7744.51         6339.45
    4     -20.12      84.35       0.74         2226.39         1486.05         1216.44
    5     -12.58      86.32       3.33         7879.99         5401.14         4421.23
    6     -12.58      89.57       3.33         8333.17         5673.44         4644.13
    7     -12.58      93.23       4.17        11878.19         8845.57         7240.75
    8     -12.58      97.30       4.17        12639.69         9359.22         7661.21
    9       8.69     101.50       4.38         7214.92         4088.73         3346.93
   10       8.69     105.83       4.38         6888.08         3943.21         3227.81
   11       8.69     110.58       5.23         8450.18         4807.61         3935.38
   12       8.69     115.75       5.23         9309.45         5190.18         4248.54
   13       8.69     120.92       5.23        10168.71         5572.74         4561.70
   14       8.69     126.08       5.23        11027.97         5955.31         4874.86
   15       8.69     131.25       5.23        11887.23         6337.88         5188.02
   16       8.69     136.42       5.23        12746.49         6720.45         5501.18
   17       8.69     141.58       5.23        13605.75         7103.01         5814.34
   18       8.69     146.75       5.23        14465.01         7485.58         6127.50
   19       8.69     151.92       5.23        15324.27         7868.15         6440.66
   20       8.69     157.08       5.23        16183.53         8250.72         6753.82
   21       8.69     162.25       5.23        17042.79         8633.28         7066.98
   22       8.69     167.42       5.23        17902.05         9015.85         7380.14
```

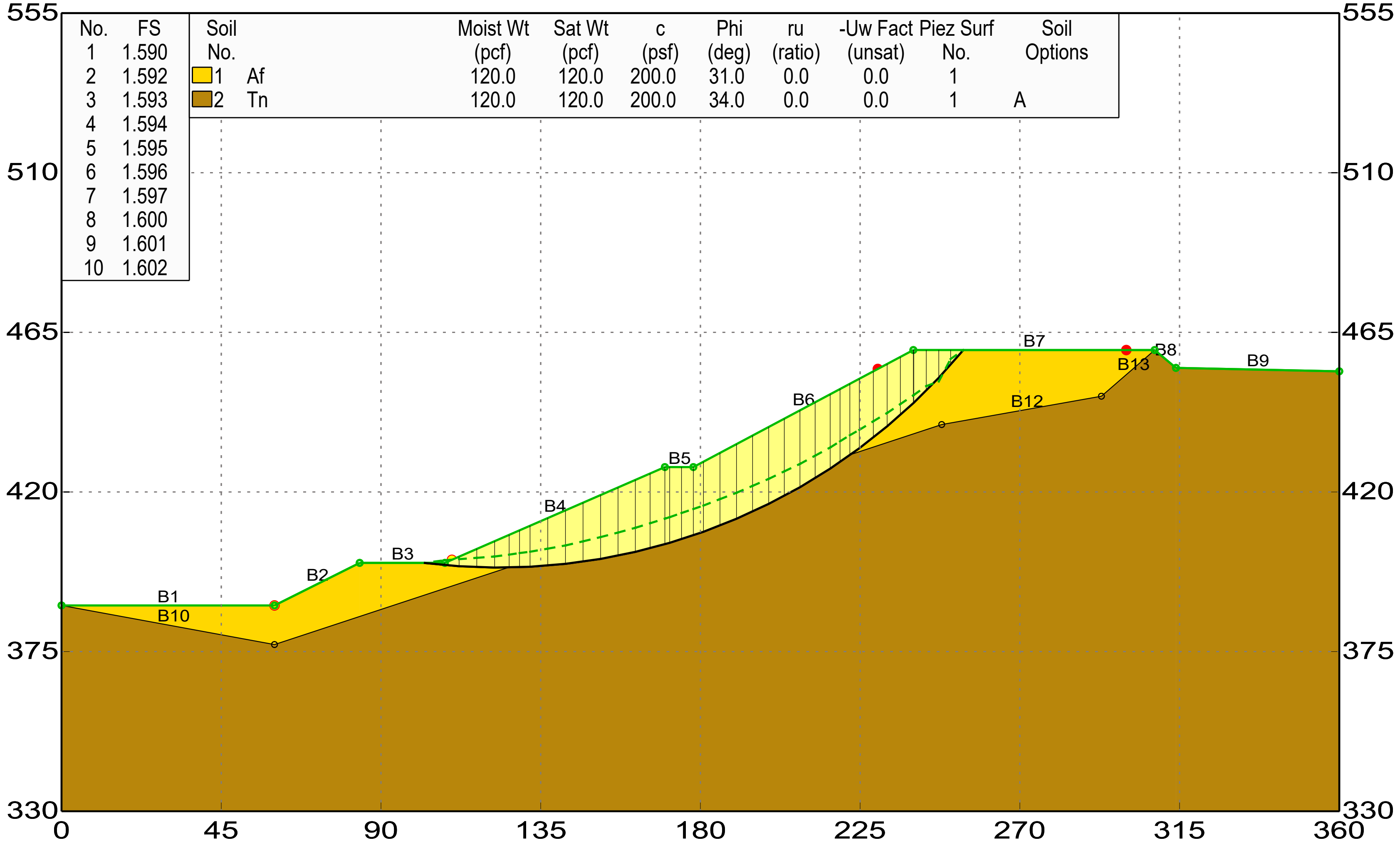
```
23       8.69     172.00       4.05        14052.93         7066.07          5784.10
24       8.69     176.00       4.05        13774.26         6941.99          5682.53
25       8.69     180.34       4.73        16419.66         8257.02          6758.98
26       8.69     185.02       4.73        17365.40         8678.09          7103.66
27       8.69     189.70       4.73        18311.13         9099.16          7448.33
28       8.69     194.37       4.73        19256.87         9520.23          7793.01
29       8.69     199.05       4.73        20202.60         9941.30          8137.68
30       8.69     203.73       4.73        21148.34        10362.37          8482.36
31      45.23     208.71       7.50        18780.07         9861.43          8072.30
32      45.23     213.99       7.50        17539.12         9308.92          7620.04
33      62.08     218.39       7.50        10573.09         6207.44          5081.25
34      62.08     221.90       7.50         8926.34         5474.26          4481.09
35      67.76     224.90       6.59         5157.72         3613.90          2958.24
36      67.76     227.74       8.41         4410.83         4332.76          3546.68
37      48.98     231.80       7.50         5337.50         4707.09          3853.10
38      48.98     236.72       7.50         4002.42         3904.90          3196.44
39      69.51     239.59       2.34          342.76          674.33           551.99
40      69.51     241.29       7.38           18.25         1486.12          1216.50

   Average Effective Normal Stress = 2188.2627(psf)
   Average Available Shear Strength = 1242.5299(psf)
   Total Length of Failure Surface = 206.9608(ft)


   INPUT PARAMETERS FOR SIMPLIFIED 3D ANALYSIS

        Composite Phi (deg)=  29.589
        3D Depth (Vertical difference between ends of Slip Surface) =   66.35(ft)
        L/D(1): L = 66.35(ft) L/D(2): L = 132.70(ft) L/D(3): L = 199.05(ft)
        L/D(4): L = 265.41(ft) L/D(5): L = 331.76(ft) L/D(6): L = 398.11(ft)

        Average Elevation of Point of Application of kh on Sliding Mass =  412.883(ft)

   SUM OF MOMENTS =  -0.740419E-01 (ft/lbs);Imbalance (Fraction of Total Weight) =  -0.1614244E-06
   SUM OF FORCES = 0.338929E-03 (lbs);Imbalance (Fraction of Total Weight) =    0.7389253E-09

   Sum of Available Shear Forces =  257155.05(lbs)

   Sum of Mobilized Shear Forces =  210500.36(lbs)
```

```
FS Balance Check: FS =  1.221637

                    **** END OF GEOSTASE OUTPUT ****
```

X-Section B-B' - Freedom Lane
Global Stability of Existing Slope

SA Geotechnical, Inc., RS

\02.gsd



No.	FS
1	1.590
2	1.592
3	1.593
4	1.594
5	1.595
6	1.596
7	1.597
8	1.600
9	1.601
10	1.602

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	-Uw Fact (unsat)	Piez Surf No.	Soil Options
1	Af	120.0	120.0	200.0	31.0	0.0	0.0	1	
2	Tn	120.0	120.0	200.0	34.0	0.0	0.0	1	A

GEOSTASE FS = 1.590

Spencer Method

GEOSTASE
Slope Stability
Analysis

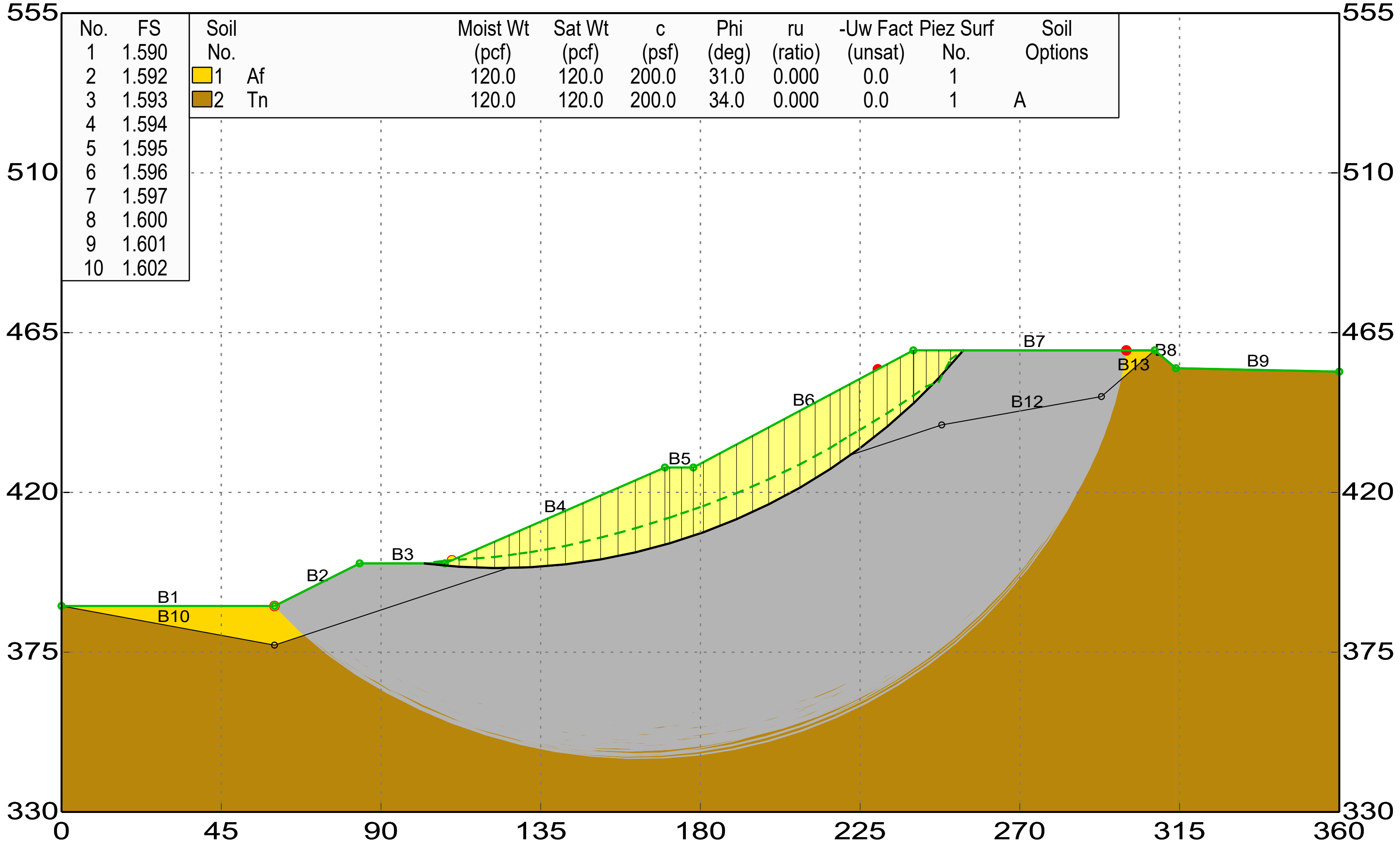
GEOSTASE® v4.30.32 by GREGORY GEOTECHNICAL SOFTWARE

PLATE C.1

X-Section B-B' - Freedom Lane
Global Stability of Existing Slope

SA Geotechnical, Inc., RS

\02.gsd



No.	FS
1	1.590
2	1.592
3	1.593
4	1.594
5	1.595
6	1.596
7	1.597
8	1.600
9	1.601
10	1.602

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	-Uw Fact (unsat)	Piez Surf No.	Soil Options
🟨 1	Af	120.0	120.0	200.0	31.0	0.000	0.0	1	
🟫 2	Tn	120.0	120.0	200.0	34.0	0.000	0.0	1	A

GEOSTASE FS = 1.590

Spencer Method

GEOSTASE
Slope Stability
Analysis

GEOSTASE® v4.30.32 by GREGORY GEOTECHNICAL SOFTWARE

```
                              ***  GEOSTASE(R)  ***

           ** GEOSTASE(R) (c)Copyright by Garry H. Gregory, Ph.D.,P.E.,S.E.,BC.GE **

                  ** Current Version 4.30.32-Double Precision, Sept 2023 **
                      (All Rights Reserved-Unauthorized Use Prohibited)


          *********************************************************************************
                         SLOPE STABILITY ANALYSIS SOFTWARE (2D & 3D)
              Simplified Bishop, Simplified Janbu, or General Equilibrium (GE) Options.
                 (Spencer, Morgenstern-Price, USACE, and Lowe & Karafiath)
                 Including Pier/Pile, Planar Reinf,  Nail, Tieback, Line Loads
                 Applied Forces, Fiber-Reinforced Soil (FRS), Distributed Loads
                 Nonlinear Undrained Shear Strength, Curved Strength Envelope,
                 Anisotropic Strengths, Water Surfaces, 3-Stage Rapid Drawdown
                 2- or 3-Stage Pseudo-Static & Simplified Newmark Seismic Analyses.
          *********************************************************************************


          Analysis Date:              6/  3/ 2024
          Analysis Time:
          Analysis By:               SA Geotechnical, Inc., RS


          Input File Name:           C:\Users\Reza Saberi\SA Geotechnical, Inc\SA Geotechnical -
Projects\2024\24064-01 Meritage - 400-700 Freedom Ln, Aliso Viejo\Engineering\Sted\B-B'\02.gsd

          Output File Name:          C:\Users\Reza Saberi\SA Geotechnical, Inc\SA Geotechnical -
Projects\2024\24064-01 Meritage - 400-700 Freedom Ln, Aliso Viejo\Engineering\Sted\B-B'\02.OUT

          Unit System:               English


          PROJECT: X-Section B-B' - Freedom Lane

          DESCRIPTION: Global Stability of Existing Slope
```

```
 PROFILE BOUNDARY DATA

     9 Surface Boundaries
    13 Total   Boundaries


 Boundary      X - 1       Y - 1       X - 2       Y - 2      Soil Type
    No.        (ft)        (ft)        (ft)        (ft)       Below Bnd

     1          0.000     388.000      60.000     388.000         1
     2         60.000     388.000      84.000     400.000         1
     3         84.000     400.000     108.000     400.000         1
     4        108.000     400.000     170.000     427.000         1
     5        170.000     427.000     178.000     427.000         1
     6        178.000     427.000     240.000     460.000         1
     7        240.000     460.000     308.000     460.000         1
     8        308.000     460.000     314.000     455.000         2
     9        314.000     455.000     360.000     454.000         2
    10          0.000     388.000      60.000     377.000         2
    11         60.000     377.000     248.000     439.000         2
    12        248.000     439.000     293.000     447.000         2
    13        293.000     447.000     308.000     460.000         2

 User Specified X-Origin =         0.000(ft)

 User Specified Y-Origin =       330.000(ft)

 SURFACE BOUNDARY POINT COORDINATES
(Information Only-Not Used Directly)
 Point No.       X-COORD             Y-COORD
   1               0.000             388.000
   2              60.000             388.000
   3              84.000             400.000
   4             108.000             400.000
   5             170.000             427.000
   6             178.000             427.000
   7             240.000             460.000
   8             308.000             460.000
   9             314.000             455.000
```

```
          10             360.000             454.000

        SUBSURFACE BOUNDARY POINT COORDINATES
         (Information Only-Not Used Directly)
        Point No.       X-COORD             Y-COORD
        Surface boundary point    1 and Subsurface boundary point   11 are duplicate points.
          11               0.000             388.000
          12              60.000             377.000
          13             248.000             439.000
          14             293.000             447.000
        Surface boundary point    8 and Subsurface boundary point   15 are duplicate points.
          15             308.000             460.000

     PROFILE BOUNDARY SLOPES AND ANGLES
        BND No.  Slope    Angle(Deg.)
           1      0.000     0.000
           2      0.500    26.565
           3      0.000     0.000
           4      0.435    23.532
           5      0.000     0.000
           6      0.532    28.025
           7      0.000     0.000
           8     -0.833   -39.806
           9     -0.022    -1.245
          10     -0.183   -10.389
          11      0.330    18.252
          12      0.178    10.081
          13      0.867    40.914


       MOHR-COULOMB SOIL PARAMETERS

         2 Type(s) of Soil Defined

     Soil Number           Moist  Saturated  Cohesion Friction   Pore      (-Uw)   Water   Water
         and              Unit Wt. Unit Wt. Intercept   Angle  Pressure    Fact.  Surface  Option
     Description           (pcf)    (pcf)     (psf)     (deg)  Ratio(ru)            No.

1 Af                       120.0    120.0     200.00    31.00    0.000      0.0      1       0
```

```
  2 Tn                       120.0   120.0    200.00   34.00   0.000     0.0      1      0


         ANISOTROPIC STRENGTH PARAMETERS

              1 soil type(s)

          Soil Type  2 Is Anisotropic

          Number Of Direction Ranges Specified =  3


          Direction    Counterclockwise     Cohesion     Friction
            Range       Direction Limit    Intercept       Angle
             No.            (deg)            (psf)         (deg)

              1              -5.0             200.00         34.00
              2               8.0             200.00         28.00
              3              90.0             200.00         24.00
↑


          TRIAL FAILURE SURFACE DATA

          Circular Trial Failure Surfaces Have Been Generated Using A Random Procedure.


↑
            3000 Trial Surfaces Have Been Generated.

            3000 Surfaces Generated at Increments of 0.2001(in) Equally Spaced Within the Start Range

          Along The Specified Surface Between  X =  60.00(ft)
                                          and  X = 110.00(ft)

          Each Surface ends within a Range Between   X = 230.00(ft)
                                                 and   X = 300.00(ft)

          All surfaces are generated left to right for both a left and right sliding slope.
```

```
Unless XCLUDE Lines Were Specified, The Minimum Elevation
To Which A Surface Extends Is  Y =     330.00(ft)


Specified Maximum Radius = 100000.000(ft)

10.000(ft) Line Segments Were Used For Each Trial Failure Surface.


The Spencer Method Was Selected for FS Analysis.

Selected fx function = Constant (1.0)

SELECTED CONVERGENCE PARAMETERS FOR SPENCER METHOD:
Initial estimate of FS =  1.500
FS tolerance =  0.000001000
Initial estimate of theta(deg) =  15.00
Theta tolerance(radians) =  0.0001000
Minimum theta(deg) = -45.00 ; Maximum theta(deg) =  45.00
Theta convergence Step Factor = 5000.00
Maximum number of iterations = 50
Allowable negative side force = -1000.0(lbs)
Maximum force imbalance  = 100.000000(lbs)
Maximum moment imbalance = 100.000000 (ft/lbs)

Selected Lambda Coefficient =  1.00

Specified Tension Crack Water Depth Factor =   0.000

Total Number of Trial Surfaces Attempted = 3000

WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
Did Not Converge in 50 Iterations.


Number of Trial Surfaces with Non-Converged FS = 22

Number of Trial Surfaces With Valid FS = 2978
```

```
Percentage of Trial Surfaces With Non-Converged and/or
Non-Valid FS Solutions of the Total Attempted =   0.7 %

Statistical Data On All Valid FS Values:
   FS Max =   3.586   FS Min =   1.590   FS Ave =   2.272
   Standard Deviation =    0.392   Coefficient of Variation =   17.25 %


Critical Surface is Sequence Number    2511 of Those Analyzed.


*****BEGINNING OF DETAILED GEOSTASE OUTPUT FOR CRITICAL SURFACE FROM A SEARCH*****

BACK-CALCULATED CIRCULAR SURFACE PARAMETERS:

Circle Center At X =    123.076892(ft) ; Y =    569.335713(ft); and Radius =    170.634476(ft)

Circular Trial Failure Surface Generated With 19 Coordinate Points

  Point      X-Coord.      Y-Coord.
   No.        (ft)          (ft)

    1       102.06402      400.00000
    2       112.01973      399.05987
    3       122.01342      398.70455
    4       132.01075      398.93527
    5       141.97741      399.75124
    6       151.87915      401.14964
    7       161.68197      403.12569
    8       171.35220      405.67258
    9       180.85662      408.78159
   10       190.16260      412.44202
   11       199.23817      416.64130
   12       208.05217      421.36502
   13       216.57431      426.59694
   14       224.77534      432.31911
   15       232.62708      438.51186
   16       240.10257      445.15393
   17        247.17613      452.22250
   18        253.82347      459.69330
   19        254.06571      460.00000


  Iter.     Theta         FS          FS
   No.      (deg)      (Moment)   (Force)
           (fx=1.0)                             Lambda        Delta FS

    1        15.0000    1.697190   1.569875     0.268      0.1273156E+00
    2        19.9500    1.573454   1.592315     0.363      0.1886023E-01
    3        19.3115    1.594540   1.589299     0.350      0.5241175E-02
    4        19.4504    1.590117   1.589952     0.353      0.1656185E-03
    5        19.4550    1.589971   1.589973     0.353      0.1493052E-05
    6        19.4549    1.589973   1.589973     0.353      0.3546542E-08


Factor Of Safety For The Preceding Specified Surface =  1.590
Theta (fx = 1.0) =  19.45 Deg    Lambda =   0.353


The Spencer Method Has Been Selected For Analysis.

Selected fx function = Constant (1.0)

SELECTED CONVERGENCE PARAMETERS FOR ANALYSIS METHOD:
Initial estimate of FS =  1.500
FS tolerance =  0.000001000
Initial estimate of theta(deg) =  15.00
Theta tolerance(radians) =  0.0001000
Minimum theta(deg) = -45.00 ; Maximum theta(deg) =  45.00
Theta convergence Step Factor = 5000.00
Maximum number of iterations = 50
Maximum force imbalance = 100.000000(lbs)
Maximum moment imbalance(if Applicable) = 100.000000 (ft/lbs)


Selected Lambda Coefficient =  1.00
```

```
Tension Crack Water Force =        0.00(lbs)

Specified Tension Crack Water Depth Factor =  0.000 (  0.00% Filled )

Depth of Tension Crack (zo) at Side of Last Slice =   0.000(ft)

Depth of Water in Tension Crack =   0.000(ft)

Theoretical Tension Crack Depth =   5.892(ft)


NOTE: In Table 1 following, when a tension crack with water is present on the
first slice (right facing slope) or on the last slice (left facing slope), the
"side force" in the tension crack is set equal to the water pressure resultant.


        *** Table 1 - Line of Thrust(if applicable) and Slice Force Data ***

Slice      X         Y               Side Force     fx    Force Angle  Vert. Shear
 No.     Coord.    Coord.    h/H        (lbs)                (Deg)      Force(lbs)

  1     105.03    400.38    1.000+     532.28     1.000       19.45         177.3
  2     108.00    400.73    1.000+    1127.27     1.000       19.45         375.5
  3     112.02    401.03    0.734     2298.27     1.000       19.45         765.5
  4     117.02    401.43    0.505     4302.21     1.000       19.45        1432.9
  5     122.01    401.82    0.422     7042.44     1.000       19.45        2345.6
  6     126.10    402.32    0.388     9381.26     1.000       19.45        3124.6
  7     129.06    402.75    0.377    11085.03     1.000       19.45        3692.0
  8     132.01    403.16    0.367    12947.80     1.000       19.45        4312.5
  9     136.99    404.04    0.354    15778.48     1.000       19.45        5255.3
 10     141.98    404.91    0.343    18910.00     1.000       19.45        6298.3
 11     146.93    406.10    0.342    20982.74     1.000       19.45        6988.6
 12     151.88    407.26    0.340    23184.09     1.000       19.45        7721.8
 13     156.78    408.59    0.338    24727.01     1.000       19.45        8235.7
 14     161.68    409.91    0.335    26324.47     1.000       19.45        8767.8
 15     165.84    411.19    0.332    27050.14     1.000       19.45        9009.5
 16     170.00    412.47    0.330    27781.73     1.000       19.45        9253.1
 17     171.35    412.89    0.338    28020.06     1.000       19.45        9332.5
 18     174.68    414.04    0.360    28089.43     1.000       19.45        9355.6
```

```
          19     178.00    415.19    0.384    28178.34     1.000        19.45        9385.2
          20     180.86    416.18    0.375    28258.62     1.000        19.45        9412.0
          21     185.51    417.97    0.361    27711.34     1.000        19.45        9229.7
          22     190.16    419.77    0.348    27126.35     1.000        19.45        9034.8
          23     194.70    421.72    0.336    25869.76     1.000        19.45        8616.3
          24     199.24    423.68    0.325    24585.28     1.000        19.45        8188.5
          25     203.65    425.79    0.314    22689.75     1.000        19.45        7557.2
          26     208.05    427.93    0.304    20796.09     1.000        19.45        6926.4
          27     212.31    430.22    0.293    18390.84     1.000        19.45        6125.3
          28     216.57    432.56    0.285    16034.43     1.000        19.45        5340.5
          29     219.35    434.26    0.280    14172.42     1.000        19.45        4720.3
          30     222.12    436.01    0.277    12360.71     1.000        19.45        4116.9
          31     224.78    437.49    0.264    11187.46     1.000        19.45        3726.2
          32     228.70    439.88    0.241     9063.36     1.000        19.45        3018.7
          33     232.63    442.28    0.215     7082.45     1.000        19.45        2358.9
          34     236.31    444.75    0.182     4991.48     1.000        19.45        1662.5
          35     240.00    447.25    0.146     3108.02     1.000        19.45        1035.2
          36     240.10    447.32    0.146     3058.70     1.000        19.45        1018.7
          37     243.64    449.84    0.102     1358.70     1.000        19.45         452.5
          38     247.18    451.13    0.000-     277.63     1.000        19.45          92.5
          39     250.50    457.51    0.383     -232.57     1.000        19.45         -77.5
          40     253.82    459.80    0.360      -44.59     1.000        19.45         -14.9
          41     254.07    460.00    0.000        0.00     1.000        19.45           0.0

         NOTE: A value of 0.000- for h/H indicates that the line of thrust is at or below
         the lower boundary of the sliding mass. A value of 1.000+ for h/H indicates that
         the line of thrust is at or above the upper boundary of the sliding mass.



              ***Table 2 - Geometry Data on the   41 Slices***


 Slice    Width    Height   X-Cntr    Y-Cntr-Base  Y-Cntr-Top    Alpha   Beta    Base Length
  No.      (ft)     (ft)     (ft)         (ft)         (ft)        (deg)   (deg)      (ft)

   1       2.97     0.14    103.55      399.86       400.00      -5.39    0.00       2.98
   2       2.97     0.42    106.52      399.58       400.00      -5.39    0.00       2.98
   3       4.02     1.63    110.01      399.25       400.88      -5.39   23.53       4.04
  4      5.00     3.87   114.52      398.97      402.84      -2.04   23.53      5.00
  5      5.00     6.22   119.51      398.79      405.01      -2.04   23.53      5.00
  6      4.09     8.24   124.06      398.75      406.99       1.32   23.53      4.09
  7      2.96     9.69   127.58      398.83      408.53       1.32   23.53      2.96
  8      2.96    10.91   130.53      398.90      409.81       1.32   23.53      2.96
  9      4.98    12.40   134.50      399.14      411.54       4.68   23.53      5.00
 10      4.98    14.16   139.49      399.55      413.71       4.68   23.53      5.00
 11      4.95    15.77   144.45      400.10      415.87       8.04   23.53      5.00
 12      4.95    17.23   149.40      400.80      418.03       8.04   23.53      5.00
 13      4.90    18.53   154.33      401.64      420.18      11.40   23.53      5.00
 14      4.90    19.68   159.23      402.63      422.31      11.40   23.53      5.00
 15      4.16    20.61   163.76      403.67      424.28      14.76   23.53      4.30
 16      4.16    21.33   167.92      404.77      426.09      14.76   23.53      4.30
 17      1.35    21.51   170.68      405.49      427.00      14.76    0.00      1.40
 18      3.32    20.78   173.01      406.22      427.00      18.11    0.00      3.50
 19      3.32    19.70   176.34      407.30      427.00      18.11    0.00      3.50
 20      2.86    19.45   179.43      408.31      427.76      18.11   28.02      3.01
 21      4.65    20.06   183.18      409.70      429.76      21.47   28.02      5.00
 22      4.65    20.71   187.84      411.53      432.24      21.47   28.02      5.00
 23      4.54    21.19   192.43      413.49      434.68      24.83   28.02      5.00
 24      4.54    21.51   196.97      415.59      437.10      24.83   28.02      5.00
 25      4.41    21.65   201.44      417.82      439.48      28.19   28.02      5.00
 26      4.41    21.64   205.85      420.18      441.82      28.19   28.02      5.00
 27      4.26    21.46   210.18      422.67      444.13      31.55   28.02      5.00
 28      4.26    21.11   214.44      425.29      446.40      31.55   28.02      5.00
 29      2.77    20.71   217.96      427.56      448.27      34.90   28.02      3.38
 30      2.77    20.25   220.73      429.50      449.74      34.90   28.02      3.38
 31      2.66    19.80   223.45      431.39      451.19      34.90   28.02      3.24
 32      3.93    19.07   226.74      433.87      452.94      38.26   28.02      5.00
 33      3.93    18.07   230.66      436.96      455.03      38.26   28.02      5.00
 34      3.69    16.91   234.47      440.15      457.06      41.62   28.02      4.93
 35      3.69    15.59   238.16      443.43      459.02      41.62   28.02      4.93
 36      0.10    14.89   240.05      445.11      460.00      41.62    0.00      0.14
 37      3.54    13.08   241.87      446.92      460.00      44.98    0.00      5.00
 38      3.54     9.54   245.41      450.46      460.00      44.98    0.00      5.00
 39      3.32     5.91   248.84      454.09      460.00      48.34    0.00      5.00
 40      3.32     2.17   252.16      457.83      460.00      48.34    0.00      5.00
 41      0.24     0.15   253.94      459.85      460.00      51.70    0.00      0.39
```

```
***Table 2A - Coordinates of Slice Points Defining the Slip Surface***


Point            X-Pt            Y-Pt
 No.             (ft)            (ft)

  1          102.064021        400.000000
  2          105.032011        399.719728
  3          108.000000        399.439457
  4          112.019731        399.059867
  5          117.016574        398.882209
  6          122.013416        398.704551
  7          126.099758        398.798856
  8          129.055256        398.867064
  9          132.010754        398.935271
 10          136.994082        399.343254
 11          141.977409        399.751236
 12          146.928279        400.450439
 13          151.879149        401.149642
 14          156.780558        402.137665
 15          161.681967        403.125687
 16          165.840984        404.221069
 17          170.000000        405.316450
 18          171.352196        405.672585
 19          174.676098        406.759870
 20          178.000000        407.847155
 21          180.856621        408.781587
 22          185.509611        410.611802
 23          190.162601        412.442016
 24          194.700387        414.541658
 25          199.238173        416.641300
 26          203.645170        419.003158
 27          208.052168        421.365017
 28          212.313240        423.980979
 29          216.574313        426.596942
 30          219.345430        428.530455
 31          222.116547        430.463968
 32          224.775339        432.319107
 33          228.701209        435.415483
 34          232.627079        438.511859
 35          236.313540        441.787327
 36          240.000000        445.062795
 37          240.102567        445.153928
 38          243.639347        448.688215
 39          247.176128        452.222502
 40          250.499797        455.957903
 41          253.823466        459.693304
 42          254.065711        460.000000


 ***Table 3 - Force and Pore Pressure Data On The   41 Slices (Excluding Reinforcement)***

                      Ubeta   Ubeta      Ualpha                             Earthquake
                      Force   Stress     Force      Pore                      Force        Distributed
Slice      Weight      Top      Top        Bot     Pressure       -Uw     Horiz     Vert       Load
  No.      (lbs)      (lbs)   (psf)      (lbs)      (psf)        (psf)   (lbs)     (lbs)      (psf)
  1          49.9       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
  2         149.7       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
  3         784.1       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
  4        2319.0       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
  5        3730.4       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
  6        4040.9       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
  7        3437.6       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
  8        3869.9       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
  9        7416.5       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 10        8470.2       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 11        9371.3       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 12       10236.8       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 13       10900.1       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 14       11574.4       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 15       10286.0       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 16       10643.2       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 17        3489.6       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 18        8290.0       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 19        7856.3       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 20        6665.9       0.0     0.0        0.0       0.00         0.00     0.0       0.0        0.00
 21       11201.8       0.0     0.0        0.0       0.00         0.00     0.0       0.0        0.00
 22       11562.7       0.0     0.0        0.0       0.00         0.00     0.0       0.0        0.00
 23       11538.4       0.0     0.0        0.0       0.00         0.00     0.0       0.0        0.00
 24       11710.3       0.0     0.0        0.0       0.00         0.00     0.0       0.0        0.00
 25       11451.9       0.0     0.0        0.0       0.00         0.00     0.0       0.0        0.00
 26       11443.3       0.0     0.0        0.0       0.00         0.00     0.0       0.0        0.00
 27       10971.3       0.0     0.0        0.0       0.00         0.00     0.0       0.0        0.00
 28       10793.4       0.0     0.0        0.0       0.00         0.00     0.0       0.0        0.00
 29        6885.2       0.0     0.0        0.0       0.00         0.00     0.0       0.0        0.00
 30        6732.7       0.0     0.0        0.0       0.00         0.00     0.0       0.0        0.00
 31        6316.5       0.0     0.0        0.0       0.00         0.00     0.0       0.0        0.00
 32        8985.9       0.0     0.0        0.0       0.00         0.00     0.0       0.0        0.00
 33        8511.6       0.0     0.0        0.0       0.00         0.00     0.0       0.0        0.00
 34        7479.3       0.0     0.0        0.0       0.00         0.00     0.0       0.0        0.00
 35        6898.3       0.0     0.0        0.0       0.00         0.00     0.0       0.0        0.00
 36         183.3       0.0     0.0        0.0       0.00         0.00     0.0       0.0        0.00
 37        5550.9       0.0     0.0        0.0       0.00         0.00     0.0       0.0        0.00
 38        4050.9       0.0     0.0        0.0       0.00         0.00     0.0       0.0        0.00
 39        2357.1       0.0     0.0        0.0       0.00         0.00     0.0       0.0        0.00
 40         867.2       0.0     0.0        0.0       0.00         0.00     0.0       0.0        0.00
 41           4.5       0.0     0.0        0.0       0.00         0.00     0.0       0.0        0.00

         TOTAL WEIGHT OF SLIDING MASS =  279078.37(lbs)

         EFFECTIVE WEIGHT OF SLIDING MASS =  279078.37(lbs)

         TOTAL AREA OF SLIDING MASS =  2325.65(ft2)
↑


***TABLE 4 - SOIL STRENGTH & SOIL OPTIONS DATA ON THE   41 SLICES***

Slice  Soil   Cohesion   Phi(Deg)   Options
 No.   Type     (psf)
  1      1     200.00     31.00
  2      1     200.00     31.00
  3      1     200.00     31.00
  4      1     200.00     31.00
 5      1     200.00     31.00
 6      1     200.00     31.00
 7      2     200.00     28.00     A
 8      2     200.00     28.00     A
 9      2     200.00     28.00     A
10      2     200.00     28.00     A
11      2     200.00     24.00     A
12      2     200.00     24.00     A
13      2     200.00     24.00     A
14      2     200.00     24.00     A
15      2     200.00     24.00     A
16      2     200.00     24.00     A
17      2     200.00     24.00     A
18      2     200.00     24.00     A
19      2     200.00     24.00     A
20      2     200.00     24.00     A
21      2     200.00     24.00     A
22      2     200.00     24.00     A
23      2     200.00     24.00     A
24      2     200.00     24.00     A
25      2     200.00     24.00     A
26      2     200.00     24.00     A
27      2     200.00     24.00     A
28      2     200.00     24.00     A
29      2     200.00     24.00     A
30      2     200.00     24.00     A
31      1     200.00     31.00
32      1     200.00     31.00
33      1     200.00     31.00
34      1     200.00     31.00
35      1     200.00     31.00
36      1     200.00     31.00
37      1     200.00     31.00
38      1     200.00     31.00
39      1     200.00     31.00
40      1     200.00     31.00
41      1     200.00     31.00

SOIL OPTIONS:
  A = ANISOTROPIC SHEAR STRENGTH
  C = CURVED STRENGTH ENVELOPE (TANGENT PHI & C)
  F = FIBER-REINFORCED SOIL (FRS)
  M = INDEPENDENT MULTI-STAGE SHEAR STRENGTH
  N = NONLINEAR UNDRAINED SHEAR STRENGTH
  R = RAPID DRAWDOWN OR RAPID LOADING (SEISMIC) SHEAR STRENGTH
  S = SHANSEP UNDRAINED SHEAR STRENGTH
  NOTE: Phi and C in Table 4 are modified values based on specified
  Soil Options (if any).

↑


         ***TABLE 5 - Total Base Stress Data on the   41 Slices***

 Slice   Alpha     X-Coord.       Base         Total            Total          Total
  No.    (deg)     Slice Cntr     Leng.     Normal Stress    Vert. Stress     Normal/Vert.
   *                  (ft)        (ft)         (psf)            (psf)         Stress Ratio

   1     -5.39     103.55         2.98           91.70            16.82           5.453
   2     -5.39     106.52         2.98          133.87            50.45           2.654
   3     -5.39     110.01         4.04          315.23           195.07           1.616
   4     -2.04     114.52         5.00          610.35           464.10           1.315
   5     -2.04     119.51         5.00          946.38           746.55           1.268
   6      1.32     124.06         4.09         1166.44           988.88           1.180
   7      1.32     127.58         2.96         1341.87          1163.13           1.154
   8      1.32     130.53         2.96         1504.80          1309.39           1.149
   9      4.68     134.50         5.00         1622.72          1488.25           1.090
  10      4.68     139.49         5.00         1848.12          1699.71           1.087
  11      8.04     144.45         5.00         1937.89          1892.85           1.024
  12      8.04     149.40         5.00         2114.38          2067.67           1.023
  13     11.40     154.33         5.00         2180.29          2223.87           0.980
  14     11.40     159.23         5.00         2314.02          2361.45           0.980
  15     14.76     163.76         4.30         2326.58          2473.18           0.941
  16     14.76     167.92         4.30         2407.02          2559.08           0.941
  17     14.76     170.68         1.40         2427.22          2580.66           0.941
  18     18.11     173.01         3.50         2253.44          2494.05           0.904
  19     18.11     176.34         3.50         2135.71          2363.58           0.904
  20     18.11     179.43         3.01         2108.57          2333.50           0.904
 21     21.47     183.18        5.00         2088.73         2407.45           0.868
 22     21.47     187.84        5.00         2156.17         2485.01           0.868
 23     24.83     192.43        5.00         2117.89         2542.73           0.833
 24     24.83     196.97        5.00         2149.61         2580.61           0.833
 25     28.19     201.44        5.00         2076.30         2598.57           0.799
 26     28.19     205.85        5.00         2074.74         2596.63           0.799
 27     31.55     210.18        5.00         1970.75         2574.78           0.765
 28     31.55     214.44        5.00         1938.38         2533.02           0.765
 29     34.90     217.96        3.38         1817.88         2484.63           0.732
 30     34.90     220.73        3.38         1776.91         2429.60           0.731
 31     34.90     223.45        3.24         1694.22         2375.69           0.713
 32     38.26     226.74        5.00         1548.06         2288.89           0.676
 33     38.26     230.66        5.00         1464.34         2168.07           0.675
 34     41.62     234.47        4.93         1293.77         2028.86           0.638
 35     41.62     238.16        4.93         1189.82         1871.26           0.636
 36     41.62     240.05        0.14         1134.24         1787.00           0.635
 37     44.98     241.87        5.00          931.80         1569.47           0.594
 38     44.98     245.41        5.00          666.25         1145.36           0.582
 39     48.34     248.84        5.00          362.65          709.18           0.511
 40     48.34     252.16        5.00           97.14          260.93           0.372
 41     51.70     253.94        0.39          -53.80           18.40          -2.924
↑

        ***TABLE 5A - Total Base Force Data on the   41 Slices***

Slice   Alpha     X-Coord.      Base         Total            Total            Total
 No.    (deg)    Slice Cntr     Leng.     Normal Force    Vert. Force      Normal/Vert.
  *                  (ft)       (ft)         (lbs)           (lbs)         Force Ratio

  1     -5.39     103.55        2.98          273.37           49.91           5.477
  2     -5.39     106.52        2.98          399.10          149.73           2.665
  3     -5.39     110.01        4.04         1272.76          784.14           1.623
  4     -2.04     114.52        5.00         3051.73         2319.04           1.316
  5     -2.04     119.51        5.00         4731.92         3730.37           1.268
  6      1.32     124.06        4.09         4767.73         4040.91           1.180
  7      1.32     127.58        2.96         3966.96         3437.62           1.154
  8      1.32     130.53        2.96         4448.61         3869.90           1.150
  9      4.68     134.50        5.00         8113.59         7416.45           1.094
  10      4.68     139.49        5.00         9240.58         8470.23           1.091
  11      8.04     144.45        5.00         9689.46         9371.28           1.034
  12      8.04     149.40        5.00        10571.92        10236.78           1.033
  13     11.40     154.33        5.00        10901.45        10900.10           1.000
  14     11.40     159.23        5.00        11570.11        11574.41           1.000
  15     14.76     163.76        4.30        10006.26        10286.00           0.973
  16     14.76     167.92        4.30        10352.20        10643.25           0.973
  17     14.76     170.68        1.40         3394.01         3489.55           0.973
  18     18.11     173.01        3.50         7880.78         8289.99           0.951
  19     18.11     176.34        3.50         7469.05         7856.30           0.951
  20     18.11     179.43        3.01         6337.47         6665.93           0.951
  21     21.47     183.18        5.00        10443.66        11201.83           0.932
  22     21.47     187.84        5.00        10780.85        11562.74           0.932
  23     24.83     192.43        5.00        10589.45        11538.38           0.918
  24     24.83     196.97        5.00        10748.05        11710.25           0.918
  25     28.19     201.44        5.00        10381.52        11451.91           0.907
  26     28.19     205.85        5.00        10373.69        11443.35           0.907
  27     31.55     210.18        5.00         9853.77        10971.33           0.898
  28     31.55     214.44        5.00         9691.91        10793.40           0.898
  29     34.90     217.96        3.38         6142.61         6885.21           0.892
  30     34.90     220.73        3.38         6004.15         6732.72           0.892
  31     34.90     223.45        3.24         5492.71         6316.47           0.870
  32     38.26     226.74        5.00         7740.29         8985.87           0.861
  33     38.26     230.66        5.00         7321.71         8511.56           0.860
  34     41.62     234.47        4.93         6380.08         7479.32           0.853
  35     41.62     238.16        4.93         5867.48         6898.34           0.851
  36     41.62     240.05        0.14          155.62          183.29           0.849
  37     44.98     241.87        5.00         4658.98         5550.88           0.839
  38     44.98     245.41        5.00         3331.25         4050.88           0.822
  39     48.34     248.84        5.00         1813.26         2357.07           0.769
  40     48.34     252.16        5.00          485.69          867.24           0.560
  41     51.70     253.94        0.39          -21.03            4.46          -4.717
↑


         ***TABLE 6 - Effective and Base Shear Stress Data on the   41 Slices***

 Slice    Alpha     X-Coord.     Base       Effective       Available         Mobilized
  No.     (deg)   Slice Cntr     Leng.    Normal Stress   Shear Strength    Shear Stress
 *               (ft)        (ft)        (psf)          (psf)          (psf)

 1     -5.39   103.55      2.98          91.70         255.10         160.44
 2     -5.39   106.52      2.98         133.87         280.44         176.38
 3     -5.39   110.01      4.04         315.23         389.41         244.91
 4     -2.04   114.52      5.00         610.35         566.73         356.44
 5     -2.04   119.51      5.00         946.38         768.64         483.43
 6      1.32   124.06      4.09        1166.44         900.87         566.59
 7      1.32   127.58      2.96        1341.87         913.49         574.53
 8      1.32   130.53      2.96        1504.80        1000.11         629.01
 9      4.68   134.50      5.00        1622.72        1062.81         668.45
10      4.68   139.49      5.00        1848.12        1182.66         743.82
11      8.04   144.45      5.00        1937.89        1062.81         668.44
12      8.04   149.40      5.00        2114.38        1141.38         717.86
13     11.40   154.33      5.00        2180.29        1170.73         736.32
14     11.40   159.23      5.00        2314.02        1230.27         773.77
15     14.76   163.76      4.30        2326.58        1235.86         777.28
16     14.76   167.92      4.30        2407.02        1271.67         799.81
17     14.76   170.68      1.40        2427.22        1280.67         805.47
18     18.11   173.01      3.50        2253.44        1203.30         756.80
19     18.11   176.34      3.50        2135.71        1150.88         723.84
20     18.11   179.43      3.01        2108.57        1138.80         716.24
21     21.47   183.18      5.00        2088.73        1129.96         710.68
22     21.47   187.84      5.00        2156.17        1159.99         729.57
23     24.83   192.43      5.00        2117.89        1142.95         718.85
24     24.83   196.97      5.00        2149.61        1157.07         727.73
25     28.19   201.44      5.00        2076.30        1124.43         707.20
26     28.19   205.85      5.00        2074.74        1123.73         706.76
27     31.55   210.18      5.00        1970.75        1077.44         677.64
28     31.55   214.44      5.00        1938.38        1063.02         668.58
29     34.90   217.96      3.38        1817.88        1009.37         634.84
30     34.90   220.73      3.38        1776.91         991.13         623.36
31     34.90   223.45      3.24        1694.22        1217.99         766.05
32     38.26   226.74      5.00        1548.06        1130.17         710.81
33     38.26   230.66      5.00        1464.34        1079.87         679.17
34     41.62   234.47      4.93        1293.77         977.37         614.71
35     41.62   238.16      4.93        1189.82         914.92         575.43
36     41.62   240.05      0.14        1134.24         881.52         554.42
37     44.98   241.87      5.00         931.80         759.88         477.92
```

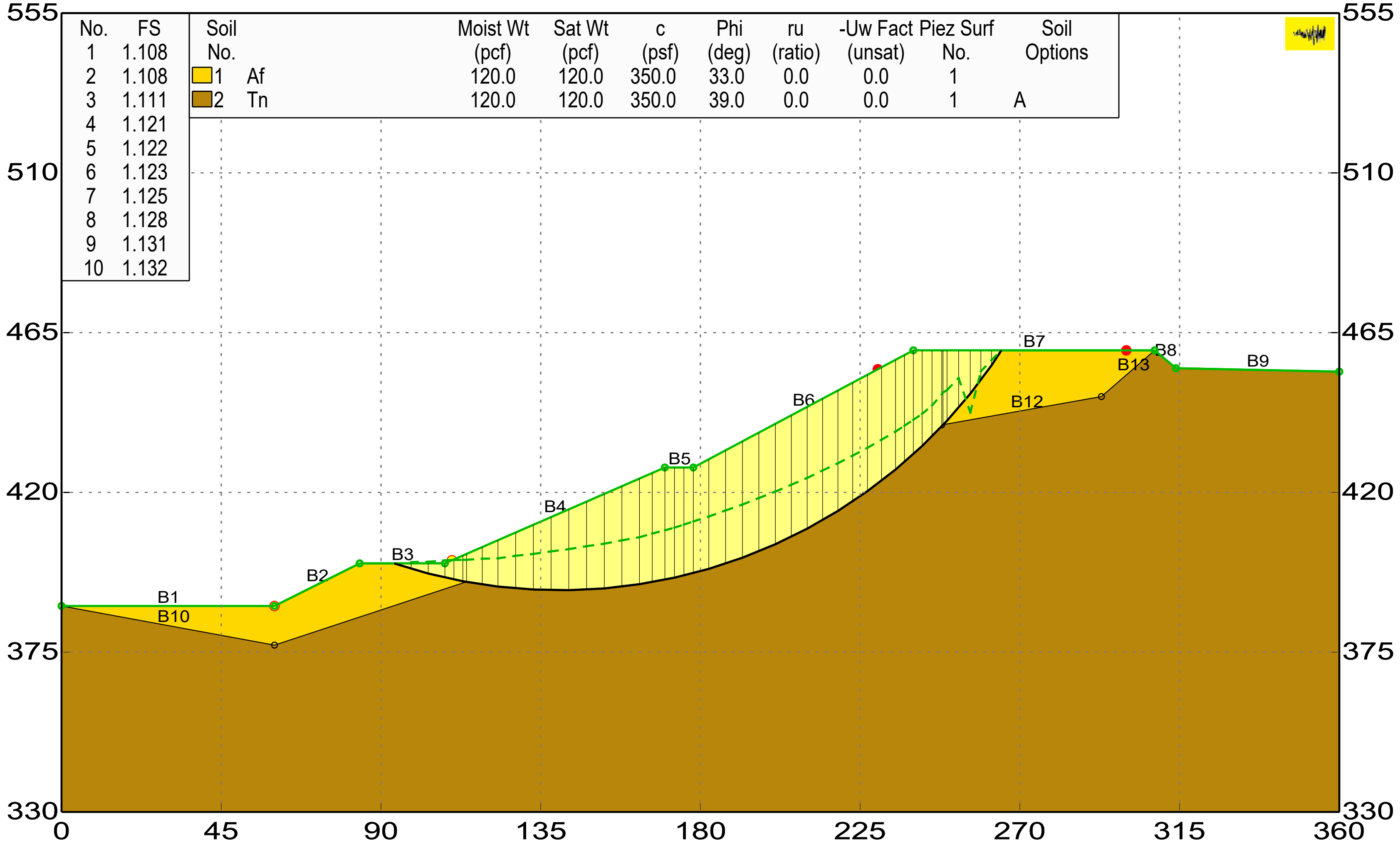
```
 38      44.98     245.41       5.00          666.25          600.32          377.57
 39      48.34     248.84       5.00          362.65          417.90          262.84
 40      48.34     252.16       5.00           97.14          258.37          162.50
 41      51.70     253.94       0.39          -53.80          167.67          105.46


        ***TABLE 6A - Effective and Base Shear Force Data on the   41 Slices***

Slice    Alpha     X-Coord.     Base       Effective       Available         Mobilized
 No.     (deg)   Slice Cntr     Leng.     Normal Force    Shear Force       Shear Force
  *                 (ft)         (ft)        (lbs)           (lbs)             (lbs)

  1      -5.39     103.55       2.98          273.37          760.50          478.31
  2      -5.39     106.52       2.98          399.10          836.04          525.82
  3      -5.39     110.01       4.04         1272.76         1572.28          988.87
  4      -2.04     114.52       5.00         3051.73         2833.67         1782.21
  5      -2.04     119.51       5.00         4731.92         3843.22         2417.16
  6       1.32     124.06       4.09         4767.73         3682.22         2315.90
  7       1.32     127.58       2.96         3966.96         2700.53         1698.47
  8       1.32     130.53       2.96         4448.61         2956.62         1859.54
  9       4.68     134.50       5.00         8113.59         5314.07         3342.24
 10       4.68     139.49       5.00         9240.58         5913.30         3719.12
 11       8.04     144.45       5.00         9689.46         5314.03         3342.21
 12       8.04     149.40       5.00        10571.92         5706.92         3589.32
 13      11.40     154.33       5.00        10901.45         5853.64         3681.60
 14      11.40     159.23       5.00        11570.11         6151.34         3868.84
 15      14.76     163.76       4.30        10006.26         5315.24         3342.98
 16      14.76     167.92       4.30        10352.20         5469.27         3439.85
 17      14.76     170.68       1.40         3394.01         1790.77         1126.29
 18      18.11     173.01       3.50         7880.78         4208.19         2646.71
 19      18.11     176.34       3.50         7469.05         4024.88         2531.41
 20      18.11     179.43       3.01         6337.47         3422.74         2152.70
 21      21.47     183.18       5.00        10443.66         5649.82         3553.40
 22      21.47     187.84       5.00        10780.85         5799.94         3647.83
 23      24.83     192.43       5.00        10589.45         5714.73         3594.23
 24      24.83     196.97       5.00        10748.05         5785.34         3638.64
 25      28.19     201.44       5.00        10381.52         5622.15         3536.00
 26      28.19     205.85       5.00        10373.69         5618.66         3533.81
```

```
27      31.55     210.18       5.00         9853.77         5387.18         3388.22
28      31.55     214.44       5.00         9691.91         5315.11         3342.90
29      34.90     217.96       3.38         6142.61         3410.66         2145.11
30      34.90     220.73       3.38         6004.15         3349.02         2106.34
31      34.90     223.45       3.24         5492.71         3948.75         2483.54
32      38.26     226.74       5.00         7740.29         5650.83         3554.04
33      38.26     230.66       5.00         7321.71         5399.33         3395.86
34      41.62     234.47       4.93         6380.08         4819.82         3031.39
35      41.62     238.16       4.93         5867.48         4511.82         2837.67
36      41.62     240.05       0.14          155.62          120.95           76.07
37      44.98     241.87       5.00         4658.98         3799.40         2389.60
38      44.98     245.41       5.00         3331.25         3001.61         1887.84
39      48.34     248.84       5.00         1813.26         2089.52         1314.18
40      48.34     252.16       5.00          485.69         1291.83          812.49
41      51.70     253.94       0.39          -21.03           65.53           41.22

   Average Effective Normal Stress = 1565.0769(psf)
   Average Available Shear Strength = 962.6192(psf)
   Total Length of Failure Surface = 170.3908(ft)


   INPUT PARAMETERS FOR SIMPLIFIED 3D ANALYSIS

        Composite Phi (deg)=  31.594
        3D Depth (Vertical difference between ends of Slip Surface) =   60.00(ft)
        L/D(1): L = 60.00(ft) L/D(2): L = 120.00(ft) L/D(3): L = 180.00(ft)
        L/D(4): L = 240.00(ft) L/D(5): L = 300.00(ft) L/D(6): L = 360.00(ft)

   SUM OF MOMENTS =  -0.217357E-03 (ft/lbs);Imbalance (Fraction of Total Weight) =  -0.7788389E-09
   SUM OF FORCES = -.431746E-07 (lbs);Imbalance (Fraction of Total Weight) =   -0.1547042E-12

   Sum of Available Shear Forces =  164021.48(lbs)

   Sum of Mobilized Shear Forces =  103159.93(lbs)

   FS Balance Check: FS =  1.589973

                       **** END OF GEOSTASE OUTPUT ****
```

X-Section B-B' - Freedom Lane
Global Stability of Existing Slope - Pseudo Static

SA Geotechnical, Inc., RS

\02p.gsd



No.	FS
1	1.108
2	1.108
3	1.111
4	1.121
5	1.122
6	1.123
7	1.125
8	1.128
9	1.131
10	1.132

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	-Uw Fact (unsat)	Piez Surf No.	Soil Options
🟨1	Af	120.0	120.0	350.0	33.0	0.0	0.0	1	
🟫2	Tn	120.0	120.0	350.0	39.0	0.0	0.0	1	A

GEOSTASE FS = 1.108

Spencer Method

kh = 0.22000

GEOSTASE
Slope Stability
Analysis

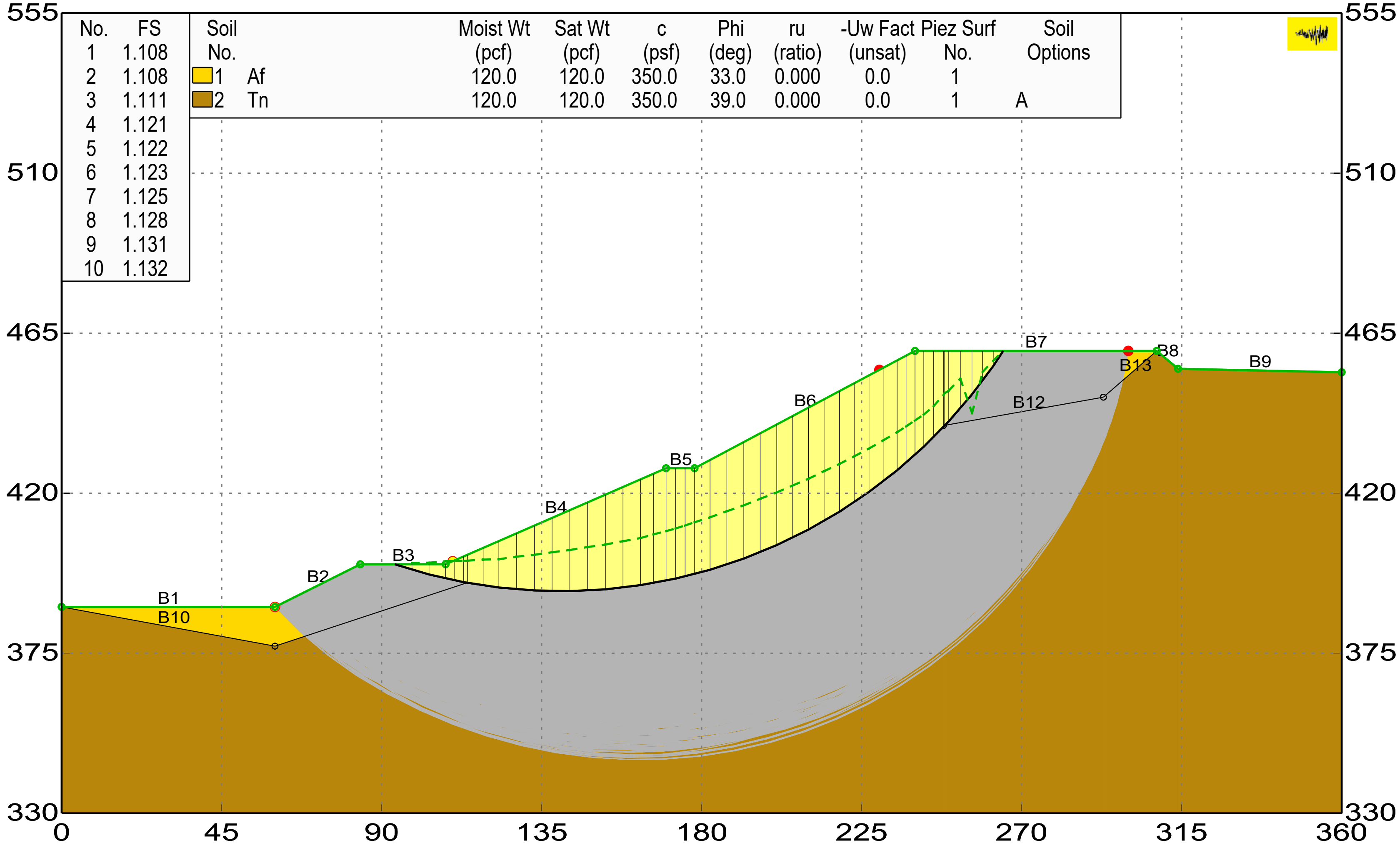
GEOSTASE® v4.30.32 by GREGORY GEOTECHNICAL SOFTWARE

PLATE C.1

X-Section B-B' - Freedom Lane
Global Stability of Existing Slope - Pseudo Static

SA Geotechnical, Inc., RS

\02p.gsd



No.	FS
1	1.108
2	1.108
3	1.111
4	1.121
5	1.122
6	1.123
7	1.125
8	1.128
9	1.131
10	1.132

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	-Uw Fact (unsat)	Piez Surf No.	Soil Options
1	Af	120.0	120.0	350.0	33.0	0.000	0.0	1	
2	Tn	120.0	120.0	350.0	39.0	0.000	0.0	1	A

GEOSTASE FS = 1.108

Spencer Method

kh = 0.22000

GEOSTASE® v4.30.32 by GREGORY GEOTECHNICAL SOFTWARE

```
                              ***  GEOSTASE(R)  ***

           ** GEOSTASE(R) (c)Copyright by Garry H. Gregory, Ph.D.,P.E.,S.E.,BC.GE **

                  ** Current Version 4.30.32-Double Precision, Sept 2023 **
                      (All Rights Reserved-Unauthorized Use Prohibited)


          *********************************************************************************
                         SLOPE STABILITY ANALYSIS SOFTWARE (2D & 3D)
              Simplified Bishop, Simplified Janbu, or General Equilibrium (GE) Options.
                 (Spencer, Morgenstern-Price, USACE, and Lowe & Karafiath)
                 Including Pier/Pile, Planar Reinf,  Nail, Tieback, Line Loads
                 Applied Forces, Fiber-Reinforced Soil (FRS), Distributed Loads
                 Nonlinear Undrained Shear Strength, Curved Strength Envelope,
                 Anisotropic Strengths, Water Surfaces, 3-Stage Rapid Drawdown
                 2- or 3-Stage Pseudo-Static & Simplified Newmark Seismic Analyses.
          *********************************************************************************


          Analysis Date:              6/  3/ 2024
          Analysis Time:
          Analysis By:               SA Geotechnical, Inc., RS


          Input File Name:           C:\Users\Reza Saberi\SA Geotechnical, Inc\SA Geotechnical -
Projects\2024\24064-01 Meritage - 400-700 Freedom Ln, Aliso Viejo\Engineering\Sted\B-B'\02p.gsd

          Output File Name:          C:\Users\Reza Saberi\SA Geotechnical, Inc\SA Geotechnical -
Projects\2024\24064-01 Meritage - 400-700 Freedom Ln, Aliso Viejo\Engineering\Sted\B-B'\02p.OUT

          Unit System:               English


          PROJECT: X-Section B-B' - Freedom Lane

          DESCRIPTION: Global Stability of Existing Slope - Pseudo Static
```

```
 PROFILE BOUNDARY DATA

     9 Surface Boundaries
    13 Total   Boundaries


 Boundary      X - 1       Y - 1       X - 2       Y - 2      Soil Type
    No.        (ft)        (ft)        (ft)        (ft)       Below Bnd

     1          0.000     388.000      60.000     388.000        1
     2         60.000     388.000      84.000     400.000        1
     3         84.000     400.000     108.000     400.000        1
     4        108.000     400.000     170.000     427.000        1
     5        170.000     427.000     178.000     427.000        1
     6        178.000     427.000     240.000     460.000        1
     7        240.000     460.000     308.000     460.000        1
     8        308.000     460.000     314.000     455.000        2
     9        314.000     455.000     360.000     454.000        2
    10          0.000     388.000      60.000     377.000        2
    11         60.000     377.000     248.000     439.000        2
    12        248.000     439.000     293.000     447.000        2
    13        293.000     447.000     308.000     460.000        2

 User Specified X-Origin =         0.000(ft)

 User Specified Y-Origin =       330.000(ft)

 SURFACE BOUNDARY POINT COORDINATES
(Information Only-Not Used Directly)
 Point No.       X-COORD             Y-COORD
    1               0.000             388.000
    2              60.000             388.000
    3              84.000             400.000
    4             108.000             400.000
    5             170.000             427.000
    6             178.000             427.000
    7             240.000             460.000
    8             308.000             460.000
    9             314.000             455.000
```

```
          10             360.000             454.000

        SUBSURFACE BOUNDARY POINT COORDINATES
         (Information Only-Not Used Directly)
        Point No.       X-COORD             Y-COORD
        Surface boundary point    1 and Subsurface boundary point   11 are duplicate points.
          11               0.000             388.000
          12              60.000             377.000
          13             248.000             439.000
          14             293.000             447.000
        Surface boundary point    8 and Subsurface boundary point   15 are duplicate points.
          15             308.000             460.000

     PROFILE BOUNDARY SLOPES AND ANGLES
        BND No.  Slope    Angle(Deg.)
           1      0.000     0.000
           2      0.500    26.565
           3      0.000     0.000
           4      0.435    23.532
           5      0.000     0.000
           6      0.532    28.025
           7      0.000     0.000
           8     -0.833   -39.806
           9     -0.022    -1.245
          10     -0.183   -10.389
          11      0.330    18.252
          12      0.178    10.081
          13      0.867    40.914


       MOHR-COULOMB SOIL PARAMETERS

         2 Type(s) of Soil Defined

     Soil Number           Moist  Saturated  Cohesion Friction   Pore      (-Uw)   Water   Water
         and              Unit Wt. Unit Wt. Intercept   Angle  Pressure    Fact.  Surface  Option
     Description           (pcf)    (pcf)     (psf)     (deg)  Ratio(ru)           No.

1 Af                       120.0    120.0     350.00    33.00    0.000      0.0      1       0
```

```
   2 Tn                         120.0    120.0     350.00    39.00    0.000      0.0      1       0

          ANISOTROPIC STRENGTH PARAMETERS

               1 soil type(s)

           Soil Type  2 Is Anisotropic

           Number Of Direction Ranges Specified =  3


           Direction    Counterclockwise     Cohesion     Friction
             Range       Direction Limit    Intercept       Angle
              No.            (deg)            (psf)         (deg)

               1              -5.0             200.00         34.00
               2               8.0             200.00         28.00
               3              90.0             200.00         24.00

          SEISMIC (EARTHQUAKE) DATA

           Specified Peak Ground Acceleration Coefficient (PGA) =   0.220(g)
           Default Velocity =   1.100(ft) per second
           Specified Horizontal Earthquake Coefficient (kh) =  0.22000(g)
           Specified Vertical Earthquake Coefficient (kv) =   0.000(g)
           (NOTE:Input Velocity = 0.0 will result in default Peak
           Velocity = 2 times(PGA) times 2.5 fps or 0.762 mps)
           Specified Seismic Pore-Pressure Factor =   0.000
           Horizontal Seismic Force is Applied at Center of Gravity of Slices
↑



           TRIAL FAILURE SURFACE DATA

           Circular Trial Failure Surfaces Have Been Generated Using A Random Procedure.


↑
             3000 Trial Surfaces Have Been Generated.
```

```
  3000 Surfaces Generated at Increments of 0.2001(in) Equally Spaced Within the Start Range

Along The Specified Surface Between  X =  60.00(ft)
                                and  X = 110.00(ft)

Each Surface ends within a Range Between   X = 230.00(ft)
                                       and   X = 300.00(ft)

All surfaces are generated left to right for both a left and right sliding slope.

Unless XCLUDE Lines Were Specified, The Minimum Elevation
To Which A Surface Extends Is  Y =     330.00(ft)


Specified Maximum Radius = 100000.000(ft)

10.000(ft) Line Segments Were Used For Each Trial Failure Surface.


The Spencer Method Was Selected for FS Analysis.

Selected fx function = Constant (1.0)

SELECTED CONVERGENCE PARAMETERS FOR SPENCER METHOD:
Initial estimate of FS =  1.500
FS tolerance =  0.000001000
Initial estimate of theta(deg) =  15.00
Theta tolerance(radians) =  0.0001000
Minimum theta(deg) = -45.00 ; Maximum theta(deg) =  45.00
Theta convergence Step Factor = 5000.00
Maximum number of iterations = 50
Allowable negative side force = -1000.0(lbs)
Maximum force imbalance  = 100.000000(lbs)
Maximum moment imbalance = 100.000000 (ft/lbs)

Selected Lambda Coefficient =  1.00

Specified Tension Crack Water Depth Factor =   0.000
```

```
Total Number of Trial Surfaces Attempted = 3000

WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
Did Not Converge in 50 Iterations.


Number of Trial Surfaces with Non-Converged FS = 1290

Number of Trial Surfaces With Valid FS = 1710


Percentage of Trial Surfaces With Non-Converged and/or
Non-Valid FS Solutions of the Total Attempted =  43.0 %

Statistical Data On All Valid FS Values:
   FS Max =   1.992   FS Min =   1.108   FS Ave =   1.529
   Standard Deviation =    0.231   Coefficient of Variation =   15.12 %


Critical Surface is Sequence Number    1164 of Those Analyzed.


*****BEGINNING OF DETAILED GEOSTASE OUTPUT FOR CRITICAL SURFACE FROM A SEARCH*****

BACK-CALCULATED CIRCULAR SURFACE PARAMETERS:

Circle Center At X =    140.459292(ft) ; Y =    540.808412(ft); and Radius =    148.360476(ft)

Circular Trial Failure Surface Generated With 21 Coordinate Points

  Point      X-Coord.      Y-Coord.
   No.        (ft)          (ft)

    1         93.72791      400.00000
    2        103.31964      397.17180
    3        113.08010      394.99617
    4        122.96495      393.48299
    5        132.92929      392.63915
    6        142.92783      392.46847
    7        152.91516      392.97174
    8        162.84590      394.14666
    9        172.67493      395.98789
   10        182.35760      398.48707
   11        191.84991      401.63286
   12        201.10875      405.41094
   13        210.09204      409.80417
   14        218.75898      414.79258
   15        227.07018      420.35350
   16        234.98789      426.46168
   17        242.47614      433.08936
   18        249.50090      440.20643
   19        256.03027      447.78056
   20        262.03457      455.77734
   21        264.78078      460.00000


  Iter.     Theta         FS         FS
   No.      (deg)      (Moment)   (Force)
           (fx=1.0)                           Lambda        Delta FS

    1        15.0000    1.291645   1.044096     0.268      0.2475488E+00
    2        19.9500    1.246158   1.076049     0.363      0.1701093E+00
    3        30.8214    0.000000   1.174142     0.597      0.1174142E+01
    4        21.3254    1.218683   1.086005     0.390      0.1326779E+00
    5        22.2912    1.191824   1.093328     0.410      0.9849529E-01
    6        25.0736    1.035421   1.116179     0.468      0.8075842E-01
    7        23.8203    1.127785   1.105543     0.441      0.2224254E-01
    8        24.0912    1.112154   1.107791     0.447      0.4362695E-02
    9        24.1572    1.108064   1.108344     0.449      0.2804869E-03
   10        24.1532    1.108314   1.108311     0.448      0.3299130E-05
   11        24.1533    1.108311   1.108311     0.448      0.4713012E-07


Factor Of Safety For The Preceding Specified Surface =  1.108
Theta (fx = 1.0) =  24.15 Deg    Lambda =   0.448
```

```
The Spencer Method Has Been Selected For Analysis.

Selected fx function = Constant (1.0)

SELECTED CONVERGENCE PARAMETERS FOR ANALYSIS METHOD:
Initial estimate of FS =  1.500
FS tolerance =  0.000001000
Initial estimate of theta(deg) =  15.00
Theta tolerance(radians) =  0.0001000
Minimum theta(deg) = -45.00 ; Maximum theta(deg) =  45.00
Theta convergence Step Factor = 5000.00
Maximum number of iterations = 50
Maximum force imbalance = 100.000000(lbs)
Maximum moment imbalance(if Applicable) = 100.000000 (ft/lbs)


Selected Lambda Coefficient =  1.00

Tension Crack Water Force =        0.00(lbs)

Specified Tension Crack Water Depth Factor =  0.000 (  0.00% Filled )

Depth of Tension Crack (zo) at Side of Last Slice =   0.000(ft)

Depth of Water in Tension Crack =   0.000(ft)

Theoretical Tension Crack Depth =  10.744(ft)


NOTE: In Table 1 following, when a tension crack with water is present on the
first slice (right facing slope) or on the last slice (left facing slope), the
"side force" in the tension crack is set equal to the water pressure resultant.


        *** Table 1 - Line of Thrust(if applicable) and Slice Force Data ***

Slice      X         Y               Side Force     fx    Force Angle  Vert. Shear
 No.     Coord.    Coord.    h/H        (lbs)                (Deg)      Force(lbs)
```

```
  1      98.52    400.37    1.000+    4894.84     1.000       24.15       2002.9
  2     103.32    400.48    1.000+   11231.63     1.000       24.15       4595.8
  3     108.00    400.86    1.000+   17100.76     1.000       24.15       6997.3
  4     110.54    400.96    0.973    20838.81     1.000       24.15       8526.8
  5     113.08    400.94    0.824    25257.79     1.000       24.15      10335.0
  6     114.10    401.01    0.789    26815.38     1.000       24.15      10972.3
  7     118.53    401.31    0.685    33691.61     1.000       24.15      13785.9
  8     122.96    401.39    0.607    42081.26     1.000       24.15      17218.8
  9     127.95    402.15    0.582    48184.21     1.000       24.15      19716.0
 10     132.93    402.70    0.552    55136.77     1.000       24.15      22560.8
 11     137.93    403.41    0.530    61031.69     1.000       24.15      24972.9
 12     142.93    404.01    0.507    67465.54     1.000       24.15      27605.5
 13     147.92    404.82    0.491    72475.38     1.000       24.15      29655.4
 14     152.92    405.55    0.473    77795.07     1.000       24.15      31832.1
 15     157.88    406.51    0.460    81484.57     1.000       24.15      33341.8
 16     162.85    407.41    0.446    85322.29     1.000       24.15      34912.1
 17     166.42    408.40    0.444    85748.77     1.000       24.15      35086.6
 18     170.00    409.36    0.440    86165.79     1.000       24.15      35257.3
 19     172.67    410.07    0.454    86476.10     1.000       24.15      35384.2
 20     175.34    410.92    0.470    85991.47     1.000       24.15      35185.9
 21     178.00    411.79    0.487    85529.81     1.000       24.15      34997.0
 22     182.36    413.20    0.477    84760.36     1.000       24.15      34682.2
 23     187.10    414.92    0.467    82530.99     1.000       24.15      33770.0
 24     191.85    416.59    0.457    80204.95     1.000       24.15      32818.2
 25     196.48    418.42    0.447    76598.27     1.000       24.15      31342.4
 26     201.11    420.22    0.437    72912.87     1.000       24.15      29834.4
 27     205.60    422.17    0.427    68108.16     1.000       24.15      27868.4
 28     210.09    424.09    0.417    63270.93     1.000       24.15      25889.1
 29     214.43    426.16    0.407    57524.76     1.000       24.15      23537.9
 30     218.76    428.20    0.396    51814.92     1.000       24.15      21201.6
 31     222.91    430.39    0.384    45441.37     1.000       24.15      18593.7
 32     227.07    432.55    0.372    39190.11     1.000       24.15      16035.8
 33     231.03    434.85    0.360    32541.06     1.000       24.15      13315.1
 34     234.99    437.13    0.346    26111.82     1.000       24.15      10684.4
 35     237.49    438.77    0.336    21688.83     1.000       24.15       8874.6
 36     240.00    440.42    0.327    17410.69     1.000       24.15       7124.1
 37     242.48    442.10    0.335    13432.57     1.000       24.15       5496.3
 38     245.24    444.48    0.356     9014.69     1.000       24.15       3688.6
 39     248.00    447.58    0.417     5153.60     1.000       24.15       2108.7
```

```
          40      248.38    448.13    0.433     4670.87     1.000       24.15       1911.2
          41      249.50    448.87    0.438     3800.36     1.000       24.15       1555.0
          42      252.77    452.21    0.514     1424.88     1.000       24.15        583.0
          43      256.03    442.52    0.000-    -158.57     1.000       24.15        -64.9
          44      259.03    454.07    0.278     -966.33     1.000       24.15       -395.4
          45      262.03    457.27    0.354     -924.93     1.000       24.15       -378.5
          46      264.78    460.00    0.000        0.01     1.000       24.15          0.0

         NOTE: A value of 0.000- for h/H indicates that the line of thrust is at or below
         the lower boundary of the sliding mass. A value of 1.000+ for h/H indicates that
         the line of thrust is at or above the upper boundary of the sliding mass.


              ***Table 2 - Geometry Data on the   46 Slices***


Slice   Width   Height   X-Cntr    Y-Cntr-Base  Y-Cntr-Top    Alpha   Beta    Base Length
 No.     (ft)    (ft)     (ft)        (ft)        (ft)        (deg)   (deg)      (ft)

  1      4.80     0.71     96.13      399.29      400.00     -16.43    0.00      5.00
  2      4.80     2.12    100.92      397.88      400.00     -16.43    0.00      5.00
  3      4.68     3.35    105.66      396.65      400.00     -12.57    0.00      4.80
  4      2.54     4.71    109.27      395.85      400.55     -12.57   23.53      2.60
  5      2.54     6.38    111.81      395.28      401.66     -12.57   23.53      2.60
  6      1.02     7.52    113.59      394.92      402.43      -8.70   23.53      1.03
  7      4.43     9.12    116.31      394.50      403.62      -8.70   23.53      4.49
  8      4.43    11.73    120.75      393.82      405.55      -8.70   23.53      4.49
  9      4.98    14.33    125.46      393.27      407.60      -4.84   23.53      5.00
 10      4.98    16.92    130.44      392.85      409.77      -4.84   23.53      5.00
 11      5.00    19.35    135.43      392.60      411.94      -0.98   23.53      5.00
 12      5.00    21.61    140.43      392.51      414.12      -0.98   23.53      5.00
 13      4.99    23.70    145.42      392.59      416.30       2.88   23.53      5.00
 14      4.99    25.63    150.42      392.85      418.47       2.88   23.53      5.00
 15      4.97    27.38    155.40      393.27      420.64       6.75   23.53      5.00
 16      4.97    28.95    160.36      393.85      422.80       6.75   23.53      5.00
 17      3.58    30.18    164.63      394.48      424.66      10.61   23.53      3.64
 18      3.58    31.07    168.21      395.15      426.22      10.61   23.53      3.64
 19      2.67    31.26    171.34      395.74      427.00      10.61    0.00      2.72
 20       2.66    30.67    174.01       396.33       427.00       14.47    0.00        2.75
 21       2.66    29.98    176.67       397.02       427.00       14.47    0.00        2.75
 22       4.36    30.23    180.18       397.92       428.16       14.47   28.02        4.50
 23       4.75    31.31    184.73       399.27       430.58       18.34   28.02        5.00
 24       4.75    32.26    189.48       400.85       433.11       18.34   28.02        5.00
 25       4.63    33.03    194.16       402.58       435.60       22.20   28.02        5.00
 26       4.63    33.60    198.79       404.47       438.07       22.20   28.02        5.00
 27       4.49    33.99    203.35       406.51       440.50       26.06   28.02        5.00
 28       4.49    34.18    207.85       408.71       442.89       26.06   28.02        5.00
 29       4.33    34.18    212.26       411.05       445.23       29.92   28.02        5.00
 30       4.33    34.00    216.59       413.55       447.54       29.92   28.02        5.00
 31       4.16    33.62    220.84       416.18       449.80       33.79   28.02        5.00
 32       4.16    33.05    224.99       418.96       452.01       33.79   28.02        5.00
 33       3.96    32.29    229.05       421.88       454.17       37.65   28.02        5.00
 34       3.96    31.34    233.01       424.93       456.28       37.65   28.02        5.00
 35       2.51    30.43    236.24       427.57       458.00       41.51   28.02        3.35
 36       2.51    29.54    238.75       429.79       459.33       41.51   28.02        3.35
 37       2.48    28.01    241.24       431.99       460.00       41.51    0.00        3.31
 38       2.76    25.51    243.86       434.49       460.00       45.37    0.00        3.93
 39       2.76    22.71    246.62       437.29       460.00       45.37    0.00        3.93
 40       0.38    21.12    248.19       438.88       460.00       45.37    0.00        0.54
 41       1.12    20.36    248.94       439.64       460.00       45.37    0.00        1.60
 42       3.26    17.90    251.13       442.10       460.00       49.24    0.00        5.00
 43       3.26    14.11    254.40       445.89       460.00       49.24    0.00        5.00
 44       3.00    10.22    257.53       449.78       460.00       53.10    0.00        5.00
 45       3.00     6.22    260.53       453.78       460.00       53.10    0.00        5.00
 46       2.75     2.11    263.41       457.89       460.00       56.96    0.00        5.04
↑


 ***Table 2A - Coordinates of Slice Points Defining the Slip Surface***


 Point           X-Pt            Y-Pt
  No.            (ft)            (ft)

   1          93.727909       400.000000
   2          98.523774       398.585899
   3         103.319638       397.171797
```

4	108.000000	396.128533
5	110.540051	395.562350
6	113.080101	394.996167
7	114.096999	394.840500
8	118.530976	394.161746
9	122.964953	393.482993
10	127.947120	393.061072
11	132.929286	392.639151
12	137.928558	392.553812
13	142.927830	392.468474
14	147.921494	392.720105
15	152.915158	392.971737
16	157.880527	393.559196
17	162.845897	394.146655
18	166.422948	394.816730
19	170.000000	395.486805
20	172.674928	395.987889
21	175.337464	396.675114
22	178.000000	397.362339
23	182.357597	398.487075
24	187.103754	400.059966
25	191.849912	401.632857
26	196.479330	403.521900
27	201.108749	405.410944
28	205.600395	407.607557
29	210.092042	409.804171
30	214.425510	412.298375
31	218.758978	414.792579
32	222.914580	417.573042
33	227.070182	420.353505
34	231.029038	423.407594
35	234.987894	426.461683
36	237.493947	428.679734
37	240.000000	430.897786
38	242.476141	433.089363
39	245.238071	435.887586
40	248.000000	438.685808
41	248.376114	439.066865
42	249.500904	440.206435

```
  43          252.765586        443.993499
  44          256.030267        447.780563
  45          259.032417        451.778950
  46          262.034566        455.777337
  47          264.780782        460.000000
↑


  ***Table 3 - Force and Pore Pressure Data On The   46 Slices (Excluding Reinforcement)***

                       Ubeta   Ubeta      Ualpha                             Earthquake
                       Force   Stress     Force      Pore                      Force        Distributed
 Slice      Weight      Top     Top        Bot     Pressure       -Uw     Horiz     Vert       Load
   No.      (lbs)      (lbs)   (psf)      (lbs)      (psf)        (psf)   (lbs)     (lbs)      (psf)
   1         406.9       0.0     0.0        0.0       0.00         0.00    89.5       0.0       0.00
   2        1220.7       0.0     0.0        0.0       0.00         0.00   268.6       0.0       0.00
   3        1881.4       0.0     0.0        0.0       0.00         0.00   413.9       0.0       0.00
   4        1434.9       0.0     0.0        0.0       0.00         0.00   315.7       0.0       0.00
   5        1944.7       0.0     0.0        0.0       0.00         0.00   427.8       0.0       0.00
   6         917.1       0.0     0.0        0.0       0.00         0.00   201.8       0.0       0.00
   7        4852.3       0.0     0.0        0.0       0.00         0.00  1067.5       0.0       0.00
   8        6240.8       0.0     0.0        0.0       0.00         0.00  1373.0       0.0       0.00
   9        8567.2       0.0     0.0        0.0       0.00         0.00  1884.8       0.0       0.00
  10       10116.6       0.0     0.0        0.0       0.00         0.00  2225.7       0.0       0.00
  11       11607.3       0.0     0.0        0.0       0.00         0.00  2553.6       0.0       0.00
  12       12964.6       0.0     0.0        0.0       0.00         0.00  2852.2       0.0       0.00
  13       14204.1       0.0     0.0        0.0       0.00         0.00  3124.9       0.0       0.00
  14       15356.5       0.0     0.0        0.0       0.00         0.00  3378.4       0.0       0.00
  15       16311.6       0.0     0.0        0.0       0.00         0.00  3588.5       0.0       0.00
  16       17249.9       0.0     0.0        0.0       0.00         0.00  3795.0       0.0       0.00
  17       12955.4       0.0     0.0        0.0       0.00         0.00  2850.2       0.0       0.00
  18       13336.4       0.0     0.0        0.0       0.00         0.00  2934.0       0.0       0.00
  19       10035.0       0.0     0.0        0.0       0.00         0.00  2207.7       0.0       0.00
  20        9798.7       0.0     0.0        0.0       0.00         0.00  2155.7       0.0       0.00
  21        9579.1       0.0     0.0        0.0       0.00         0.00  2107.4       0.0       0.00
  22       15810.2       0.0     0.0        0.0       0.00         0.00  3478.2       0.0       0.00
  23       17831.7       0.0     0.0        0.0       0.00         0.00  3923.0       0.0       0.00
  24       18374.6       0.0     0.0        0.0       0.00         0.00  4042.4       0.0       0.00
  25       18347.1       0.0     0.0        0.0       0.00         0.00  4036.4       0.0       0.00
 26       18666.6       0.0     0.0        0.0       0.00         0.00  4106.6      0.0       0.00
 27       18318.3       0.0     0.0        0.0       0.00         0.00  4030.0      0.0       0.00
 28       18423.0       0.0     0.0        0.0       0.00         0.00  4053.0      0.0       0.00
 29       17775.8       0.0     0.0        0.0       0.00         0.00  3910.7      0.0       0.00
 30       17678.2       0.0     0.0        0.0       0.00         0.00  3889.2      0.0       0.00
 31       16764.1       0.0     0.0        0.0       0.00         0.00  3688.1      0.0       0.00
 32       16480.5       0.0     0.0        0.0       0.00         0.00  3625.7      0.0       0.00
 33       15340.3       0.0     0.0        0.0       0.00         0.00  3374.9      0.0       0.00
 34       14890.4       0.0     0.0        0.0       0.00         0.00  3275.9      0.0       0.00
 35        9150.6       0.0     0.0        0.0       0.00         0.00  2013.1      0.0       0.00
 36        8884.8       0.0     0.0        0.0       0.00         0.00  1954.6      0.0       0.00
 37        8321.7       0.0     0.0        0.0       0.00         0.00  1830.8      0.0       0.00
 38        8455.3       0.0     0.0        0.0       0.00         0.00  1860.2      0.0       0.00
 39        7527.9       0.0     0.0        0.0       0.00         0.00  1656.1      0.0       0.00
 40         953.4       0.0     0.0        0.0       0.00         0.00   209.7      0.0       0.00
 41        2748.5       0.0     0.0        0.0       0.00         0.00   604.7      0.0       0.00
 42        7012.5       0.0     0.0        0.0       0.00         0.00  1542.8      0.0       0.00
 43        5528.9       0.0     0.0        0.0       0.00         0.00  1216.4      0.0       0.00
 44        3681.9       0.0     0.0        0.0       0.00         0.00   810.0      0.0       0.00
 45        2241.5       0.0     0.0        0.0       0.00         0.00   493.1      0.0       0.00
 46         695.8       0.0     0.0        0.0       0.00         0.00   153.1      0.0       0.00

         TOTAL WEIGHT OF SLIDING MASS =  470885.03(lbs)

         EFFECTIVE WEIGHT OF SLIDING MASS =  470885.03(lbs)

         TOTAL AREA OF SLIDING MASS =  3924.04(ft2)
↑


***TABLE 4 - SOIL STRENGTH & SOIL OPTIONS DATA ON THE   46 SLICES***

Slice  Soil   Cohesion   Phi(Deg)   Options
 No.   Type     (psf)
  1      1     350.00     33.00
  2      1     350.00     33.00
  3      1     350.00     33.00
  4      1     350.00     33.00
  5      1     350.00     33.00
  6      1     350.00     33.00
  7      2     200.00     34.00     A
  8      2     200.00     34.00     A
  9      2     200.00     28.00     A
 10      2     200.00     28.00     A
 11      2     200.00     28.00     A
 12      2     200.00     28.00     A
 13      2     200.00     28.00     A
 14      2     200.00     28.00     A
 15      2     200.00     28.00     A
 16      2     200.00     28.00     A
 17      2     200.00     24.00     A
 18      2     200.00     24.00     A
 19      2     200.00     24.00     A
 20      2     200.00     24.00     A
 21      2     200.00     24.00     A
 22      2     200.00     24.00     A
 23      2     200.00     24.00     A
 24      2     200.00     24.00     A
 25      2     200.00     24.00     A
 26      2     200.00     24.00     A
 27      2     200.00     24.00     A
 28      2     200.00     24.00     A
 29      2     200.00     24.00     A
 30      2     200.00     24.00     A
 31      2     200.00     24.00     A
 32      2     200.00     24.00     A
 33      2     200.00     24.00     A
 34      2     200.00     24.00     A
 35      2     200.00     24.00     A
 36      2     200.00     24.00     A
 37      2     200.00     24.00     A
 38      2     200.00     24.00     A
 39      2     200.00     24.00     A
 40      2     200.00     24.00     A
 41      1     350.00     33.00
 42      1     350.00     33.00
 43      1     350.00     33.00
 44      1     350.00     33.00
```

```
  45      1     350.00     33.00
  46      1     350.00     33.00

  SOIL OPTIONS:
  A = ANISOTROPIC SHEAR STRENGTH
  C = CURVED STRENGTH ENVELOPE (TANGENT PHI & C)
  F = FIBER-REINFORCED SOIL (FRS)
  M = INDEPENDENT MULTI-STAGE SHEAR STRENGTH
  N = NONLINEAR UNDRAINED SHEAR STRENGTH
  R = RAPID DRAWDOWN OR RAPID LOADING (SEISMIC) SHEAR STRENGTH
  S = SHANSEP UNDRAINED SHEAR STRENGTH
  NOTE: Phi and C in Table 4 are modified values based on specified
  Soil Options (if any).



        ***TABLE 5 - Total Base Stress Data on the   46 Slices***

 Slice   Alpha     X-Coord.      Base        Total            Total           Total
  No.    (deg)    Slice Cntr     Leng.    Normal Stress    Vert. Stress     Normal/Vert.
   *                 (ft)        (ft)        (psf)            (psf)         Stress Ratio

   1    -16.43      96.13        5.00        719.98            84.85           8.486
   2    -16.43     100.92        5.00       1073.83           254.54           4.219
   3    -12.57     105.66        4.80       1133.53           401.98           2.820
   4    -12.57     109.27        2.60       1423.38           564.92           2.520
   5    -12.57     111.81        2.60       1780.38           765.60           2.325
   6     -8.70     113.59        1.03       1732.31           901.85           1.921
   7     -8.70     116.31        4.49       1936.97          1094.34           1.770
   8     -8.70     120.75        4.49       2436.32          1407.50           1.731
   9     -4.84     125.46        5.00       2330.78          1719.57           1.355
  10     -4.84     130.44        5.00       2727.67          2030.56           1.343
  11     -0.98     135.43        5.00       2830.55          2321.80           1.219
  12     -0.98     140.43        5.00       3148.76          2593.30           1.214
  13      2.88     145.42        5.00       3169.22          2844.43           1.114
  14      2.88     150.42        5.00       3419.33          3075.19           1.112
  15      6.75     155.40        5.00       3376.13          3285.06           1.028
  16      6.75     160.36        5.00       3566.52          3474.05           1.027
  17     10.61     164.63        3.64         3382.26         3621.80           0.934
  18     10.61     168.21        3.64         3480.32         3728.32           0.933
  19     10.61     171.34        2.72         3501.67         3751.52           0.933
  20     14.47     174.01        2.75         3224.79         3680.22           0.876
  21     14.47     176.67        2.75         3153.27         3597.75           0.876
  22     14.47     180.18        4.50         3179.68         3628.20           0.876
  23     18.34     184.73        5.00         3093.26         3757.07           0.823
  24     18.34     189.48        5.00         3186.86         3871.47           0.823
  25     22.20     194.16        5.00         3067.86         3963.16           0.774
  26     22.20     198.79        5.00         3121.16         4032.16           0.774
  27     26.06     203.35        5.00         2969.07         4078.31           0.728
  28     26.06     207.85        5.00         2986.06         4101.60           0.728
  29     29.92     212.26        5.00         2806.62         4101.99           0.684
  30     29.92     216.59        5.00         2791.11         4079.47           0.684
  31     33.79     220.84        5.00         2589.71         4034.09           0.642
  32     33.79     224.99        5.00         2545.42         3965.86           0.642
  33     37.65     229.05        5.00         2327.24         3874.92           0.601
  34     37.65     233.01        5.00         2257.84         3761.29           0.600
  35     41.51     236.24        3.35         2043.10         3651.42           0.560
  36     41.51     238.75        3.35         1982.28         3545.32           0.559
  37     41.51     241.24        3.31         1876.49         3360.77           0.558
  38     45.37     243.86        3.93         1580.71         3061.38           0.516
  39     45.37     246.62        3.93         1400.68         2725.60           0.514
  40     45.37     248.19        0.54         1298.41         2534.84           0.512
  41     45.37     248.94        1.60         1133.87         2443.60           0.464
  42     49.24     251.13        5.00          883.46         2148.00           0.411
  43     49.24     254.40        5.00          672.01         1693.56           0.397
  44     53.10     257.53        5.00          390.78         1226.43           0.319
  45     53.10     260.53        5.00          186.29          746.62           0.250
  46     56.96     263.41        5.04          -49.66          253.36          -0.196
↑


         ***TABLE 5A - Total Base Force Data on the   46 Slices***

 Slice   Alpha     X-Coord.      Base         Total            Total           Total
 No.     (deg)    Slice Cntr     Leng.     Normal Force    Vert. Force      Normal/Vert.
   *                 (ft)        (ft)          (lbs)           (lbs)        Force Ratio
  1    -16.43      96.13          5.00          3599.88          406.91           8.847
  2    -16.43     100.92          5.00          5369.14         1220.73           4.398
  3    -12.57     105.66          4.80          5435.51         1881.41           2.889
  4    -12.57     109.27          2.60          3704.19         1434.92           2.581
  5    -12.57     111.81          2.60          4633.23         1944.65           2.383
  6     -8.70     113.59          1.03          1782.11          917.09           1.943
  7     -8.70     116.31          4.49          8688.54         4852.27           1.791
  8     -8.70     120.75          4.49         10928.41         6240.82           1.751
  9     -4.84     125.46          5.00         11653.90         8567.21           1.360
 10     -4.84     130.44          5.00         13638.36        10116.61           1.348
 11     -0.98     135.43          5.00         14152.76        11607.33           1.219
 12     -0.98     140.43          5.00         15743.80        12964.60           1.214
 13      2.88     145.42          5.00         15846.11        14204.11           1.116
 14      2.88     150.42          5.00         17096.65        15356.46           1.113
 15      6.75     155.40          5.00         16880.63        16311.55           1.035
 16      6.75     160.36          5.00         17832.59        17249.94           1.034
 17     10.61     164.63          3.64         12308.96        12955.37           0.950
 18     10.61     168.21          3.64         12665.83        13336.40           0.950
 19     10.61     171.34          2.72          9529.65        10035.04           0.950
 20     14.47     174.01          2.75          8867.53         9798.72           0.905
 21     14.47     176.67          2.75          8670.86         9579.15           0.905
 22     14.47     180.18          4.50         14309.85        15810.22           0.905
 23     18.34     184.73          5.00         15466.31        17831.66           0.867
 24     18.34     189.48          5.00         15934.30        18374.59           0.867
 25     22.20     194.16          5.00         15339.29        18347.15           0.836
 26     22.20     198.79          5.00         15605.81        18666.58           0.836
 27     26.06     203.35          5.00         14845.33        18318.33           0.810
 28     26.06     207.85          5.00         14930.28        18422.95           0.810
 29     29.92     212.26          5.00         14033.09        17775.84           0.789
 30     29.92     216.59          5.00         13955.56        17678.24           0.789
 31     33.79     220.84          5.00         12948.53        16764.07           0.772
 32     33.79     224.99          5.00         12727.10        16480.52           0.772
 33     37.65     229.05          5.00         11636.22        15340.26           0.759
 34     37.65     233.01          5.00         11289.19        14890.39           0.758
 35     41.51     236.24          3.35          6837.55         9150.65           0.747
 36     41.51     238.75          3.35          6633.99         8884.75           0.747
 37     41.51     241.24          3.31          6204.98         8321.74           0.746
 38     45.37     243.86          3.93          6214.87         8455.32           0.735
 39     45.37     246.62          3.93          5507.05         7527.90           0.732
```

```
  40     45.37     248.19        0.54          695.18          953.39           0.729
  41     45.37     248.94        1.60         1815.52         2748.54           0.661
  42     49.24     251.13        5.00         4417.29         7012.55           0.630
  43     49.24     254.40        5.00         3360.03         5528.92           0.608
  44     53.10     257.53        5.00         1953.92         3681.92           0.531
  45     53.10     260.53        5.00          931.47         2241.47           0.416
  46     56.96     263.41        5.04         -250.15          695.78          -0.360
↑


         ***TABLE 6 - Effective and Base Shear Stress Data on the   46 Slices***

 Slice    Alpha     X-Coord.     Base       Effective       Available         Mobilized
  No.     (deg)   Slice Cntr     Leng.    Normal Stress   Shear Strength    Shear Stress
   *                 (ft)         (ft)        (psf)           (psf)            (psf)

   1     -16.43      96.13       5.00          719.98          817.56          737.66
   2     -16.43     100.92       5.00         1073.83         1047.35          945.00
   3     -12.57     105.66       4.80         1133.53         1086.12          979.98
   4     -12.57     109.27       2.60         1423.38         1274.35         1149.82
   5     -12.57     111.81       2.60         1780.38         1506.19         1359.00
   6      -8.70     113.59       1.03         1732.31         1474.98         1330.83
   7      -8.70     116.31       4.49         1936.97         1506.51         1359.28
   8      -8.70     120.75       4.49         2436.32         1843.32         1663.18
   9      -4.84     125.46       5.00         2330.78         1439.30         1298.64
  10      -4.84     130.44       5.00         2727.67         1650.33         1489.05
  11      -0.98     135.43       5.00         2830.55         1705.03         1538.40
  12      -0.98     140.43       5.00         3148.76         1874.23         1691.06
  13       2.88     145.42       5.00         3169.22         1885.11         1700.88
  14       2.88     150.42       5.00         3419.33         2018.09         1820.87
  15       6.75     155.40       5.00         3376.13         1995.12         1800.14
  16       6.75     160.36       5.00         3566.52         2096.35         1891.48
  17      10.61     164.63       3.64         3382.26         1705.88         1539.17
  18      10.61     168.21       3.64         3480.32         1749.54         1578.56
  19      10.61     171.34       2.72         3501.67         1759.05         1587.14
  20      14.47     174.01       2.75         3224.79         1635.77         1475.91
  21      14.47     176.67       2.75         3153.27         1603.93         1447.18
  22      14.47     180.18       4.50         3179.68         1615.68         1457.79
  23      18.34     184.73       5.00         3093.26         1577.21         1423.07
 24      18.34    189.48       5.00         3186.86         1618.88         1460.67
 25      22.20    194.16       5.00         3067.86         1565.90         1412.87
 26      22.20    198.79       5.00         3121.16         1589.63         1434.28
 27      26.06    203.35       5.00         2969.07         1521.91         1373.18
 28      26.06    207.85       5.00         2986.06         1529.48         1380.01
 29      29.92    212.26       5.00         2806.62         1449.59         1307.92
 30      29.92    216.59       5.00         2791.11         1442.68         1301.70
 31      33.79    220.84       5.00         2589.71         1353.01         1220.79
 32      33.79    224.99       5.00         2545.42         1333.29         1203.00
 33      37.65    229.05       5.00         2327.24         1236.16         1115.35
 34      37.65    233.01       5.00         2257.84         1205.25         1087.47
 35      41.51    236.24       3.35         2043.10         1109.65         1001.21
 36      41.51    238.75       3.35         1982.28         1082.57          976.77
 37      41.51    241.24       3.31         1876.49         1035.47          934.27
 38      45.37    243.86       3.93         1580.71          903.78          815.45
 39      45.37    246.62       3.93         1400.68          823.62          743.13
 40      45.37    248.19       0.54         1298.41          778.09          702.05
 41      45.37    248.94       1.60         1133.87         1086.34          980.18
 42      49.24    251.13       5.00          883.46          923.72          833.45
 43      49.24    254.40       5.00          672.01          786.41          709.55
 44      53.10    257.53       5.00          390.78          603.78          544.77
 45      53.10    260.53       5.00          186.29          470.98          424.95
 46      56.96    263.41       5.04          -49.66          317.75          286.70
↑


        ***TABLE 6A - Effective and Base Shear Force Data on the   46 Slices***

Slice    Alpha     X-Coord.     Base       Effective       Available         Mobilized
 No.     (deg)   Slice Cntr     Leng.     Normal Force    Shear Force       Shear Force
  *                 (ft)         (ft)        (lbs)           (lbs)             (lbs)

  1     -16.43     96.13       5.00         3599.88         4087.79         3688.30
  2     -16.43    100.92       5.00         5369.14         5236.76         4724.99
  3     -12.57    105.66       4.80         5435.51         5208.19         4699.22
  4     -12.57    109.27       2.60         3704.19         3316.36         2992.27
  5     -12.57    111.81       2.60         4633.23         3919.69         3536.64
  6      -8.70    113.59       1.03         1782.11         1517.37         1369.09
  7      -8.70    116.31       4.49         8688.54         6757.62         6097.23
  8      -8.70     120.75       4.49        10928.41         8268.43         7460.39
  9      -4.84     125.46       5.00        11653.90         7196.49         6493.20
 10      -4.84     130.44       5.00        13638.36         8251.64         7445.24
 11      -0.98     135.43       5.00        14152.76         8525.15         7692.02
 12      -0.98     140.43       5.00        15743.80         9371.13         8455.32
 13       2.88     145.42       5.00        15846.11         9425.53         8504.41
 14       2.88     150.42       5.00        17096.65        10090.45         9104.35
 15       6.75     155.40       5.00        16880.63         9975.59         9000.71
 16       6.75     160.36       5.00        17832.59        10481.76         9457.42
 17      10.61     164.63       3.64        12308.96         6208.16         5601.46
 18      10.61     168.21       3.64        12665.83         6367.05         5744.82
 19      10.61     171.34       2.72         9529.65         4787.17         4319.33
 20      14.47     174.01       2.75         8867.53         4498.04         4058.46
 21      14.47     176.67       2.75         8670.86         4410.47         3979.45
 22      14.47     180.18       4.50        14309.85         7271.24         6560.65
 23      18.34     184.73       5.00        15466.31         7886.04         7115.37
 24      18.34     189.48       5.00        15934.30         8094.41         7303.37
 25      22.20     194.16       5.00        15339.29         7829.49         7064.35
 26      22.20     198.79       5.00        15605.81         7948.15         7171.41
 27      26.06     203.35       5.00        14845.33         7609.57         6865.91
 28      26.06     207.85       5.00        14930.28         7647.39         6900.04
 29      29.92     212.26       5.00        14033.09         7247.94         6539.62
 30      29.92     216.59       5.00        13955.56         7213.42         6508.48
 31      33.79     220.84       5.00        12948.53         6765.06         6103.94
 32      33.79     224.99       5.00        12727.10         6666.47         6014.98
 33      37.65     229.05       5.00        11636.22         6180.78         5576.75
 34      37.65     233.01       5.00        11289.19         6026.27         5437.35
 35      41.51     236.24       3.35         6837.55         3713.60         3350.69
 36      41.51     238.75       3.35         6633.99         3622.97         3268.91
 37      41.51     241.24       3.31         6204.98         3423.98         3089.37
 38      45.37     243.86       3.93         6214.87         3553.38         3206.12
 39      45.37     246.62       3.93         5507.05         3238.24         2921.78
 40      45.37     248.19       0.54          695.18          416.60          375.89
 41      45.37     248.94       1.60         1815.52         1739.43         1569.44
 42      49.24     251.13       5.00         4417.29         4618.62         4167.26
 43      49.24     254.40       5.00         3360.03         3932.03         3547.77
 44      53.10     257.53       5.00         1953.92         3018.89         2723.87
 45      53.10     260.53       5.00          931.47         2354.90         2124.77
 46      56.96     263.41       5.04         -250.15         1600.54         1444.13
```

```
Average Effective Normal Stress = 2288.6476(psf)
Average Available Shear Strength = 1371.6376(psf)
Total Length of Failure Surface = 195.0371(ft)


INPUT PARAMETERS FOR SIMPLIFIED 3D ANALYSIS

     Composite Phi (deg)=  30.935
     3D Depth (Vertical difference between ends of Slip Surface) =   60.00(ft)
     L/D(1): L = 60.00(ft) L/D(2): L = 120.00(ft) L/D(3): L = 180.00(ft)
     L/D(4): L = 240.00(ft) L/D(5): L = 300.00(ft) L/D(6): L = 360.00(ft)

     Average Elevation of Point of Application of kh on Sliding Mass =  422.231(ft)

SUM OF MOMENTS =  -0.466948E-02 (ft/lbs);Imbalance (Fraction of Total Weight) =  -0.9916386E-08
SUM OF FORCES = -.116072E-03 (lbs);Imbalance (Fraction of Total Weight) =   -0.2464971E-09

Sum of Available Shear Forces =  267520.24(lbs)

Sum of Mobilized Shear Forces =  241376.51(lbs)

FS Balance Check: FS =  1.108311

                    **** END OF GEOSTASE OUTPUT ****
```

Appendix F

APPENDIX F

GENERAL EARTHWORK AND GRADING SPECIFICATIONS

1.0 GENERAL

1.1 **Intent:** These General Earthwork and Grading Specifications are for the grading and earthwork shown on the approved grading plan(s) and/or indicated in the geotechnical report(s). These Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the specific recommendations in the geotechnical report shall supersede these general Specifications. Observations of the earthwork by the project Geotechnical Consultant during grading may result in new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

1.2 **Geotechnical Consultant:** Prior to commencement of work, the project owner shall employ a geotechnical consultant. The geotechnical consultant shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of grading.

Prior to commencement of grading, the Geotechnical Consultant shall review the "work plan" prepared by the Earthwork Contractor (Contractor) and schedule sufficient personnel to perform the appropriate level of observation, mapping, and compaction testing.

During grading and earthwork operations, the Geotechnical Consultant shall observe, map, and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the Geotechnical Consultant shall inform the owner, recommend appropriate changes in design to accommodate the observed conditions, and notify the review agency where required. Subsurface areas to be geotechnically observed, mapped, elevations recorded, and/or tested include natural ground after it has been cleared for receiving fill but before fill is placed, bottoms of all "remedial removal" areas, all keyway bottoms, and benches made on sloping ground to receive fill.

The Geotechnical Consultant shall observe the moisture-conditioning and processing of subgrade and fill materials and perform adequate relative compaction testing of fill to determine the attained level of compaction and assess if, in their opinion, if the work was performed in substantial compliance with the geotechnical report(s) and these specifications. The Geotechnical Consultant shall provide test results to the owner on a routine and frequent basis.

1.3 **The Earthwork Contractor:** The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Specifications prior to commencement of grading. The Contractor shall be solely responsible for performing the grading in accordance with applicable grading codes, the project plans, and these specifications.

The Contractor shall prepare and submit to the owner and the Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "spreads" of work and the estimated quantities of daily earthwork planned for the site prior to commencement of grading. The Contractor shall inform the owner and the Geotechnical Consultant of changes in work schedules and updates to the work plan at least 24 hours in advance of such changes so that appropriate observations and tests can be planned and accomplished. The Contractor shall not assume that the Geotechnical Consultant is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the earthwork in accordance with the applicable grading codes and agency ordinances, these Specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of the Geotechnical Consultant, unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, insufficient buttress key size, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the Geotechnical Consultant shall reject the work and may recommend to the owner that construction be stopped until the conditions are corrected.

2.0 PREPARATION OF FILL AREAS

2.1 **Clearing and Grubbing:** Areas to be excavated and filled shall be cleared and grubbed. Vegetation, such as brush, grass, roots, and other deleterious material, man-made structures, and similar debris shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies, and the Geotechnical Consultant. Borrow areas shall be cleared and grubbed to the extent necessary to provide a suitable fill material.

Concrete fragments that are free of reinforcing street may be placed in fills, provided they are placed in accordance with Section 3 and 4. Earth fill material shall not contain more than 1 percent of organic materials (by volume). No fill lift shall contain more than 5 percent organic matter. Nesting of organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area. As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, etc.) have chemical constituents that are considered hazardous waste. As such, the indiscriminate dumping or spillage of such fluids may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed.

The Geotechnical Consultant shall not be responsible for the identification or analysis of potentially hazardous materials; however, if observations, odors, or soil discoloration are suspect, the Geotechnical Consultant may request from the owner the termination of grading operations until such materials are deemed not hazardous as defined by applicable laws and regulations.

2.2 **Evaluation/Acceptance of Fill Areas:** All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive fill. The Contractor shall obtain a written acceptance from the Geotechnical Consultant prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys, and benches.

2.3 **Processing:** Ground that has been declared satisfactory for support of fill by the Geotechnical Consultant shall be scarified to a minimum depth of 6 inches. Ground that is not satisfactory shall be removed/overexcavated as specified in the following section. Scarification shall continue until soils are broken down and free of large clay lumps or clods and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction. After scarification, the surface should be moisture conditioned, as necessary, to achieve the proper moisture content and compacted in accordance with Section 4 of these specifications.

2.4 **Overexcavation:** In addition to removals and overexcavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured, or otherwise unsuitable ground shall be overexcavated to competent ground as recommended by the Geotechnical Consultant during grading.

2.5 **Benching:** Fills to be placed on ground sloping steeper than 5H:1V (horizontal to vertical units) shall be stepped or benched. The lowest bench or key shall be a minimum of 15 feet wide and at least 2 feet deep, into competent material as evaluated by the Geotechnical Consultant. Other benches shall be excavated a minimum height of 4 feet into competent material or as otherwise recommended by the Geotechnical Consultant. Fill placed on ground sloping flatter than 5:1 shall also be benched or otherwise overexcavated to provide a flat subgrade for fill placement.

3.0 FILL MATERIAL

3.1 **General:** Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by the Geotechnical Consultant prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to the Geotechnical Consultant or mixed with other soils to achieve satisfactory fill material.

3.2 **Oversize:** Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 12 inches, shall not be buried or placed in fill unless location, materials, and placement methods are specifically accepted by the Geotechnical Consultant. Placement operations shall be such that nesting of oversized material does not occur and that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 vertical feet of finish grade or within 2 feet of future utilities or other underground construction.

3.3 **Import:** If importing of fill material is required for grading, proposed import material shall meet the requirements of Section 3.1 and/or requirements defined in the project geotechnical report(s). The potential import source shall be given to the Geotechnical Consultant at least 48 hours (2 working days) before import begins so that suitability can be determined, and appropriate laboratory tests performed.

4.0 FILL PLACEMENT AND COMPACTION

4.1 **Fill Layers:** Approved fill material shall be placed in areas prepared to receive fill (per Section 3.0) in near-horizontal layers not exceeding 8 inches in loose thickness. The Geotechnical Consultant may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

4.2 **Fill Moisture Conditioning:** Fill soils shall be watered, dried back, blended, and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with ASTM International (ASTM Test Method D1557).

4.3 **Compaction of Fill:** After each layer has been moisture-conditioned, mixed, and evenly spread, it shall be uniformly compacted to not less than 90 percent of maximum dry density (ASTM Test Method D1557). Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction and uniformity.

Compaction of Fill Slopes: In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by backrolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet in fill elevation, or by other methods producing satisfactory results acceptable to the Geotechnical Consultant. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of maximum density per ASTM Test Method D1557.

4.4 **Compaction Testing:** Field tests for moisture content and relative compaction of the fill soils shall be performed by the Geotechnical Consultant. Location and frequency of tests shall be at the Consultant's discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

4.5 **Frequency of Compaction Testing:** Tests shall be taken at intervals required by the governing agency and as deemed necessary by the Geotechnical Consultant in order to adequately qualify the fill material. In general, it should be anticipated that tests will be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of compacted fill, unless recommended otherwise by the Geotechnical Consultant. In addition, test(s) shall be taken on slope faces and/or each 10 feet of vertical height of slope as deemed necessary by the Geotechnical Consultant. The Contractor shall assure that fill construction is such that the testing schedule can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork construction if these minimum standards are not met.

4.6 **Compaction Test Locations:** The Geotechnical Consultant shall document the approximate elevation and location of each compaction test. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so the Geotechnical Consultant can determine the test locations with sufficient accuracy. At a minimum, two grade stakes within a horizontal distance of 100 feet and vertically less than 5 feet apart from potential test locations shall be provided. Alternatively, GPS units may be used to determine the approximate location/coordinates of the field density tests.

5.0 SUBDRAIN INSTALLATION

Subdrain systems shall be installed in accordance with the approved geotechnical report(s), the grading plan, and standard details. The Geotechnical Consultant may recommend additional subdrains and/or changes in subdrain extent, location, grade, or material depending on conditions encountered during grading. All subdrains shall be surveyed for line and grade after installation and prior to burial. Sufficient time should be allowed by the Contractor for these surveys. The Contractor should consider videoing the subdrains shortly after burial to check proper installation and functionality. The Contractor is responsible for the performance of subdrains.

6.0 EXCAVATION

Excavations, including over-excavation for remedial purposes, shall be evaluated by the Geotechnical Consultant during grading. Remedial removal depths shown on geotechnical report(s) and plans are estimates. The actual extent of removal shall be determined by the Geotechnical Consultant based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, evaluated, and accepted by the Geotechnical Consultant prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by the Geotechnical Consultant.

7.0 TRENCH BACKFILLS

7.1 Contractor shall follow all OHSA and Cal/OSHA requirements for safety of trench excavations.

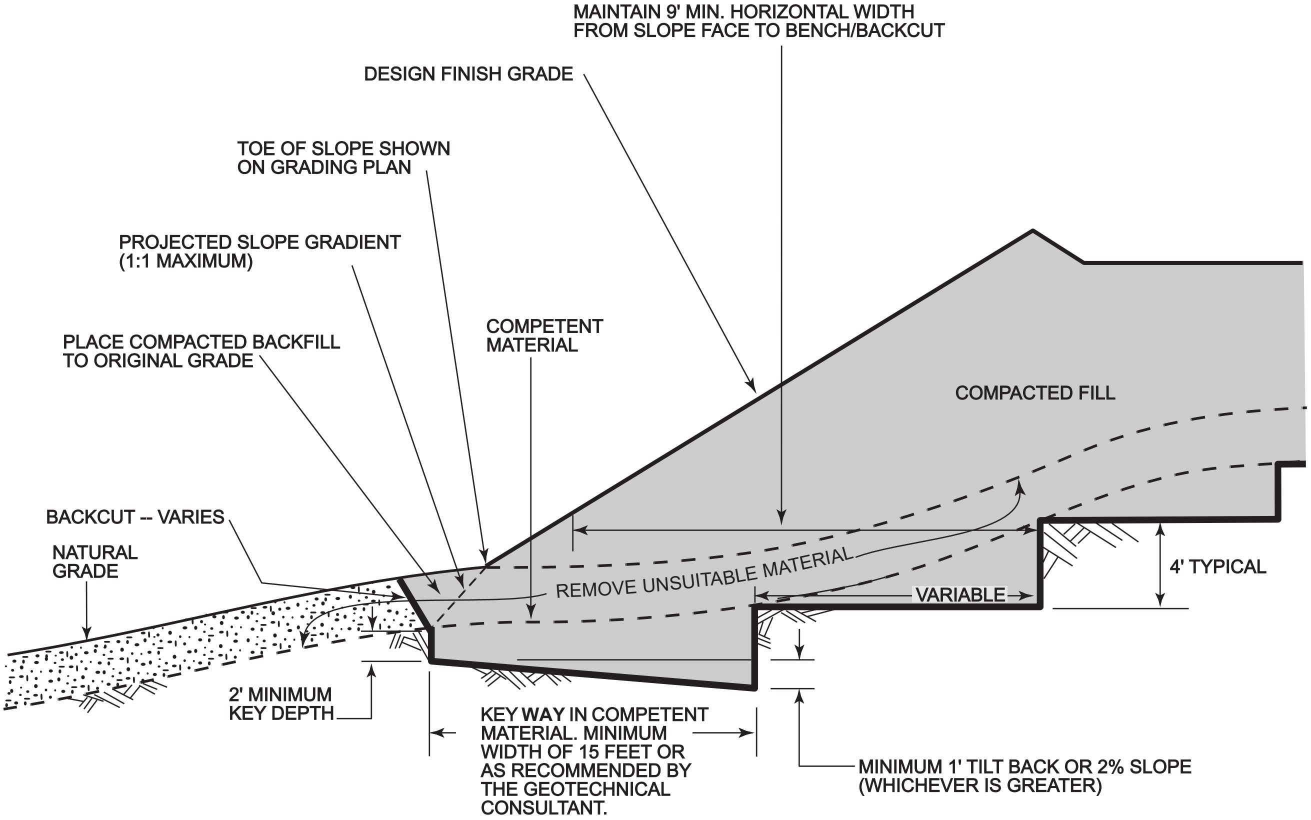
7.2 Bedding and backfill of utility trenches shall be done in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding material shall have a Sand Equivalent greater than 30 (SE>30). The bedding shall be placed to 1 foot over the top of the conduit and densified by jetting. Backfill shall be placed and densified to a minimum 90 percent of maximum from 1 foot above the top of the conduit to the surface, except in traveled ways (see Section 7.6 below).

7.3 Jetting of the bedding around the conduits shall be observed by the Geotechnical Consultant.

7.4 Geotechnical Consultant shall test the trench backfill for relative compaction. At least one test should be made for every 300 feet of trench and 2 feet of fill, unless required differently by the governing agency or the Geotechnical Consultant.

7.5 Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method.

7.6 Trench backfill in the upper foot measured from finish grade within existing or future traveled way, shoulder, and other paved areas (or areas to receive pavement) should be placed to a minimum 95 percent relative compaction.

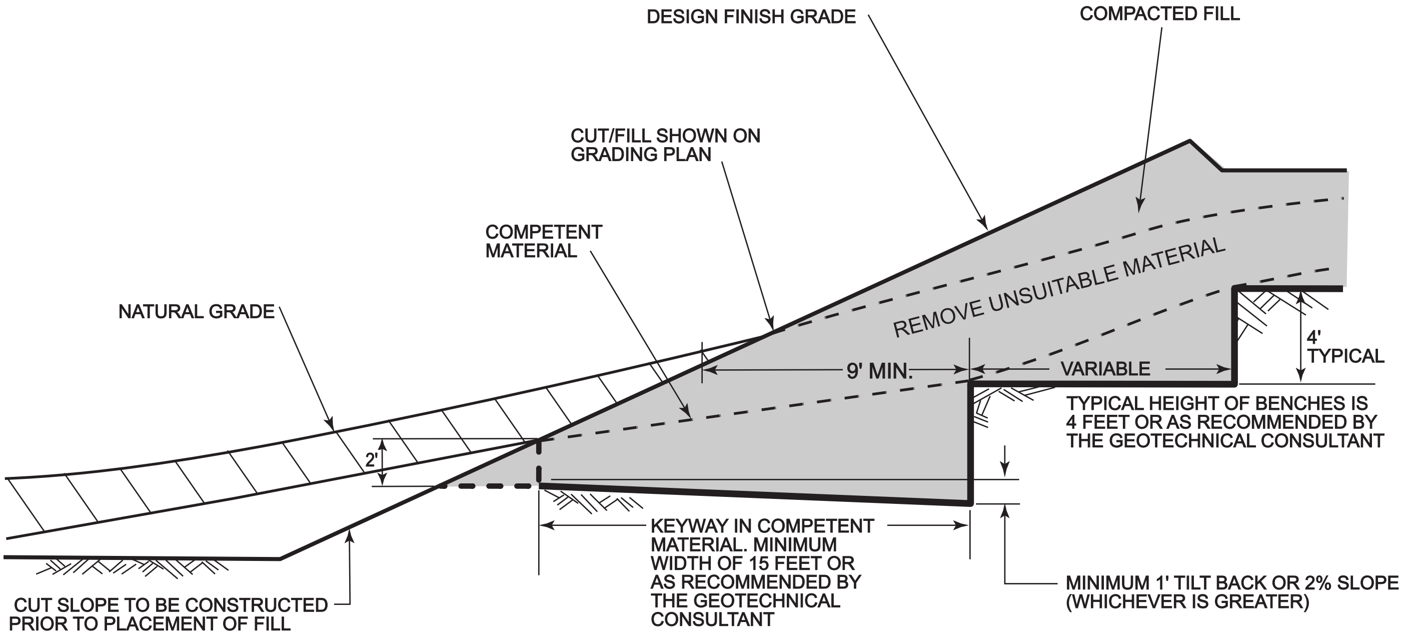

MAINTAIN 9' MIN. HORIZONTAL WIDTH
FROM SLOPE FACE TO BENCH/BACKCUT
DESIGN FINISH GRADE
TOE OF SLOPE SHOWN
ON GRADING PLAN
PROJECTED SLOPE GRADIENT
(1:1 MAXIMUM)
COMPETENT
MATERIAL
PLACE COMPACTED BACKFILL
TO ORIGINAL GRADE
COMPACTED FILL
BACKCUT -- VARIES
NATURAL
GRADE
REMOVE UNSUITABLE MATERIAL
VARIABLE
4' TYPICAL
2' MINIMUM
KEY DEPTH
KEY WAY IN COMPETENT
MATERIAL. MINIMUM
WIDTH OF 15 FEET OR
AS RECOMMENDED BY
THE GEOTECHNICAL
CONSULTANT.
MINIMUM 1' TILT BACK OR 2% SLOPE
(WHICHEVER IS GREATER)

NOTE: BENCHING SHALL BE REQUIRED WHEN SLOPES ARE EQUAL TO OR STEEPER THAN 5H:1V OR WHEN RECOMMENDED BY THE GEOTECHNICAL CONSULTANT. WHERE THE NATURAL SLOPE APPROACHES OR EXCEEDS THE DESIGN SLOPE RATIO, SPECIFIC RECOMMENDATIONS SHOULD BE PROVIDED BY THE GEOTECHNICAL CONSULTANT.

FIGURE 1

TYPICAL FILL KEY ABOVE NATURAL SLOPE
MINIMUM STANDARD GRADING DETAIL

S/A

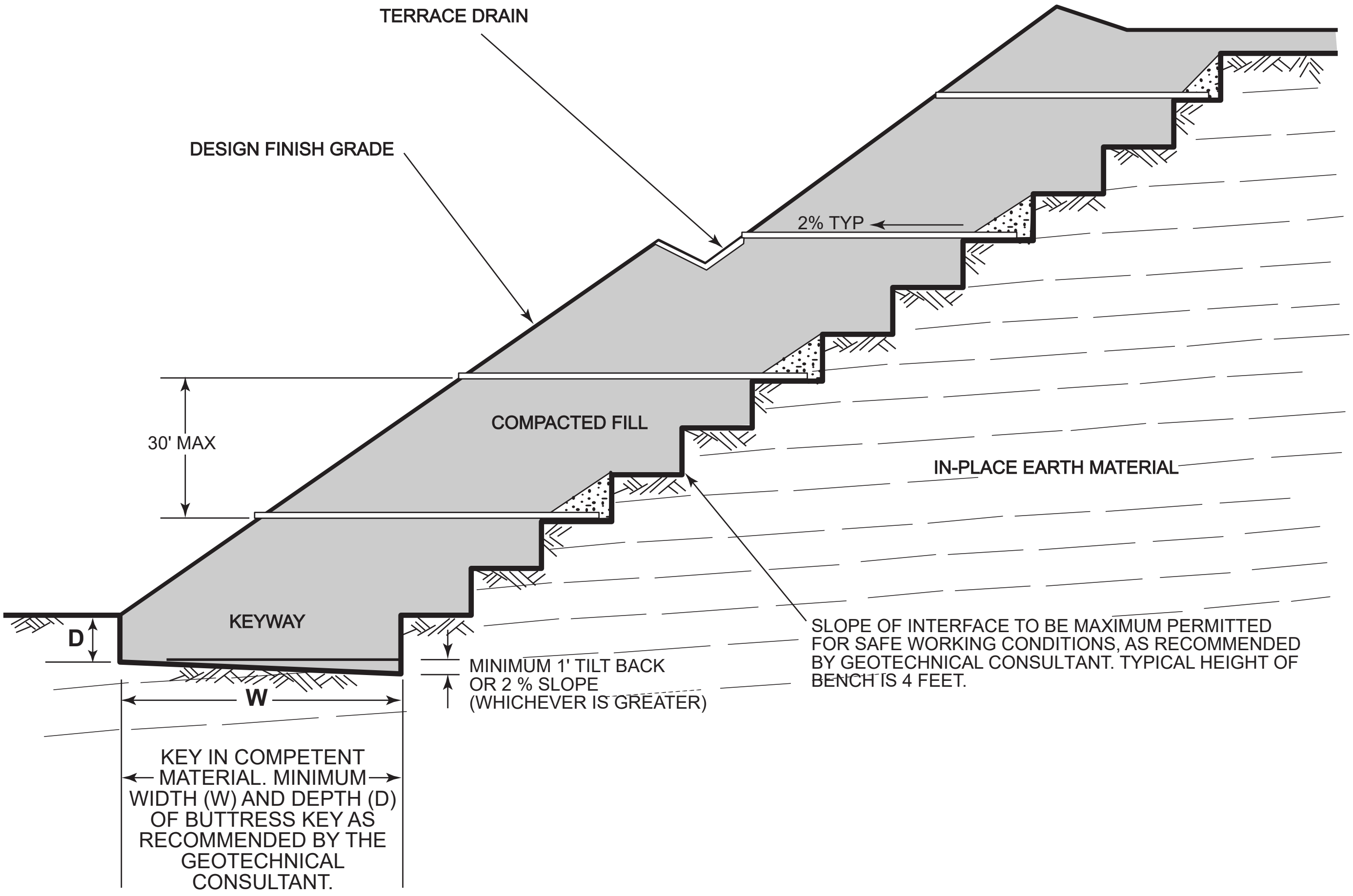

DESIGN FINISH GRADE
COMPACTED FILL
CUT/FILL SHOWN ON GRADING PLAN
COMPETENT MATERIAL
NATURAL GRADE
REMOVE UNSUITABLE MATERIAL
9' MIN.
VARIABLE
4' TYPICAL
TYPICAL HEIGHT OF BENCHES IS 4 FEET OR AS RECOMMENDED BY THE GEOTECHNICAL CONSULTANT
2'
KEYWAY IN COMPETENT MATERIAL. MINIMUM WIDTH OF 15 FEET OR AS RECOMMENDED BY THE GEOTECHNICAL CONSULTANT
MINIMUM 1' TILT BACK OR 2% SLOPE (WHICHEVER IS GREATER)
CUT SLOPE TO BE CONSTRUCTED PRIOR TO PLACEMENT OF FILL

NOTE: BENCHING SHALL BE REQUIRED WHEN SLOPES ARE EQUAL TO OR STEEPER THAN 5H:1V OR WHEN RECOMMENDED BY THE GEOTECHNICAL CONSULTANT. WHERE THE NATURAL SLOPE APPROACHES OR EXCEEDS THE DESIGN SLOPE RATIO, SPECIFIC RECOMMENDATIONS SHOULD BE PROVIDED BY THE GEOTECHNICAL CONSULTANT.

FIGURE 2

TYPICAL FILL ABOVE CUT SLOPE
MINIMUM STANDARD GRADING DETAIL

S/A

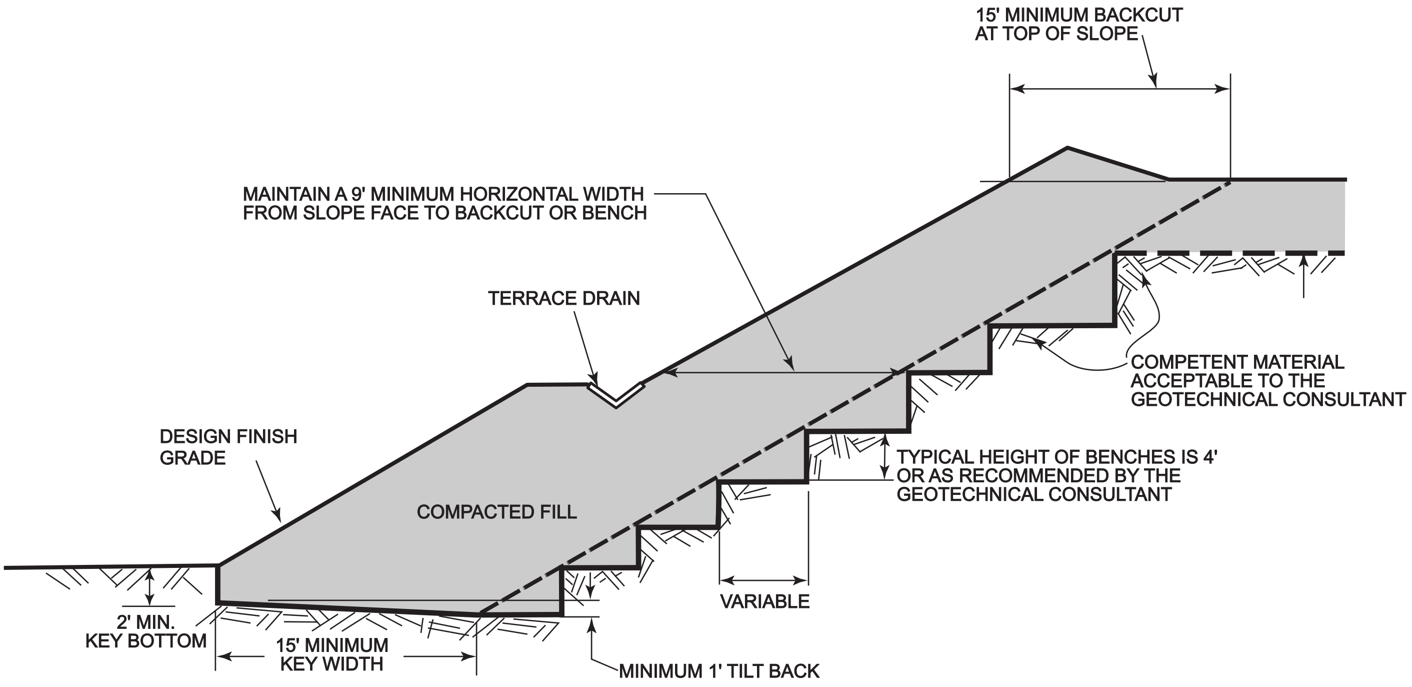

TERRACE DRAIN
DESIGN FINISH GRADE
2% TYP
30' MAX
COMPACTED FILL
IN-PLACE EARTH MATERIAL
KEYWAY
D
W
MINIMUM 1' TILT BACK
OR 2 % SLOPE
(WHICHEVER IS GREATER)
SLOPE OF INTERFACE TO BE MAXIMUM PERMITTED
FOR SAFE WORKING CONDITIONS, AS RECOMMENDED
BY GEOTECHNICAL CONSULTANT. TYPICAL HEIGHT OF
BENCH IS 4 FEET.
KEY IN COMPETENT
MATERIAL. MINIMUM
WIDTH (W) AND DEPTH (D)
OF BUTTRESS KEY AS
RECOMMENDED BY THE
GEOTECHNICAL
CONSULTANT.

NOTE: FOR SUBDRAIN DETAILS, SEE FIGURE 5.

FIGURE 3

TYPICAL BUTTRESS FILL
MINIMUM STANDARD GRADING DETAIL

S/A


15' MINIMUM BACKCUT AT TOP OF SLOPE
MAINTAIN A 9' MINIMUM HORIZONTAL WIDTH FROM SLOPE FACE TO BACKCUT OR BENCH
TERRACE DRAIN
COMPETENT MATERIAL ACCEPTABLE TO THE GEOTECHNICAL CONSULTANT
DESIGN FINISH GRADE
TYPICAL HEIGHT OF BENCHES IS 4' OR AS RECOMMENDED BY THE GEOTECHNICAL CONSULTANT
COMPACTED FILL
VARIABLE
2' MIN. KEY BOTTOM
15' MINIMUM KEY WIDTH
MINIMUM 1' TILT BACK

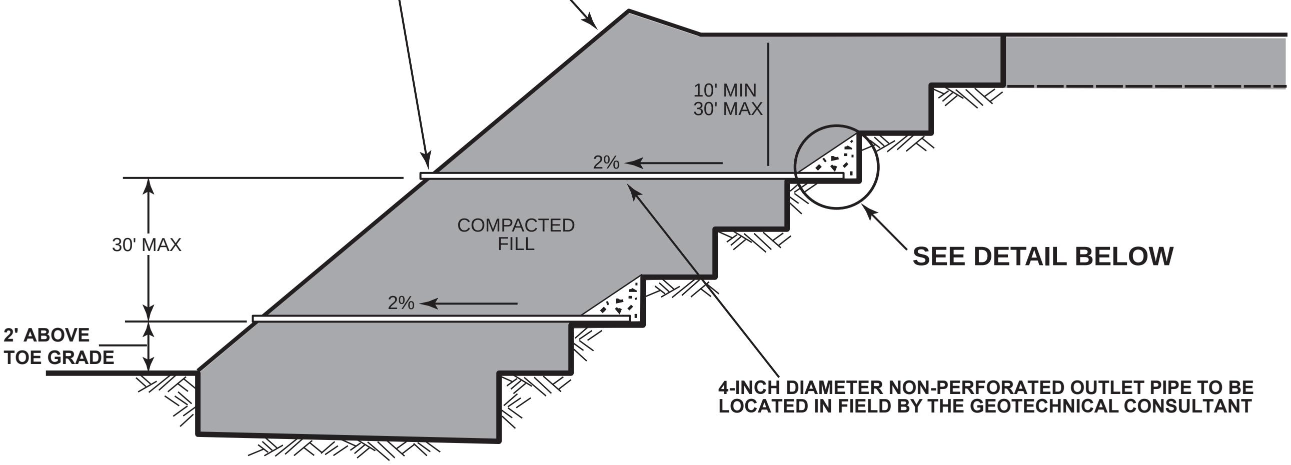
NOTE: FOR SUBDRAIN DETAILS, SEE FIGURE 5.

FIGURE 4

TYPICAL STABILIZATION FILL MINIMUM STANDARD GRADING DETAIL

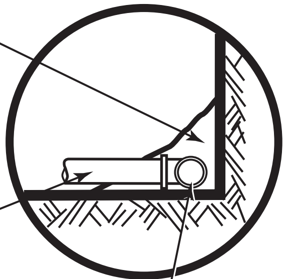
S/A

OUTLETS TO BE SPACED AT 100' MAXIMUM INTERVALS. EXTEND 12 INCHES BEYOND FACE OF SLOPE AT TIME OF ROUGH GRADING CONSTRUCTION.



4-INCH DIAMETER NON-PERFORATED OUTLET PIPE TO BE LOCATED IN FIELD BY THE GEOTECHNICAL CONSULTANT

DETAIL



FILTER MATERIAL - MINIMUM OF THREE CUBIC FEET PER FOOT OF PIPE. SEE FILTER MATERIAL SPECIFICATION.

ALTERNATE: IN LIEU OF FILTER MATERIAL, THREE CUBIC FEET OF GRAVEL PER FOOT OF SUBDRAIN (WITHOUT PIPE) MAY BE ENCASED IN FILTER FABRIC.

GRAVEL TO CONSIST OF 1/2" TO 1" CRUSHED ROCK PER STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION. FIGURE 6 FOR FILTER FABRIC SPECIFICATION

FILTER FABRIC SHALL BE LAPPED A MINIMUM OF 12 INCHES ON ALL JOINTS. SEE FIGURE 6 FOR FILTER FABRIC SPECIFICATION

OUTLET PIPE TO BE CONNECTED TO SUBDRAIN PIPE WITH TEE OR ELBOW

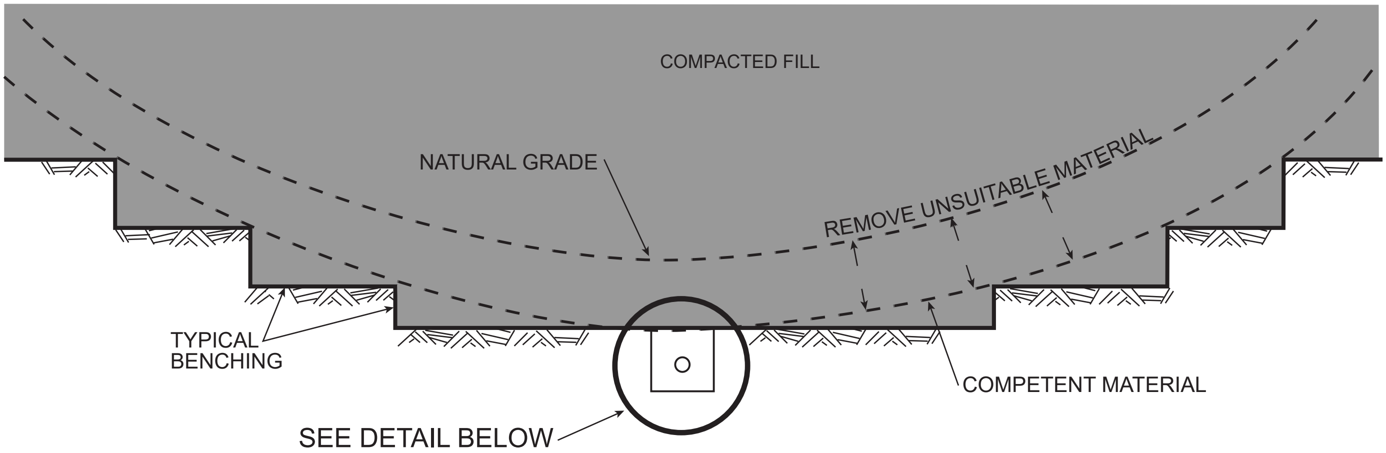
MINIMUM 4-INCH DIAMETER SCHEDULE 40 ASTM D1527 OR D1785 OR SDR 35 ASTM D2751 OR D 3034. FOR FILL DEPTH OF 60 FEET OR GREATER, USE ONLY SCHEDULE 40 OR EQUIVALENT. THERE SHALL BE A MINIMUM OF 8 UNIFORMLY SPACED PERFORATIONS PER FOOT OF PIPE INSTALLED WITH PERFORATIONS ON BOTTOM OF PIPE. PROVIDE CAP AT UPSTREAM END OF PIPE. SLOPE A MINIMUM OF 2 PERCENT TO OUTLET PIPE.

"FILTER MATERIAL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT.

SIEVE SIZE	PERCENTAGE PASSING
1"	100
3/4"	90-100
3/8"	40-100
NO. 4	25-40
NO. 8	18-33
NO. 30	5-15
NO. 50	0-7
NO. 200	0-3

FIGURE 5

TYPICAL STABILIZATION AND BUTTRESS FILL SUBDRAINS MINIMUM STANDARD GRADING DETAIL


COMPACTED FILL
NATURAL GRADE
REMOVE UNSUITABLE MATERIAL
TYPICAL BENCHING
COMPETENT MATERIAL
SEE DETAIL BELOW

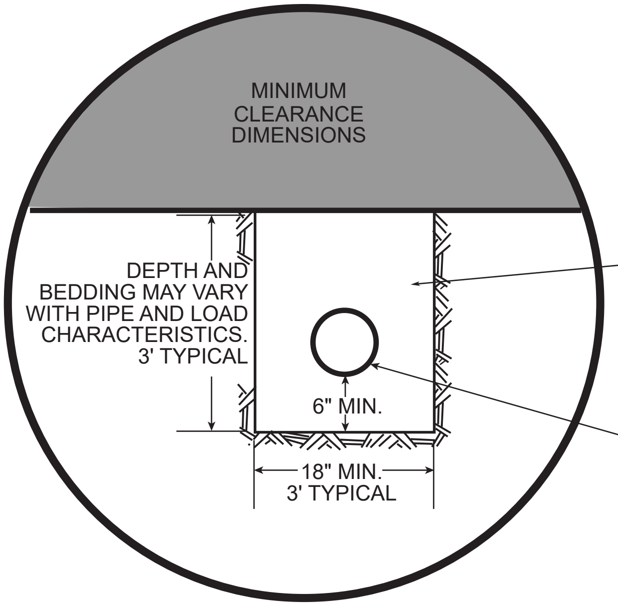
FILTER FABRICS SHALL BE PERMEABLE NON-WOVEN POLYESTER, NYLON, OR POLYPROPYLENE MATERIAL CONFORMING TO THE FOLLOWING:

1) GRAB TENSILE STRENGTH. POUNDS, MIN. ASTM D 4632	90
2) ELONGATION, AT PEAK LOAD, PERCENT, MIN. ASTM D 4632	50
3) PUNCTURE STRENGTH, LBS., MIN. ASTM D 3787	45
4) COEFFICIENT OF WATER PERMITTIVITY, 1/SEC. ASTM D 4491	>0.7
5) BURST STRENGTH, P.S.I., MIN. ASTM D 3786	180

NOTES: DOWNSTREAM 20' OF PIPE AT OUTLET SHALL BE NON-PERFORATED AND BACKFILLED WITH FINE-GRAINED MATERIAL

PIPE SHALL BE A MINIMUM OF 4-INCH DIAMETER. FOR RUNS OF 500 FEET OR MORE, USE 6-INCH DIAMETER PIPE, OR AS RECOMMENDED BY THE GEOTECHNICAL CONSULTANT

DETAIL


MINIMUM CLEARANCE DIMENSIONS
DEPTH AND BEDDING MAY VARY WITH PIPE AND LOAD CHARACTERISTICS. 3' TYPICAL
6" MIN.
18" MIN. 3' TYPICAL

FILTER MATERIAL - MINIMUM OF NINE CUBIC FEET PER FOOT OF PIPE. SEE FIGURE 5 FOR FILTER MATERIAL SPECIFICATIONS.

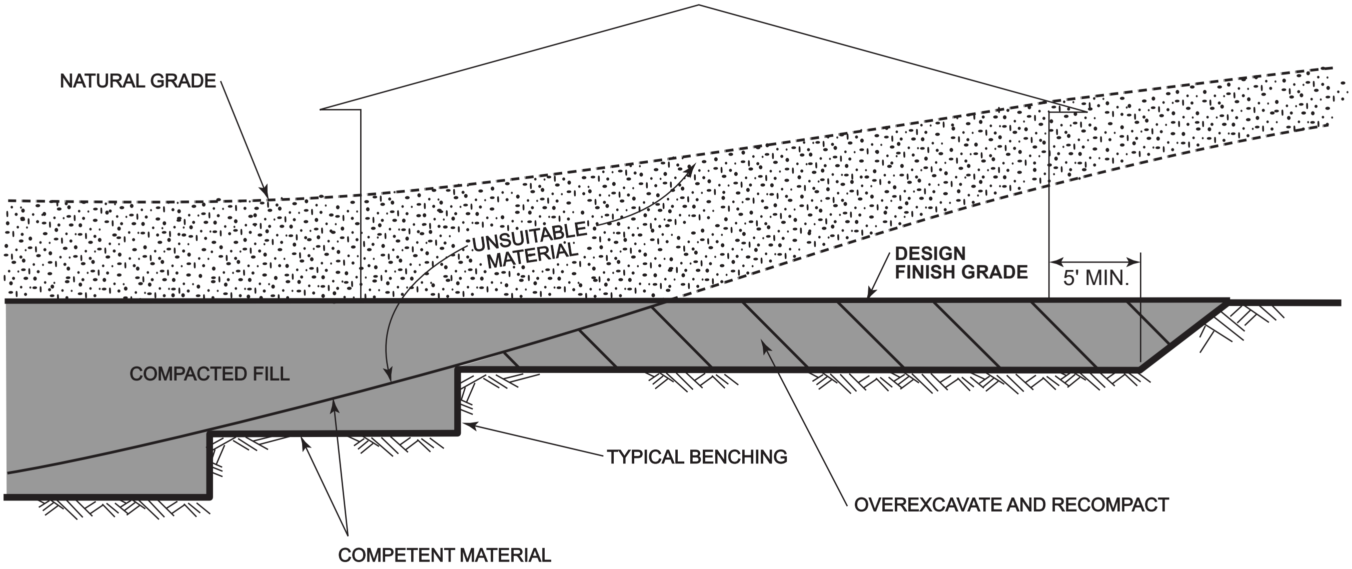
ALTERNATE: IN LIEU OF FILTER MATERIAL, NINE CUBIC FEET OF GRAVEL PER FOOT OF SUBDRAIN (WITHOUT PIPE) MAY BE ENCASED IN FILTER FABRIC. SEE FIGURE 5 TO GRAVEL SPECIFICATION. SEE ABOVE FOR FILTER FABRIC SPECIFICATION. FILTER FABRIC SHALL BE LAPPED MINIMUM OF 12 INCHES ON ALL JOINTS.

MINIMUM 4 INCH DIAMETER SCHEDULE 40 ASTM D 1527, OR D 1785, OR SDR 35 ASTM 2751 OR D 3034. FOR FILL DEPTH OF 60 FEET OR GREATER, USE ONLY SCHEDULE 40 OR APPROVED EQUIVALENT. THERE SHALL BE A MINIMUM OF 8 UNIFORMLY SPACED PERFORATIONS PER FOOT OF PIPE INSTALLED WITH PERFORATIONS ON BOTTOM OF PIPE.

FIGURE 6

TYPICAL CANYON SUBDRAIN
MINIMUM STANDARD GRADING DETAIL

CUT LOT


NATURAL GRADE
UNSUITABLE MATERIAL
DESIGN FINISH GRADE
5' MIN.
COMPACTED FILL
TYPICAL BENCHING
OVEREXCAVATE AND RECOMPACT
COMPETENT MATERIAL

CUT/FILL LOT TRANSITION LOT

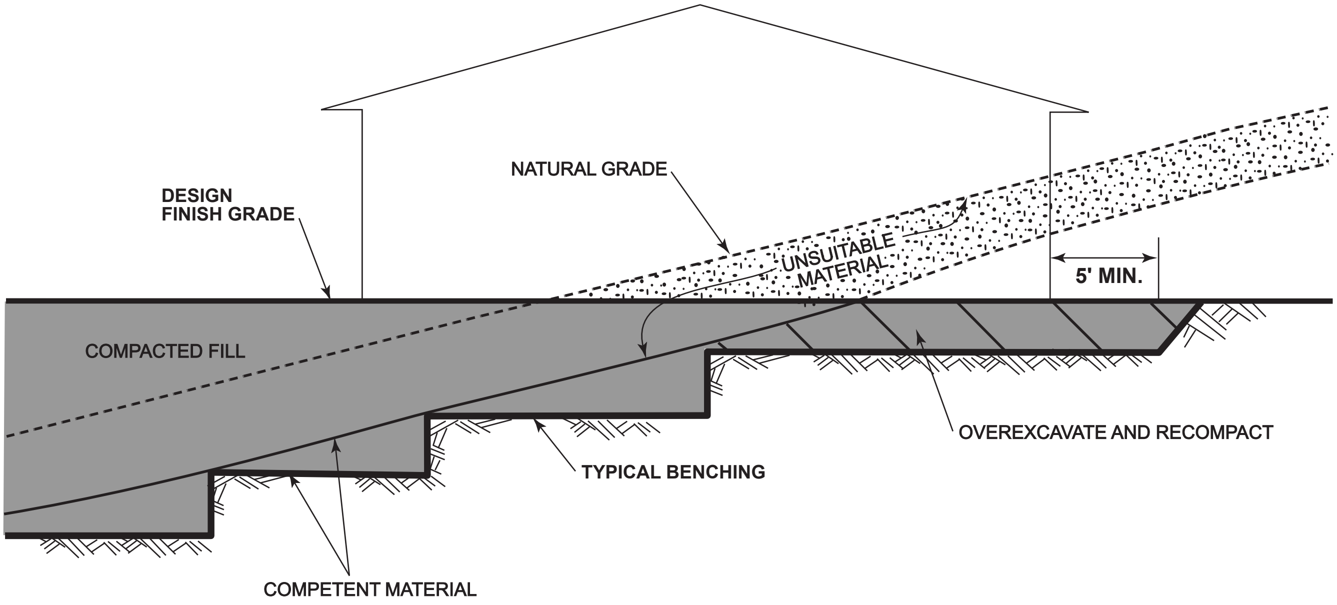
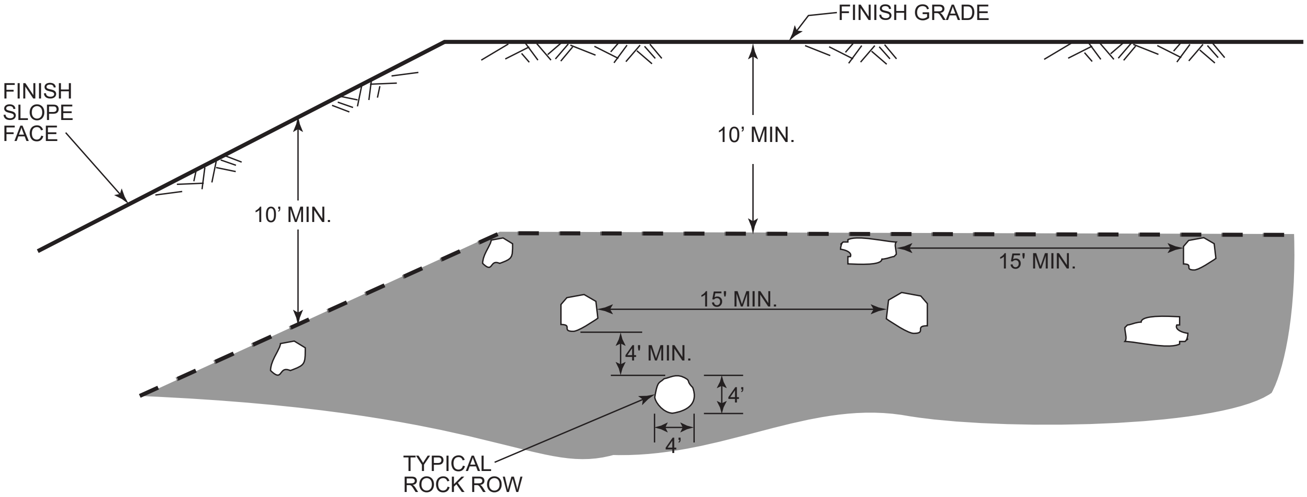
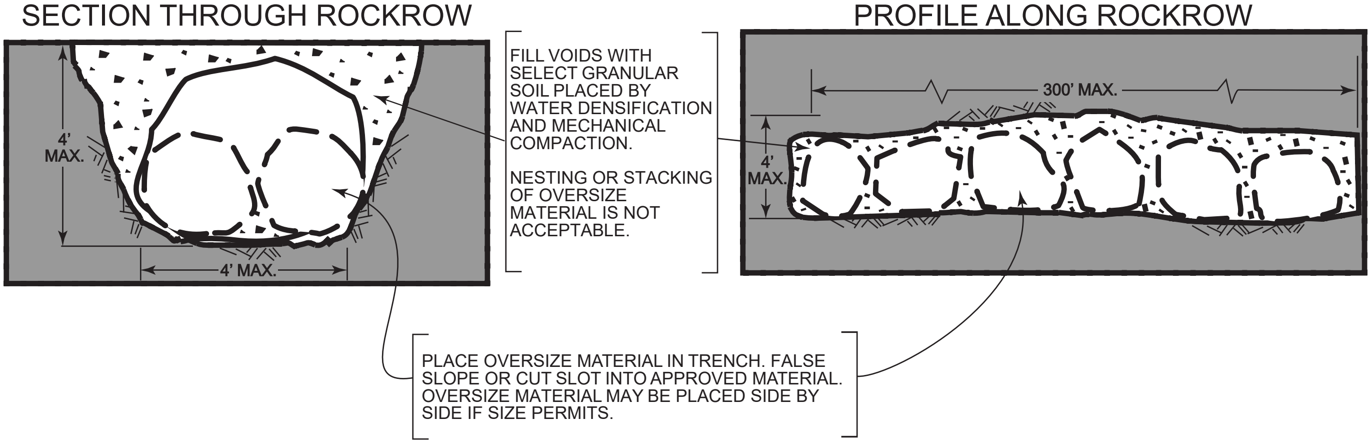

NATURAL GRADE
DESIGN FINISH GRADE
UNSUITABLE MATERIAL
5' MIN.
COMPACTED FILL
OVEREXCAVATE AND RECOMPACT
TYPICAL BENCHING
COMPETENT MATERIAL

FIGURE 7

TYPICAL OVEREXCAVATION OF DAYLIGHT LINE
MINIMUM STANDARD GRADING DETAIL




SECTION THROUGH ROCKROW

PROFILE ALONG ROCKROW

FILL VOIDS WITH SELECT GRANULAR SOIL PLACED BY WATER DENSIFICATION AND MECHANICAL COMPACTION.

NESTING OR STACKING OF OVERSIZE MATERIAL IS NOT ACCEPTABLE.

PLACE OVERSIZE MATERIAL IN TRENCH. FALSE SLOPE OR CUT SLOT INTO APPROVED MATERIAL. OVERSIZE MATERIAL MAY BE PLACED SIDE BY SIDE IF SIZE PERMITS.

NOTES:

A) OVERSIZED ROCK IS DEFINED AS LARGER THAN 12" IN SIZE IN GREATEST DIMENSION.

B) SPACE BETWEEN ROCKROWS SHOULD BE ONE EQUIPMENT WIDTH OR A MINIMUM OF 15 FEET.

C) THE WIDTH AND HEIGHT OF THE ROCKROW SHALL BE LIMITED TO FOUR FEET AND THE LENGTH LIMITED TO 300 FEET UNLESS APPROVED OTHERWISE BY THE GEOTECHNICAL CONSULTANT. OVERSIZE SHOULD BE PLACED WITH FLATEST SIDE ON THE BOTTOM.

D) OVERSIZE MATERIAL EXCEEDING FOUR FEET MAY BE PLACED ON AN INDIVIDUAL BASIS IF APPROVED BY THE GEOTECHNICAL CONSULTANT.

E) FILLING OF VOIDS WILL REQUIRE SELECT GRANULAR SOIL (SE > 20, OR LESS THAN 20 PERCENT FINES) AS APPROVED BY THE GEOTECHNICAL CONSULTANT. VOIDS IN THE ROCKROW TO BE FILLED BY WATER DENSIFYING GRANULAR SOIL INTO PLACE ALONG WITH MECHANICAL COMPACTION EFFORT.

F) IF APPROVED BY THE GEOTECHNICAL CONSULTANT, ROCKROWS MAY BE PLACED DIRECTLY ON COMPETENT MATERIALS OR BEDROCK, PROVIDED ADEQUATE SPACE IS AVAILABLE FOR COMPACTION.

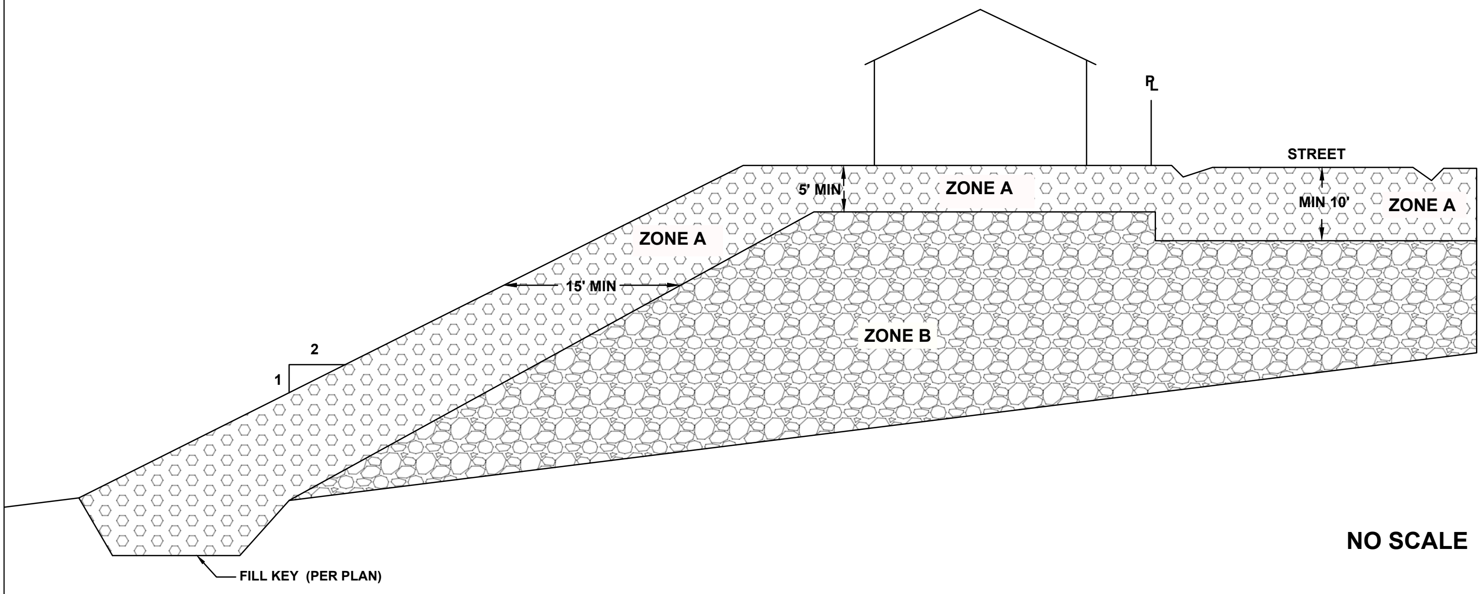
G) THE FIRST LIFT OF MATERIAL ABOVE THE ROCKROW SHALL CONSIST OF GRANULAR MATERIAL AND SHALL BE PROOF-ROLLED WITH A D-8 OR LARGER DOZER OR EQUIVALENT.

H) ROCKROWS NEAR SLOPES SHOULD BE ORIENTED PARALLEL TO SLOPE FACE.

I) NESTING OR STACKING OF ROCKS IS NOT ACCEPTABLE.

FIGURE 8

TYPICAL OVERSIZE ROCK PLACEMENT METHOD
MINIMUM STANDARD GRADING DETAIL



NO SCALE

LEGEND

ZONE A:

- THE UPPER 5 FEET OF FILL UNDER PADS SHOULD NOT HAVE ROCKS GREATER THAN 12 INCHES IN THE LARGEST DIMENSION (12-INCH MINUS).
- FILLS IN PUBLIC STREETS, RIGHT OF WAYS AND EASEMENTS SHOULD CONTAIN ONLY 12-INCH MINUS MATERIALS TO A DEPTH OF 10 FEET BELOW FINISH GRADE OR 2 FEET BELOW THE DEEPEST UTILITY, WHICHEVER IS DEEPER.
- FILLS IN SLOPE AREAS MAY HAVE OVERSIZE ROCK PLACED PER ROCK BLANKET DETAIL TO WITHIN 15 FEET OF SLOPE FACE. FILL WITHIN 15 FEET OF SLOPE FACE SHOULD ONLY CONSIST OF 12-INCH MINUS MATERIAL.

ZONE B:

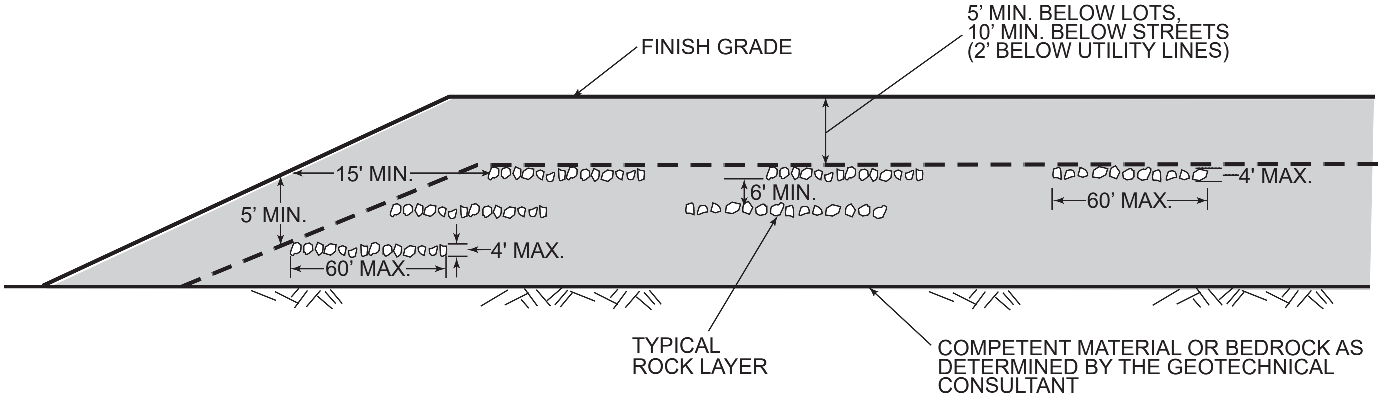
- ROCKS UP TO 2 FEET IN HEIGHT (LYING FLAT) WITH OCCASIONAL INDIVIDUAL FRAGMENTS UP TO 4 FEET MAXIMUM DIMENSION MAY BE PLACED WITHIN ZONE B AREA.
- ROCKS EXCEEDING 2 FEET IN THE SMALLEST DIMENSION MAY BE PLACED IN ROWS WITH THE FLATTEST SIDE DOWN (SEE NEXT PAGE). THE WIDTH OF THE ROWS MAY EXCEED 4 FEET PROVIDED THE FILL OPERATION CAN ACCOMMODATE A MINIMUM OF 15 FEET BETWEEN ROWS, AND PROVIDED THAT THERE IS SUFFICIENT EQUIPMENT TO PLACE FILL AGAINST AND OVER THE ROWS.
- FILL SOILS PLACED AGAINST OR OVER ROCK ROWS SHOULD BE FREE OF ROCKS THAT MAY CAUSE NESTING/VOIDS WITHIN THE ROCK ROWS AND ROCK FILL. THIS CONDITION SHOULD BE CAREFULLY REVIEWED IN THE FIELD BY THE GEOTECHNICAL CONSULTANT TO VERIFY SATISFACTORY OPERATIONS.
- ROCKS UP TO 10 FEET IN THE LEAST DIMENSION MAY BE PLACED AS INDIVIDUAL ROCKS WITHIN THE COMPACTED FILL. THE FILL SOILS NEAR AND AGAINST THESE ROCKS SHOULD BE FREE OF ROCKS THAT MAY CAUSE NESTING/VOIDS WITH THE LARGER ROCKS. THIS CONDITION SHOULD BE CAREFULLY REVIEWED IN THE FIELD BY THE GEOTECHNICAL CONSULTANT TO VERIFY SATISFACTORY OPERATIONS.
- ROCKS, LARGER THAN 10 FEET IN THE SMALLEST DIMENSION, SHOULD BE REDUCED IN SIZE TO MEET THE SPECIFIED DIMENSIONS FOR INDIVIDUAL ROCK PLACEMENT AND/OR FOR PLACEMENT IN ROCK ROWS.

NOTES: CONTINUOUS OBSERVATION IS REQUIRED BY GEOTECHNICAL CONSULTANT DURING ROCK PLACEMENT.

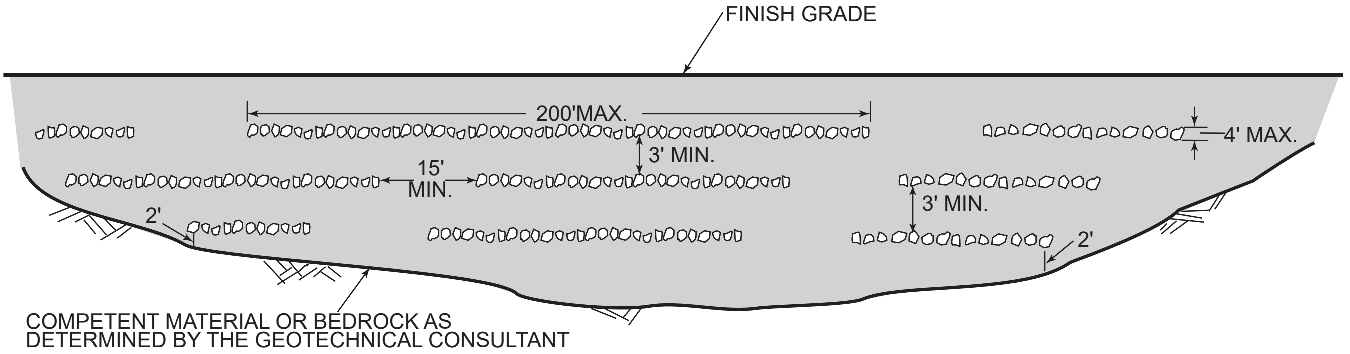
FIGURE 9

STRUCTURAL ROCK FILL PLACEMENT DETAIL

VIEW NORMAL TO SLOPE FACE


FINISH GRADE
5' MIN. BELOW LOTS,
10' MIN. BELOW STREETS
(2' BELOW UTILITY LINES)
15' MIN.
5' MIN.
6' MIN.
4' MAX.
60' MAX.
4' MAX.
60' MAX.
TYPICAL
ROCK LAYER
COMPETENT MATERIAL OR BEDROCK AS
DETERMINED BY THE GEOTECHNICAL
CONSULTANT

VIEW PARALLEL TO SLOPE FACE


FINISH GRADE
200'MAX.
4' MAX.
3' MIN.
15'
MIN.
3' MIN.
2'
2'
COMPETENT MATERIAL OR BEDROCK AS
DETERMINED BY THE GEOTECHNICAL CONSULTANT

NOTES:

1) ORIENTATION AND STAGGERING MAY VARY, BUT SHALL BE AS RECOMMENDED BY THE GEOTECHNICAL CONSULTANT.

2) ROCK LAYERS SHALL NOT BE MORE THAN 4 FEET IN HEIGHT. ROCK SHALL NOT BE STACKED OR NESTED.

3) EACH ROCK CELL MUST BE COVERED WITH A GRANULAR SOIL WITH A MINIMUM SAND EQUIVALENT (SE) OF 20 OR WITH LESS THAN 10% PASSING THE NO. 200 SIEVE AS DETERMINED BY THE GEOTECHNICAL CONSULTANT. THE GRANULAR SOIL IS TO BE FLUSHED, FLOODED, AND JETTED IN THE ROCK LAYER IN ORDER TO FILL THE VOIDS. ADDITIONAL LIFTS OF GRANULAR SOIL SHALL BE PLACED AS NECESSARY TO ALLOW FOR THE FILLING OF VOIDS BY FLOODING, AND JETTING. THE ROCK LAYER SHALL THEN BE ADEQUATELY COMPACTED WITH HEAVY EARTH MOVING EQUIPMENT.

4) ADEQUACY OF ABOVE PROCEDURE SHALL BE VERIFIED BY THE GEOTECHNICAL CONSULTANT.

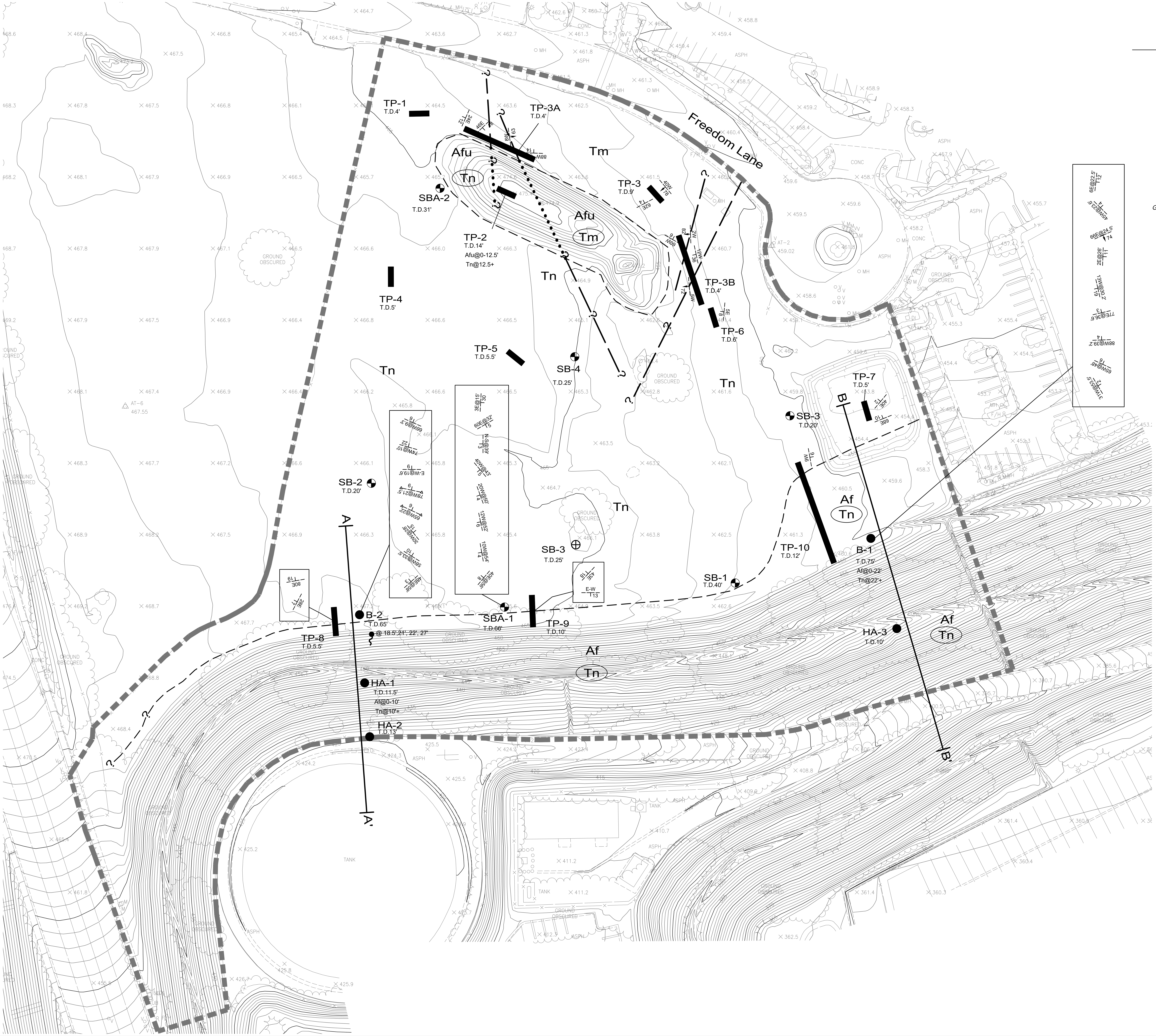
5) ROCKS EXCEEDING 2 FEET IN THE SMALLEST DIMENSION MAY BE PLACED IN ROWS AS SHOWN IN THE FIGURE WITH THE FLATTEST SIDE DOWN. THE WIDTH OF THE ROWS MAY EXCEED 4 FEET PROVIDED THE FILL OPERATION CAN ACCOMMODATE A MINIMUM OF 15 FEET BETWEEN ROWS, AND PROVIDED THAT THERE IS SUFFICIENT EQUIPMENT TO PLACE FILL AGAINST AND OVER THE ROWS. THE FILL SOILS SHOULD BE FREE OF ROCKS THAT MAY CAUSE NESTING/VOIDS WITHIN THE ROCK ROWS. THIS CONDITION SHOULD BE CAREFULLY REVIEWED IN THE FIELD BY THE GEOTECHNICAL CONSULTANT TO VERIFY SATISFACTORY OPERATIONS.

6) ROCKS UP TO 10 FEET IN THE LEAST DIMENSION MAY BE PLACED AS INDIVIDUAL ROCKS WITHIN THE COMPACTED FILL. THE FILL SOILS NEAR AND AGAINST THESE ROCKS SHOULD BE FREE OF ROCKS THAT MAY CAUSE NESTING/VOIDS WITH THE LARGER ROCKS. THIS CONDITION SHOULD BE CAREFULLY REVIEWED IN THE FIELD BY THE GEOTECHNICAL CONSULTANT TO VERIFY SATISFACTORY OPERATIONS.

7) ROCKS, LARGER THAN 10 FEET IN THE SMALLEST DIMENSION, SHOULD BE REDUCED IN SIZE TO MEET THE SPECIFIED DIMENSIONS FOR INDIVIDUAL ROCK PLACEMENT AND/OR FOR PLACEMENT IN ROCK ROWS.

FIGURE 10

OVERSIZE ROCK ROW PLACEMENT
FOR ZONE B STRUCTURAL ROCK FILL


Freedom Lane
TP-1 T.D.4'
TP-3A T.D.4'
TP-2 T.D.14' Afu@0-12.5' Tn@12.5+
TP-3 T.D.9'
TP-3B T.D.4'
TP-4 T.D.5'
TP-5 T.D.5.5'
TP-6 T.D.6'
TP-7 T.D.5'
TP-8 T.D.5.5'
TP-9 T.D.10'
TP-10 T.D.12'
SBA-2 T.D.31'
SBA-1 T.D.66'
SB-1 T.D.40'
SB-2 T.D.20'
SB-3 T.D.25'
SB-3 T.D.20'
SB-4 T.D.25'
B-1 T.D.75' Af@0-22' Tn@22'+
B-2 T.D.65'
@ 18.5',21', 22', 27'
HA-1 T.D.11.5' Af@0-10' Tn@10'+
HA-2 T.D.13'
HA-3 T.D.10'
Afu
Af
Tn
Tm
A
A'
B
B'
TANK
GROUND OBSCURED
ASPH
CONC

LEGEND

EARTH UNITS - CIRCLED WHERE BURIED

Af	ARTIFICIAL FILL
Afu	UNCERTIFIED/UNDOCUMENTED FILL/STOCKPILE
Tn	NIGUEL FORMATION
Tm	MONTEREY FORMATION

SYMBOLS - LOCATIONS ARE APPROXIMATE, QUERIED WHERE UNCERTAIN

— — — —·····	GEOLOGIC CONTACT, DOTTED WHERE BURIED
—— ——● ● ●	FAULT, DOTTED WHERE BURIED

GEOLOGIC ATTITUDES- LOCATIONS ARE APPROXIMATE, DASHED WHERE BURIED

E-W 30	BEDDING
┬	FAULT ATTITUDE
▽—┬—▽	CLAY BED

OTHER SYMBOLS - LOCATIONS ARE APPROXIMATE

● B-2 T.D.65'	APPROXIMATE LOCATION OF BUCKET AUGER BORING, SHOWING TOTAL DEPTH AND DEPTH TO EARTH UNITS IN FEET.
▬ T-10 T.D. 11'	APPROXIMATE TEST PIT LOCATION, SHOWING TOTAL DEPTH AND DEPTH TO EARTH UNITS IN FEET
● HA-3 T.D.10'	APPROXIMATE LOCATION OF HAND-AUGER BORING, SHOWING TOTAL DEPTH AND DEPTH TO EARTH UNITS IN FEET
◕ SB-4 SBA-2 T.D.65'	APPROXIMATE HOLLOW STEM AUGER (SB) OR BUCKET AUGER (SBA) BORING LOCATION BY OTHERS (SOUTHERN CALIFORNIA GEOTECHNICAL, 2021), SHOWING TOTAL DEPTH.
⊕ SB-3 T.D.25'	APPROXIMATE HOLLOW STEM AUGER BORING LOCATION BY OTHERS (SOUTHERN CALIFORNIA GEOTECHNICAL, 2014), SHOWING TOTAL DEPTH.
B├─┤B'	GEOTECHNICAL CROSS-SECTION
●～	SEEPAGE
▬ ▬ ▬	APPROXIMATE SITE BOUDARY

GRAPHIC SCALE

30 0 15 30 60

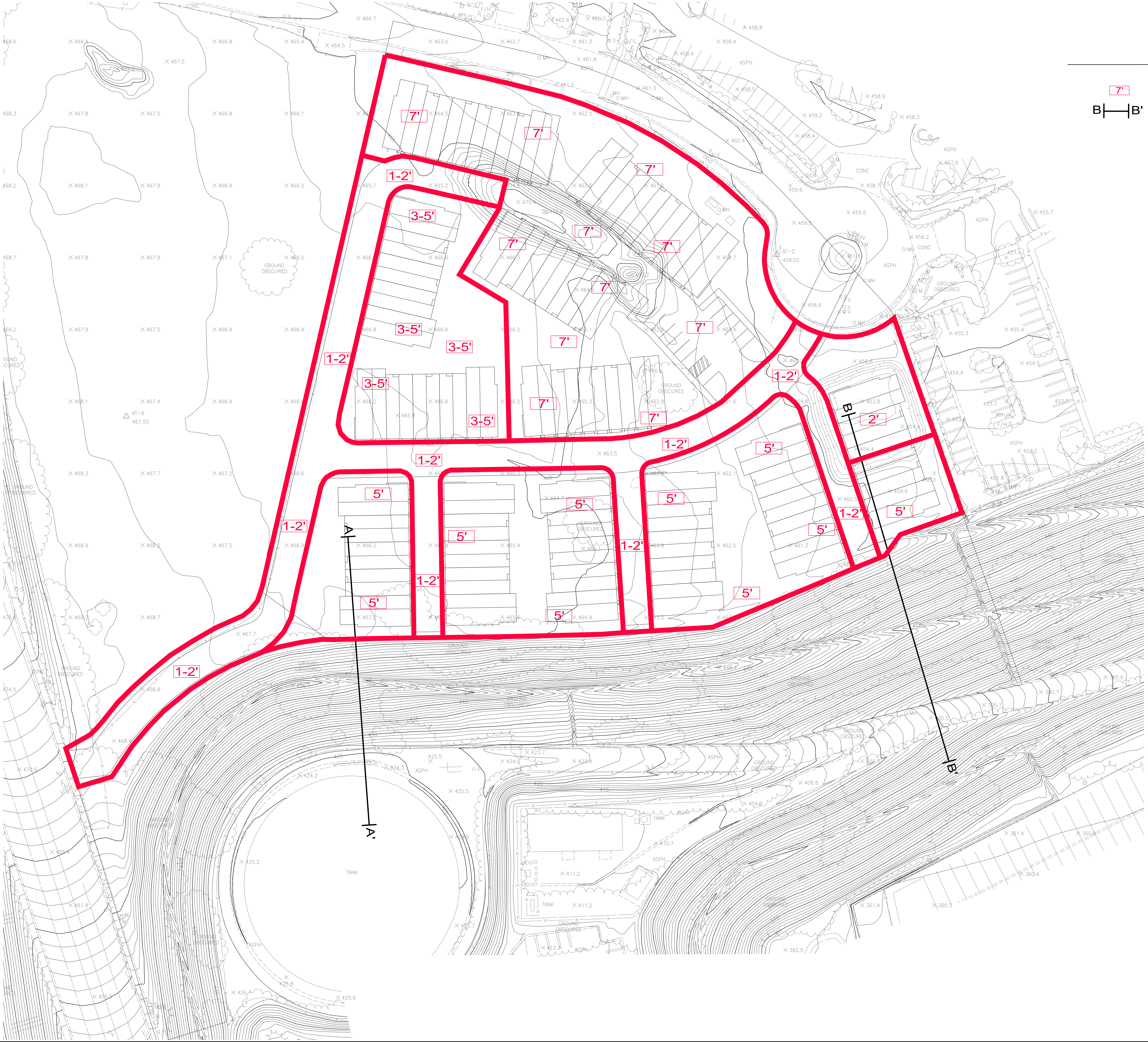
(IN FEET)
1 inch = 30 ft.

PLATE 1

GEOTECHNICAL MAP
400-700 FREEDOM LANE
CITY OF ALISO VIEJO, CALIFORNIA

Project No.: 24064-01 By: RS/AZ
Project Name: Meritage Homes/Freedom Lane
Date: 6/3/2024 SCALE: 1" = 30'

Drawing: P:\2024\24064-01 Meritage - 400-700 Freedom Ln, Aliso Viejo\Drafting_WIP\24064-01 Plate.dwg Layout: 1 Last Saved: Tue Jun 04, 2024 - 5:18pm Last Plotted: Tue Jun 04, 2024 - 5:18pm By: Anthony Zepeda


7'
1-2'
3-5'
5'
2'
A
A'
B
B'
AT-2
459.02
AT-6
467.55
TANK
GROUND OBSCURED
ASPH
CONC
MH
SIGN

LEGEND

7'	RECOMMENDED DEPTH OF REMEDIAL REMOVAL/OVEREXCAVATION, BELOW EXISTING GRADE OR PROPOSED GRADE, WHICHEVER IS LOWER
B├─┤B'	GEOTECHNICAL CROSS-SECTION

GRAPHIC SCALE

30 0 15 30 60

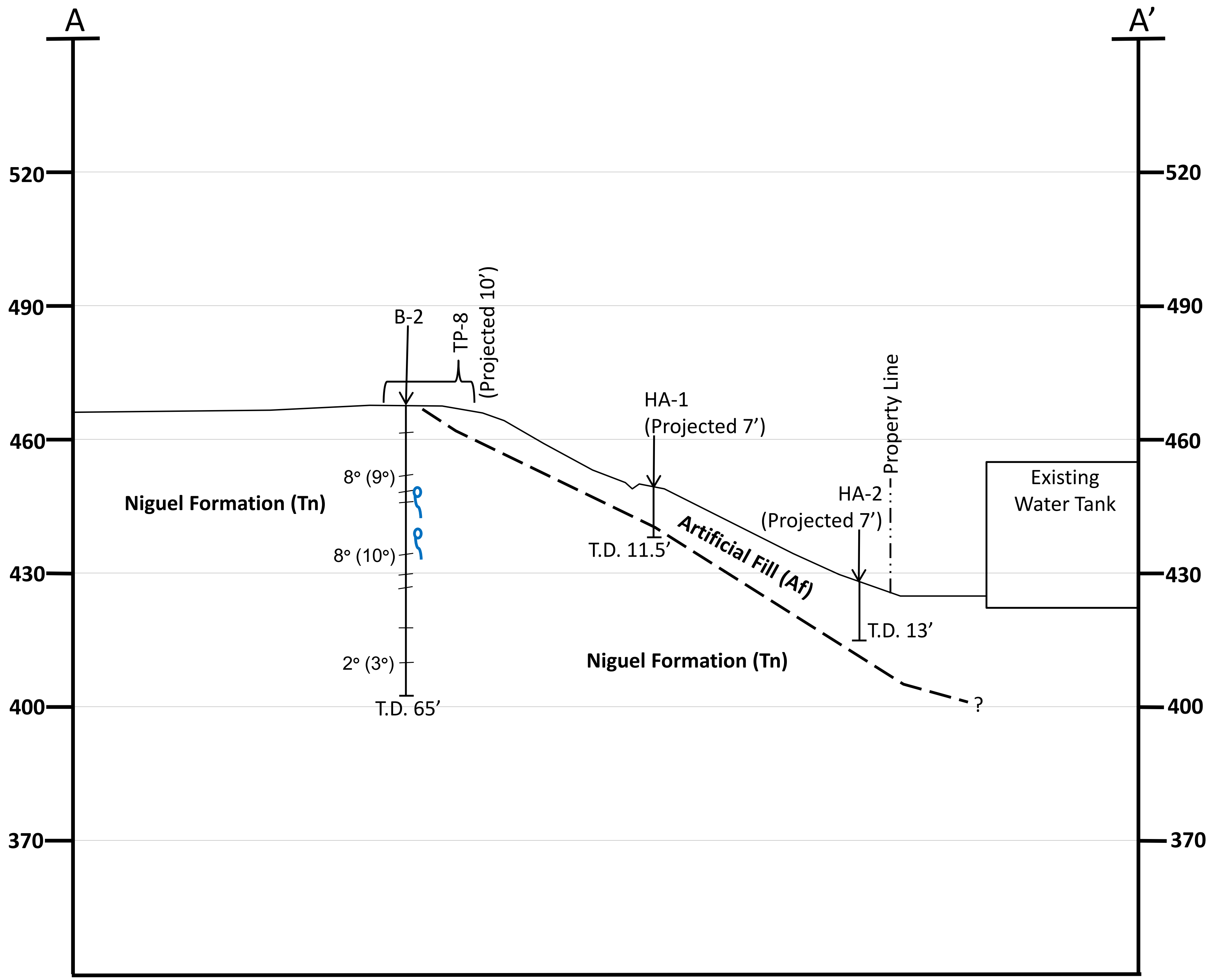
(IN FEET)
1 inch = 30 ft.

PLATE 2

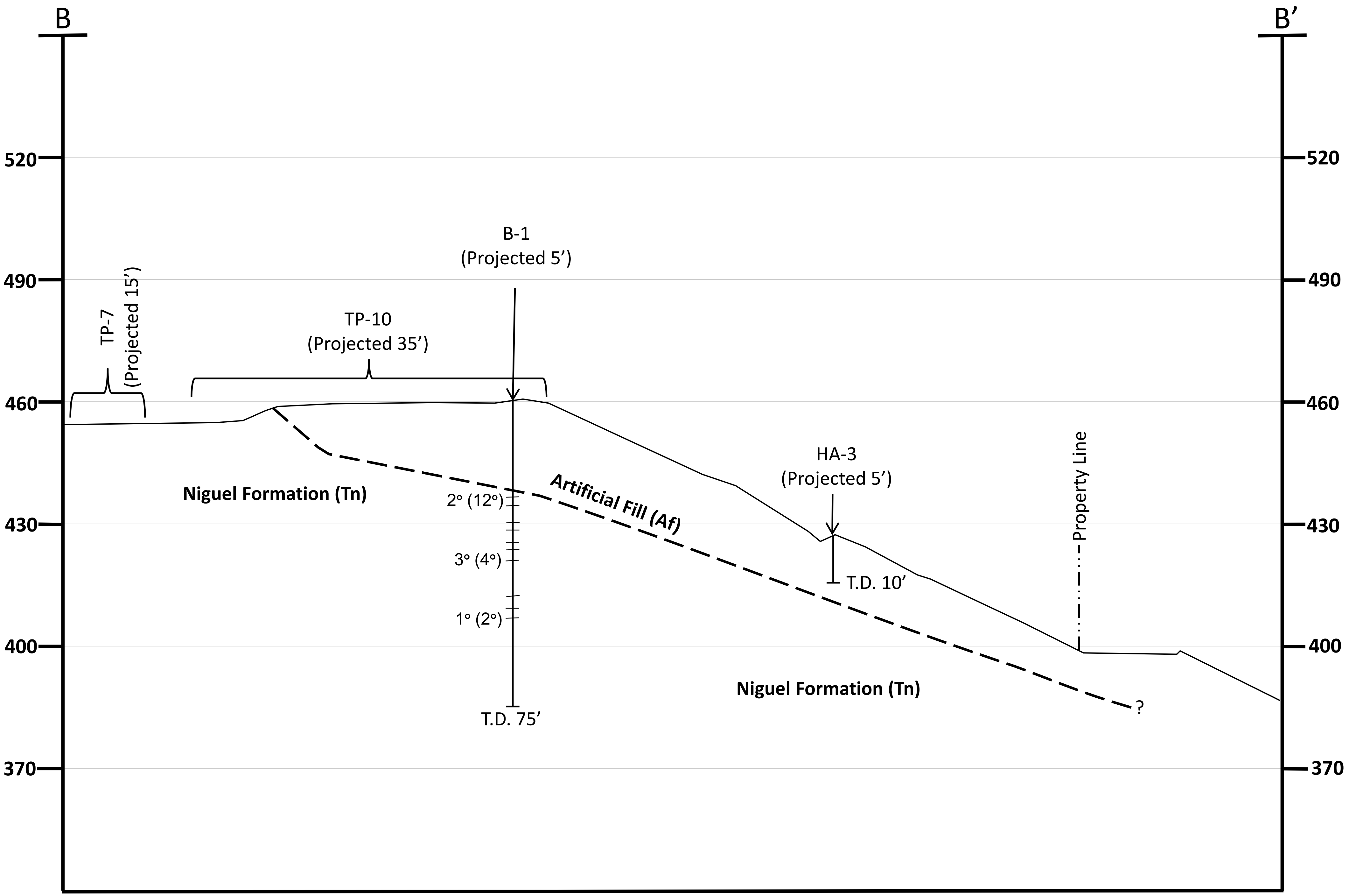
REMEDIAL MEASURES MAP
400-700 FREEDOM LANE
CITY OF ALISO VIEJO, CALIFORNIA

Project No.: 24064-01
By: RS/AZ
Project Name: Meritage Homes/Freedom Lane
Date: 6/3/2024
SCALE: 1" = 30'

Drawing: P:\2024\24064-01 Meritage – 400-700 Freedom Ln, Aliso Viejo\Drafting_WIP\24064-01 Plate – Rem.dwg Layout: 2 Last Saved: Tue Jun 04, 2024 – 5:21pm Last Plotted: Tue Jun 04, 2024 – 5:21pm By: Anthony Zepeda


A
A’
520
490
460
430
400
370
B-2
TP-8
(Projected 10’)
HA-1
(Projected 7’)
Property Line
HA-2
(Projected 7’)
Existing
Water Tank
8° (9°)
8° (10°)
2° (3°)
T.D. 65’
T.D. 11.5’
T.D. 13’
Niguel Formation (Tn)
Artificial Fill (Af)
Niguel Formation (Tn)
?

Legend	**Geotechnical Cross-Section A-A’**	
N3W ← Scale: 1 inch=30 feet	Meritage Homes Proposed Residential Development 400-700 Freedom Lane Aliso Viejo, California	Project Number: 24064-01 Date: June 3, 2024 Plate 3


B
B’
520
490
460
430
400
370
TP-7
(Projected 15’)
TP-10
(Projected 35’)
B-1
(Projected 5’)
Niguel Formation (Tn)
Artificial Fill (Af)
2° (12°)
3° (4°)
1° (2°)
T.D. 75’
HA-3
(Projected 5’)
T.D. 10’
Property Line
?
Niguel Formation (Tn)

Legend

← N15W

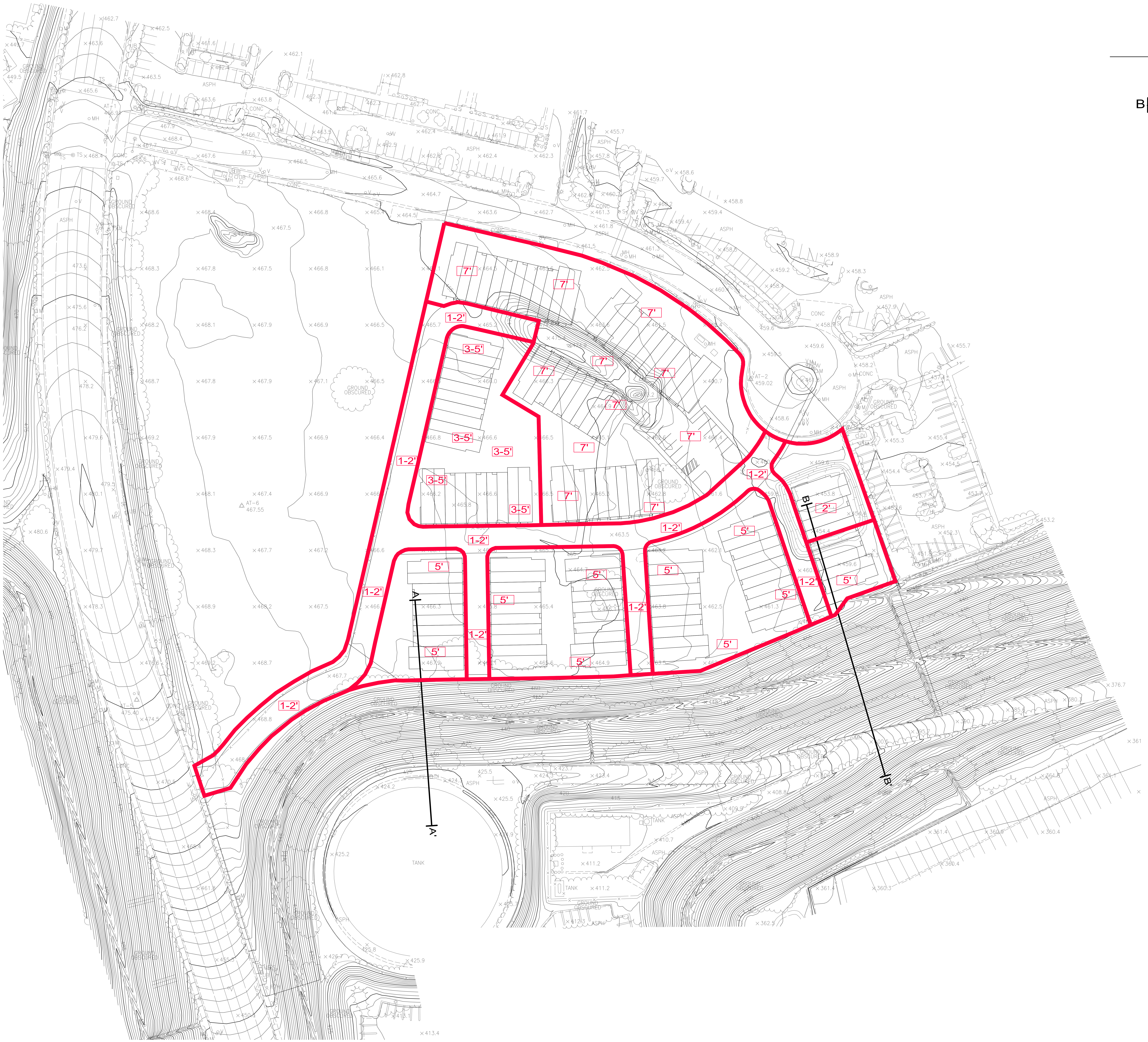
Scale: 1 inch=30 feet

Geotechnical Cross-Section B-B’

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01
Date: June 3, 2024

Plate 4


7'
1-2'
3-5'
5'
2'
A
A'
B
B'
AT-1
AT-2
459.02
AT-5
475.40
AT-6
467.55
TANK
ASPH
CONC
GROUND OBSCURED

LEGEND

7'	RECOMMENDED DEPTH OF REMEDIAL REMOVAL/OVEREXCAVATION, BELOW EXISTING GRADE OR PROPOSED GRADE, WHICHEVER IS LOWER
B⊢⊣B'	GEOTECHNICAL CROSS-SECTION

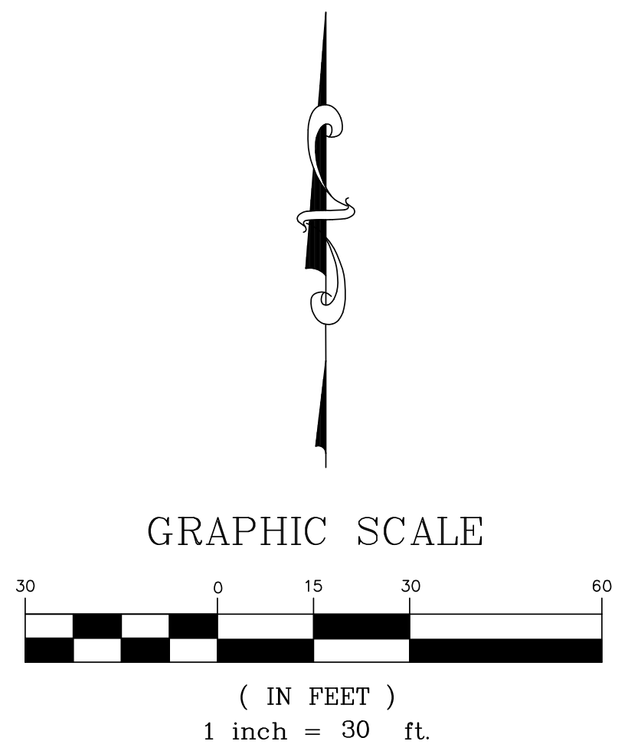

GRAPHIC SCALE
30
0
15
30
60
(IN FEET)
1 inch = 30 ft.

PLATE 2

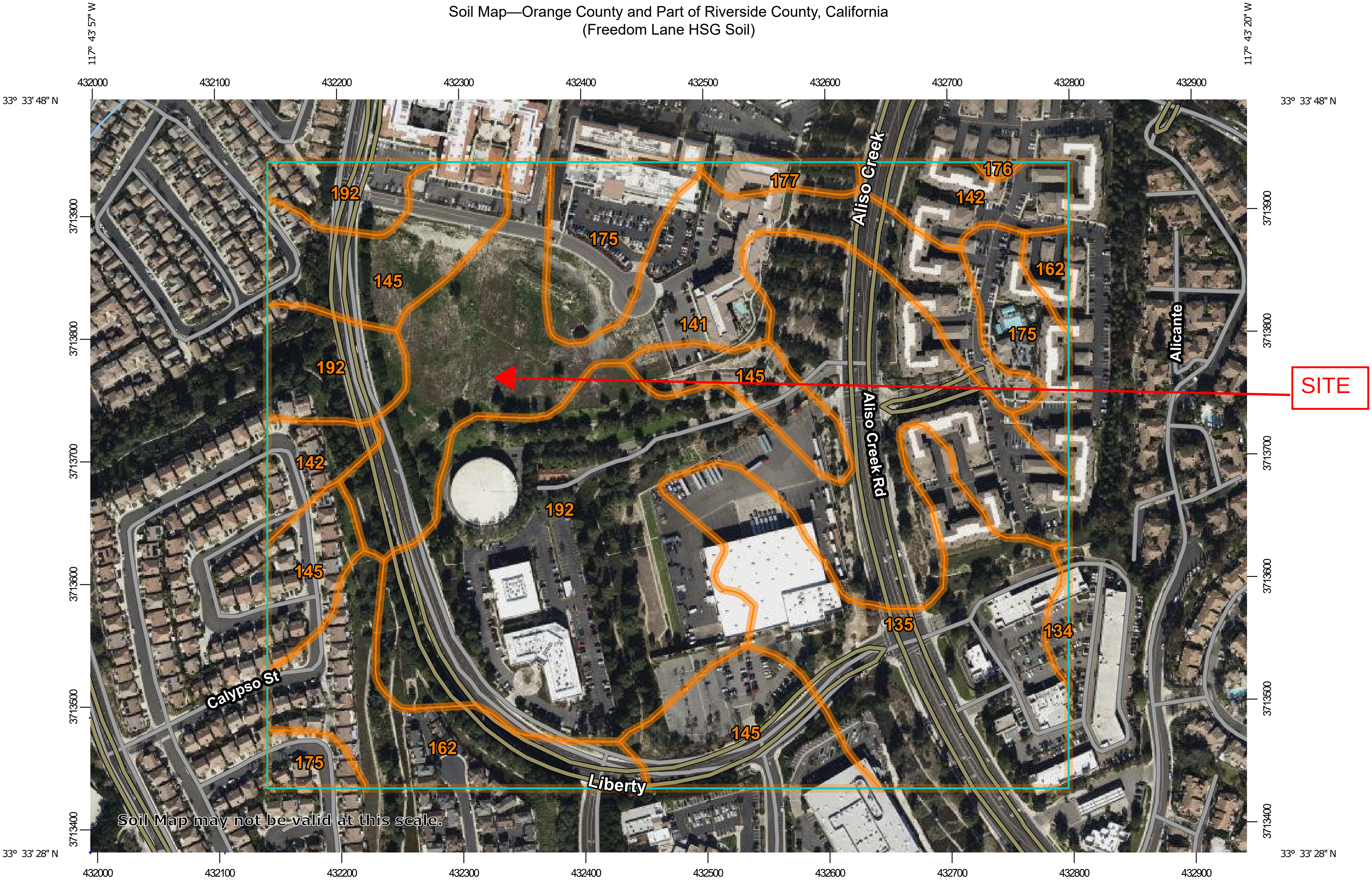
REMEDIAL MEASURES MAP
400-700 FREEDOM LANE
CITY OF ALISO VIEJO, CALIFORNIA

Project No.: 24064-01
By: RS/AZ
Project Name: Meritage Homes/Freedom Lane
Date: 6/3/2024
SCALE: 1" = 30'

Drawing: P:\2024\24064-01 Meritage – 400-700 Freedom Ln, Aliso Viejo\Drafting_WP\24064-01 Plate – Rem.dwg Layout: 2 Last Saved: Mon Jun 03, 2024 – 9:42am Last Plotted: Mon Jun 03, 2024 – 9:42am By: Anthony Zepeda

APPENDIX E

Soil Map—Orange County and Part of Riverside County, California
(Freedom Lane HSG Soil)


117° 43' 57" W
117° 43' 20" W
33° 33' 48" N
33° 33' 28" N
432000
432100
432200
432300
432400
432500
432600
432700
432800
432900
3713900
3713800
3713700
3713600
3713500
3713400
192
177
176
142
175
145
162
141
145
175
192
142
192
145
135
134
145
162
175
Aliso Creek
Aliso Creek Rd
Alicante
Calypso St
Liberty
SITE
Soil Map may not be valid at this scale.

Map Scale: 1:4,330 if printed on A landscape (11" x 8.5") 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 11N WGS84

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
- ʎ 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
- ø Sodic Spot
- ≡ Spoil Area
- ● Stony Spot
- ∞ Very Stony Spot
- ψ 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: Orange County and Part of Riverside County, California
Survey Area Data: Version 17, Aug 30, 2023

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

Date(s) aerial images were photographed: Jan 17, 2023—Feb 8, 2023

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
134	Calleguas clay loam, 50 to 75 percent slopes, eroded	0.3	0.4%
135	Capistrano sandy loam, 2 to 9 percent slopes	12.0	14.5%
141	Cieneba sandy loam, 15 to 30 percent slopes	12.5	15.0%
142	Cieneba sandy loam, 30 to 75 percent slopes, eroded	3.5	4.2%
145	Cieneba-Rock outcrop complex, 30 to 75 percent slopes	11.4	13.7%
162	Marina loamy sand, 2 to 9 percent slopes	5.8	6.9%
175	Myford sandy loam, 9 to 15 percent slopes	6.1	7.3%
176	Myford sandy loam, 15 to 30 percent slopes	0.1	0.1%
177	Myford sandy loam, 9 to 30 percent slopes, eroded	0.8	0.9%
192	Rock outcrop-Cieneba complex, 30 to 75 percent slopes	30.8	37.0%
Totals for Area of Interest		**83.2**	**100.0%**

Orange County and Part of Riverside County, California

141—Cieneba sandy loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: hcmk
Elevation: 500 to 4,000 feet
Mean annual precipitation: 12 to 35 inches
Mean annual air temperature: 57 to 64 degrees F
Frost-free period: 200 to 300 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Cieneba

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from granite

Typical profile

H1 - 0 to 17 inches: sandy loam
H2 - 17 to 59 inches: weathered bedrock

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: 4 to 20 inches to paralithic bedrock
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Ecological site: R019XD060CA - SHALLOW LOAMY
Hydric soil rating: No

Minor Components

Soper, gravelly loam

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

San andreas, sandy loam

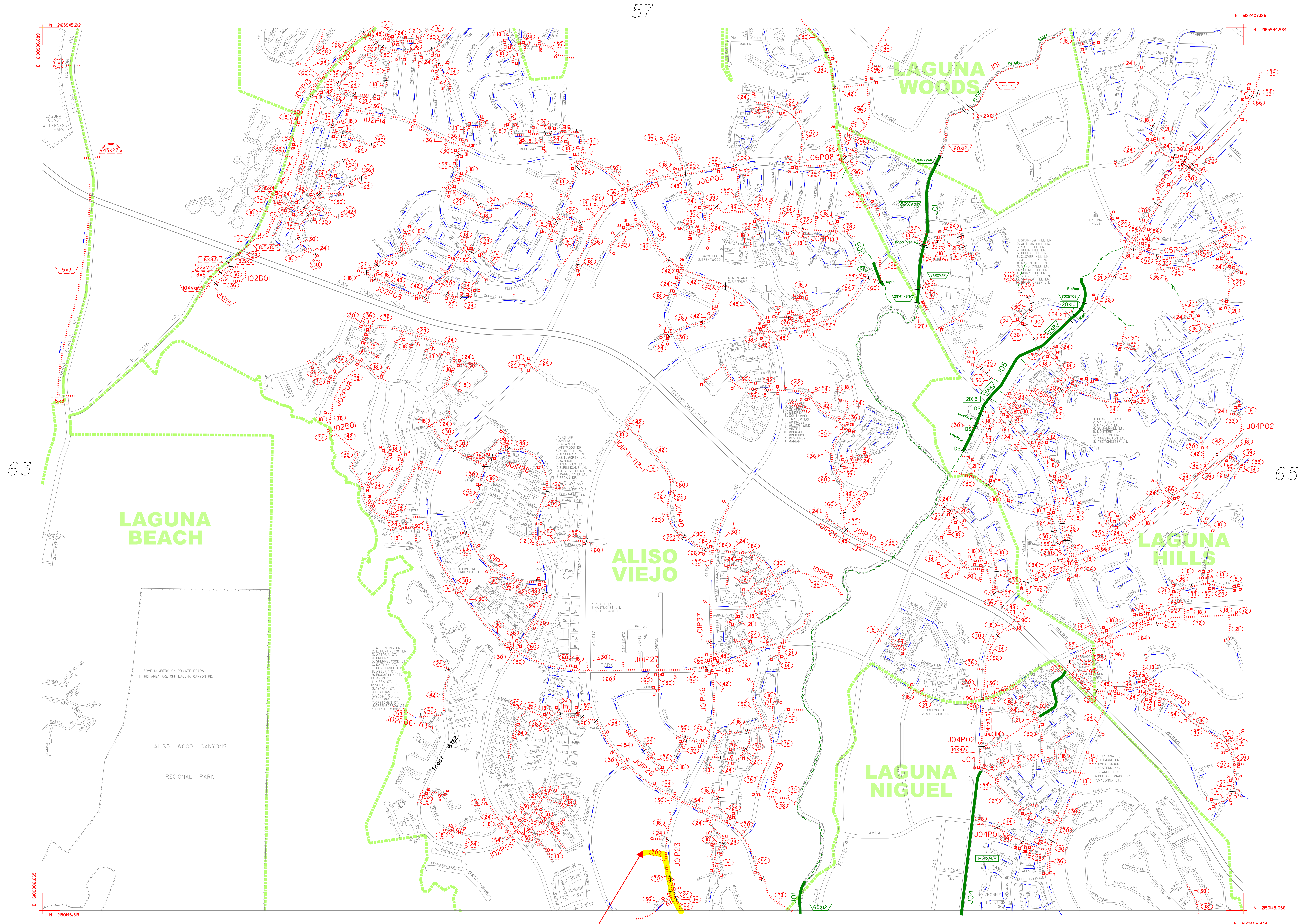
Percent of map unit: 5 percent
Hydric soil rating: No

Anaheim, loam

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

Data Source Information

Soil Survey Area: Orange County and Part of Riverside County, California
Survey Area Data: Version 17, Aug 30, 2023


57
63
65
70
64
LAGUNA WOODS
LAGUNA BEACH
ALISO VIEJO
LAGUNA HILLS
LAGUNA NIGUEL
ALISO WOOD CANYONS
REGIONAL PARK
SOME NUMBERS ON PRIVATE ROADS IN THIS AREA ARE OFF LAGUNA CANYON RD.
J01
J04
J05
J04P02
J01P23
J01P27
J02P08
J02B01
I02P13
I02P14
I02B01
J06P03
J06P08
Tract 15152
SITE
N
Scale: 1"=600'
DRAINAGE ROUTE

NOTICE

This drainage map has been prepared for information purposes only. The location and ownership of facilities have been determined from available information provided by public agencies, but may not be exact. The user of this map is responsible for verifying exact location, ownership and regional versus local character of drainage facilities.
Additional information may be obtained from public plans and recorded deeds.
Character designations shown on this map are for convenience only and are not controlling.
Neither the County of Orange nor The Orange County Flood Control District (OCFCD) assume any liabilities for inaccuracy of this map.

Call: Alan Vu at (714) 834-5986 to notify Public Facility and Resources Department (PFRD) of additions or corrections.

ORANGE COUNTY FLOOD CONTROL DISTRICT

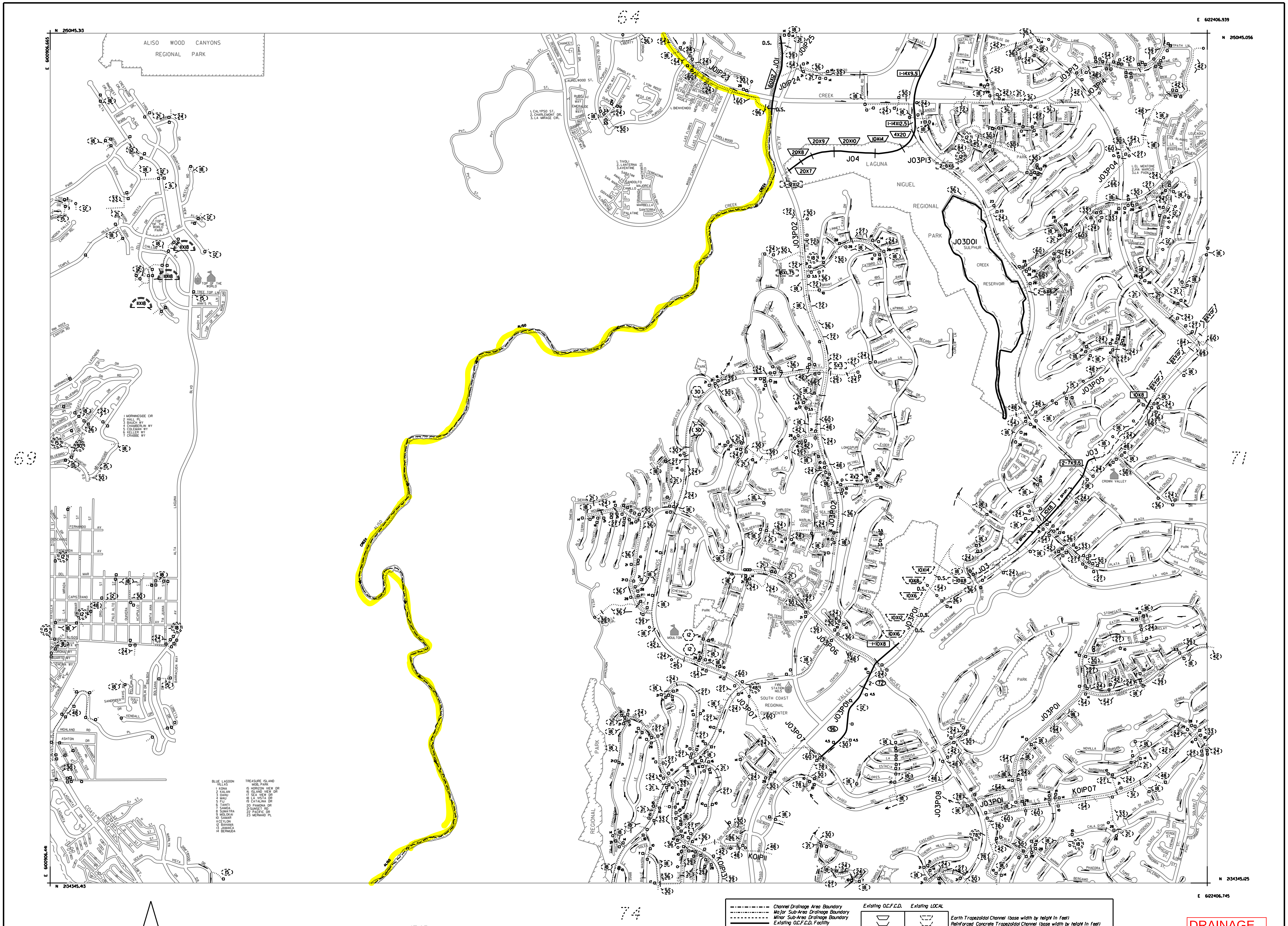
BASEMAP
OF DRAINAGE FACILITIES
IN ORANGE COUNTY

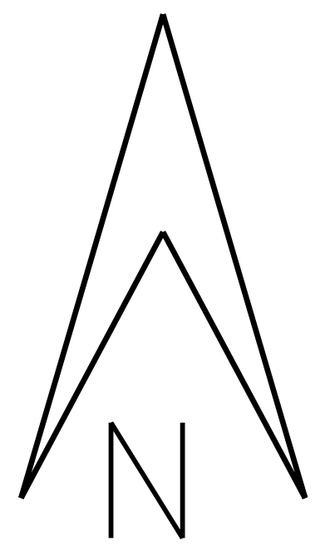
REVISION	DATE	SHEET NO.	DWG. NO.
S.GUTIERREZ	JAN.16 2007	64	MAPS-113-3

Channel Drainage Area Boundary
Major Sub-Area Drainage Boundary
Minor Sub-Area Drainage Boundary
Existing O.C.F.C.D. Facility
Existing Local Facility
Existing Retarding Basin or Reservoir
Natural Watercourse
City Limits
G G *Greenbelt*
P.S. P.S. *Pump Station*
□ *Catch Basin (length in feet)*
○ *Drop Inlet or Other Entry*
Ownership (If other than city or county)
P *Private*
S *State*
F *Federal*

Existing O.C.F.C.D. *Existing LOCAL*

Earth Trapezoidal Channel (base width by height in feet)
Reinforced Concrete Trapezoidal Channel (base width by height in feet)
Reinforced Concrete Rectangular Channel (base width by height in feet)
Reinforced Concrete Box (RCB) (number of barrels-span by height in feet)
Reinforced Concrete Pipe (RCP) (diameter in inches)
Corrugated Metal Pipe (CMP) (diameter in inches)
Concrete Pipe (diameter in inches)
Concrete Oval Pipe (width by height in inches)
Steel Pipe (diameter in inches)
Reinforced Concrete Arch (base span by height in inches)
Corrugated Metal Arch (base span by height in inches)


64
69
71
74
ALISO WOOD CANYONS REGIONAL PARK
ALISO CREEK
LAGUNA NIGUEL REGIONAL PARK
SULPHUR CREEK RESERVOIR
J03D01
J01
J01P23
J01P24
J01P25
J03P13
J03P14
J04
J03P02
J03P04
J03P05
J03
J03P01
J03P06
J03P07
J03P08
K01P07
K01P11
K01P13
SOUTH COAST REGIONAL CENTER
CROWN VALLEY
MOULTON
TOP OF THE WORLD
D.S.
DRAINAGE ROUTE



Scale: 1"=600'

70

NOTICE

This drainage map has been prepared for information purposes only. The location and ownership of facilities have been determined from available information provided by public agencies, but may not be exact. The user of this map is responsible for verifying exact location, ownership and regional versus local character of drainage facilities.
Additional information may be obtained from public plans and recorded deeds.
Character designations shown on this map are for convenience only and are not controlling.
Neither the County of Orange nor The Orange County Flood Control District (OCFCD) assume any liabilities for inaccuracy of this map.

Call: Alan Vu at (714) 834-5986 to notify Public Facility and Resources Department (PFRD) of additions or corrections.

ORANGE COUNTY FLOOD CONTROL DISTRICT

BASEMAP
OF DRAINAGE FACILITIES
IN ORANGE COUNTY

REVISION	DATE	SHEET NO.	DWG. NO.
AVU	JAN.12/2000	70	MAPS-113-3

Channel Drainage Area Boundary
Major Sub-Area Drainage Boundary
Minor Sub-Area Drainage Boundary
Existing O.C.F.C.D. Facility
Existing Local Facility
Existing Retarding Basin or Reservoir
Natural Watercourse
City Limits
G G Greenbelt
P.S. P.S. Pump Station
Catch Basin (length in feet)
Drop Inlet or Other Entry
Ownership (if other than city or county)
P Private
S State
F Federal

Existing O.C.F.C.D. | Existing LOCAL

Earth Trapezoidal Channel (base width by height in feet)
Reinforced Concrete Trapezoidal Channel (base width by height in feet)
Reinforced Concrete Rectangular Channel (base width by height in feet)
Reinforced Concrete Box (RCB) (number of barrels-span by height in feet)
Reinforced Concrete Pipe (RCP) (diameter in inches)
Corrugated Metal Pipe (CMP) (diameter in inches)
Concrete Pipe (diameter in inches)
Concrete Oval Pipe (width by height in inches)
Steel Pipe (diameter in inches)
Reinforced Concrete Arch (base span by height in inches)
Corrugated Metal Arch (base span by height in inches)

70

StormTrap®

MODULAR CONCRETE
STORMWATER MANAGEMENT

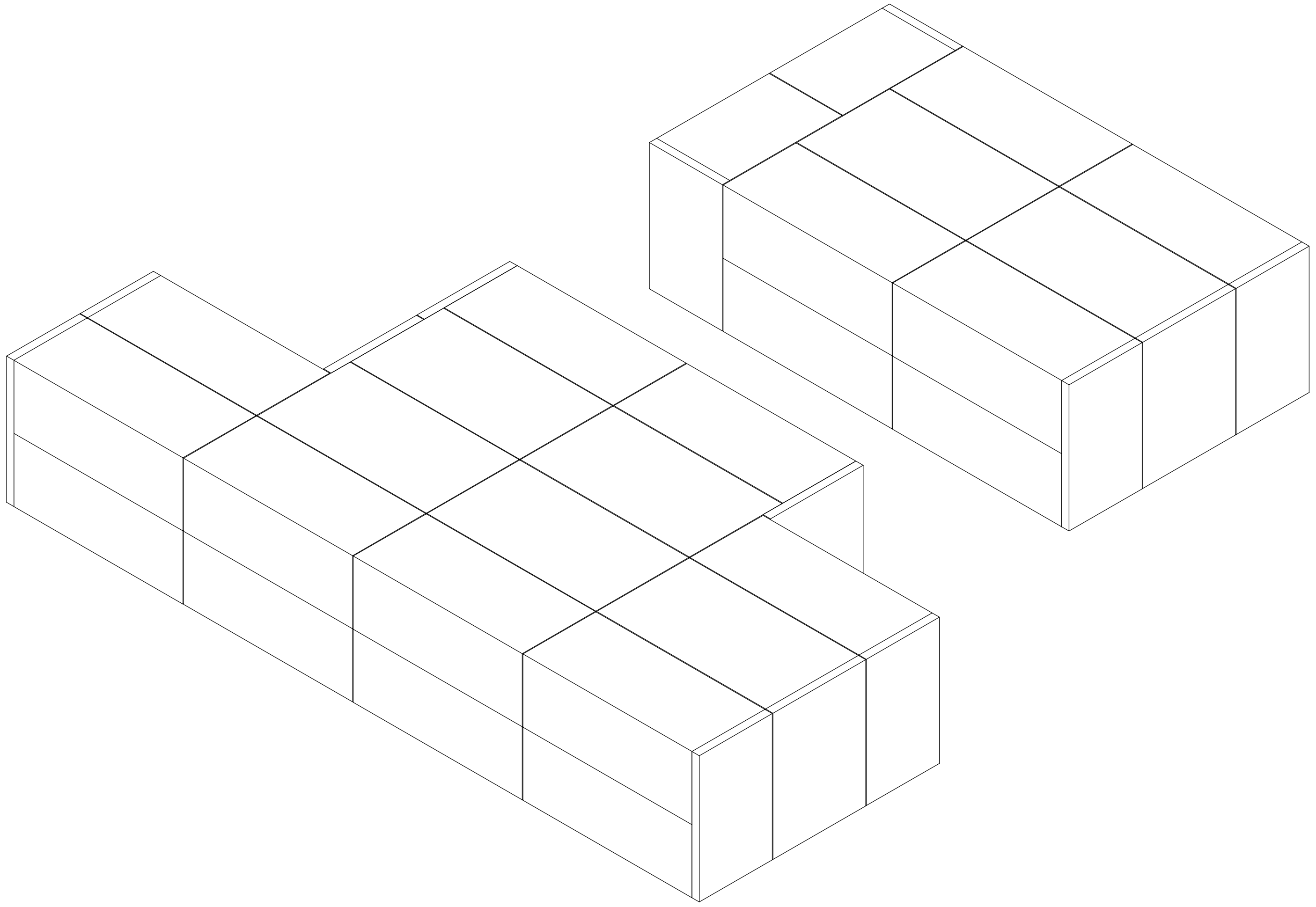
SHEET INDEX

PAGE	DESCRIPTION
0.0	COVER SHEET
1.0	GENERAL NOTES
1.1	DOUBLETRAP DESIGN CRITERIA
2.0	DOUBLETRAP SYSTEM LAYOUT
3.0	DOUBLETRAP INSTALLATION SPECIFICATION
3.1	DOUBLETRAP INSTALLATION SPECIFICATION
4.0	DOUBLETRAP BACKFILL SPECIFICATION
5.0	PIPE / ACCESS OPENING SPECIFICATION
6.0	DOUBLETRAP MODULE TYPES

THE STORMTRAP DRAWINGS SHALL NOT BE ALTERED OR MANIPULATED IN WHOLE OR IN PART WITHOUT WRITTEN CONSENT OF STORMTRAP. USE OF THESE DRAWINGS IS STRICTLY GRANTED TO YOU, OUR CLIENT, FOR THE SPECIFIED AND NAMED PROJECT ONLY. THESE DRAWINGS ARE FOR YOUR REFERENCE ONLY AND SHALL NOT BE USED FOR MANUFACTURING PURPOSES.

STORMTRAP CONTACT INFORMATION

STORMTRAP SUPPLIER:	STORMTRAP
CONTACT NAME:	Charlie Carter
CELL PHONE:	(760) 212-5628
SALES EMAIL:	ccarter@stormtrap.com



Freedom Lane
Aliso Viejo, CA

StormTrap®

PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]

1287 WINDHAM PARKWAY
ROMEOVILLE, IL 60446
P:815-941-4549 / F:331-318-5347

ENGINEER INFORMATION:

X Engineering
6 Hutton Centre Dr.
#650
Santa Ana, CA 92707
949-522-7100

PROJECT INFORMATION:

Freedom Lane

Aliso Viejo, CA

CURRENT ISSUE DATE:

10/16/2025

ISSUED FOR:

PRELIMINARY

REV.	DATE:	ISSUED FOR:	DWN BY:
1	10/16/2025	PRELIMINARY	DG

SCALE:

NTS

SHEET TITLE:

COVER SHEET

SHEET NUMBER:

0.0

GENERAL NOTES:

1. STRUCTURE PROXIMITY LOADING DISCLAIMER:

STORMTRAP MODULES AND FOUNDATION ARE NOT DESIGNED TO ACCEPT ANY ADDITIONAL LOADING FROM ANY NEARBY STRUCTURES NEXT TO OR OVER THE TOP OF STORMTRAP. EXAMPLES OF NEARBY STRUCTURES MAY INCLUDE BUT ARE NOT LIMITED TO BUILDINGS, FOUNDATION ELEMENTS, RETAINING WALLS, LIGHT POLES, BOLLARDS, SIGNPOSTS, FENCES. ADDITIONALLY, STORMTRAP IS NOT RESPONSIBLE FOR INSTALLATION CONFLICTS ARISING FROM ANY OF THESE NEARBY STRUCTURES. IF ADDITIONAL LOADING CONSIDERATIONS ARE REQUIRED FOR STRUCTURAL DESIGN OF STORMTRAP, PLEASE CONTACT STORMTRAP IMMEDIATELY. FOR LIGHT POLES SHOWN OVER THE TOP OF THE SYSTEM, STORMTRAP WILL PROVIDE A 5'–0" LATERAL DISTANCE CAVITY AROUND THE LIGHT POLE TO ACCOMMODATE IT. THE EOR TO TAKE RESPONSIBILITY FOR ENSURING THE LIGHT POLE IS NOT INFLICTING ANY LOADING ON THE STORMTRAP MODULES AND FOUNDATION.

2. TREE LOADING DISCLAIMER:

THE NUMBER OF TREES OR WEIGHT OF TOTAL PLANT MATERIAL PRESENT ON TOP OF A SINGLE STORMTRAP MODULE SHALL NOT EXCEED 16,000 LBS. THE REQUIREMENTS LISTED HERE APPLY AT BOTH THE TIME OF INSTALLATION AND FOR THE LIFE OF THE TREES AND PLANTS IN QUESTION. THE EOR AND LANDSCAPE ARCHITECT ARE RESPONSIBLE FOR ENSURING THAT TREE AND OTHER PLANT ROOTS DO NOT INTERFERE WITH OR COMPROMISE THE FUNCTIONAL AND STRUCTURAL INTEGRITY OF STORMTRAP'S UNDERGROUND MODULES. APPROPRIATE MEASURES SHOULD BE TAKEN TO PREVENT ROOT GROWTH INTO THE STORMTRAP SYSTEM FROM ADJACENT OR OVERHEAD TREES. FURTHERMORE, THE ROOTS OF THE TREES MUST BE CONTAINED TO PREVENT FUTURE DAMAGE TO THE STORMTRAP SYSTEM. STORMTRAP ACCEPTS NO LIABILITY FOR DAMAGES CAUSED BY TREES OR OTHER VEGETATION PLACED AROUND OR ON TOP OF THE SYSTEM.

3. PRE–TREATMENT/SEDIMENT/FILTER CHAMBER DISCLAIMER:

FOR SYSTEMS CONTAINING PRE–TREATMENT, SEDIMENTATION AND/OR FILTER CHAMBERS; IF REQUIRED TO BE SEALED TO PREVENT SAND AND/OR PRE–TREATED WATER FROM MIGRATING INTO ADJOINING MODULES, IT IS THE SOLE RESPONSIBILITY OF THE INSTALLING CONTRACTOR TO ENSURE THAT THOSE MODULES ARE SEALED.

4. OUTLET CONTROL STRUCTURE DISCLAIMER (IF SHOWN ON THESE PLANS):

IF A WATERTIGHT SOLUTION IS REQUIRED FOR AN OUTLET CONTROL STRUCTURE, ALL EXTERIOR COLD JOINTS, INCLUDING JOINT BETWEEN TOP AND BASE MODULES, BETWEEN TOP AND BASE OF ADJOINING SYMONS WALLS, AND JOINTS BETWEEN MODULE AND ADJACENT END PANELS WILL BE THE SOLE RESPONSIBILITY OF THE INSTALLING CONTRACTOR TO PROVIDE AND INSTALL THE WATERTIGHT APPLICATION PER THE EOR'S SPECIFICATION.

StormTrap®

PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]

1287 WINDHAM PARKWAY
ROMEOVILLE, IL 60446
P:815–941–4549 / F:331–318–5347

ENGINEER INFORMATION:

X Engineering
6 Hutton Centre Dr.
#650
Santa Ana, CA 92707
949–522–7100

PROJECT INFORMATION:

Freedom Lane

Aliso Viejo, CA

CURRENT ISSUE DATE:

10/16/2025

ISSUED FOR:

PRELIMINARY

REV.	DATE:	ISSUED FOR:	DWN BY:
△1	10/16/2025	PRELIMINARY	DG

SCALE:

NTS

SHEET TITLE:

GENERAL NOTES

SHEET NUMBER:

1.0

STRUCTURAL DESIGN LOADING CRITERIA

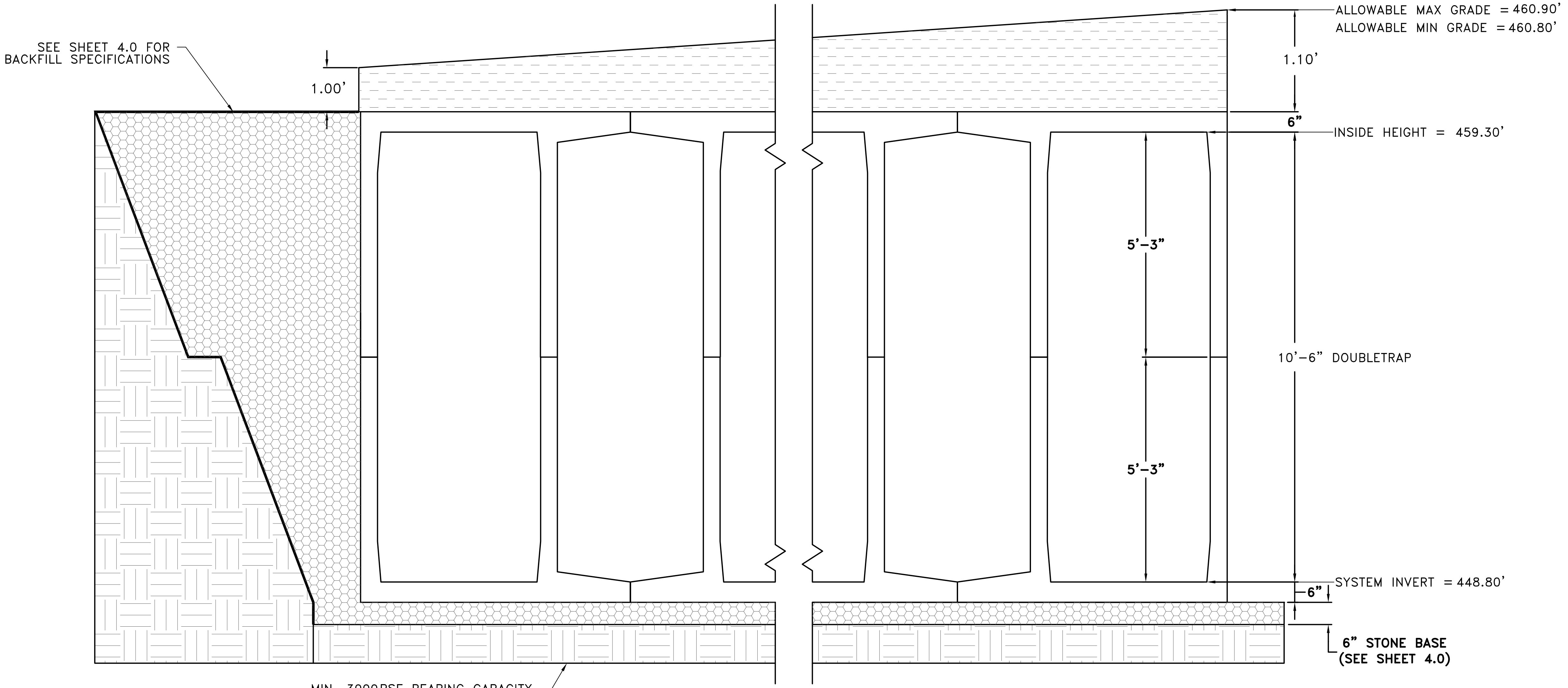
LIVE LOADING: AASHTO HS-20 HIGHWAY LOADING
GROUND WATER TABLE: BELOW INVERT OF SYSTEM
SOIL BEARING PRESSURE: 3000PSF
SOIL DENSITY: 120 PCF
EQUIVALENT UNSATURATED LATERAL ACTIVE EARTH PRESSURE: 35 PSF / FT.
EQUIVALENT SATURATED LATERAL ACTIVE EARTH PRESSURE: 80 PSF/FT. (IF WATER TABLE PRESENT)
APPLICABLE CODES: ASTM C857
ACI-318
BACKFILL TYPE: SEE SHEET 4.0 FOR BACKFILL OPTIONS

STORMTRAP SYSTEM INFORMATION

UNIT HEADROOM: 10'-6" DOUBLETRAP
TOTAL STORAGE PROV: 21,677.95 CUBIC FEET

SITE SPECIFIC DESIGN CRITERIA

1. STORMTRAP UNITS SHALL BE MANUFACTURED AND INSTALLED ACCORDING TO SHOP DRAWINGS APPROVED BY THE INSTALLING CONTRACTOR AND ENGINEER OF RECORD. THE SHOP DRAWINGS SHALL INDICATE SIZE AND LOCATION OF ROOF OPENINGS AND INLET/OUTLET PIPE TYPES, SIZES, INVERT ELEVATIONS AND SIZE OF OPENINGS.
2. COVER RANGE: MIN. 1.00' MAX. 1.10' CONSULT STORMTRAP FOR ADDITIONAL COVER OPTIONS.
3. ALL DIMENSIONS AND SOIL CONDITIONS, INCLUDING BUT NOT LIMITED TO GROUNDWATER AND SOIL BEARING CAPACITY ARE REQUIRED TO BE VERIFIED IN THE FIELD BY OTHERS PRIOR TO STORMTRAP INSTALLATION.
4. FOR STRUCTURAL CALCULATIONS THE GROUND WATER TABLE IS ASSUMED TO BE BELOW INVERT OF SYSTEM IF WATER TABLE IS DIFFERENT THAN ASSUMED, CONTACT STORMTRAP.
5. SYSTEM DESIGN MAY ALLOW FOR INCIDENTAL LEAKAGE AND WILL NOT BE SUBJECT TO LEAKAGE TESTING.


SEE SHEET 4.0 FOR BACKFILL SPECIFICATIONS
1.00'
ALLOWABLE MAX GRADE = 460.90'
ALLOWABLE MIN GRADE = 460.80'
1.10'
6"
INSIDE HEIGHT = 459.30'
5'-3"
10'-6" DOUBLETRAP
5'-3"
SYSTEM INVERT = 448.80'
6"
6" STONE BASE (SEE SHEET 4.0)
MIN. 3000PSF BEARING CAPACITY TO BE VERIFIED IN FIELD BY OTHERS

10'-6" DOUBLETRAP

StormTrap
PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]
1287 WINDHAM PARKWAY
ROMEOVILLE, IL 60446
P:815-941-4549 / F:331-318-5347

ENGINEER INFORMATION:

X Engineering
6 Hutton Centre Dr.
#650
Santa Ana, CA 92707
949-522-7100

PROJECT INFORMATION:

Freedom Lane

Aliso Viejo, CA

CURRENT ISSUE DATE:

10/16/2025

ISSUED FOR:

PRELIMINARY

REV.	DATE:	ISSUED FOR:	DWN BY:
△1	10/16/2025	PRELIMINARY	DG

SCALE:

NTS

SHEET TITLE:

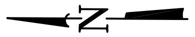
DOUBLETRAP DESIGN CRITERIA

SHEET NUMBER:

1.1

BILL OF MATERIALS

QTY.	UNIT TYPE	DESCRIPTION	TOP WEIGHT	BASE WEIGHT
7	I	10’–6” DOUBLETRAP	15646	15444
0	II	10’–6” DOUBLETRAP	–	–
11	III	10’–6” DOUBLETRAP	15728	15627
1	IV	10’–6” DOUBLETRAP	17018	16917
0	VII	10’–6” DOUBLETRAP	–	–
0	VII–1	10’–6” DOUBLETRAP	–	–
0	VII–2	10’–6” DOUBLETRAP	–	–
0	VII–3	10’–6” DOUBLETRAP	–	–
0	VII–4	10’–6” DOUBLETRAP	–	–
0	SPIII	10’–6” DOUBLETRAP	VARIES	VARIES
2	SPIV	10’–6” DOUBLETRAP	VARIES	VARIES
5	T2 PANEL	8” THICK PANEL	9679	
8	T4 PANEL	8” THICK PANEL	7618	
0	T7 PANEL	8” THICK PANEL	–	
7	JOINT WRAP	150’ PER ROLL		
32	JOINT TAPE	14.5’ PER ROLL		
TOTAL PIECES = 42				
TOTAL PANELS = 13				
HEAVIEST PICK WEIGHT = 17018				

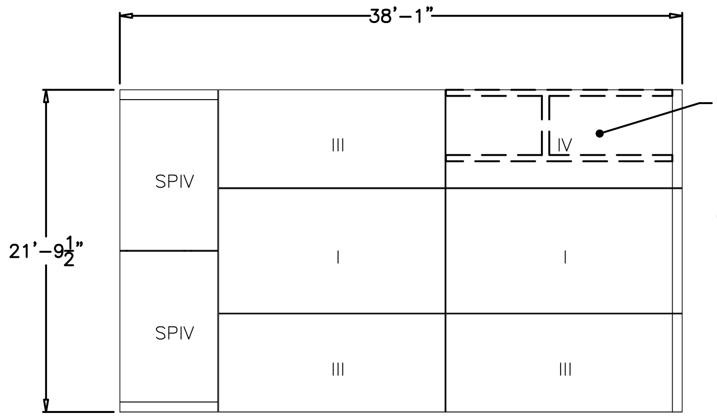


DESIGN CRITERIA

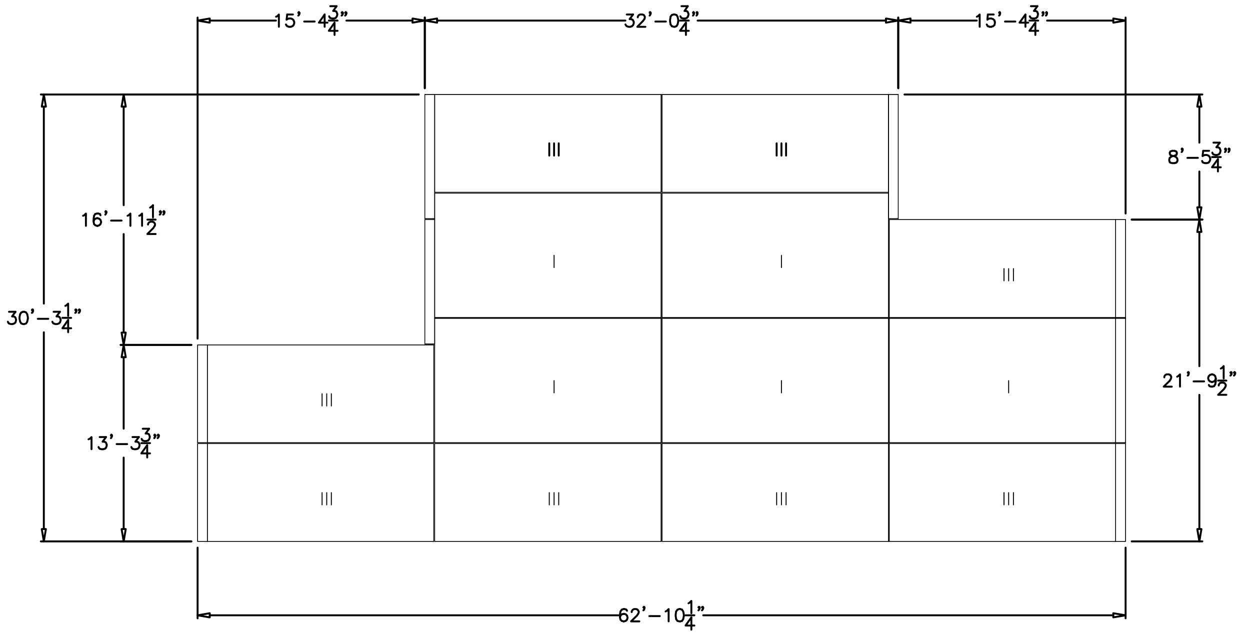
ALLOWABLE MAX GRADE = 460.90’
ALLOWABLE MIN GRADE = 460.80’
INSIDE HEIGHT ELEVATION = 459.30’
SYSTEM INVERT = 448.80’

NOTES:

1. DIMENSIONING OF STORMTRAP SYSTEM SHOWN BELOW ALLOW FOR A 3/4” GAP BETWEEN EACH MODULE.
2. ALL DIMENSIONS TO BE VERIFIED IN THE FIELD BY OTHERS.
3. SEE SHEET 3.0 FOR INSTALLATION SPECIFICATIONS.
4. SP – INDICATES A MODULE WITH MODIFICATIONS.
5. P – INDICATES A MODULE WITH A PANEL ATTACHMENT.
6. CONTRACTORS RESPONSIBILITY TO ENSURE CONSISTENCY/ACCURACY TO FINAL ENGINEER OF RECORD PLAN SET.
7. IN ORDER FOR STORMTRAP TO GENERATE APPROVAL DRAWINGS, CIVIL ENGINEERING DRAWINGS MUST BE PROVIDED TO STORMTRAP AND SHALL INCLUDE ALL PIPE SIZES, PIPE MATERIAL, PIPE INVERT ELEVATIONS, ACCESS OPENING SIZE AND SHAPE. IN ADDITION, FINAL GRADING PLANS SHALL ALSO INCLUDE MINIMUM AND MAXIMUM GRADES OVER THE TOP OF THE STORMTRAP SYSTEM.



OUTLET CONTROL STRUCTURE
WEIR ELEV. = 9.00’
18”Ø ORIFICE = INV. TBD
1’W x 1’H ORIFICE = INV. TBD
3.25”Ø ORIFICE = INV. TBD
(SEE NOTE 4; SHEET 1.0)



1287 WINDHAM PARKWAY
ROMEOVILLE, IL 60446
P:815–941–4549 / F:331–318–5347

PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]

ENGINEER INFORMATION:

X Engineering
6 Hutton Centre Dr.
#650
Santa Ana, CA 92707
949–522–7100

PROJECT INFORMATION:

Freedom Lane

Aliso Viejo, CA

CURRENT ISSUE DATE:

10/16/2025

ISSUED FOR:

PRELIMINARY

REV.	DATE:	ISSUED FOR:	DWN BY:
△1	10/16/2025	PRELIMINARY	DG

SCALE:

NTS

SHEET TITLE:

DOUBLETRAP
SYSTEM LAYOUT

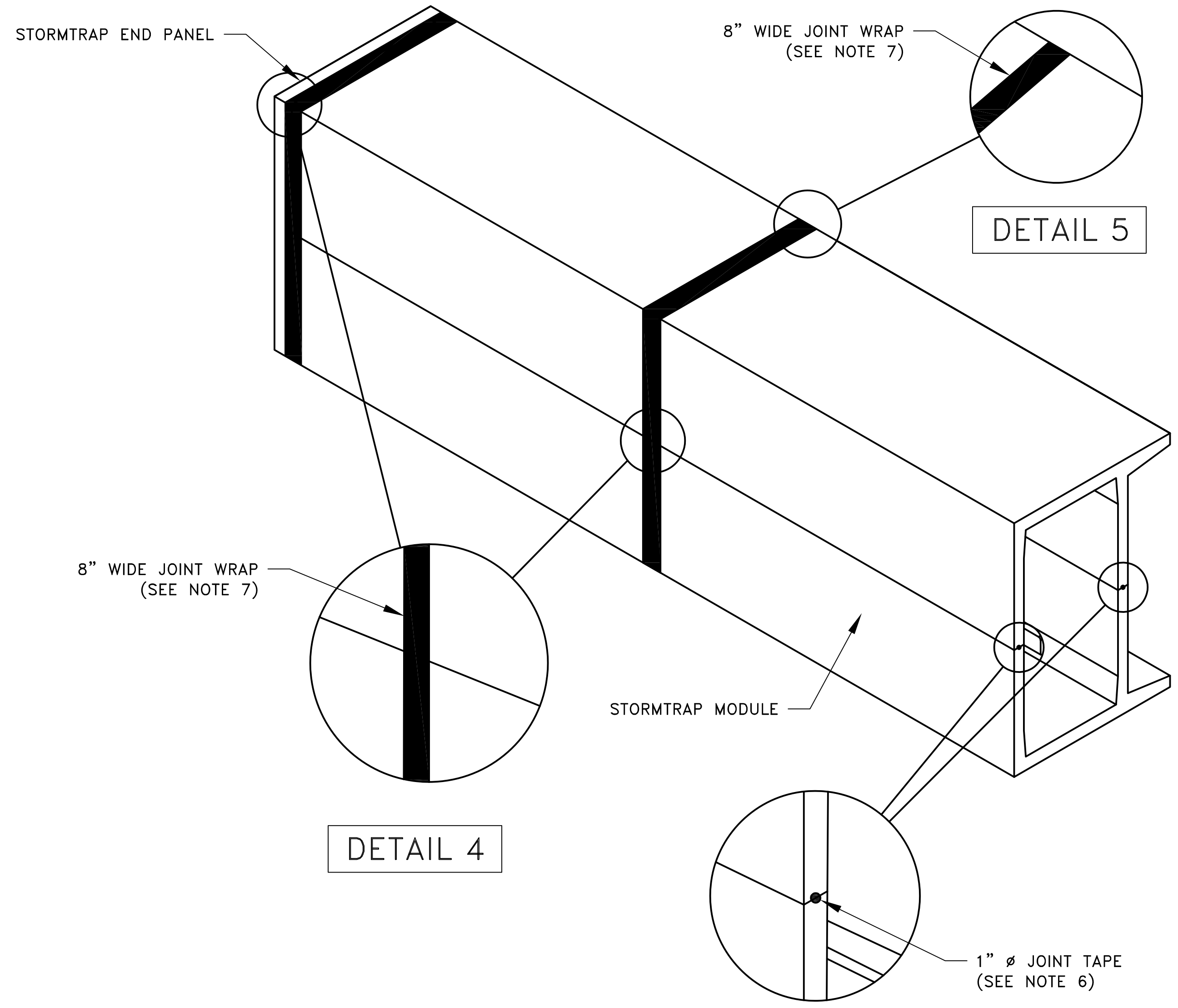
SHEET NUMBER:

2.0

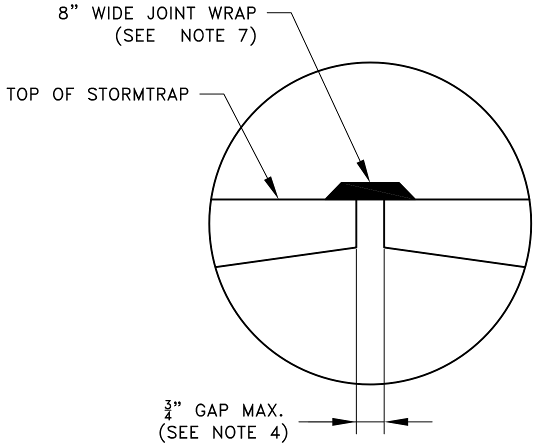
STORMTRAP INSTALLATION SPECIFICATION

1. STORMTRAP SHALL BE INSTALLED IN ACCORDANCE WITH ASTM C891 (STANDARD PRACTICE FOR INSTALLATION OF UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURES). THE FOLLOWING ADDITIONS AND/OR EXCEPTIONS ARE PROVIDED FOR EMPHASIS. THE MENTION OF THESE ITEMS DOES NOT PRECLUDE THE INSTALLING CONTRACTOR FROM FOLLOWING ASTM C891 IN ITS ENTIRETY AND IMPLEMENTING ALL APPROPRIATE MEASURES. THE INSTALLING CONTRACTOR OWNS AND IS RESPONSIBLE FOR THE STORMTRAP SYSTEM UPON REMOVAL OF THE MODULES FROM THE DELIVERY TRUCK THROUGH 'FINAL CONSTRUCTION'. FINAL CONSTRUCTION IS ACHIEVED WHEN ALL MODULES ARE SET, FULLY BACKFILLED, AND WHEN FINAL FINISHED GRADES ARE REACHED. THE CONTRACTOR IS RESPONSIBLE FOR ANY COUNTERMEASURES NECESSARY TO RESIST UPLIFT/BUOYANCY BEFORE 'FINAL CONSTRUCTION' IS ACHIEVED.
2. IT IS THE RESPONSIBILITY OF THE INSTALLING CONTRACTOR TO ENSURE THAT PROPER/ADEQUATE EQUIPMENT IS USED TO SET/INSTALL THE MODULES.
3. STORMTRAP MODULES SHALL BE PLACED ON A LEVEL, 6" FOUNDATION OF ¾" AGGREGATE EXTENDING 2'–0" PAST THE OUTSIDE OF THE SYSTEM (SEE DETAIL 1) AND SHALL BE PLACED ON PROPERLY COMPACTED SOILS (SEE SHEET 1.1 FOR SOIL BEARING CAPACITY REQUIREMENTS), AND IN ACCORDANCE WITH ASTM C891 STANDARD PRACTICE FOR INSTALLATION OF UNDERGROUND PRECAST UTILITY STRUCTURES.
4. THE STORMTRAP MODULES SHALL BE PLACED SUCH THAT THE MAXIMUM SPACE BETWEEN ADJACENT MODULES DOES NOT EXCEED ¾" (SEE DETAIL 2). IF THE SPACE EXCEEDS ¾", THE MODULES SHALL BE RESET WITH APPROPRIATE ADJUSTMENT MADE TO LINE AND GRADE TO BRING THE SPACE INTO SPECIFICATION.
5. STORMTRAP MODULES ARE NOT WATERTIGHT.

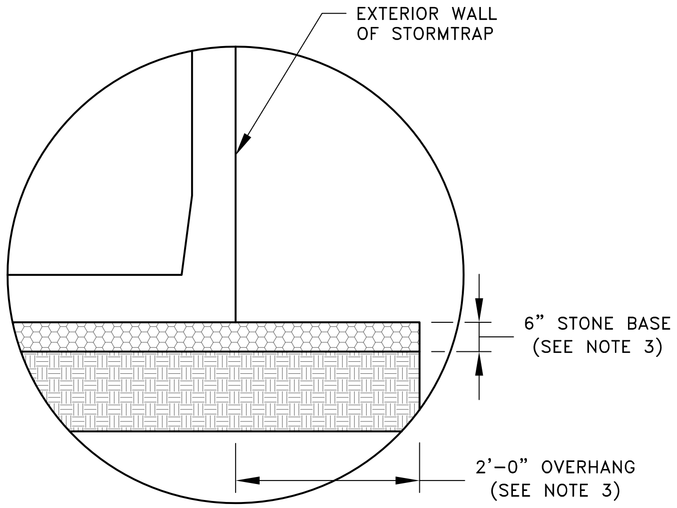
6. THE HORIZONTAL JOINT BETWEEN THE TOP AND BASE LEG CONNECTIONS OF ALL PERIMETER STORMTRAP MODULES SHALL BE SEALED WITH PREFORMED MASTIC JOINT TAPE ACCORDING TO ASTM C891, 8.8 AND 8.12. (SEE DETAIL 3). THE MASTIC JOINT TAPE DOES NOT PROVIDE A WATERTIGHT SEAL.
7. ALL EXTERIOR ROOF AND EXTERIOR VERTICAL WALL JOINTS BETWEEN ADJACENT STORMTRAP MODULES SHALL BE SEALED WITH 8" WIDE PRE–FORMED, COLD–APPLIED, SELF–ADHERING ELASTOMERIC RESIN, BONDED TO A WOVEN , HIGHLY PUNCTURE RESISTANT POLYMER WRAP, CONFORMING TO ASTM C891 AND SHALL BE INTEGRATED WITH PRIMER SEALANT AS APPROVED BY STORMTRAP (SEE DETAILS 2, 4, & 5). THE JOINT WRAP DOES NOT PROVIDE A WATERTIGHT SEAL. THE SOLE PURPOSE OF THE JOINT WRAP IS TO PROVIDE A SILT AND SOIL TIGHT SYSTEM. THE ADHESIVE EXTERIOR JOINT WRAP SHALL BE INSTALLED ACCORDING TO THE FOLLOWING INSTALLATION INSTRUCTIONS:
   - 7.1. USE A BRUSH OR WET CLOTH TO THOROUGHLY CLEAN THE OUTSIDE SURFACE AT THE POINT WHERE JOINT WRAP IS TO BE APPLIED.
   - 7.2. A RELEASE PAPER PROTECTS THE ADHESIVE SIDE OF THE JOINT WRAP. PLACE THE ADHESIVE TAPE (ADHESIVE SIDE DOWN) AROUND THE STRUCTURE, REMOVING THE RELEASE PAPER AS YOU GO. PRESS THE JOINT WRAP FIRMLY AGAINST THE STORMTRAP MODULE SURFACE WHEN APPLYING.
8. IF THE CONTRACTOR NEEDS TO CANCEL ANY SHIPMENTS, THEY MUST DO SO 48 HOURS PRIOR TO THEIR SCHEDULED ARRIVAL AT THE JOB SITE. IF CANCELED AFTER THAT TIME, PLEASE CONTACT THE PROJECT MANAGER.
9. IF THE STORMTRAP MODULE(S) IS DAMAGED IN ANY WAY PRIOR, DURING, OR AFTER INSTALL, STORMTRAP MUST BE CONTACTED IMMEDIATELY TO ASSESS THE DAMAGE AND TO DETERMINE WHETHER OR NOT THE MODULE(S) WILL NEED TO BE REPLACED. IF ANY MODULE ARRIVES AT THE JOBSITE DAMAGED DO NOT UNLOAD IT; CONTACT STORMTRAP IMMEDIATELY. ANY DAMAGE NOT REPORTED BEFORE THE TRUCK IS UNLOADED WILL BE THE CONTRACTOR'S RESPONSIBILITY.
10. STORMTRAP MODULES CANNOT BE ALTERED IN ANY WAY AFTER MANUFACTURING WITHOUT WRITTEN CONSENT FROM STORMTRAP.



DETAIL 3



DETAIL 2



DETAIL 1

PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]

1287 WINDHAM PARKWAY
ROMEOVILLE, IL 60446
P:815–941–4549 / F:331–318–5347

ENGINEER INFORMATION:

X Engineering
6 Hutton Centre Dr.
#650
Santa Ana, CA 92707
949–522–7100

PROJECT INFORMATION:

Freedom Lane

Aliso Viejo, CA

CURRENT ISSUE DATE:

10/16/2025

ISSUED FOR:

PRELIMINARY

REV.	DATE:	ISSUED FOR:	DWN BY:
⚠1	10/16/2025	PRELIMINARY	DG

SCALE:

NTS

SHEET TITLE:

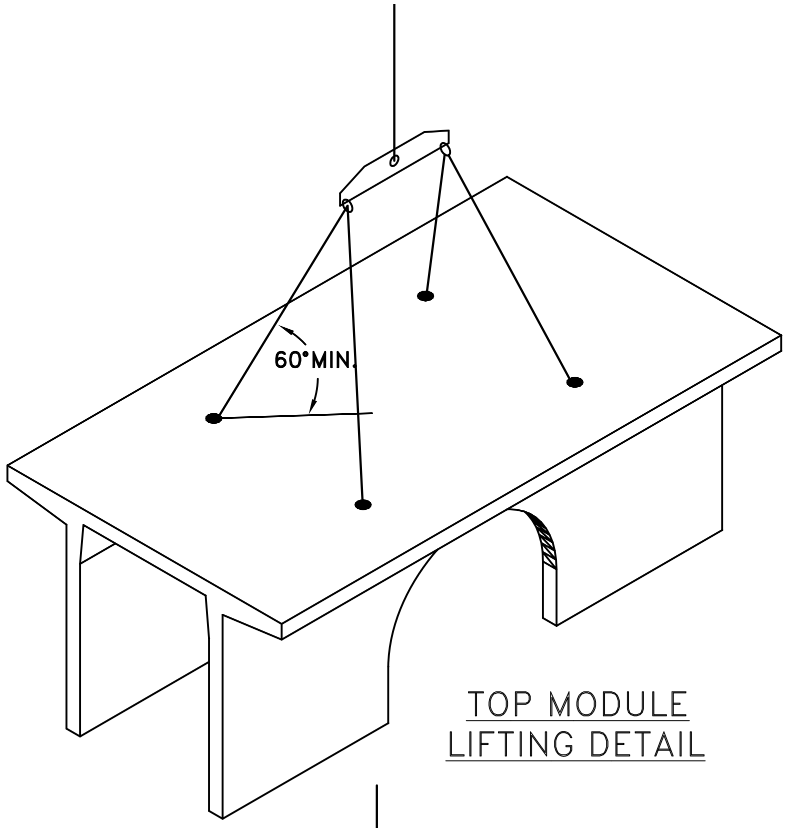
DOUBLETRAP
INSTALLATION
SPECIFICATION

SHEET NUMBER:

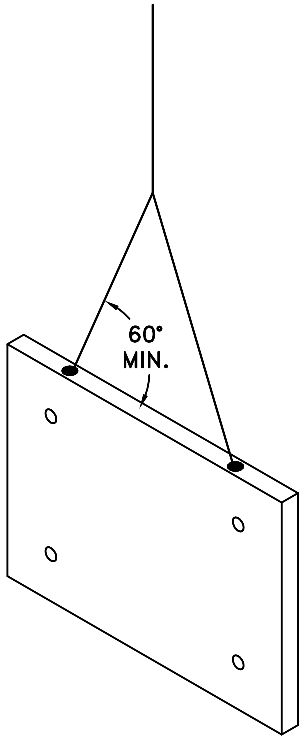
3.0

STORMTRAP MODULE LIFTING SPECIFICATION

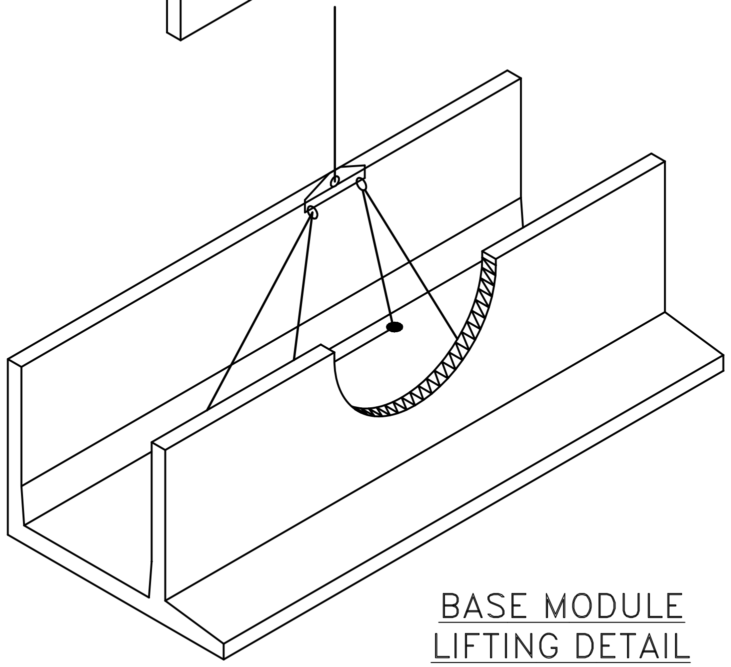
1. IT IS THE CONTRACTOR'S RESPONSIBILITY TO ENSURE THAT ALL (4) CHAINS/CABLES ARE SECURED PROPERLY TO THE LIFTING ANCHORS AND IN EQUAL TENSION WHEN LIFTING THE STORMTRAP MODULE.
2. MINIMUM 7'-0" CHAIN/CABLE LENGTH TO BE USED TO LIFT STORMTRAP MODULES (SUPPLIED BY CONTRACTOR).
3. CONTRACTOR TO ENSURE MINIMUM LIFTING ANGLE IS 60° FROM TOP SURFACE OF STORMTRAP MODULE. SEE DETAIL.
4. IT IS UNDERSTOOD AND AGREED THAT AT ALL TIMES DURING WHICH HOISTING AND RIGGING EQUIPMENT IS BEING SUPPLIED TO THE PURCHASER, OPERATOR OF SUCH EQUIPMENT SHALL BE IN CHARGE OF HIS ENTIRE EQUIPMENT AND SHALL AT ALL TIMES BE THE JUDGE OF THE SAFETY AND PROPERTY OF ANY SUGGESTION TO HIM FROM THE SELLER, ITS AGENTS OR EMPLOYEES. PURCHASER AGREES TO SAVE, INDEMNIFY AND HOLD HARMLESS SELLER FROM ALL LOSS, CLAIMS, DEMANDS OR CAUSES OF ACTION, WHICH MAY ARISE FROM THE EXISTENCE OR OPERATION OF SAID EQUIPMENT.



TOP MODULE LIFTING DETAIL



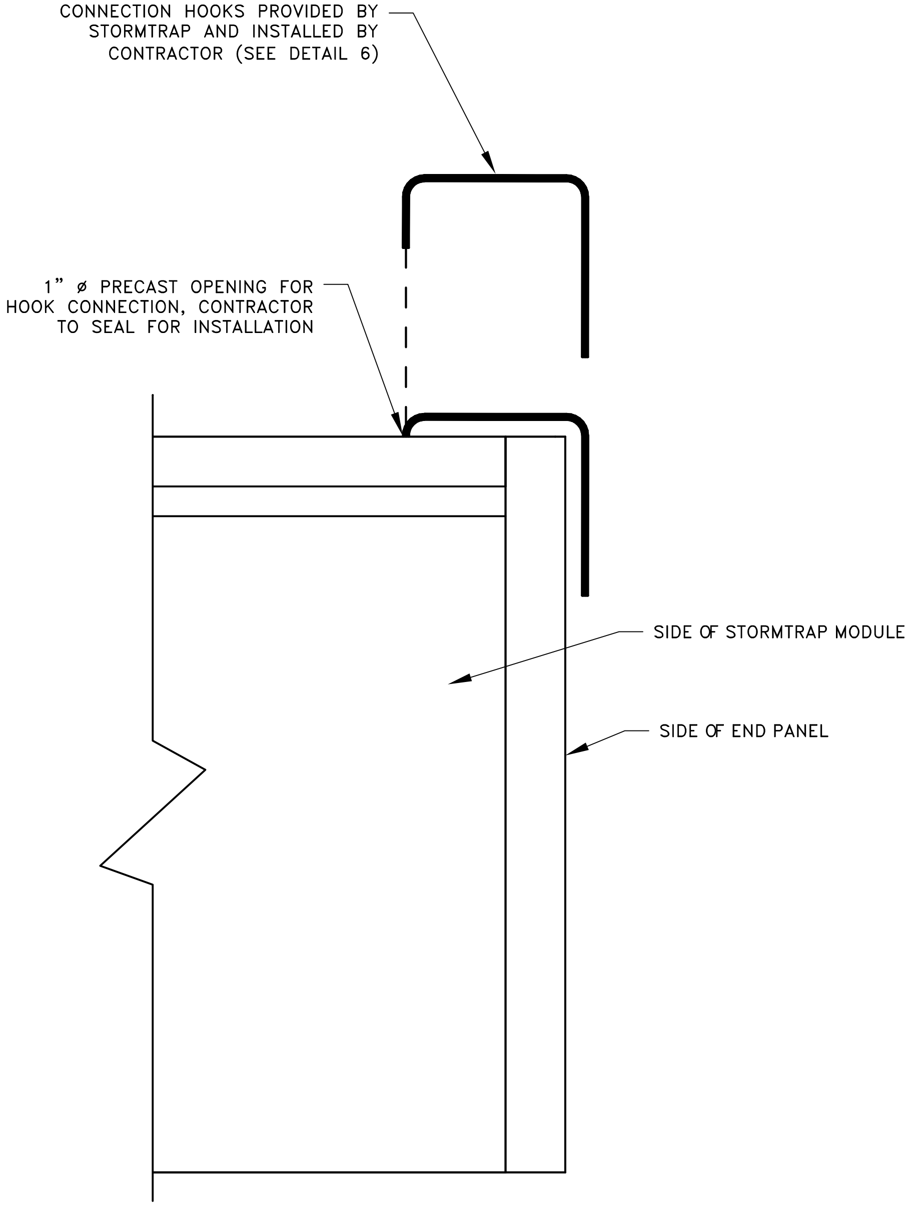
END PANEL LIFTING DETAIL



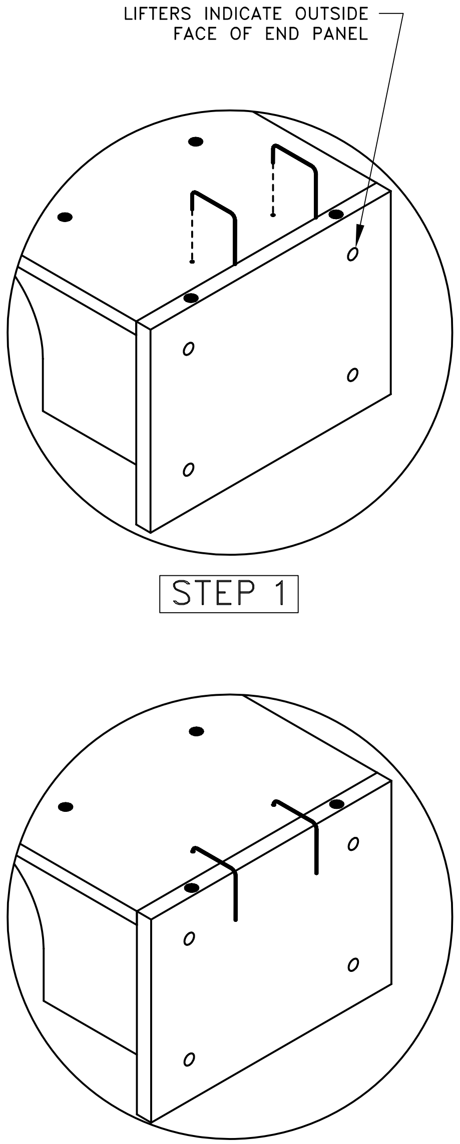
BASE MODULE LIFTING DETAIL

END PANEL ERECTION/INSTALLATION SPECIFICATION

1. END PANELS WILL BE SUPPLIED TO CLOSE OFF OPEN ENDS OF ROWS.
2. PANELS SHALL BE INSTALLED IN A TILT UP FASHION DIRECTLY ADJACENT TO OPEN END OF MODULE (REFER TO SHEET 2.0 FOR END PANEL LOCATIONS). SIDE WITH LIFTERS INDICATES OUTSIDE FACE.
3. CONNECTION HOOKS WILL BE SUPPLIED WITH END PANELS TO SECURELY CONNECT PANEL TO ADJACENT STORMTRAP MODULE (SEE PANEL CONNECTION ELEVATION VIEW).
4. ONCE CONNECTION HOOK IS ATTACHED, LIFTING CLUTCHES MAY BE REMOVED.
5. JOINT WRAP SHALL BE PLACED AROUND PERIMETER JOINT PANEL (SEE SHEET 3.0).


CONNECTION HOOKS PROVIDED BY STORMTRAP AND INSTALLED BY CONTRACTOR (SEE DETAIL 6)
1" ⌀ PRECAST OPENING FOR HOOK CONNECTION, CONTRACTOR TO SEAL FOR INSTALLATION
SIDE OF STORMTRAP MODULE
SIDE OF END PANEL

PANEL CONNECTION ELEVATION VIEW


LIFTERS INDICATE OUTSIDE FACE OF END PANEL

STEP 1

STEP 2

DETAIL 6

StormTrap

PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]

1287 WINDHAM PARKWAY
ROMEOVILLE, IL 60446
P:815-941-4549 / F:331-318-5347

ENGINEER INFORMATION:

X Engineering
6 Hutton Centre Dr.
#650
Santa Ana, CA 92707
949-522-7100

PROJECT INFORMATION:

Freedom Lane

Aliso Viejo, CA

CURRENT ISSUE DATE:

10/16/2025

ISSUED FOR:

PRELIMINARY

REV.	DATE:	ISSUED FOR:	DWN BY:
△1	10/16/2025	PRELIMINARY	DG

SCALE:

NTS

SHEET TITLE:

DOUBLETRAP
INSTALLATION
SPECIFICATION

SHEET NUMBER:

3.1

ZONE CHART

ZONES	ZONE DESCRIPTIONS	REMARKS
ZONE 1	FOUNDATION AGGREGATE	#5 (¾") STONE ANGULAR AGGREGATE (SEE NOTE 4)
ZONE 2	BACKFILL	UNIFIED SOILS CLASSIFICATION (GW, GP, SW, SP) OR SEE BELOW FOR APPROVED BACKFILL OPTIONS
ZONE 3	FINAL COVER OVERTOP	MATERIALS NOT TO EXCEED 120 PCF

APPROVED ZONE 2 BACKFILL OPTIONS

OPTION	REMARKS
¾" STONE AGGREGATE	THE STONE AGGREGATE SHALL CONSIST OF CLEAN AND FREE DRAINING ANGULAR MATERIAL. THE SIZE OF THIS MATERIAL SHALL HAVE 100% PASSING THE 1" SIEVE WITH 0% TO 5% PASSING THE #8 SIEVE. THIS MATERIAL SHALL BE SEPARATED FROM NATIVE MATERIAL USING GEOFABRIC AROUND THE PERIMETER OF THE BACKFILL (ASTM SIZE #57) AS DETERMINED BY THE GEOTECHNICAL ENGINEER.
SAND	IMPORTED PURE SAND IS PERMITTED TO BE USED AS BACKFILL IF IT IS CLEAN AND FREE DRAINING. THE SAND USED FOR BACKFILLING SHALL HAVE LESS THAN 40% PASSING #40 SIEVE AND LESS THAN 5% PASSING #200 SIEVE. THIS MATERIAL SHALL BE SEPARATED FROM NATIVE MATERIAL USING GEOFABRIC AROUND THE PERIMETER OF THE SAND BACKFILL.
CRUSHED CONCRETE AGGREGATE	CLEAN, FREE DRAINING CRUSHED CONCRETE AGGREGATE MATERIAL CAN BE USED AS BACKFILL FOR STORMTRAP'S MODULES. THE SIZE OF THIS MATERIAL SHALL HAVE 100% PASSING THE 1" SIEVE WITH 0% TO 5% PASSING THE #8 SIEVE. THIS MATERIAL SHALL BE SEPARATED FROM NATIVE MATERIAL USING GEOFABRIC AROUND THE PERIMETER OF THE BACKFILL.
ROAD PACK	STONE AGGREGATE 100% PASSING THE 1-1/2" SIEVE WITH LESS THAN 12% PASSING THE #200 SIEVE (ASTM SIZE #467). GEOFABRIC AS PER GEOTECHNICAL ENGINEER RECOMMENDATION.

FILL DEPTH	TRACK WIDTH	MAX VEHICLE WEIGHT (KIPS)	MAX GROUND PRESSURE
12"	12"	51.8	1690 psf
	18"	56.1	1219 psf
	24"	68.1	1111 psf
	30"	76.7	1000 psf
	36"	85.0	924 psf

NOTE:
TRACK LENGTH NOT TO EXCEED 15'-4".
ONLY TWO TRACKS PER VEHICLE.

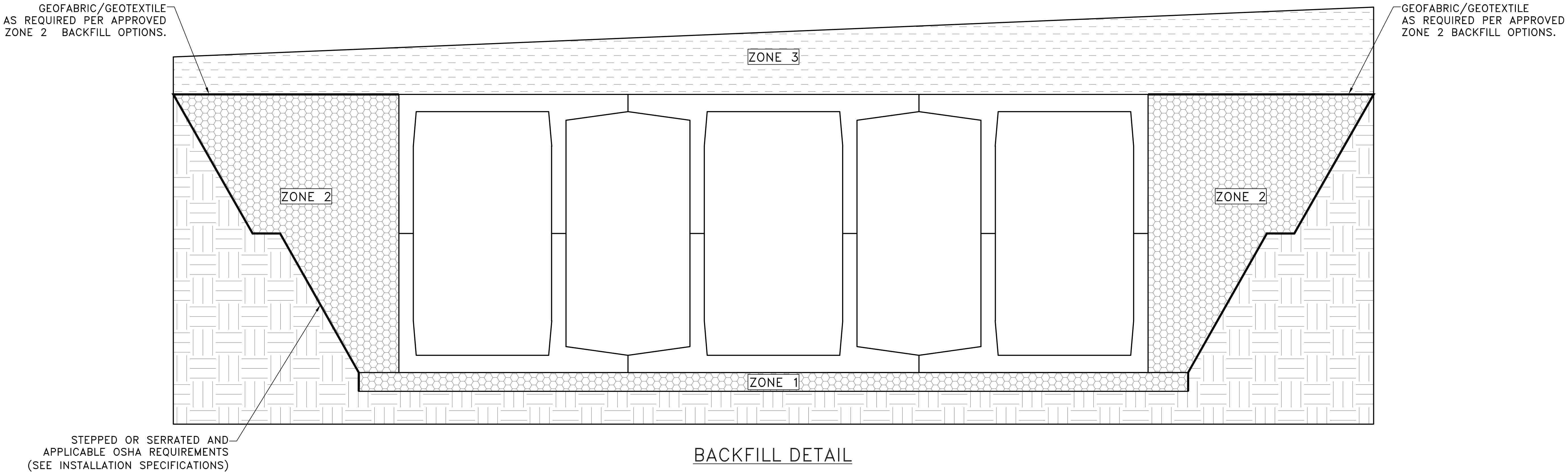
STORMTRAP ZONE INSTALLATION SPECIFICATION/PROCEDURE

1. THE FILL PLACED AROUND THE STORMTRAP MODULES MUST BE DEPOSITED ON BOTH SIDES AT THE SAME TIME AND TO APPROXIMATELY THE SAME ELEVATION. AT NO TIME SHALL THE FILL BEHIND ONE SIDE WALL BE MORE THAN 2'-0" HIGHER THAN THE FILL ON THE OPPOSITE SIDE. BACKFILL SHALL EITHER BE COMPACTED AND/OR VIBRATED TO ENSURE THAT BACKFILL AGGREGATE/STONE MATERIAL IS WELL SEATED AND PROPERLY INTER LOCKED. CARE SHALL BE TAKEN TO PREVENT ANY WEDGING ACTION AGAINST THE STRUCTURE, AND ALL SLOPES WITHIN THE AREA TO BE BACKFILLED MUST BE STEPPED OR SERRATED TO PREVENT WEDGING ACTION. CARE SHALL ALSO BE TAKEN AS NOT TO DISRUPT THE JOINT WRAP FROM THE JOINT DURING THE BACKFILL PROCESS. BACKFILL MUST BE FREE-DRAINING MATERIAL. SEE ZONE 2 BACKFILL CHART ON THIS PAGE FOR APPROVED BACKFILL OPTIONS. IF NATIVE EARTH IS SUSCEPTIBLE TO MIGRATION, CONFIRM WITH GEOTECHNICAL ENGINEER AND PROVIDE PROTECTION AS REQUIRED (PROVIDED BY OTHERS). ALL MODULES MUST BE SET AND ALL SIDES MUST BE FULLY BACKFILLED BEFORE TRAVEL OVERTOP THE SYSTEM IS PERMITTED. SEE NOTE 2 FOR EXCEPTIONS AND LIMITATIONS.

2. THE FILL PLACED OVERTOP THE SYSTEM SHALL BE PLACED IN MINIMUM 6" LIFTS. AT NO TIME SHALL MACHINERY OR VEHICLES GREATER THAN THE DESIGN LIVE LOAD LISTED ON SHEET 1.1 TRAVEL OVERTOP THE SYSTEM. IF TRAVEL OVER THE SYSTEM OCCURS BEFORE THE MINIMUM DESIGN COVER IS ACHIEVED, IT MAY BE NECESSARY TO REDUCE THE ULTIMATE LOAD/BURDEN OF THE OPERATING MACHINERY SO AS TO NOT EXCEED THE DESIGN CAPACITY OF THE SYSTEM. VEHICLES AND MACHINERY USED TO PLACE FILL MATERIAL ON TOP OF THE SYSTEM SHALL TRAVEL PARALLEL TO THE LONGITUDINAL AXIS OF THE STORMTRAP MODULES WHENEVER POSSIBLE.

3. THE VIBRATORY FUNCTION OF ANY ROLLER, COMPACTOR, VEHICLE, ETC. SHALL NOT BE USED OVERTOP THE SYSTEM WITHOUT PRIOR APPROVAL FROM STORMTRAP. IN SOME CASES, HAND COMPACTION MAY BE NECESSARY TO ENSURE THAT THE ALLOWABLE DESIGN LOADING IS NOT EXCEEDED.

4. STONE AGGREGATE FOUNDATION IN ZONE 1 IS FOR LEVELING PURPOSES.


GEOFABRIC/GEOTEXTILE AS REQUIRED PER APPROVED ZONE 2 BACKFILL OPTIONS.
ZONE 3
GEOFABRIC/GEOTEXTILE AS REQUIRED PER APPROVED ZONE 2 BACKFILL OPTIONS.
ZONE 2
ZONE 2
ZONE 1
STEPPED OR SERRATED AND APPLICABLE OSHA REQUIREMENTS (SEE INSTALLATION SPECIFICATIONS)

BACKFILL DETAIL

StormTrap®
PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]

1287 WINDHAM PARKWAY
ROMEOVILLE, IL 60446
P:815-941-4549 / F:331-318-5347

ENGINEER INFORMATION:

X Engineering
6 Hutton Centre Dr.
#650
Santa Ana, CA 92707
949-522-7100

PROJECT INFORMATION:

Freedom Lane

Aliso Viejo, CA

CURRENT ISSUE DATE:

10/16/2025

ISSUED FOR:

PRELIMINARY

REV.	DATE:	ISSUED FOR:	DWN BY:
1	10/16/2025	PRELIMINARY	DG

SCALE:

NTS

SHEET TITLE:

DOUBLETRAP BACKFILL SPECIFICATION

SHEET NUMBER:

4.0

ACCESS OPENING SPECIFICATION

1. A TYPICAL ACCESS OPENING FOR THE STORMTRAP SYSTEM ARE 2'–0" IN DIAMETER. ACCESS OPENINGS LARGER THAN 4'–0" IN DIAMETER NEED TO BE APPROVED BY STORMTRAP. ALL OPENINGS MUST RETAIN AT LEAST 2'–0" OF CLEARANCE FROM THE END OF THE STORMTRAP MODULE UNLESS NOTED OTHERWISE. ALL ACCESS OPENINGS TO BE LOCATED ON INSIDE LEG UNLESS OTHERWISE SPECIFIED. SEE SHEET 2.0 FOR SIZES AND LOCATIONS.
2. UNLESS OTHERWISE SPECIFIED, PLASTIC COATED STEPS ARE PROVIDED INSIDE ANY MODULE WHERE DEEMED NECESSARY. THE HIGHEST STEP IN THE MODULE IS TO BE PLACED A DISTANCE OF 1'–0" FROM THE INSIDE EDGE OF THE STORMTRAP MODULES. ALL ENSUING STEPS SHALL BE PLACED AT A DISTANCE BETWEEN 10" MIN AND 14" MAX BETWEEN THEM. STEPS MAY BE MOVED OR ALTERED TO AVOID OPENINGS OR OTHER IRREGULARITIES IN THE MODULE.
3. STORMTRAP LIFTING INSERTS MAY BE RELOCATED TO AVOID INTERFERENCE WITH ACCESS OPENINGS OR THE CENTER OF GRAVITY OF THE MODULE AS NEEDED.
4. STORMTRAP ACCESS OPENINGS MAY BE RELOCATED TO AVOID INTERFERENCE WITH INLET AND/OR OUTLET PIPE OPENINGS SO PLACEMENT OF STEPS IS ATTAINABLE.
5. ACCESS OPENINGS SHOULD BE LOCATED IN ORDER TO MEET THE APPROPRIATE MUNICIPAL REQUIREMENTS. STORMTRAP RECOMMENDS AT LEAST TWO ACCESS OPENINGS PER SYSTEM FOR ACCESS AND INSPECTION.
6. USE PRECAST ADJUSTING RINGS AS NEEDED TO MEET GRADE. STORMTRAP RECOMMENDS FOR COVER OVER 2' TO USE PRECAST BARREL OR CONE SECTIONS. (PROVIDED BY OTHERS)

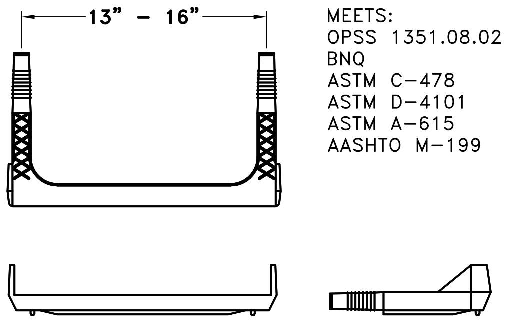
PIPE OPENING SPECIFICATION

1. MINIMUM EDGE DISTANCE FOR AN OPENING ON THE OUTSIDE WALL SHALL BE NO LESS THAN 1'–0".
2. CONNECTING PIPES MAY BE INSTALLED WITH A 1'–0" CONCRETE COLLAR AND AN AGGREGATE CRADLE (AS REQUIRED) FOR AT LEAST ONE PIPE LENGTH (SEE PIPE CONNECTION DETAIL). A STRUCTURAL GRADE CONCRETE OR HIGH STRENGTH, NON–SHRINK GROUT WITH A MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 3000 PSI MAY BE USED.
3. THE ANNULAR SPACE BETWEEN THE PIPE AND THE HOLE SHALL BE FILLED WITH HIGH STRENGTH NON–SHRINK GROUT.

PIPE INSTALLATION INSTRUCTIONS

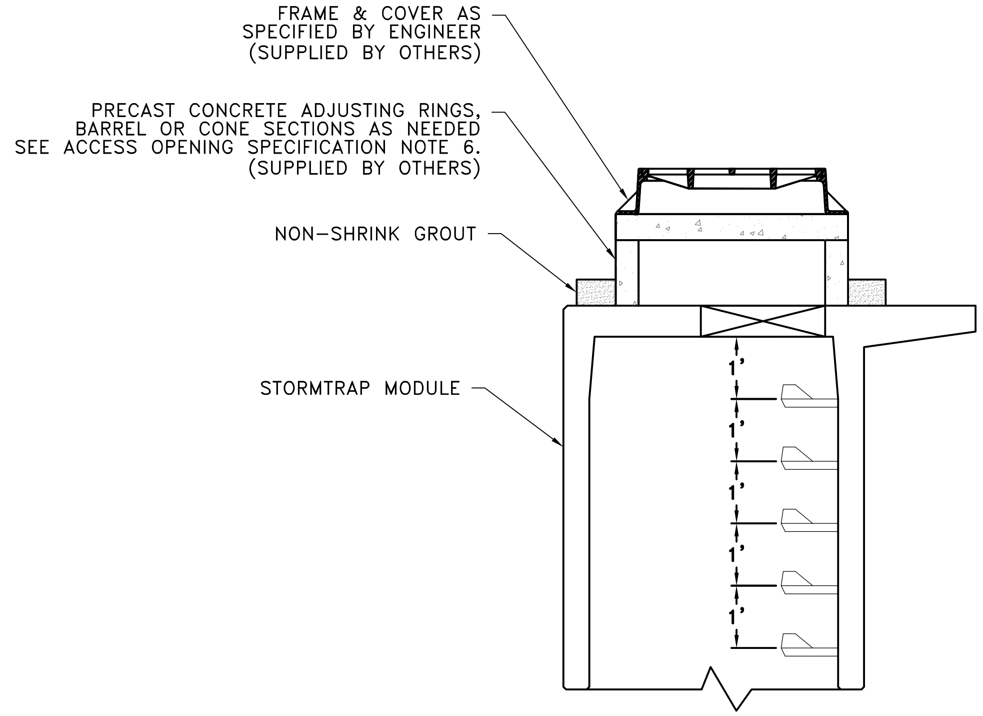
1. CLEAN AND LIGHTLY LUBRICATE ALL OF THE PIPE TO BE INSERTED INTO STORMTRAP.
2. IF PIPE IS CUT, CARE SHOULD BE TAKEN TO ALLOW NO SHARP EDGES. BEVEL AND LUBRICATE LEAD END OF PIPE.
3. ALIGN CENTER OF PIPE TO CORRECT ELEVATION AND INSERT INTO OPENING.

NOTE: ALL ANCILLARY PRODUCTS/SPECIFICATIONS RECOMMENDED AND SHOWN ON THIS SHEET INCLUDING BUT NOT LIMITED TO CONCRETE COLLARS, AGGREGATE CRADLES, GRADE RINGS, RISER SECTIONS, ETC., ARE RECOMMENDATIONS ONLY AND SUBJECT TO CHANGE PER THE INSTALLING CONTRACTOR AND/OR PER LOCAL MUNICIPAL CODE/REQUIREMENTS.

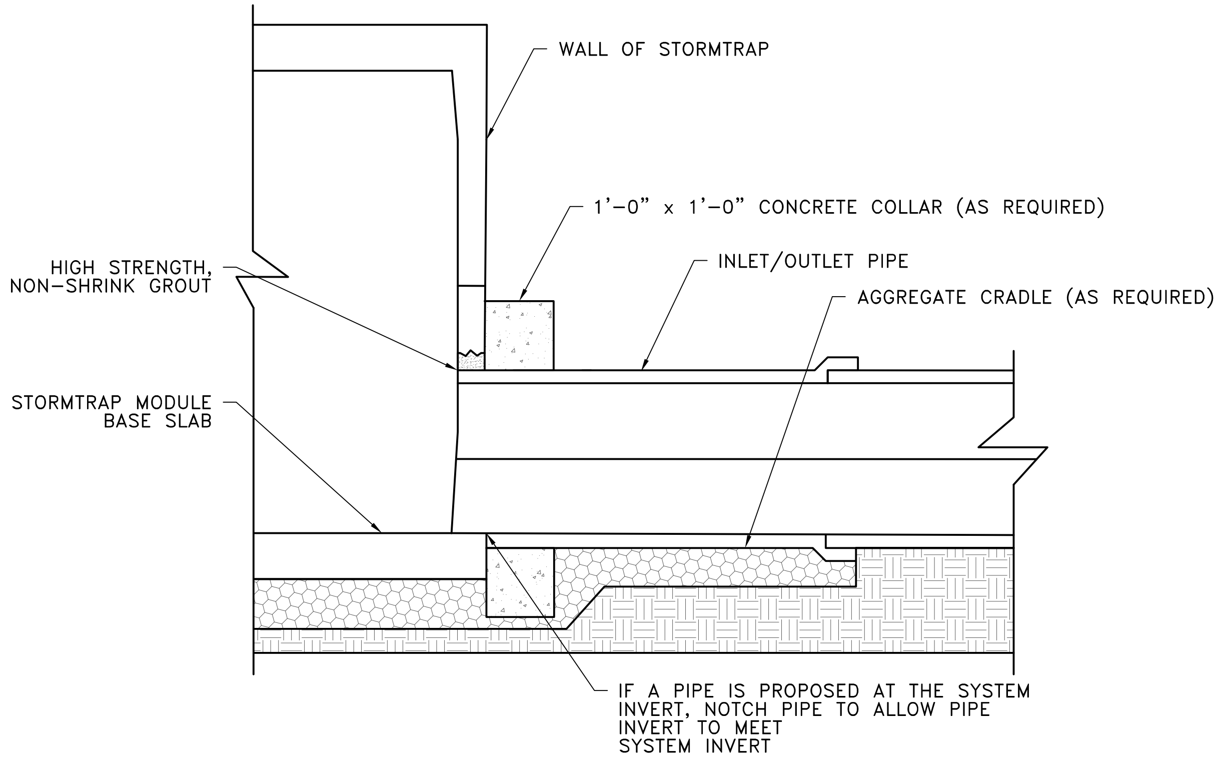


MEETS:
OPSS 1351.08.02
BNQ
ASTM C–478
ASTM D–4101
ASTM A–615
AASHTO M–199

STEP DETAIL


FRAME & COVER AS SPECIFIED BY ENGINEER (SUPPLIED BY OTHERS)
PRECAST CONCRETE ADJUSTING RINGS, BARREL OR CONE SECTIONS AS NEEDED SEE ACCESS OPENING SPECIFICATION NOTE 6. (SUPPLIED BY OTHERS)
NON–SHRINK GROUT
STORMTRAP MODULE
1'
1'
1'
1'
1'

RISER/STAIR DETAIL


WALL OF STORMTRAP
1'–0" x 1'–0" CONCRETE COLLAR (AS REQUIRED)
INLET/OUTLET PIPE
AGGREGATE CRADLE (AS REQUIRED)
HIGH STRENGTH, NON–SHRINK GROUT
STORMTRAP MODULE BASE SLAB
IF A PIPE IS PROPOSED AT THE SYSTEM INVERT, NOTCH PIPE TO ALLOW PIPE INVERT TO MEET SYSTEM INVERT

NOTCHED PIPE CONNECTION DETAIL
WHEN PIPE INVERT IS AT
INVERT OF STORMTRAP SYSTEM

StormTrap®
PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]
1287 WINDHAM PARKWAY
ROMEOVILLE, IL 60446
P:815–941–4549 / F:331–318–5347

ENGINEER INFORMATION:

X Engineering
6 Hutton Centre Dr.
#650
Santa Ana, CA 92707
949–522–7100

PROJECT INFORMATION:

Freedom Lane

Aliso Viejo, CA

CURRENT ISSUE DATE:

10/16/2025

ISSUED FOR:

PRELIMINARY

REV.	DATE:	ISSUED FOR:	DWN BY:
1	10/16/2025	PRELIMINARY	DG

SCALE:

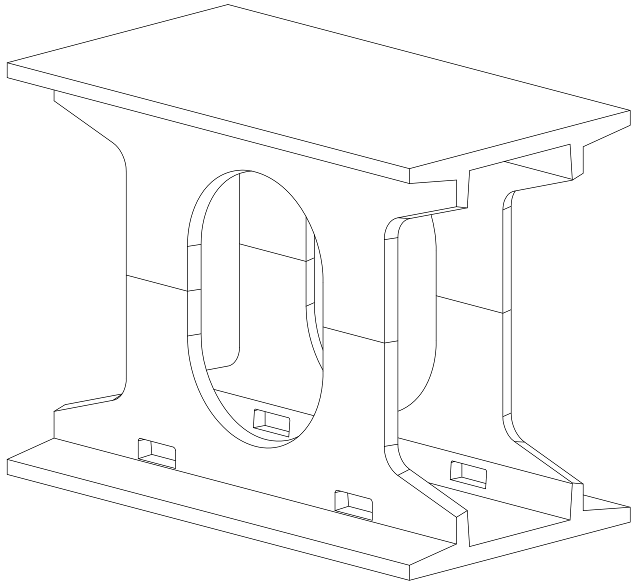
NTS

SHEET TITLE:

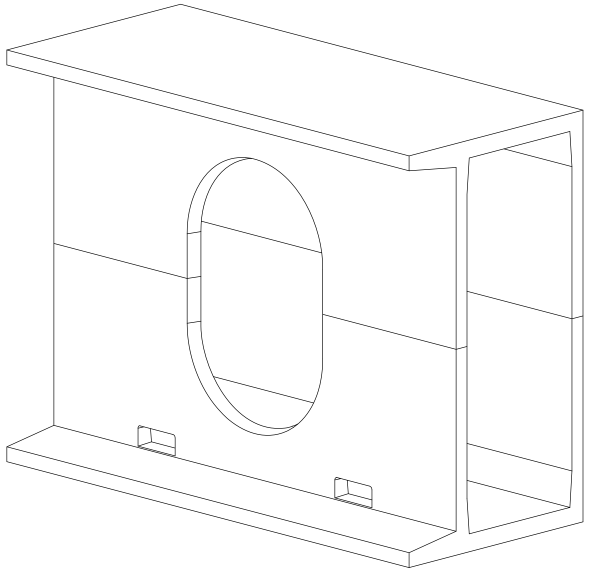
PIPE / ACCESS OPENING SPECIFICATION

SHEET NUMBER:

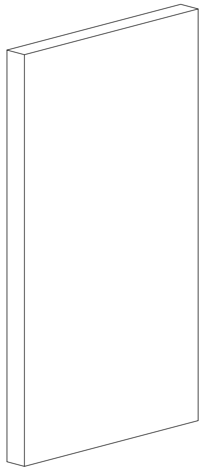
5.0



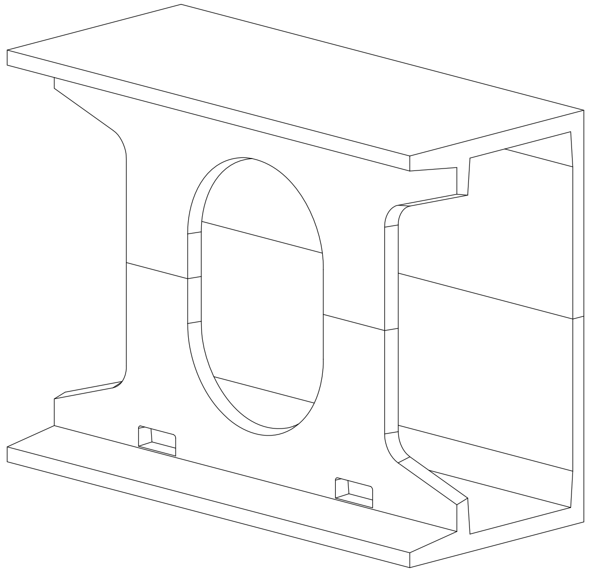
TYPE I



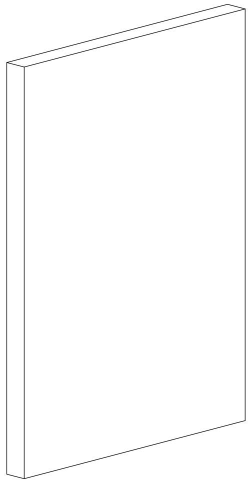
TYPE IV



TYPE IV END PANEL



TYPE III



TYPE II END PANEL

NOTES:
1. OPENING LOCATIONS AND SHAPES MAY VARY.
2. SP – INDICATES A MODULE WITH MODIFICATIONS.
3. P – INDICATES A MODULE WITH A PANEL ATTACHMENT.
4. POCKET WINDOW OPENINGS ARE OPTIONAL.

PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]

1287 WINDHAM PARKWAY
ROMEOVILLE, IL 60446
P:815-941-4549 / F:331-318-5347

ENGINEER INFORMATION:

X Engineering
6 Hutton Centre Dr.
#650
Santa Ana, CA 92707
949-522-7100

PROJECT INFORMATION:

Freedom Lane

Aliso Viejo, CA

CURRENT ISSUE DATE:

10/16/2025

ISSUED FOR:

PRELIMINARY

REV.	DATE:	ISSUED FOR:	DWN BY:
1	10/16/2025	PRELIMINARY	DG

SCALE:

NTS

SHEET TITLE:

DOUBLETRAP
MODULE TYPES

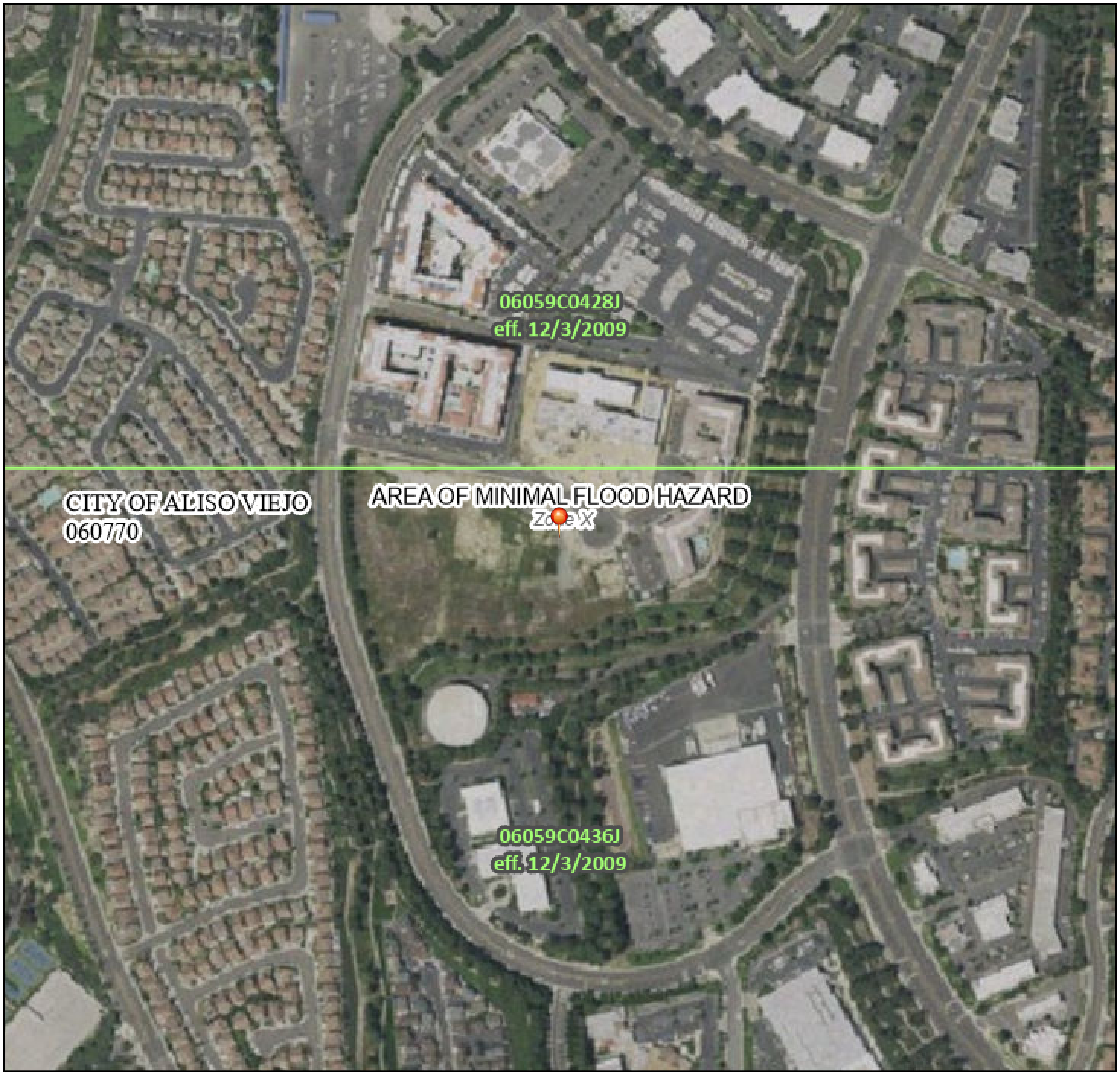
SHEET NUMBER:

6.0

National Flood Hazard Layer FIRMette

FEMA

117°44'W 33°33'58"N



117°43'23"W 33°33'28"N

Feet

0 250 500 1,000 1,500 2,000

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS	🟦	Without Base Flood Elevation (BFE) *Zone A, V, A99*
		With BFE or Depth *Zone AE, AO, AH, VE, AR*
	▨	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	🟧	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
	▨	Future Conditions 1% Annual Chance Flood Hazard *Zone X*
	▨	Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
	▨	Area with Flood Risk due to Levee *Zone D*
OTHER AREAS	NO SCREEN	Area of Minimal Flood Hazard *Zone X*
	▭	Effective LOMRs
	▭	Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES	– – –	Channel, Culvert, or Storm Sewer
	IIIIIII	Levee, Dike, or Floodwall
OTHER FEATURES	B 20.2 17.5	Cross Sections with 1% Annual Chance Water Surface Elevation
	8 – – –	Coastal Transect
	513	Base Flood Elevation Line (BFE)
	—	Limit of Study
	—	Jurisdiction Boundary
	– – –	Coastal Transect Baseline
	—	Profile Baseline
	—	Hydrographic Feature
MAP PANELS	☐	Digital Data Available
	☐	No Digital Data Available
	☒	Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/6/2024 at 2:50 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

THIS PAGE INTENTIONALLY LEFT BLANK

Preliminary Water Quality Management Plan (PWQMP)

Project Name:

Freedom Lane

TTM 19343

Prepared for:

Meritage Homes
230 Progress
Irvine, CA 92618
949-299-3824

Prepared by:

X Engineering & Consulting, Inc.

Engineer: Eric Lissner, P.E.
Registration No. 84264
6 Hutton Centre Drive, Suite 650
Santa Ana, CA 92707
949-522-1700
eric.lissner@xengineeringinc.com

Engineer's Seal

ERIC LISSNER
No. 84264
CIVIL

Prepared on:

October 22, 2025

Project Owner's Certification

Permit/Application No.	TBD	Grading Permit No.	TBD
Tract/Parcel Map No.	TTM 19343	Building Permit No.	TBD
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract)			APNs: 632-141-12, 632-141-13, 632-141-14, 632-141-15

This Water Quality Management Plan (WQMP) has been prepared for Meritage Homes by X Engineering & Consulting, Inc.. The WQMP is intended to comply with the requirements of the local NPDES Stormwater Program requiring the preparation of the plan.

The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with the current Orange County Drainage Area Management Plan (DAMP) and the intent of the non-point source NPDES Permit for Waste Discharge Requirements for the County of Orange, Orange County Flood Control District and the incorporated Cities of Orange County within the San Diego Region (South Orange County). Once the undersigned transfers its interest in the property, its successors-in-interest shall bear the aforementioned responsibility to implement and amend the WQMP. An appropriate number of approved and signed copies of this document shall be available on the subject site in perpetuity.

Owner:			
Title	Brent Ball		
Company	Meritage Homes		
Address	230 Progress, Irvine, CA, 92618		
Email	Brent.ball@meritagehomes.com		
Telephone #	(949) 299-3831		
Signature		Date	

Contents

Page No.

Section 1 Discretionary Permit(s) and Water Quality Conditions 3

Section 2 Project Description 4

- **2.1 General Description** 4
- **2.2 Post Development Drainage Characteristics** 6
- **2.3 Property Ownership/Management** 6

Section 3 Site & Watershed Characterization 7

- **3.1 Site Conditions** 7
  - *3.1.1 Existing Site Conditions* 7
  - *3.1.2 Infiltration-Related Characteristics* 7
- **3.2 Proposed Site Development Activities** 8
  - *3.2.1 Overview of Site Development Activities* 8
  - *3.2.2 Project Attributes Influencing Stormwater Management* 8
  - *3.2.3 Effects on Infiltration and Harvest and Use Feasibility* 9
- **3.3 Receiving Waterbodies** 9
- **3.4 Stormwater Pollutants or Conditions of Concern** 10
- **3.5 Hydrologic Conditions of Concern** 10
- **3.6 Critical Course Sediment Yield Areas** 11

Section 4 Site Plan and Drainage Plan 12

- **4.1 Drainage Management Area Delineation** 12
- **4.2 Overall Site Design BMPs** 12
- **4.3 DMA Characteristics and Site Design BMPs** 13
  - *4.3.1 DMA 1* 13
  - *4.3.2 DMA 2* 13
  - *4.3.3 DMA 3* 14
  - *4.3.4 DMA 4* 14
  - *4.3.5 DMA 5* 14
  - *4.3.6 DMA Summary* 15
- **4.4 Source Control BMPs** 16

Section 5 Low Impact Development BMPs 21

- **5.1 LID BMPs in DMA 1** 21
  - *5.1.1 Hydrologic Source Controls for DMA 1* 21
  - *5.1.2 Structural LID BMP for DMA 1* 21
- **5.2 LID BMPs in DMA 2 & DMA 5** 21
  - *5.2.1 Hydrologic Source Controls for DMA 2 & DMA 5* 22
  - *5.2.2 Structural LID BMP for DMA 2 & DMA 5* 22
- **5.3 LID BMPs in DMA 3** 22
  - *5.3.1 Hydrologic Source Controls for DMA 3* 22
  - *5.3.2 Structural LID BMP for DMA 3* 22
- **5.4 LID BMPs in DMA 4** 23
  - *5.4.1 Hydrologic Source Controls for DMA 4* 23
  - *5.4.2 Structural LID BMP for DMA 4* 23

5.5 Summary of LID BMPs 24
Section 6 Hydromodification BMPs 25
6.1 Points of Compliance 25
6.2 Pre-Development (Natural) Conditions 25
6.3 Post-Development Conditions and Hydromodification BMPs 25
6.4 Measures for Avoidance of Critical Coarse Sediment Yield Areas 25
6.5 Hydrologic Modeling and Hydromodification Compliance 25
Section 7 Educational Materials Index 28
Attachment A: Educational Materials 29
Attachment B: Operations and Maintenance Plan 30
Attachment C: Calculations and Worksheets 31
Attachment D: Supporting Exhibits 32
Attachment E: Geotechnical Report 33

Section 1 Discretionary Permit(s) and Water Quality Conditions

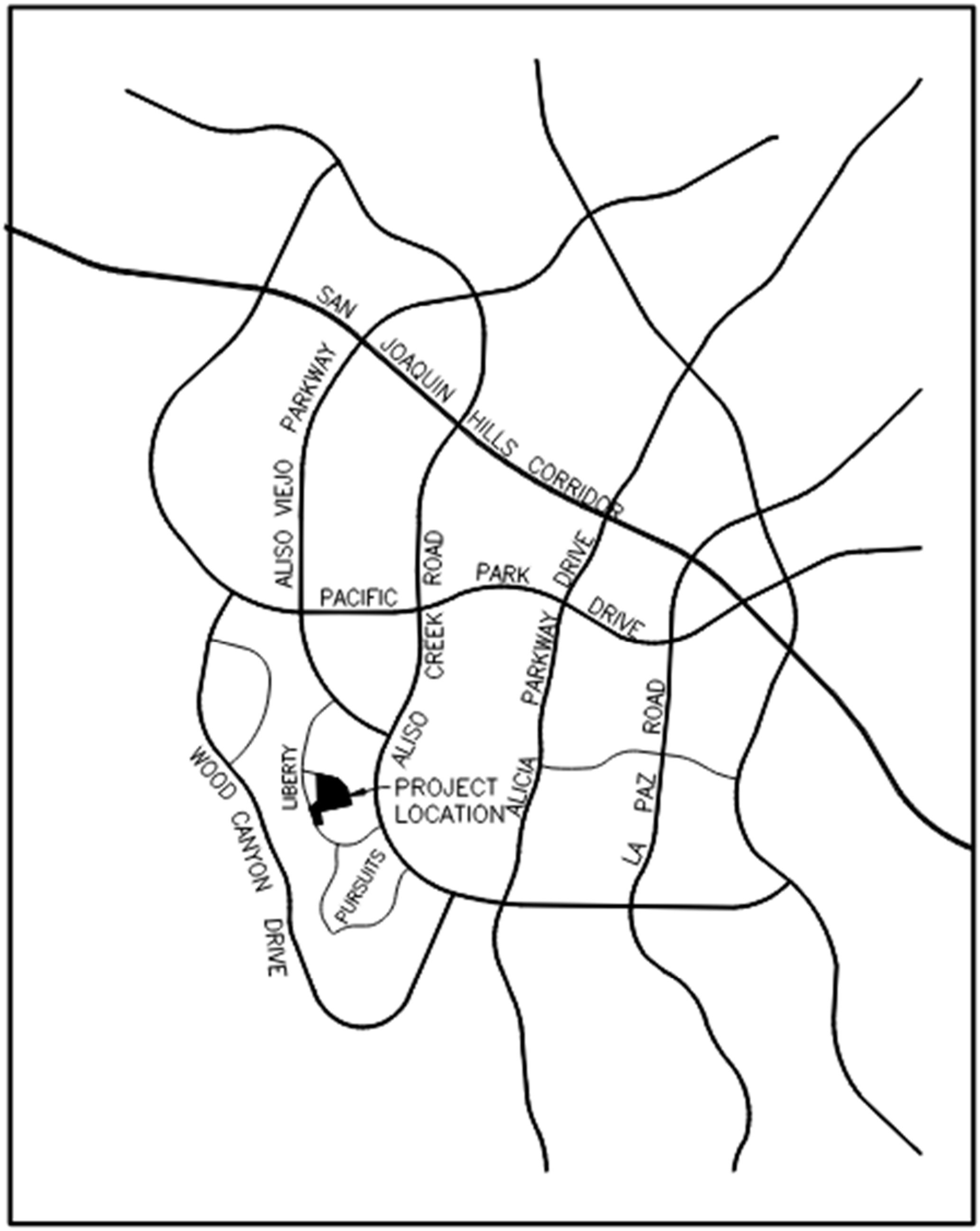
Project Infomation			
Permit/Application No.	TBD	Site Address or Tract/Parcel Map No.	400-700 Freedom Lane, Aliso Viejo CA 92656
Additional Information/ Comments:	TTM 19343		

Water Quality Conditions	
Water Quality Conditions from prior approvals or applicable watershed-based plans	*Pending, to be included in the Final WQMP*

Section 2 Project Description

2.1 General Description

Description of Proposed Project				
Site Location	*400-700 Freedom Lane, Aliso Viejo, CA 92566*			
Project Area (ft²): 193,406	Number of Dwelling Units: 72		SIC Code: __________	
Narrative Project Description:	This priority redevelopment project will construct a housing development on existing vacant land. The completed project will consist of 72 dwelling units, consisting of 8 single units and 32 buildings (64 dwelling units) within the property. There will be 181 parking spaces including 144 for garage parking and 37 guest stalls. 90,287-square feet of open space is provided in this development. This project qualifies as a priority project due to the creation and replacement of more than 10,000-square feet of impervious surface.			
Project Area	Pervious		Impervious	
	Area (acres or sq ft)	Percentage	Area (acres or sq ft)	Percentage
Pre-Project Conditions	4.44	100	0	0
Post-Project Conditions	1.10	25	3.34	75


SAN
JOAQUIN
HILLS
CORRIDOR
ALISO VIEJO
PARKWAY
PACIFIC
PARK
DRIVE
ALISO
CREEK
ROAD
PARKWAY
DRIVE
ALICIA
LA PAZ
ROAD
WOOD
CANYON
DRIVE
LIBERTY
PURSUITS
PROJECT
LOCATION

VICINITY MAP

2.2 Post Development Drainage Characteristics

The proposed condition drainage will mimic the existing condition drainage to the maximum extent possible. Runoff generally flows from west to east. Proposed condition drainage generally concentrates sheet flow into drainage inlets, catch basins, and routes it into subsurface storm drainage pipes. Runoff is conveyed to four MWS units, one MWS-L-6-8-V unit, one MWS L-8-8-V unit, one MWS L-8-12-V unit, and one MWS-L-8-20-V unit, for water quality treatment of the 85th percentile, 24-hour storm event. Stormwater flows exceeding this value, including flows from the MWS will then be routed into a subsurface detention facility with a flow control outlet orifice suitable for mitigating hydromodification and peak stormwater flows.

The project is not covered by an existing WQMP and is not subject to cross-lot drainage. There are no existing stormwater BMPs onsite.

2.3 Property Ownership/Management

This project is owned by Meritage Homes.

Section 3 Site & Watershed Characterization

3.1 Site Conditions

3.1.1 Existing Site Conditions

The existing condition is vacant land. The existing site sheet flows drainage from west to east at an approximately 2.5% slope. Existing slopes range from 467.5 feet in the west to 454 feet in the east of the site. In the existing condition, a siltation basin lies in the east portion of the property. The basin collects stormwater and drains it into an existing 18-inch high density polyethylene pipe (HDPE) at the cul-de-sac on Freedom Lane. The 18-inch HDPE eventually increases to a 24-inch HDPE storm drain. Existing site drainage flows northeast through the Belmont Village property to the north of the site. A 24-inch reinforced concrete pipe (RCP) conveys stormwater to a 30-inch RCP storm drain on Aliso Creek Road that eventually increases up to a 96-inch RCP downstream. The 96-inch RCP terminates at a rip rap energy dissipation structure at Aliso Creek, where stormwater is conveyed to the Pacific Ocean at South Laguna Beach (**Attachment D12**).

This project is not covered by an existing WQMP. In the existing condition, the adjacent property to the west of the project sheet flows into the siltation basin on the project. In the proposed condition, the adjacent property plans to control stormwater flows on their site.

Existing Land Uses

Land Use Description	Total Area (acres)	Impervious Area (acres)	Pervious Area (acres)	Imperviousness (%)
Vacant land	4.44	0	4.44	0
Total	**4.44**	**0**	**4.44**	**0**

3.1.2 Infiltration-Related Characteristics

3.1.2.1 Hydrogeologic Conditions

Groundwater was not encountered within the 75 foot range during exploration. Groundwater seepage was encountered during subsurface exploration by SA Geotechnical at a depth between 18.5 to 27 feet below ground surface (bgs). Historic high groundwater has been measured at depths greater than 20-feet bgs. It is expected that groundwater will remain more than 20 feet below design grades upon completion of grading. (SA Geotechnical 2024).

3.1.2.2 Soil and Geologic Infiltration Characteristics

The SA Geotechnical report indicates that stormwater infiltration is not recommended for this project. The site is underlain by thick artificial fill soil overlying bedrock. Additionally, the native hydrologic soil classification is HSG D (**Attachment D1**).

3.1.2.3 Geotechnical Conditions

The site is not located within a mapped liquefaction hazard zone. Expansive soil exists within the northern region of the site. The existing slope to the south of the property was found to be stable.

3.1.2.4 Summary of Infiltration Opportunities and Constraints of Existing Site

Due to the geotechnical constraints previously mentioned, infiltration is not recommended onsite. The presence of thick artificial fill soil overlying bedrock, HSG D soil group, and deep groundwater indicates that infiltration is not suitable at this site.

3.2 Proposed Site Development Activities

3.2.1 Overview of Site Development Activities

The housing redevelopment project will construct 72 dwelling units consisting of 8 single dwelling units and 32 new buildings (64 dwelling units), new landscaping, and private streets.

3.2.2 Project Attributes Influencing Stormwater Management

The proposed residential development will retain the drainage pattern of the existing condition to the maximum extent possible with stormwater flowing west to east. Slope and grade changes will be minimal. The proposed landscaping will be California friendly, drought resistant plants. The overall proposed pervious landscape will be 25% pervious. There is no stormwater runon to the site. Stormwater runoff will flow to the catch basin at the cul-de-sac of Freedom Lane in the same manner as the existing condition.

No SIC codes are known to the site. Waste generated from the site will be general household waste, not including any hazardous waste. Refer to the table below for a summary of the proposed land uses on site.

Proposed Land Uses				
Land Use Description	Total Area (acres)	Impervious Area (acres)	Pervious Area (acres)	Imperviousness (%)
Residential	4.44	3.34	1.10	75%
Total	4.44	3.34	1.10	75%

3.2.3 Effects on Infiltration and Harvest and Use Feasibility

Infiltration is not recommended for the site due to low infiltration rates of existing engineered fill and the presence of HSG class D soil. Harvest and use for the planned community is not feasible due to lack of space.

3.3 Receiving Waterbodies

The project drains to the public storm drain which in turn drains to Aliso Creek prior to discharge into the Pacific Ocean. 303(d) listings associated with Aliso Creek along with the SWRCB decision ID are phosphorous (111092), nitrogen (127601), selenium (111093), benthic community effects (125926), toxicity (111095), indicator bacteria (79858), and malathion (81901).

3.4 Stormwater Pollutants or Conditions of Concern

Pollutants or Conditions of Concern				
Pollutant	Expected from Proposed Land Uses/Activities (Yes or No)	Receiving Waterbody Impaired (Yes or No)	Priority Pollutant from WQIP or other Water Quality Condition? (Yes or No)	**Pollutant of Concern (Primary, Other, or No)**
Suspended-Solids	Yes	No	No	No
Nutrients	Yes	Yes	No	Primary
Heavy Metals	No	No	No	No
Bacteria/Virus/Pathogens	Yes	Yes	Yes	Primary
Pesticides	Yes	No	No	No
Oil and Grease	Yes	No	No	No
Toxic Organic Compounds	No	No	No	No
Trash and Debris	Yes	No	No	No
Dry Weather Runoff	Yes	No	Yes	Primary

3.5 Hydrologic Conditions of Concern

Does a hydrologic condition of concern exist for this project?

☐ No – An HCOC does not exist for this receiving water because *(select one)*:

  ☐ Project discharges directly to a protected conveyance (bed and bank are concrete lined the entire way from the point(s) of discharge to a receiving lake, reservoir, embayment, or the Ocean

  ☐ Project discharges directly to storm drains which discharge directly to a reservoir, lake, embayment, ocean or protected conveyance (as described above)

  ☐ The project discharges to an area identified in the WMAA as exempt from hydromodification concerns

☒ Yes – An HCOC does exist for this receiving water because none of the above are applicable.

Repeat this checklist for each different receiving water to which the project would discharge.

3.6 Critical Course Sediment Yield Areas

Critical coarse sediment provisions do not apply to this project (redevelopment of an existing developed site). The site is also not listed within the Potential Coarse Sediment area on the OCPW Potential Coarse Sediment Map of Aliso Creek (**Attachment D3**).

Section 4 Site Plan and Drainage Plan

4.1 Drainage Management Area Delineation

Five DMAs are designated for this project. See attached **DMA Exhibit**.

The site DMA consists of 72 dwelling units, including 32 buildings and 8 single units, hardscape, and drought resistant landscaping. All drainage is intercepted by inlet drains, roof drains, catch basins and conveyed through subsurface storm drains. In the northwest of the site DMA 1 has drainage directed north of the site to be treated in a MWS-L-6-8-V modular wetland system (MWS). Any water flowing through the MWS as well as stormwater peak flows exceeding the 85th percentile water quality design volume will be routed through a subsurface detention vault. In the center, DMA 2 has drainage directed near the center of the site to be treated in a MWS-L-8-12-V modular wetland system (MWS). In the southwest of the site, DMA 5 has drainage directed to DMA 2's MWS-L-8-12-V modular wetland system (MWS) near the center as well. Any water flowing through the MWS as well as stormwater peak flows exceeding the 85th percentile water quality design volume will be routed through a subsurface detention vault. DMA 3 encompasses street drainage in which drainage is directed southeast of the site to be treated in a MWS-L-8-20-V modular wetland system (MWS). Any water flowing through the MWS as well as stormwater peak flows exceeding the 85th percentile water quality design volume will be routed through a subsurface detention vault. In the south of the site, DMA 4 has drainage directed south of the site to be treated in a MWS-L-8-8-V modular wetland system (MWS). Any water flowing through the MWS as well as stormwater peak flows exceeding the 85th percentile water quality design volume will be routed through a subsurface detention vault.

4.2 Overall Site Design BMPs

Minimize Impervious Area - Impervious areas will be minimized through provision of landscaped areas to the maximum extent possible.

Maximize Natural Infiltration Capacity - Infiltration is not recommended on site as referenced in the geotechnical report. However, natural infiltration is maximized in landscaped areas to the maximum extent possible.

Preserve Existing Drainage Patterns and Time of Concentration - Existing drainage patterns are preserved with routing stormwater flows from west to east. The proposed condition will use a subsurface detention/hydromodification vault that will increase the time of concentration comparable to the existing condition.

Disconnect Impervious Areas - Runoff from impervious areas will be dispersed to landscaped areas to the maximum extent possible.

Protect Existing Vegetation and Sensitive Areas - Existing vegetation that consists of sparse weeds will not be preserved. The remaining areas will be replaced by California friendly drought tolerant vegetation. There are no sensitive areas for this project.

Revegetate Disturbed Areas - Disturbed areas will be hardscaped and landscaped.

Soil Stockpiling and Site Generated Organics – No organic wastes are anticipated for the project. Soil stockpiling is to be managed through erosion and sediment control plans.

Firescaping - Drought resistant landscaping and firescaping measures will be incorporated to the maximum extent possible.

Water Efficient Landscaping - Water-efficient irrigation methods will be implemented on proposed landscaping.

Slopes and Channel Buffers – The existing slope to the south of the project will be protected with a 5 foot setback. Additionally, deepened footing on the buildings adjacent to the slope will be incorporated. The vegetation on the existing slope will remain and not be disturbed.

4.3 DMA Characteristics and Site Design BMPs

4.3.1 DMA 1

The northwest portion of the site has been graded to drain to one LID BMP located to the northwest of the project. Stormwater peak flows will be conveyed to a Modular Wetland System MWS-L- 6-8-V for water quality treating the 85th percentile 24-hour storm event. Overflow during heavy storm events will be bypassed through an internal weir within each MWS. Treated stormwater and bypassed flow will be routed to the subsurface detention basin for hydromodification management and attenuating peak flows before exiting to the 18-inch public storm drain at the cul-de-sac of Freedom Lane.

The DMA will contain approximately 70% imperviousness (0.38-acres) and 30% perviousness (0.15-acres). The DMA is flat with average slopes between 1-2%. Anticipated pollutants generated from this site are suspended solids/sediments, nutrients, pathogens (bacteria and viruses), oils/grease, trash, and debris.

4.3.2 DMA 2

The center portion of the site has been graded to drain to one LID BMP located to the center of the project. Stormwater peak flows will be conveyed to a Modular Wetland System MWS-L- 8-12-V for water quality treating the 85th percentile 24-hour storm event. Overflow during heavy storm events will be bypassed through an internal weir within each MWS. Treated stormwater and bypassed flow will be routed to the subsurface detention basin for hydromodification management and attenuating peak flows before exiting to the 18-inch public storm drain at the cul-de-sac of Freedom Lane.

The DMA will contain approximately 80% imperviousness (0.76-acres) and 20% perviousness (0.24-acres). The DMA is flat with average slopes between 1-2%. Anticipated pollutants generated from this site are suspended solids/sediments, nutrients, pathogens (bacteria and viruses), oils/grease, trash, and debris.

4.3.3 DMA 3

The street drainage portion of the site has been graded to drain to one LID BMP located to the southeast of the project. Stormwater peak flows will be conveyed to a Modular Wetland System MWS-L- 8-20-V for water quality treating the 85th percentile 24-hour storm event. Overflow during heavy storm events will be bypassed through an internal weir within each MWS. Treated stormwater and bypassed flow will be routed to the subsurface detention basin for hydromodification management and attenuating peak flows before exiting to the 18-inch public storm drain at the cul-de-sac of Freedom Lane.

The DMA will contain approximately 90% imperviousness (1.55-acres) and 10% perviousness (0.26-acres). The DMA is flat with average slopes between 1-2%. Anticipated pollutants generated from this site are suspended solids/sediments, nutrients, pathogens (bacteria and viruses), oils/grease, trash, and debris.

4.3.4 DMA 4

The south portion of the site has been graded to drain to one LID BMP located to the south of the project. Stormwater peak flows will be conveyed to a Modular Wetland System MWS-L- 8-8-V for water quality treating the 85th percentile 24-hour storm event. Overflow during heavy storm events will be bypassed through an internal weir within each MWS. Treated stormwater and bypassed flow will be routed to the subsurface detention basin for hydromodification management and attenuating peak flows before exiting to the 18-inch public storm drain at the cul-de-sac of Freedom Lane.

The DMA will contain approximately 60% imperviousness (0.51-acres) and 40% perviousness (0.38acres). The DMA is flat with average slopes between 1-2%. Anticipated pollutants generated from this site are suspended solids/sediments, nutrients, pathogens (bacteria and viruses), oils/grease, trash, and debris.

4.3.5 DMA 5

The southwest portion of the site has been graded to drain toward the same Modular Wetland System MWS-L-8-12-V that serves DMA 2, located near the center of the project. Stormwater peak flows will be conveyed to the Modular Wetland System for water quality treating the 85th percentile 24-hour storm event. Overflow during heavy storm events will be bypassed through an internal weir within each MWS. Treated stormwater and bypassed flow will be routed to the subsurface detention basin for hydromodification management and attenuating peak flows before exiting to the 18-inch public storm drain at the cul-de-sac of Freedom Lane.

The DMA will contain approximately 70% imperviousness (0.15-acres) and 30% perviousness (0.06-acres). The DMA is flat with average slopes between 1-2%. Anticipated pollutants generated from this site are suspended solids/sediments, nutrients, pathogens (bacteria and viruses), oils/grease, trash, and debris.

4.3.6 DMA Summary

Drainage Management Areas				
DMA (Number/Description)	Total Area (acres)	Imperviousness (%)	Infiltration Feasibility Category (Full, Partial, or No Infiltration)	Hydrologic Source Controls Used
DMA 1, North Section	0.53	70%	No Infiltration	Not applicable.
DMA 2, Center Section	1.00	80%	No Infiltration	Not applicable.
DMA 3, Street Drainage	1.81	90%	No Infiltration	Not applicable.
DMA 4, South Section	0.89	60%	No Infiltration	Not applicable.
DMA 5, Southwest Section	0.21	70%	No Infiltration	Not applicable.

4.4 Source Control BMPs

Non-Structural Source Control BMPs				
Identifier	**Name**	**Check One**		**Reason Source Control is Not Applicable**
		Included	**Not Applicable**	
N1	Education for Property Owners, Tenants and Occupants	☒	☐	
N2	Activity Restrictions	☒	☐	
N3	Common Area Landscape Management	☒	☐	
N4	BMP Maintenance	☒	☐	
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	No hazardous waste will be generated from this site.
N6	Local Industrial Permit Compliance	☐	☒	No industrial business on this site.
N7	Spill Contingency Plan	☐	☒	No hazardous waste will be generated from this site.
N8	Underground Storage Tank Compliance	☐	☒	Not applicable.
N9	Hazardous Materials Disclosure Compliance	☐	☒	No hazardous waste will be generated from this site.
N10	Uniform Fire Code Implementation	☐	☒	No use or storage of hazardous materials.
N11	Common Area Litter Control	☒	☐	
N12	Employee Training	☐	☒	Not applicable.
N13	Housekeeping of Loading Docks	☐	☒	No loading docks are proposed for this site.
N14	Common Area Catch Basin Inspection	☒	☐	
N15	Street Sweeping Private Streets and Parking Lots	☒	☐	
N16	Retail Gasoline Outlets	☐	☒	No retail gasoline outlets are proposed for this project.

N1: Education for Property Owners, Tenants and Occupants
– Education materials pertaining to environmental awareness will be identified in this WQMP and shown to the respective homeowner. These education materials will also include information describing use of household chemicals to limit the discharge wastes directly into the storm drain facilities. Educational materials are made available from the County of Orange on their website.

N2: Activity Restrictions
– Education materials pertaining to activity restrictions such as no car washing will be identified in this WQMP and shown to the respective homeowner. Educational materials are made available from the County of Orange on their website.

N3 (SC-73): Landscape Management
– Education materials pertaining to best management practices associated with landscape maintenance and individual residence water management will be identified in this WQMP and shown to the respective homeowner. This is to be consistent with Orange County water conservation standards or City of Aliso Viejo equivalent including but not limited to fertilizer or pesticide usages. Refer to the DAMP Section 5.5 for further details. Educational materials are made available from the County of Orange on their website.

N4: BMP Maintenance
– This WQMP shall identify responsibility form implementation and maintenance of each BMP.

N11 (SC60): Litter Control
– The property owner will be educated on proper litter control procedures to reduce pollution of stormwater runoff.

N14 (SC74): Common Area Catch Basin Inspection
– The property owner will be educated on proper inspection, cleaning, maintenance and documentation of drainage facilities annually. Cleaning should take place prior to the start of the rainy season and inspected before and after storm events.

N15 (SC43, SC70): Street Sweeping Private Streets and Parking Lots
– The property owner will be educated on proper street sweeping procedures for the community. Streets and parking regions are to be swept prior to storm season in late summer or early fall, or as required by City of Aliso Viejo standards.

Structural Source Control BMPs

Identifier	Name	Check One		Reason Source Control is Not Applicable
		Included	Not Applicable	
S1	Provide storm drain system stenciling and signage	☒	☐	
S2	Design and construct outdoor material storage areas to reduce pollution introduction	☐	☒	Not applicable, each residence responsible for own waste cans.
S3	Design and construct trash and waste storage areas to reduce pollution introduction	☒	☐	
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	☒	☐	
S5	Protect slopes and channels and provide energy dissipation	☒	☐	
	Incorporate requirements applicable to individual priority project categories (from SDRWQCB NPDES Permit)	☒	☐	
S6	Dock areas	☐	☒	Not applicable, residential development
S7	Maintenance bays	☐	☒	Not applicable, residential development
S8	Vehicle wash areas	☐	☒	Not applicable, residential development
S9	Outdoor processing areas	☐	☒	Not applicable, residential development
S10	Equipment wash areas	☐	☒	Not applicable, residential development
S11	Fueling areas	☐	☒	Not applicable, residential development
S12	Hillside landscaping	☐	☒	Flat site, slopes less than 2% overall
S13	Wash water control for food preparation areas	☐	☒	Not applicable, residential development
S14	Community car wash racks	☐	☒	Not applicable

S1 (SD13): Provide storm drain system stenciling and signage

– Storm drain stencils are highly visible source control messages, typically placed directly adjacent to storm drain inlets. The stencil as shown in Attachment G contain a brief statement that prohibits the dumping of improper materials into the municipal storm drain system. Graphical icons, either illustrating anti-dumping symbols or images of receiving water fauna, are effective supplements to the antidumping message. Stencils and signs alert the public to the destination of pollutants discharged into stormwater. The following requirements should be included in the project design and shown on the project plans:

1. Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language (such as: "NO DUMPING DRAINS TO OCEAN") and/or graphical icons to discourage illegal dumping.

2. Post signs and prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

3. Maintain legibility of stencils and signs.

S3 (SD32): Design and construct trash and waste storage areas to reduce pollution introduction –All trash container areas shall meet the following requirements:

1. Paved with an impervious surface, designed not to allow run-on from adjoining areas, designed to divert drainage from adjoining roofs and pavements diverted around the area, screened or walled to prevent off-site transport of trash; and

2. Provide solid roof or awning to prevent direct precipitation. See CASQA Stormwater Handbook Section 3.2.9 and BMP Fact Sheet SD-32 for additional information.

S4 (SD12): Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control

– Projects shall design the timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the municipal storm drain system. The following methods to reduce excessive irrigation runoff shall be considered, and incorporated on common areas of development and other areas where determined applicable and feasible by the Permittee:

1. Employing rain shutoff devices to prevent irrigation after precipitation.

2. Designing irrigation systems to each landscape area's specific water requirements.

3. Using flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.

4. Implementing landscape plan consistent with County Water Conservation Resolution or city equivalent, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.

5. The timing and application methods of irrigation water shall be designed to minimize the runoff of excess irrigation water into the municipal storm drain system.

6. Employing other comparable, equally effective, methods to reduce irrigation water runoff.

7. Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider other design features, such as:

  - Use mulches (such as wood chips or shredded wood products) in planter areas without ground cover to minimize sediment in runoff.
  - Install appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant material where possible and/or as recommended by the landscape architect.
  - Leave a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible.
  - Choose plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth. Irrigation practices shall comply with local and statewide ordinances related to irrigation efficiency.

S5 : Protect slopes and channels and provide energy dissipation.

– The existing south slope will maintain the original grades and vegetation will not be disturbed. Energy dissipation for the community will be provided:

1. Attenuation of stormwater leaving each BMP through a flow control orifice for hydromodification compliance.

Section 5 Low Impact Development BMPs

5.1 LID BMPs in DMA 1

Due to the site's infeasibility for infiltration, the LID BMP used in DMA 1 is a proprietary biofiltration BMP with no infiltration. Harvest and use BMP is not feasible due to the project's lack of demand for stormwater harvest.

5.1.1 Hydrologic Source Controls for DMA 1

Hydrologic source control BMPs are not practical for this project and are not used. The site's soil characteristics are not suitable for stormwater retention to achieve volume reduction.

5.1.2 Structural LID BMP for DMA 1

The LID BMPs utilized in DMA 1 is one Modular Wetland System (MWS) for pollutant control. The MWS units are WA TAPE (Washington State Technology Acceptance Protocol-Ecology) approved proprietary biofiltration (BIO-5) device that provides biofiltration via horizontal flow. The MWS is used as a compact LID BMPs to accommodate the tight space constraints of the project and to receive subsurface pipe flows for treatment.

The MWS is paired with a downstream subsurface detention vault for HMP compliance and attenuation of peak flows. This MWS' have been sized to accommodate 150% of the 85th percentile, 24-hour storm for water quality treatment per Appendix E.3.5 and Worksheet 9. Stormwater flows exceeding the water quality flows will be bypassed through an internal weir within each MWS and discharge into the detention vault. Both the runoff treated by the MWS, and bypassed flows are routed through the detention vault.

The vault is capable of regulating hydromodification events from 10% of the 2-year through the 10-year storms with a riser. Equipped with a 3.25 inch low-flow diameter orifice at the bottom of the structure as well as a rectangular notch at the top, this riser controls the hydromodification events and attenuates peak flows. Stormwater flows exceeding the hydromodification events will pass through the 18-inch diameter opening at the top of the riser. Stormwater discharges from the vault to the 18-inch RCP storm drain at the cul-de-sac of Freedom Lane.

See the attached DMA Exhibit at the end of section 5 for details.

5.2 LID BMPs in DMA 2 & DMA 5

Due to the site's infeasibility for infiltration, the LID BMP used in DMA 2 and DMA 5 is a proprietary biofiltration BMP with no infiltration. Harvest and use BMP is not feasible due to the project's lack of demand for stormwater harvest.

5.2.1 Hydrologic Source Controls for DMA 2 & DMA 5

Hydrologic source control BMPs are not practical for this project and are not used. The site's soil characteristics are not suitable for stormwater retention to achieve volume reduction.

5.2.2 Structural LID BMP for DMA 2 & DMA 5

The LID BMPs utilized in DMA 2 and DMA 5 is one Modular Wetland System (MWS) for pollutant control. The MWS units are WA TAPE (Washington State Technology Acceptance Protocol-Ecology) approved proprietary biofiltration (BIO-5) device that provides biofiltration via horizontal flow. The MWS is used as a compact LID BMPs to accommodate the tight space constraints of the project and to receive subsurface pipe flows for treatment.

The MWS is paired with a downstream subsurface detention vault for HMP compliance and attenuation of peak flows. This MWS' have been sized to accommodate 150% of the 85th percentile, 24-hour storm for water quality treatment per Appendix E.3.5 and Worksheet 9. Stormwater flows exceeding the water quality flows will be bypassed through an internal weir within each MWS and discharge into the detention vault. Both the runoff treated by the MWS, and bypassed flows are routed through the detention vault.

The vault is capable of regulating hydromodification events from 10% of the 2-year through the 10-year storms with a riser. Equipped with a 3.25 inch low-flow diameter orifice at the bottom of the structure as well as a rectangular notch at the top, this riser controls the hydromodification events and attenuates peak flows. Stormwater flows exceeding the hydromodification events will pass through the 18-inch diameter opening at the top of the riser. Stormwater discharges from the vault to the 18-inch RCP storm drain at the cul-de-sac of Freedom Lane.

See the attached DMA Exhibit at the end of section 5 for details.

5.3 LID BMPs in DMA 3

Due to the site's infeasibility for infiltration, the LID BMP used in DMA 3 is a proprietary biofiltration BMP with no infiltration. Harvest and use BMP is not feasible due to the project's lack of demand for stormwater harvest.

5.3.1 Hydrologic Source Controls for DMA 3

Hydrologic source control BMPs are not practical for this project and are not used. The site's soil characteristics are not suitable for stormwater retention to achieve volume reduction.

5.3.2 Structural LID BMP for DMA 3

The LID BMPs utilized in DMA 3 is one Modular Wetland System (MWS) for pollutant control. The MWS units are WA TAPE (Washington State Technology Acceptance Protocol-Ecology) approved proprietary biofiltration (BIO-5) device that provides biofiltration via horizontal flow. The MWS is used as a compact LID BMPs to accommodate the tight space constraints of the project and to receive subsurface pipe flows for treatment.

The MWS is paired with a downstream subsurface detention vault for HMP compliance and attenuation of peak flows. This MWS' have been sized to accommodate 150% of the 85th percentile, 24-hour storm for water quality treatment per Appendix E.3.5 and Worksheet 9. Stormwater flows exceeding the water quality flows will be bypassed through an internal weir within each MWS and discharge into the detention vault. Both the runoff treated by the MWS, and bypassed flows are routed through the detention vault.

The vault is capable of regulating hydromodification events from 10% of the 2-year through the 10-year storms with a riser. Equipped with a 3.25 inch low-flow diameter orifice at the bottom of the structure as well as a rectangular notch at the top, this riser controls the hydromodification events and attenuates peak flows. Stormwater flows exceeding the hydromodification events will pass through the 18-inch diameter opening at the top of the riser. Stormwater discharges from the vault to the 18-inch RCP storm drain at the cul-de-sac of Freedom Lane.

See the attached DMA Exhibit at the end of section 5 for details.

5.4 LID BMPs in DMA 4

Due to the site's infeasibility for infiltration, the LID BMP used in DMA 4 is a proprietary biofiltration BMP with no infiltration. Harvest and use BMP is not feasible due to the project's lack of demand for stormwater harvest.

5.4.1 Hydrologic Source Controls for DMA 4

Hydrologic source control BMPs are not practical for this project and are not used. The site's soil characteristics are not suitable for stormwater retention to achieve volume reduction.

5.4.2 Structural LID BMP for DMA 4

The LID BMPs utilized in DMA 2 and DMA 5 is one Modular Wetland System (MWS) for pollutant control. The MWS units are WA TAPE (Washington State Technology Acceptance Protocol-Ecology) approved proprietary biofiltration (BIO-5) device that provides biofiltration via horizontal flow. The MWS is used as a compact LID BMPs to accommodate the tight space constraints of the project and to receive subsurface pipe flows for treatment.

The MWS is paired with a downstream subsurface detention vault for HMP compliance and attenuation of peak flows. This MWS' have been sized to accommodate 150% of the 85th percentile, 24-hour storm for water quality treatment per Appendix E.3.5 and Worksheet 9. Stormwater flows exceeding the water quality flows will be bypassed through an internal weir within each MWS and discharge into the detention vault. Both the runoff treated by the MWS, and bypassed flows are routed through the detention vault.

The vault is capable of regulating hydromodification events from 10% of the 2-year through the 10-year storms with a riser. Equipped with a 3.25 inch low-flow diameter orifice at the bottom of the structure as well as a rectangular notch at the top, this riser controls the hydromodification events and attenuates peak flows. Stormwater flows exceeding the hydromodification events will pass through the 18-inch diameter opening at the top of the riser. Stormwater discharges from the vault to the 18-inch RCP storm drain at the cul-de-sac of Freedom Lane.

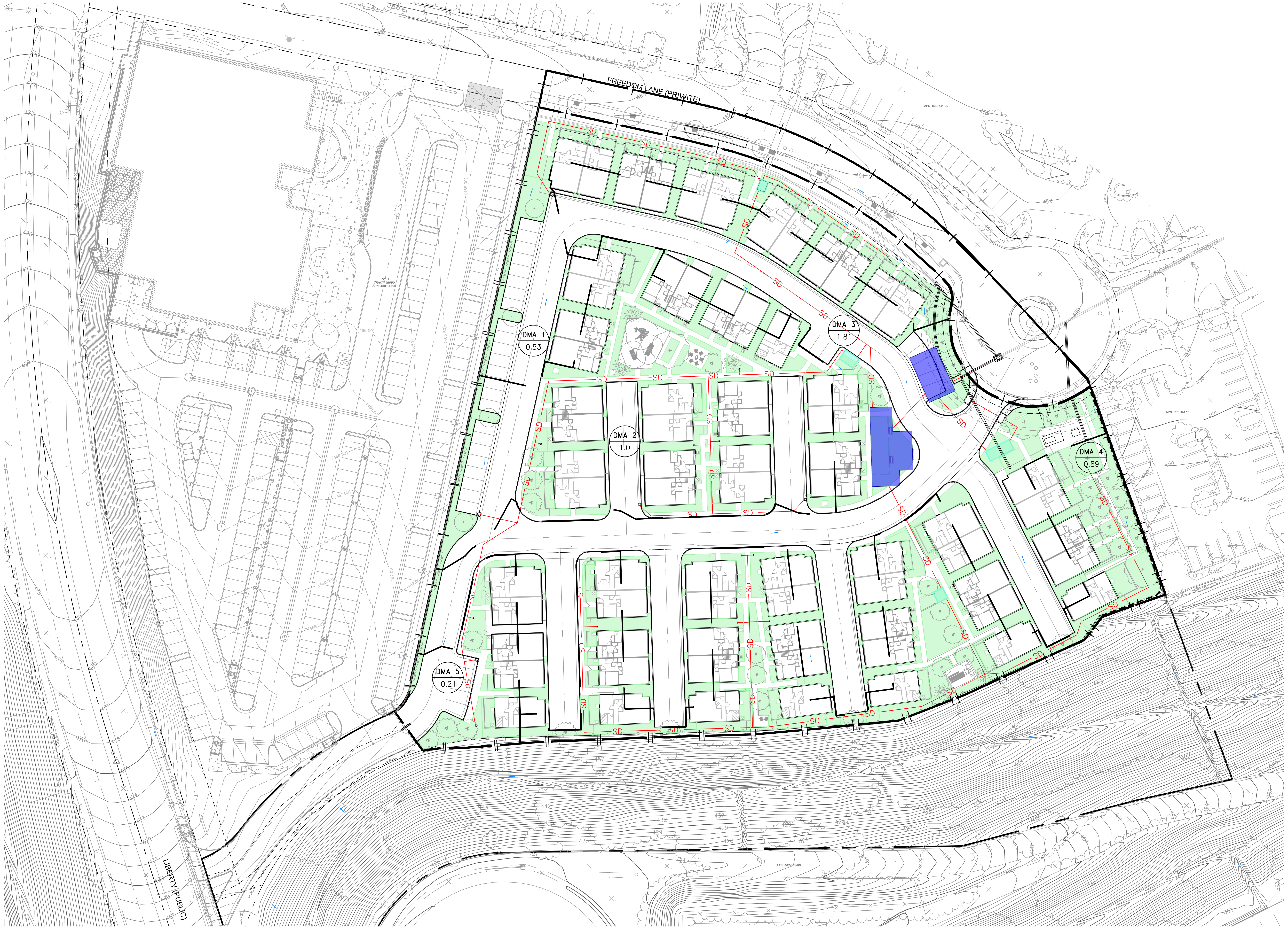
See the attached DMA Exhibit at the end of section 5 for details.

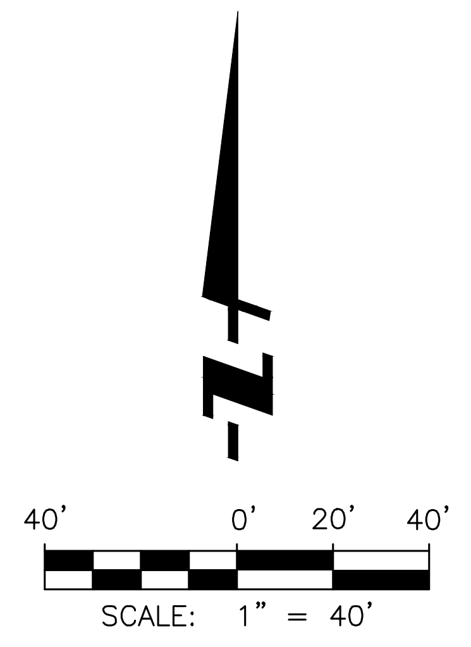
5.5 Summary of LID BMPs

Water quality requirements for the project are met with the use of four MWS units. The following table summarizes the water quality flow by each DMA. See **Attachment C2, Worksheet 9** for detailed calculations.

LID BMP Design Parameters

DMA	Acres	IMP %	C	$I_{design,\ 80\%}$ (in/hr)	$Q_{80\%}$ (cfs)	$Q_{150\%\ design}$ (cfs)
1	0.53	70	0.675	0.23	0.081	0.121
2 & 5	1.21	80	0.75	0.23	0.209	0.313
3	1.81	90	0.825	0.23	0.347	0.521
4	0.89	60	0.6	0.23	0.121	0.182


FREEDOM LANE (PRIVATE)
LIBERTY (PUBLIC)
DMA 1
0.53
DMA 2
1.0
DMA 3
1.81
DMA 4
0.89
DMA 5
0.21
SD


40'
0'
20'
40'
SCALE: 1" = 40'

LEGEND

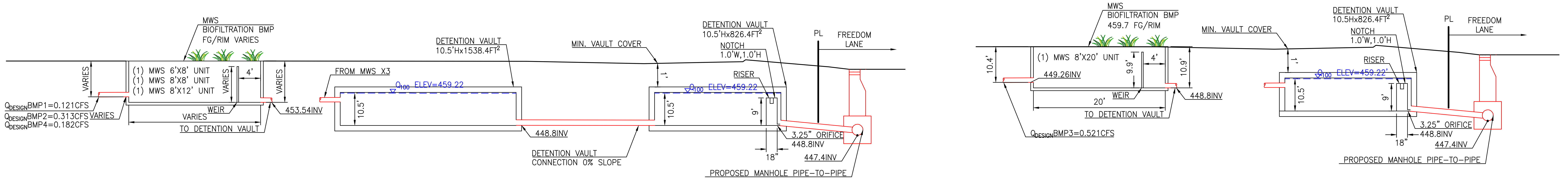
▬ ▬ ▬	DMA BOUNDARY
—— – – ——	EXISTING RIGHT OF WAY
━━ ━ ━ ━━	PROPERTY BOUNDARY
*L=270'	SURFACE FLOW PATH LENGTH
→	SURFACE FLOW PATH
DMA A	DMA ID
0.64	AREA ACREAGE
→	DIRECTION OF SURFACE FLOW
═ ═ ═	EXISTING STORM DRAIN
L=270'	PIPE FLOW LENGTH
—SD—	PROPOSED STORM DRAIN
🟦	PROPOSED DETENTION BASIN
🟩	PROPOSED BMP
🟩	PERVIOUS AREA

WQMP SUMMARY

DMA DESIGNATION	DMA 1	DMA 2	DMA 3	DMA 4	DMA 5	PROJECT TOTAL
PERVIOUS AREA (AC)	0.15	0.24	0.26	0.38	0.06	1.10
IMPERVIOUS AREA (AC)	0.38	0.76	1.55	0.51	0.15	3.34
TOTAL AREA (AC)	0.53	1.00	1.81	0.89	0.21	4.44
DESIGN CAPTURE VOL (CF)	–	–	–	–	–	9,186.8
BMP TYPE	MWS–L–6–8–V	MWS–L–8–12–V	MWS–L–8–20–V	MWS–L–8–8–V	–	–
REQUIRED DESIGN VOLUME OR FLOWRATE (CF OR CFS)	0.12	0.31	0.52	0.18	–	CFS
PROVIDED DESIGN VOLUME OR FLOWRATE (CF OR CFS)	0.15	0.35	0.58	0.23	–	CFS

NOTES

1. PROJECT IS LOCATED WITHIN ALISO CREEK WATERSHED AND IS SUBJECT TO HYDROMODIFICATION MANAGEMENT REQUIREMENTS.
2. GROUNDWATER NOT ENCOUNTERED DURING SOILS EXPLORATION. GROUNDWATER ANTICIPATED TO REMAIN 20' FEET BELOW DESIGN GRADE.
3. ENTIRE PROJECT SITE IS UNDERLAIN BY HYDROLOGIC SOILS GROUP D.
4. DMA 5 CONVEYS TO SAME BMP AS DMA 2


MWS
BIOFILTRATION BMP
FG/RIM VARIES
(1) MWS 6'X8' UNIT
(1) MWS 8'X8' UNIT
(1) MWS 8'X12' UNIT
VARIES
4'
VARIES
Q_{DESIGN}BMP1=0.121CFS
Q_{DESIGN}BMP2=0.313CFS
Q_{DESIGN}BMP4=0.182CFS
VARIES
WEIR
VARIES
TO DETENTION VAULT
453.54INV
DETENTION VAULT
10.5'Hx1538.4FT^2
FROM MWS X3
Q_{100} ELEV=459.22
10.5'
448.8INV
DETENTION VAULT
CONNECTION 0% SLOPE
MIN. VAULT COVER
1'
DETENTION VAULT
10.5'Hx826.4FT^2
NOTCH
1.0'W,1.0'H
RISER
Q_{100} ELEV=459.22
10.5'
9'
PL
FREEDOM LANE
3.25" ORIFICE
448.8INV
18"
447.4INV
PROPOSED MANHOLE PIPE–TO–PIPE
MWS
BIOFILTRATION BMP
459.7 FG/RIM
(1) MWS 8'X20' UNIT
10.4'
449.26INV
9.9'
4'
10.9'
WEIR
20'
TO DETENTION VAULT
448.8INV
Q_{DESIGN}BMP3=0.521CFS
MIN. VAULT COVER
1'
DETENTION VAULT
10.5Hx826.4FT^2
NOTCH
1.0'W,1.0'H
RISER
Q_{100} ELEV=459.22'
10.5'
9'
PL
FREEDOM LANE
3.25" ORIFICE
448.8INV
18"
447.4INV
PROPOSED MANHOLE PIPE–TO–PIPE

PROPOSED STORMWATER SYSTEM

N.T.S

FIGURE 1: WQMP EXHIBIT

TTM 19343
ALISO VIEJO, CA

X ENGINEERING & CONSULTING, INC.
6 Hutton Centre Drive, Suite 650
Santa Ana, California 92707
949.522.7100 | xengineeringinc.com

Section 6 Hydromodification BMPs

6.1 Points of Compliance

The POC is located at the entrance on the east side of the site. The drainage areas accounted for this POC include DMA 1 through 5. This location will account for the stormwater treatment and detention aspect of the four BMPs to meet hydromodification requirements.

6.2 Pre-Development (Natural) Conditions

The natural pre-development condition of the site consisted of steep slopes. This was determined through use of a USGS topographic quadrangle map (1949) and historical aerial photograph (1938) courtesy of Historical Aerials. Historical information pertaining to the land cover was limited to the use of the 1938 historical photograph. However, it could be reasonably deduced from the photograph that the land cover existing before development was open brush, most likely native grasses and shrubs. The pre-development condition utilized in the SOHM model was HSG class D soils, with open brush and moderately steep slopes. Refer to **Attachment D7 and D8** for historical photograph (1938) and topographic map (1949).

6.3 Post-Development Conditions and Hydromodification BMPs

In the post-development condition, the land cover is residential urban with flat slopes. The subsurface detention vault serves as a HM BMP. The stormwater flow exiting the system at the POC is controlled by an orifice plate.

6.4 Measures for Avoidance of Critical Coarse Sediment Yield Areas

The project does not lie in a critical coarse sediment region (**Attachment D3**).

6.5 Hydrologic Modeling and Hydromodification Compliance

South Orange County Hydrologic Model (SOHM) was used to design and size hydromodification mitigation BMPs. SOHM is an HSPF-based watershed model that has been specifically calibrated to natural and developed condition subwatersheds in southern Orange County and runs more than 48 years of 15-minute precipitation, evapotranspiration, and irrigation data collected at the Laguna Beach meteorological station. SOHM defines the pre-developed (natural) condition as predevelopment and the post-developed condition as mitigated.

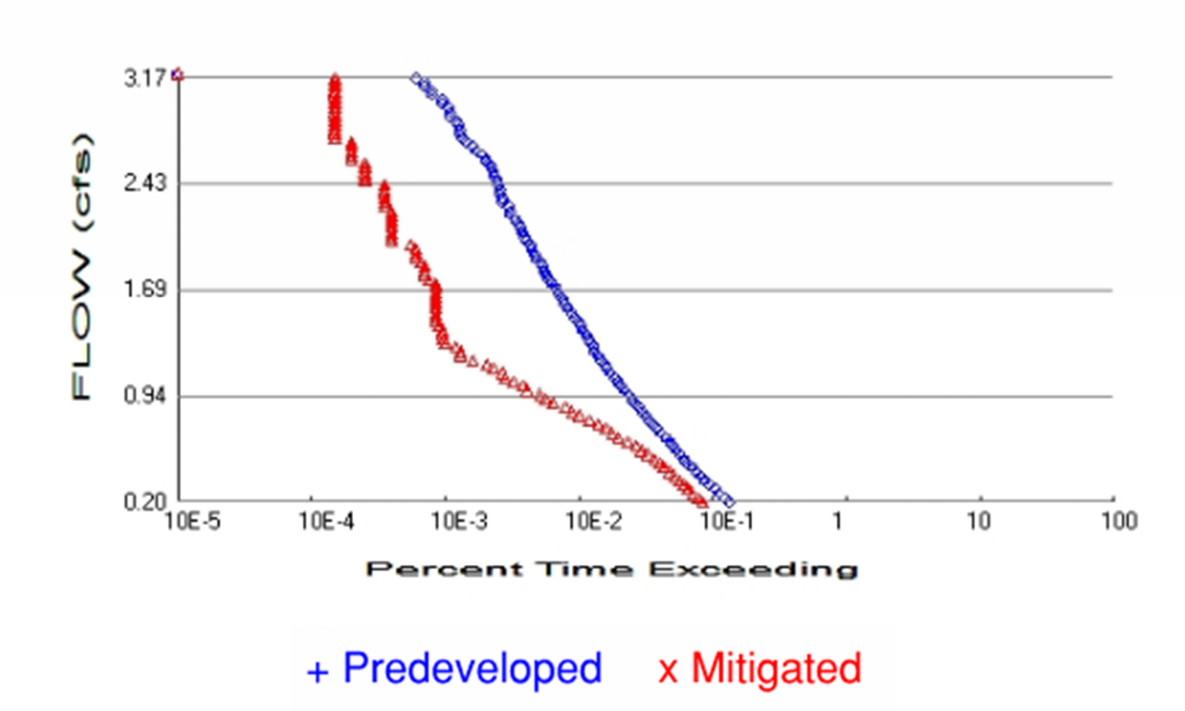
Areas of the predevelopment condition were broken down by land use and soil type and entered into SOHM. In the predeveloped condition, the area acts as one watershed which is selected as the Point of Compliance (POC). Areas of the mitigated condition were broken down likewise. BMPs were connected downstream of the mitigated condition. The POC of the mitigated condition was determined immediately downstream of the StormTrap detention system at the manhole by the entrance to the development. An outlet structure, which is configured with an orifice plate with openings to control flow rate is located within the StormTrap detention vault. Next, an analysis was performed at the POC for the predevelopment and mitigated scenarios. The analysis compares flow durations for each scenario with the specific flow values and number of times predevelopment and mitigated flows exceeded those flow values. A percentage is calculated to determine if the system passes or fails if the percentages exceed the allowable 110%. A summary table for the key hydromodification BMP design parameters and the drawdown time is provided as follows. Full details are available in the SOHM reported included in Attachment C.

Summary for Hydromodification Compliance

BMP Elements	Size	Elevation	Drawdown time
Detention system (StormTrap)	48.6’ x 48.6’ x 10.5’ (24,801 cf)*	448.80 (bottom of vault)	17.8 hours**
Orifice on weir plate	3.25” ∅	448.80 (invert)	
Elevation of weir plate	1.0’	457.8	

*BMP is used for hydromodification management only, not for LID requirements. Thus, required volume criterion is not applicable. See flow-duration plot for Predevelopment and Mitigated Flow below for hydromodification compliance.

** Drawdown time per Detention Basin Routing. Drawdown Time is the Water Surface Elevation (WSE) at 0 subtracted by the Max WSE. See Attachment C4.



Section 7 Educational Materials Index

Educational Materials			
Residential Material (http://www.ocwatersheds.com)	**Check If Applicable**	**Business Material (http://www.ocwatersheds.com)**	**Check If Applicable**
The Ocean Begins at Your Front Door	☐	Tips for the Automotive Industry	☐
Tips for Car Wash Fund-raisers	☐	Tips for Using Concrete and Mortar	☐
Tips for the Home Mechanic	☐	Tips for the Food Service Industry	☐
Homeowners Guide for Sustainable Water Use	☐	Proper Maintenance Practices for Your Business	☐
Household Tips	☐	Compliance BMPs for Mobile Businesses	☐
Proper Disposal of Household Hazardous Waste	☐	**Other Material**	**Check If Attached**
Recycle at Your Local Used Oil Collection Center (North County)	☐		
Recycle at Your Local Used Oil Collection Center (Central County)	☐		☐
Recycle at Your Local Used Oil Collection Center (South County)	☐		☐
Tips for Maintaining a Septic Tank System	☐		☐
Responsible Pest Control	☐		☐
Sewer Spill	☐		☐
Tips for the Home Improvement Projects	☐		☐
Tips for Horse Care	☐		☐
Tips for Landscaping and Gardening	☐		☐
Tips for Pet Care	☐		☐
Tips for Projects Using Paint	☐		☐

Attachment A: Educational Materials

Educational materials are available at https://h2oc.org/

Attachment B: Operations and Maintenance Plan

To be included in Final Engineering.

Attachment C: Calculations and Worksheets

- Attachment C1: OCTGD Worksheet 01 Infiltration Feasibility Categorization
- Attachment C2: OCTGD Worksheet 09 Flow-Based Compact Biofiltration Method
- Attachment C3: SOHM HMP Sizing Calculations
- Attachment C4: Detention Basin Routing Results

Worksheet 1: Infiltration Feasibility Categorization

Categorization of Infiltration Feasibility Condition			***Page 1 of 5***
Part 1: Physical Limitations of Infiltration Based on the criteria for physical limitations of infiltration described in Section 4.2.2.2, what level of physical feasibility of infiltration is the maximum that the BMP location will support?			
	Physical Infiltration Feasibility Category	**Mark applicable category**	**Next step**
1	Full Infiltration of the DCV		Continue to Part 2
	Biotreatment with Partial Infiltration		Continue to Part 3
	Biotreatment with No Infiltration	X	Select and Utilize Biotreatment without Infiltration
Provide summary of basis: The site is underlain by engineered artificial fill which is not conducive to infiltration. Infiltration is not recommended for the site. See SA Geotechnical report in Appendix E for more information. Summarize findings of studies, provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			

<table>
<tr><th colspan="2"><i>Categorization of Infiltration Feasibility Condition</i></th><th colspan="2"><i>Page 2 of 5</i></th></tr>
<tr><td colspan="2"><i>Part 2: Risks Limiting Full Infiltration of the DCV –</i><i>Would infiltration of the full DCV introduce risks of undesirable consequences that cannot reasonably be mitigated?</i></td><td><i>Yes</i></td><td><i>No</i></td></tr>
<tr><td>2</td><td>Would infiltration of the DCV pose significant risk for groundwater related concerns? Use criteria described in Section 4.2.2.3 and results from Worksheet 2 (Appendix C) to describe groundwater-related infiltration feasibility criteria.</td><td></td><td>X</td></tr>
<tr><td colspan="4">Provide basis:

Groundwater was not encountered up to 75 feet during SA Geotechnical explorations. Seepage was encountered between 18.5 feet and 27 feet below ground surface (bgs).See SA Geotechnical report Appendix E.

Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td>3</td><td>Would infiltration of the full DCV pose significant risk of increasing risk of geotechnical hazards that cannot be mitigated to an acceptable level? Use criteria described in Section 4.2.2.4.</td><td>X</td><td></td></tr>
<tr><td colspan="4">Provide basis:

Due to the site being underlain by dense bedrock and artificial fill and the presence of the large slope (approximately 45%) to the south, infiltration of stormwater is not feasible and constitutes a geotechnical hazard.

Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td>4</td><td>Would infiltration of the DCV cause an increase in groundwater flow or decrease in surface runoff over predevelopment conditions that would cause impairment to downstream beneficial uses, such as change of seasonality of ephemeral washes or increased discharge of contaminated groundwater to surface waters? Use criteria in Section 4.2.2.5</td><td></td><td>X</td></tr>
</table>

Provide basis: Not applicable to the site. Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
Categorization of Infiltration Feasibility Condition		***Page 3 of 5***	
Part 2 (continued): Risks Limiting Full Infiltration of the DCV –_Would infiltration of the full DCV introduce risks of undesirable consequences that cannot reasonably be mitigated?_		***Yes***	***No***
5	Is there substantial evidence that infiltration of the DCV would **result in a significant increase in I&I to the sanitary sewer** that cannot be sufficiently mitigated?		X
Provide basis: Not applicable to the site. Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
6	Would infiltration of the DCV **violate downstream water rights**?		X
Provide basis: Not applicable to the site. Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			

Part 2 Result	If the answer to all questions 2-6 are “No”, then the DMA is categorized as “Full Infiltration” for the purposes of LID BMP type selection. Describe finding. At the Preliminary/Conceptual WQMP phase, describe the additional design-phase testing required to confirm this determination and identify contingencies for final design. At the Final Project WQMP phase, identify any required construction-phase testing and identify the design contingencies that should result based on construction-phase testing. If the answer to any of questions 2-6 is “Yes” then the site cannot be categorized as “Full Infiltration”. Continue to Part 3: Partial Infiltration Feasibility		
Categorization of Infiltration Feasibility Condition		***Page 4 of 5***	
Part 3: Partial Infiltration Feasibility Criteria –*Would infiltration of any appreciable volume of stormwater result in risks of undesirable consequences that cannot reasonably be mitigated?*		***Yes***	***No***
8	**Would use of biotreatment BMPs with partial infiltration pose significant risk for groundwater related concerns?** Refer to criteria in Section 4.2.2.3 and Worksheet 1 (Appendix C) for guidance on groundwater-related infiltration feasibility criteria.		X
Provide basis: Groundwater was not observed up to 75 feet bgs. Historic high groundwater indicates high groundwater up to 20 feet bgs before mass grading in the 1980s. Groundwater is expected to remain below at least 20 feet bgs. See SA Geotechnical report in Appendix E. Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
9	**Would the use of biotreatment BMPs with partial infiltration pose elevated risks of geotechnical hazards that cannot be mitigated to an acceptable level**? Refer to Section 4.2.2.4.	X	
Provide basis: Due to the site being underlain by dense bedrock and artificial fill and the presence of the large slope (approximately 45%) to the south, infiltration of stormwater is not feasible and constitutes a geotechnical hazard. Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			

10	**Would the use of biotreatment BMPs with partial infiltration elevate risks or introduced conflicts related to groundwater balance, inflow and infiltration, or water rights?** Refer to Section 4.2.2.5. Note: this is uncommon and must be supported by site-specific analysis if it is used as a basis to reject biotreatment with partial infiltration.		X
Provide basis: Not applicable to the site. Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
Categorization of Infiltration Feasibility Condition		***Page 5 of 5***	
Part 3 Result	If the answer to all questions 8-10 are “No”, then the DMA is categorized as “Biotreatment with Partial Infiltration” for the purposes of LID BMP type selection. If the answer to any of questions 8-10 is “Yes” then the site is categorized as “Biotreatment with No Infiltration” for the purposes of LID BMP type selection.		

Site is categorized as “Biotreatment with No Infiltration” per step 3 and 9 marked as Yes.

DMA 1

Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method

Part 1: Determine the design storm intensity of the compact biofiltration BMP				
1	Enter the time of concentration, T_c (min) (See E.2.3) (account for upstream detention by increasing Tc to a maximum 60 minutes per Section E.3.5.2 if detention is provided)	T_c=	7.2	min
2	Using Figure E-7 or the figure included in the worksheet, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.23	in/hr
3	Enter capture efficiency corresponding to upstream HSCs and/or upstream BMPs, Y_2. Attach associated calculations.	Y_2 =	0	%
4	Using Figure E-7, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	in/hr
5	Determine the design intensity that must be provided by BMP to achieve 80 percent capture, $I_{design}= I_1-I_2$	$I_{design\_80\%}$ =	0.23	in/hr
Part 2: Calculate the design flowrate of the compact biofiltration BMP (Section E.2.6)				
6a	Enter DMA area tributary to BMP (s), *A* (acres)	A=	.53	acres
6b	Enter DMA Imperviousness, imp (unitless)	imp=	0.7	
6c	Calculate runoff coefficient, $c= (0.75 \times imp) + 0.15$	c=	0.675	
6d	Calculate flowrate to achieve 80 percent capture, $Q_{80\%}= (c \times I_{design} \times A)$	$Q_{80\%}$=	0.081	cfs
7	Calculate design flowrate, $Q_{design}= Q_{80\%} \times 150\%$	Q_{design}=	0.121	cfs
Part 3: Demonstrate that Supplemental Retention BMPs Conform to Volume Reduction Targets (Only DMAs Categorized as "Biotreatment with Partial Infiltration")				
8	Describe system, including features to maximize volume reduction (if applicable): Not applicable.			
9	Summarize calculations to demonstrate that volume reduction targets are met, where feasible and applicable. Not applicable.			

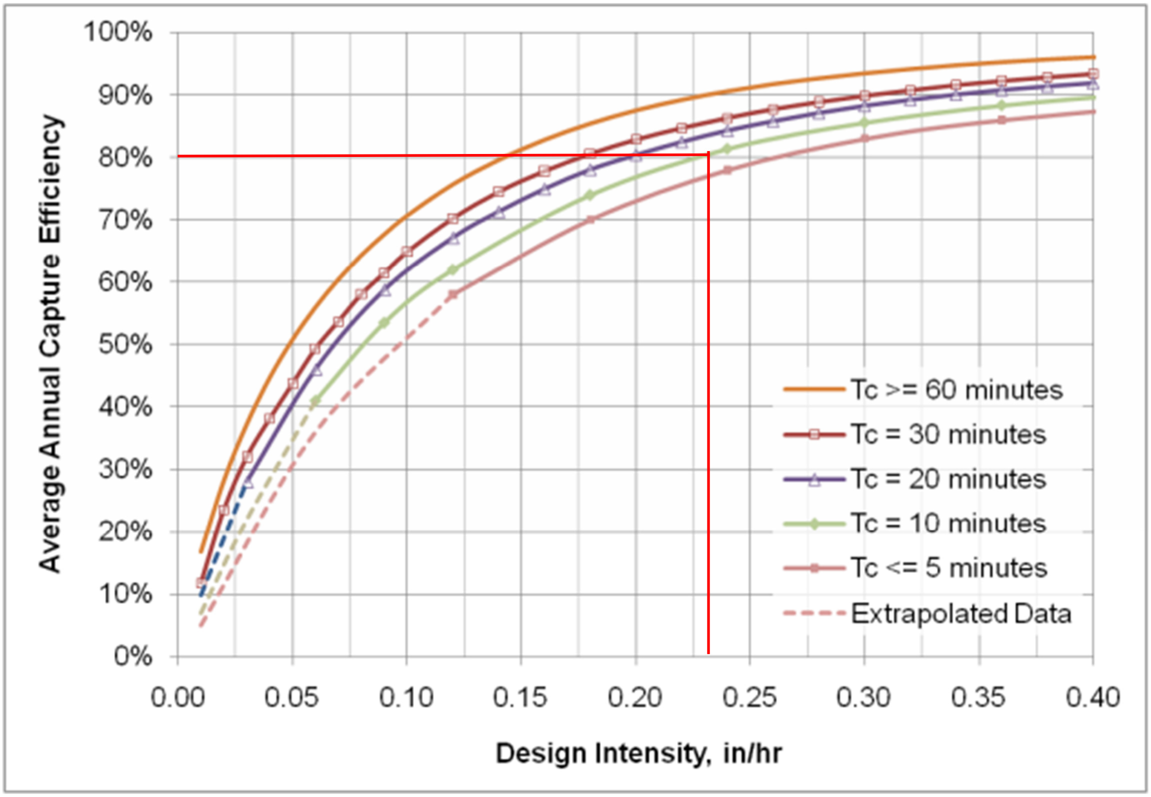
Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method

Supporting Calculations

Provide time of concentration assumptions:

Time of concentration was calculated via the rational method with CivilDesign software, 2018 version, developed by Civil Design Corporation and Joseph E. Bonadiman and Associates, Inc, and is accepted by the County of Orange for hydrologic study purposes.

Graphical Operations



Provide supporting graphical operations in figure above.

DMA 2 & 5

Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method

Part 1: Determine the design storm intensity of the compact biofiltration BMP				
1	Enter the time of concentration, T_c (min) (See E.2.3) (account for upstream detention by increasing Tc to a maximum 60 minutes per Section E.3.5.2 if detention is provided)	T_c=	6.9	min
2	Using Figure E-7 or the figure included in the worksheet, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.23	in/hr
3	Enter capture efficiency corresponding to upstream HSCs and/or upstream BMPs, Y_2. Attach associated calculations.	Y_2 =	0	%
4	Using Figure E-7, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	in/hr
5	Determine the design intensity that must be provided by BMP to achieve 80 percent capture, $I_{design}= I_1-I_2$	$I_{design\_80\%}$ =	0.23	in/hr
Part 2: Calculate the design flowrate of the compact biofiltration BMP (Section E.2.6)				
6a	Enter DMA area tributary to BMP (s), *A* (acres)	A=	1.21	acres
6b	Enter DMA Imperviousness, imp (unitless)	imp=	0.8	
6c	Calculate runoff coefficient, $c= (0.75 \times imp) + 0.15$	c=	0.75	
6d	Calculate flowrate to achieve 80 percent capture, $Q_{80\%}= (c \times I_{design} \times A)$	$Q_{80\%}$=	0.209	cfs
7	Calculate design flowrate, $Q_{design}= Q_{80\%} \times 150\%$	Q_{design}=	0.313	cfs
Part 3: Demonstrate that Supplemental Retention BMPs Conform to Volume Reduction Targets (Only DMAs Categorized as "Biotreatment with Partial Infiltration")				
8	Describe system, including features to maximize volume reduction (if applicable): Not applicable.			
9	Summarize calculations to demonstrate that volume reduction targets are met, where feasible and applicable. Not applicable.			

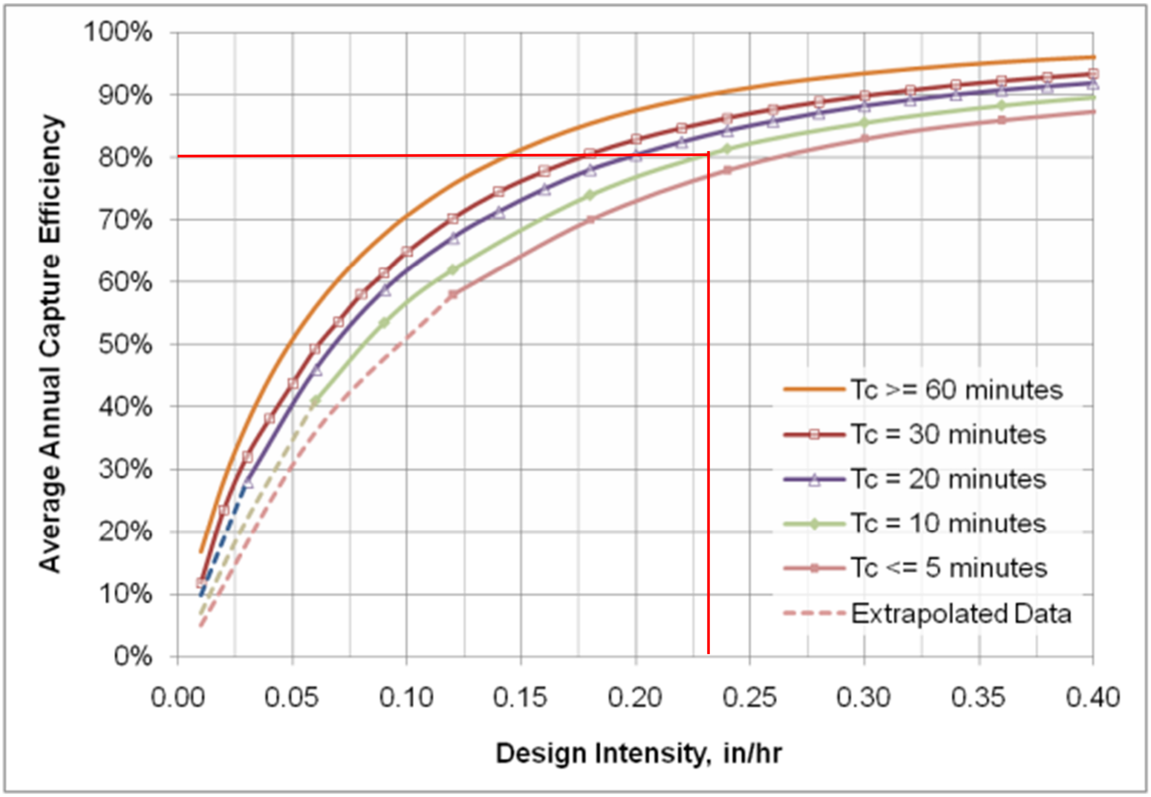
Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method

Supporting Calculations

Provide time of concentration assumptions:

Time of concentration was calculated via the rational method with CivilDesign software, 2018 version, developed by Civil Design Corporation and Joseph E. Bonadiman and Associates, Inc, and is accepted by the County of Orange for hydrologic study purposes.

Graphical Operations



Provide supporting graphical operations in figure above.

DMA 3

Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method

Part 1: Determine the design storm intensity of the compact biofiltration BMP

1	Enter the time of concentration, T_c (min) (See E.2.3) (account for upstream detention by increasing Tc to a maximum 60 minutes per Section E.3.5.2 if detention is provided)	T_c=	8.3	min
2	Using Figure E-7 or the figure included in the worksheet, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.23	in/hr
3	Enter capture efficiency corresponding to upstream HSCs and/or upstream BMPs, Y_2. Attach associated calculations.	Y_2 =	0	%
4	Using Figure E-7, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	in/hr
5	Determine the design intensity that must be provided by BMP to achieve 80 percent capture, $I_{design}= I_1\text{-}I_2$	$I_{design\_80\%}$ =	0.23	in/hr

Part 2: Calculate the design flowrate of the compact biofiltration BMP (Section E.2.6)

6a	Enter DMA area tributary to BMP (s), *A* (acres)	A=	1.81	acres
6b	Enter DMA Imperviousness, imp (unitless)	imp=	0.9	
6c	Calculate runoff coefficient, $c= (0.75 \times imp) + 0.15$	c=	0.825	
6d	Calculate flowrate to achieve 80 percent capture, $Q_{80\%}= (c \times I_{design} \times A)$	$Q_{80\%}$=	0.347	cfs
7	Calculate design flowrate, $Q_{design}= Q_{80\%} \times 150\%$	Q_{design}=	0.521	cfs

Part 3: Demonstrate that Supplemental Retention BMPs Conform to Volume Reduction Targets (Only DMAs Categorized as "Biotreatment with Partial Infiltration")

8	Describe system, including features to maximize volume reduction (if applicable): Not applicable.
9	Summarize calculations to demonstrate that volume reduction targets are met, where feasible and applicable. Not applicable.

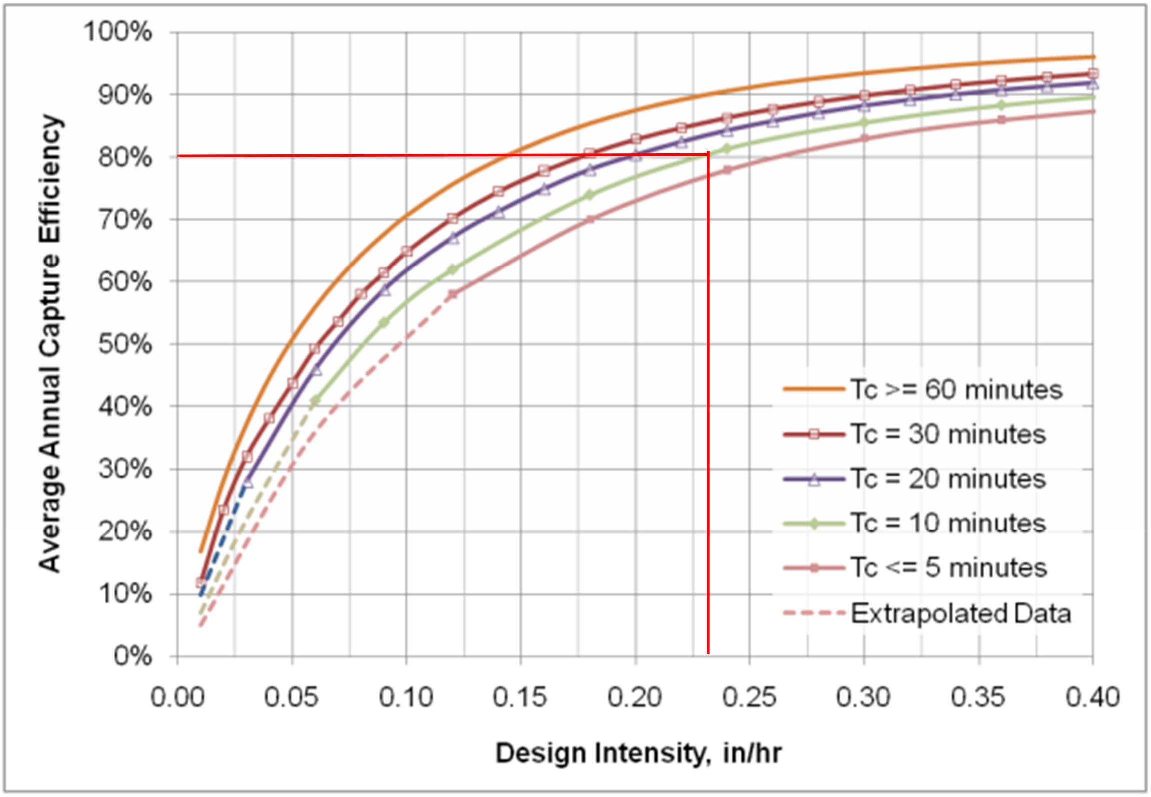
Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method

Supporting Calculations

Provide time of concentration assumptions:

Time of concentration was calculated via the rational method with CivilDesign software, 2018 version, developed by Civil Design Corporation and Joseph E. Bonadiman and Associates, Inc, and is accepted by the County of Orange for hydrologic study purposes.

Graphical Operations



Provide supporting graphical operations in figure above.

DMA 4

Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method

Part 1: Determine the design storm intensity of the compact biofiltration BMP				
1	Enter the time of concentration, T_c (min) (See E.2.3) (account for upstream detention by increasing Tc to a maximum 60 minutes per Section E.3.5.2 if detention is provided)	T_c=	9.9	min
2	Using Figure E-7 or the figure included in the worksheet, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.23	in/hr
3	Enter capture efficiency corresponding to upstream HSCs and/or upstream BMPs, Y_2. Attach associated calculations.	Y_2 =	0	%
4	Using Figure E-7, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	in/hr
5	Determine the design intensity that must be provided by BMP to achieve 80 percent capture, $I_{design}= I_1 - I_2$	$I_{design\_80\%}$ =	0.23	in/hr
Part 2: Calculate the design flowrate of the compact biofiltration BMP (Section E.2.6)				
6a	Enter DMA area tributary to BMP (s), *A* (acres)	A=	0.89	acres
6b	Enter DMA Imperviousness, imp (unitless)	imp=	0.6	
6c	Calculate runoff coefficient, *c= (0.75 x imp) + 0.15*	c=	0.6	
6d	Calculate flowrate to achieve 80 percent capture, $Q_{80\%} = (c \times I_{design} \times A)$	$Q_{80\%}$=	0.121	cfs
7	Calculate design flowrate, $Q_{design} = Q_{80\%} \times 150\%$	Q_{design}=	0.182	cfs
Part 3: Demonstrate that Supplemental Retention BMPs Conform to Volume Reduction Targets (Only DMAs Categorized as "Biotreatment with Partial Infiltration")				
8	Describe system, including features to maximize volume reduction (if applicable): Not applicable.			
9	Summarize calculations to demonstrate that volume reduction targets are met, where feasible and applicable. Not applicable.			

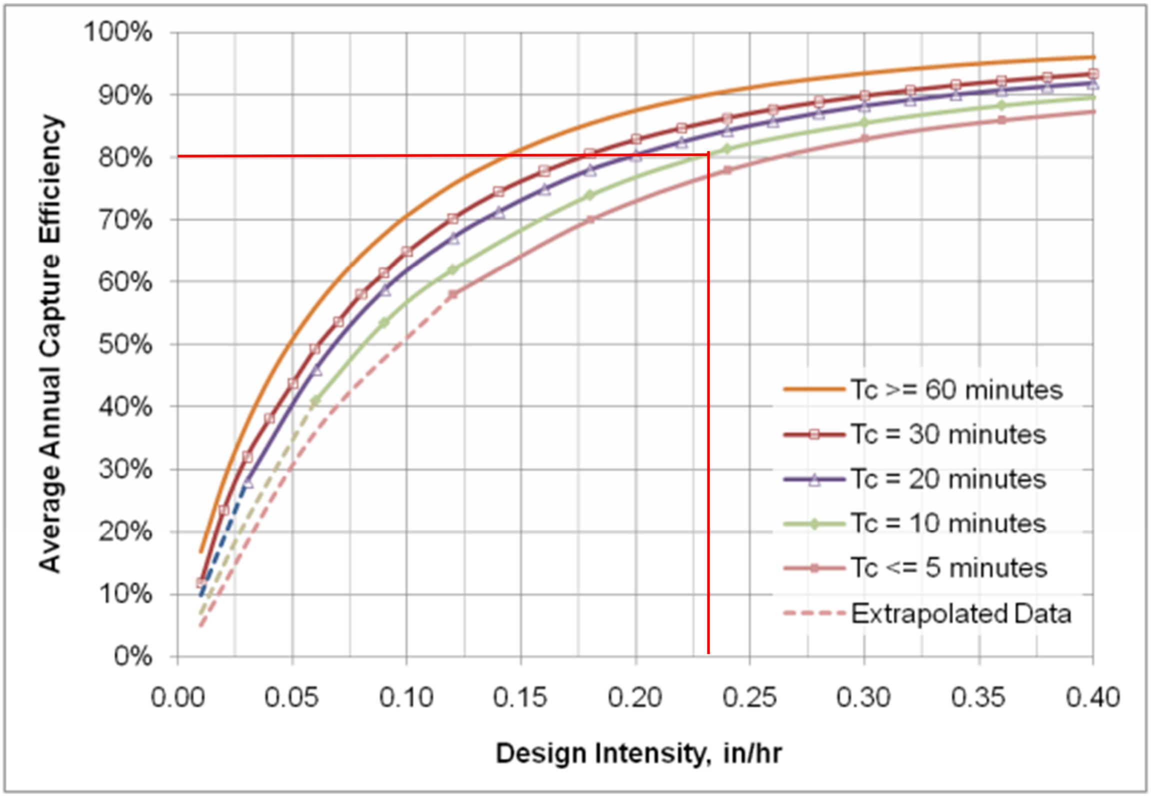
Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method

Supporting Calculations

Provide time of concentration assumptions:

Time of concentration was calculated via the rational method with CivilDesign software, 2018 version, developed by Civil Design Corporation and Joseph E. Bonadiman and Associates, Inc, and is accepted by the County of Orange for hydrologic study purposes.

Graphical Operations



Provide supporting graphical operations in figure above.

SOHM

PROJECT REPORT

General Model Information

Project Name:	117-011 Freedom Lane SOHM
Site Name:	
Site Address:	
City:	
Report Date:	10/14/2025
Gage:	Laguna Beach
Data Start:	10/01/1949
Data End:	09/30/2006
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2021/05/25

POC Thresholds

Low Flow Threshold for POC1:	10 Percent of the 2 Year
High Flow Threshold for POC1:	10 Year

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
D,Open Brush,Steep	0.53
Pervious Total	0.53
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.53

Element Flows To:

Surface	Interflow	Groundwater

Basin 2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
D,Open Brush,Steep	1.21
Pervious Total	1.21
Impervious Land Use	acre
Impervious Total	0
Basin Total	1.21

Element Flows To:

Surface	Interflow	Groundwater

Basin 3

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
D,Open Brush,Steep	1.81
Pervious Total	1.81
Impervious Land Use	acre
Impervious Total	0
Basin Total	1.81

Element Flows To:

Surface	Interflow	Groundwater

Basin 4

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
D,Open Brush,Steep	0.89
Pervious Total	0.89
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.89

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
D,Urban,Flat(0-5%)	0.15
Pervious Total	0.15
Impervious Land Use	acre
Impervious,Flat(0-5)	0.38
Impervious Total	0.38
Basin Total	0.53

Element Flows To:

Surface	Interflow	Groundwater
MWS 1	MWS 1	

Basin 2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
D,Urban,Flat(0-5%)	0.3
Pervious Total	0.3
Impervious Land Use	acre
Impervious,Flat(0-5)	0.91
Impervious Total	0.91
Basin Total	1.21

Element Flows To:

Surface	Interflow	Groundwater
MWS 2	MWS 2	

Basin 3

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
D,Urban,Flat(0-5%)	0.26
Pervious Total	0.26
Impervious Land Use	acre
Impervious,Flat(0-5)	1.55
Impervious Total	1.55
Basin Total	1.81

Element Flows To:

Surface	Interflow	Groundwater
MWS 3	MWS 3	

Basin 4

Bypass: No

GroundWater: No

Pervious Land Use	acre
D,Urban,Flat(0-5%)	0.38
Pervious Total	0.38

Impervious Land Use	acre
Impervious,Flat(0-5)	0.51
Impervious Total	0.51
Basin Total	0.89

Element Flows To:

Surface	Interflow	Groundwater
MWS 4	MWS 4	

Routing Elements

Predeveloped Routing

Mitigated Routing

MWS 1

MWS Model Number: MWS-L-6-8
Media Filter Rate (in/hr): 25

Element Flows To:

Outlet 1	Outlet 2
Vault 2	Vault 2

MWS Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
9.0000	0.000551	0.000000	0.000	0.000
9.0000	0.000551	0.000067	0.000	0.004
9.0000	0.000551	0.000202	0.000	0.008
9.0000	0.000551	0.000404	0.000	0.012
9.0000	0.000551	0.000673	0.000	0.016
9.0000	0.000551	0.001010	0.000	0.020
9.0000	0.000551	0.001413	0.000	0.025
9.0000	0.000551	0.001884	0.000	0.029
9.0000	0.000551	0.002423	0.000	0.033
9.0000	0.000551	0.003029	0.000	0.037
9.0000	0.000551	0.003702	0.000	0.041
9.0000	0.000551	0.004442	0.000	0.045
9.0000	0.000551	0.005249	0.000	0.049
9.0000	0.000551	0.006124	0.000	0.054
9.0000	0.000551	0.007067	0.000	0.058
9.0000	0.000551	0.008076	0.000	0.062
9.0000	0.000551	0.009153	0.000	0.066
9.0000	0.000551	0.010297	0.000	0.070
9.0000	0.000551	0.011508	0.000	0.074
9.0000	0.000551	0.012787	0.000	0.079
9.0000	0.000551	0.014133	0.000	0.083
9.0000	0.000551	0.015546	0.000	0.087
9.0000	0.000551	0.017027	0.000	0.091
9.0000	0.000551	0.018575	0.000	0.095
9.0000	0.000551	0.020190	0.000	0.099
9.0000	0.000551	0.021873	0.000	0.104
9.0000	0.000551	0.023622	0.000	0.108
9.0000	0.000551	0.025440	0.000	0.112
9.0000	0.000551	0.027324	0.000	0.116
9.0000	0.000551	0.029276	0.000	0.120
9.0000	0.000551	0.031295	0.000	0.124
9.0000	0.000551	0.033381	0.000	0.129
9.0000	0.000551	0.035535	0.000	0.133
9.0000	0.000551	0.037755	0.000	0.137
9.0000	0.000551	0.040044	0.000	0.141
9.0000	0.000551	0.042399	6.000	0.141

MWS 2

MWS Model Number: MWS-L-8-12
Media Filter Rate (in/hr): 25

Element Flows To:

Outlet 1	Outlet 2
Vault 2	Vault 2

MWS Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
11.000	0.001102	0.000000	0.000	0.000
11.000	0.001102	0.000130	0.000	0.009
11.000	0.001102	0.000391	0.000	0.019
11.000	0.001102	0.000782	0.000	0.029
11.000	0.001102	0.001303	0.000	0.039
11.000	0.001102	0.001954	0.000	0.049
11.000	0.001102	0.002736	0.000	0.058
11.000	0.001102	0.003648	0.000	0.068
11.000	0.001102	0.004690	0.000	0.078
11.000	0.001102	0.005863	0.000	0.088
11.000	0.001102	0.007166	0.000	0.098
11.000	0.001102	0.008599	0.000	0.107
11.000	0.001102	0.010163	0.000	0.117
11.000	0.001102	0.011856	0.000	0.127
11.000	0.001102	0.013680	0.000	0.137
11.000	0.001102	0.015635	0.000	0.147
11.000	0.001102	0.017719	0.000	0.157
11.000	0.001102	0.019934	0.000	0.166
11.000	0.001102	0.022279	0.000	0.176
11.000	0.001102	0.024755	0.000	0.186
11.000	0.001102	0.027361	0.000	0.196
11.000	0.001102	0.030097	0.000	0.206
11.000	0.001102	0.032963	0.000	0.215
11.000	0.001102	0.035960	0.000	0.225
11.000	0.001102	0.039087	0.000	0.235
11.000	0.001102	0.042344	0.000	0.245
11.000	0.001102	0.045732	0.000	0.255
11.000	0.001102	0.049249	0.000	0.264
11.000	0.001102	0.052897	0.000	0.274
11.000	0.001102	0.056676	0.000	0.284
11.000	0.001102	0.060585	0.000	0.294
11.000	0.001102	0.064623	0.000	0.304
11.000	0.001102	0.068793	0.000	0.314
11.000	0.001102	0.073092	0.000	0.323
11.000	0.001102	0.077522	0.000	0.333
11.000	0.001102	0.082082	6.000	0.333

MWS 3

MWS Model Number: MWS-L-8-20
Media Filter Rate (in/hr): 25

Element Flows To:

Outlet 1	Outlet 2
Vault 2	Vault 2

MWS Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
13.000	0.001837	0.000000	0.000	0.000
13.000	0.001837	0.000218	0.000	0.016
13.000	0.001837	0.000653	0.000	0.032
13.000	0.001837	0.001305	0.000	0.049
13.000	0.001837	0.002175	0.000	0.065
13.000	0.001837	0.003263	0.000	0.081
13.000	0.001837	0.004568	0.000	0.098
13.000	0.001837	0.006091	0.000	0.114
13.000	0.001837	0.007831	0.000	0.130
13.000	0.001837	0.009789	0.000	0.147
13.000	0.001837	0.011965	0.000	0.163
13.000	0.001837	0.014358	0.000	0.179
13.000	0.001837	0.016968	0.000	0.196
13.000	0.001837	0.019796	0.000	0.212
13.000	0.001837	0.022842	0.000	0.228
13.000	0.001837	0.026105	0.000	0.245
13.000	0.001837	0.029586	0.000	0.261
13.000	0.001837	0.033284	0.000	0.278
13.000	0.001837	0.037200	0.000	0.294
13.000	0.001837	0.041333	0.000	0.310
13.000	0.001837	0.045684	0.000	0.327
13.000	0.001837	0.050252	0.000	0.343
13.000	0.001837	0.055038	0.000	0.359
13.000	0.001837	0.060041	0.000	0.376
13.000	0.001837	0.065262	0.000	0.392
13.000	0.001837	0.070701	0.000	0.408
13.000	0.001837	0.076357	0.000	0.425
13.000	0.001837	0.082231	0.000	0.441
13.000	0.001837	0.088322	0.000	0.457
13.000	0.001837	0.094630	0.000	0.474
13.000	0.001837	0.101157	0.000	0.490
13.000	0.001837	0.107900	0.000	0.507
13.000	0.001837	0.114862	0.000	0.523
13.000	0.001837	0.122041	0.000	0.539
13.000	0.001837	0.129437	0.000	0.556
13.000	0.001837	0.137051	6.000	0.556

MWS 4

MWS Model Number: MWS-L-8-8
Media Filter Rate (in/hr): 25

Element Flows To:

Outlet 1	Outlet 2
Vault 2	Vault 2

MWS Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
10.000	0.000735	0.000000	0.000	0.000
10.000	0.000735	0.000086	0.000	0.006
10.000	0.000735	0.000258	0.000	0.013
10.000	0.000735	0.000515	0.000	0.019
10.000	0.000735	0.000859	0.000	0.026
10.000	0.000735	0.001289	0.000	0.032
10.000	0.000735	0.001804	0.000	0.039
10.000	0.000735	0.002405	0.000	0.045
10.000	0.000735	0.003093	0.000	0.052
10.000	0.000735	0.003866	0.000	0.058
10.000	0.000735	0.004725	0.000	0.065
10.000	0.000735	0.005670	0.000	0.072
10.000	0.000735	0.006701	0.000	0.078
10.000	0.000735	0.007817	0.000	0.085
10.000	0.000735	0.009020	0.000	0.091
10.000	0.000735	0.010309	0.000	0.098
10.000	0.000735	0.011683	0.000	0.104
10.000	0.000735	0.013143	0.000	0.111
10.000	0.000735	0.014690	0.000	0.117
10.000	0.000735	0.016322	0.000	0.124
10.000	0.000735	0.018040	0.000	0.130
10.000	0.000735	0.019844	0.000	0.137
10.000	0.000735	0.021734	0.000	0.143
10.000	0.000735	0.023710	0.000	0.150
10.000	0.000735	0.025771	0.000	0.157
10.000	0.000735	0.027919	0.000	0.163
10.000	0.000735	0.030152	0.000	0.170
10.000	0.000735	0.032472	0.000	0.176
10.000	0.000735	0.034877	0.000	0.183
10.000	0.000735	0.037368	0.000	0.189
10.000	0.000735	0.039946	0.000	0.196
10.000	0.000735	0.042609	0.000	0.202
10.000	0.000735	0.045358	0.000	0.209
10.000	0.000735	0.048192	0.000	0.215
10.000	0.000735	0.051113	0.000	0.222
10.000	0.000735	0.054120	6.000	0.222

Vault 2

Width:	48.6 ft.
Length:	48.6 ft.
Depth:	10.5 ft.
Discharge Structure	
Riser Height:	9 ft.
Riser Diameter:	18 in.
Notch Type:	Rectangular
Notch Width:	1.000 ft.
Notch Height:	1.000 ft.
Orifice 1 Diameter:	3.25 in. Elevation:0 ft.
Element Flows To:	
Outlet 1	Outlet 2

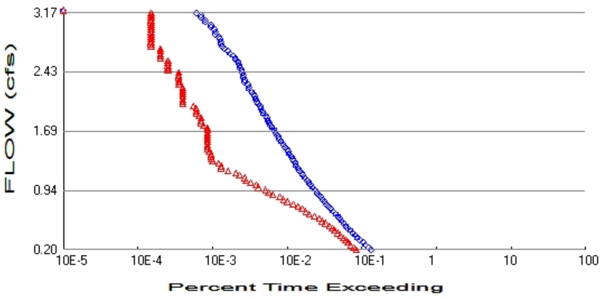
Vault Hydraulic Table

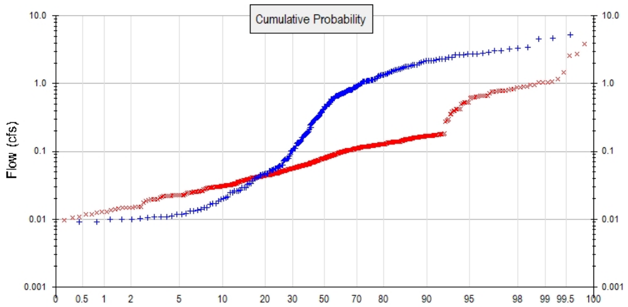
Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.054	0.000	0.000	0.000
0.1167	0.054	0.006	0.097	0.000
0.2333	0.054	0.012	0.138	0.000
0.3500	0.054	0.019	0.169	0.000
0.4667	0.054	0.025	0.195	0.000
0.5833	0.054	0.031	0.218	0.000
0.7000	0.054	0.038	0.239	0.000
0.8167	0.054	0.044	0.259	0.000
0.9333	0.054	0.050	0.276	0.000
1.0500	0.054	0.056	0.293	0.000
1.1667	0.054	0.063	0.309	0.000
1.2833	0.054	0.069	0.324	0.000
1.4000	0.054	0.075	0.339	0.000
1.5167	0.054	0.082	0.353	0.000
1.6333	0.054	0.088	0.366	0.000
1.7500	0.054	0.094	0.379	0.000
1.8667	0.054	0.101	0.391	0.000
1.9833	0.054	0.107	0.403	0.000
2.1000	0.054	0.113	0.415	0.000
2.2167	0.054	0.120	0.426	0.000
2.3333	0.054	0.126	0.437	0.000
2.4500	0.054	0.132	0.448	0.000
2.5667	0.054	0.139	0.459	0.000
2.6833	0.054	0.145	0.469	0.000
2.8000	0.054	0.151	0.479	0.000
2.9167	0.054	0.158	0.489	0.000
3.0333	0.054	0.164	0.499	0.000
3.1500	0.054	0.170	0.508	0.000
3.2667	0.054	0.177	0.518	0.000
3.3833	0.054	0.183	0.527	0.000
3.5000	0.054	0.189	0.536	0.000
3.6167	0.054	0.196	0.545	0.000
3.7333	0.054	0.202	0.553	0.000
3.8500	0.054	0.208	0.562	0.000
3.9667	0.054	0.215	0.570	0.000
4.0833	0.054	0.221	0.579	0.000
4.2000	0.054	0.227	0.587	0.000
4.3167	0.054	0.234	0.595	0.000
4.4333	0.054	0.240	0.603	0.000

4.5500	0.054	0.246	0.611	0.000
4.6667	0.054	0.253	0.619	0.000
4.7833	0.054	0.259	0.626	0.000
4.9000	0.054	0.265	0.634	0.000
5.0167	0.054	0.272	0.642	0.000
5.1333	0.054	0.278	0.649	0.000
5.2500	0.054	0.284	0.656	0.000
5.3667	0.054	0.291	0.664	0.000
5.4833	0.054	0.297	0.671	0.000
5.6000	0.054	0.303	0.678	0.000
5.7167	0.054	0.310	0.685	0.000
5.8333	0.054	0.316	0.692	0.000
5.9500	0.054	0.322	0.699	0.000
6.0667	0.054	0.329	0.706	0.000
6.1833	0.054	0.335	0.712	0.000
6.3000	0.054	0.341	0.719	0.000
6.4167	0.054	0.347	0.726	0.000
6.5333	0.054	0.354	0.732	0.000
6.6500	0.054	0.360	0.739	0.000
6.7667	0.054	0.366	0.745	0.000
6.8833	0.054	0.373	0.752	0.000
7.0000	0.054	0.379	0.758	0.000
7.1167	0.054	0.385	0.764	0.000
7.2333	0.054	0.392	0.770	0.000
7.3500	0.054	0.398	0.777	0.000
7.4667	0.054	0.404	0.783	0.000
7.5833	0.054	0.411	0.789	0.000
7.7000	0.054	0.417	0.795	0.000
7.8167	0.054	0.423	0.801	0.000
7.9333	0.054	0.430	0.807	0.000
8.0500	0.054	0.436	0.850	0.000
8.1667	0.054	0.442	1.045	0.000
8.2833	0.054	0.449	1.327	0.000
8.4000	0.054	0.455	1.673	0.000
8.5167	0.054	0.461	2.073	0.000
8.6333	0.054	0.468	2.520	0.000
8.7500	0.054	0.474	3.010	0.000
8.8667	0.054	0.480	3.540	0.000
8.9833	0.054	0.487	4.106	0.000
9.1000	0.054	0.493	4.696	0.000
9.2167	0.054	0.499	5.778	0.000
9.3333	0.054	0.506	7.088	0.000
9.4500	0.054	0.512	8.371	0.000
9.5667	0.054	0.518	9.395	0.000
9.6833	0.054	0.525	10.04	0.000
9.8000	0.054	0.531	10.56	0.000
9.9167	0.054	0.537	11.01	0.000
10.033	0.054	0.544	11.44	0.000
10.150	0.054	0.550	11.84	0.000
10.267	0.054	0.556	12.22	0.000
10.383	0.054	0.563	12.58	0.000
10.500	0.054	0.569	12.93	0.000
10.617	0.054	0.575	13.27	0.000
10.733	0.000	0.000	13.59	0.000

Analysis Results

POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 4.44
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 1.09
Total Impervious Area: 3.35

Flow Frequency Method: Cunnane

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	2.009035
5 year	2.71755
10 year	3.170826
25 year	4.622614

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.657276
5 year	0.920666
10 year	1.06427
25 year	2.608271

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.2009	2666	1688	63	Pass
0.2309	2450	1544	63	Pass
0.2609	2250	1416	62	Pass
0.2909	2063	1298	62	Pass
0.3209	1882	1212	64	Pass
0.3509	1729	1121	64	Pass
0.3809	1618	1039	64	Pass
0.4109	1505	949	63	Pass
0.4409	1401	866	61	Pass
0.4709	1294	804	62	Pass
0.5009	1216	731	60	Pass
0.5309	1138	655	57	Pass
0.5609	1072	580	54	Pass
0.5909	1010	535	52	Pass
0.6209	952	461	48	Pass
0.6509	890	392	44	Pass
0.6809	820	354	43	Pass
0.7109	762	316	41	Pass
0.7409	712	280	39	Pass
0.7709	663	239	36	Pass
0.8009	630	202	32	Pass
0.8309	589	179	30	Pass
0.8609	559	158	28	Pass
0.8909	527	128	24	Pass
0.9209	498	113	22	Pass
0.9509	473	102	21	Pass
0.9809	438	82	18	Pass
1.0109	414	77	18	Pass
1.0409	389	65	16	Pass
1.0709	372	56	15	Pass
1.1009	348	54	15	Pass
1.1309	326	46	14	Pass
1.1609	311	41	13	Pass
1.1909	293	32	10	Pass
1.2209	283	26	9	Pass
1.2509	262	26	9	Pass
1.2809	256	24	9	Pass
1.3109	245	20	8	Pass
1.3409	234	19	8	Pass
1.3709	226	19	8	Pass
1.4009	214	19	8	Pass
1.4309	205	18	8	Pass
1.4609	200	17	8	Pass
1.4909	186	17	9	Pass
1.5209	176	17	9	Pass
1.5509	165	17	10	Pass
1.5809	157	17	10	Pass
1.6109	153	17	11	Pass
1.6409	145	17	11	Pass
1.6709	139	17	12	Pass
1.7009	134	17	12	Pass
1.7309	125	17	13	Pass
1.7609	119	15	12	Pass

1.7909	114	14	12	Pass
1.8209	110	14	12	Pass
1.8509	106	14	13	Pass
1.8809	102	13	12	Pass
1.9109	95	12	12	Pass
1.9409	92	12	13	Pass
1.9709	88	12	13	Pass
2.0009	86	11	12	Pass
2.0309	81	8	9	Pass
2.0609	78	8	10	Pass
2.0909	75	8	10	Pass
2.1209	73	8	10	Pass
2.1509	71	8	11	Pass
2.1809	67	8	11	Pass
2.2109	62	8	12	Pass
2.2409	61	8	13	Pass
2.2708	60	7	11	Pass
2.3008	54	7	12	Pass
2.3308	53	7	13	Pass
2.3608	52	7	13	Pass
2.3908	52	7	13	Pass
2.4208	50	7	14	Pass
2.4508	49	5	10	Pass
2.4808	47	5	10	Pass
2.5108	46	5	10	Pass
2.5408	44	5	11	Pass
2.5708	42	5	11	Pass
2.6008	40	4	10	Pass
2.6308	38	4	10	Pass
2.6608	34	4	11	Pass
2.6908	32	4	12	Pass
2.7208	29	4	13	Pass
2.7508	27	3	11	Pass
2.7808	26	3	11	Pass
2.8108	26	3	11	Pass
2.8408	25	3	12	Pass
2.8708	24	3	12	Pass
2.9008	22	3	13	Pass
2.9308	22	3	13	Pass
2.9608	21	3	14	Pass
2.9908	19	3	15	Pass
3.0208	19	3	15	Pass
3.0508	16	3	18	Pass
3.0808	16	3	18	Pass
3.1108	14	3	21	Pass
3.1408	14	3	21	Pass
3.1708	12	3	25	Pass

Water Quality

POC 2

POC #2 was not reported because POC must exist in both scenarios and both scenarios must have been run.

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

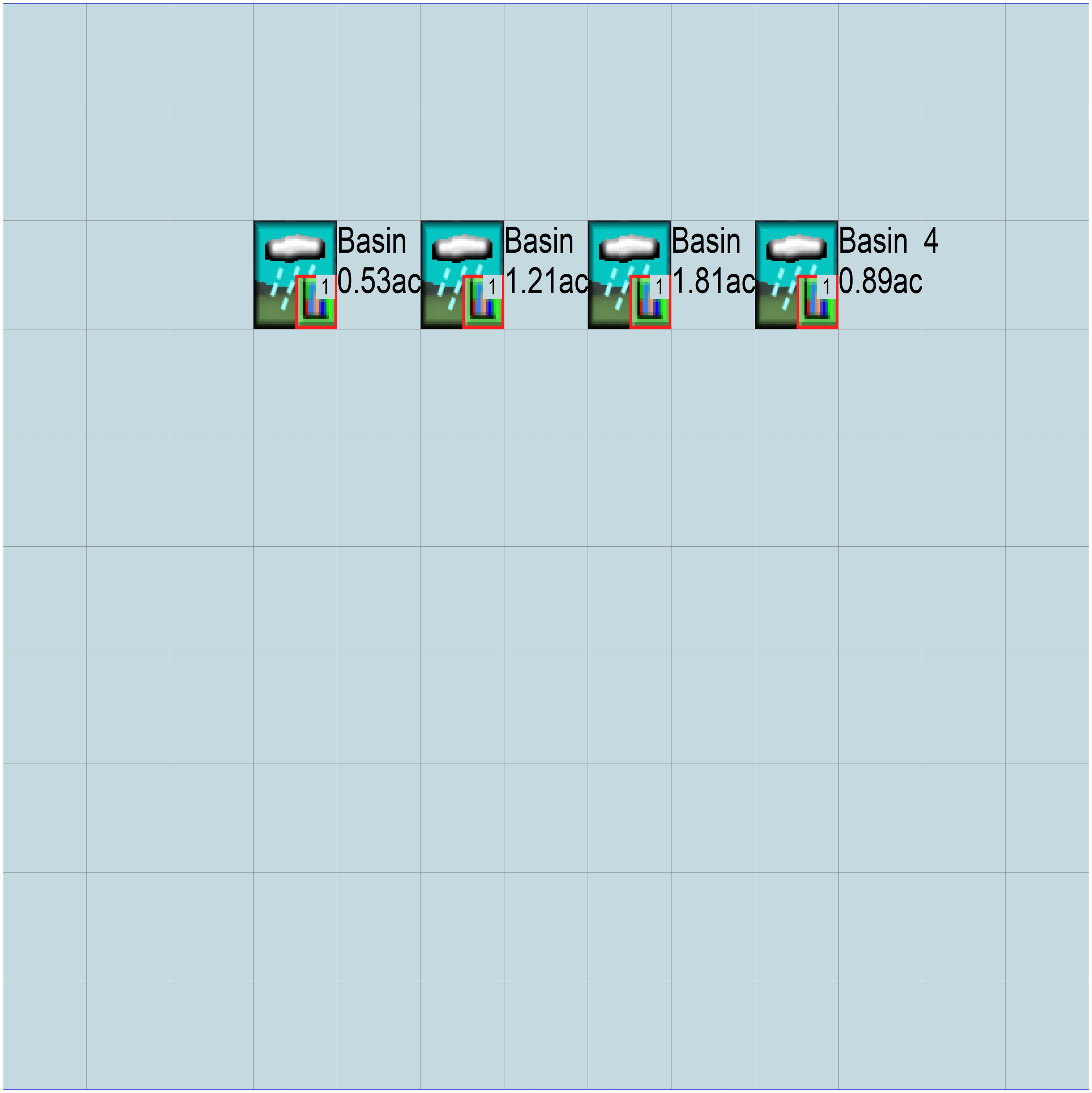
No PERLND changes have been made.

IMPLND Changes

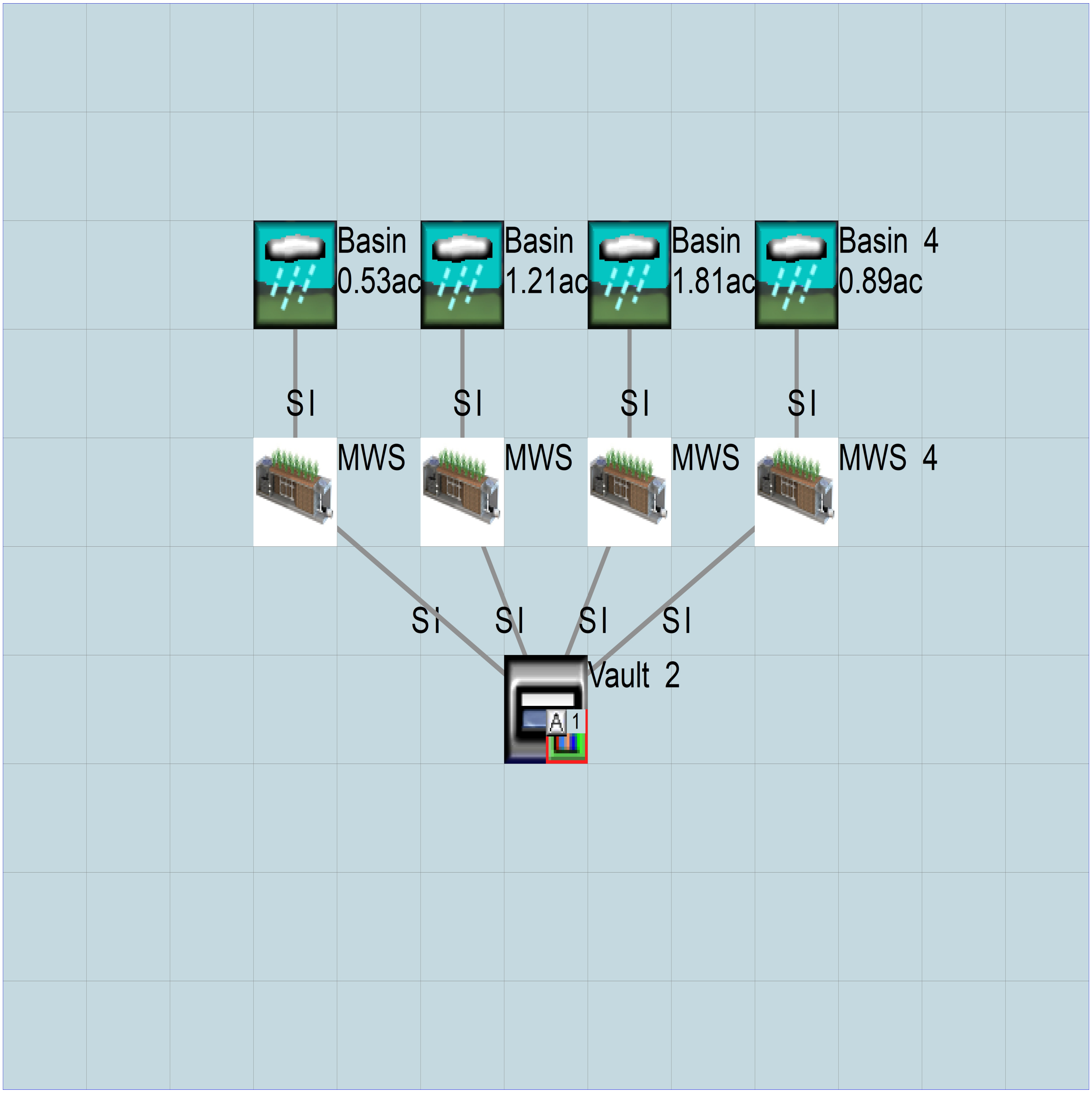
No IMPLND changes have been made.

Appendix

Predeveloped Schematic


Basin
0.53ac
1
Basin
1.21ac
1
Basin
1.81ac
1
Basin 4
0.89ac
1

Mitigated Schematic


Basin
0.53ac
Basin
1.21ac
Basin
1.81ac
Basin 4
0.89ac
SI
SI
SI
SI
MWS
MWS
MWS
MWS 4
SI
SI
SI
SI
Vault 2
A
1

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1949 10 01        END    2006 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM        26   117-011 Freedom Lane SOHM.wdm
MESSU      25   Pre117-011 Freedom Lane SOHM.MES
           27   Pre117-011 Freedom Lane SOHM.L61
           28   Pre117-011 Freedom Lane SOHM.L62
           30   POC117-011 Freedom Lane SOHM1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      43
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                    MAX                      1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out            ***
   43     D,Open Brush,Steep      1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   43         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   43         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   43         0    0    0    1    0    0    0    0    1    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   43            0         4     0.025       300      0.15       0.8     0.955
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   43           40        35         4         2         0      0.03         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   43            0      0.45      0.25       0.6       0.4         0
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   43       0.4  0.4  0.4  0.5 0.55 0.55 0.55 0.55 0.55 0.55 0.45  0.4
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   43      0.12 0.12 0.12 0.12 0.12 0.12 0.12 0.12 0.12 0.12 0.12 0.12
  END MON-INTERCEP

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   43            0         0     0.045         0       0.8       0.3      0.01
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2
  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  43                        0.53     COPY   501     12
PERLND  43                        0.53     COPY   501     13
Basin  2***
PERLND  43                        1.21     COPY   501     12
PERLND  43                        1.21     COPY   501     13
Basin  3***
PERLND  43                        1.81     COPY   501     12
PERLND  43                        1.81     COPY   501     13
Basin  4***
PERLND  43                        0.89     COPY   501     12
PERLND  43                        0.89     COPY   501     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG             ***
                                           in  out                           ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                       ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1949 10 01        END    2006 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM        26   117-011 Freedom Lane SOHM.wdm
MESSU      25   Mit117-011 Freedom Lane SOHM.MES
           27   Mit117-011 Freedom Lane SOHM.L61
           28   Mit117-011 Freedom Lane SOHM.L62
           30   POC117-011 Freedom Lane SOHM1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      61
      IMPLND       1
      RCHRES       1
      RCHRES       2
      RCHRES       3
      RCHRES       4
      RCHRES       5
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Vault  2                   MAX                     1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                         User  t-series Engl Metr ***
                                         in  out           ***
   61     D,Urban,Flat(0-5%)      1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   61         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   61         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   61         0    0    0    1    0    0    0    0    1    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   61              0       4.4      0.04       400      0.05       0.8     0.955
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   61             40        35         4         2         0      0.03         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   61              0       0.7      0.25         3       0.7         0
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   61       0.5  0.5  0.5  0.6 0.65 0.65 0.65 0.65 0.65 0.65 0.55  0.5
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   61      0.12 0.12 0.12 0.12 0.12 0.12 0.12 0.12 0.12 0.12 0.12 0.12
  END MON-INTERCEP

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   61              0         0      0.07         0      0.88       0.3      0.01
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name-------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
    1     Impervious,Flat(0-5)    1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
  END PRINT-INFO
  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            100      0.05       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  61                        0.15     RCHRES   1      2
PERLND  61                        0.15     RCHRES   1      3
IMPLND   1                        0.38     RCHRES   1      5
Basin  2***
PERLND  61                         0.3     RCHRES   2      2
PERLND  61                         0.3     RCHRES   2      3
IMPLND   1                        0.91     RCHRES   2      5
Basin  3***
PERLND  61                        0.26     RCHRES   3      2
PERLND  61                        0.26     RCHRES   3      3
IMPLND   1                        1.55     RCHRES   3      5
Basin  4***
PERLND  61                        0.38     RCHRES   4      2
PERLND  61                        0.38     RCHRES   4      3
IMPLND   1                        0.51     RCHRES   4      5

******Routing******
RCHRES   1                           1     RCHRES   5      7
RCHRES   1                                 COPY     1     17
RCHRES   1                           1     RCHRES   5      8
RCHRES   1                                 COPY     1     18
RCHRES   2                           1     RCHRES   5      7
RCHRES   2                                 COPY     1     17
RCHRES   2                           1     RCHRES   5      8
RCHRES   2                                 COPY     1     18
RCHRES   3                           1     RCHRES   5      7
RCHRES   3                                 COPY     1     17
RCHRES   3                           1     RCHRES   5      8
RCHRES   3                                 COPY     1     18
RCHRES   4                           1     RCHRES   5      7
RCHRES   4                                 COPY     1     17
RCHRES   4                           1     RCHRES   5      8
RCHRES   4                                 COPY     1     18
RCHRES   5                           1     COPY   501     16
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
```

```
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                           in  out                           ***
    1     MWS  1                  2    1    1    1   28    0    1
    2     MWS  2                  2    1    1    1   28    0    1
    3     MWS  3                  2    1    1    1   28    0    1
    4     MWS  4                  2    1    1    1   28    0    1
    5     Vault  2                1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
    3         1    0    0    0    0    0    0    0    0    0
    4         1    0    0    0    0    0    0    0    0    0
    5         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
    3         4    0    0    0    0    0    0    0    0    0    1    9
    4         4    0    0    0    0    0    0    0    0    0    1    9
    5         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *          ***
    1        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    2        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    3        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    4        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    5        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1              1      0.01       0.0       9.0       0.5       0.0
    2              2      0.01       0.0      11.0       0.5       0.0
    3              3      0.01       0.0      13.0       0.5       0.0
    4              4      0.01       0.0      10.0       0.5       0.0
    5              5      0.01       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1           0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2           0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    3           0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    4           0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    5            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   36    5
     Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.000551  0.000000  0.000000  0.000000
  0.100000  0.000551  0.000067  0.000000  0.004162
  0.200000  0.000551  0.000202  0.000000  0.008324
  0.300000  0.000551  0.000404  0.000000  0.012486
  0.400000  0.000551  0.000673  0.000000  0.016648
  0.500000  0.000551  0.001010  0.000000  0.020810
  0.600000  0.000551  0.001413  0.000000  0.024971
  0.700000  0.000551  0.001884  0.000000  0.029133
  0.800000  0.000551  0.002423  0.000000  0.033295
  0.900000  0.000551  0.003029  0.000000  0.037457
  1.000000  0.000551  0.003702  0.000000  0.041619
  1.100000  0.000551  0.004442  0.000000  0.045781
  1.200000  0.000551  0.005249  0.000000  0.049943
  1.300000  0.000551  0.006124  0.000000  0.054105
  1.400000  0.000551  0.007067  0.000000  0.058267
  1.500000  0.000551  0.008076  0.000000  0.062429
  1.600000  0.000551  0.009153  0.000000  0.066590
  1.700000  0.000551  0.010297  0.000000  0.070752
  1.800000  0.000551  0.011508  0.000000  0.074914
  1.900000  0.000551  0.012787  0.000000  0.079076
  2.000000  0.000551  0.014133  0.000000  0.083238
  2.100000  0.000551  0.015546  0.000000  0.087400
  2.200000  0.000551  0.017027  0.000000  0.091562
  2.300000  0.000551  0.018575  0.000000  0.095724
  2.400000  0.000551  0.020190  0.000000  0.099886
  2.500000  0.000551  0.021873  0.000000  0.104048
  2.600000  0.000551  0.023622  0.000000  0.108210
  2.700000  0.000551  0.025440  0.000000  0.112371
  2.800000  0.000551  0.027324  0.000000  0.116533
  2.900000  0.000551  0.029276  0.000000  0.120695
  3.000000  0.000551  0.031295  0.000000  0.124857
  3.100000  0.000551  0.033381  0.000000  0.129019
  3.200000  0.000551  0.035535  0.000000  0.133181
  3.300000  0.000551  0.037755  0.000000  0.137343
  3.400000  0.000551  0.040044  0.000000  0.141505
  4.400000  0.000551  0.042399  6.000000  0.141505
  END FTABLE  1
  FTABLE      2
   36    5
     Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.001102  0.000000  0.000000  0.000000
  0.100000  0.001102  0.000130  0.000000  0.009812
  0.200000  0.001102  0.000391  0.000000  0.019624
  0.300000  0.001102  0.000782  0.000000  0.029436
  0.400000  0.001102  0.001303  0.000000  0.039248
  0.500000  0.001102  0.001954  0.000000  0.049061
  0.600000  0.001102  0.002736  0.000000  0.058873
  0.700000  0.001102  0.003648  0.000000  0.068685
  0.800000  0.001102  0.004690  0.000000  0.078497
  0.900000  0.001102  0.005863  0.000000  0.088309
  1.000000  0.001102  0.007166  0.000000  0.098121
  1.100000  0.001102  0.008599  0.000000  0.107933
  1.200000  0.001102  0.010163  0.000000  0.117745
  1.300000  0.001102  0.011856  0.000000  0.127557
  1.400000  0.001102  0.013680  0.000000  0.137370
  1.500000  0.001102  0.015635  0.000000  0.147182
  1.600000  0.001102  0.017719  0.000000  0.156994
  1.700000  0.001102  0.019934  0.000000  0.166806
```

```
1.800000  0.001102  0.022279  0.000000  0.176618
1.900000  0.001102  0.024755  0.000000  0.186430
2.000000  0.001102  0.027361  0.000000  0.196242
2.100000  0.001102  0.030097  0.000000  0.206054
2.200000  0.001102  0.032963  0.000000  0.215866
2.300000  0.001102  0.035960  0.000000  0.225679
2.400000  0.001102  0.039087  0.000000  0.235491
2.500000  0.001102  0.042344  0.000000  0.245303
2.600000  0.001102  0.045732  0.000000  0.255115
2.700000  0.001102  0.049249  0.000000  0.264927
2.800000  0.001102  0.052897  0.000000  0.274739
2.900000  0.001102  0.056676  0.000000  0.284551
3.000000  0.001102  0.060585  0.000000  0.294363
3.100000  0.001102  0.064623  0.000000  0.304175
3.200000  0.001102  0.068793  0.000000  0.313988
3.300000  0.001102  0.073092  0.000000  0.323800
3.400000  0.001102  0.077522  0.000000  0.333612
4.400000  0.001102  0.082082  6.000000  0.333612
END FTABLE  2
FTABLE      3
 36    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)     (cfs)   (ft/sec)    (Minutes)***
0.000000  0.001837  0.000000  0.000000  0.000000
0.100000  0.001837  0.000218  0.000000  0.016354
0.200000  0.001837  0.000653  0.000000  0.032707
0.300000  0.001837  0.001305  0.000000  0.049061
0.400000  0.001837  0.002175  0.000000  0.065414
0.500000  0.001837  0.003263  0.000000  0.081768
0.600000  0.001837  0.004568  0.000000  0.098121
0.700000  0.001837  0.006091  0.000000  0.114475
0.800000  0.001837  0.007831  0.000000  0.130828
0.900000  0.001837  0.009789  0.000000  0.147182
1.000000  0.001837  0.011965  0.000000  0.163535
1.100000  0.001837  0.014358  0.000000  0.179889
1.200000  0.001837  0.016968  0.000000  0.196242
1.300000  0.001837  0.019796  0.000000  0.212596
1.400000  0.001837  0.022842  0.000000  0.228949
1.500000  0.001837  0.026105  0.000000  0.245303
1.600000  0.001837  0.029586  0.000000  0.261656
1.700000  0.001837  0.033284  0.000000  0.278010
1.800000  0.001837  0.037200  0.000000  0.294363
1.900000  0.001837  0.041333  0.000000  0.310717
2.000000  0.001837  0.045684  0.000000  0.327070
2.100000  0.001837  0.050252  0.000000  0.343424
2.200000  0.001837  0.055038  0.000000  0.359777
2.300000  0.001837  0.060041  0.000000  0.376131
2.400000  0.001837  0.065262  0.000000  0.392484
2.500000  0.001837  0.070701  0.000000  0.408838
2.600000  0.001837  0.076357  0.000000  0.425192
2.700000  0.001837  0.082231  0.000000  0.441545
2.800000  0.001837  0.088322  0.000000  0.457899
2.900000  0.001837  0.094630  0.000000  0.474252
3.000000  0.001837  0.101157  0.000000  0.490606
3.100000  0.001837  0.107900  0.000000  0.506959
3.200000  0.001837  0.114862  0.000000  0.523313
3.300000  0.001837  0.122041  0.000000  0.539666
3.400000  0.001837  0.129437  0.000000  0.556020
4.400000  0.001837  0.137051  6.000000  0.556020
END FTABLE  3
FTABLE      4
 36    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)     (cfs)   (ft/sec)    (Minutes)***
0.000000  0.000735  0.000000  0.000000  0.000000
0.100000  0.000735  0.000086  0.000000  0.006541
0.200000  0.000735  0.000258  0.000000  0.013083
0.300000  0.000735  0.000515  0.000000  0.019624
0.400000  0.000735  0.000859  0.000000  0.026166
0.500000  0.000735  0.001289  0.000000  0.032707
```

```
 0.600000  0.000735  0.001804  0.000000  0.039248
 0.700000  0.000735  0.002405  0.000000  0.045790
 0.800000  0.000735  0.003093  0.000000  0.052331
 0.900000  0.000735  0.003866  0.000000  0.058873
 1.000000  0.000735  0.004725  0.000000  0.065414
 1.100000  0.000735  0.005670  0.000000  0.071955
 1.200000  0.000735  0.006701  0.000000  0.078497
 1.300000  0.000735  0.007817  0.000000  0.085038
 1.400000  0.000735  0.009020  0.000000  0.091580
 1.500000  0.000735  0.010309  0.000000  0.098121
 1.600000  0.000735  0.011683  0.000000  0.104663
 1.700000  0.000735  0.013143  0.000000  0.111204
 1.800000  0.000735  0.014690  0.000000  0.117745
 1.900000  0.000735  0.016322  0.000000  0.124287
 2.000000  0.000735  0.018040  0.000000  0.130828
 2.100000  0.000735  0.019844  0.000000  0.137370
 2.200000  0.000735  0.021734  0.000000  0.143911
 2.300000  0.000735  0.023710  0.000000  0.150452
 2.400000  0.000735  0.025771  0.000000  0.156994
 2.500000  0.000735  0.027919  0.000000  0.163535
 2.600000  0.000735  0.030152  0.000000  0.170077
 2.700000  0.000735  0.032472  0.000000  0.176618
 2.800000  0.000735  0.034877  0.000000  0.183159
 2.900000  0.000735  0.037368  0.000000  0.189701
 3.000000  0.000735  0.039946  0.000000  0.196242
 3.100000  0.000735  0.042609  0.000000  0.202784
 3.200000  0.000735  0.045358  0.000000  0.209325
 3.300000  0.000735  0.048192  0.000000  0.215866
 3.400000  0.000735  0.051113  0.000000  0.222408
 4.400000  0.000735  0.054120  6.000000  0.222408
 END FTABLE  4
 FTABLE      5
  92    4
    Depth      Area    Volume  Outflow1 Velocity  Travel Time***
     (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
 0.000000  0.050712  0.000000  0.000000
 0.100000  0.050712  0.005071  0.021968
 0.200000  0.050712  0.010142  0.031068
 0.300000  0.050712  0.015213  0.038050
 0.400000  0.050712  0.020285  0.043937
 0.500000  0.050712  0.025356  0.049123
 0.600000  0.050712  0.030427  0.053811
 0.700000  0.050712  0.035498  0.058123
 0.800000  0.050712  0.040569  0.062136
 0.900000  0.050712  0.045640  0.065905
 1.000000  0.050712  0.050712  0.069470
 1.100000  0.050712  0.055783  0.072861
 1.200000  0.050712  0.060854  0.076101
 1.300000  0.050712  0.065925  0.079208
 1.400000  0.050712  0.070996  0.082198
 1.500000  0.050712  0.076067  0.085083
 1.600000  0.050712  0.081139  0.087874
 1.700000  0.050712  0.086210  0.090578
 1.800000  0.050712  0.091281  0.093204
 1.900000  0.050712  0.096352  0.095758
 2.000000  0.050712  0.101423  0.098246
 2.100000  0.050712  0.106494  0.100672
 2.200000  0.050712  0.111566  0.103041
 2.300000  0.050712  0.116637  0.105357
 2.400000  0.050712  0.121708  0.107623
 2.500000  0.050712  0.126779  0.109842
 2.600000  0.050712  0.131850  0.112017
 2.700000  0.050712  0.136921  0.114151
 2.800000  0.050712  0.141993  0.116246
 2.900000  0.050712  0.147064  0.118304
 3.000000  0.050712  0.152135  0.120326
 3.100000  0.050712  0.157206  0.122315
 3.200000  0.050712  0.162277  0.124272
 3.300000  0.050712  0.167348  0.126199
 3.400000  0.050712  0.172420  0.128097
```

```
  3.500000  0.050712  0.177491  0.129967
  3.600000  0.050712  0.182562  0.131810
  3.700000  0.050712  0.187633  0.133629
  3.800000  0.050712  0.192704  0.135422
  3.900000  0.050712  0.197775  0.137193
  4.000000  0.050712  0.202847  0.138940
  4.100000  0.050712  0.207918  0.140666
  4.200000  0.050712  0.212989  0.142372
  4.300000  0.050712  0.218060  0.144057
  4.400000  0.050712  0.223131  0.145722
  4.500000  0.050712  0.228202  0.147369
  4.600000  0.050712  0.233274  0.148997
  4.700000  0.050712  0.238345  0.150608
  4.800000  0.050712  0.243416  0.152202
  4.900000  0.050712  0.248487  0.153779
  5.000000  0.050712  0.253558  0.155340
  5.100000  0.050712  0.258629  0.156886
  5.200000  0.050712  0.263701  0.158416
  5.300000  0.050712  0.268772  0.159932
  5.400000  0.050712  0.273843  0.161434
  5.500000  0.050712  0.278914  0.162922
  5.600000  0.050712  0.283985  0.164397
  5.700000  0.050712  0.289056  0.165858
  5.800000  0.050712  0.294128  0.167306
  5.900000  0.050712  0.299199  0.168743
  6.000000  0.050712  0.304270  0.170167
  6.100000  0.050712  0.309341  0.171579
  6.200000  0.050712  0.314412  0.172979
  6.300000  0.050712  0.319483  0.174369
  6.400000  0.050712  0.324555  0.175747
  6.500000  0.050712  0.329626  0.177115
  6.600000  0.050712  0.334697  0.178472
  6.700000  0.050712  0.339768  0.179819
  6.800000  0.050712  0.344839  0.181156
  6.900000  0.050712  0.349910  0.182483
  7.000000  0.050712  0.354982  0.183801
  7.100000  0.050712  0.360053  0.290413
  7.200000  0.050712  0.365124  0.484252
  7.300000  0.050712  0.370195  0.734873
  7.400000  0.050712  0.375266  1.031410
  7.500000  0.050712  0.380337  1.367585
  7.600000  0.050712  0.385409  1.739160
  7.700000  0.050712  0.390480  2.143027
  7.800000  0.050712  0.395551  2.576774
  7.900000  0.050712  0.400622  3.038463
  8.000000  0.050712  0.405693  3.526491
  8.100000  0.050712  0.410764  4.197957
  8.200000  0.050712  0.415836  5.415609
  8.300000  0.050712  0.420907  6.951329
  8.400000  0.050712  0.425978  8.665936
  8.500000  0.050712  0.431049  10.42007
  8.600000  0.050712  0.436120  12.07372
  8.700000  0.050712  0.441191  13.50272
  8.800000  0.050712  0.446263  14.62371
  8.900000  0.050712  0.451334  15.42506
  9.000000  0.050712  0.456405  16.00235
  9.100000  0.050712  0.461476  16.75300
  END FTABLE  5
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP
WDM     22 IRRG     ENGL    0.7       SAME PERLND  61     EXTNL  SURLI
WDM      2 PREC     ENGL    1              RCHRES   1     EXTNL  PREC
WDM      2 PREC     ENGL    1              RCHRES   2     EXTNL  PREC
WDM      2 PREC     ENGL    1              RCHRES   3     EXTNL  PREC
WDM      2 PREC     ENGL    1              RCHRES   4     EXTNL  PREC
WDM      1 EVAP     ENGL    1              RCHRES   1     EXTNL  POTEV
WDM      1 EVAP     ENGL    1              RCHRES   2     EXTNL  POTEV
WDM      1 EVAP     ENGL    1              RCHRES   3     EXTNL  POTEV
WDM      1 EVAP     ENGL    1              RCHRES   4     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   5 HYDR   RO      1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   5 HYDR   STAGE  1 1        1      WDM   1001 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        7
RCHRES     OFLOW  OVOL   1                 RCHRES         INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                 RCHRES         INFLOW IVOL
  END MASS-LINK    8

  MASS-LINK       16
RCHRES     ROFLOW                          COPY           INPUT  MEAN
  END MASS-LINK   16

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17

  MASS-LINK       18
RCHRES     OFLOW  OVOL   2                 COPY           INPUT  MEAN
  END MASS-LINK   18


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

Legal Notice

This program and accompanying documentation are provided 'as-is' without warranty of any kind. The entire risk regarding the performance and results of this program is assumed by End User. Clear Creek Solutions Inc. and the governmental licensee or sublicensees disclaim all warranties, either expressed or implied, including but not limited to implied warranties of program and accompanying documentation. In no event shall Clear Creek Solutions Inc. be liable for any damages whatsoever (including without limitation to damages for loss of business profits, loss of business information, business interruption, and the like) arising out of the use of, or inability to use this program even if Clear Creek Solutions Inc. or their authorized representatives have been advised of the possibility of such damages. Software Copyright © by : Clear Creek Solutions, Inc. 2005-2025; All Rights Reserved.

Clear Creek Solutions, Inc.
6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
Local (360)943-0304

www.clearcreeksolutions.com

```
                     FLOOD HYDROGRAPH ROUTING PROGRAM
            Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2018
                        Study date: 10/14/25


---------------------------------------------------------------------


117-011 Freedom Lane
Basin Routing, Proposed Condition
100-year storm
2025-10-14 HA
--------------------------------------------------------------------


Program License Serial Number 6440

--------------------------------------------------------------------
********************* HYDROGRAPH INFORMATION **********************

                From study/file name: 117011FreedomUH100yr1.rte
****************************HYDROGRAPH DATA****************************
                Number of intervals =   293
                Time interval =    5.0 (Min.)
                Maximum/Peak flow rate =      16.642 (CFS)
                Total volume =       1.944 (Ac.Ft)
        Status of hydrographs being held in storage
                   Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
        Peak (CFS)      0.000     0.000     0.000     0.000     0.000
        Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
***********************************************************************



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      101.000
**** RETARDING BASIN ROUTING ****
______________________________________________________________________

User entry of depth-outflow-storage data
--------------------------------------------------------------------
Total number of inflow hydrograph intervals = 293
Hydrograph time unit =  5.000 (Min.)
Initial depth in storage basin =   0.00(Ft.)
--------------------------------------------------------------------
--------------------------------------------------------------------
Initial basin depth =   0.00 (Ft.)
Initial basin storage =      0.00 (Ac.Ft)
Initial basin outflow =   0.00 (CFS)
```

```
       ---------------------------------------------------------------------
       --------------------------------------------------------------------
       Depth vs. Storage and Depth vs. Discharge data:
        Basin Depth  Storage    Outflow   (S-O*dt/2)   (S+O*dt/2)
            (Ft.)    (Ac.Ft)    (CFS)     (Ac.Ft)    (Ac.Ft)
       ---------------------------------------------------------------------
         0.000      0.000      0.000      0.000        0.000
         0.117      0.005      0.097      0.005        0.005
         0.350      0.016      0.169      0.015        0.017
         1.050      0.048      0.293      0.047        0.049
         2.100      0.096      0.415      0.095        0.097
         3.033      0.139      0.499      0.137        0.141
         4.083      0.188      0.579      0.186        0.190
         5.017      0.231      0.642      0.229        0.233
         6.067      0.280      0.706      0.278        0.282
         7.000      0.322      0.758      0.319        0.325
         7.933      0.366      0.807      0.363        0.369
         8.050      0.371      0.850      0.368        0.374
         8.517      0.392      2.073      0.385        0.399
         9.100      0.419      4.696      0.403        0.435
         9.800      0.451     10.560      0.415        0.487
        10.500      0.484     12.930      0.439        0.529
       --------------------------------------------------------------------
                       Hydrograph Detention Basin Routing
       ---------------------------------------------------------------------

       Graph values: 'I'= unit inflow; 'O'=outflow at time shown
       ---------------------------------------------------------------------
 Time   Inflow  Outflow    Storage                                     Depth
(Hours)  (CFS)   (CFS)     (Ac.Ft) .0       4.2    8.32   12.48   16.64 (Ft.)
 0.083    0.03    0.00      0.000  O       |       |       |       |     0.00
 0.167    0.19    0.02      0.001  O       |       |       |       |     0.02
 0.250    0.32    0.05      0.002  O       |       |       |       |     0.06
 0.333    0.35    0.08      0.004  O       |       |       |       |     0.10
 0.417    0.36    0.10      0.006  O       |       |       |       |     0.14
 0.500    0.36    0.12      0.008  O       |       |       |       |     0.18
 0.583    0.37    0.13      0.010  O       |       |       |       |     0.21
 0.667    0.37    0.14      0.011  O       |       |       |       |     0.25
 0.750    0.37    0.15      0.013  O       |       |       |       |     0.28
 0.833    0.37    0.16      0.014  O       |       |       |       |     0.31
 0.917    0.37    0.17      0.016  O       |       |       |       |     0.34
 1.000    0.37    0.17      0.017  O       |       |       |       |     0.37
 1.083    0.37    0.18      0.018  O       |       |       |       |     0.40
 1.167    0.37    0.18      0.020  O       |       |       |       |     0.43
 1.250    0.38    0.19      0.021  O       |       |       |       |     0.46
 1.333    0.38    0.19      0.022  O       |       |       |       |     0.49
 1.417    0.38    0.20      0.024  O       |       |       |       |     0.51
 1.500    0.38    0.20      0.025  O       |       |       |       |     0.54
 1.583    0.38    0.21      0.026  O       |       |       |       |     0.57
 1.667    0.38    0.21      0.027  O       |       |       |       |     0.59
```

```
1.750    0.38    0.22      0.028  O        |       |       |       |     0.62
1.833    0.39    0.22      0.029  O        |       |       |       |     0.64
1.917    0.39    0.23      0.031  O        |       |       |       |     0.67
2.000    0.39    0.23      0.032  O        |       |       |       |     0.69
2.083    0.39    0.23      0.033  O        |       |       |       |     0.72
2.167    0.39    0.24      0.034  O        |       |       |       |     0.74
2.250    0.39    0.24      0.035  O        |       |       |       |     0.76
2.333    0.39    0.25      0.036  O        |       |       |       |     0.79
2.417    0.40    0.25      0.037  O        |       |       |       |     0.81
2.500    0.40    0.25      0.038  O        |       |       |       |     0.83
2.583    0.40    0.26      0.039  O        |       |       |       |     0.85
2.667    0.40    0.26      0.040  O        |       |       |       |     0.87
2.750    0.40    0.27      0.041  O        |       |       |       |     0.89
2.833    0.40    0.27      0.042  O        |       |       |       |     0.91
2.917    0.41    0.27      0.043  O        |       |       |       |     0.93
3.000    0.41    0.28      0.044  O        |       |       |       |     0.95
3.083    0.41    0.28      0.044  O        |       |       |       |     0.97
3.167    0.41    0.28      0.045  O        |       |       |       |     0.99
3.250    0.41    0.29      0.046  O        |       |       |       |     1.01
3.333    0.41    0.29      0.047  O        |       |       |       |     1.03
3.417    0.42    0.29      0.048  O        |       |       |       |     1.05
3.500    0.42    0.30      0.049  O        |       |       |       |     1.07
3.583    0.42    0.30      0.050  O        |       |       |       |     1.09
3.667    0.42    0.30      0.050  O        |       |       |       |     1.10
3.750    0.42    0.30      0.051  O        |       |       |       |     1.12
3.833    0.42    0.30      0.052  O        |       |       |       |     1.14
3.917    0.43    0.31      0.053  O        |       |       |       |     1.16
4.000    0.43    0.31      0.054  O        |       |       |       |     1.18
4.083    0.43    0.31      0.055  O        |       |       |       |     1.19
4.167    0.43    0.31      0.055  O        |       |       |       |     1.21
4.250    0.43    0.31      0.056  O        |       |       |       |     1.23
4.333    0.44    0.32      0.057  O        |       |       |       |     1.25
4.417    0.44    0.32      0.058  O        |       |       |       |     1.27
4.500    0.44    0.32      0.059  O        |       |       |       |     1.28
4.583    0.44    0.32      0.060  O        |       |       |       |     1.30
4.667    0.44    0.32      0.060  O        |       |       |       |     1.32
4.750    0.44    0.33      0.061  O        |       |       |       |     1.34
4.833    0.45    0.33      0.062  O        |       |       |       |     1.36
4.917    0.45    0.33      0.063  O        |       |       |       |     1.37
5.000    0.45    0.33      0.064  O        |       |       |       |     1.39
5.083    0.45    0.33      0.064  O        |       |       |       |     1.41
5.167    0.46    0.34      0.065  O        |       |       |       |     1.43
5.250    0.46    0.34      0.066  O        |       |       |       |     1.44
5.333    0.46    0.34      0.067  O        |       |       |       |     1.46
5.417    0.46    0.34      0.068  O        |       |       |       |     1.48
5.500    0.46    0.35      0.069  O        |       |       |       |     1.50
5.583    0.47    0.35      0.069  O        |       |       |       |     1.52
5.667    0.47    0.35      0.070  O        |       |       |       |     1.53
5.750    0.47    0.35      0.071  O        |       |       |       |     1.55
5.833    0.47    0.35      0.072  O        |       |       |       |     1.57
```

```
 5.917    0.48    0.36      0.073  O        |       |       |       |    1.59
 6.000    0.48    0.36      0.073  O        |       |       |       |    1.61
 6.083    0.48    0.36      0.074  O        |       |       |       |    1.63
 6.167    0.48    0.36      0.075  O        |       |       |       |    1.64
 6.250    0.49    0.36      0.076  O        |       |       |       |    1.66
 6.333    0.49    0.37      0.077  O        |       |       |       |    1.68
 6.417    0.49    0.37      0.078  O        |       |       |       |    1.70
 6.500    0.49    0.37      0.078  O        |       |       |       |    1.72
 6.583    0.50    0.37      0.079  O        |       |       |       |    1.74
 6.667    0.50    0.37      0.080  O        |       |       |       |    1.75
 6.750    0.50    0.38      0.081  O        |       |       |       |    1.77
 6.833    0.50    0.38      0.082  O        |       |       |       |    1.79
 6.917    0.51    0.38      0.083  O        |       |       |       |    1.81
 7.000    0.51    0.38      0.084  O        |       |       |       |    1.83
 7.083    0.51    0.39      0.085  O        |       |       |       |    1.85
 7.167    0.52    0.39      0.085  O        |       |       |       |    1.87
 7.250    0.52    0.39      0.086  O        |       |       |       |    1.89
 7.333    0.52    0.39      0.087  OI       |       |       |       |    1.91
 7.417    0.53    0.39      0.088  OI       |       |       |       |    1.93
 7.500    0.53    0.40      0.089  OI       |       |       |       |    1.95
 7.583    0.53    0.40      0.090  OI       |       |       |       |    1.97
 7.667    0.54    0.40      0.091  OI       |       |       |       |    1.99
 7.750    0.54    0.40      0.092  OI       |       |       |       |    2.01
 7.833    0.54    0.41      0.093  OI       |       |       |       |    2.03
 7.917    0.55    0.41      0.094  OI       |       |       |       |    2.05
 8.000    0.55    0.41      0.095  OI       |       |       |       |    2.07
 8.083    0.55    0.41      0.095  OI       |       |       |       |    2.09
 8.167    0.56    0.42      0.096  OI       |       |       |       |    2.11
 8.250    0.56    0.42      0.097  OI       |       |       |       |    2.13
 8.333    0.56    0.42      0.098  OI       |       |       |       |    2.15
 8.417    0.57    0.42      0.099  OI       |       |       |       |    2.17
 8.500    0.57    0.42      0.100  OI       |       |       |       |    2.20
 8.583    0.57    0.43      0.101  OI       |       |       |       |    2.22
 8.667    0.58    0.43      0.102  OI       |       |       |       |    2.24
 8.750    0.58    0.43      0.103  OI       |       |       |       |    2.26
 8.833    0.59    0.43      0.105  OI       |       |       |       |    2.29
 8.917    0.59    0.43      0.106  OI       |       |       |       |    2.31
 9.000    0.60    0.44      0.107  OI       |       |       |       |    2.33
 9.083    0.60    0.44      0.108  OI       |       |       |       |    2.36
 9.167    0.60    0.44      0.109  OI       |       |       |       |    2.38
 9.250    0.61    0.44      0.110  OI       |       |       |       |    2.41
 9.333    0.61    0.44      0.111  OI       |       |       |       |    2.43
 9.417    0.62    0.45      0.112  OI       |       |       |       |    2.46
 9.500    0.62    0.45      0.114  OI       |       |       |       |    2.48
 9.583    0.63    0.45      0.115  OI       |       |       |       |    2.51
 9.667    0.63    0.45      0.116  OI       |       |       |       |    2.53
 9.750    0.64    0.46      0.117  OI       |       |       |       |    2.56
 9.833    0.64    0.46      0.119  OI       |       |       |       |    2.59
 9.917    0.65    0.46      0.120  OI       |       |       |       |    2.62
10.000    0.65    0.46      0.121  OI       |       |       |       |    2.64
```

```
10.083    0.66    0.47      0.122  OI       |        |        |        |      2.67
10.167    0.67    0.47      0.124  OI       |        |        |        |      2.70
10.250    0.67    0.47      0.125  OI       |        |        |        |      2.73
10.333    0.68    0.47      0.126  OI       |        |        |        |      2.76
10.417    0.68    0.48      0.128  OI       |        |        |        |      2.79
10.500    0.69    0.48      0.129  OI       |        |        |        |      2.82
10.583    0.70    0.48      0.131  OI       |        |        |        |      2.85
10.667    0.70    0.49      0.132  OI       |        |        |        |      2.89
10.750    0.71    0.49      0.134  OI       |        |        |        |      2.92
10.833    0.72    0.49      0.135  OI       |        |        |        |      2.95
10.917    0.72    0.49      0.137  OI       |        |        |        |      2.99
11.000    0.73    0.50      0.138  OI       |        |        |        |      3.02
11.083    0.74    0.50      0.140  OI       |        |        |        |      3.06
11.167    0.75    0.50      0.142  OI       |        |        |        |      3.09
11.250    0.75    0.51      0.143  OI       |        |        |        |      3.13
11.333    0.76    0.51      0.145  OI       |        |        |        |      3.16
11.417    0.77    0.51      0.147  OI       |        |        |        |      3.20
11.500    0.78    0.51      0.149  OI       |        |        |        |      3.24
11.583    0.79    0.52      0.150  OI       |        |        |        |      3.28
11.667    0.80    0.52      0.152   |O      |        |        |        |      3.32
11.750    0.81    0.52      0.154   |O      |        |        |        |      3.36
11.833    0.82    0.53      0.156   |O      |        |        |        |      3.40
11.917    0.82    0.53      0.158   |O      |        |        |        |      3.45
12.000    0.84    0.53      0.160   |O      |        |        |        |      3.49
12.083    0.86    0.54      0.162   |O      |        |        |        |      3.54
12.167    0.97    0.54      0.165   |O      |        |        |        |      3.59
12.250    1.06    0.55      0.168   |OI     |        |        |        |      3.66
12.333    1.10    0.55      0.172   |OI     |        |        |        |      3.74
12.417    1.11    0.56      0.176   |OI     |        |        |        |      3.82
12.500    1.13    0.57      0.180   |OI     |        |        |        |      3.90
12.583    1.14    0.57      0.184   |OI     |        |        |        |      3.99
12.667    1.16    0.58      0.187   |OI     |        |        |        |      4.07
12.750    1.17    0.58      0.191   |OI     |        |        |        |      4.16
12.833    1.19    0.59      0.196   |OI     |        |        |        |      4.25
12.917    1.20    0.60      0.200   |OI     |        |        |        |      4.34
13.000    1.22    0.60      0.204   |OI     |        |        |        |      4.43
13.083    1.23    0.61      0.208   |OI     |        |        |        |      4.52
13.167    1.25    0.61      0.213   |OI     |        |        |        |      4.62
13.250    1.27    0.62      0.217   |OI     |        |        |        |      4.71
13.333    1.29    0.63      0.221   |OI     |        |        |        |      4.81
13.417    1.31    0.63      0.226   |OI     |        |        |        |      4.91
13.500    1.33    0.64      0.231   |OI     |        |        |        |      5.01
13.583    1.36    0.65      0.236   |OI     |        |        |        |      5.12
13.667    1.38    0.65      0.241   |OI     |        |        |        |      5.22
13.750    1.40    0.66      0.246   |OI     |        |        |        |      5.33
13.833    1.43    0.67      0.251   |OI     |        |        |        |      5.44
13.917    1.46    0.67      0.256   |OI     |        |        |        |      5.56
14.000    1.49    0.68      0.262   |OI     |        |        |        |      5.67
14.083    1.52    0.69      0.267   |OI     |        |        |        |      5.79
14.167    1.56    0.70      0.273   |OI     |        |        |        |      5.92
```

```
14.250    1.59    0.70      0.279  |O I    |       |       |       |     6.05
14.333    1.63    0.71      0.285  |O I    |       |       |       |     6.19
14.417    1.67    0.72      0.292  |O I    |       |       |       |     6.33
14.500    1.72    0.73      0.298  |O I    |       |       |       |     6.48
14.583    1.76    0.74      0.305  |O I    |       |       |       |     6.63
14.667    1.81    0.75      0.313  |O I    |       |       |       |     6.79
14.750    1.87    0.76      0.320  |O I    |       |       |       |     6.96
14.833    1.93    0.76      0.328  |O I    |       |       |       |     7.13
14.917    1.99    0.77      0.336  |O I    |       |       |       |     7.30
15.000    2.07    0.78      0.345  |O I    |       |       |       |     7.48
15.083    2.15    0.79      0.354  |O  I   |       |       |       |     7.68
15.167    2.24    0.80      0.363  |O  I   |       |       |       |     7.88
15.250    2.34    0.97      0.373  |O  I   |       |       |       |     8.10
15.333    2.46    1.45      0.381  | O I   |       |       |       |     8.28
15.417    2.57    1.81      0.387  |  OI   |       |       |       |     8.42
15.500    2.58    2.06      0.392  |  OI   |       |       |       |     8.51
15.583    2.64    2.33      0.395  |   OI  |       |       |       |     8.57
15.667    2.88    2.55      0.397  |   OI  |       |       |       |     8.62
15.750    3.20    2.79      0.399  |    OI |       |       |       |     8.68
15.833    3.69    3.12      0.403  |    O I|       |       |       |     8.75
15.917    4.39    3.58      0.408  |     O I       |       |       |     8.85
16.000    5.75    4.33      0.415  |       O  I    |       |       |     9.02
16.083    9.24    6.58      0.429  |       |   O   |I      |       |     9.32
16.167   16.64   11.04      0.458  |       |       |    O  |       I     9.94
16.250   13.60   12.66      0.480  |       |       |       O I     |    10.42
16.333    6.40   11.60      0.466  |       |   I   |     O |       |    10.11
16.417    3.76    7.55      0.435  |      I|     O |       |       |     9.44
16.500    3.02    4.46      0.417  |    I  O       |       |       |     9.05
16.583    2.62    3.64      0.408  |    IO |       |       |       |     8.87
16.667    2.37    3.06      0.402  |   IO  |       |       |       |     8.74
16.750    2.17    2.66      0.398  |   IO  |       |       |       |     8.65
16.833    2.01    2.37      0.395  |  IO   |       |       |       |     8.58
16.917    1.88    2.16      0.393  |  IO   |       |       |       |     8.54
17.000    1.77    2.02      0.391  |  O    |       |       |       |     8.50
17.083    1.68    1.92      0.389  |  O    |       |       |       |     8.46
17.167    1.60    1.83      0.388  |  O    |       |       |       |     8.42
17.250    1.52    1.74      0.386  | IO    |       |       |       |     8.39
17.333    1.46    1.66      0.385  | IO    |       |       |       |     8.36
17.417    1.41    1.58      0.384  | IO    |       |       |       |     8.33
17.500    1.36    1.52      0.382  | O     |       |       |       |     8.30
17.583    1.31    1.46      0.381  | O     |       |       |       |     8.28
17.667    1.27    1.40      0.380  | O     |       |       |       |     8.26
17.750    1.24    1.35      0.380  | O     |       |       |       |     8.24
17.833    1.20    1.31      0.379  | O     |       |       |       |     8.23
17.917    1.17    1.27      0.378  | O     |       |       |       |     8.21
18.000    1.14    1.23      0.378  | O     |       |       |       |     8.20
18.083    1.10    1.19      0.377  | O     |       |       |       |     8.18
18.167    0.97    1.14      0.376  |IO     |       |       |       |     8.16
18.250    0.87    1.07      0.375  |IO     |       |       |       |     8.13
18.333    0.83    1.00      0.373  |O      |       |       |       |     8.11
```

MAX
WSE

```
18.417     0.81     0.94      0.372  |O        |        |        |        |      8.08
18.500     0.79     0.89      0.372  |O        |        |        |        |      8.07
18.583     0.77     0.85      0.371  |O        |        |        |        |      8.05
18.667     0.75     0.85      0.370  |O        |        |        |        |      8.04
18.750     0.74     0.84      0.370  |O        |        |        |        |      8.02
18.833     0.72     0.83      0.369  |O        |        |        |        |      8.00
18.917     0.71     0.83      0.368  |O        |        |        |        |      7.99
19.000     0.70     0.82      0.367  |O        |        |        |        |      7.97
19.083     0.68     0.81      0.367  |O        |        |        |        |      7.95
19.167     0.67     0.81      0.366  |O        |        |        |        |      7.93
19.250     0.66     0.81      0.365  |O        |        |        |        |      7.91
19.333     0.65     0.80      0.364  |O        |        |        |        |      7.88
19.417     0.64     0.80      0.363  |O        |        |        |        |      7.86
19.500     0.63     0.80      0.361  |O        |        |        |        |      7.84
19.583     0.62     0.80      0.360  |O        |        |        |        |      7.81
19.667     0.61     0.80      0.359  |O        |        |        |        |      7.78
19.750     0.60     0.80      0.358  |O        |        |        |        |      7.75
19.833     0.59     0.80      0.356  |O        |        |        |        |      7.73
19.917     0.58     0.79      0.355  |O        |        |        |        |      7.69
20.000     0.57     0.79      0.353  |O        |        |        |        |      7.66
20.083     0.57     0.79      0.352  |O        |        |        |        |      7.63
20.167     0.56     0.79      0.350  |O        |        |        |        |      7.60
20.250     0.55     0.79      0.349  |O        |        |        |        |      7.56
20.333     0.55     0.79      0.347  |O        |        |        |        |      7.53
20.417     0.54     0.78      0.345  |O        |        |        |        |      7.49
20.500     0.53     0.78      0.344  |O        |        |        |        |      7.46
20.583     0.53     0.78      0.342  |O        |        |        |        |      7.42
20.667     0.52     0.78      0.340  IO        |        |        |        |      7.38
20.750     0.51     0.78      0.338  IO        |        |        |        |      7.35
20.833     0.51     0.77      0.336  IO        |        |        |        |      7.31
20.917     0.50     0.77      0.335  IO        |        |        |        |      7.27
21.000     0.50     0.77      0.333  IO        |        |        |        |      7.23
21.083     0.49     0.77      0.331  IO        |        |        |        |      7.19
21.167     0.49     0.77      0.329  IO        |        |        |        |      7.15
21.250     0.48     0.76      0.327  IO        |        |        |        |      7.11
21.333     0.48     0.76      0.325  IO        |        |        |        |      7.06
21.417     0.47     0.76      0.323  IO        |        |        |        |      7.02
21.500     0.47     0.76      0.321  IO        |        |        |        |      6.98
21.583     0.46     0.75      0.319  IO        |        |        |        |      6.94
21.667     0.46     0.75      0.317  IO        |        |        |        |      6.89
21.750     0.45     0.75      0.315  IO        |        |        |        |      6.85
21.833     0.45     0.75      0.313  IO        |        |        |        |      6.80
21.917     0.45     0.74      0.311  IO        |        |        |        |      6.75
22.000     0.44     0.74      0.309  IO        |        |        |        |      6.71
22.083     0.44     0.74      0.307  IO        |        |        |        |      6.66
22.167     0.43     0.74      0.305  IO        |        |        |        |      6.62
22.250     0.43     0.73      0.303  IO        |        |        |        |      6.57
22.333     0.43     0.73      0.301  IO        |        |        |        |      6.52
22.417     0.42     0.73      0.298  IO        |        |        |        |      6.48
22.500     0.42     0.73      0.296  IO        |        |        |        |      6.43
```

```
22.583    0.42    0.72      0.294  IO        |         |         |         |        6.38
22.667    0.41    0.72      0.292  IO        |         |         |         |        6.33
22.750    0.41    0.72      0.290  IO        |         |         |         |        6.29
22.833    0.41    0.72      0.288  IO        |         |         |         |        6.24
22.917    0.40    0.71      0.286  IO        |         |         |         |        6.19
23.000    0.40    0.71      0.283  IO        |         |         |         |        6.14
23.083    0.40    0.71      0.281  IO        |         |         |         |        6.10
23.167    0.39    0.70      0.279  IO        |         |         |         |        6.05
23.250    0.39    0.70      0.277  IO        |         |         |         |        6.00
23.333    0.39    0.70      0.275  IO        |         |         |         |        5.96
23.417    0.38    0.70      0.273  IO        |         |         |         |        5.91
23.500    0.38    0.69      0.271  IO        |         |         |         |        5.87
23.583    0.38    0.69      0.268  IO        |         |         |         |        5.82
23.667    0.38    0.69      0.266  IO        |         |         |         |        5.77
23.750    0.37    0.69      0.264  IO        |         |         |         |        5.73
23.833    0.37    0.68      0.262  IO        |         |         |         |        5.68
23.917    0.37    0.68      0.260  IO        |         |         |         |        5.64
24.000    0.37    0.68      0.258  IO        |         |         |         |        5.59
24.083    0.33    0.67      0.255  IO        |         |         |         |        5.54
24.167    0.17    0.67      0.253  IO        |         |         |         |        5.48
24.250    0.04    0.67      0.249  IO        |         |         |         |        5.40
24.333    0.01    0.66      0.244  IO        |         |         |         |        5.30
24.417    0.00    0.65      0.240  IO        |         |         |         |        5.21
24.500    0.00    0.65      0.235  IO        |         |         |         |        5.11
24.583    0.00    0.64      0.231  IO        |         |         |         |        5.02
24.667    0.00    0.64      0.227  IO        |         |         |         |        4.92
24.750    0.00    0.63      0.222  IO        |         |         |         |        4.83
24.833    0.00    0.62      0.218  IO        |         |         |         |        4.73
24.917    0.00    0.62      0.214  IO        |         |         |         |        4.64
25.000    0.00    0.61      0.209  IO        |         |         |         |        4.55
25.083    0.00    0.60      0.205  IO        |         |         |         |        4.46
25.167    0.00    0.60      0.201  IO        |         |         |         |        4.37
25.250    0.00    0.59      0.197  IO        |         |         |         |        4.28
25.333    0.00    0.59      0.193  IO        |         |         |         |        4.19
25.417    0.00    0.58      0.189  IO        |         |         |         |        4.10
25.500    0.00    0.57      0.185  IO        |         |         |         |        4.02
25.583    0.00    0.57      0.181  IO        |         |         |         |        3.93
25.667    0.00    0.56      0.177  IO        |         |         |         |        3.85
25.750    0.00    0.55      0.173  IO        |         |         |         |        3.77
25.833    0.00    0.55      0.169  IO        |         |         |         |        3.69
25.917    0.00    0.54      0.166  IO        |         |         |         |        3.60
26.000    0.00    0.54      0.162  IO        |         |         |         |        3.53
26.083    0.00    0.53      0.158  IO        |         |         |         |        3.45
26.167    0.00    0.52      0.155  IO        |         |         |         |        3.37
26.250    0.00    0.52      0.151  O         |         |         |         |        3.29
26.333    0.00    0.51      0.148  O         |         |         |         |        3.22
26.417    0.00    0.51      0.144  O         |         |         |         |        3.14
26.500    0.00    0.50      0.141  O         |         |         |         |        3.07
26.583    0.00    0.50      0.137  O         |         |         |         |        2.99
26.667    0.00    0.49      0.134  O         |         |         |         |        2.92
```

```
26.750    0.00    0.48     0.130  O        |       |       |       |      2.85
26.833    0.00    0.48     0.127  O        |       |       |       |      2.77
26.917    0.00    0.47     0.124  O        |       |       |       |      2.70
27.000    0.00    0.46     0.121  O        |       |       |       |      2.63
27.083    0.00    0.46     0.117  O        |       |       |       |      2.57
27.167    0.00    0.45     0.114  O        |       |       |       |      2.50
27.250    0.00    0.44     0.111  O        |       |       |       |      2.43
27.333    0.00    0.44     0.108  O        |       |       |       |      2.36
27.417    0.00    0.43     0.105  O        |       |       |       |      2.30
27.500    0.00    0.43     0.102  O        |       |       |       |      2.23
27.583    0.00    0.42     0.099  O        |       |       |       |      2.17
27.667    0.00    0.42     0.096  O        |       |       |       |      2.11
27.750    0.00    0.41     0.094  O        |       |       |       |      2.05
27.833    0.00    0.40     0.091  O        |       |       |       |      1.99
27.917    0.00    0.39     0.088  O        |       |       |       |      1.93
28.000    0.00    0.39     0.085  O        |       |       |       |      1.87
28.083    0.00    0.38     0.083  O        |       |       |       |      1.81
28.167    0.00    0.37     0.080  O        |       |       |       |      1.75
28.250    0.00    0.37     0.078  O        |       |       |       |      1.70
28.333    0.00    0.36     0.075  O        |       |       |       |      1.64
28.417    0.00    0.36     0.073  O        |       |       |       |      1.59
28.500    0.00    0.35     0.070  O        |       |       |       |      1.53
28.583    0.00    0.34     0.068  O        |       |       |       |      1.48
28.667    0.00    0.34     0.065  O        |       |       |       |      1.43
28.750    0.00    0.33     0.063  O        |       |       |       |      1.38
28.833    0.00    0.33     0.061  O        |       |       |       |      1.33
28.917    0.00    0.32     0.059  O        |       |       |       |      1.28
29.000    0.00    0.31     0.056  O        |       |       |       |      1.23
29.083    0.00    0.31     0.054  O        |       |       |       |      1.19
29.167    0.00    0.30     0.052  O        |       |       |       |      1.14
29.250    0.00    0.30     0.050  O        |       |       |       |      1.10
29.333    0.00    0.29     0.048  O        |       |       |       |      1.05
29.417    0.00    0.29     0.046  O        |       |       |       |      1.01
29.500    0.00    0.28     0.044  O        |       |       |       |      0.97
29.583    0.00    0.27     0.042  O        |       |       |       |      0.92
29.667    0.00    0.26     0.040  O        |       |       |       |      0.88
29.750    0.00    0.26     0.039  O        |       |       |       |      0.84
29.833    0.00    0.25     0.037  O        |       |       |       |      0.81
29.917    0.00    0.24     0.035  O        |       |       |       |      0.77
30.000    0.00    0.24     0.034  O        |       |       |       |      0.73
30.083    0.00    0.23     0.032  O        |       |       |       |      0.70
30.167    0.00    0.22     0.030  O        |       |       |       |      0.66
30.250    0.00    0.22     0.029  O        |       |       |       |      0.63
30.333    0.00    0.21     0.027  O        |       |       |       |      0.60
30.417    0.00    0.21     0.026  O        |       |       |       |      0.57
30.500    0.00    0.20     0.024  O        |       |       |       |      0.54
30.583    0.00    0.20     0.023  O        |       |       |       |      0.51
30.667    0.00    0.19     0.022  O        |       |       |       |      0.48
30.750    0.00    0.19     0.020  O        |       |       |       |      0.45
30.833    0.00    0.18     0.019  O        |       |       |       |      0.42
```

```
30.917     0.00     0.18       0.018  O        |        |        |        |      0.39
31.000     0.00     0.17       0.017  O        |        |        |        |      0.37
31.083     0.00     0.17       0.016  O        |        |        |        |      0.34
31.167     0.00     0.16       0.014  O        |        |        |        |      0.32
31.250     0.00     0.15       0.013  O        |        |        |        |      0.30
31.333     0.00     0.15       0.012  O        |        |        |        |      0.27
31.417     0.00     0.14       0.011  O        |        |        |        |      0.25
31.500     0.00     0.13       0.010  O        |        |        |        |      0.23
31.583     0.00     0.13       0.010  O        |        |        |        |      0.21
31.667     0.00     0.12       0.009  O        |        |        |        |      0.20
31.750     0.00     0.12       0.008  O        |        |        |        |      0.18
31.833     0.00     0.11       0.007  O        |        |        |        |      0.16
31.917     0.00     0.11       0.006  O        |        |        |        |      0.15
32.000     0.00     0.10       0.006  O        |        |        |        |      0.13
32.083     0.00     0.10       0.005  O        |        |        |        |      0.12
32.167     0.00     0.08       0.004  O        |        |        |        |      0.10
32.250     0.00     0.07       0.004  O        |        |        |        |      0.09
32.333     0.00     0.06       0.003  O        |        |        |        |      0.08
32.417     0.00     0.06       0.003  O        |        |        |        |      0.07
32.500     0.00     0.05       0.003  O        |        |        |        |      0.06
32.583     0.00     0.04       0.002  O        |        |        |        |      0.05
32.667     0.00     0.04       0.002  O        |        |        |        |      0.05
32.750     0.00     0.03       0.002  O        |        |        |        |      0.04
32.833     0.00     0.03       0.001  O        |        |        |        |      0.03
32.917     0.00     0.03       0.001  O        |        |        |        |      0.03
33.000     0.00     0.02       0.001  O        |        |        |        |      0.03
33.083     0.00     0.02       0.001  O        |        |        |        |      0.02
33.167     0.00     0.02       0.001  O        |        |        |        |      0.02
33.250     0.00     0.01       0.001  O        |        |        |        |      0.02
33.333     0.00     0.01       0.001  O        |        |        |        |      0.02
33.417     0.00     0.01       0.001  O        |        |        |        |      0.01
33.500     0.00     0.01       0.001  O        |        |        |        |      0.01
33.583     0.00     0.01       0.000  O        |        |        |        |      0.01
33.667     0.00     0.01       0.000  O        |        |        |        |      0.01
33.750     0.00     0.01       0.000  O        |        |        |        |      0.01
33.833     0.00     0.01       0.000  O        |        |        |        |      0.01
33.917     0.00     0.01       0.000  O        |        |        |        |      0.01
34.000     0.00     0.00       0.000  O        |        |        |        |      0.01
34.083     0.00     0.00       0.000  O        |        |        |        |      0.00
34.167     0.00     0.00       0.000  O        |        |        |        |      0.00
34.250     0.00     0.00       0.000  O        |        |        |        |      0.00
34.333     0.00     0.00       0.000  O        |        |        |        |      0.00
34.417     0.00     0.00       0.000  O        |        |        |        |      0.00
34.500     0.00     0.00       0.000  O        |        |        |        |      0.00
34.583     0.00     0.00       0.000  O        |        |        |        |      0.00
34.667     0.00     0.00       0.000  O        |        |        |        |      0.00
34.750     0.00     0.00       0.000  O        |        |        |        |      0.00
34.833     0.00     0.00       0.000  O        |        |        |        |      0.00
34.917     0.00     0.00       0.000  O        |        |        |        |      0.00
35.000     0.00     0.00       0.000  O        |        |        |        |      0.00
```

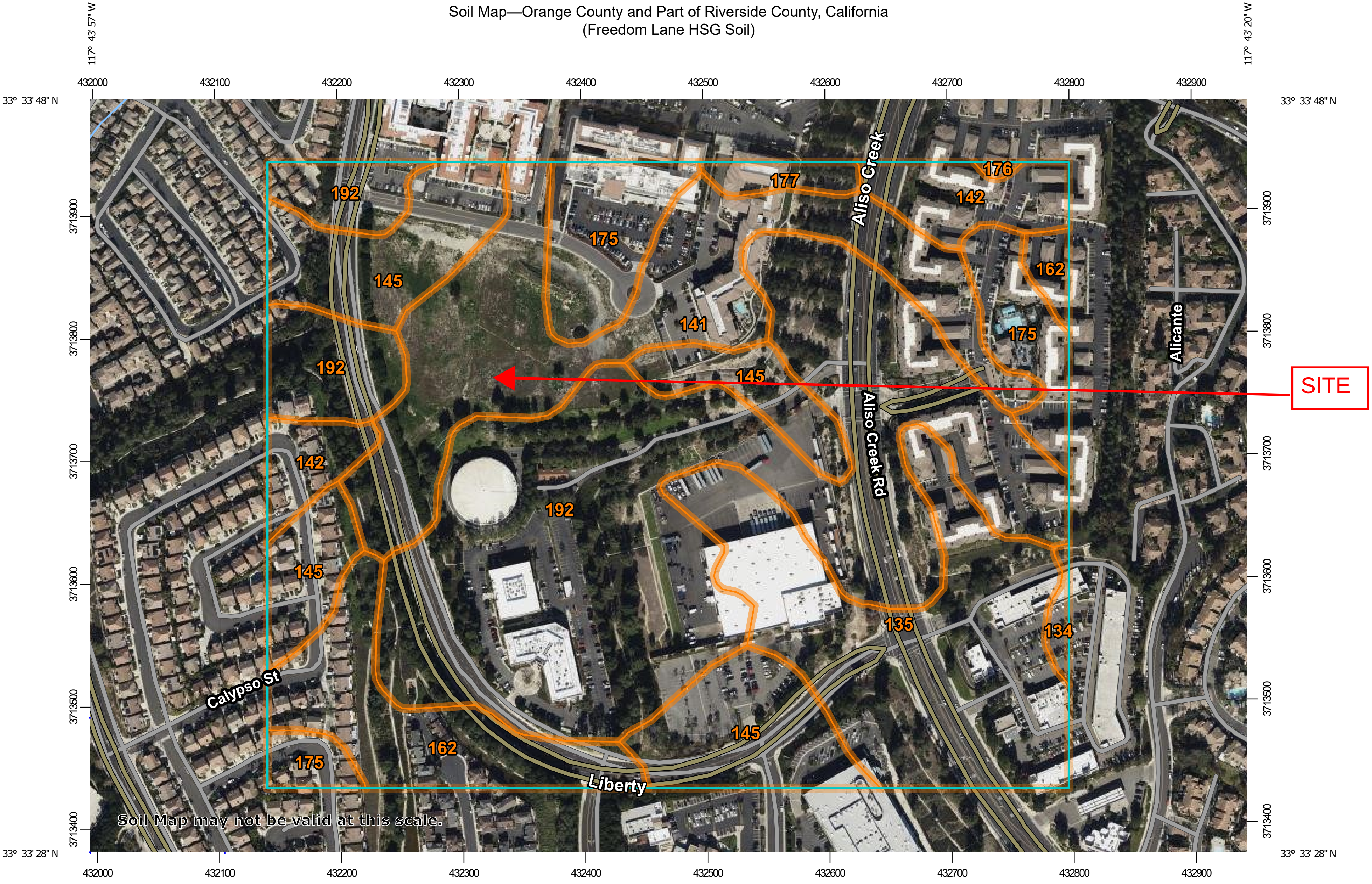
WSE = 0

```
****************************HYDROGRAPH DATA****************************
                Number of intervals =   420
                Time interval =    5.0 (Min.)
                Maximum/Peak flow rate =       12.659 (CFS)
                Total volume =       1.944 (Ac.Ft)
        Status of hydrographs being held in storage
                   Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
        Peak (CFS)      0.000     0.000     0.000     0.000     0.000
        Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
***********************************************************************

--------------------------------------------------------------------
```

Attachment D: Supporting Exhibits

- Attachment D1: USDA HSG Soil Map
- Attachment D2 – USDA HSG Soil Description
- Attachment D3: Southern Orange County TGD Critical Coarse Sediment Map
- Attachment D4: Hydromodification Exemption Map
- Attachment D5: OCTGD Rainfall Zones Design Capture Storm Depth Map
- Attachment D6: OCTGD Capture Efficiency Nomograph
- Attachment D7: 400 Freedom Lane Historical Photograph 1938 (https://www.historicaerials.com/)
- Attachment D8: 400 Freedom Lane Historical Topographic Map 1949 (https://www.historicaerials.com/)
- Attachment D9: OCTGD BIO-7 Proprietary Biotreatment BMP Checklist
- Attachment D10: Modular Wetland System Linear 6x8 Contech preliminary plan sheets
- Attachment D11: Modular Wetland System Linear 8x8 Contech preliminary plan sheets
- Attachment D12: Modular Wetland System Linear 8x12 Contech preliminary plan sheets
- Attachment D13: Modular Wetland System Linear 8x20 Contech preliminary plan sheets
- Attachment D14: StormTrap subsurface detention basin and flow control structure
- Attachment D15: OCFD Storm Drain Map

Soil Map—Orange County and Part of Riverside County, California
(Freedom Lane HSG Soil)


117° 43' 57" W
117° 43' 20" W
33° 33' 48" N
33° 33' 28" N
432000
432100
432200
432300
432400
432500
432600
432700
432800
432900
3713900
3713800
3713700
3713600
3713500
3713400
192
177
176
142
175
145
162
141
175
192
145
142
192
145
135
134
175
162
145
Aliso Creek
Aliso Creek Rd
Alicante
Calypso St
Liberty
SITE
Soil Map may not be valid at this scale.

Map Scale: 1:4,330 if printed on A landscape (11" x 8.5") sheet.

N

0 50 100 200 300 Meters

0 200 400 800 1200 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

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
Λ Lava Flow
ψ Marsh or swamp
⚒ Mine or Quarry
◎ Miscellaneous Water
○ Perennial Water
∨ Rock Outcrop
+ Saline Spot
⁙ Sandy Spot
⊖ Severely Eroded Spot
◈ Sinkhole
» Slide or Slip
ø Sodic Spot
≡ Spoil Area
◊ Stony Spot
∞ Very Stony Spot
ψ 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: Orange County and Part of Riverside County, California
Survey Area Data: Version 17, Aug 30, 2023

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

Date(s) aerial images were photographed: Jan 17, 2023—Feb 8, 2023

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
134	Calleguas clay loam, 50 to 75 percent slopes, eroded	0.3	0.4%
135	Capistrano sandy loam, 2 to 9 percent slopes	12.0	14.5%
141	Cieneba sandy loam, 15 to 30 percent slopes	12.5	15.0%
142	Cieneba sandy loam, 30 to 75 percent slopes, eroded	3.5	4.2%
145	Cieneba-Rock outcrop complex, 30 to 75 percent slopes	11.4	13.7%
162	Marina loamy sand, 2 to 9 percent slopes	5.8	6.9%
175	Myford sandy loam, 9 to 15 percent slopes	6.1	7.3%
176	Myford sandy loam, 15 to 30 percent slopes	0.1	0.1%
177	Myford sandy loam, 9 to 30 percent slopes, eroded	0.8	0.9%
192	Rock outcrop-Cieneba complex, 30 to 75 percent slopes	30.8	37.0%
Totals for Area of Interest		**83.2**	**100.0%**

Orange County and Part of Riverside County, California

141—Cieneba sandy loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: hcmk
Elevation: 500 to 4,000 feet
Mean annual precipitation: 12 to 35 inches
Mean annual air temperature: 57 to 64 degrees F
Frost-free period: 200 to 300 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Cieneba

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from granite

Typical profile

H1 - 0 to 17 inches: sandy loam
H2 - 17 to 59 inches: weathered bedrock

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: 4 to 20 inches to paralithic bedrock
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Ecological site: R019XD060CA - SHALLOW LOAMY
Hydric soil rating: No

Minor Components

Soper, gravelly loam

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

San andreas, sandy loam

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

Anaheim, loam

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

Data Source Information

Soil Survey Area: Orange County and Part of Riverside County, California
Survey Area Data: Version 17, Aug 30, 2023

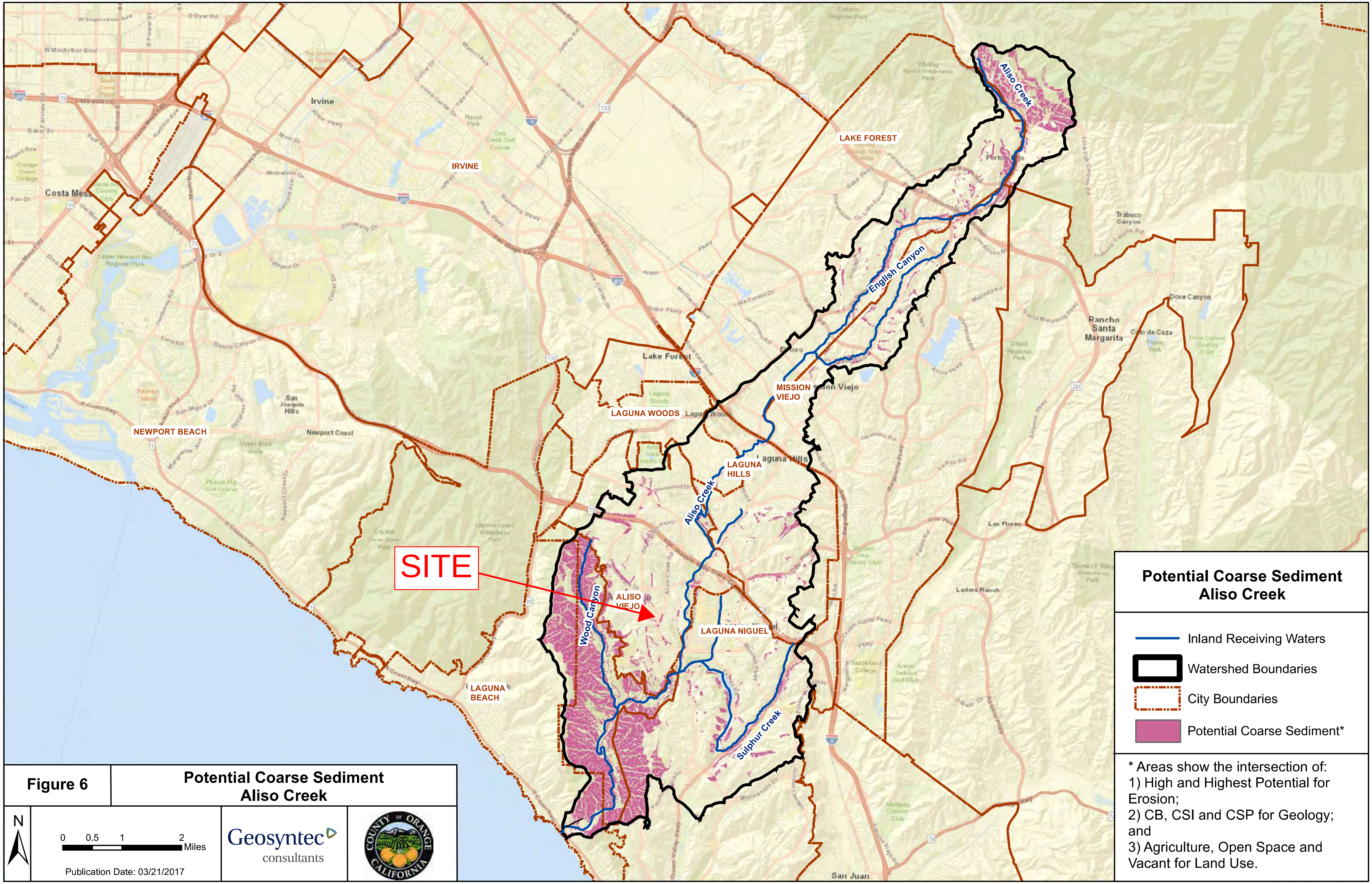

SITE
Aliso Creek
English Canyon
Wood Canyon
Sulphur Creek
LAKE FOREST
IRVINE
Irvine
Costa Mesa
NEWPORT BEACH
LAGUNA WOODS
MISSION VIEJO
LAGUNA HILLS
ALISO VIEJO
LAGUNA NIGUEL
LAGUNA BEACH
Rancho Santa Margarita
Lake Forest
Laguna Hills
San Joaquin Hills
Newport Coast
Trabuco Canyon
Dove Canyon
Coto de Caza
Las Flores
Ladera Ranch
San Juan
N
0
0.5
1
2
Miles

Figure 6

Potential Coarse Sediment Aliso Creek

Publication Date: 03/21/2017

Geosyntec consultants

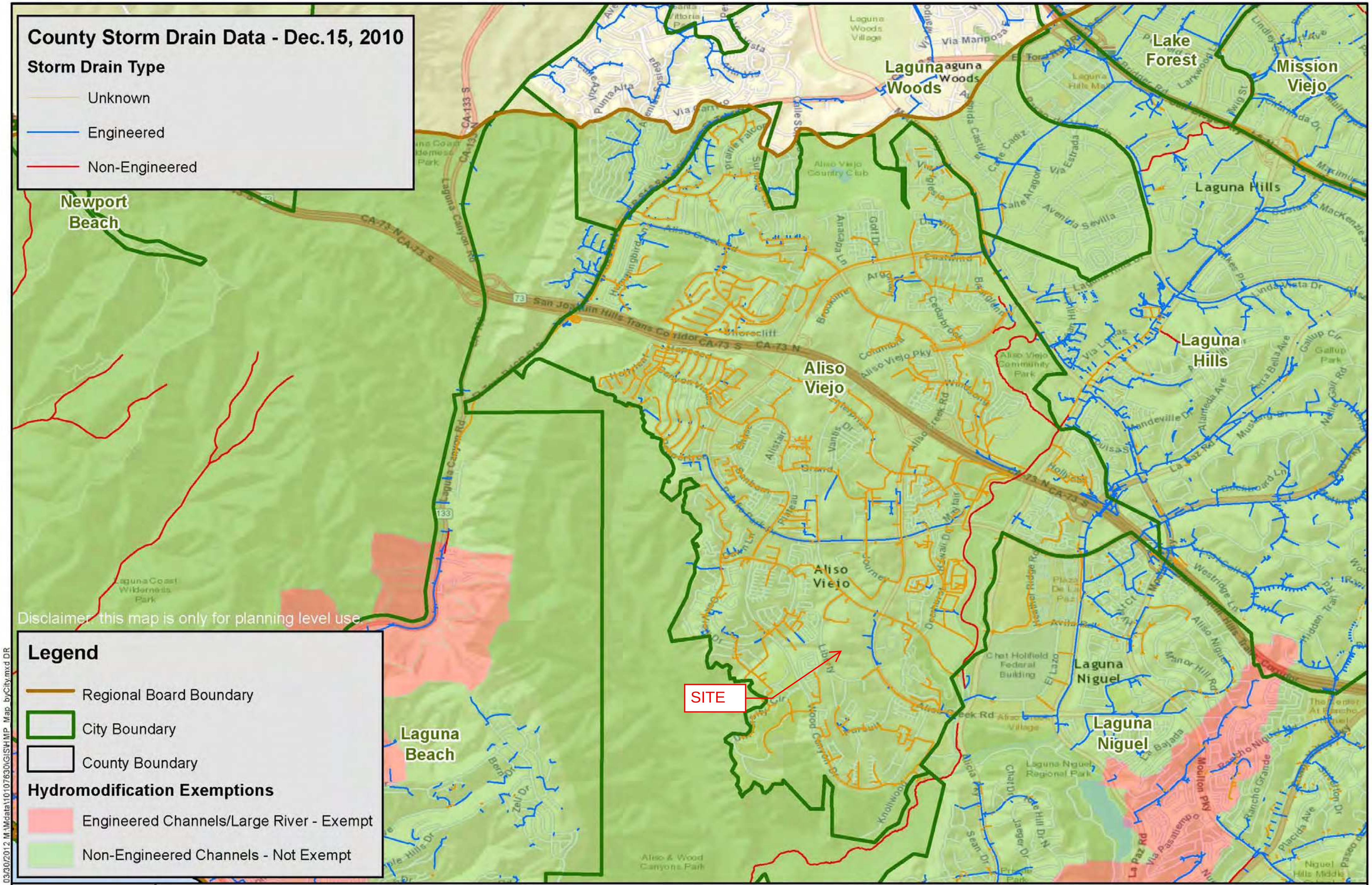
COUNTY OF ORANGE CALIFORNIA

Potential Coarse Sediment Aliso Creek

—	Inland Receiving Waters
▭	Watershed Boundaries
▭	City Boundaries
▇	Potential Coarse Sediment*

* Areas show the intersection of:
1) High and Highest Potential for Erosion;
2) CB, CSI and CSP for Geology; and
3) Agriculture, Open Space and Vacant for Land Use.

Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community


County Storm Drain Data - Dec.15, 2010
Storm Drain Type
Unknown
Engineered
Non-Engineered
Legend
Regional Board Boundary
City Boundary
County Boundary
Hydromodification Exemptions
Engineered Channels/Large River - Exempt
Non-Engineered Channels - Not Exempt
Disclaimer: this map is only for planning level use.
Newport Beach
Laguna Woods
Lake Forest
Mission Viejo
Laguna Hills
Aliso Viejo
Laguna Niguel
Laguna Beach
SITE
San Joaquin Hills Trans Corridor
CA-73 N
CA-73 S
Laguna Coast Wilderness Park
Aliso Viejo Country Club
Aliso Viejo Community Park
Chet Holifield Federal Building
Laguna Niguel Regional Park
Aliso & Wood Canyons Park
Moulton Pky
La Paz Rd
03/30/2012 M:\Mdata\10107630\GIS\HMP_Map_byCity.mxd DR

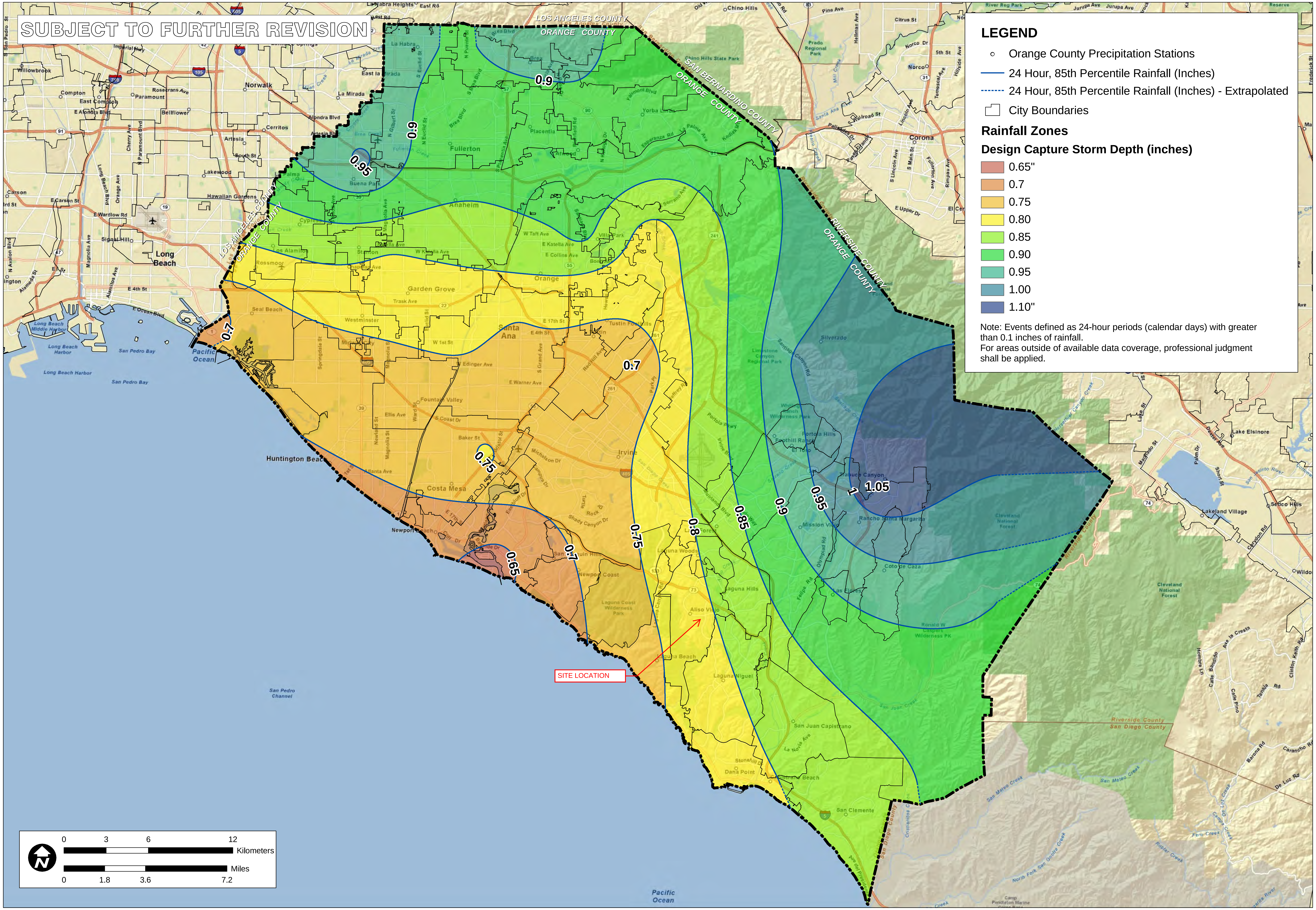
RBF CONSULTING A Baker Company GIS

0 0.5 1 Miles

South Orange County Engineered Channel Exemption Areas

Aliso Viejo Exemption Map

Sources: County of Orange; Caltrans; ESRI; RBF Consulting; San Diego RWQCB; SWRCB



SUBJECT TO FURTHER REVISION
LEGEND
○ Orange County Precipitation Stations
24 Hour, 85th Percentile Rainfall (Inches)
24 Hour, 85th Percentile Rainfall (Inches) - Extrapolated
City Boundaries
Rainfall Zones
Design Capture Storm Depth (inches)
0.65"
0.7
0.75
0.80
0.85
0.90
0.95
1.00
1.10"
Note: Events defined as 24-hour periods (calendar days) with greater than 0.1 inches of rainfall.
For areas outside of available data coverage, professional judgment shall be applied.
LOS ANGELES COUNTY
ORANGE COUNTY
SAN BERNARDINO COUNTY
RIVERSIDE COUNTY
0.9
0.95
0.7
0.75
0.8
0.85
0.65
1
1.05
SITE LOCATION
Fullerton
Anaheim
Garden Grove
Santa Ana
Orange
Irvine
Costa Mesa
Huntington Beach
Newport Beach
Laguna Beach
Laguna Niguel
San Juan Capistrano
Dana Point
San Clemente
Long Beach
Pacific Ocean
0 3 6 12 Kilometers
0 1.8 3.6 7.2 Miles
N

RAINFALL ZONES

TITLE

ORANGE COUNTY TECHNICAL GUIDANCE DOCUMENT

JOB

ORANGE CO.

CA

SCALE 1" = 1.8 miles

DESIGNED TH

DRAWING TH

CHECKED BMP

DATE 04/22/10

JOB NO. 9526-E

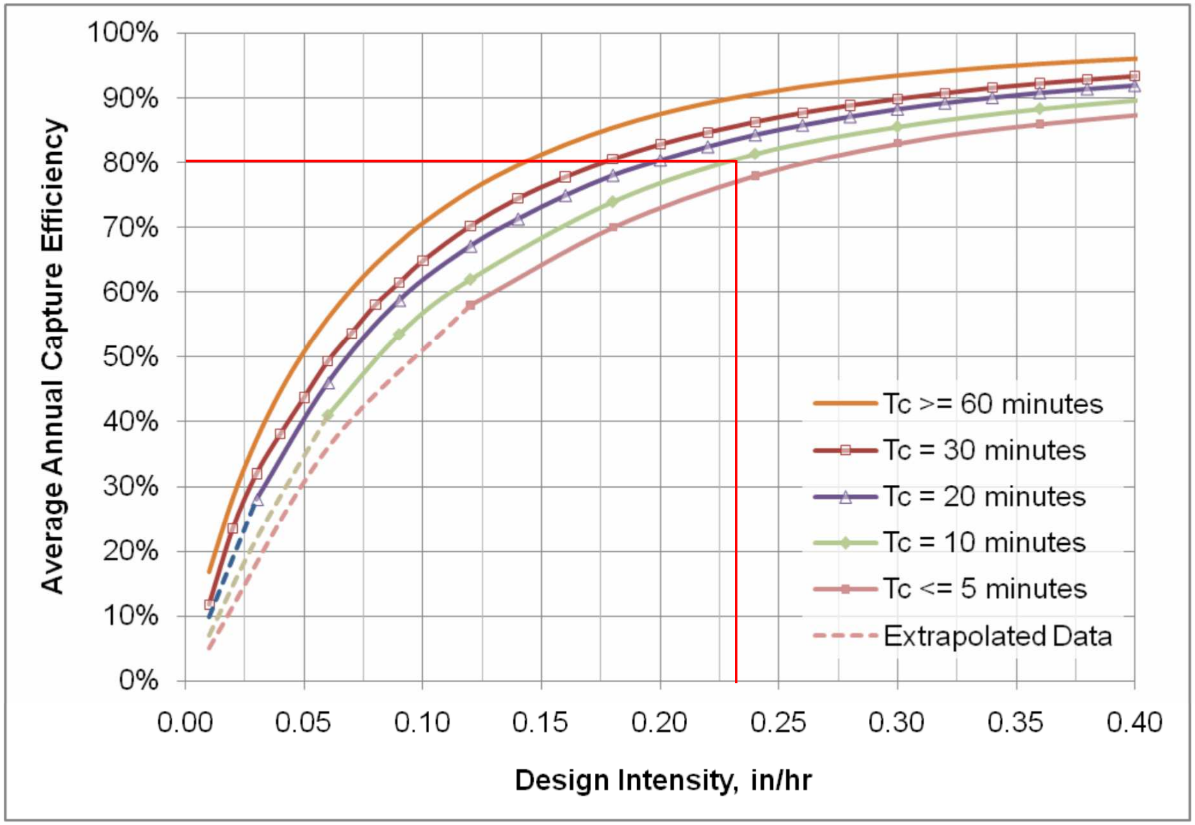
PACE Advanced Water Engineering

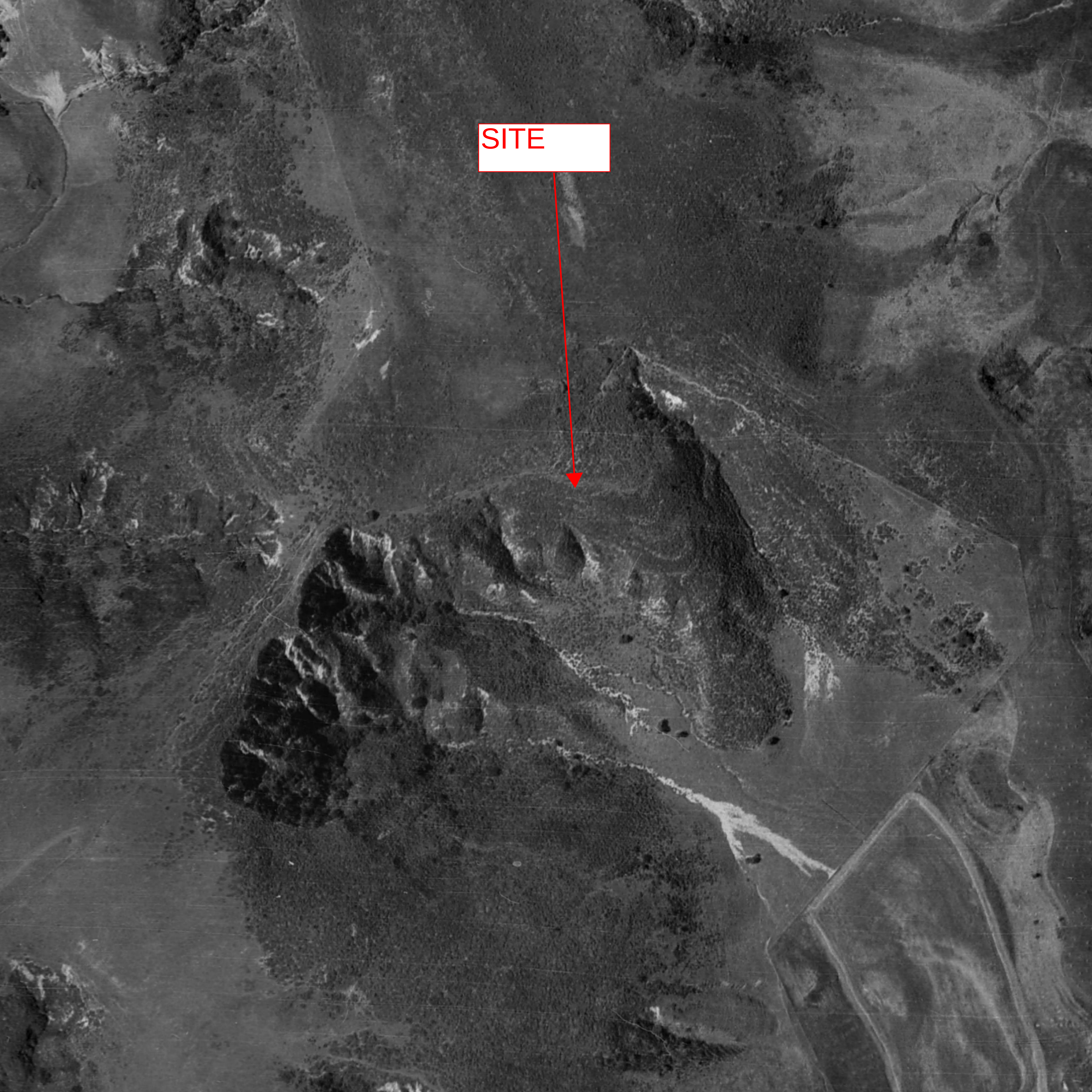
FIGURE

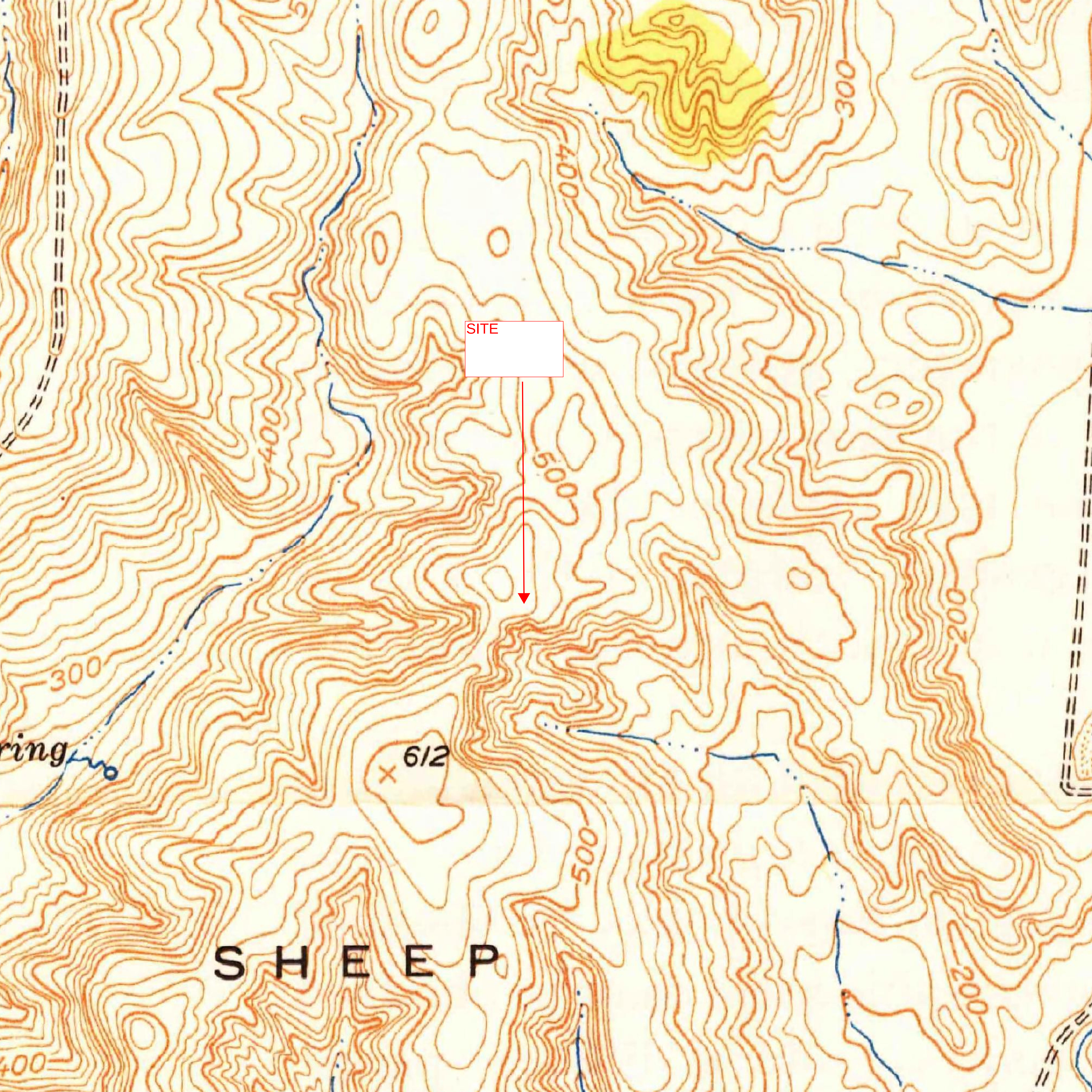
XVI-1

P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-1_RainfallZones_20110215.mxd

Figure III.4. Capture Efficiency Nomograph for Off-line Flow-based Systems in Orange County




SITE


SITE
400
300
400
500
200
300
ring
6/2
500
200
SHEEP
400

BIO-5/BIO-7: PROPRIETARY BIOTREATMENT

Category: Biotreatment with Partial Infiltration (when accompanied by supplemental retention)

Biotreatment with No Infiltration (when used without supplemental retention)

Proprietary biotreatment BMPs are proprietary devices that are manufactured to treat stormwater. **Acceptance criteria for proprietary biotreatment BMPs are defined in Appendix J**. Proprietary BMPs that do not meet these acceptance criteria are not permitted. In addition, proprietary biotreatment BMPs must meet the definition of biofiltration in order to be used as LID biotreatment BMPs. There are two configurations of proprietary biotreatment, as explained in the following subsections.

BIO-5: Proprietary Biotreatment with Enhanced Retention Configuration

As standalone systems, proprietary biotreatment BMPs typically provide negligible volume reduction. To be used as a “biotreatment BMP with partial infiltration,” these BMPs must be accompanied by a retention compartment. This could consist of several options:

- Permeable pavement upstream of the proprietary BMPl
- Shallow infiltration gallery or chambers downstream of the BMP, connected to underdrains.
- Proprietary biotreatment downstream of a cistern for harvest and use.
- Use of adequate hydrologic source controls in the watershed to meet volume reduction targets (see Sizing section of this Fact Sheet).
- Other configurations that are determined to be appropriate to maximize the feasible volume reduction for the DMA.

Guidance for retention compartments is provided in other fact sheets, such as INF-5 (Permeable Pavement) and INF-6 (Underground Infiltration).

BIO-7: Standard Configuration without Supplemental Retention

For conditions that do not require partial infiltration, volume retention is not a performance goal. Acceptable proprietary biotreatment BMPs may be used as standalone systems. Guidance related to complementary retention can be disregarded.

Pollutant Removal Considerations

BMPs that meet the acceptance criteria in **Appendix J** are considered to provide adequate treatment for pollutants of concern. According to these critera, there are different levels of treatment certification needed for different pollutants of concern.

Recommended Design Criteria and Considerations

	Design Criteria	Intent/Rationale
☐	Sediment sources should be controlled prior to operation of the system.	Proprietary systems are susceptible to clogging similar to other BMPs. Systems should not be used in areas that will continue to receive elevated sediment loading following construction, such as from open space area.
☐	When accompanied by infiltration compartments, the ponding should not be higher than the underdrain elevation of the proprietary BMP.	This is intended to ensure that the complementary retention compartment does not reduce the hydraulic capacity of the proprietary biotreatment BMP.
☐	When accompanied by infiltration compartments, these infiltration BMPs must adhere to siting guidance found in the respective fact sheet for the BMP	Specific siting considerations apply to infiltration BMPs.
☐	Proprietary biotreatment systems typically do not require separate pretreatment	These BMPs typically include integrated mechanisms for pretreatment.
☐	Proprietary BMPs must be designed in a manner consistent with manufacturer recommendations and consistent with the design configuration that was tested as part of the BMP certification	Proprietary devices have device-specific design, installation, and maintenance details which must be followed for proper treatment results.
☐	In right of way areas, plant selection should not impair traffic sightlines or vehicle access.	Vegetation must not be prohibitive for typical vehicular movement and parking access needs.
☐	Manufacturer guidance on vegetation selection and establishment should be followed	Manufacturers have experience with plant survival in specific climates for the BMP-specific conditions.

Calculations and Sizing Method

Proprietary Biotreatment BMPs are flow-based BMPs. See **Appendix E** for acceptable sizing methods.

Supplemental retention elements (for BIO-5 configuration) should be sized for one of the following targets, where possible:

- Approximately 40 percent long term volume reduction.
- Retention storage provided for approximately one-third of the DCV.
- Infiltration footprint (collective of all infiltrating elements of the project design) meeting target defined in **Section E.4.2**.

Construction Guidance

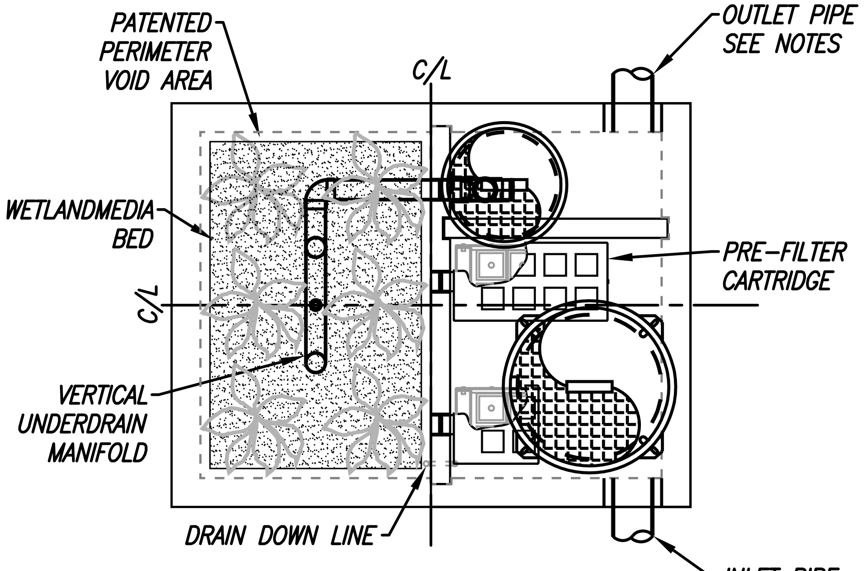
	Construction Guidance	Intent/Rationale
☐	Plans should include a construction sequence for the BMP. Revisions proposed by the contractor should be reviewed by the engineer. The construction sequence should address erosion control, utilities, BMP installation, inspections, testing and certifications, vegetation, stabilization, and post-construction monitoring.	Construction sequencing is critical to avoid issues/damage and allow appropriate inspections, testing, and certifications to be performed.
☐	Provide for inspection of buried infrastructure (e.g., underdrain, filter course) before it is buried.	It is impractical to inspect buried elements once they are covered.
☐	Fully stabilize sources of sediment within the tributary area (i.e., no exposed soil) prior to placing the finished BMP into service.	Sediment loading can seriously impair the capacity of the BMP.
☐	Allow plants and mulch to stabilize for as long as practicable (preferably several months) prior to placing the finished BMP into service.	Stabilization of the system allows plants to mature before stressing the system with stormwater loading.

O&M Activities and Frequencies

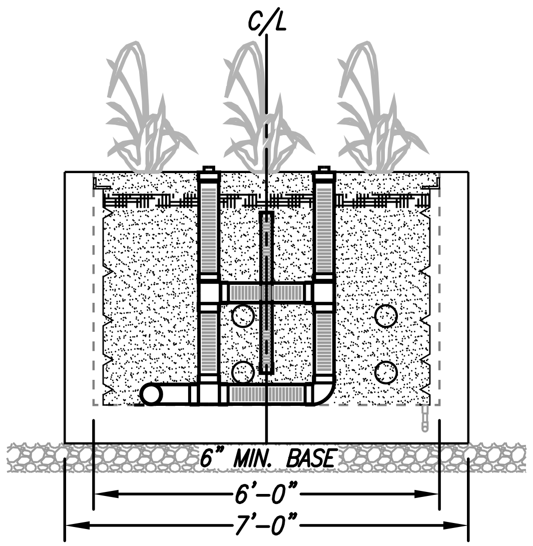
Activity	Frequency
GENERAL INSPECTIONS	
Remove trash and debris	Four times per year during wet season, including inspection just before the wet season and within 24 hours after at least two storm events ≥ 0.5 inches.
Identify excess erosion or scour	
Identify sediment accumulation that requires maintenance	
Inspect during storm event, when possible, to estimate treatment capacity and determine if premature bypass is occurring	
Evaluate plant health and need for corrective action	
Identify any needed corrective maintenance that will require site-specific planning or design	
OPERATION AND MAINTENANCE	
• O&M of proprietary BMPs must follow established manufacturer guidelines • O&M of accompanying retention BMPs should follow the guidelines established in the associated fact sheet for that BMP.	

SITE SPECIFIC DATA

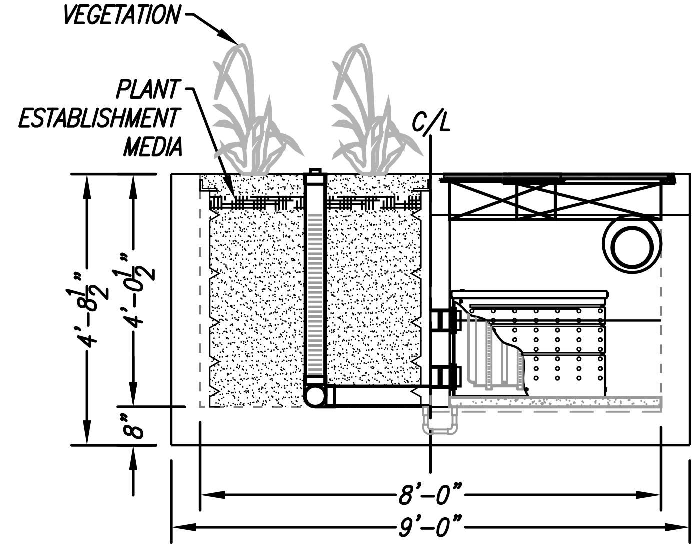
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
TREATMENT HGL AVAILABLE (FT)			
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PARKWAY	OPEN PLANTER	PARKWAY
FRAME & COVER	ø30"	N/A	ø24"
WETLANDMEDIA VOLUME (CY)			4.75
WETLANDMEDIA DELIVERY METHOD			TBD
ORIFICE SIZE (DIA. INCHES)			ø1.73"
MAXIMUM PICK WEIGHT (LBS)			TBD
NOTES:			



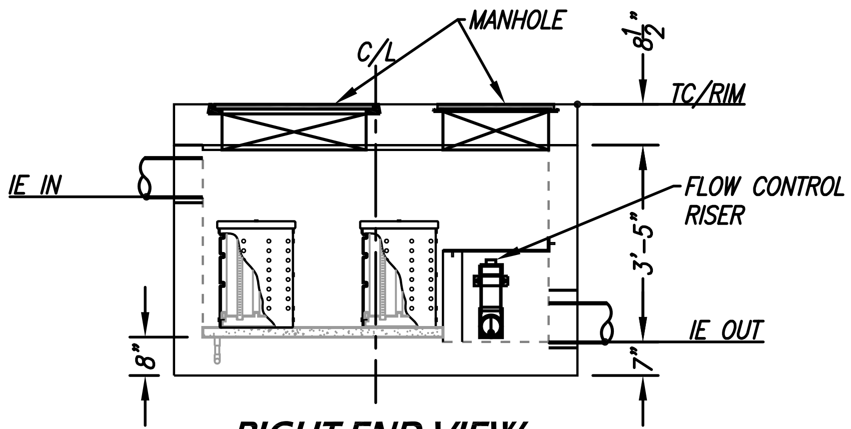
PLAN VIEW



LEFT END VIEW
BIOFILTRATION



ELEVATION VIEW



RIGHT END VIEW
PRETREATMENT/DISCHARGE

INSTALLATION NOTES

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURERS CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE TO VERIFY PROJECT ENGINEERS RECOMMENDED BASE SPECIFICATIONS.
3. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE. (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL GAPS AROUND PIPES SHALL BE SEALED WATER TIGHT WITH A NON-SHRINK GROUT PER MANUFACTURERS STANDARD CONNECTION DETAIL AND SHALL MEET OR EXCEED REGIONAL PIPE CONNECTION STANDARDS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. DRIP OR SPRAY IRRIGATION REQUIRED ON ALL UNITS WITH VEGETATION.

GENERAL NOTES

1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT MANUFACTURER.

4/27/15JOHN

TREATMENT FLOW (CFS)	0.147
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	TBD
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

THE PRODUCT DESCRIBED MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING US PATENTS: 7,425,262; 7,470,362; 7,674,378; 8,303,816; RELATED FOREIGN PATENTS OR OTHER PATENTS PENDING

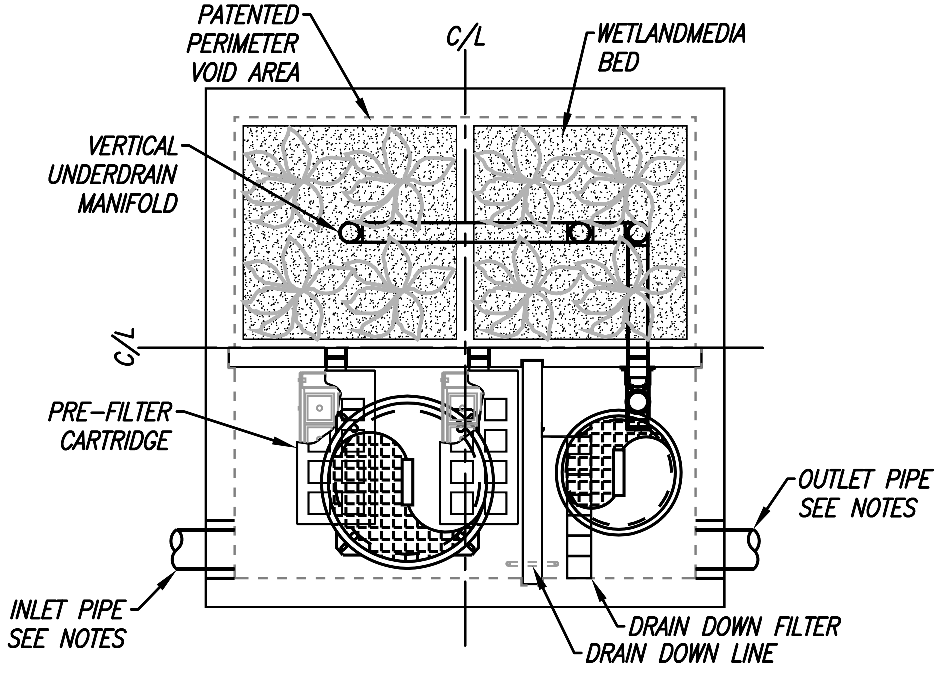
PROPRIETARY AND CONFIDENTIAL:

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF MODULAR WETLANDS SYSTEMS. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF MODULAR WETLANDS SYSTEMS IS PROHIBITED.

MODULAR WETLANDS
www.ModularWetlands.com | (855) 5MOD-WET

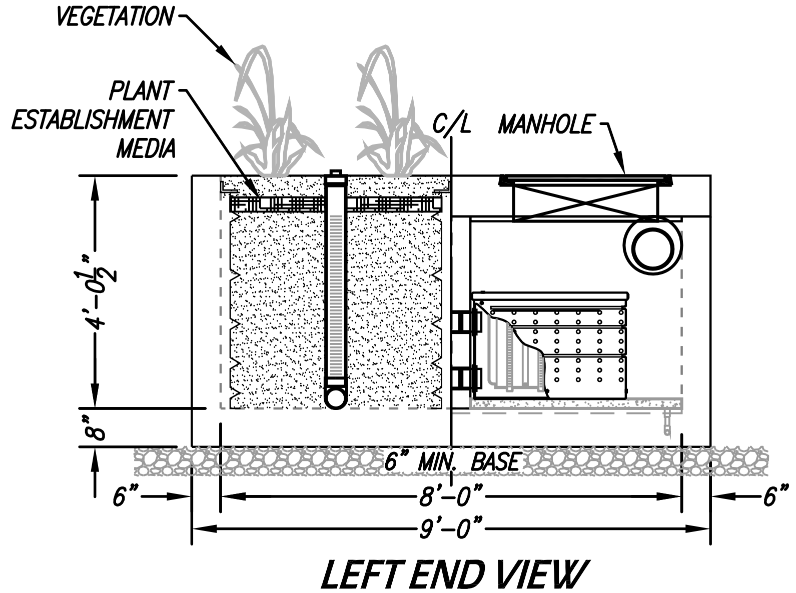
MWS-L-6-8-V
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

SITE SPECIFIC DATA			
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
TREATMENT HGL AVAILABLE (FT)			
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PARKWAY	OPEN PLANTER	PARKWAY
FRAME & COVER	ø30"	N/A	ø24"
WETLANDMEDIA VOLUME (CY)			4.84
WETLANDMEDIA DELIVERY METHOD			TBD
ORIFICE SIZE (DIA. INCHES)			ø2.16"
MAXIMUM PICK WEIGHT (LBS)			TBD
NOTES:			



PATENTED PERIMETER VOID AREA
C/L
WETLANDMEDIA BED
VERTICAL UNDERDRAIN MANIFOLD
C/L
PRE-FILTER CARTRIDGE
OUTLET PIPE SEE NOTES
INLET PIPE SEE NOTES
DRAIN DOWN FILTER
DRAIN DOWN LINE

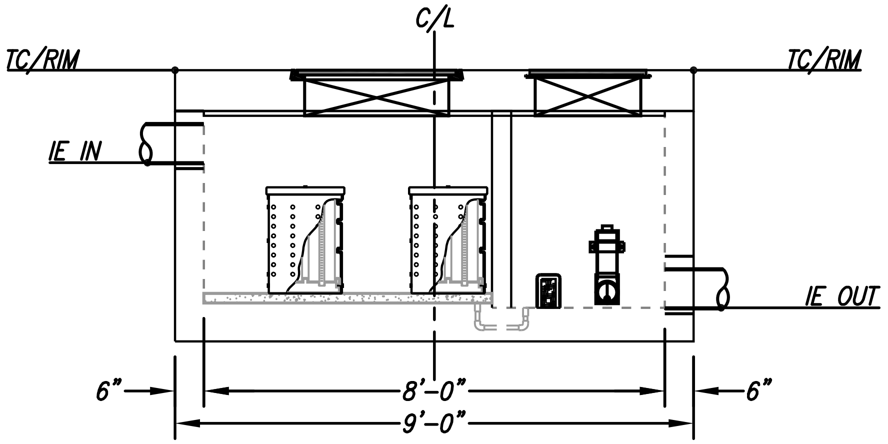
PLAN VIEW



VEGETATION
PLANT ESTABLISHMENT MEDIA
C/L
MANHOLE
4'-0½"
8"
6" MIN. BASE
6"
8'-0"
9'-0"
6"

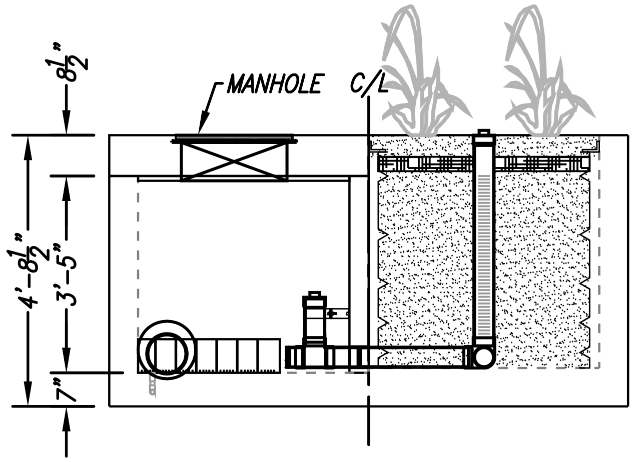
LEFT END VIEW

BIOFILTRATION/PRETREATMENT



C/L
TC/RIM
TC/RIM
IE IN
IE OUT
6"
8'-0"
9'-0"
6"

ELEVATION VIEW



8½"
MANHOLE
C/L
4'-8½"
3'-5"
7"

RIGHT END VIEW

DISCHARGE/BIOFILTRATION

INSTALLATION NOTES

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURERS CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE TO VERIFY PROJECT ENGINEERS RECOMMENDED BASE SPECIFICATIONS.
3. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE. (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL GAPS AROUND PIPES SHALL BE SEALED WATER TIGHT WITH A NON-SHRINK GROUT PER MANUFACTURERS STANDARD CONNECTION DETAIL AND SHALL MEET OR EXCEED REGIONAL PIPE CONNECTION STANDARDS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. DRIP OR SPRAY IRRIGATION REQUIRED ON ALL UNITS WITH VEGETATION.

GENERAL NOTES

1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT MANUFACTURER.

TREATMENT FLOW (CFS)	0.230
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	TBD
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

THE PRODUCT DESCRIBED MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING US PATENTS: 7,425,262; 7,470,362; 7,674,378; 8,303,816; RELATED FOREIGN PATENTS OR OTHER PATENTS PENDING

PROPRIETARY AND CONFIDENTIAL:

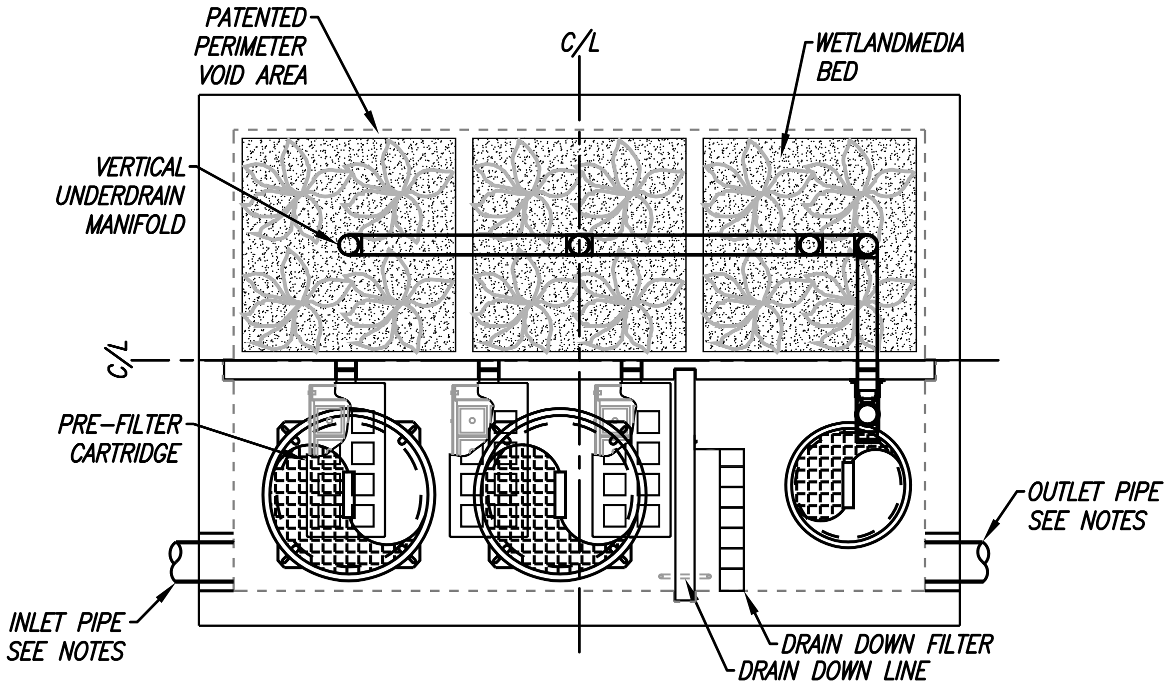
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF MODULAR WETLANDS SYSTEMS. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF MODULAR WETLANDS SYSTEMS IS PROHIBITED.

MODULAR WETLANDS
www.ModularWetlands.com | (855) 5MOD-WET

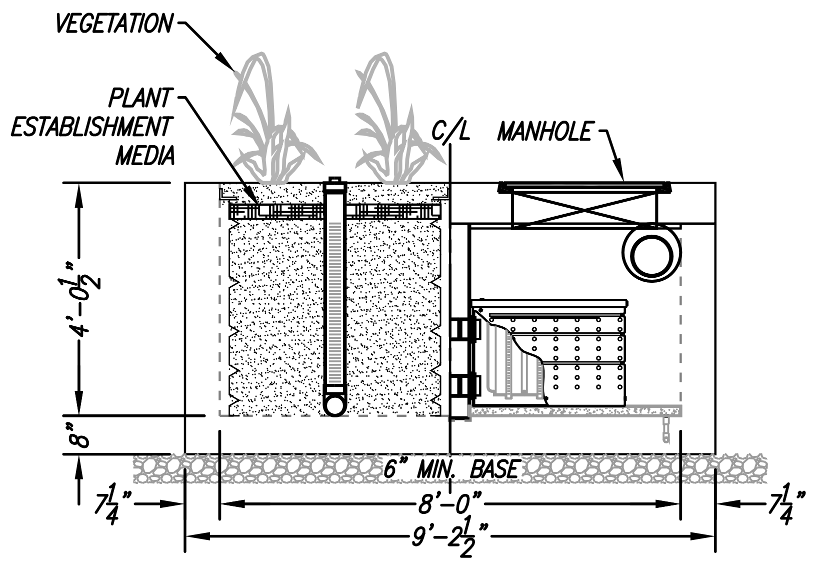
MWS-L-8-8-V
STORMWATER BIOFILTRATION SYSTEM STANDARD DETAIL

SITE SPECIFIC DATA

PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
TREATMENT HGL AVAILABLE (FT)			
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PARKWAY	OPEN PLANTER	PARKWAY
FRAME & COVER	ø30"	N/A	ø24"
WETLANDMEDIA VOLUME (CY)			7.26
WETLANDMEDIA DELIVERY METHOD			TBD
ORIFICE SIZE (DIA. INCHES)			ø2.66"
MAXIMUM PICK WEIGHT (LBS)			TBD
NOTES:			

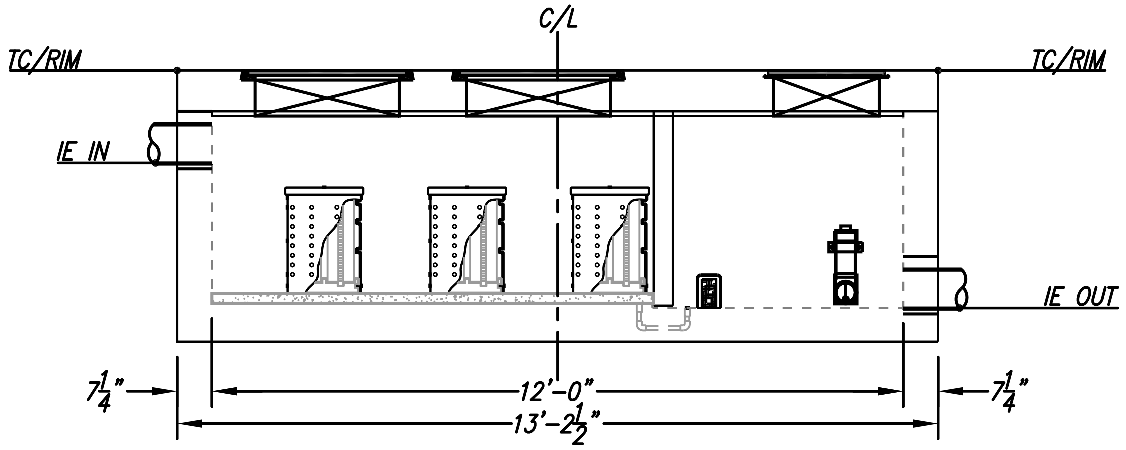

PATENTED PERIMETER VOID AREA
C/L
WETLANDMEDIA BED
VERTICAL UNDERDRAIN MANIFOLD
C/L
PRE-FILTER CARTRIDGE
OUTLET PIPE SEE NOTES
INLET PIPE SEE NOTES
DRAIN DOWN FILTER
DRAIN DOWN LINE

PLAN VIEW

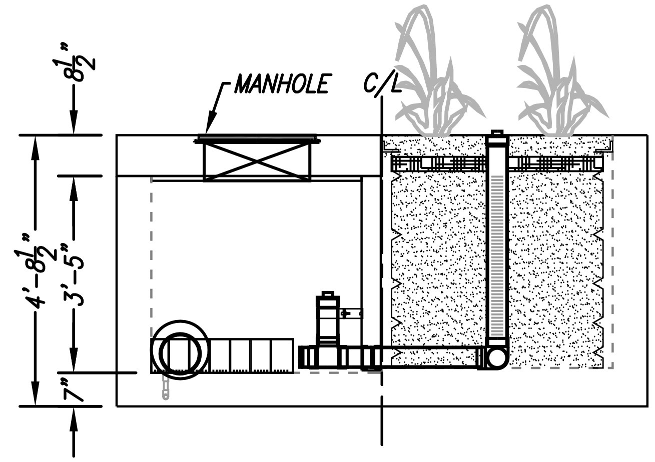

VEGETATION
PLANT ESTABLISHMENT MEDIA
C/L
MANHOLE
4'-0 1/2"
8"
6" MIN. BASE
7 1/4"
8'-0"
9'-2 1/2"
7 1/4"

LEFT END VIEW

BIOFILTRATION/PRETREATMENT


C/L
TC/RIM
TC/RIM
IE IN
IE OUT
7 1/4"
12'-0"
13'-2 1/2"
7 1/4"

ELEVATION VIEW


8 1/2"
MANHOLE
C/L
4'-8 1/2"
3'-5"
7"

RIGHT END VIEW

DISCHARGE/BIOFILTRATION

INSTALLATION NOTES

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURERS CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE TO VERIFY PROJECT ENGINEERS RECOMMENDED BASE SPECIFICATIONS.
3. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE. (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL GAPS AROUND PIPES SHALL BE SEALED WATER TIGHT WITH A NON-SHRINK GROUT PER MANUFACTURERS STANDARD CONNECTION DETAIL AND SHALL MEET OR EXCEED REGIONAL PIPE CONNECTION STANDARDS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. DRIP OR SPRAY IRRIGATION REQUIRED ON ALL UNITS WITH VEGETATION.

GENERAL NOTES

1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT MANUFACTURER.

TREATMENT FLOW (CFS)	0.346
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	TBD
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

THE PRODUCT DESCRIBED MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING US PATENTS: 7,425,262; 7,470,362; 7,674,378; 8,303,816; RELATED FOREIGN PATENTS OR OTHER PATENTS PENDING

PROPRIETARY AND CONFIDENTIAL:

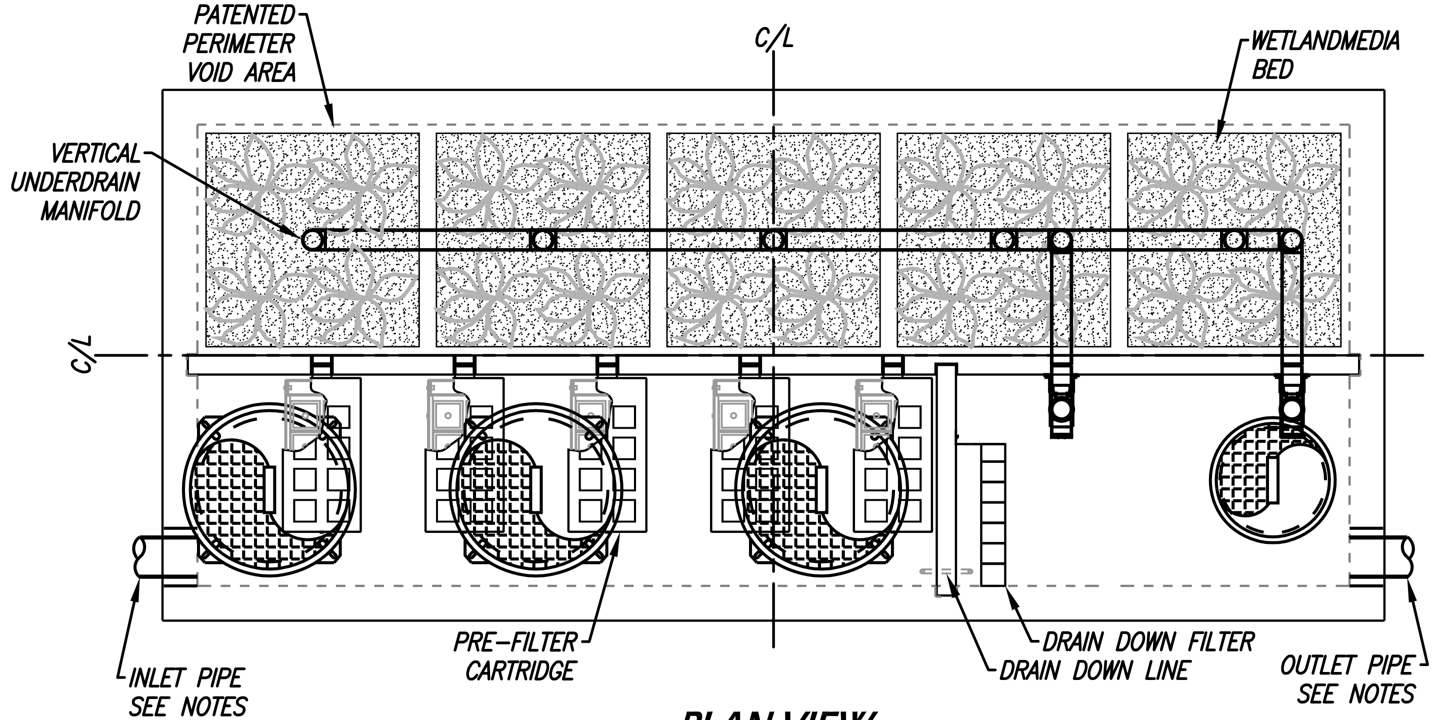
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF MODULAR WETLANDS SYSTEMS. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF MODULAR WETLANDS SYSTEMS IS PROHIBITED.

MODULAR WETLANDS
www.ModularWetlands.com | (855) 5MOD-WET

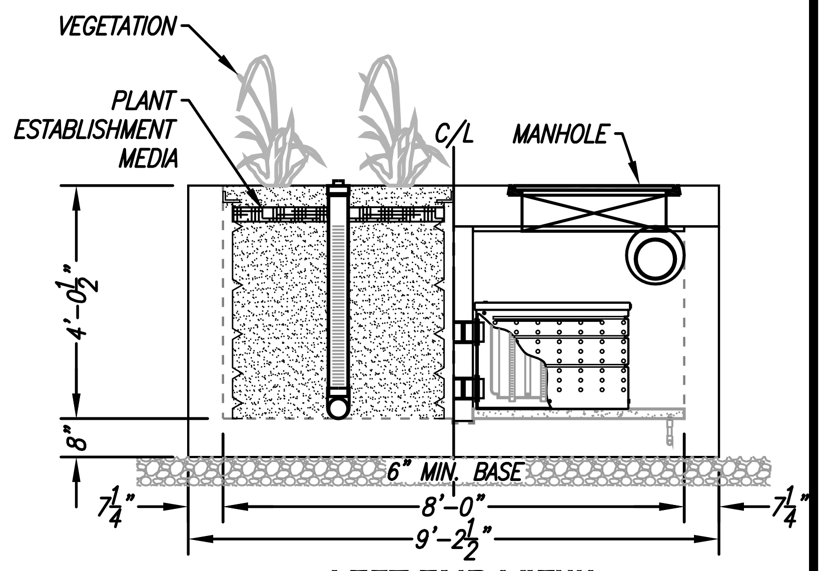
MWS-L-8-12-V
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

SITE SPECIFIC DATA

PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
TREATMENT HGL AVAILABLE (FT)			
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PARKWAY	OPEN PLANTER	PARKWAY
FRAME & COVER	ø30"	N/A	ø24"
WETLANDMEDIA VOLUME (CY)			11.85
WETLANDMEDIA DELIVERY METHOD			TBD
ORIFICE SIZE (DIA. INCHES)			ø2.43"
MAXIMUM PICK WEIGHT (LBS)			TBD
NOTES:			

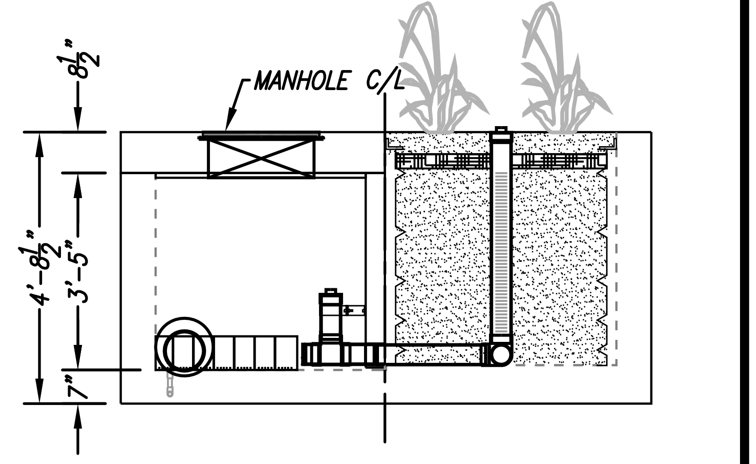

PATENTED PERIMETER VOID AREA
C/L
WETLANDMEDIA BED
VERTICAL UNDERDRAIN MANIFOLD
C/L
INLET PIPE SEE NOTES
PRE-FILTER CARTRIDGE
DRAIN DOWN FILTER
DRAIN DOWN LINE
OUTLET PIPE SEE NOTES

PLAN VIEW


VEGETATION
PLANT ESTABLISHMENT MEDIA
C/L
MANHOLE
4'-0½"
8"
6" MIN. BASE
7¼"
8'-0"
9'-2½"
7¼"

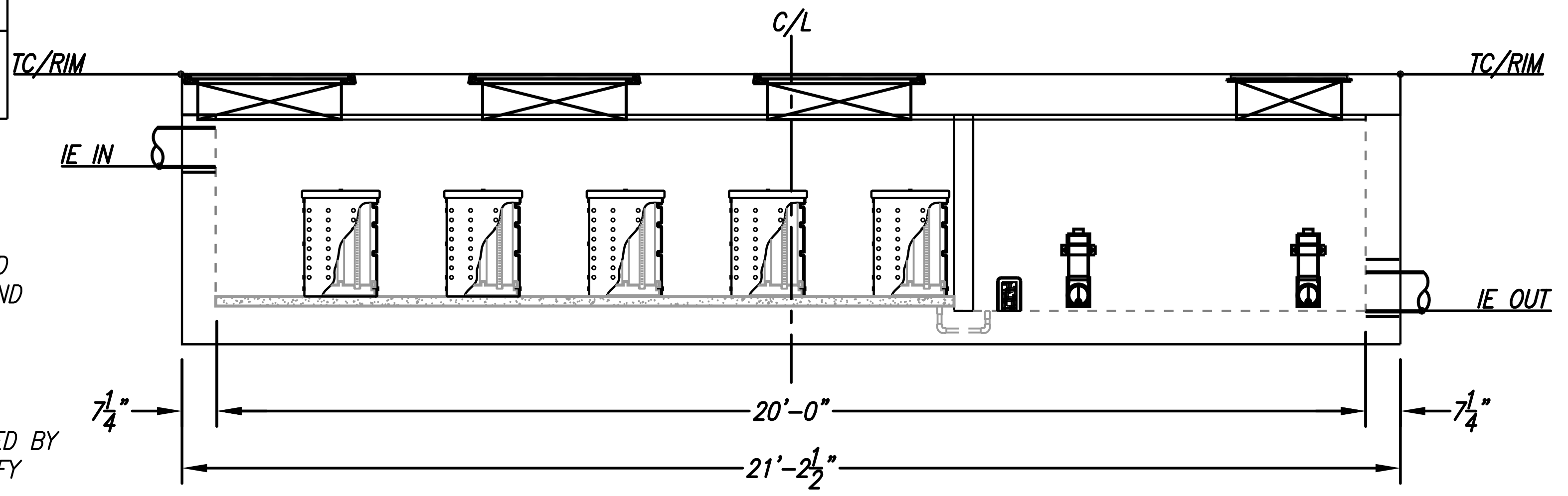
LEFT END VIEW

BIOFILTRATION/PRETREATMENT


8½"
MANHOLE
C/L
4'-8½"
3'-5"
7"

RIGHT END VIEW

DISCHARGE/BIOFILTRATION


C/L
TC/RIM
TC/RIM
IE IN
IE OUT
7¼"
20'-0"
7¼"
21'-2½"

ELEVATION VIEW

INSTALLATION NOTES

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURERS CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE TO VERIFY PROJECT ENGINEERS RECOMMENDED BASE SPECIFICATIONS.
3. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE. (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL GAPS AROUND PIPES SHALL BE SEALED WATER TIGHT WITH A NON-SHRINK GROUT PER MANUFACTURERS STANDARD CONNECTION DETAIL AND SHALL MEET OR EXCEED REGIONAL PIPE CONNECTION STANDARDS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. DRIP OR SPRAY IRRIGATION REQUIRED ON ALL UNITS WITH VEGETATION.

GENERAL NOTES

1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT MANUFACTURER.

6/2/15JOHN

TREATMENT FLOW (CFS)	0.577
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	TBD
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

THE PRODUCT DESCRIBED MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING US PATENTS: 7,425,262; 7,470,362; 7,674,378; 8,303,816; RELATED FOREIGN PATENTS OR OTHER PATENTS PENDING

PROPRIETARY AND CONFIDENTIAL:

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF MODULAR WETLANDS SYSTEMS. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF MODULAR WETLANDS SYSTEMS IS PROHIBITED.

MODULAR WETLANDS
www.ModularWetlands.com | (855) 5MOD-WET

MWS-L-8-20-V
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

MODULAR CONCRETE
STORMWATER MANAGEMENT

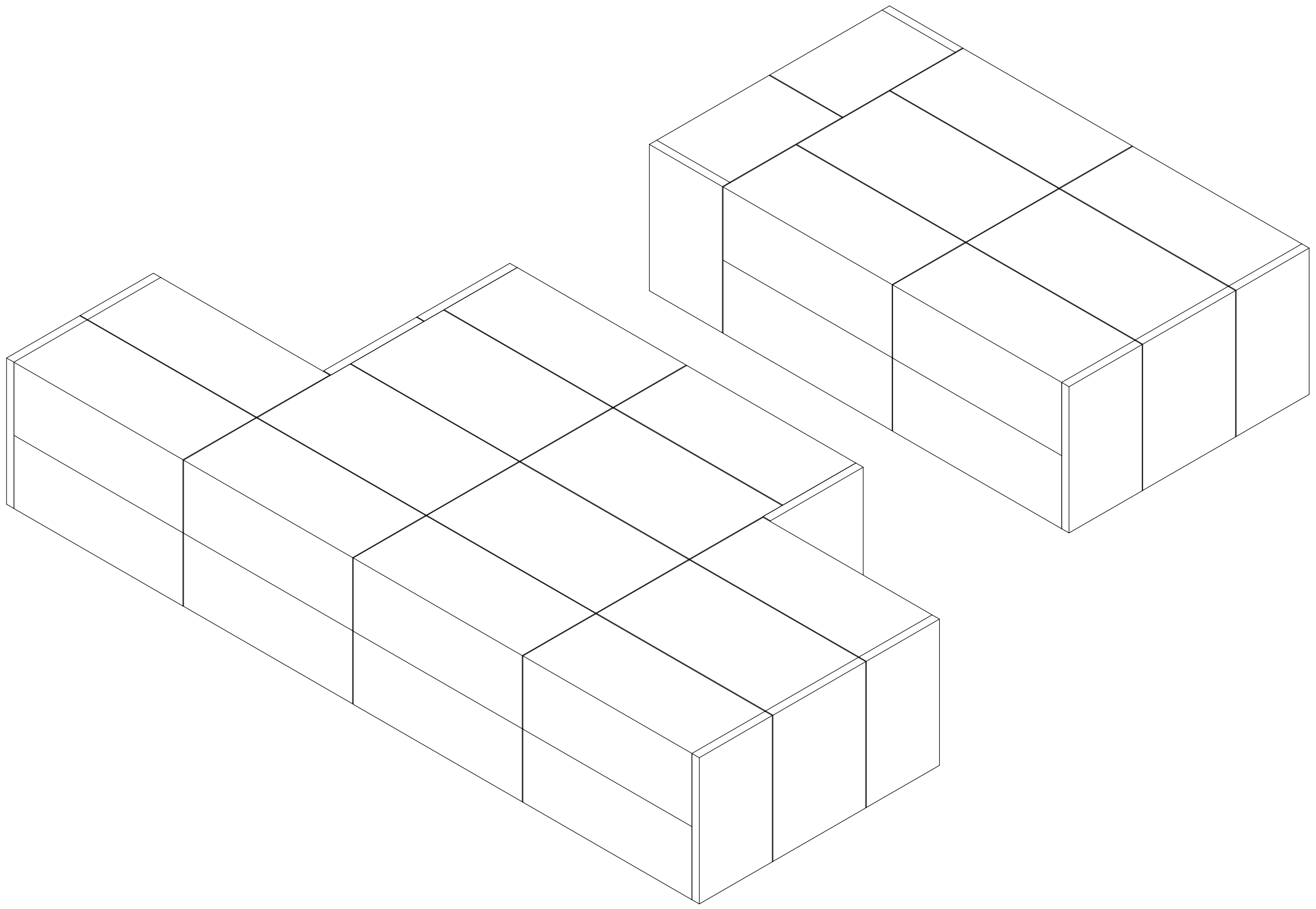
THE STORMTRAP DRAWINGS SHALL NOT BE ALTERED OR MANIPULATED IN WHOLE OR IN PART WITHOUT WRITTEN CONSENT OF STORMTRAP. USE OF THESE DRAWINGS IS STRICTLY GRANTED TO YOU, OUR CLIENT, FOR THE SPECIFIED AND NAMED PROJECT ONLY. THESE DRAWINGS ARE FOR YOUR REFERENCE ONLY AND SHALL NOT BE USED FOR MANUFACTURING PURPOSES.

SHEET INDEX

PAGE	DESCRIPTION
0.0	COVER SHEET
1.0	GENERAL NOTES
1.1	DOUBLETRAP DESIGN CRITERIA
2.0	DOUBLETRAP SYSTEM LAYOUT
3.0	DOUBLETRAP INSTALLATION SPECIFICATION
3.1	DOUBLETRAP INSTALLATION SPECIFICATION
4.0	DOUBLETRAP BACKFILL SPECIFICATION
5.0	PIPE / ACCESS OPENING SPECIFICATION
6.0	DOUBLETRAP MODULE TYPES

STORMTRAP CONTACT INFORMATION

STORMTRAP SUPPLIER:	STORMTRAP
CONTACT NAME:	Charlie Carter
CELL PHONE:	(760) 212-5628
SALES EMAIL:	ccarter@stormtrap.com



Freedom Lane
Aliso Viejo, CA

PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]

1287 WINDHAM PARKWAY
ROMEOVILLE, IL 60446
P:815-941-4549 / F:331-318-5347

ENGINEER INFORMATION:

X Engineering
6 Hutton Centre Dr.
#650
Santa Ana, CA 92707
949-522-7100

PROJECT INFORMATION:

Freedom Lane

Aliso Viejo, CA

CURRENT ISSUE DATE:

10/16/2025

ISSUED FOR:

PRELIMINARY

REV.	DATE:	ISSUED FOR:	DWN BY:
△1	10/16/2025	PRELIMINARY	DG

SCALE:

NTS

SHEET TITLE:

COVER SHEET

SHEET NUMBER:

0.0

GENERAL NOTES:

1. STRUCTURE PROXIMITY LOADING DISCLAIMER:

STORMTRAP MODULES AND FOUNDATION ARE NOT DESIGNED TO ACCEPT ANY ADDITIONAL LOADING FROM ANY NEARBY STRUCTURES NEXT TO OR OVER THE TOP OF STORMTRAP. EXAMPLES OF NEARBY STRUCTURES MAY INCLUDE BUT ARE NOT LIMITED TO BUILDINGS, FOUNDATION ELEMENTS, RETAINING WALLS, LIGHT POLES, BOLLARDS, SIGNPOSTS, FENCES. ADDITIONALLY, STORMTRAP IS NOT RESPONSIBLE FOR INSTALLATION CONFLICTS ARISING FROM ANY OF THESE NEARBY STRUCTURES. IF ADDITIONAL LOADING CONSIDERATIONS ARE REQUIRED FOR STRUCTURAL DESIGN OF STORMTRAP, PLEASE CONTACT STORMTRAP IMMEDIATELY. FOR LIGHT POLES SHOWN OVER THE TOP OF THE SYSTEM, STORMTRAP WILL PROVIDE A 5'–0" LATERAL DISTANCE CAVITY AROUND THE LIGHT POLE TO ACCOMMODATE IT. THE EOR TO TAKE RESPONSIBILITY FOR ENSURING THE LIGHT POLE IS NOT INFLICTING ANY LOADING ON THE STORMTRAP MODULES AND FOUNDATION.

2. TREE LOADING DISCLAIMER:

THE NUMBER OF TREES OR WEIGHT OF TOTAL PLANT MATERIAL PRESENT ON TOP OF A SINGLE STORMTRAP MODULE SHALL NOT EXCEED 16,000 LBS. THE REQUIREMENTS LISTED HERE APPLY AT BOTH THE TIME OF INSTALLATION AND FOR THE LIFE OF THE TREES AND PLANTS IN QUESTION. THE EOR AND LANDSCAPE ARCHITECT ARE RESPONSIBLE FOR ENSURING THAT TREE AND OTHER PLANT ROOTS DO NOT INTERFERE WITH OR COMPROMISE THE FUNCTIONAL AND STRUCTURAL INTEGRITY OF STORMTRAP'S UNDERGROUND MODULES. APPROPRIATE MEASURES SHOULD BE TAKEN TO PREVENT ROOT GROWTH INTO THE STORMTRAP SYSTEM FROM ADJACENT OR OVERHEAD TREES. FURTHERMORE, THE ROOTS OF THE TREES MUST BE CONTAINED TO PREVENT FUTURE DAMAGE TO THE STORMTRAP SYSTEM. STORMTRAP ACCEPTS NO LIABILITY FOR DAMAGES CAUSED BY TREES OR OTHER VEGETATION PLACED AROUND OR ON TOP OF THE SYSTEM.

3. PRE–TREATMENT/SEDIMENT/FILTER CHAMBER DISCLAIMER:

FOR SYSTEMS CONTAINING PRE–TREATMENT, SEDIMENTATION AND/OR FILTER CHAMBERS; IF REQUIRED TO BE SEALED TO PREVENT SAND AND/OR PRE–TREATED WATER FROM MIGRATING INTO ADJOINING MODULES, IT IS THE SOLE RESPONSIBILITY OF THE INSTALLING CONTRACTOR TO ENSURE THAT THOSE MODULES ARE SEALED.

4. OUTLET CONTROL STRUCTURE DISCLAIMER (IF SHOWN ON THESE PLANS):

IF A WATERTIGHT SOLUTION IS REQUIRED FOR AN OUTLET CONTROL STRUCTURE, ALL EXTERIOR COLD JOINTS, INCLUDING JOINT BETWEEN TOP AND BASE MODULES, BETWEEN TOP AND BASE OF ADJOINING SYMONS WALLS, AND JOINTS BETWEEN MODULE AND ADJACENT END PANELS WILL BE THE SOLE RESPONSIBILITY OF THE INSTALLING CONTRACTOR TO PROVIDE AND INSTALL THE WATERTIGHT APPLICATION PER THE EOR'S SPECIFICATION.

StormTrap®

PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]

1287 WINDHAM PARKWAY
ROMEOVILLE, IL 60446
P:815–941–4549 / F:331–318–5347

ENGINEER INFORMATION:

X Engineering
6 Hutton Centre Dr.
#650
Santa Ana, CA 92707
949–522–7100

PROJECT INFORMATION:

Freedom Lane

Aliso Viejo, CA

CURRENT ISSUE DATE:

10/16/2025

ISSUED FOR:

PRELIMINARY

REV.	DATE:	ISSUED FOR:	DWN BY:
△1	10/16/2025	PRELIMINARY	DG

SCALE:

NTS

SHEET TITLE:

GENERAL NOTES

SHEET NUMBER:

1.0

STRUCTURAL DESIGN LOADING CRITERIA

LIVE LOADING: AASHTO HS-20 HIGHWAY LOADING

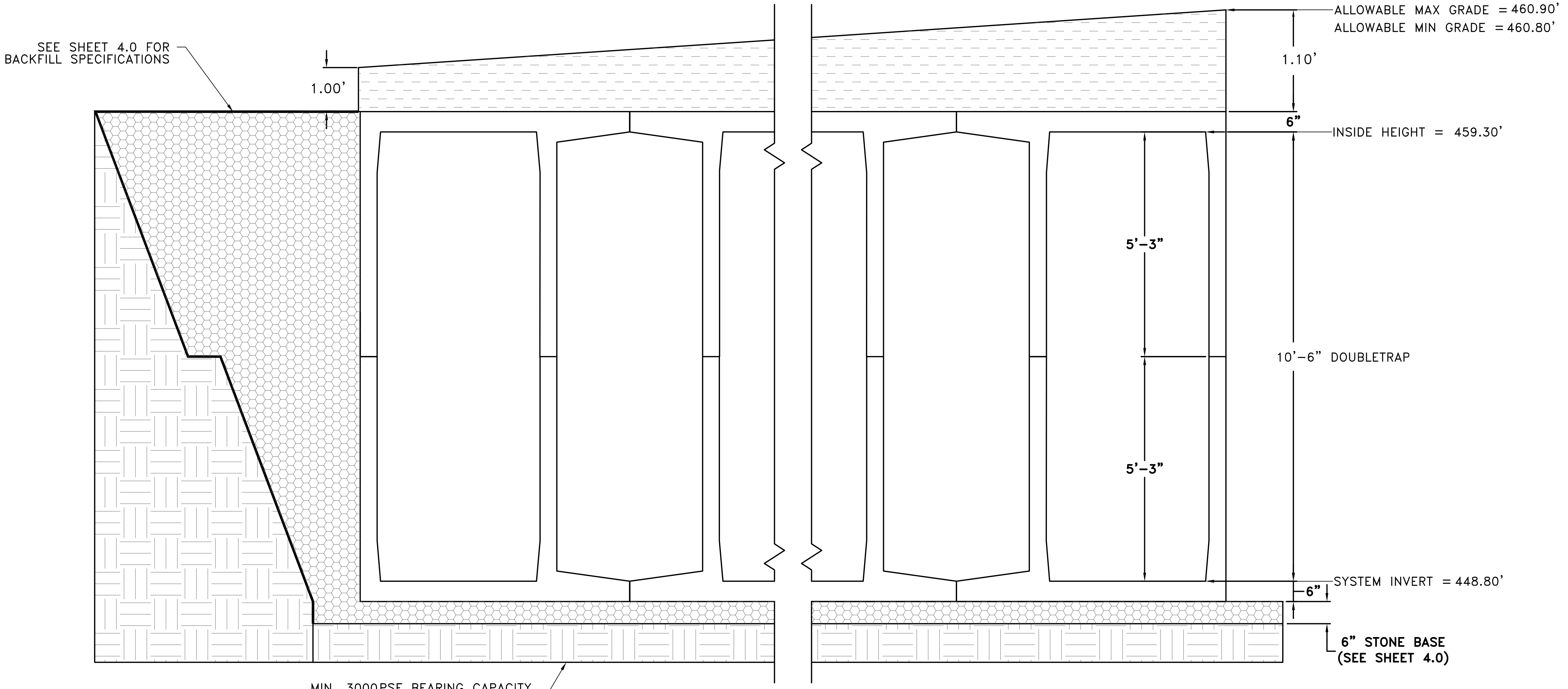
GROUND WATER TABLE: BELOW INVERT OF SYSTEM
SOIL BEARING PRESSURE: 3000PSF
SOIL DENSITY: 120 PCF
EQUIVALENT UNSATURATED LATERAL ACTIVE EARTH PRESSURE: 35 PSF / FT.
EQUIVALENT SATURATED LATERAL ACTIVE EARTH PRESSURE: 80 PSF/FT. (IF WATER TABLE PRESENT)
APPLICABLE CODES: ASTM C857
ACI-318
BACKFILL TYPE: SEE SHEET 4.0 FOR BACKFILL OPTIONS

STORMTRAP SYSTEM INFORMATION

UNIT HEADROOM: 10'-6" DOUBLETRAP
TOTAL STORAGE PROV: 21,677.95 CUBIC FEET

SITE SPECIFIC DESIGN CRITERIA

1. STORMTRAP UNITS SHALL BE MANUFACTURED AND INSTALLED ACCORDING TO SHOP DRAWINGS APPROVED BY THE INSTALLING CONTRACTOR AND ENGINEER OF RECORD. THE SHOP DRAWINGS SHALL INDICATE SIZE AND LOCATION OF ROOF OPENINGS AND INLET/OUTLET PIPE TYPES, SIZES, INVERT ELEVATIONS AND SIZE OF OPENINGS.
2. COVER RANGE: MIN. 1.00' MAX. 1.10' CONSULT STORMTRAP FOR ADDITIONAL COVER OPTIONS.
3. ALL DIMENSIONS AND SOIL CONDITIONS, INCLUDING BUT NOT LIMITED TO GROUNDWATER AND SOIL BEARING CAPACITY ARE REQUIRED TO BE VERIFIED IN THE FIELD BY OTHERS PRIOR TO STORMTRAP INSTALLATION.
4. FOR STRUCTURAL CALCULATIONS THE GROUND WATER TABLE IS ASSUMED TO BE BELOW INVERT OF SYSTEM IF WATER TABLE IS DIFFERENT THAN ASSUMED, CONTACT STORMTRAP.
5. SYSTEM DESIGN MAY ALLOW FOR INCIDENTAL LEAKAGE AND WILL NOT BE SUBJECT TO LEAKAGE TESTING.


SEE SHEET 4.0 FOR BACKFILL SPECIFICATIONS
1.00'
ALLOWABLE MAX GRADE = 460.90'
ALLOWABLE MIN GRADE = 460.80'
1.10'
6"
INSIDE HEIGHT = 459.30'
5'-3"
10'-6" DOUBLETRAP
5'-3"
SYSTEM INVERT = 448.80'
6"
6" STONE BASE (SEE SHEET 4.0)
MIN. 3000PSF BEARING CAPACITY TO BE VERIFIED IN FIELD BY OTHERS

10'-6" DOUBLETRAP

StormTrap®
PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]

1287 WINDHAM PARKWAY
ROMEOVILLE, IL 60446
P:815-941-4549 / F:331-318-5347

ENGINEER INFORMATION:

X Engineering
6 Hutton Centre Dr.
#650
Santa Ana, CA 92707
949-522-7100

PROJECT INFORMATION:

Freedom Lane

Aliso Viejo, CA

CURRENT ISSUE DATE:

10/16/2025

ISSUED FOR:

PRELIMINARY

REV.	DATE:	ISSUED FOR:	DWN BY:
△1	10/16/2025	PRELIMINARY	DG

SCALE:

NTS

SHEET TITLE:

DOUBLETRAP
DESIGN
CRITERIA

SHEET NUMBER:

1.1

BILL OF MATERIALS

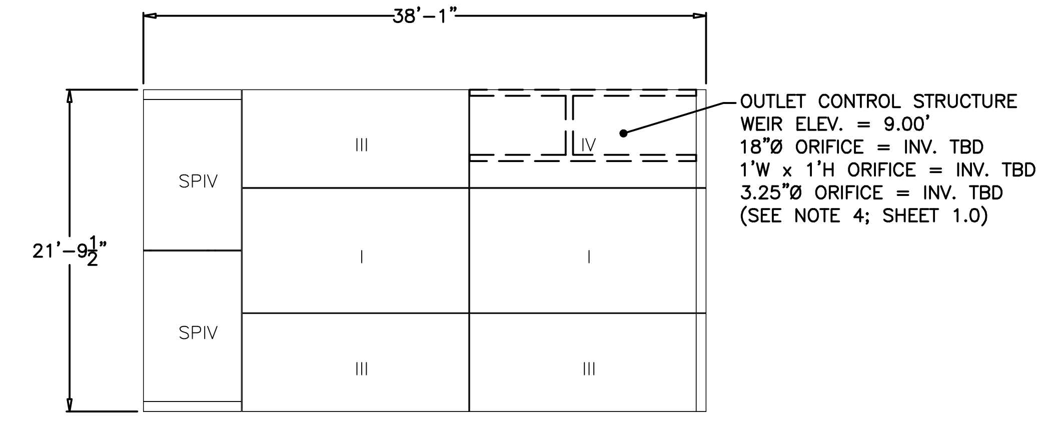
QTY.	UNIT TYPE	DESCRIPTION	TOP WEIGHT	BASE WEIGHT
7	I	10'–6" DOUBLETRAP	15646	15444
0	II	10'–6" DOUBLETRAP	–	–
11	III	10'–6" DOUBLETRAP	15728	15627
1	IV	10'–6" DOUBLETRAP	17018	16917
0	VII	10'–6" DOUBLETRAP	–	–
0	VII–1	10'–6" DOUBLETRAP	–	–
0	VII–2	10'–6" DOUBLETRAP	–	–
0	VII–3	10'–6" DOUBLETRAP	–	–
0	VII–4	10'–6" DOUBLETRAP	–	–
0	SPIII	10'–6" DOUBLETRAP	VARIES	VARIES
2	SPIV	10'–6" DOUBLETRAP	VARIES	VARIES
5	T2 PANEL	8" THICK PANEL	9679	
8	T4 PANEL	8" THICK PANEL	7618	
0	T7 PANEL	8" THICK PANEL	–	
7	JOINT WRAP	150' PER ROLL		
32	JOINT TAPE	14.5' PER ROLL		
TOTAL PIECES = 42				
TOTAL PANELS = 13				
HEAVIEST PICK WEIGHT = 17018				

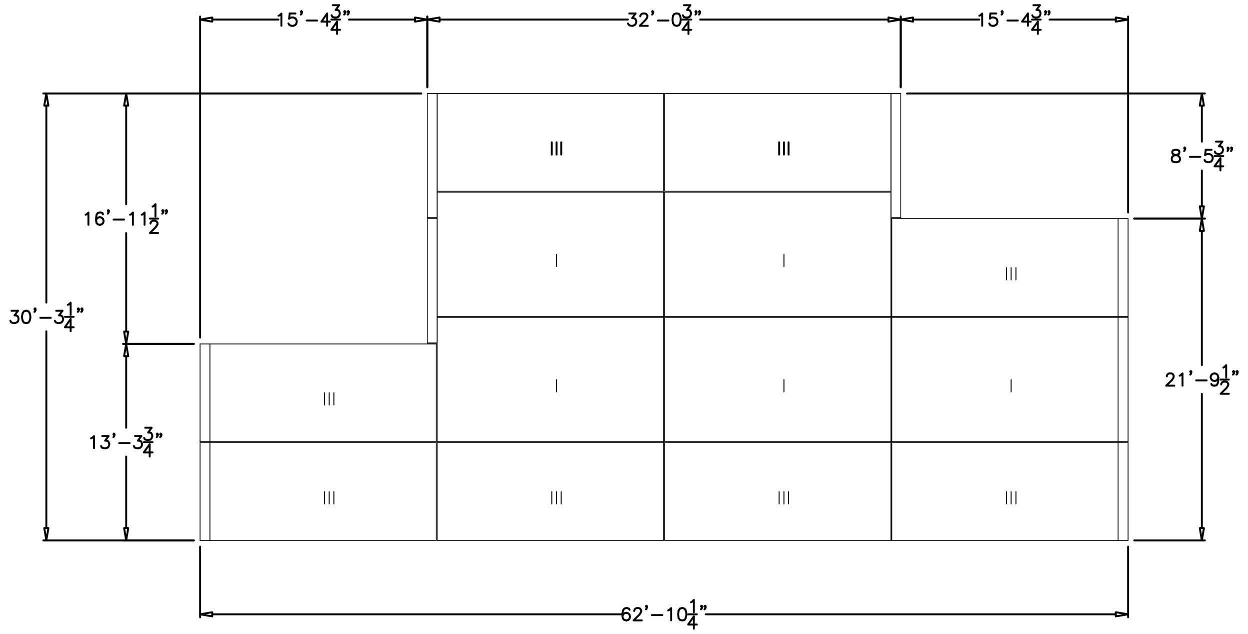
DESIGN CRITERIA

ALLOWABLE MAX GRADE = 460.90'
ALLOWABLE MIN GRADE = 460.80'
INSIDE HEIGHT ELEVATION = 459.30'
SYSTEM INVERT = 448.80'

NOTES:

1. DIMENSIONING OF STORMTRAP SYSTEM SHOWN BELOW ALLOW FOR A 3/4" GAP BETWEEN EACH MODULE.
2. ALL DIMENSIONS TO BE VERIFIED IN THE FIELD BY OTHERS.
3. SEE SHEET 3.0 FOR INSTALLATION SPECIFICATIONS.
4. SP – INDICATES A MODULE WITH MODIFICATIONS.
5. P – INDICATES A MODULE WITH A PANEL ATTACHMENT.
6. CONTRACTORS RESPONSIBILITY TO ENSURE CONSISTENCY/ACCURACY TO FINAL ENGINEER OF RECORD PLAN SET.
7. IN ORDER FOR STORMTRAP TO GENERATE APPROVAL DRAWINGS, CIVIL ENGINEERING DRAWINGS MUST BE PROVIDED TO STORMTRAP AND SHALL INCLUDE ALL PIPE SIZES, PIPE MATERIAL, PIPE INVERT ELEVATIONS, ACCESS OPENING SIZE AND SHAPE. IN ADDITION, FINAL GRADING PLANS SHALL ALSO INCLUDE MINIMUM AND MAXIMUM GRADES OVER THE TOP OF THE STORMTRAP SYSTEM.


N
38'–1"
21'–9½"
SPIV
SPIV
III
I
III
IV
I
III
OUTLET CONTROL STRUCTURE
WEIR ELEV. = 9.00'
18"Ø ORIFICE = INV. TBD
1'W x 1'H ORIFICE = INV. TBD
3.25"Ø ORIFICE = INV. TBD
(SEE NOTE 4; SHEET 1.0)


15'–4¾"
32'–0¾"
15'–4¾"
16'–11½"
30'–3¼"
13'–3¾"
8'–5¾"
21'–9½"
62'–10¼"
III
III
I
I
III
III
I
I
I
III
III
III
III
III

StormTrap®

PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]

1287 WINDHAM PARKWAY
ROMEOVILLE, IL 60446
P:815–941–4549 / F:331–318–5347

ENGINEER INFORMATION:

X Engineering
6 Hutton Centre Dr.
#650
Santa Ana, CA 92707
949–522–7100

PROJECT INFORMATION:

Freedom Lane

Aliso Viejo, CA

CURRENT ISSUE DATE:

10/16/2025

ISSUED FOR:

PRELIMINARY

REV.	DATE:	ISSUED FOR:	DWN BY:
1	10/16/2025	PRELIMINARY	DG

SCALE:

NTS

SHEET TITLE:

DOUBLETRAP
SYSTEM LAYOUT

SHEET NUMBER:

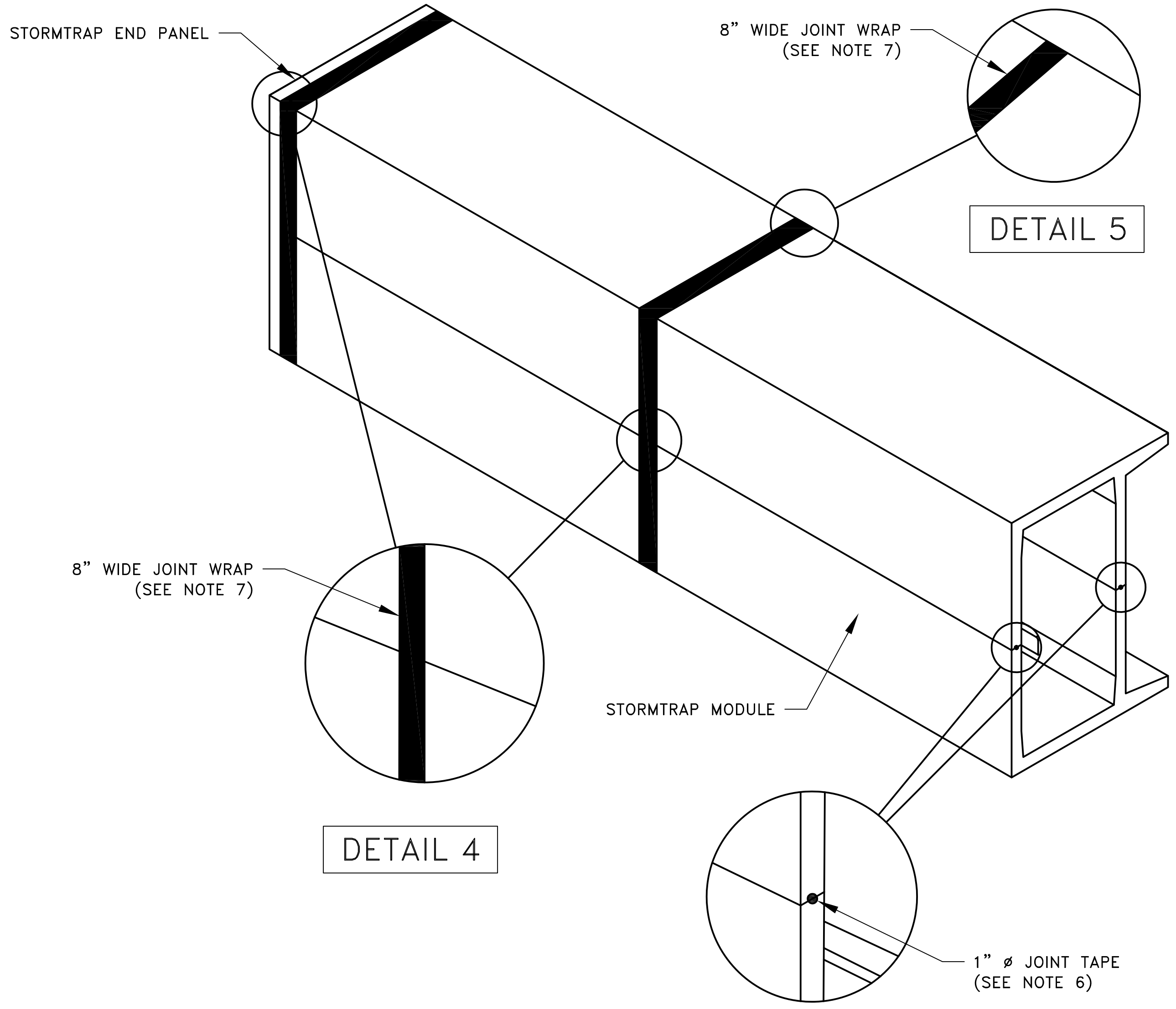
2.0

STORMTRAP INSTALLATION SPECIFICATION

1. STORMTRAP SHALL BE INSTALLED IN ACCORDANCE WITH ASTM C891 (STANDARD PRACTICE FOR INSTALLATION OF UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURES). THE FOLLOWING ADDITIONS AND/OR EXCEPTIONS ARE PROVIDED FOR EMPHASIS. THE MENTION OF THESE ITEMS DOES NOT PRECLUDE THE INSTALLING CONTRACTOR FROM FOLLOWING ASTM C891 IN ITS ENTIRETY AND IMPLEMENTING ALL APPROPRIATE MEASURES. THE INSTALLING CONTRACTOR OWNS AND IS RESPONSIBLE FOR THE STORMTRAP SYSTEM UPON REMOVAL OF THE MODULES FROM THE DELIVERY TRUCK THROUGH 'FINAL CONSTRUCTION'. FINAL CONSTRUCTION IS ACHIEVED WHEN ALL MODULES ARE SET, FULLY BACKFILLED, AND WHEN FINAL FINISHED GRADES ARE REACHED. THE CONTRACTOR IS RESPONSIBLE FOR ANY COUNTERMEASURES NECESSARY TO RESIST UPLIFT/BUOYANCY BEFORE 'FINAL CONSTRUCTION' IS ACHIEVED.
2. IT IS THE RESPONSIBILITY OF THE INSTALLING CONTRACTOR TO ENSURE THAT PROPER/ADEQUATE EQUIPMENT IS USED TO SET/INSTALL THE MODULES.
3. STORMTRAP MODULES SHALL BE PLACED ON A LEVEL, 6" FOUNDATION OF ¾" AGGREGATE EXTENDING 2'-0" PAST THE OUTSIDE OF THE SYSTEM (SEE DETAIL 1) AND SHALL BE PLACED ON PROPERLY COMPACTED SOILS (SEE SHEET 1.1 FOR SOIL BEARING CAPACITY REQUIREMENTS), AND IN ACCORDANCE WITH ASTM C891 STANDARD PRACTICE FOR INSTALLATION OF UNDERGROUND PRECAST UTILITY STRUCTURES.
4. THE STORMTRAP MODULES SHALL BE PLACED SUCH THAT THE MAXIMUM SPACE BETWEEN ADJACENT MODULES DOES NOT EXCEED ¾" (SEE DETAIL 2). IF THE SPACE EXCEEDS ¾", THE MODULES SHALL BE RESET WITH APPROPRIATE ADJUSTMENT MADE TO LINE AND GRADE TO BRING THE SPACE INTO SPECIFICATION.
5. STORMTRAP MODULES ARE NOT WATERTIGHT.
6. THE HORIZONTAL JOINT BETWEEN THE TOP AND BASE LEG CONNECTIONS OF ALL PERIMETER STORMTRAP MODULES SHALL BE SEALED WITH PREFORMED MASTIC JOINT TAPE ACCORDING TO ASTM C891, 8.8 AND 8.12. (SEE DETAIL 3). THE MASTIC JOINT TAPE DOES NOT PROVIDE A WATERTIGHT SEAL.
7. ALL EXTERIOR ROOF AND EXTERIOR VERTICAL WALL JOINTS BETWEEN ADJACENT STORMTRAP MODULES SHALL BE SEALED WITH 8" WIDE PRE-FORMED, COLD-APPLIED, SELF-ADHERING ELASTOMERIC RESIN, BONDED TO A WOVEN , HIGHLY PUNCTURE RESISTANT POLYMER WRAP, CONFORMING TO ASTM C891 AND SHALL BE INTEGRATED WITH PRIMER SEALANT AS APPROVED BY STORMTRAP (SEE DETAILS 2, 4, & 5). THE JOINT WRAP DOES NOT PROVIDE A WATERTIGHT SEAL. THE SOLE PURPOSE OF THE JOINT WRAP IS TO PROVIDE A SILT AND SOIL TIGHT SYSTEM. THE ADHESIVE EXTERIOR JOINT WRAP SHALL BE INSTALLED ACCORDING TO THE FOLLOWING INSTALLATION INSTRUCTIONS:

   7.1. USE A BRUSH OR WET CLOTH TO THOROUGHLY CLEAN THE OUTSIDE SURFACE AT THE POINT WHERE JOINT WRAP IS TO BE APPLIED.

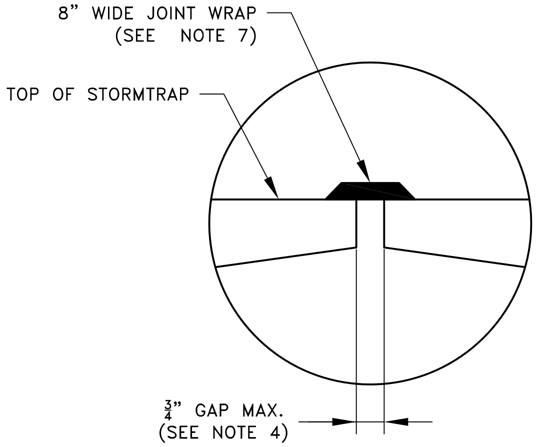
   7.2. A RELEASE PAPER PROTECTS THE ADHESIVE SIDE OF THE JOINT WRAP. PLACE THE ADHESIVE TAPE (ADHESIVE SIDE DOWN) AROUND THE STRUCTURE, REMOVING THE RELEASE PAPER AS YOU GO. PRESS THE JOINT WRAP FIRMLY AGAINST THE STORMTRAP MODULE SURFACE WHEN APPLYING.
8. IF THE CONTRACTOR NEEDS TO CANCEL ANY SHIPMENTS, THEY MUST DO SO 48 HOURS PRIOR TO THEIR SCHEDULED ARRIVAL AT THE JOB SITE. IF CANCELED AFTER THAT TIME, PLEASE CONTACT THE PROJECT MANAGER.
9. IF THE STORMTRAP MODULE(S) IS DAMAGED IN ANY WAY PRIOR, DURING, OR AFTER INSTALL, STORMTRAP MUST BE CONTACTED IMMEDIATELY TO ASSESS THE DAMAGE AND TO DETERMINE WHETHER OR NOT THE MODULE(S) WILL NEED TO BE REPLACED. IF ANY MODULE ARRIVES AT THE JOBSITE DAMAGED DO NOT UNLOAD IT; CONTACT STORMTRAP IMMEDIATELY. ANY DAMAGE NOT REPORTED BEFORE THE TRUCK IS UNLOADED WILL BE THE CONTRACTOR'S RESPONSIBILITY.
10. STORMTRAP MODULES CANNOT BE ALTERED IN ANY WAY AFTER MANUFACTURING WITHOUT WRITTEN CONSENT FROM STORMTRAP.



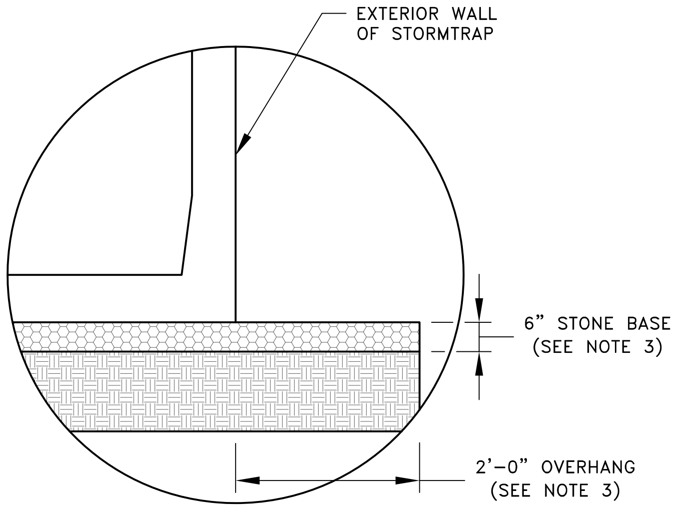
DETAIL 5

DETAIL 4

DETAIL 3



DETAIL 2



DETAIL 1

StormTrap®

PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]

1287 WINDHAM PARKWAY
ROMEOVILLE, IL 60446
P:815-941-4549 / F:331-318-5347

ENGINEER INFORMATION:

X Engineering
6 Hutton Centre Dr.
#650
Santa Ana, CA 92707
949-522-7100

PROJECT INFORMATION:

Freedom Lane

Aliso Viejo, CA

CURRENT ISSUE DATE:

10/16/2025

ISSUED FOR:

PRELIMINARY

REV.	DATE:	ISSUED FOR:	DWN BY:
1	10/16/2025	PRELIMINARY	DG

SCALE:

NTS

SHEET TITLE:

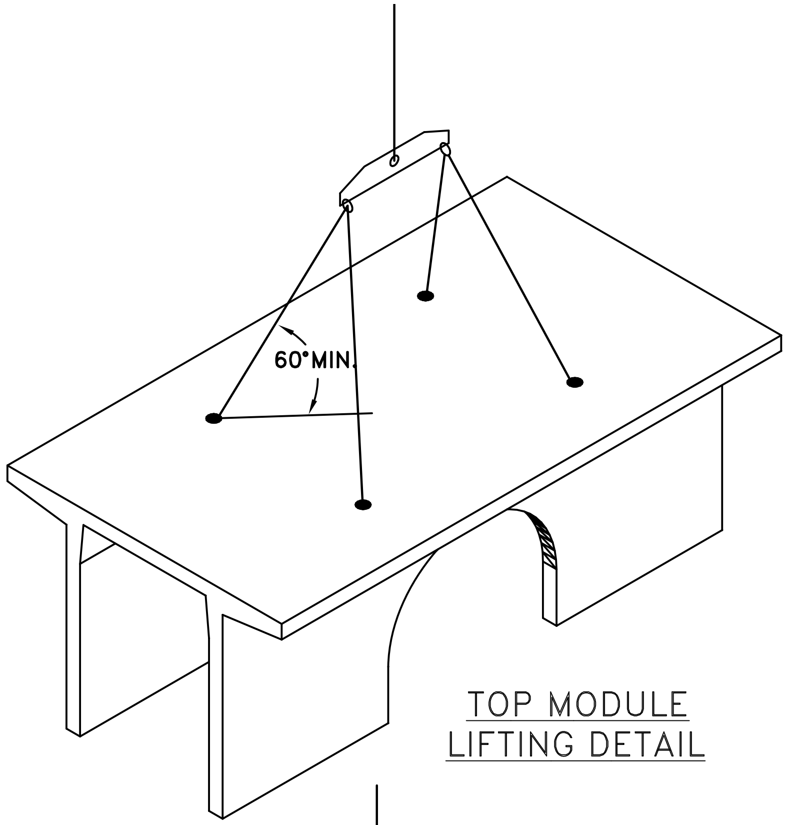
DOUBLETRAP
INSTALLATION
SPECIFICATION

SHEET NUMBER:

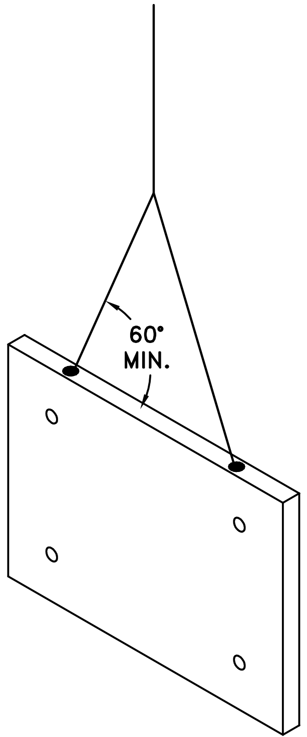
3.0

STORMTRAP MODULE LIFTING SPECIFICATION

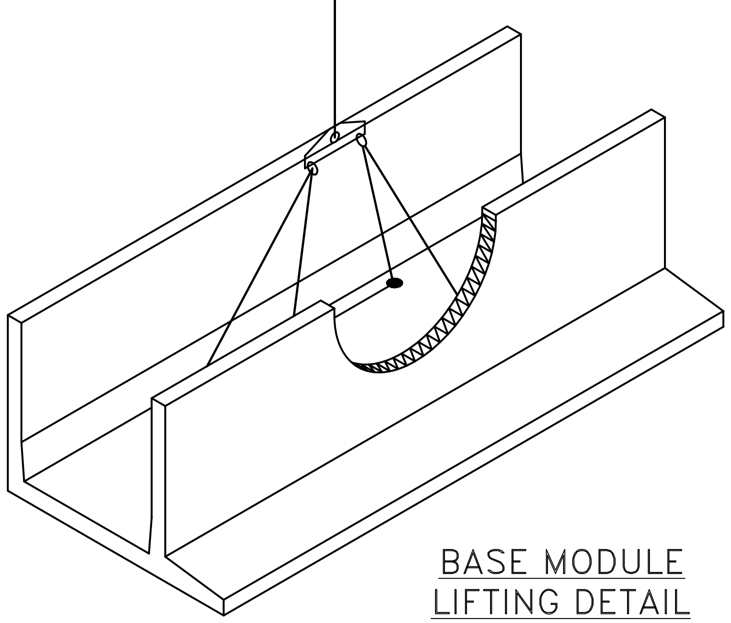
1. IT IS THE CONTRACTOR'S RESPONSIBILITY TO ENSURE THAT ALL (4) CHAINS/CABLES ARE SECURED PROPERLY TO THE LIFTING ANCHORS AND IN EQUAL TENSION WHEN LIFTING THE STORMTRAP MODULE.
2. MINIMUM 7'-0" CHAIN/CABLE LENGTH TO BE USED TO LIFT STORMTRAP MODULES (SUPPLIED BY CONTRACTOR).
3. CONTRACTOR TO ENSURE MINIMUM LIFTING ANGLE IS 60° FROM TOP SURFACE OF STORMTRAP MODULE. SEE DETAIL.
4. IT IS UNDERSTOOD AND AGREED THAT AT ALL TIMES DURING WHICH HOISTING AND RIGGING EQUIPMENT IS BEING SUPPLIED TO THE PURCHASER, OPERATOR OF SUCH EQUIPMENT SHALL BE IN CHARGE OF HIS ENTIRE EQUIPMENT AND SHALL AT ALL TIMES BE THE JUDGE OF THE SAFETY AND PROPERTY OF ANY SUGGESTION TO HIM FROM THE SELLER, ITS AGENTS OR EMPLOYEES. PURCHASER AGREES TO SAVE, INDEMNIFY AND HOLD HARMLESS SELLER FROM ALL LOSS, CLAIMS, DEMANDS OR CAUSES OF ACTION, WHICH MAY ARISE FROM THE EXISTENCE OR OPERATION OF SAID EQUIPMENT.



TOP MODULE LIFTING DETAIL



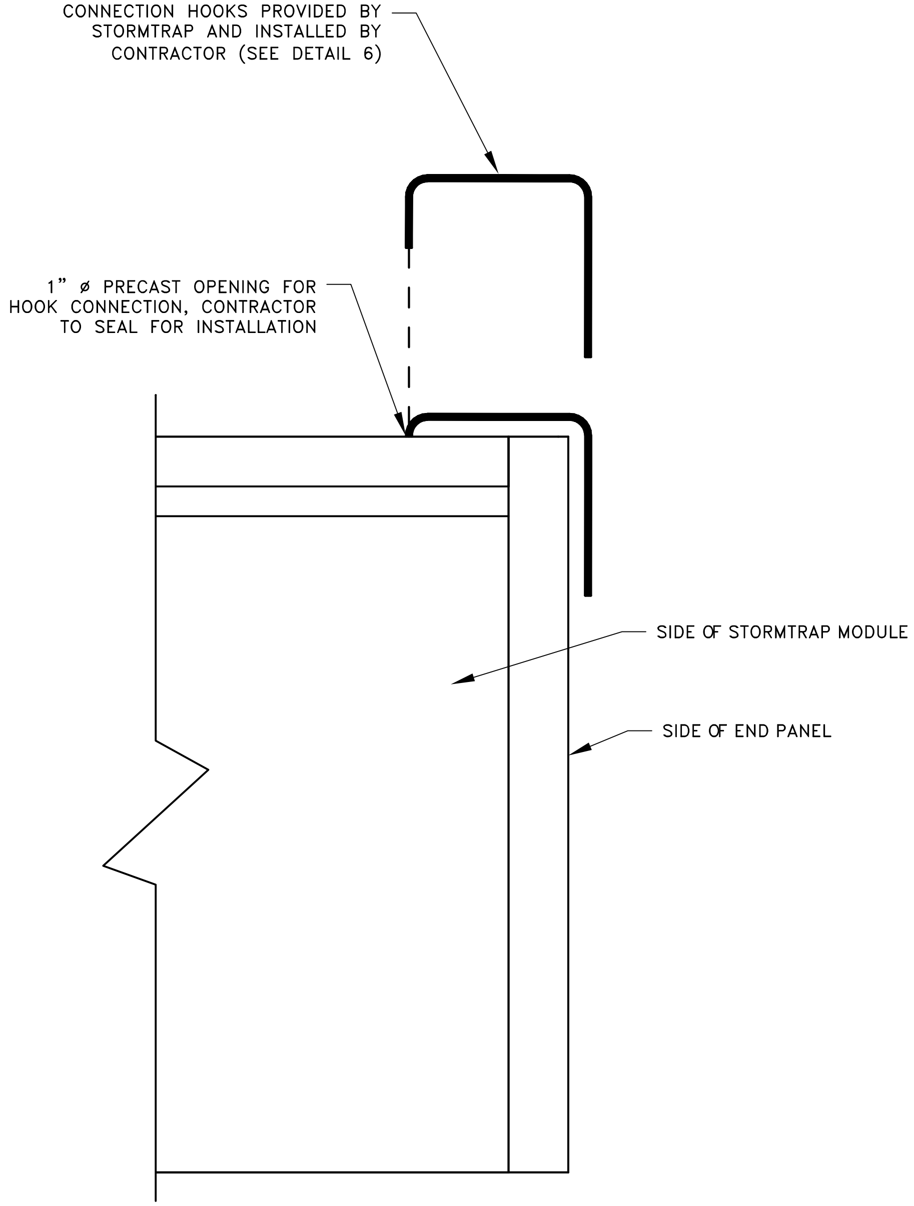
END PANEL LIFTING DETAIL



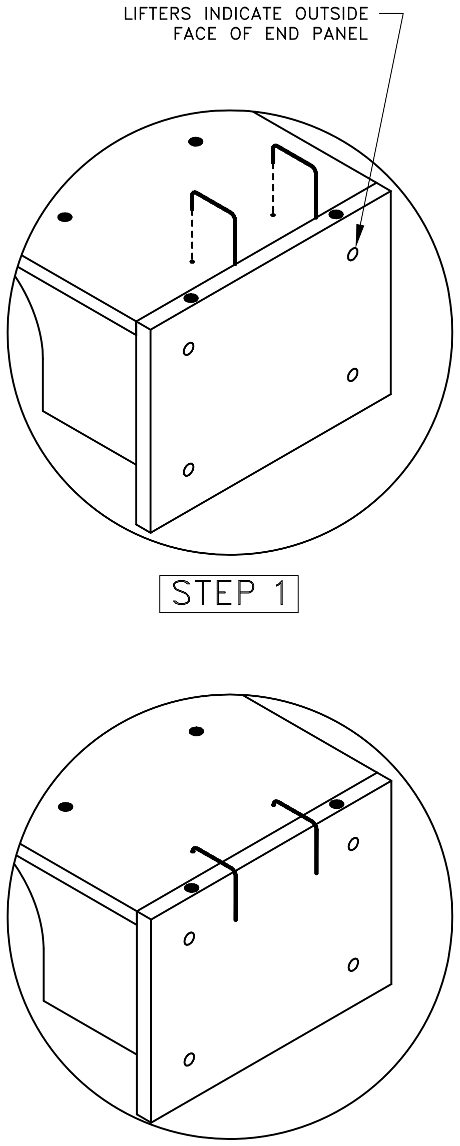
BASE MODULE LIFTING DETAIL

END PANEL ERECTION/INSTALLATION SPECIFICATION

1. END PANELS WILL BE SUPPLIED TO CLOSE OFF OPEN ENDS OF ROWS.
2. PANELS SHALL BE INSTALLED IN A TILT UP FASHION DIRECTLY ADJACENT TO OPEN END OF MODULE (REFER TO SHEET 2.0 FOR END PANEL LOCATIONS). SIDE WITH LIFTERS INDICATES OUTSIDE FACE.
3. CONNECTION HOOKS WILL BE SUPPLIED WITH END PANELS TO SECURELY CONNECT PANEL TO ADJACENT STORMTRAP MODULE (SEE PANEL CONNECTION ELEVATION VIEW).
4. ONCE CONNECTION HOOK IS ATTACHED, LIFTING CLUTCHES MAY BE REMOVED.
5. JOINT WRAP SHALL BE PLACED AROUND PERIMETER JOINT PANEL (SEE SHEET 3.0).


CONNECTION HOOKS PROVIDED BY STORMTRAP AND INSTALLED BY CONTRACTOR (SEE DETAIL 6)
1" ø PRECAST OPENING FOR HOOK CONNECTION, CONTRACTOR TO SEAL FOR INSTALLATION
SIDE OF STORMTRAP MODULE
SIDE OF END PANEL

PANEL CONNECTION ELEVATION VIEW


LIFTERS INDICATE OUTSIDE FACE OF END PANEL

STEP 1

STEP 2

DETAIL 6

StormTrap®

PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]

1287 WINDHAM PARKWAY
ROMEOVILLE, IL 60446
P:815-941-4549 / F:331-318-5347

ENGINEER INFORMATION:

X Engineering
6 Hutton Centre Dr.
#650
Santa Ana, CA 92707
949-522-7100

PROJECT INFORMATION:

Freedom Lane

Aliso Viejo, CA

CURRENT ISSUE DATE:

10/16/2025

ISSUED FOR:

PRELIMINARY

REV.	DATE:	ISSUED FOR:	DWN BY:
1	10/16/2025	PRELIMINARY	DG

SCALE:

NTS

SHEET TITLE:

DOUBLETRAP
INSTALLATION
SPECIFICATION

SHEET NUMBER:

3.1

ZONE CHART

ZONES	ZONE DESCRIPTIONS	REMARKS
ZONE 1	FOUNDATION AGGREGATE	#5 (¾") STONE ANGULAR AGGREGATE (SEE NOTE 4)
ZONE 2	BACKFILL	UNIFIED SOILS CLASSIFICATION (GW, GP, SW, SP) OR SEE BELOW FOR APPROVED BACKFILL OPTIONS
ZONE 3	FINAL COVER OVERTOP	MATERIALS NOT TO EXCEED 120 PCF

APPROVED ZONE 2 BACKFILL OPTIONS

OPTION	REMARKS
¾" STONE AGGREGATE	THE STONE AGGREGATE SHALL CONSIST OF CLEAN AND FREE DRAINING ANGULAR MATERIAL. THE SIZE OF THIS MATERIAL SHALL HAVE 100% PASSING THE 1" SIEVE WITH 0% TO 5% PASSING THE #8 SIEVE. THIS MATERIAL SHALL BE SEPARATED FROM NATIVE MATERIAL USING GEOFABRIC AROUND THE PERIMETER OF THE BACKFILL (ASTM SIZE #57) AS DETERMINED BY THE GEOTECHNICAL ENGINEER.
SAND	IMPORTED PURE SAND IS PERMITTED TO BE USED AS BACKFILL IF IT IS CLEAN AND FREE DRAINING. THE SAND USED FOR BACKFILLING SHALL HAVE LESS THAN 40% PASSING #40 SIEVE AND LESS THAN 5% PASSING #200 SIEVE. THIS MATERIAL SHALL BE SEPARATED FROM NATIVE MATERIAL USING GEOFABRIC AROUND THE PERIMETER OF THE SAND BACKFILL.
CRUSHED CONCRETE AGGREGATE	CLEAN, FREE DRAINING CRUSHED CONCRETE AGGREGATE MATERIAL CAN BE USED AS BACKFILL FOR STORMTRAP'S MODULES. THE SIZE OF THIS MATERIAL SHALL HAVE 100% PASSING THE 1" SIEVE WITH 0% TO 5% PASSING THE #8 SIEVE. THIS MATERIAL SHALL BE SEPARATED FROM NATIVE MATERIAL USING GEOFABRIC AROUND THE PERIMETER OF THE BACKFILL.
ROAD PACK	STONE AGGREGATE 100% PASSING THE 1-1/2" SIEVE WITH LESS THAN 12% PASSING THE #200 SIEVE (ASTM SIZE #467). GEOFABRIC AS PER GEOTECHNICAL ENGINEER RECOMMENDATION.

FILL DEPTH	TRACK WIDTH	MAX VEHICLE WEIGHT (KIPS)	MAX GROUND PRESSURE
12"	12"	51.8	1690 psf
	18"	56.1	1219 psf
	24"	68.1	1111 psf
	30"	76.7	1000 psf
	36"	85.0	924 psf

NOTE:
TRACK LENGTH NOT TO EXCEED 15'-4".
ONLY TWO TRACKS PER VEHICLE.

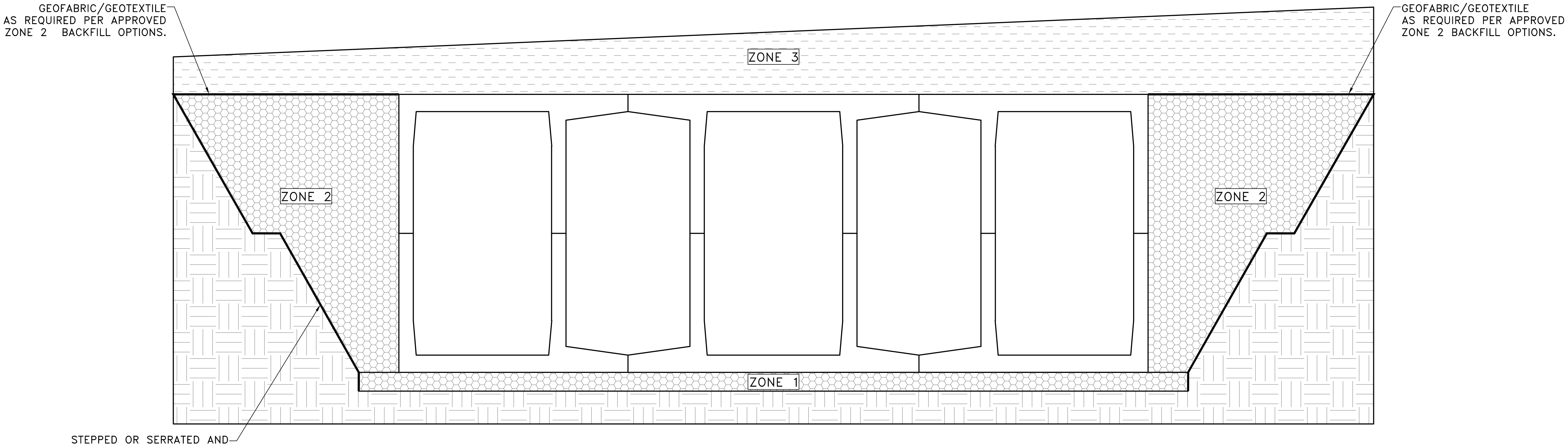
STORMTRAP ZONE INSTALLATION SPECIFICATION/PROCEDURE

1. THE FILL PLACED AROUND THE STORMTRAP MODULES MUST BE DEPOSITED ON BOTH SIDES AT THE SAME TIME AND TO APPROXIMATELY THE SAME ELEVATION. AT NO TIME SHALL THE FILL BEHIND ONE SIDE WALL BE MORE THAN 2'-0" HIGHER THAN THE FILL ON THE OPPOSITE SIDE. BACKFILL SHALL EITHER BE COMPACTED AND/OR VIBRATED TO ENSURE THAT BACKFILL AGGREGATE/STONE MATERIAL IS WELL SEATED AND PROPERLY INTER LOCKED. CARE SHALL BE TAKEN TO PREVENT ANY WEDGING ACTION AGAINST THE STRUCTURE, AND ALL SLOPES WITHIN THE AREA TO BE BACKFILLED MUST BE STEPPED OR SERRATED TO PREVENT WEDGING ACTION. CARE SHALL ALSO BE TAKEN AS NOT TO DISRUPT THE JOINT WRAP FROM THE JOINT DURING THE BACKFILL PROCESS. BACKFILL MUST BE FREE-DRAINING MATERIAL. SEE ZONE 2 BACKFILL CHART ON THIS PAGE FOR APPROVED BACKFILL OPTIONS. IF NATIVE EARTH IS SUSCEPTIBLE TO MIGRATION, CONFIRM WITH GEOTECHNICAL ENGINEER AND PROVIDE PROTECTION AS REQUIRED (PROVIDED BY OTHERS). ALL MODULES MUST BE SET AND ALL SIDES MUST BE FULLY BACKFILLED BEFORE TRAVEL OVERTOP THE SYSTEM IS PERMITTED. SEE NOTE 2 FOR EXCEPTIONS AND LIMITATIONS.

2. THE FILL PLACED OVERTOP THE SYSTEM SHALL BE PLACED IN MINIMUM 6" LIFTS. AT NO TIME SHALL MACHINERY OR VEHICLES GREATER THAN THE DESIGN LIVE LOAD LISTED ON SHEET 1.1 TRAVEL OVERTOP THE SYSTEM. IF TRAVEL OVER THE SYSTEM OCCURS BEFORE THE MINIMUM DESIGN COVER IS ACHIEVED, IT MAY BE NECESSARY TO REDUCE THE ULTIMATE LOAD/BURDEN OF THE OPERATING MACHINERY SO AS TO NOT EXCEED THE DESIGN CAPACITY OF THE SYSTEM. VEHICLES AND MACHINERY USED TO PLACE FILL MATERIAL ON TOP OF THE SYSTEM SHALL TRAVEL PARALLEL TO THE LONGITUDINAL AXIS OF THE STORMTRAP MODULES WHENEVER POSSIBLE.

3. THE VIBRATORY FUNCTION OF ANY ROLLER, COMPACTOR, VEHICLE, ETC. SHALL NOT BE USED OVERTOP THE SYSTEM WITHOUT PRIOR APPROVAL FROM STORMTRAP. IN SOME CASES, HAND COMPACTION MAY BE NECESSARY TO ENSURE THAT THE ALLOWABLE DESIGN LOADING IS NOT EXCEEDED.

4. STONE AGGREGATE FOUNDATION IN ZONE 1 IS FOR LEVELING PURPOSES.


GEOFABRIC/GEOTEXTILE AS REQUIRED PER APPROVED ZONE 2 BACKFILL OPTIONS.
GEOFABRIC/GEOTEXTILE AS REQUIRED PER APPROVED ZONE 2 BACKFILL OPTIONS.
ZONE 3
ZONE 2
ZONE 2
ZONE 1
STEPPED OR SERRATED AND APPLICABLE OSHA REQUIREMENTS (SEE INSTALLATION SPECIFICATIONS)

BACKFILL DETAIL

StormTrap®

PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]

1287 WINDHAM PARKWAY
ROMEOVILLE, IL 60446
P:815-941-4549 / F:331-318-5347

ENGINEER INFORMATION:

X Engineering
6 Hutton Centre Dr.
#650
Santa Ana, CA 92707
949-522-7100

PROJECT INFORMATION:

Freedom Lane

Aliso Viejo, CA

CURRENT ISSUE DATE:

10/16/2025

ISSUED FOR:

PRELIMINARY

REV.	DATE:	ISSUED FOR:	DWN BY:
1	10/16/2025	PRELIMINARY	DG

SCALE:

NTS

SHEET TITLE:

DOUBLETRAP BACKFILL SPECIFICATION

SHEET NUMBER:

4.0

ACCESS OPENING SPECIFICATION

1. A TYPICAL ACCESS OPENING FOR THE STORMTRAP SYSTEM ARE 2'–0" IN DIAMETER. ACCESS OPENINGS LARGER THAN 4'–0" IN DIAMETER NEED TO BE APPROVED BY STORMTRAP. ALL OPENINGS MUST RETAIN AT LEAST 2'–0" OF CLEARANCE FROM THE END OF THE STORMTRAP MODULE UNLESS NOTED OTHERWISE. ALL ACCESS OPENINGS TO BE LOCATED ON INSIDE LEG UNLESS OTHERWISE SPECIFIED. SEE SHEET 2.0 FOR SIZES AND LOCATIONS.
2. UNLESS OTHERWISE SPECIFIED, PLASTIC COATED STEPS ARE PROVIDED INSIDE ANY MODULE WHERE DEEMED NECESSARY. THE HIGHEST STEP IN THE MODULE IS TO BE PLACED A DISTANCE OF 1'–0" FROM THE INSIDE EDGE OF THE STORMTRAP MODULES. ALL ENSUING STEPS SHALL BE PLACED AT A DISTANCE BETWEEN 10" MIN AND 14" MAX BETWEEN THEM. STEPS MAY BE MOVED OR ALTERED TO AVOID OPENINGS OR OTHER IRREGULARITIES IN THE MODULE.
3. STORMTRAP LIFTING INSERTS MAY BE RELOCATED TO AVOID INTERFERENCE WITH ACCESS OPENINGS OR THE CENTER OF GRAVITY OF THE MODULE AS NEEDED.
4. STORMTRAP ACCESS OPENINGS MAY BE RELOCATED TO AVOID INTERFERENCE WITH INLET AND/OR OUTLET PIPE OPENINGS SO PLACEMENT OF STEPS IS ATTAINABLE.
5. ACCESS OPENINGS SHOULD BE LOCATED IN ORDER TO MEET THE APPROPRIATE MUNICIPAL REQUIREMENTS. STORMTRAP RECOMMENDS AT LEAST TWO ACCESS OPENINGS PER SYSTEM FOR ACCESS AND INSPECTION.
6. USE PRECAST ADJUSTING RINGS AS NEEDED TO MEET GRADE. STORMTRAP RECOMMENDS FOR COVER OVER 2' TO USE PRECAST BARREL OR CONE SECTIONS. (PROVIDED BY OTHERS)

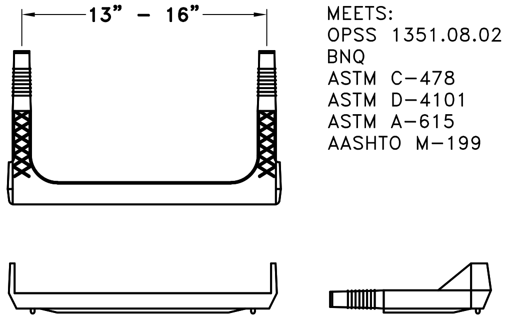
PIPE OPENING SPECIFICATION

1. MINIMUM EDGE DISTANCE FOR AN OPENING ON THE OUTSIDE WALL SHALL BE NO LESS THAN 1'–0".
2. CONNECTING PIPES MAY BE INSTALLED WITH A 1'–0" CONCRETE COLLAR AND AN AGGREGATE CRADLE (AS REQUIRED) FOR AT LEAST ONE PIPE LENGTH (SEE PIPE CONNECTION DETAIL). A STRUCTURAL GRADE CONCRETE OR HIGH STRENGTH, NON–SHRINK GROUT WITH A MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 3000 PSI MAY BE USED.
3. THE ANNULAR SPACE BETWEEN THE PIPE AND THE HOLE SHALL BE FILLED WITH HIGH STRENGTH NON–SHRINK GROUT.

PIPE INSTALLATION INSTRUCTIONS

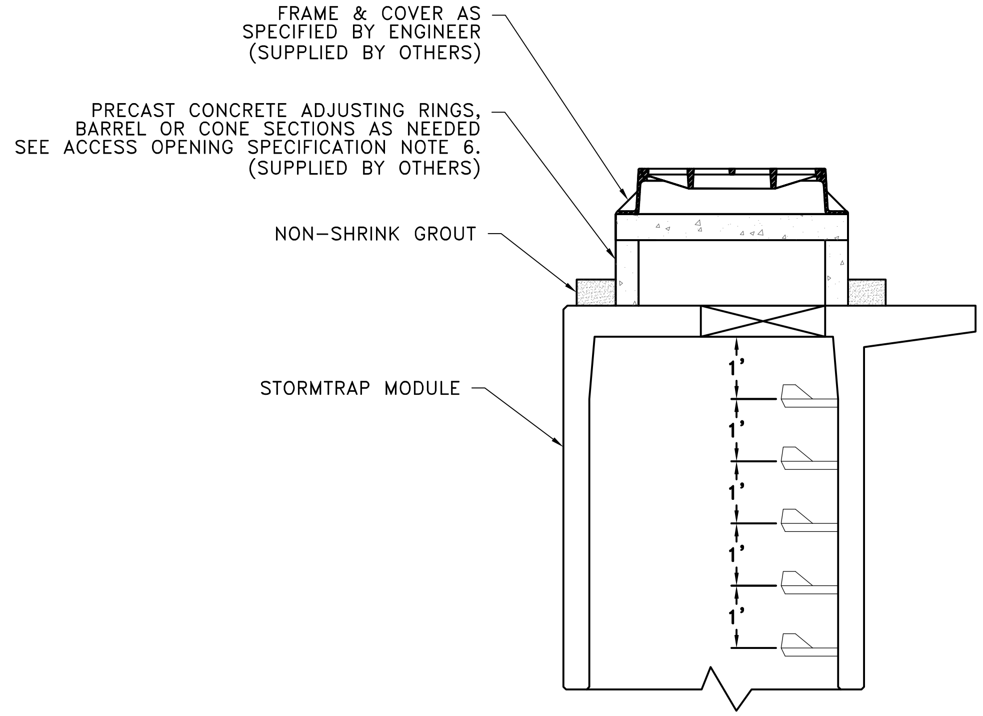
1. CLEAN AND LIGHTLY LUBRICATE ALL OF THE PIPE TO BE INSERTED INTO STORMTRAP.
2. IF PIPE IS CUT, CARE SHOULD BE TAKEN TO ALLOW NO SHARP EDGES. BEVEL AND LUBRICATE LEAD END OF PIPE.
3. ALIGN CENTER OF PIPE TO CORRECT ELEVATION AND INSERT INTO OPENING.

NOTE: ALL ANCILLARY PRODUCTS/SPECIFICATIONS RECOMMENDED AND SHOWN ON THIS SHEET INCLUDING BUT NOT LIMITED TO CONCRETE COLLARS, AGGREGATE CRADLES, GRADE RINGS, RISER SECTIONS, ETC., ARE RECOMMENDATIONS ONLY AND SUBJECT TO CHANGE PER THE INSTALLING CONTRACTOR AND/OR PER LOCAL MUNICIPAL CODE/REQUIREMENTS.

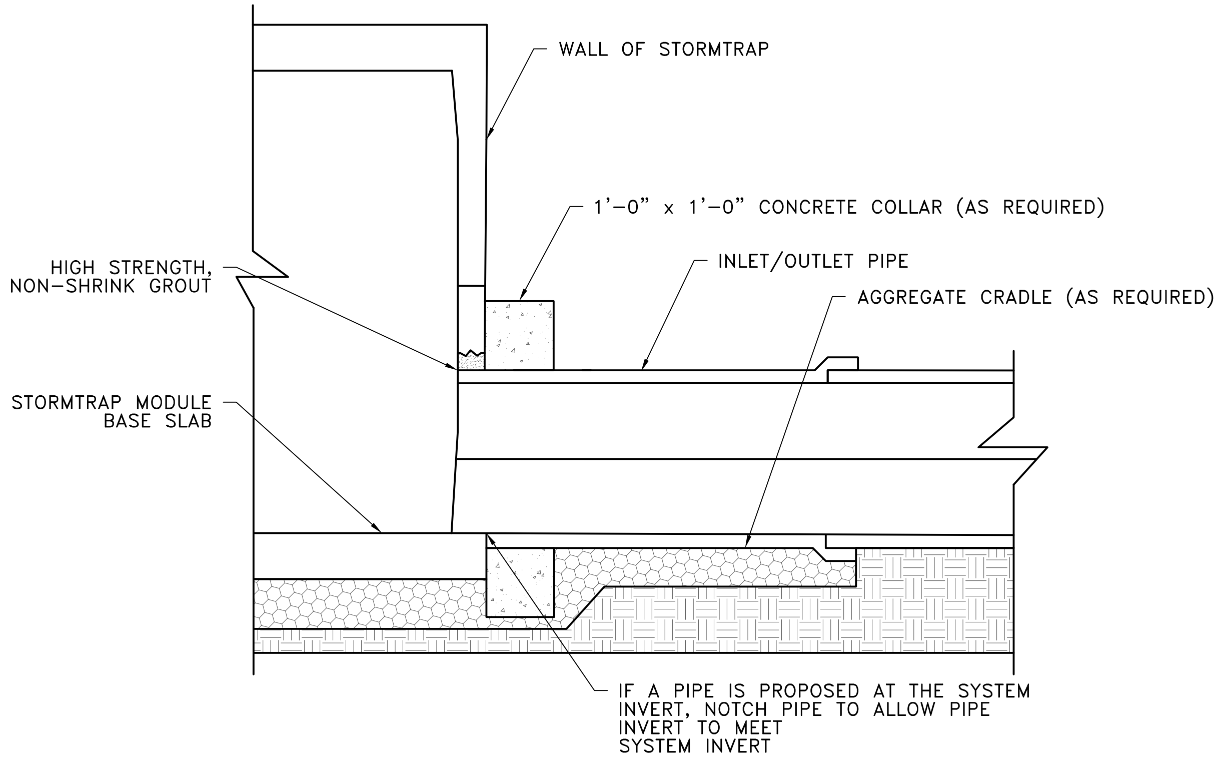


MEETS:
OPSS 1351.08.02
BNQ
ASTM C–478
ASTM D–4101
ASTM A–615
AASHTO M–199

STEP DETAIL


FRAME & COVER AS SPECIFIED BY ENGINEER (SUPPLIED BY OTHERS)
PRECAST CONCRETE ADJUSTING RINGS, BARREL OR CONE SECTIONS AS NEEDED SEE ACCESS OPENING SPECIFICATION NOTE 6. (SUPPLIED BY OTHERS)
NON–SHRINK GROUT
STORMTRAP MODULE
1'
1'
1'
1'
1'

RISER/STAIR DETAIL


WALL OF STORMTRAP
1'–0" x 1'–0" CONCRETE COLLAR (AS REQUIRED)
INLET/OUTLET PIPE
AGGREGATE CRADLE (AS REQUIRED)
HIGH STRENGTH, NON–SHRINK GROUT
STORMTRAP MODULE BASE SLAB
IF A PIPE IS PROPOSED AT THE SYSTEM INVERT, NOTCH PIPE TO ALLOW PIPE INVERT TO MEET SYSTEM INVERT

NOTCHED PIPE CONNECTION DETAIL
WHEN PIPE INVERT IS AT
INVERT OF STORMTRAP SYSTEM

StormTrap®

PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]

1287 WINDHAM PARKWAY
ROMEOVILLE, IL 60446
P:815–941–4549 / F:331–318–5347

ENGINEER INFORMATION:

X Engineering
6 Hutton Centre Dr.
#650
Santa Ana, CA 92707
949–522–7100

PROJECT INFORMATION:

Freedom Lane

Aliso Viejo, CA

CURRENT ISSUE DATE:

10/16/2025

ISSUED FOR:

PRELIMINARY

REV.	DATE:	ISSUED FOR:	DWN BY:
△1	10/16/2025	PRELIMINARY	DG

SCALE:

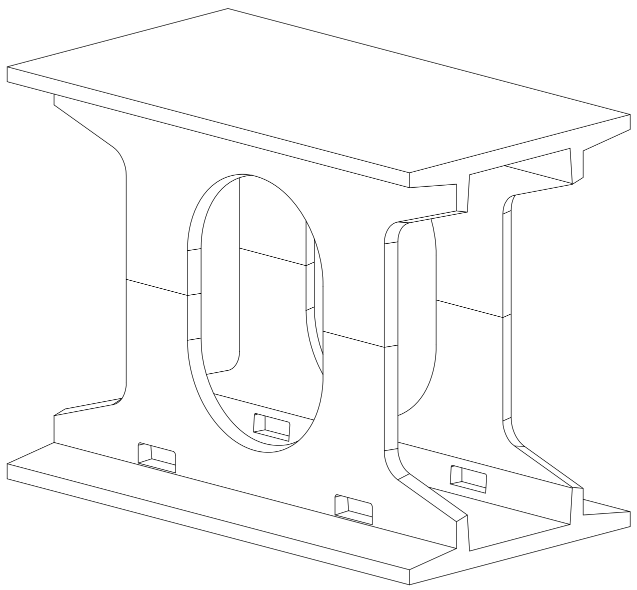
NTS

SHEET TITLE:

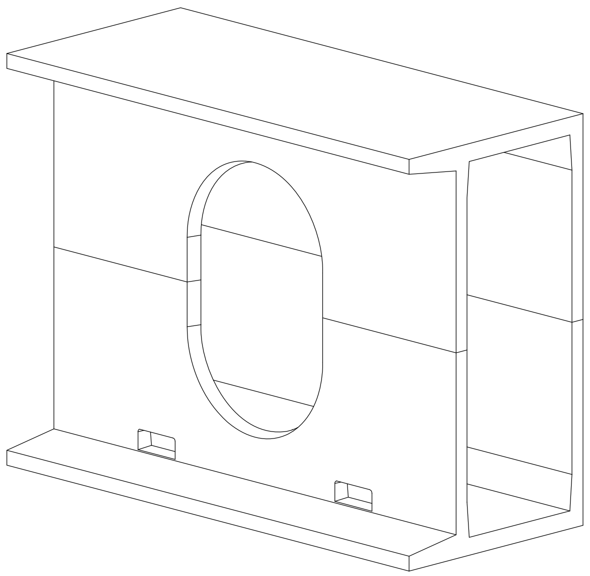
PIPE / ACCESS OPENING SPECIFICATION

SHEET NUMBER:

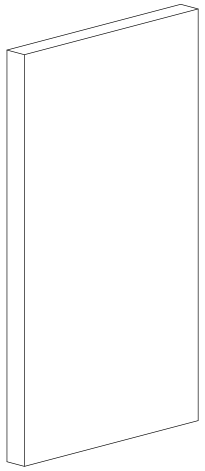
5.0



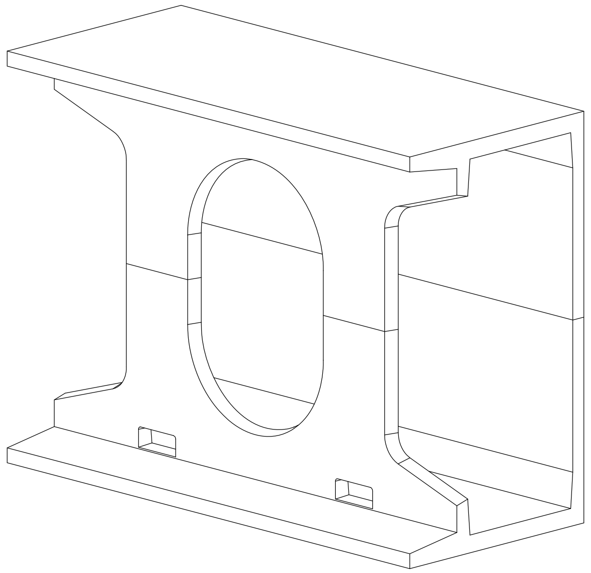
TYPE I



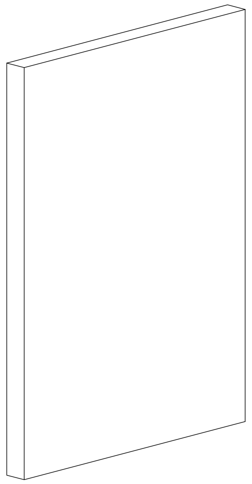
TYPE IV



TYPE IV END PANEL



TYPE III



TYPE II END PANEL

NOTES:
1. OPENING LOCATIONS AND SHAPES MAY VARY.
2. SP – INDICATES A MODULE WITH MODIFICATIONS.
3. P – INDICATES A MODULE WITH A PANEL ATTACHMENT.
4. POCKET WINDOW OPENINGS ARE OPTIONAL.

StormTrap
PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]

1287 WINDHAM PARKWAY
ROMEOVILLE, IL 60446
P:815-941-4549 / F:331-318-5347

ENGINEER INFORMATION:

X Engineering
6 Hutton Centre Dr.
#650
Santa Ana, CA 92707
949-522-7100

PROJECT INFORMATION:

Freedom Lane

Aliso Viejo, CA

CURRENT ISSUE DATE:

10/16/2025

ISSUED FOR:

PRELIMINARY

REV.	DATE:	ISSUED FOR:	DWN BY:
⚠1	10/16/2025	PRELIMINARY	DG

SCALE:

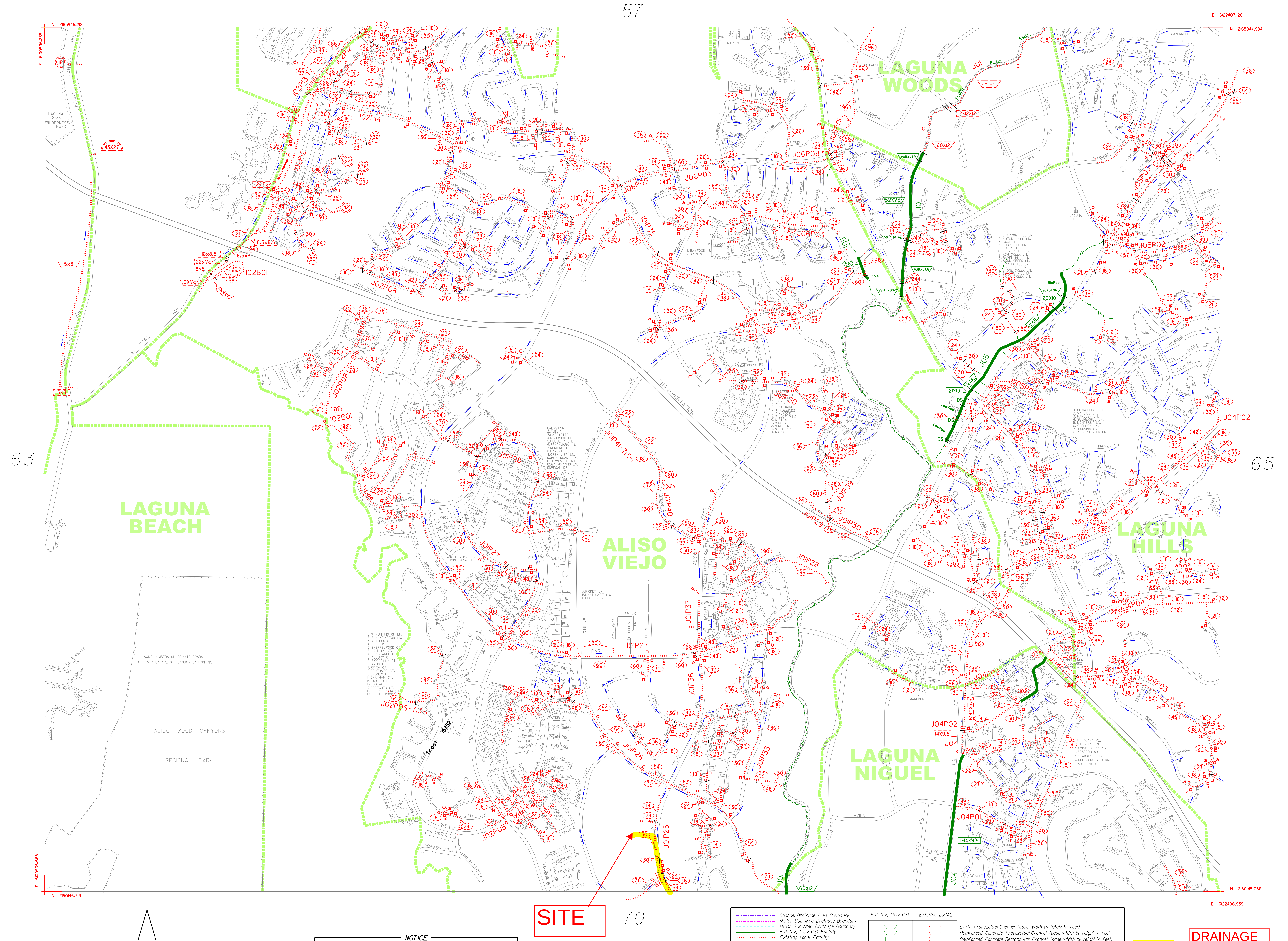
NTS

SHEET TITLE:

DOUBLETRAP
MODULE TYPES

SHEET NUMBER:

6.0



64

Scale: 1"=600'

NOTICE

This drainage map has been prepared for information purposes only. The location and ownership of facilities have been determined from available information provided by public agencies, but may not be exact. The user of this map is responsible for verifying exact location, ownership and regional versus local character of drainage facilities.
Additional information may be obtained from public plans and recorded deeds.
Character designations shown on this map are for convenience only and are not controlling.
Neither the County of Orange nor The Orange County Flood Control District (OCFCD) assume any liabilities for inaccuracy of this map.

Call: Alan Vu at (714) 834-5986 to notify Public Facility and Resources Department (PFRD) of additions or corrections.

ORANGE COUNTY FLOOD CONTROL DISTRICT

BASEMAP
OF DRAINAGE FACILITIES
IN ORANGE COUNTY

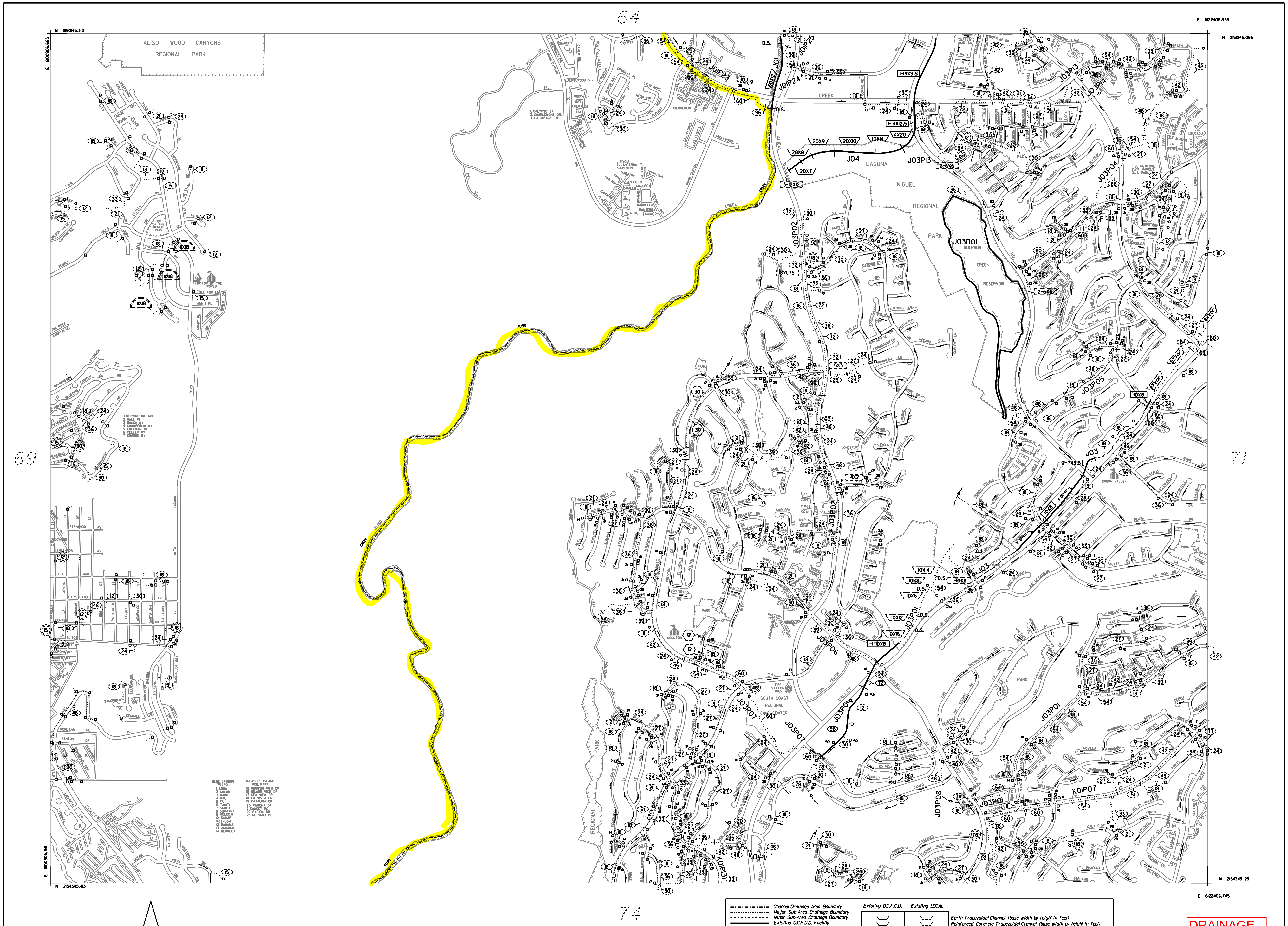
REVISION	DATE	SHEET NO.	DWG. NO.
S.GUTIERREZ	JAN.16 2007	64	MAPS-113-3

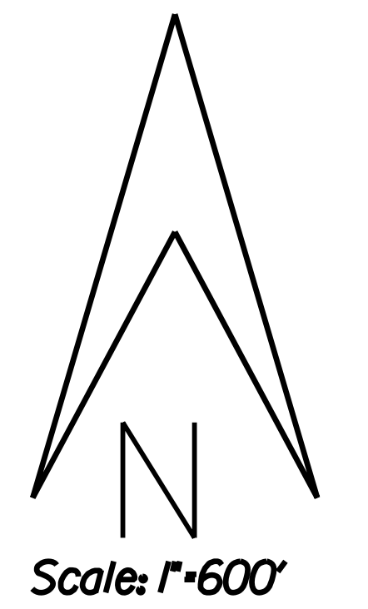
Channel Drainage Area Boundary
Major Sub-Area Drainage Boundary
Minor Sub-Area Drainage Boundary
Existing O.C.F.C.D. Facility
Existing Local Facility
Existing Retarding Basin or Reservoir
Natural Watercourse
City Limits
G G Greenbelt
P.S. P.S. Pump Station
Catch Basin (length in feet)
Drop Inlet or Other Entry
Ownership (if other than city or county)
P Private
S State
F Federal

Existing O.C.F.C.D.	Existing LOCAL	
		Earth Trapezoidal Channel (base width by height in feet)
		Reinforced Concrete Trapezoidal Channel (base width by height in feet)
		Reinforced Concrete Rectangular Channel (base width by height in feet)
		Reinforced Concrete Box (RCB) (number of barrels-span by height in feet)
		Reinforced Concrete Pipe (RCP) (diameter in inches)
		Corrugated Metal Pipe (CMP) (diameter in inches)
		Concrete Pipe (diameter in inches)
		Concrete Oval Pipe (width by height in inches)
		Steel Pipe (diameter in inches)
		Reinforced Concrete Arch (base span by height in inches)
		Corrugated Metal Arch (base span by height in inches)

DRAINAGE ROUTE

64


64
69
71
74
N 2150145.313
E 6000906.665
E 6000906.441
N 2134345.413
E 6122406.939
N 2150145.056
N 2134345.125
E 6122406.745
ALISO WOOD CANYONS REGIONAL PARK
TOP OF THE WORLD PARK
ALISO CREEK
LAGUNA NIGUEL REGIONAL PARK
J03D01 SULPHUR CREEK RESERVOIR
J01
J01P23
J01P24
J01P25
J03
J03P01
J03P02
J03P04
J03P05
J03P06
J03P07
J03P08
J03P13
J03P14
J04
K01P07
K01P11
K01P13
CROWN VALLEY
MOULTON
SOUTH COAST REGIONAL COMMUNITY CENTER
FIRE STATION HDQS
D.S.



Scale: 1"=600'

DRAINAGE ROUTE

NOTICE

This drainage map has been prepared for information purposes only. The location and ownership of facilities have been determined from available information provided by public agencies, but may not be exact. The user of this map is responsible for verifying exact location, ownership and regional versus local character of drainage facilities.

Additional information may be obtained from public plans and recorded deeds.

Character designations shown on this map are for convenience only and are not controlling.

Neither the County of Orange nor The Orange County Flood Control District (OCFCD) assume any liabilities for inaccuracy of this map.

Call: Alan Vu at (714) 834-5986 to notify Public Facility and Resources Department (PFRD) of additions or corrections.

ORANGE COUNTY FLOOD CONTROL DISTRICT

BASEMAP
OF DRAINAGE FACILITIES
IN ORANGE COUNTY

REVISION	DATE	SHEET NO.	DWG. NO.
AVU	JAN.12/2000	70	MAPS-113-3

Channel Drainage Area Boundary
Major Sub-Area Drainage Boundary
Minor Sub-Area Drainage Boundary
Existing O.C.F.C.D. Facility
Existing Local Facility
Existing Retarding Basin or Reservoir
Natural Watercourse
City Limits
G G Greenbelt
P.S. P.S. Pump Station
Catch Basin (length in feet)
Drop Inlet or Other Entry
Ownership (if other than city or county)
P Private
S State
F Federal

Existing O.C.F.C.D. | Existing LOCAL

Earth Trapezoidal Channel (base width by height in feet)
Reinforced Concrete Trapezoidal Channel (base width by height in feet)
Reinforced Concrete Rectangular Channel (base width by height in feet)
Reinforced Concrete Box (RCB) (number of barrels-span by height in feet)
Reinforced Concrete Pipe (RCP) (diameter in inches)
Corrugated Metal Pipe (CMP) (diameter in inches)
Concrete Pipe (diameter in inches)
Concrete Oval Pipe (width by height in inches)
Steel Pipe (diameter in inches)
Reinforced Concrete Arch (base span by height in inches)
Corrugated Metal Arch (base span by height in inches)

Attachment E: Geotechnical Report

- Attachment E1: SA Geotechnical Report

SA GEOTECHNICAL
OPTIMIZED SOIL ENGINEERING

June 3, 2024

Project No. 24064-01

To: Meritage Homes
5 Peters Canyon Road, Suite 310
Irvine, California 92606

Attention: Ms. Johanna Crooker

Subject: Geotechnical Exploration and Preliminary Design Recommendations, Proposed Residential Development, 400 - 700 Freedom Lane, Lots 2 through 5 of Tract No. 18080, City of Aliso Viejo, California

At your request, SA Geotechnical, Inc. (SA GEO) has conducted a geotechnical subsurface exploration and due diligence study for the subject proposed residential development at 400 - 700 Freedom Lane in the City of Aliso Viejo, California (Figure 1), legally described as Lots 2 through 5 of Tract No. 18080, Assessor's Parcel Numbers (APNs) 632-141-12, -13, -14, and -15. The purpose of this study was to evaluate the geotechnical site conditions considering the proposed grading and improvements in order to provide a geotechnical summary and preliminary geotechnical recommendations for project design, grading, and construction. Our evaluation included review of background geologic and geotechnical engineering maps and reports for the subject site; a site-specific subsurface exploration; laboratory testing; geotechnical analysis and preparation of this report.

The subject site was previously mass graded during the 1980s but has remained undeveloped since that time. No documentation of this grading was recovered during our archive search of City records. Based on our exploration, the mass grading resulted in bedrock at or near existing grades throughout a majority of the site, while the southeastern corner of the site and southerly slope was filled to current grades. The primary geotechnical constraints include the presence of friable sands prone to caving in steep-sided excavations (Niguel Formation), presence of highly expansive earth materials (Monterey Formation) within the northern portion of the site, existing onsite utilities that must be protected in place during grading, and the potential for seismic shaking during a strong seismic event. Groundwater was not encountered during this or prior subsurface exploration to a maximum depth of 75 feet. Seepage was encountered at depths ranging from 18.5 to 27 feet below ground surface in one boring (B-2).

This report presents our findings, conclusions, and preliminary design recommendations for the proposed residential development. Based on our review, the proposed grading and development is considered geotechnically feasible provided the recommendations in this report are implemented during design, grading, and construction. Additional geotechnical evaluation and analysis will need to be performed once the project plans for grading, utility improvements and foundations are developed. Stormwater infiltration at the subject site is not considered feasible from a geotechnical viewpoint.

References pertinent to the site are included in Appendix A. Boring and test pit logs are included in Appendix B. Laboratory test data is included in Appendix C. Seismic design parameters are presented in Appendix D. Slope stability analysis is attached as Appendix E. General earthwork and grading specifications are presented in Appendix F.

If you have any questions regarding this report, please contact our office. We appreciate the opportunity to provide our services.

Respectfully submitted,

SA GEOTECHNICAL, INC.

Anthony Zepeda, CEG 2681
Project Geologist

Reza Saberi, GE 3071
Principal Engineer

Peter Anderson, CEG 2596
Principal Engineering Geologist

ANTHONY L. ZEPEDA
CEG No. 2681

PETER G. ANDERSON
No. 2596

MOHAMMAD REZA SABERI
No. 3071

TABLE OF CONTENTS

EXECUTIVE SUMMARY 1
1.0 INTRODUCTION 2
1.1 Introduction and Scope of Services 2
1.2 Site Condition and History 2
1.3 Proposed Grading and Improvements 4
1.4 Prior Geotechnical Studies 4
1.5 Subsurface Exploration 4
1.6 Laboratory Testing 5
2.0 GEOTECHNICAL FINDINGS 6
2.1 Geologic Setting and Earth Units 6
2.2 Geotechnical Conditions 7
2.3 Groundwater and Surface Water 8
2.4 Regional Faulting and Seismicity 8
2.5 Slope Stability 9
2.6 Settlement and Foundation Considerations 9
2.7 Stormwater Infiltration Feasibility 10
2.8 Shrinkage and Bulking 10
2.9 Existing Utilities 10
3.0 CONCLUSION AND PRELIMINARY RECOMMENDATIONS 11
3.1 General Conclusion and Recommendation 11
3.2 Site Preparation and Earthwork 11
3.2.1 Site Demolition and Clearing 11
3.2.2 Protection of Existing Improvements and Utilities 11
3.2.3 Remedial Grading Measures 12
3.2.4 Placement of Oversize Material 12
3.2.5 Fill Placement 13
3.2.6 Import 13
3.3 Settlement Potential 13
3.4 Foundation Design 14
3.5 Caisson Design 15
3.6 Retaining Wall Design and Lateral Earth Pressures 16
3.7 Seismic Design Parameters 17
3.8 Slope Stability and Slope Setback 18
3.9 Corrosivity 18
3.10 Expansion Potential 19
3.11 Interior Slab Moisture Mitigation 19
3.12 Exterior Concrete 20
3.13 Preliminary Asphalt Concrete Pavement Design 20
3.14 Vehicular PCC Pavements 21
3.15 Concrete Paver Section 21
3.16 Trench Excavation and Backfill 22
3.17 Groundwater 23
3.18 Stormwater Infiltration Feasibility 23
3.19 Surface Drainage and Irrigation 23
3.20 Slope Maintenance, Lot Drainage, and Erosion Control 24
3.21 Additional Subsurface Exploration and Laboratory Testing 24
3.22 Review of Future Plans 24
3.23 Observation and Testing during Grading and Construction 24
4.0 LIMITATIONS 26

TABLE OF CONTENTS (Continued)

List of Illustrations

Figure 1 – Site Location Map – Rear of Text
Figure 2 – Regional Geologic Map – Rear of Text
Figure 3 – Regional Fault Map – Rear of Text
Figure 4 – Retaining Wall Drainage Detail – Rear of Text

Appendices

Appendix A – References
Appendix B – Boring and Test Pit Logs
Appendix C – Laboratory Test Results,
Appendix D – Seismicity Data
Appendix E – Slope Stability Analysis
Appendix F – General Earthwork and Grading Specifications

Plates

Plate 1 – Geotechnical Map – Rear of Appendices
Plate 2 – Remedial Measures Map – Rear of Appendices
Plates 3 and 4 – Geotechnical Cross Sections A-A' and B-B' – Rear of Appendices

EXECUTIVE SUMMARY

The subject site is underlain by bedrock of the Niguel and Monterey Formations and partially by artificial fill material as a result of mass grading in the 1980s. The majority of the site is underlain by bedrock at or near existing grades. The southerly perimeter and southeastern corner of the site were brought to current grades with compacted artificial fill. The artificial fill materials generally consisted of yellowish brown, brown, olive brown, and grayish brown fine to medium-grained, sand that was damp to very moist, and medium dense. Bedrock of the Niguel and Monterey Formations were encountered during our exploration. The Niguel Formation generally consisted of silty to clean sandstone with minor amounts of siltstone; the Monterey Formation consisted of diatomaceous clayey siltstone with minor amounts of silty sandstone.

The primary geotechnical constraints for the proposed site redevelopment include the following:

- Presence of highly expansive earth materials (Monterey Formation) within the northern portion of the site;
- Presence of friable sands prone to caving in steep-sided excavations;
- Existing onsite utilities that must be protected in place; and,
- Potential for strong seismic shaking during an earthquake event.

Remedial grading for the site should consist of the removal and recompaction of all undocumented fill materials and near-surface weathered/disturbed or highly faulted bedrock. In general, remedial removals are anticipated to range from 1 to 7 feet below existing grades. Remedial removal/overexcavation within the building pads is recommended 3 to 5 feet below design grades or existing grades, whichever is lower. For areas underlain by faulted, highly expansive diatomaceous bedrock (Monterey Formation), we recommended a 7-foot removal/overexcavation. Remedial grading within the proposed drive areas may be limited to removal and recompaction of the upper 1 to 2 feet (see Plate 2).

Static groundwater was not encountered during our exploration. Seepage was encountered in Boring B-2 at depths between 18.5 and 27 feet below ground surface. In general, groundwater is anticipated to remain more than 20 feet below design grades upon the completion of grading. However, seepage/groundwater may be present at shallow depth locally and fluctuates on an annual and seasonal basis.

Building foundations and slabs should be designed to tolerate a total settlement of 1-inch and differential settlement of ½-inch over a span of 40 feet. The site is categorized as Site Class "C" for seismic design. Onsite soils are anticipated to have "Medium" expansion potential at the completion of grading. Onsite soils are not anticipated to be corrosive to concrete but are anticipated to be corrosive to metals.

Based on our findings, we conclude that the proposed residential development is feasible from a geotechnical viewpoint, provided it is designed and constructed in accordance with the recommendations presented in this report and any future design/plan review reports. The site is not considered suitable for infiltration of stormwater.

1.0 INTRODUCTION

1.1 Introduction and Scope of Services

At your request, SA Geotechnical, Inc. (SA GEO) has conducted geotechnical exploration and due diligence study for the subject proposed residential development at 400-700 Freedom Lane in the city of Aliso Viejo, California (Figure 1). The purpose of our review was to assess the onsite geologic and geotechnical conditions and provide preliminary recommendations for design, grading, and construction of the proposed improvements. We have reviewed the Conceptual Site Plan, dated May 2024, and the site topographic survey prepared by X Engineering & Consulting, Inc., received on May 15, 2024, which was used as the base for our Geotechnical Map and Remedial Measures Map (Plates 1 and 2). The Conceptual Site Plan was also used as the base for our Remedial Measures Map (Plate 2).

Our scope of services for this study included the following tasks:

- Review of available geologic and geotechnical maps, reports, and data for the subject site and surrounding area, including an archive search of City of Aliso Viejo records. A list of references is included in Appendix A.
- Review of available historic aerial photographs dating back to 1931.
- Subsurface exploration consisting of two bucker auger borings (B-1 and B-2) to depths of 65 and 75 feet bgs, twelve test pits (TP-1 through TP-3, TP-3a, TP-3b, and TP-4 through TP-10) to depths ranging from 4 to 14 feet bgs, and three hand auger borings (HA-1 through HA-3) to depths ranging from 10 to 13 feet below ground surface (bgs).
- Laboratory testing of selected samples to determine engineering properties of onsite soils, including in-situ moisture and density, grain size distribution, Atterberg limits, consolidation, shear strength, maximum density and optimum moisture content, expansion potential, and soluble sulfate content.
- Geotechnical evaluation and analysis of the compiled data regarding the proposed grading and development.
- Evaluation of faulting, seismicity, and seismic and static settlement in accordance with the 2022 California Building Code (CBC).
- Preparation of this report including our findings, conclusions, preliminary recommendations, and accompanying illustrations.
- Consultations with the project team.

SA GEO's expertise and scope of services do not include assessment of potential subsurface environmental contaminants or environmental health hazards.

1.2 Site Condition and History

The approximately 7.1-acre (4.3 net acres), roughly triangular-shaped site is located in Aliso Viejo, California (Figure 1), and is legally described as Lots 2 through 5 of Tract No. 18080, Assessor's Parcel Numbers (APNs) 632-141-12, -13, -14, and -15. The site is bound to the north by Freedom Lane, Belmont Village Senior Living to the east, undeveloped land to the west, and to the south by a Moulton Niguel Water District reservoir tank.

Overall site topography is relatively flat, with grade changes on the order of 5 feet, aside from an approximately 12-foot-high stockpile in the northern portion of the site. An approximately 5- to 6-foot-deep temporary desilting basin is present in the eastern portion of the site. A descending slope is present along the entire southern portion of the property approximately 40 to 70 feet in height, extending beyond the property boundary. The slope is generally 2H:1V (horizontal:vertical) or flatter, and includes terrace drains (v-ditches) every 30 vertical feet. During our site reconnaissance we observed the presence of scattered 2- to 4- foot-diameter boulders at the ground surface, presumed to have been placed concurrent with the onsite undocumented fill stockpile. The site is variably vegetated with large, mature trees on the southern slope, and scrubs, grasses, and bushes in the flat portion of the landscape.

The subject site was mass graded in the 1980s, resulting in the current topography but has remained undeveloped since that time. Based on our review of historic and current topography, during mass grading the flat portion of the site was cut on the order of 40 to 100 feet below original grades, while the southeastern corner of the site and southerly slope was filled to current grades. Following grading, dry utilities and a 12-inch domestic water pipeline were installed in the northern and central portions of the site, respectively. An existing temporary 18-inch storm drain pipe/riser is present draining the desilting basin to a junction structure adjacent to Freedom Lane.

Based on our review of available historic aerial photographs dating back to 1931, the following summarizes our understanding of the site history:

- **1931-1987:** The site and surrounding area were undeveloped natural scrubland. A natural descending slope and drainage were present in the southernmost portion of the site, in approximate alignment with the present-day slope. A northeast trending ridgeline is present just north of the site. The site remained undeveloped during this period except for various dirt access roads traversing the site and surrounding area.
- **1988-1995:** Mass grading began for the site and the surrounding area to the north, east, and south, encompassing a large portion of the City of Aliso Viejo. Grading onsite was completed by 1990. The water reservoir tank and light industrial facilities to the south were constructed by 1990. The existing southerly slope was landscaped with trees around 1993.
- **1996-2015:** No changes were observed onsite.
- **2016-2018:** Grading and construction of Freedom Lane began in late 2016; grading/paving was completed in 2017. The construction of the senior living development (Liberty at Aliso and Belmont Village) and Aliso Ridge Behavioral Health Center, north and east of the subject site began in 2017. Beginning in 2016, the subject site was utilized as an equipment/materials storage yard and staging area for the adjacent construction. It was during this time that the onsite artificial fill stockpile was placed, likely generated from excavations associated with the adjacent developments. The onsite desilting basin and storm drain improvements were constructed by late 2017.
- **2019-Present:** The adjacent senior living developments were completed by 2019 and the health center by 2021. The subject site was utilized as a storage yard/staging area through 2019. Temporary fencing associated with the storage yard was removed by 2020. The site has remained largely unchanged since 2020.

1.3 Proposed Grading and Improvements

Based on our review of the Conceptual Site Plan, the site is proposed to be developed for residential use. The Conceptual Site Plan shows 12 multifamily residential buildings with approximately 124 total units proposed. The project will also include stormwater quality/filtration devices, paved drive aisles and parking, and utility infrastructure improvements to support the development. We anticipate that the proposed attached units will be 3- to 4-story and consist of wood-framed construction.

The planned earthwork/grading is currently unknown; however, considering the relatively flat topographic relief across the site, we anticipate design cuts and fills generally on the order of 1 to 3 feet will be required to create a relatively level site and building pads. Locally deeper cuts/fills (i.e., stockpile area, temporary desilting basin) on the order of 4 to 12 feet will be required.

1.4 Prior Geotechnical Studies

Southern California Geotechnical, Inc. (SCG) performed a geotechnical exploration at the subject site in 2021. The subsurface exploration program included four hollow-stem auger borings (SB-1 through SB-4) to depths ranging from 20 to 40 feet below ground surface (bgs), and two bucket auger borings (SBA-1 and SBA-2), to depths of 31 and 66 feet. An additional boring (SB-3) was also included in the report from a prior 2014 study that was performed by SCG; however, the report associated with that boring was not available for our review. The boring and laboratory data included in the 2021 exploration report were reviewed as part of study.

The approximate boring locations are shown on the Boring Location Map (Plate 1). The associated boring logs are provided in Appendix B. Laboratory testing included in-situ moisture content and dry density, maximum density and optimum moisture content, consolidation, and direct shear. The associated laboratory test data is provided in Appendix C.

1.5 Subsurface Exploration

Our field exploration was performed between May 3 and May 9, 2024, and included excavation of two bucker auger borings (B-1 and B-2) to depths of 65 and 75 feet bgs, twelve test pits (TP-1 through TP-3, TP-3a, TP-3b, and TP-4 through TP-10) to depths ranging from 4 to 14 feet bgs, and three hand auger borings (HA-1 through HA-3) to depths ranging from 10 to 13 feet bgs. The borings and trenches were geologically logged, and samples were obtained at selected intervals. After completion of boring and test pit logging, the excavations were backfilled with soil cuttings. The approximate boring and test pit locations are shown on the Geotechnical Map (Plate 1). Boring and trench logs are included in Appendix B.

Soil sampling was performed using a Modified California ring sampler. Relatively undisturbed ring samples were obtained from the borings at various depths with a 2.5-inch inside-diameter, split-barrel sampler. The sampler was driven using the kelly bar, free falling 12 inches. The hammer weights varied with depth due to the telescoping kelly bar, with drive weights of 2500 pounds (lbs) from 0-25 feet bgs, 1500 lbs from 25 to 45 feet bgs, 750 lbs from 45 to 65 feet bgs, and 1500 lbs from 65 to 90 feet bgs. The sampling was used to assess the soil beneath the site as well as to obtain a measure of resistance of the soil to penetration (recorded as blows-per-foot on the geotechnical boring logs). Representative bulk samples of onsite soils were also collected from soil cuttings and used for additional soil identification purposes and laboratory testing.

1.6 Laboratory Testing

Representative samples of onsite soils collected during our field exploration were tested to characterize the engineering properties. Laboratory tests performed on selected relatively undisturbed and bulk soil samples included:

- Moisture content and dry density;
- Sieve analysis;
- Atterberg limits;
- Direct shear;
- Consolidation;
- Maximum density and optimum moisture content;
- Expansion potential; and
- Soluble sulfate.

Laboratory tests were conducted in general conformance with applicable ASTM International standards. The laboratory test results for this and prior studies are provided in Appendix C.

2.0 GEOTECHNICAL FINDINGS

2.1 Geologic Setting and Earth Units

The subject site is located on the eastern foothills of the San Joaquin Hills range, within the Peninsular Ranges geomorphic province of Southern California. The site is mapped by the United States Geologic Survey (2006) as underlain by Tertiary-age sedimentary bedrock of the Niguel Formation. Based on our subsurface exploration and understanding of the site history, the subject site was mass graded in the 1980's resulting in a relatively flat lot with bedrock at or near existing grades. The southeastern corner of the site and southerly slope were constructed with compacted fill materials overlying bedrock. No alluvium/colluvium was encountered in any of our borings and is assumed to have been removed during mass grading. The earth unit distribution and our interpretation of the subsurface conditions are shown on the Geotechnical Map (Plate 1) and Geotechnical Cross-Sections A-A' and B-B' (Plates 3 and 4).

Within the southern portion of the site, the bedrock is overlain by compacted **Artificial Fill (Af)** associated with prior mass grading. The artificial fill was found to be up to 22 feet thick and generally consisted of pale brown, yellowish brown, dark brown, and olive brown silty fine to medium sand that was damp to very moist and medium dense. The stockpile in the northern portion of the site is composed of **Undocumented Artificial Fill (Afu)** presumed to have been placed during grading and construction of the neighboring developments. The undocumented artificial fill (stockpile) encountered was up to 12.5 feet thick and generally consisted of pale brown, yellowish brown, and pale yellowish gray silty to clean fine to coarse sand and sandy silt that was damp to moist and loose to medium dense. The limits of artificial fill and undocumented artificial fill are shown on the Geotechnical Map (Plate 1).

The **Niguel Formation (Tn)** is mapped throughout the majority of the site. The bedrock was found to consist of pale olive brown, yellowish brown, pale gray, and white fine to coarse-grained sandstone that was massive to poorly bedded. Crossbedding and variable structure (strike/dip) was observed throughout the site with dips at generally low inclination. The sandstone is weakly indurated and friable, resulting in minor caving in Boring B-1 and some test pits. A minor siltstone package (with clay beds) was encountered in Boring B-2 and was olive brown to gray and massive to thinly laminated. The siltstone package was found to be hard and moderately indurated/cemented. Seepage was also encountered at varying depths within the siltstone package.

The **Monterey Formation (Tm)** is not mapped onsite per published geologic mapping by the United States Geological Survey (USGS, 2006), nor was the formation encountered during the prior onsite exploration by others (SCG, 2021). We encountered Monterey Formation in three test pits (TP-3, TP-3a, and TP-3b) which consisted of pale brownish gray, bluish gray, and white diatomaceous siltstone with minor claystone and silty sandstone. The bedrock was generally damp to very moist and locally wet. Bedding was observed to be laminated/thinly bedded with variable structure, similar to the Niguel Formation. The contact between Monterey and Niguel Formations was found to be fault controlled, with several faults/fault zones observed in Test Pits TP-3a and TP-3b. The Monterey Formation exhibits very different engineering properties ("high" expansion) compared to Niguel Formation ("very low" expansion) and will require additional remedial grading (see Section 3.2).

2.2 Geotechnical Conditions

Based on our geotechnical exploration and laboratory testing data (Appendix C), the geotechnical conditions are generally as follows:

Soil Moisture Content and Dry Density: The collected samples show that dry densities of the Niguel Formation bedrock generally vary from 87.5 to 120.5 pcf with moisture contents in the range of 2.0 to 30.6 percent. Dry densities of the artificial fill material varied from 106.1 to 117.3 pcf with moisture contents in the range of 8.8 to 14.8 percent.

Soil Properties: A grain-size distribution test was conducted on three samples, representative of the Niguel Formation, Monterey Formation, and existing artificial fill material. The Niguel Formation sample had a fines content (passing Sieve No. 200) of 14 percent, the Monterey Formation sample had a fines content of 72 percent, and the artificial fill sample had a fines content of 26 percent. The samples were classified as silty sand (SM), highly plastic silt (MH), and clayey sand (SC), respectively, per the Unified Soil Classification System (USCS).

Soil plasticity testing was performed on the bulk sample representative of Monterey Formation and was classified as highly plastic silt (MH) with a Plasticity Index of 30 and Liquid Limit of 75 percent. Plasticity testing was also performed on the fines portion of the sample representative of the Niguel Formation and indicated the fines were highly plastic silt (MH); however, considering the fines content of less than 50 percent, the sample was classified as SM.

Maximum density testing was performed on a bulk sample representative of the existing artificial fill materials and indicates a maximum dry density of 117.4 pcf at an optimum moisture content of 12.1 percent. Testing by Southern California Geotechnical (SCG, 2021) conducted on one sample taken from the uppermost 5 feet (Boring SB-2), representative of the Niguel Formation, shows a maximum dry density of 114 pcf at an optimum moisture content of 12 percent.

Shear Strength: Direct shear testing was conducted on four relatively undisturbed samples representative of the existing fill materials along the southerly slope and of the Niguel Formation. Direct shear testing was also performed by SCG during their prior study, generally representing the Niguel Formation. The following table includes the direct shear test results for various earth units and soil types:

Earth Unit	**Soil Type**	**Ultimate Strengths**		**Peak Strengths**		**Residual Strengths**	
		ϕ	**C (psf)**	**ϕ**	**C (psf)**	**ϕ**	**C (psf)**
Fill (Af)	Silty/Clayey Sand (SM)	31	170	34	450	--	--
	Silty/Clayey Sand (SM)	31	300	33	825	--	--
Niguel Formation (Tn)	Sandstone	36	800	40	1265	--	--
	Sandstone	37	100	41	300	--	--
	Siltstone (Silt Beds)	31	405	43	240	--	--
	Fine Grained Sandstone	34	200	39	335	31	200

Expansion Potential: Two samples were tested to determine the expansion potential of the onsite artificial fill materials and Monterey Formation. The artificial fill sample had an Expansion Index of 10, indicating "Very Low" expansion potential. The Monterey Formation sample had an Expansion Index of 106, indicating "High" expansion potential.

Chemical Properties: Soluble sulfate content of the soil was measured in two samples, one representative of the artificial fill materials and one of the Monterey Formation. Soluble sulfate content testing indicates the samples may be classified as "S0" per Table 19.3.1.1 of ACI-318-14.

Consolidation: Tests were performed on two samples at depths of 5 and 10 feet bgs, representative of existing fill materials. The testing shows that the fill materials have low compressibility. The samples had minor collapse upon the addition of water at a load of 0.8 ksf which is most likely related to sandy/disturbed nature of the soil.

Consolidation tests were performed on four samples collected by SCG (2021), from depths of 1, 3, 5, and 7 feet bgs, representative of the Niguel Formation. The testing showed that the materials have low compressibility. The tests show minor collapse (less than one-quarter percent) upon the addition of water at a load of 1.6 ksf.

2.3 Groundwater and Surface Water

Groundwater was not encountered in any of our onsite borings to a maximum depth of 75 feet bgs. Seepage was encountered in Boring B-2 at depths between 18.5 to 27 feet. Historic high groundwater mapping by the State shows high groundwater depths greater than 20 feet bgs (CDMG, 2001a).

Groundwater levels may fluctuate on an annual and seasonal basis based on rainfall and variations in future residential irrigation and/or adjacent land use. Perched water may be encountered during grading for deepened foundation elements or deep utility lines.

2.4 Regional Faulting and Seismicity

Regional Faults: The site is not located within a fault-rupture hazard zone as defined by the Alquist-Priolo Special Studies Zones Act (CGS, 2018). Also, based on mapping by the State (Jennings and Bryant, 2010), there are no active faults mapped at the site. Regional faults are presented on Figure 3. Several inactive (Pre-Quaternary-age) faults were observed during our subsurface exploration as shown on Plate 1 and the boring/test pit logs.

Seismicity: Properties in southern California are subject to seismic hazards of varying degrees depending upon the proximity, degree of activity, and capability of nearby faults. These hazards can be primary (i.e., directly related to the energy release of an earthquake) or secondary (i.e., related to the effect of earthquake energy on the physical world). Since there are no active faults at the site, the potential for primary ground rupture is considered very low. The primary seismic hazard for this site is ground shaking during a future earthquake. The maximum moment magnitude for the controlling fault is 7.1 Mw, which would be generated from the San Joaquin Hills Fault. Using the site coordinates of 33.56181 degrees latitude and -117.72862 degrees longitude, the San Joaquin Hills Fault is the closest fault to the site, approximately 2.7 miles to the west.

The site is not located within a mapped potential liquefaction hazard zone per the State's Seismic Hazard Mapping (CDMG, 2001b). A portion of the southerly slope is located adjacent to a potential earthquake-induced landslide zone; however, this potential hazard has been mitigated during mass grading as the original slope inclination was flattened to the current 2H:1V configuration. Slope stability was reviewed as part of our study and is discussed in the following section (Section 2.5). The attached Site Location and Seismic Hazards Map (Figure 1) depicts the site relative to County mapped potential seismic hazard zones. Other secondary seismic hazards, such as tsunami and seiche are considered nil due to site elevation and distance from the ocean or other confined bodies of water (CGS, 2022).

2.5 Slope Stability

The site geologic/geotechnical conditions are generally favorable for overall stability of the existing slope along the southerly portion of the site. The existing fill/stabilization fill slope ranges in height from approximately 40 to 70 feet at an inclination of 2H:1V or flatter. We prepared two cross-sections (Plates 3 and 4) depicting the existing descending slope at the site. Slope stability analysis was performed on cross-section B-B', which represents the highest portion of the perimeter slope at the site. The soil strength parameters were developed during this study per the direct shear test results and our experience with the earth units. The following table includes the strength parameters used for slope stability analysis:

Earth Unit	Soil Type	Ultimate Strength		Peak Strength	
		ɸ	C (psf)	ɸ	C (psf)
Fill (Af)	Silty/Clayey Sand (SM)	31	200	33	350
Niguel Formation (Tn)	Sandstone	34	200	39	350
	Siltstone with Along Bedding Strength	28	200	32	240

For pseudo-static analysis, we applied a seismic horizontal coefficient (k_h) of 0.22 in accordance with Special Publication 117A, Guidelines for Evaluation and Mitigating Seismic Hazards in California (CGS, 2008).

The results of the slope stability analysis are presented in Appendix E. The existing slope at the site was found to be grossly stable with a factor of safety of more than 1.5 under static conditions and a factor of safety of 1.1 or greater for pseudo-static conditions.

2.6 Settlement and Foundation Considerations

In general, the anticipated settlements depend upon the building loads, type of foundations, and the geotechnical properties of the supporting subgrade. Considering the subsurface soil conditions, laboratory test data, and anticipated lightly loaded residential structures, we estimate total settlement (combined static and seismic) to be on the order of 1-inch with differential settlement of ½-inch over a 40-foot span. The settlement estimate assumes remedial grading measures recommended in Section 3.2 of this report are implemented during grading.

2.7 Stormwater Infiltration Feasibility

The southern portion of the site is underlain by variably thick artificial fill overlying bedrock. The remainder of the site is generally underlain by shallow bedrock. County of Orange guidelines prohibit stormwater infiltration in compacted fill (OCPW, 2013). Additionally, infiltration of stormwater in bedrock can result in migration of subsurface water along bedding, faults, or lithologic contacts, resulting in seepage or springs in where previously none existed, potentially impacting offsite properties and slopes. Stormwater infiltration is not considered feasible from a geotechnical viewpoint.

2.8 Shrinkage and Bulking

The shrinkage and bulking (reduction or increase in volume of excavated materials upon recompaction and replacement as fill) varies by soil type, earth unit, and location. The volume change primarily depends on in-situ density and the maximum dry density of the soil type. We anticipate that shrinkage/bulking of the bedrock and compacted artificial fill (Af) will be relatively minor, and shrinkage of the undocumented fill/stockpile materials will be on the order of 5 to 15 percent. Ground subsidence at the site is estimated to be on the order of 0.1 foot.

2.9 Existing Utilities

Based on our review of the ALTA Survey and the DigAlert markings provided during the utility clearance procedure, there are several dry utility services present along the northern property boundary, adjacent to Freedom Lane. An exiting 12-inch water pipeline transects the site from east to west. Within the temporary desilting basin at the southeastern corner of the site, an 18-inch storm drain/tin whistle drains the basin to a junction structure located adjacent to Freedom Lane.

3.0 CONCLUSION AND PRELIMINARY RECOMMENDATIONS

3.1 General Conclusion and Recommendation

Construction of the proposed residential development, as described herein, is considered geotechnically feasible provided the preliminary recommendations in this report are implemented during design, grading, and construction. Additional geotechnical exploration is not considered necessary provided there are no significant plan changes. Grading, foundation, utility/street improvements, structural and wall plans for the project should be reviewed by the geotechnical consultant during the design phase. Updated recommendations may be provided once the project plans are finalized and as needed.

The recommendations in this report should be considered minimum and may be superseded by more restrictive requirements of others. In addition to the following recommendations, General Earthwork and Grading Specifications are provided in Appendix F.

3.2 Site Preparation and Earthwork

Site preparation and grading should be performed in accordance with the recommendations herein and the requirements of the City of Aliso Viejo.

3.2.1 Site Demolition and Clearing

Prior to remedial grading, any existing structures and utilities to be abandoned should be demolished. Deleterious materials and debris should be cleared and disposed of offsite. Excavations for the removal of existing utilities (i.e. temporary storm drain line, etc.) and vegetation, including any onsite trees, should be observed by the geotechnical consultant. Large roots, highly organic soils, and utility/pipeline debris should be removed and should not be incorporated into new fills.

Soil that is disturbed as part of excavations or during removal of trees or underground utilities should be evaluated by the geotechnical consultant. Excavations that require backfill should be properly documented and compacted under the observation and testing of the geotechnical consultant in accordance with the recommendations provided in Section 3.2.5.

3.2.2 Protection of Existing Improvements and Utilities

Existing buildings, improvements, and utilities adjacent to the site that are to be protected in place should be located and visually marked prior to grading operations. Excavations adjacent to improvements to be protected in-place or any utility easement should be performed with care, so as not to undermine existing foundations or destabilize the adjacent ground.

Stockpiling of soils more than 5 feet in height at or near existing structures and over utility lines should not be allowed. If deep excavation/removals are required, shoring or other special measures (i.e., setback or laybacks) to provide safety and mitigate the potential for lateral/vertical movements may be required.

3.2.3 Remedial Grading Measures

Remedial grading at the site should consist of removal of highly weathered/disturbed/faulted bedrock and all undocumented fill materials. Remedial removals are anticipated to range from 1 to 7 feet below existing grades. In general, remedial removal/overexcavation within the building pads is recommended to extend 3 to 5 feet below design grades or existing grades, whichever is lower. For areas underlain by faulted, highly expansive diatomaceous bedrock (Monterey Formation), we recommended a 7-foot removal/overexcavation. Remedial grading within the proposed drive areas may be limited to removal and recompaction of the upper 1 to 2 feet. The recommended remedial grading is shown on the Remedial Measures Map (Plate 2).

Considering the very different geotechnical conditions between the bedrock of Monterey Formation (northern portion of the site) and Niguel Formation, we recommend that the grading contractor attempt to mix the materials during the remedial grading/fill placement to achieve a more uniform subsurface soil conditions across the site. If that is not achieved, the geotechnical design parameters provided herein will be re-evaluated at the completion of grading and more stringent recommendations will need to be provided for the building pads underlain by highly expansive soils.

The geotechnical consultant should review and approve the removal bottoms prior to fill placement and should provide specific recommendations based on actual conditions, as necessary.

Excavations deeper than 4 feet will need to be laid back a minimum inclination of 1H:1V (horizontal to vertical) or provided with shoring. Shallow, unconfined excavations (4 feet or less) may consist of near-vertical excavation. In general, the excavation within the existing bedrock and fill materials should be in accordance with Cal/OSHA requirements for Soil Type "C". Friable sands prone to caving should be anticipated throughout the site. The contractor's qualified person should verify compliance with Cal/OSHA requirements. Excavations near existing structures (within a 1:1 projection) should be provided with shoring that is designed to support the surcharge load of the existing structure. Otherwise, excavations may be performed in sections (A/B/C slot cuts). The conditions should be reviewed in the field by the project geotechnical consultant. Additional recommendations will be provided based on the actual conditions encountered during excavation and grading, as needed.

3.2.4 Placement of Oversize Material

In general, bedrock at the site is friable and can be broken down. However, as discussed previously, boulders on the order of 2 to 4 feet in diameter are present at the ground surface (approximately two truckloads). If grading equipment cannot break down the material into smaller pieces, oversize rock will need to be disposed of in deeper fill areas, if any, or disposed offsite. Oversize rocks may be placed in fills deeper than 10 feet below design grades. The grading contractor should consider performing deeper remedial removals within design fill areas to facilitate placement of oversize rocks. Rocks larger than 6 inches and smaller than 12 inches in the largest dimension may be placed at depth between 4 and 10 feet below design finish grades or 1 foot below the deepest utility line, whichever is deeper. Rocks greater than 3 inches in dimension are typically not suitable for backfill of utility trench excavations (unless accepted by the agency/utility owner). Thus, we recommend that the grading contractor consider placement of rocks larger than 3 inches in dimension, if any, outside of proposed utility alignments.

The Grading and Earthwork Specifications in Appendix F include details for placement of oversize rock.

3.2.5 Fill Placement

Upon the completion of remedial grading measures, the approved removal/overexcavation bottoms should be scarified a minimum of 6 inches. The removal bottoms and fill materials should be compacted to at least 90 percent of maximum dry density, as determined by ASTM Test Method D1557. Fill materials should be placed in loose lifts no thicker than 8 inches.

Considering the very different geotechnical conditions between the bedrock of Monterey Formation (northern portion of the site) and Niguel Formation, we recommend that the grading contractor attempt to mix the materials during the remedial grading/fill placement to achieve a more uniform subsurface soil conditions across the site. If that is not achieved, the geotechnical design parameters provided herein will be re-evaluated at the completion of grading and more stringent recommendations will need to be provided for the building pads underlain by highly expansive soils.

Fill materials should be relatively free of deleterious material. The onsite artificial fill and bedrock materials are considered suitable for re-use as compacted fill provided any deleterious material is removed.

We recommend that the moisture content of new compacted fill soils be above the optimum moisture content but should be within the compactable moisture range. Appropriate equipment should be used and other measures (e.g., mixing, stockpiling, drying) may be needed to achieve the uniform and correct moisture content for fill placement. If the soils become extremely wet, special measures for mixing and drying may be required that will need to be determined based on the actual field conditions.

3.2.6 Import

The geotechnical consultant should evaluate and accept any import soils prior to transportation to the subject site. We recommend that import soils have similar engineering properties as onsite soils. At minimum, the import materials should have Expansion Index of less than 50, Plasticity Index of less than 15, fines content (passing Sieve 200) of less than 50 percent, and negligible soluble sulfate content.

3.3 Settlement Potential

The amount of settlement will depend upon the type of foundation(s) selected and future loading by additional fill and structures. Based on the subsurface exploration and laboratory data, our review and analysis, considering the remedial grading recommendations provided in this report are implemented during grading, and the anticipated structural loads typically associated with the proposed structures, we estimate that total and differential settlement (combined static and seismic) will be less than 1-inch and ½-inch over a span of 40 feet, respectively.

SA GEO should be provided with the foundation plans and structural loads, once available, to further evaluate the potential for post-construction settlement of the proposed buildings and associated improvements. The parameters provided herein will then be confirmed/updated based on the planned foundation layout and loads and any additional testing/analysis.

3.4 Foundation Design

The slab and foundations should be designed by the project structural engineer based on the proposed structure type and the anticipated loading conditions. Onsite soils are anticipated to have "Medium" expansion potential at the completion of grading. However, this will need to be confirmed upon the completion of grading as the northern portion of the site is underlain by highly expansive bedrock of the Monterey Formation. The following foundation recommendations are provided with the assumption that the recommendations included in Section 3.2 of this report are implemented during grading.

The recommended net allowable bearing capacity for continuous and isolated footings may be calculated based on the following equation:

$q_{all} = 800\ D + 300\ B + 700$ (but not to exceed 4,000 psf)

where:
D = embedment depth of footing, in feet
B = width of footing, in feet

Also, the following parameters may be used for design of foundation and slabs:

- Soil unit weight = 120 pcf
- Soil internal friction angle = 30 degrees
- Coefficient of Friction = 0.38
- Subgrade modulus (k) of 100 pci (corrected for large slabs)
- Soil elastic modulus (Es) of 1,500 psi

The dead load of concrete below adjacent grades (buried concrete foundations) may be neglected. The allowable bearing pressure and friction coefficient may be increased by one-third for wind and seismic loading.

We recommend that strip and isolated footings for the buildings have a minimum embedment depth of 18 inches below the lowest adjacent grade. Continuous footings should be at least 12 inches wide and isolated column footings should be at least 24 inches wide. The footings of freestanding and isolated structures, such as walls and pilasters, should have a minimum embedment depth of 18 inches into approved soils.

The following table provides our general guidelines and preliminary recommendations for design of post-tensioned foundations and slabs on expansive soil in accordance with the 2022 CBC and Post-Tension Institute (PTI) DC 10.5 Edition provisions.

GEOTECHNICAL GUIDELINES FOR DESIGN OF POST-TENSIONED SLABS*

Parameter	*Recommendation*
Center Lift	
* Edge Moisture Variation Distance, e_m	9.00 feet
* Center Lift, y_m	0.70 inches
Edge Lift	
* Edge Moisture Variation Distance, e_m	4.5 feet
* Edge Lift, y_m	0.80 inch
Presaturation, as needed, to obtain the minimum moisture down to the minimum depth	1.2 x optimum down to 12 inches
***Based on method in CBC 2022**	

For post-tensioned slabs, we recommend that the slabs have a thickened edge such that the slab is embedded a minimum of 12 inches below the lowest adjacent grade. The thickened edge should be tapered and have a minimum width of 12 inches.

In addition, as indicated in the DC 10.5 Edition of PTI, shape factor calculations should be performed by the project structural engineer in order to determine if strengthening/modification of foundations are necessary. Per PTI guidelines, the modifications to the foundations design should be considered if the shape factor (ratio of square of foundation perimeter over foundation area) exceeds 24.

If non-post-tensioned slabs-on-grade and foundations are considered at the site in accordance with Wire Reinforcement Institute (WRI) method (per the 2022 CBC), an effective Plasticity Index of 25 is considered appropriate for the upper 15 feet of soil materials. For non-post-tensioned slabs, we recommend a minimum embedment of 12 inches below the lowest adjacent grade for the perimeter footings. Also, the upper 12 inches of subgrade soil should be moisture conditioned to 120 percent of optimum moisture content prior to placement of moisture barrier and concrete.

The foundations and slabs should be designed to tolerate the total and differential settlements discussed in Section 3.3 of these recommendations.

For the design of pole-type foundations (i.e., light poles, shade structures, etc.), an allowable soil-bearing pressure (s_1) of 360 psf/ft may be used for Equation 18-1 (the "pole" equation) of the 2022 CBC Section 1807.3.2.1 to determine the depth of embedment for the footings, considering level ground conditions. The equation is applicable for designed embedment depths of less than 12 feet for the purpose of computing lateral pressure. Also, for vertical loads on pole-type foundations, an allowable skin friction of 300 pounds per square foot may be used. For cast-in-place pole-type foundations, the vertical end bearing pressure should be neglected.

3.5 Caisson Design

All caissons, if any, should have a minimum embedment of 5 feet into competent fill or bedrock materials. An average skin friction value of 300 pounds per square foot may be utilized to calculate the axial capacity of caissons. The lateral capacity of caissons may be computed using a value of 360 psf/ft but should not exceed 5,400 psf/ft for level conditions. For caissons near the existing descending slope with passive envelope impacted by the slope, the passive pressure should be limited to 180 psf/ft. Passive resistance may be doubled for isolated piles/caissons spaced a minimum of 3 diameters apart center-to-center. The allowable bearing pressure (both axial and lateral) may be increased by one-third for wind or seismic loading. Other minimum footing dimensions should be provided by the Structural Engineer and should comply with Table 1809.7 of the 2022 CBC.

Caissons should be designed in accordance with ACI recommendations and applicable building code requirements. The accepted criteria for caisson installation are detailed below:

- Caissons should be constructed as pre-drilled cast-in-place elements. A representative of the geotechnical consultant should be present during drilling of all caisson excavations in order to verify proper embedment and to geotechnically review appropriate drilling methods.
- Caisson excavations should be cleaned of loose soil, cuttings and groundwater and should be reviewed by the project geologist prior to placement of steel or concrete.
- No caisson boring shall be excavated within 6 feet from the nearest edge of a completed caisson unless the completed caisson has been filled with concrete for more than 24 hours.

3.6 Retaining Wall Design and Lateral Earth Pressures

Recommendations for lateral earth pressures for permanent retaining walls and structures with approved onsite drained soils and above groundwater table (drained condition) are as follows:

Conditions	*Level (pcf)*	*2:1 Sloping*
Active	40	65
At-Rest	60	85
Passive	360	180 (sloping down)

parameters provided above are based on a soil internal friction angle of 30 degrees and soil unit weight of 120 pcf.

To design an unrestrained retaining wall, such as a cantilever wall, the active earth pressure may be used. For a restrained retaining wall, the at-rest pressure should be used. Passive pressure is used to compute lateral soils resistance developed against lateral structural movement. The passive pressures provided above may be increased by one-third for wind and seismic loads. The passive resistance is taken into account only if it is ensured that the soil against embedded structure will remain intact with time. Future landscaping/planting and improvements adjacent to the retaining walls should also be taken into account in the design of the retaining walls. Excessive soil disturbance, trenches (excavation and backfill), future landscaping adjacent to footings and over-saturation can adversely impact retaining structures and result in reduced lateral resistance.

For sliding resistance, the friction coefficient of 0.38 may be used at the concrete and soil interface. The coefficient of friction may be increased by one-third for wind and seismic loading. The retaining walls may also need to be designed for additional lateral loads if other structures or walls are planned within a 1H:1V projection.

The seismic lateral earth pressure for walls retaining more than 6 feet of soil may be estimated to be an additional 18 pcf for active and at-rest conditions. The earthquake soil pressure has a triangular distribution and is added to the static pressures. For the active and at-rest conditions, the additional earthquake loading is zero at the top and maximum at the base. The seismic lateral earth pressure does not apply to walls retaining less than, or equal to, 6 feet of soil (2022 CBC Section 1803.5.12).

Drainage behind retaining walls (retaining more than 30 inches of soil) should also be provided in accordance with the attached Figure 4. Specific drainage connections, outlets and avoiding open joints should be considered for the retaining wall design.

3.7 Seismic Design Parameters

The following table summarizes the seismic design criteria for the subject site. The seismic design parameters are developed in accordance with ASCE 7-16 and 2022 CBC. Considering shallow bedrock across the site, the site is classified as Site Class "C". Please note that, considering the proposed structures and anticipated structural periods, site-specific ground-motion hazard analysis was not performed for the site. The seismic response coefficient, Cs, should be determined per the parameters provided below and using equation 12.8-2 of ASCE 7-16.

Selected Seismic Design Parameters from 2022 CBC/ASCE 7-16	*Seismic Design Values*	*Reference*
Latitude	33.56181 North	
Longitude	-117.72862 West	
Controlling Seismic Source	San Joaquin Hills	USGS, 2024
Site Class per Table 20.3-1 of ASCE 7-16	C	
Spectral Acceleration for Short Periods (Ss)	1.244 g	SEA/OSHPD, 2024
Spectral Accelerations for 1-Second Periods (S_1)	0.444 g	SEA/OSHPD, 2024
Site Coefficient F_a, Table 11.4-1 of ASCE 7-16	1.2	SEA/OSHPD, 2024
Site Coefficient F_v, Table 11.4-2 of ASCE 7-16	1.5	SEA/OSHPD, 2024
Design Spectral Response Acceleration at Short Periods (S_{DS}) from Equation 11.4-4 of ASCE 7-16	0.995 g	SEA/OSHPD, 2024
Design Spectral Response Acceleration at 1-Second Period (S_{D1}) from Equation 11.4-4 of ASCE 7-16	0.444 g	SEA/OSHPD, 2024
T_S, S_{D1} /S_{DS} 11.4.6 of ASCE 7-16	0.446 sec	
T_L, Long-Period Transition Period	8 sec	SEA/OSHPD, 2024
Peak Ground Acceleration Corrected for Site Class Effects (PGA_M) from Equation 11.8-1 of ASCE 7-16	0.639 g	SEA/OSHPD, 2024
Seismic Design Category Section 11.6 of ASCE 7-16	D	SEA/OSHPD, 2024

3.8 Slope Stability and Slope Setback

No significant modifications to the existing slope are planned as part of this project. The existing slope generally consists of artificial fill and Niguel Formation bedrock. The proposed improvements are not anticipated to adversely impact the slope. Based on our slope stability analysis (Appendix E), the existing slope was found to be grossly stable. In general, slopes are considered susceptible to surficial instability in the form of erosion, raveling, and slumping. Special care should be taken to ensure that onsite runoff is controlled and directed offsite in a non-erosive manner and that site drainage, and slopes are maintained over the life of the project.

Footings for structures located above descending slopes should be set back from the slope face in accordance with the minimum requirements of the City of Aliso Viejo and section 1808.7.1 of the 2022 CBC, whichever is greater. The setback distance is measured from the outside edge of the footing bottom along a horizontal line to the face of the slope.

The tables below summarize the minimum setback criteria for structures above descending slopes:

Case A – Building and Retaining Wall Footings Above Descending Slopes

Slope Height [H] (feet)	*Minimum Setback from Slope face (feet)*
Less than 10	5
10 to 20	½ * H
20 to 30	10
Greater than 30	⅓ * H (maximum of 40')

Case B – Freestanding Wall Footings Above Descending Slopes

Slope Height [H] (feet)	*Minimum Setback from Slope face (feet)*
Less than 10	5
10 to 20	½ * H
Greater than 20	Maximum of 10

For freestanding walls and other structures that are sensitive to lateral movement (e.g., smooth stucco finish, glass screens, etc.), SA GEO recommends that the structural setback requirements in accordance with Case A above be followed or that additional design measures be used to help control the potential for cracking and displacements. Otherwise, typical freestanding walls may have a setback in accordance with Case B.

3.9 Corrosivity

Based on laboratory testing, soluble sulfate exposure in the onsite soils may be classified as "S0" per Table 19.3.1.1 of ACI-318-14. Structural concrete elements in contact with soil include footings and building slabs-on-grade. The flatwork and sidewalk concrete are typically not considered structural elements. Concrete mix for structural elements should be based on the "S0" soluble sulfate exposure class of Table 19.3.2.1 in ACI-318-14. Other ACI guidelines for structural concrete are recommended. Also, onsite soils are anticipated to be corrosive to metals.

3.10 Expansion Potential

At the completion of grading, we anticipate that onsite soils will have "Medium" expansion potential. The geotechnical recommendations provided in this report including the design parameters for foundations, slab-on-grade and flatwork improvement should be implemented during design and construction. Updated recommendations will be provided upon additional testing at the completion of grading at the site and as needed.

3.11 Interior Slab Moisture Mitigation

In addition to geotechnical and structural considerations, the project owner should also consider interior moisture mitigation when designing and constructing slabs-on-grade.

The intended use of the interior space, type of flooring, and type of goods in contact with the floor may dictate the need for, and design of, measures to mitigate potential effects of moisture emission from and/or moisture vapor transmission through the slab. Typically, for human occupied structures, a vapor retarder or barrier is recommended under the slab to help mitigate moisture transmission through slabs. The most recent guidelines by the American Concrete Institute (ACI 302.1R-04) suggest that the vapor retarder be placed directly under the slab (no sand layer). However, the location of the vapor retarder may also be subject to the builder's past successful practice. Placement of 1 or 2 inches of sand over the moisture retardant has been common practice by builders in southern California. Specifying the strength of the retarder to resist puncture and its permeance rating is important. These qualities are not necessarily a function of the retarder thickness. A minimum of 10-mil is typical but some materials, such as 10-mil polyethylene ("Visqueen"), may not meet the desired standards for toughness and permeance.

Vapor retarders, when used, should be installed in accordance with standards such as ASTM E 1643 and/or those specified by the manufacturer.

Concrete mix design and curing are also significant factors in mitigating slab moisture problems. Concrete with lower water/cement ratios results in denser, less permeable slabs that also "dry" faster with regard to when flooring can be installed (reduced moisture emissions quantities and rates). Rewetting of the slab following curing should be avoided since it can result in additional drying time required prior to flooring installation. Proper concrete slab testing prior to flooring installation is also important.

Concrete mix design, the type and location of the vapor retarder should be determined in coordination with all parties involved in the finished product, including the project owner, architect, structural engineer, geotechnical consultant, concrete subcontractors, and flooring subcontractors.

3.12 Exterior Concrete

The driveway, patio slabs and other flatwork elements should be at least 4 inches thick. We recommend that the concrete be reinforced with No. 3 rebars placed at 24 inches on center both ways. Equivalent wire mesh reinforcement may also be used. Concrete slabs should be provided with construction or weakened plane control joints at a maximum spacing of 8 feet. The control joints should have a thickness that is ¼ of the total concrete thickness. The subgrade soils in the upper 12 inches should be pre-saturated to 120 percent of optimum moisture content.

For exterior slabs, the use of a granular sublayer is primarily intended to facilitate presaturation and subsequent construction by providing a better working surface over the saturated soil. It also helps retain the added moisture in the native soil in the event that the slab is not placed immediately. Where these factors are not significant, the layer may be omitted. If used, we recommend placement of 2 to 4 inches of granular material over subgrade soils.

Exterior concrete elements such as curb and gutter, driveways, sidewalks and patios are susceptible to lifting and cracking when constructed over expansive soils. With expansive soils, the impacts to flatwork/hardscape can be significant, generally requiring removal and replacement of the affected improvements. Please also note that reducing concrete problems is often a function of proper slab design, concrete mix design, placement, and curing/finishing practices. Adherence to guidelines of the American Concrete Institute (ACI) is recommended. Also, the amount of post-construction watering, or lack thereof, can have a very significant impact on the adjacent concrete flatwork.

On projects with expansive soils, additional measures such as thickened concrete edges/footings, subdrains and/or moisture barriers should be considered where planter or natural areas with irrigation are located adjacent to the concrete improvements. Design and maintenance of proper surface drainage is also very important. If the concrete will be subject to heavy loading from cars/trucks or other heavy objects, thicker pavement section will be required the design of which should be performed by the geotechnical consultant, as needed.

3.13 Preliminary Asphalt Concrete Pavement Design

Final structural pavement sections should be based on R-value testing after the completion of grading and in accordance with City of Aliso Viejo/County of Orange requirements. Using a design R-value of 15 and estimated traffic indices (TIs), we recommend the following preliminary pavement sections:

Street Location	*Estimated TIs*	*Pavement Section*
Parking Stalls	TI – 4.0	3 inches of AC / 6 inches of AB
General Drives	TI – 5.5	4 inches of AC / 9 inches of AB
AC = Asphalt Concrete, AB = Aggregate Base		

Please note that for two-stage paving operations, we recommend that the final AC cap be a minimum of 0.10 foot thick and the base AC course have a minimum thickness of 0.25 foot.

If pavement repair is needed within the adjacent streets, the section should match the existing section and follow standard City/County guidelines for trench/pavement repair. The new pavement section should at minimum consist of 4 inches of AC over 9 inches of AB unless approved otherwise by the geotechnical consultant and based on evaluation of subgrade soils.

Asphalt concrete pavement should be placed in accordance with the requirements of Sections 301 and 302 of the Standard Specifications of Public Works Construction (the Greenbook). Prior to construction of pavement sections, the subgrade soils should be scarified to a minimum depth of 6 inches, moisture-conditioned as needed, and recompacted in-place to a minimum of 90 percent relative compaction (per ASTM D1557). Subgrade should be firm prior to AB placement.

AB materials can be crushed aggregate base or crushed miscellaneous base in accordance with the Greenbook (Section 200-2). The materials should be free of any deleterious materials. Aggregate base materials should be placed in 6- to 8-inch-thick loose lifts, moisture-conditioned as necessary, and compacted to a minimum of 95 percent relative compaction (per ASTM D1557). Asphalt concrete should also be compacted to a minimum relative compaction of 95 percent.

Unpaved median and parkway areas should be provided with vertical moisture barriers.

3.14 Vehicular PCC Pavements

If trash enclosures or truck loading areas are to be constructed at the site, we recommend 6 inches of PCC reinforced with No. 4 rebar at 18 inches on-center, both ways, over compacted subgrade. For parking stalls, the section may consist of 4 inches of PCC reinforced with No. 4 rebar at 18 inches on-center, both ways, over compacted subgrade.

The subgrade soils should be scarified to a minimum depth of 6 inches, moisture-conditioned as needed, and recompacted in place to a minimum of 90 percent relative compaction (per ASTM D1557).

Aggregate base materials can be crushed aggregate base or crushed miscellaneous base in accordance with the Greenbook (Section 200-2). The materials should be free of any deleterious materials. Aggregate base materials should be placed in 6- to 8-inch-thick loose lifts, moisture-conditioned as necessary, and compacted to a minimum of 95 percent relative compaction (per ASTM D1557).

3.15 Concrete Paver Section

For concrete pavers within **pedestrian** walkways, we recommend 60-millimeter-thick concrete pavers over approximately 1 inch of sand, over a minimum of 6 inches of AB, over compacted subgrade. This should also accommodate the rare maintenance cart or light truck that might drive up on these areas.

For concrete pavers within **vehicular** drive areas, if any, we recommend 80-millimeter-thick concrete pavers over 6 inches of concrete reinforced with No. 3 rebar at 24 inches on-center, over compacted subgrade. Alternatively, the concrete low pour slab may be replaced with a minimum of 13 inches of AB over compacted subgrade; or 10 inches of AB over a layer of geotextile (e.g., Mirafi 600X or equivalent), over compacted subgrade.

A concrete band along the perimeter of the pavers should be provided for lateral restraint. The concrete band should, at minimum, be 12 inches deep and deepened to below the depth of disturbed soil, if adjacent to landscape/planter areas.

Also, a drainage system consisting of a 2-inch PVC drainage pipe should be installed at the low end of the concrete low pour at 10-foot intervals through the slab and filled with pea gravel. The PVC drainage pipe should drain to a minimum of 6-inch-diameter by 12-inch-deep drain pit filled with pea gravel below the pipe. The paver surfaces should slope away from structures a minimum of 2 percent. The concrete underlayment for the drive areas should be provided with weakened plane joints at maximum 8-foot intervals. If the pavers are to be set in mortar or are underlain with AB, this drainage system is not required.

Prior to construction of the paver sections, the subgrade soils should be scarified to a minimum depth of 6 inches, moisture conditioned as needed, and recompacted in place to a minimum of 90 percent relative compaction (per ASTM D1557). The upper 12 inches of subgrade for pedestrian walkway and patio areas should then be presaturated to 120 percent of optimum moisture content. Subgrade for vehicular pavers need not be pre-saturated.

Aggregate base materials can be crushed aggregate base or crushed miscellaneous base in accordance with the Greenbook (Section 200-2). The materials should be free of deleterious materials. Aggregate base materials should be placed in 6- to 8-inch-thick loose lifts, moisture-conditioned as necessary, and compacted to a minimum of 95 percent relative compaction (per ASTM D1557).

3.16 Trench Excavation and Backfill

Excavations should be performed in accordance with the requirements set forth by Cal/OSHA Excavation Safety Regulations (Construction Safety Orders, Section 1504, 1539 through 1547, Title 8, California Code of Regulations). In general, onsite soils may be classified as Type "C" soils for excavations into compacted fill and/or bedrock. Cal/OSHA regulations indicate that, for workmen in confined conditions, the steepest allowable slopes in Type "C" soils is 1.5H:1V (horizontal to vertical), respectively, for excavations less than 20 feet deep. Where there is no room for these layback slopes, we anticipate that shoring will be necessary. The subsurface soils are generally sandy and may be friable, locally loose, and prone to caving. This condition should also be anticipated for excavations within the streets adjacent to the site. Adequate shoring/shield should be provided, as deemed necessary. Backfilling may require sand-cement slurry in order to reduce the potential of caving during the removal of shoring. Excavations should be reviewed periodically by the contractor's qualified person to confirm compliance with Cal/OSHA requirements.

Onsite soils should be suitable for use as trench backfill. Utility trench backfill should be in accordance with City of Aliso Viejo and/or the governing jurisdiction's specifications. Backfill materials should be compacted to a minimum of 90 percent relative compaction (per ASTM D1557). Rocks greater than 3 inches in largest diameter should generally not be used as trench backfill unless approved by the agency and geotechnical consultant of record. Excavation and backfilling of HDPE pipes (if any) should be in accordance with the manufacturer's requirement and the Greenbook. Select granular backfill (i.e., clean sand with SE 30 or better) may be used in lieu of native soils but should also be compacted or densified with water jetting and flooding.

Trenches excavated next to structures and foundations should also be properly backfilled and compacted to provide full lateral support and reduce settlement potential.

3.17 Groundwater

In general, groundwater is anticipated to remain more than 20 feet below design grades upon the completion of grading. However, shallow, perched groundwater/seepage may occur on an annual and seasonal basis as a result of rainfall, irrigation and/or seepage from adjacent properties, and along earth unit contacts (i.e., artificial fill and bedrock). Groundwater is not expected to be encountered during grading or utility construction; however, the presence of locally saturated soils and/or perched water cannot be ruled out, especially during rainy seasons.

3.18 Stormwater Infiltration Feasibility

Considering that the site is underlain by very dense bedrock and artificial fill, and the presence of a relatively large perimeter slope along the southern property boundary, infiltration of stormwater is not feasible at the site from a geotechnical viewpoint and is considered a geotechnical hazard per County of Orange's guidelines (OCPW, 2013). Other methods of stormwater treatment, such as detention and biofiltration basins, should be evaluated by the project civil engineer.

3.19 Surface Drainage and Irrigation

Maintaining adequate surface drainage, proper disposal of run-off water, and control of irrigation will help reduce the potential for future moisture-related problems and differential movements from soil heave/settlement.

Surface drainage should be carefully taken into consideration during grading, landscaping, and building construction. Positive surface drainage should be provided to direct surface water away from structures and slopes and toward the street or suitable drainage devices. Ponding of water adjacent to the structures should not be allowed. Buildings should have roof gutter systems and the run-off should be directed to parking lot/street gutters by area drainpipes or by sheet flow over paved areas. Paved areas should be provided with adequate drainage devices, gradients, and curbing to prevent run-off flowing from paved areas onto adjacent unpaved areas.

Considering the climatic conditions in southern California and provided that the recommendations included in this report are implemented during grading and construction, a minimum two-percent slope away from structures is considered acceptable and in substantial compliance with the 2022 CBC. Also, swales with one-percent slopes are acceptable from a geotechnical standpoint and are common practice in this locale.

Construction of planter areas immediately adjacent to structures should be avoided if possible. If planter boxes are constructed adjacent to or near buildings, the planters should be provided with controls to prevent excessive penetration of the irrigation water into the foundation and flatwork subgrades. Provisions should be made to drain excess irrigation water from the planters without saturating the subgrade below or adjacent to the planters. Raised planter boxes may be drained with weepholes. Deep planters (such as palm tree planters) should be drained with below-ground, water-tight drainage lines connected to a suitable outlet. Moisture barriers should also be considered.

It is also important to maintain a consistent level of soil moisture, not allowing the subgrade soils to become overly dry or overly wet. Properly designed landscaping and irrigation systems can help in that regard.

3.20 Slope Maintenance, Lot Drainage, and Erosion Control

Maintenance of proper pad drainage, the design and construction of property improvements in accordance with sound engineering practices, and proper maintenance of landscaping, including regular pad and slope irrigation, should be performed. Irrigation should not be excessive or sporadic; maintaining a relatively constant level of soil moisture around structures and improvements is important. Oversteepening of slopes should be avoided.

Planters and landscape areas adjacent to structures should be avoided or provided with measures to mitigate the potential for water getting under the foundations and slabs. Water should not be allowed to pond and drainage should be maintained away from structures and tops of slopes.

Establishing and maintaining a rodent-control program is also recommended to reduce surficial slope deterioration often associated with rodent burrowing. The improvements at or near the tops of slopes may be subject to varying degrees of slope-creep related movements and should be designed with that in mind.

3.21 Additional Subsurface Exploration and Laboratory Testing

Additional subsurface exploration during the design phase of the project is not anticipated provided no significant plan changes occur. Additional laboratory testing should be performed during and upon completion of the grading to confirm/update the design parameters provided herein.

3.22 Review of Future Plans

The project grading, foundation, street improvement, wall, and landscape plans should be reviewed and accepted by the geotechnical consultant prior to grading and construction. Additional recommendations should be provided upon the review of the project plans and as needed.

3.23 Observation and Testing during Grading and Construction

Geotechnical observation and testing should be performed by SA GEO during the following phases of grading and construction:

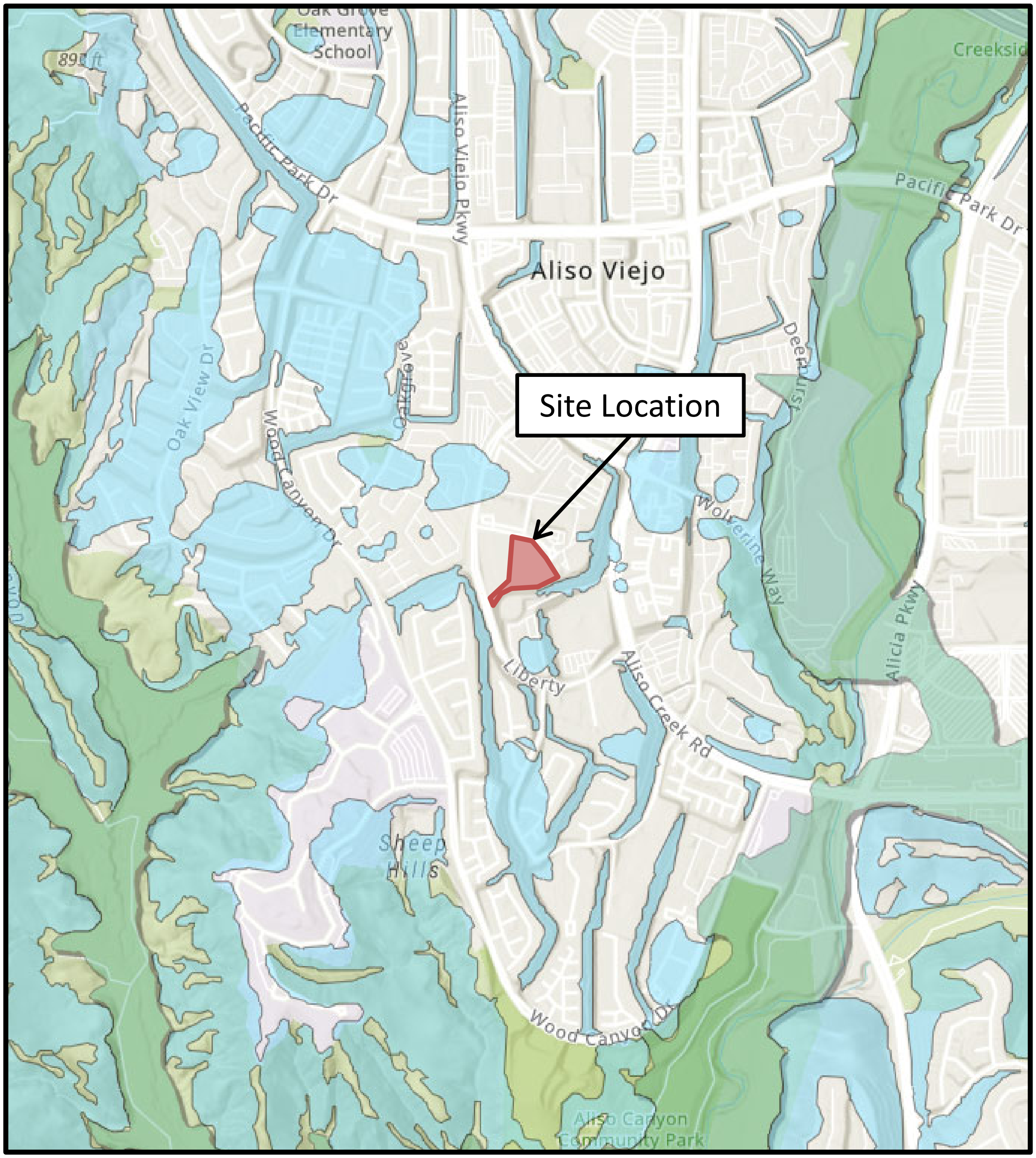
- During site demolition, preparation and clearing;
- During excavations performed for remedial grading and to relocate or remove existing underground improvements and structures;

- During earthwork, including observation and acceptance of remedial removal/overexcavation bottoms and fill placement, including import material (if any);
- Following the completion of grading, in order to verify soil properties for foundations, slab-on-grade and pavement areas;
- Upon completion of any foundation or structural excavation, prior to pouring concrete;
- During slab and flatwork subgrade preparation including pre-saturation, prior to pouring of concrete;
- During placement of backfill for utility trenches;
- During construction of the stormwater filtration devices/basins;
- During placement of backfill for retaining structures, if any;
- During installation and backfill of subdrainage systems; and
- When any unusual soil conditions are encountered.

4.0 LIMITATIONS

This report has been prepared for the exclusive use of our client, Meritage Homes, within the scope of services requested for the subject property described herein. This report or its contents should not be used or relied upon for other projects or purposes, or by other parties without the acknowledgement of SA GEO and the consultation of a geotechnical professional. The means and methods used by SA GEO for this study are based on local geotechnical standards of practice, care, and requirements of governing agencies. No warranty or guarantee, expressed or implied, is given.

Our findings, conclusions, and recommendations are professional opinions based on interpretations and inferences made from geologic and engineering data from specific locations and depths, observed or collected at a given time. By nature, geologic conditions can vary from point to point, can be very different in-between exploration points, and can also change over time. Our conclusions and recommendations are, by nature, preliminary and subject to verification and/or modification during grading and construction when more subsurface data is exposed.


Oak Grove Elementary School
890 ft
Creekside
Pacific Park Dr
Aliso Viejo Pkwy
Pacific Park Dr
Aliso Viejo
Deerhurst
Site Location
Oak View Dr
Wood Canyon Dr
Oakgrove
Wolverine Way
Alicia Pkwy
Liberty
Aliso Creek Rd
Sheep Hills
Wood Canyon Dr
Aliso Canyon Community Park

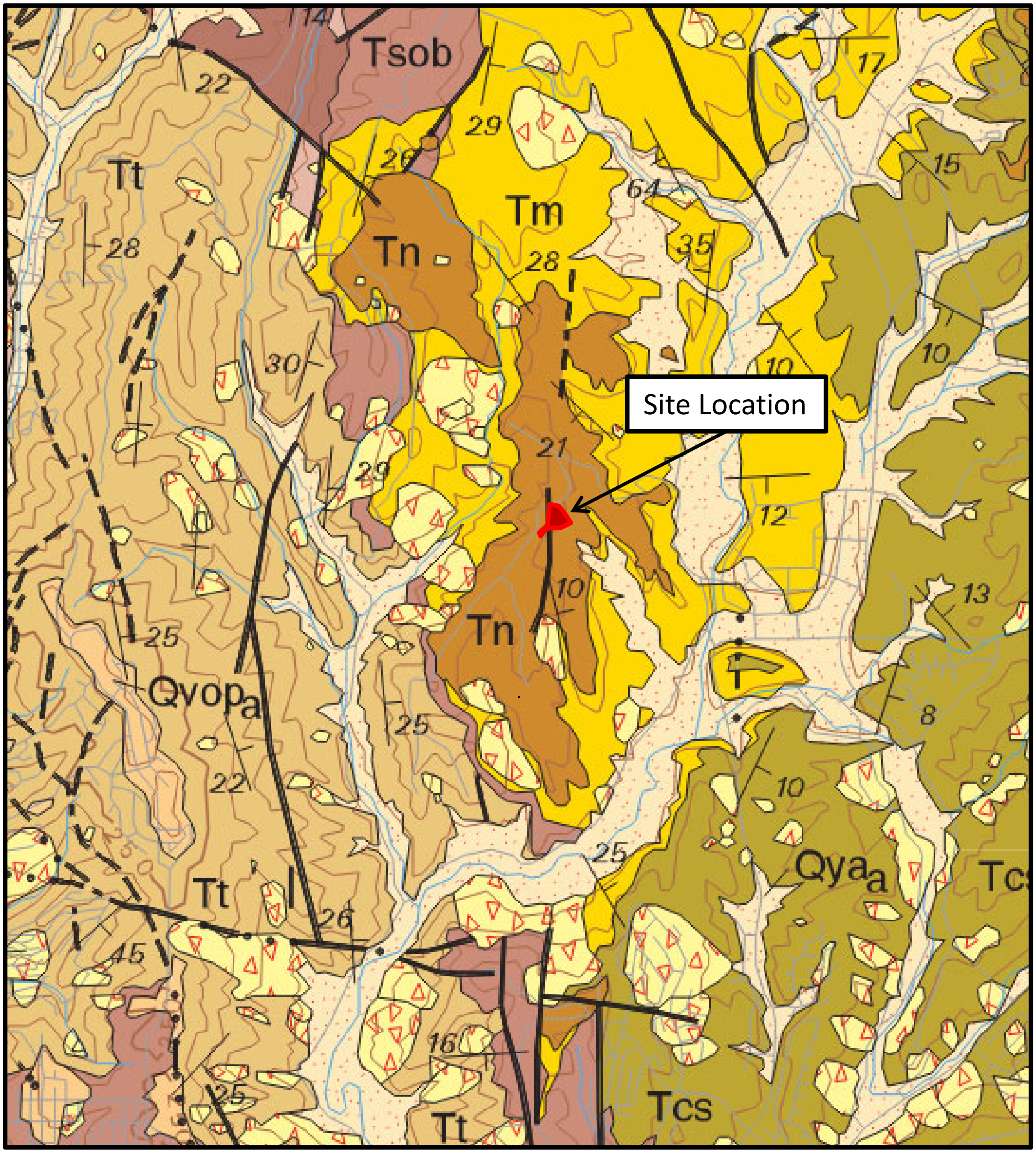
Source: Seismic Hazard Zones, San Juan Capistrano Quadrangle (CDMG, 2001b)

🟩	**Liquefaction** Areas where historic occurrence of liquefaction, or local geological, geotechnical and groundwater conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resource Code Section 2693(c) would be required.
🟦	**Earthquake-Induced Landslides** Areas where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resource Code Section 2693(c) would be required.

Site Location and Seismic Hazard Map

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01
Date: June 3, 2024
Figure 1


Tsob
14
22
29
26
Tt
Tm
64
17
15
Tn
28
35
28
10
30
10
Site Location
21
29
12
10
Tn
13
25
Qvopa
25
8
22
10
25
Qyaa
Tc
Tt
26
45
16
25
Tcs
Tt

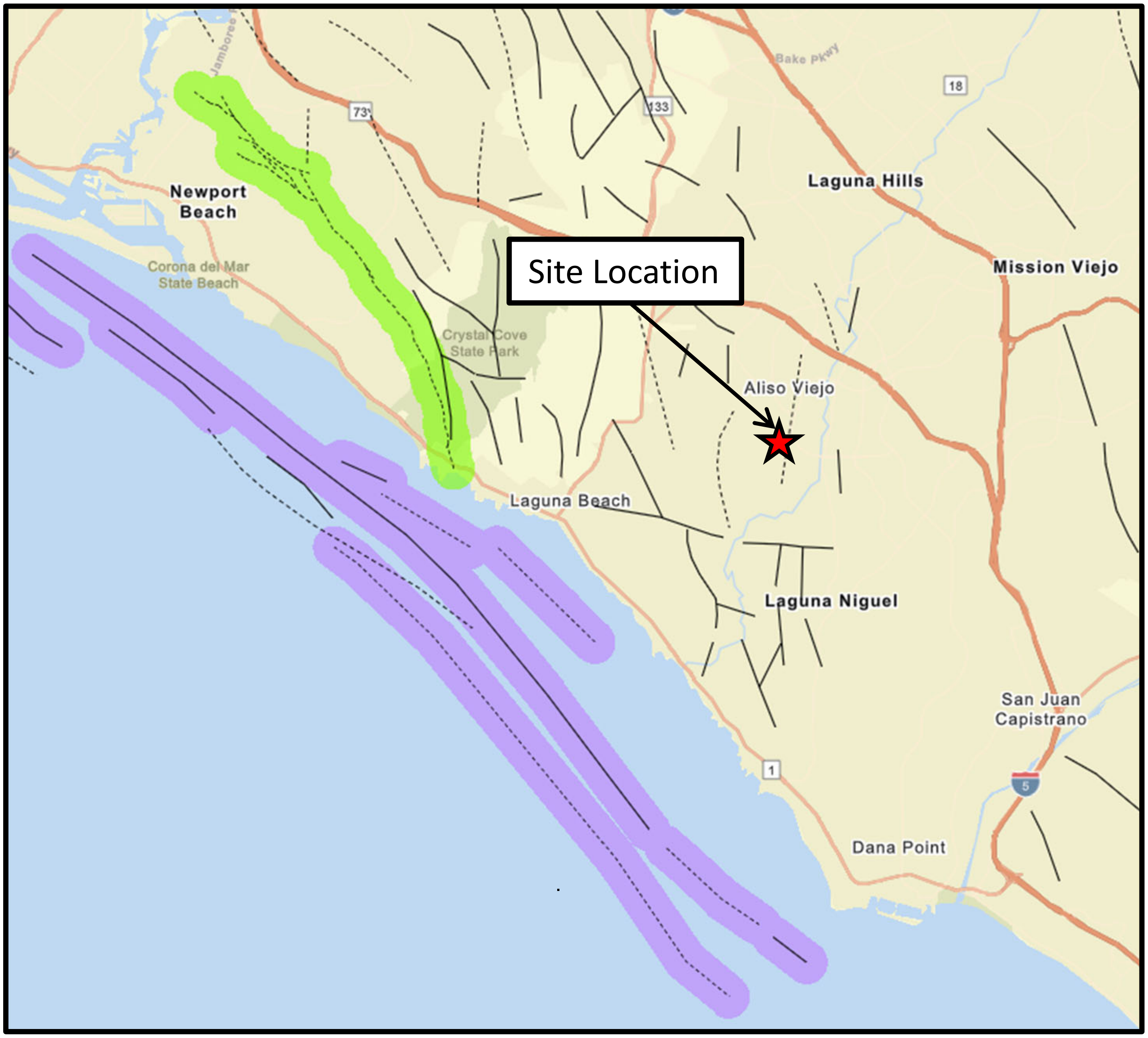
Source: Geologic Map of the San Bernardino and Santa Ana 30' X 60' Quadrangles (USGS, 2006)

Regional Geologic Map

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01
Date: June 3, 2024
Figure 2

S/A


Site Location
Newport Beach
Corona del Mar State Beach
Crystal Cove State Park
Laguna Beach
Aliso Viejo
Laguna Hills
Mission Viejo
Laguna Niguel
San Juan Capistrano
Dana Point
Bake Pkwy
Jamboree
73
133
18
1
5

Source: Fault Activity Map of California (Jennings and Bryant, 2010)

🟧 ——— — — — ....?	Holocene fault displacement (during past 11,700 years) without historic record. Geomorphic evidence for Holocene faulting includes sag ponds, scarps showing little erosion, or the following features in Holocene age deposits: offset stream courses, linear scarps, shutter ridges, and triangular faceted spurs. Recency of faulting offshore is based on the interpreted age of the youngest strata displaced by faulting.
🟩 ——— — — — ....?	Late Quaternary fault displacement (during past 700,000 years). Geomorphic evidence similar to that described for Holocene faults except features are less distinct. Faulting may be younger, but lack of younger overlying deposits precludes more accurate age classification.
🟪 ——— — — — ....?	Quaternary fault (age undifferentiated). Most faults of this category show evidence of displacement sometime during the past 1.6 million years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age. Unnumbered Quaternary faults were based on Fault Map of California, 1975. See Bulletin 201, Appendix D for source data.
——— — — — ....?	Pre-Quaternary fault (older that 1.6 million years) or fault without recognized Quaternary displacement. Some faults are shown in this category because the source of mapping used was of reconnaissnce nature, or was not done with the object of dating fault displacements. Faults in this category are not necessarily inactive.

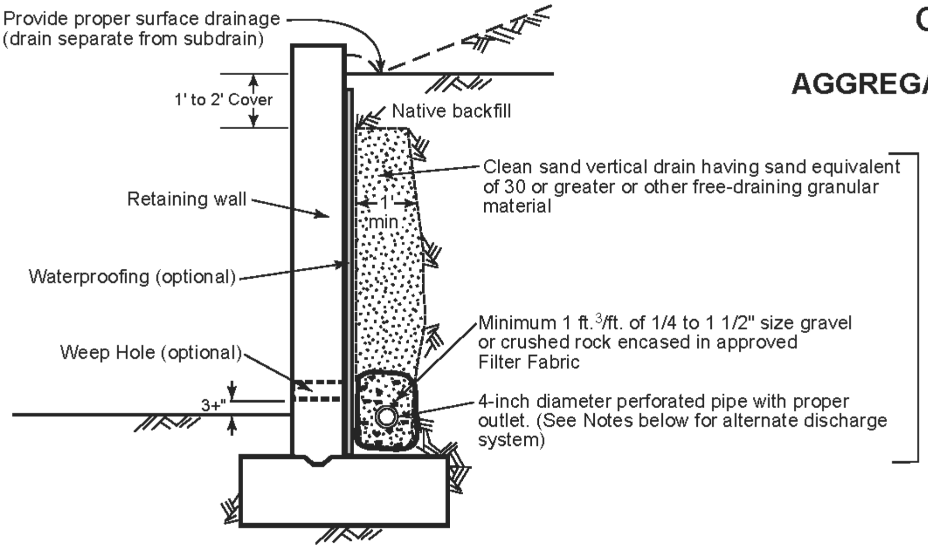
Regional Fault Map

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01
Date: June 3, 2024
Figure 3

OPTION 1:

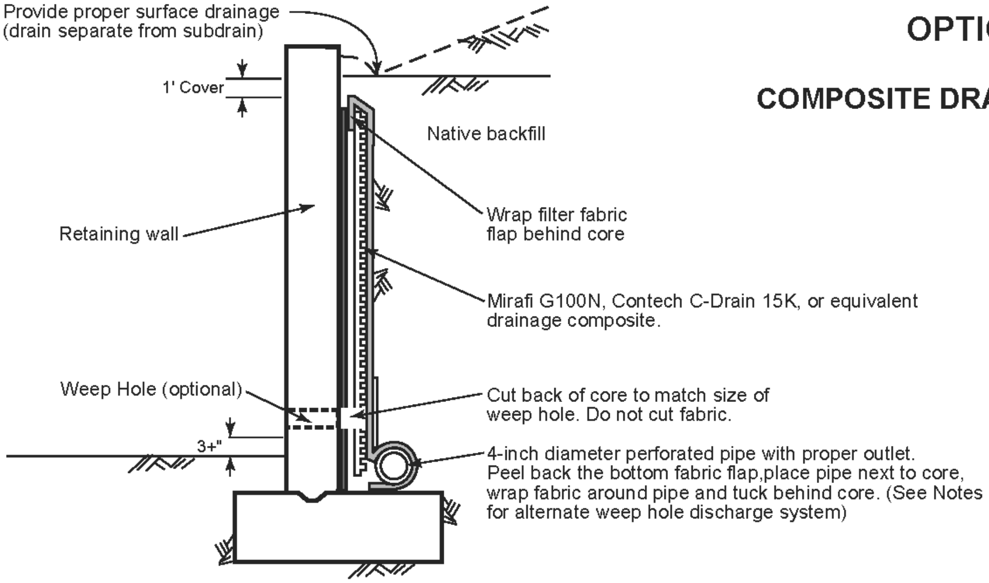
AGGREGATE SYSTEM DRAIN


Provide proper surface drainage (drain separate from subdrain)
1' to 2' Cover
Native backfill
Clean sand vertical drain having sand equivalent of 30 or greater or other free-draining granular material
Retaining wall
1' min
Waterproofing (optional)
Minimum 1 ft.^{3}/ft. of 1/4 to 1 1/2" size gravel or crushed rock encased in approved Filter Fabric
Weep Hole (optional)
3+"
4-inch diameter perforated pipe with proper outlet. (See Notes below for alternate discharge system)

Alternative: Class 2 permeable filter material (Per Caltrans specifications) may be used for vertical drain and around perforated pipe (without filter fabric)

OPTION 2:

COMPOSITE DRAINAGE SYSTEM


Provide proper surface drainage (drain separate from subdrain)
1' Cover
Native backfill
Retaining wall
Wrap filter fabric flap behind core
Mirafi G100N, Contech C-Drain 15K, or equivalent drainage composite.
Weep Hole (optional)
Cut back of core to match size of weep hole. Do not cut fabric.
3+"
4-inch diameter perforated pipe with proper outlet. Peel back the bottom fabric flap,place pipe next to core, wrap fabric around pipe and tuck behind core. (See Notes for alternate weep hole discharge system)

NOTES:

1. PIPE TYPE SHOULD BE PVC OR ABS, SCHEDULE 40 OR SDR35 SATISFYING THE REQUIREMENTS OF ASTM TEST STANDARD D1527, D1785, D2751 , OR D3034.
2. FILTER FABRIC SHALL BE APPROVED PERMEABLE NON-WOVEN POLYESTER, NYLON, OR POLYPROPYLENE MATERIAL.
3. DRAIN PIPE SHOULD HAVE A GRADIENT OF 1 PERCENT MINIMUM.
4. WATERPROOFING MEMBRANE MAY BE REQUIRED FOR A SPECIFIC RETAINING WALL (SUCH AS A STUCCO OR BASEMENT WALL).
5. WEEP HOLES MAY BE PROVIDED FOR LOW RETAINING WALLS (LESS THAN 3 FEET IN HEIGHT) IN LIEU OF A VERTICAL DRAIN AND PIPE AND WHERE POTENTIAL WATER FROM BEHIND THE RETAINING WALL WILL NOT CREATE A NUISANCE WATER CONDITION. IF EXPOSURE IS NOT PERMITTED, A PROPER SUBDRAIN OUTLET SYSTEM SHOULD BE PROVIDED.
6. IF EXPOSURE IS PERMITTED, WEEP HOLES SHOULD BE 2-INCH MINIMUM DIAMETER AND PROVIDED AT 25-FOOT MAXIMUM SPACING ALONG WALL. WEEP HOLES SHOULD BE LOCATED 3+ INCHES ABOVE FINISHED GRADE.
7. SCREENING SUCH AS WITH A FILTER FABRIC SHOULD BE PROVIDED FOR WEEP HOLES/OPEN JOINTS TO PREVENT EARTH MATERIALS FROM ENTERING THE HOLES/JOINTS.
8. OPEN VERTICAL MASONRY JOINTS (I.E., OMIT MORTAR FROM JOINTS OF FIRST COURSE ABOVE FINISHED GRADE) AT 32-INCH MAXIMUM INTERVALS MAY BE SUBSTITUTED FOR WEEP HOLES.
9 THE GEOTECHNICAL CONSULTANT MAY PROVIDE ADDITIONAL RECOMMENDATIONS FOR RETAINING WALLS DESIGNED FOR SELECT SAND BACKFILL.

Retaining Wall Drainage Detail

Figure 4

Appendix A

APPENDIX A

REFERENCES

California Division of Mines and Geology (CDMG), 2001a, Seismic Hazard Zone Report for the San Juan Capistrano 7.5-Minute Quadrangle, Orange County, California, Seismic Hazard Zone Report 053.

California Division of Mines and Geology (CDMG), 2001b, Seismic Hazard Zones, San Juan Capistrano Quadrangle, Official Map dated December 21, 2001.

California Geological Survey (CGS), 2008, Guidelines for Evaluation and Mitigating Seismic Hazards in California, Special Publication 117A.

California Geological Survey (CGS), 2018, Earthquake Fault Zones, A Guide for Government Agencies, Property Owners / Developers, and Geoscience Practitioners for Assessing Fault Rupture Hazards in California, Special Publication 42, Revised 2018.

California Geological Survey (CGS), 2021, Tsunami Hazard Area Map, County of Orange, California, Official Map dated July 8, 2021.

Jennings, Charles W. and Bryant W.A., 2010, Fault Activity Map of California, Department of Conservation, California Geological Survey, Geologic Data Map No. 6.

Nationwide Environmental Title Research, LLC (NETR), 2024, Historic Aerials by NETR Online, Date Accessed: May 24, 2024; website address: http://historicaerials.com

Orange County Public Works (OCPW), 2013, Orange County Watersheds Water Quality Management Plan (WQMP) Technical Guidance Document for the Preparation of Conceptual/Preliminary and/or Project Water Quality Management Plans, Exhibit 7.III, Dated December 20, 2013.

Orange County Public Works (OCPW), 2024, County of Orange, Historic Aerial Imagery, Date Accessed: May 24, 2024; website address: https://www.ocgis.com/ocpw/historicalimagery/

Southern California Geotechnical, Inc., 2021, Geotechnical Investigation, Proposed Commercial/Industrial Development, 400-700 Freedom Lane, Aliso Viejo, California, Project No.: 21G167-1, dated July 2, 2021.

Structural Engineers Association/Office of Statewide Health Planning and Development (SEA/OSHPD), 2024, U.S. Seismic Design Maps, web site address: https://seismicmaps.org/; Date Accessed: May 31, 2024.

APPENDIX A (Cont'd)

REFERENCES

U.S. Geological Survey, 2006, Geologic Map of the San Bernardino and Santa Ana 30' X 60' Quadrangles, California, dated 2006, Open File Report 2006-1217.

U.S. Geological Survey, 2024, Unified Hazard Tool, NSHM 2014 Dynamic Deaggregation Program; web site address: https://earthquake.usgs.gov/hazards/interactive/; Date Accessed: May 31, 2024.

Appendix B

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	*GRAVEL AND GRAVELLY SOILS* MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	*CLEAN GRAVELS* (LITTLE OR NO FINES)	**GW**	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	**GM**	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	*CLEAN SANDS* (LITTLE OR NO FINES)	**SW**	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	**SM**	SILTY SANDS, SAND - SILT MIXTURES
			SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	*SILTS AND CLAYS*	LIQUID LIMIT LESS THAN 50	**ML**	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50	**MH**	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			**PT**	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: Dual symbols are used to indicate gravels or sand with 5-12% fines and soils with fines classifying as CL-ML. Symbols separated by a slash indicate borderline soil classifications.

Sampler and Symbol Descriptions

■ Modified California sample (D-#)
◩ Standard Penetration Test (S-#)
◫ Shelby tube sample (T-#)
▩ Large bulk sample (B-#)
☒ Small bulk sample (SB-#)
∇ Approximate depth of groundwater during drilling
▼ Approximate depth of static groundwater

Note: Number of blows required to advance driven sample 12 inches (or length noted).

Laboratory and Field Test Abbreviations

AL	Atterberg limits (plasticity)
CC	Chemical Testing incl. Soluble Sulfate
CN	Consolidation
DS	Direct Shear
EI	Expansion Index
GS	Grain Size Analysis (Sieve, Hydro. and/or -No. 200)
MD	Maximum Density and Optimum Moisture
RV	Resistance Value (R-Value)
SE	Sand Equivalent
UU	Unconsolidated Undrained Shear Strength

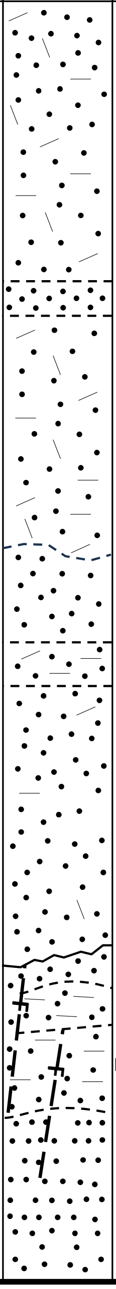
Notes:

1. Soil classifications are based on the Unified Soil Classification System and include color, moisture, and relative density or consistency. Field descriptions have been modified to reflect results of laboratory tests where deemed appropriate. Bedrock descriptions are based on visual classification and include rock type, moisture, color, grain size, strength, and weathering.
2. Descriptions on these boring logs apply only at the specific boring locations and at the time the borings were drilled. They are not warranted to be representative of subsurface conditions at other locations or times.

S/A

KEY TO LOG OF BORING

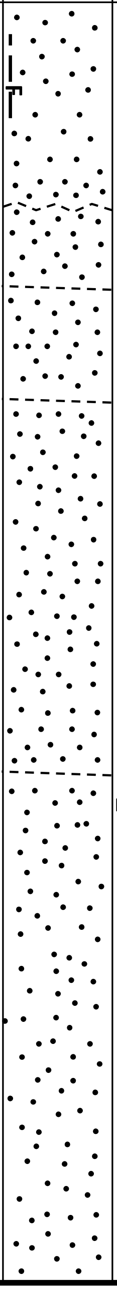
Date(s) Drilled: 05-07/08-2024	**Logged By:** AC/PA/AZ	**B-1** Page 1 of 3
Drilling Method: Bucket Auger	**Drill Bit Size/Type:** 24”	
Drill Rig Type: Cal Weld	**Hammer Drive Drop (in.):** 12”	
Drive Weight (lbs.): 0-25’: 2500, 25-45’: 1500, 45-65’: 750, 65-90’: 1300		**Total Depth Drilled (ft):** 75
Drilling Company: Big Johnny’s		**Approximate Ground Surface Elevation (ft):** 460.5
Comments:		

Depth (ft)	SAMPLES Type and Number	SAMPLES Blows Per Foot	Graphic Log S N	Attitudes	USCS	DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Remarks
						**Artificial Fill (Af)** @0’: Yellowish brown silty fine to medium SAND, moist, medium dense. Visible fill lifts 4 to 6 inches thick. Roots in the upper 1.5’. Trace bedrock fragments 2 to 4 inches in diameter.			
5	D-1	3			SM	@5’ SAMPLE: Yellowish brown silty fine to medium SAND, moist, medium dense, clean sand stringers, iron staining.	14.8	112.5	DS, CN
						@6.5’: 8-inch-thick clean sand layer, damp.			
10	D-2	9			SM	@10’ SAMPLE: Dark brown to pale gray silty fine to coarse SAND, moist, medium dense.	10.3	117.3	DS, CN
						@10.7’: Dark brown silty clayey SAND, moist, medium dense.			
						@12.9’:Undulatory fill lift/contact, friable sand below.			
						@14.8’: Brown silty SAND, about 1’ thick.			
15	D-3	4			SM	@15’ SAMPLE: Pale olive brown to pale brown silty fine to medium SAND with gravel, damp, medium dense.	14.6	108.7	
						@15.7’: Pale yellowish brown SAND, slightly friable.			
20	D-4	3			SP-SM	@20’ SAMPLE: Pale brownish gray to olive brown fine to coarse SAND with silt, moist to very moist, medium dense, trace bedrock fragments.	8.8	106.1	
				@22.5 B: N6E, 12E		@ 22.0’-22.5’: Undulatory contact with bedrock below (Tn).			
				@23.6 B: N45W, 4N @24.1 F: N40E, 85SE		**Niguel Formation (Tn)** @22.5’: Pale yellow fine to medium SANDSTONE, slightly friable, damp, about 16” thick, jarosite staining. @23.8’: Olive yellow silty fine to medium SANDSTONE, damp, dense, weakly cemented, flame structure/soft-sediment deformation.			
25				@24.5 F: N66E, 74S @26.0 B: N2E, 11E		@24.1’: Pale yellow to white silty fine to medium SAND, slightly friable. @25’: Open joint/fracture, ½-inch thick, steeply dipping, iron staining. @24.3-28.3’: Fault set, massive on hanging wall, iron stained bedding on foot wall.			
30						@29’: Fine to medium SANDSTONE, trace silt, massive, friable, damp.			

Geotechnical Log Of Boring

Project Number: 24064-01
Project Name: Meritage Homes
400-700 Freedom Lane

Date(s) Drilled: 05-08-2024	**Logged By:** AC/AZ	**B-1** Page 2 of 3
Drilling Method: Bucket Auger	**Drill Bit Size/Type:** 24”	
Drill Rig Type: Cal Weld	**Hammer Drive Drop (in.):** 12”	
Drive Weight (lbs.): 0-25’: 2500, 25-45’: 1500, 45-65’: 750, 65-90’: 1300		**Total Depth Drilled (ft):** 75
Drilling Company: Big Johnny’s		**Approximate Ground Surface Elevation (ft):** 460.5
Comments:		

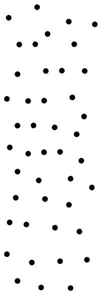


Depth (ft)	SAMPLES Type and Number	SAMPLES Blows Per Foot	Graphic Log	Attitudes	USCS	DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Remarks
	D-5	6		@30.2 B: N13W, 19W @31.8 B: Flat	SP	@30’ SAMPLE: White to pale yellowish gray fine to coarse SANDSTONE, damp, medium dense, iron staining, slightly micaceous, friable.	2.0	103.0	
						@30.2’: Iron staining along bedding, cross bedded.			
						@30.6-32.9’: Vertical fault on southeast wall, 1-inch of apparent offset on sand/iron stained beds.			
35				@34.8 B: Flat		@34.8’: Yellow fine to medium SANDSTONE, little to no silt, damp, friable, erosional/undulatory contact with SANDSTONE below.			
				@36.6 B: N77E, 3N		@37’: Color change to pale yellow, dense, friable SANDSTONE, very massive.			
				@39.2 B: N88W, 4N		@39.2’: Color change to olive yellow.			
40	D-6	10		@39.0 B: N84W, 4N	SP	@40’ SAMPLE: Pale yellowish brown to white fine to medium SANDSTONE, moist to very moist, dense, iron staining, friable.	4.7	108.4	DS
						@40’: Interbedded pale yellow, olive yellow, reddish yellow clean fine to medium SANDSTONE, moist to very moist, friable.			
						@43’: Interbedded pale yellow and reddish yellow SANDSTONE, very moist to wet.			
45						@46’: Fine to coarse SANDSTONE, moist, massive, shells.			
				@48.0 B: N65W, 6NE		@48’: Pale yellow to white SANDSTONE, moist, mostly massive, no iron staining.			
50	D-7	13			SP	@50’ SAMPLE: Pale yellowish gray to white fine to coarse SANDSTONE with fine gravel, moist, very dense, trace iron staining, trace shell fragments, slightly friable.	3.8	105.8	
				@51.1 B: Flat		@51.1: 8-inch-thick SANDSTONE bed highlighted by iron staining along bedding, damp. Horizontal/flat bedding.			
				@53.5 B: N31W, 2N					
55									
						@58: Very massive, no iron staining.			
60									

Geotechnical Log Of Boring

Project Number: 24064-01
Project Name: Meritage Homes
400-700 Freedom Lane

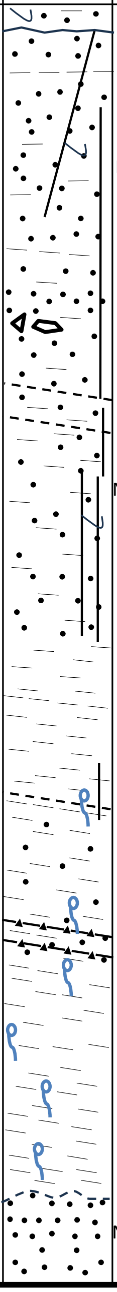
Date(s) Drilled: 05-08-2024	**Logged By:** AC/AZ	**B-1** Page 3 of 3
Drilling Method: Bucket Auger	**Drill Bit Size/Type:** 24”	
Drill Rig Type: Cal Weld	**Hammer Drive Drop (in.):** 12”	
Drive Weight (lbs.): 0-25’: 2500, 25-45’: 1500, 45-65’: 750, 65-90’: 1300		**Total Depth Drilled (ft):** 75
Drilling Company: Big Johnny’s		**Approximate Ground Surface Elevation (ft):** 460.5
Comments:		

Depth (ft)	SAMPLES Type and Number	 Blows Per Foot	Graphic Log S N	Attitudes	USCS	DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Remarks
	D-8	17			SP	@60’ SAMPLE: Pale olive brown to white fine to coarse SANDSTONE, very moist, very dense, trace iron staining, trace fine gravel, friable.	3.3	108.5	
65									
						@68’: Heavily iron stained.			
70	D-9	19			SP	@70’ SAMPLE: Yellowish brown to pale yellowish gray medium to coarse SANDSTONE, very moist, very dense, trace iron staining, friable.	5.9	120.5	
75						Notes: Total Depth: 75’ (Caved in to 71’). Downhole Logged to 67’. No Groundwater. Backfilled With Cuttings And Tamped.			
80									
85									
90									

Geotechnical Log Of Boring

Project Number: 24064-01
Project Name: Meritage Homes
400-700 Freedom Lane

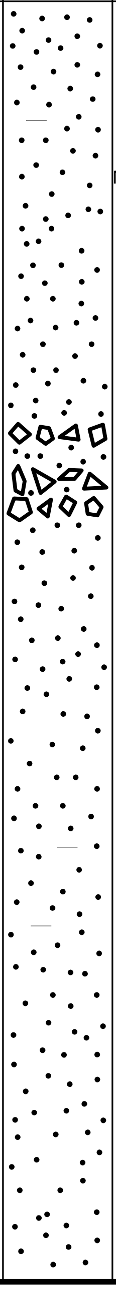
Date(s) Drilled: 05-09-2024	**Logged By:** AC/PA	**B-2** Page 1 of 3
Drilling Method: Bucket Auger	**Drill Bit Size/Type:** 24”	
Drill Rig Type: Cal Weld	**Hammer Drive Drop (in.):** 12”	
Drive Weight (lbs.): 0-25’: 2500, 25-45’: 1500, 45-65’: 750, 65-90’: 1300		**Total Depth Drilled (ft):** 65
Drilling Company: Big Johnny’s		**Approximate Ground Surface Elevation (ft):** 468
Comments: Seepage at 18.4, 19.6-28.4.		

Depth (ft)	SAMPLES Type and Number	SAMPLES Blows Per Foot	Graphic Log S N	Attitudes	USCS	DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Remarks
				@1.5 B: N22W, 2W		**Niguel Formation (Tn)** @0-0.7’: Top soil.			
				@3.0 J: N34E, 82W		@0.7’-5’: Pale olive brown silty SANDSTONE, moist, medium dense, iron staining, scattered roots, jointed.			
5	D-1	3		@5.0 J: N8E, 90	SP	@5’: SAMPLE: Pale olive brown fine to medium SANDSTONE, moist to very moist, medium dense, iron staining, trace silt, massive.	11.6	107.6	
				@6.4 B: N66W, 4N		@7’: Iron stained layer/bedding, siltstone ripup clasts, wet.			
				@7.0 B: N67E, 9N		@8’: Pale olive brown silty SANDSTONE, moist, iron and manganese staining.			
				@9.3 C: N66W, 6N		@8.8-9.3’: Contact with SILTSTONE below, slight seepage on downdip side, manganese staining, cemented along bedding.			
10	D-2	7		@9.5 J: N7E, 87E @10.0 C: N74W, 22N	SM/ ML	@10’ SAMPLE: Yellowish brown to pale gray silty fine SANDSTONE/ sandy SILTSTONE, very moist, dense, iron staining, fractured.	19.3	106.6	
						@9.7’: Iron stained contact with pale gray silty fine SANDSTONE, moist, massive.			
						@11’: Near-vertical parallel joints, manganese stained, roots.			
15						@14.5’: Gradational contact with gray massive siltstone.			
				@16.0 B: N76E, 8N					
				@18.5 J: N28W, 90E		@18.5’: Near-vertical joint, light seepage.			
				@19.6 B: E-W, 9N		@19.4’: Contact, laminated SILTSTONE below, well bedded.			
20	D-3	6			ML	@20’ SAMPLE: Olive brown to yellowish brown sandy SILTSTONE, very moist to wet, hard, thinly laminated, well bedded.	30.6	87.5	GS, AL, DS
				@21.5 CB: N78W, 9N		@21.5’: Clay bed 1/8” thick, slightly sheared.			
				@22.0 CB: N65W, 6N		@22’: Clay bed 1/8” thick, gray, slightly sheared, plastic.			
25						@22’: Pale gray massive iron stained SILTSTONE, seepage.			
						@27’: Seepage.			
				@28.0 C: N30W, 15N		@27.8’: Undulatory contact, pale gray to brown SANDSTONE, clean, massive.			
30									

Geotechnical Log Of Boring

Project Number: 24064-01
Project Name: Meritage Homes
400-700 Freedom Lane

Date(s) Drilled: 05-09-2024	**Logged By:** AC/PA	**B-2** Page 2 of 3
Drilling Method: Bucket Auger	**Drill Bit Size/Type:** 24”	
Drill Rig Type: Cal Weld	**Hammer Drive Drop (in.):** 12”	
Drive Weight (lbs.): 0-25’: 2500, 25-45’: 1500, 45-65’: 750, 65-90’: 1300		**Total Depth Drilled (ft):** 65
Drilling Company: Big Johnny’s		**Approximate Ground Surface Elevation (ft):** 468
Comments:		

Depth (ft)	SAMPLES Type and Number	SAMPLES Blows Per Foot	Graphic Log S N	Attitudes	USCS	DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Remarks
	D-4	12			SP	@30’ SAMPLE: Pale gray to white fine to medium SANDSTONE, damp, dense, iron staining, massive, slightly friable. – Sample Disturbed - @30.5’: Iron stained cross bedding. @32’: Pale gray SANDSTONE, damp, dense, slightly friable, trace silt, little to no iron staining, massive.	2.3	81.5	
				@33.5 B: N58W, 10N					
35									
				@38.0 B: N67W, 7N		@38’: Iron staining along bedding.			
40	D-5	9			SP	@40’-42’: Siltstone rip-up clasts along bedding. @40’ SAMPLE: Pale gray to white fine to medium SANDSTONE, damp, dense, some iron staining, slightly friable. @41’: Scattered shell fragments.	5.3	107.8	
				@41.0 B: N86E, 9N					
45									
50	D-6	20		@50.0 B: Flat	SP	@50’ SAMPLE: Pale yellowish gray to white SANDSTONE, damp to moist, dense to very dense, trace iron staining, slightly friable. @50’: Pale gray slightly silty SANDSTONE, moist, dense, slightly friable, massive, iron staining along bedding.	6.6	106.5	
55									
				@58.0 B: N48E, 3N		@58’: Increasingly friable, banded iron staining.			
60									

Geotechnical Log Of Boring

Project Number: 24064-01
Project Name: Meritage Homes
400-700 Freedom Lane

Date(s) Drilled: 05-09-2024	**Logged By:** AC/PA	**B-2** Page 3 of 3
Drilling Method: Bucket Auger	**Drill Bit Size/Type:** 24”	
Drill Rig Type: Cal Weld	**Hammer Drive Drop (in.):** 12”	
Drive Weight (lbs.): 0-25’: 2500, 25-45’: 1500, 45-65’: 750, 65-90’: 1300		**Total Depth Drilled (ft):** 65
Drilling Company: Big Johnny’s		**Approximate Ground Surface Elevation (ft):** 468
Comments:		

Depth (ft)	SAMPLES		Graphic Log	Attitudes	USCS	DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Remarks
	Type and Number	Blows Per Foot	S N						
	■ D-7	18			SP	@60’ SAMPLE: Pale olive brown fine to coarse SANDSTONE, damp to moist, dense to very dense, some iron staining, micaceous, trace shell fragments. @60’: Pale gray SANDSTONE, moist, trace silt, banded iron staining.	6.9	111.5	
65						Notes: Total Depth: 65’. Downhole Logged to 63’. No Groundwater. Backfilled With Cuttings And Tamped.			
70									
75									
80									
85									
90									

Geotechnical Log Of Boring

Project Number: 24064-01
Project Name: Meritage Homes
400-700 Freedom Lane

Date(s)Excavated: 05-03-2024	**Logged By:** AC/AZ
Excavation Method: Backhoe	
Equipment Type: Deere 310 SL	
Sampling Method(s): Bulk	
Approximate Groundwater Depth: Groundwater Not Encountered.	
Comments:	

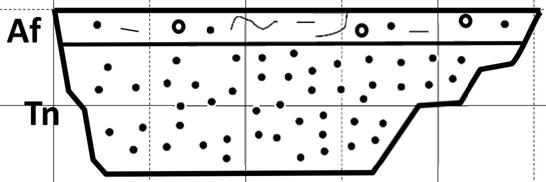
TP-1

Total Depth (ft): 4

Approximate Ground Surface Elevation (ft): 464.5

Sample Depth (ft)	SAMPLES Type Number	SAMPLES Blows Per Foot	USCS	Log Of Test Pit	Moisture Content (%)	Dry Density (pcf)	REMARKS
				Surface: Weeds			
0				**Artificial Fill (Af)**			
	▨ B-1		SM	@ 0-0.6’: Pale olive gray to pale brown silty fine SAND with coarse gravel, dry, loose, vegetation and roots.			Bulk Bag @ 1-4'
				Niguel Formation (Tn)			
			SM	@ 0.6’-4’: Yellowish gray to reddish yellow fine to coarse SANDSTONE, damp, medium dense, banded iron staining, friable, slight caving, massive.			
5							
				Notes: Total Depth: 4 Feet. Groundwater Not Encountered. Backfilled with Cuttings and Rolled.			
10							
15							

Graphic Orientation: North Wall **Trend:** E-W **Scale:** 1”=5’



Log Of Test Pit

Meritage Homes Proposed Residential Development 400-700 Freedom Lane Aliso Viejo, California	Project Number: 24064-01 Appendix B

Date(s)Excavated: 05-03-2024

Logged By: AC/AZ

Excavation Method: Backhoe

Equipment Type: Deere 310 SL

Sampling Method(s):

Approximate Groundwater Depth: Groundwater Not Encountered.

Comments:

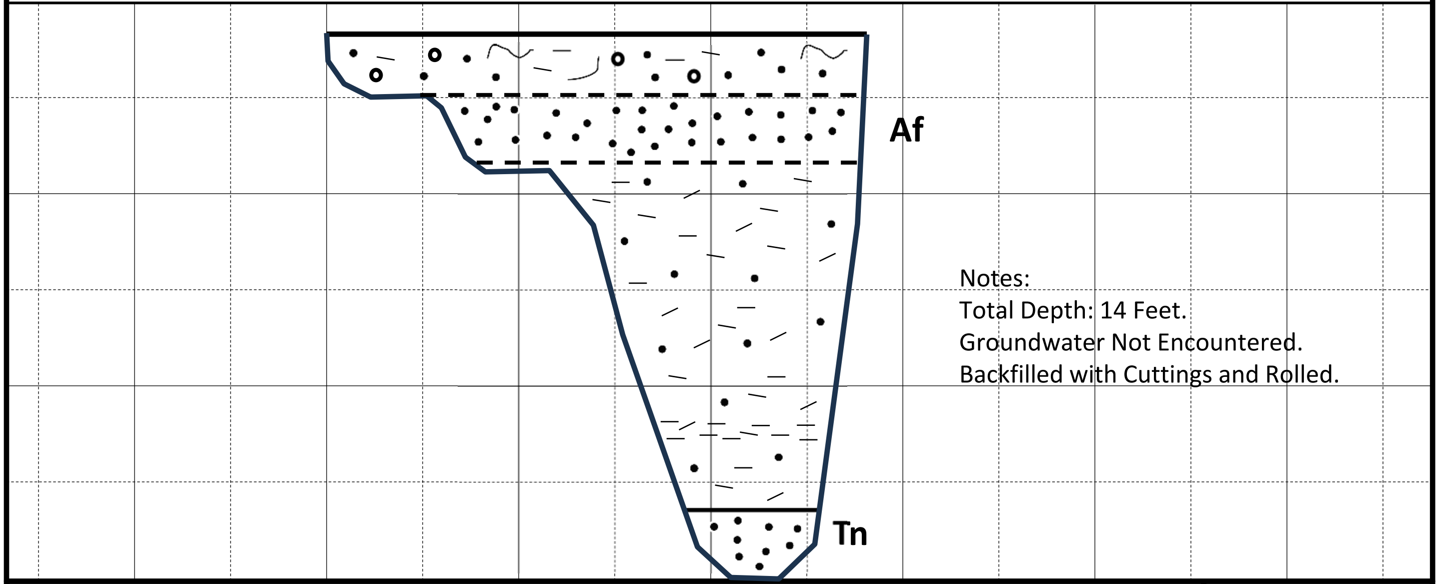
TP-2

Total Depth (ft): 14

Approximate Ground Surface Elevation (ft): 475

Sample Depth (ft)	SAMPLES Type Number	SAMPLES Blows Per Foot	USCS	Log Of Test Pit	Moisture Content (%)	Dry Density (pcf)	REMARKS
				Surface: Weeds			
0				**Undocumented Artificial Fill (Afu)**			
			SM	@ 0-1.5’: Yellowish gray to pale brown silty fine SAND dry, loose, little coarse gravel, roots, scattered vegetation.			
			SP	@ 1.5-3’: Pale yellowish gray to white fine to coarse SAND, damp, loose, friable/caving.			
			SM	@ 3-12.5’: Pale brown to yellowish brown silty fine to coarse SAND, damp to moist, medium dense, trace clay and asphalt debris.			
5							
10			SM/	@ 10’: Moist to very moist.			
			ML	@ 11’: Brown sandy SILT.			
				Niguel Formation (Tn)			
			SM	@ 12.5-14’: Pale yellowish gray to white fine to coarse SANDSTONE, moist, dense, iron staining, friable, caving, massive.			
15							

Graphic Orientation: North Wall **Trend:** <-N69W- **Scale:** 1”=5’



Notes:
Total Depth: 14 Feet.
Groundwater Not Encountered.
Backfilled with Cuttings and Rolled.

Log Of Test Pit

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

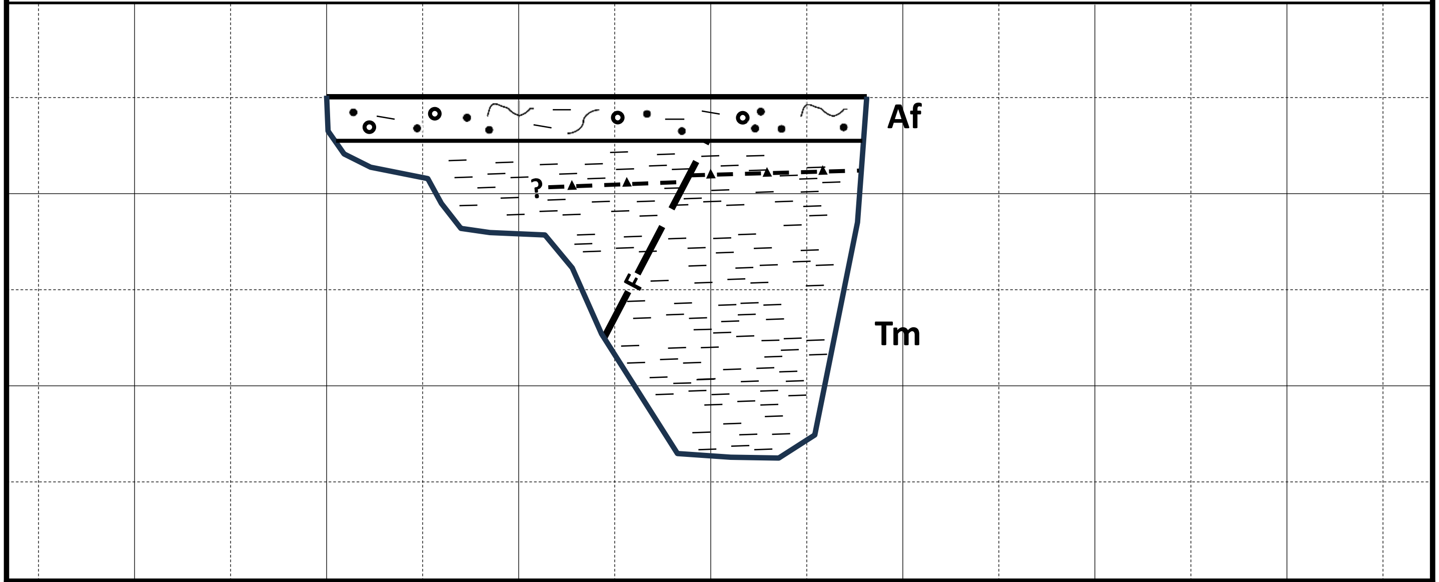
Project Number: 24064-01

Appendix B

Date(s)Excavated: 05-03-2024	**Logged By:** AC/AZ	**TP-3**
Excavation Method: Backhoe		
Equipment Type: Deere 310 SL		
Sampling Method(s): Bulk		**Total Depth (ft)**: 9
Approximate Groundwater Depth: Groundwater Not Encountered.		**Approximate Ground Surface Elevation (ft):** 461.5
Comments:		

Sample Depth (ft)	SAMPLES Type Number	SAMPLES Blows Per Foot	USCS	Log Of Test Pit Surface: Weeds	Moisture Content (%)	Dry Density (pcf)	REMARKS
0			SM	**Artificial Fill (Af)** @ 0-1': Pale brown silty fine SAND with gravel, dry, loose.			Bulk Bag @ 1-4' GS, AL, EI, CC
	B-1		MH	**Monterey Formation (Tm)** @ 1-9': Pale brown to white SILTSTONE, moist, medium dense, well laminated, diatomaceous. @2': 0.25-inch-thick olive gray CLAY, very moist, slightly plastic, offset by fault 1 to 2 inches, pinches out north of fault.			@2' CB: N62E, 4W @2.5' F: N40W, 78SW @4' J: N44E, 82E
5							
10				Notes: Total Depth: 9 Feet. Groundwater Not Encountered. Backfilled with Cuttings and Rolled.			
15							

Graphic Orientation: North Wall **Trend:** <-N45W- **Scale:** 1"=5'



Log Of Test Pit

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01

Appendix B

Date(s)Excavated: 05-07-2024
Logged By: AC/AZ
Excavation Method: Backhoe
Equipment Type: Deere 310 SL
Sampling Method(s):
Approximate Groundwater Depth: Groundwater Not Encountered.
Comments:

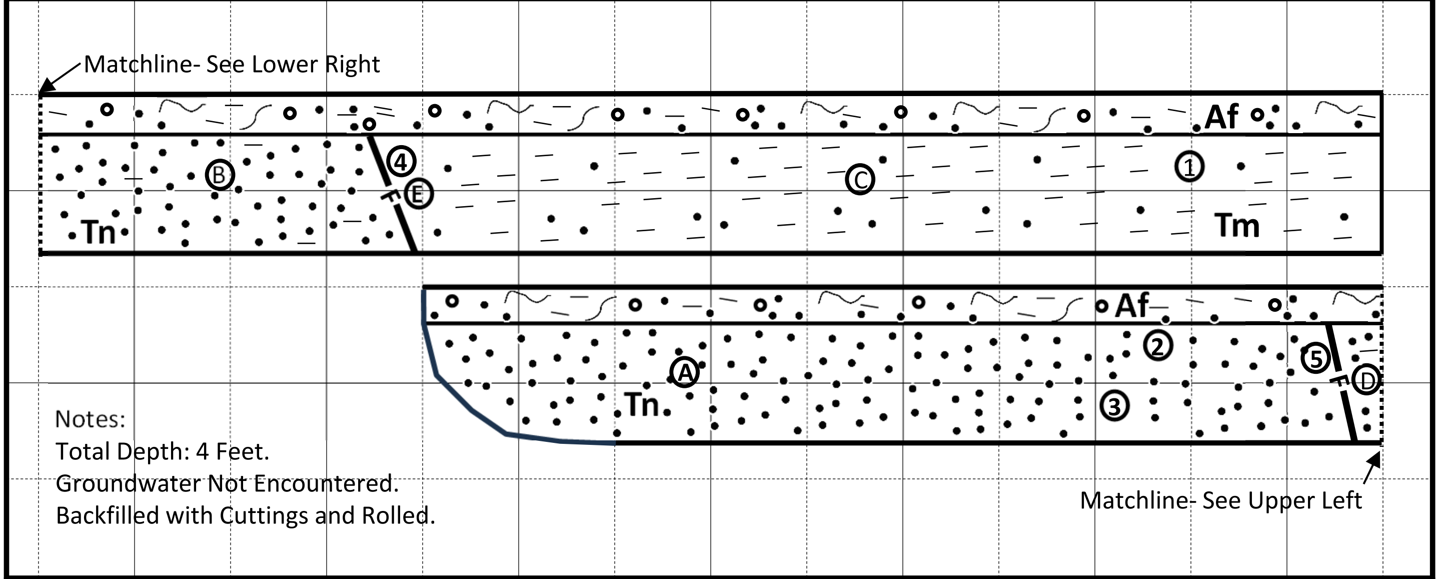
TP-3a

Total Depth (ft): 4

Approximate Ground Surface Elevation (ft): 464

Sample Depth (ft)	SAMPLES		USCS	Log Of Test Pit Surface: Weeds	Moisture Content (%)	Dry Density (pcf)	REMARKS
	Type Number	Blows Per Foot					
0			SM	**Artificial Fill (Af)** Pale brown silty fine SAND with coarse gravel, dry, loose, vegetation and roots.			(1) B: N88W, 14N (2) B: N46E, 18S (3) B: N24E, 12NE (4) F: N8W, 63E (5) F: N4E, 60E
			SP	**Niguel Formation (Tn)** (A) Pale brownish gray to white fine to coarse SANDSTONE, damp to moist, medium dense, iron staining, friable, caving, locally crossbedded.			
5			SM-SP	(B) Pale brownish gray to pale brown slightly silty fine to coarse SANDSTONE, moist, medium dense, friable, caving, massive.			
			SM/ML	**Monterey Formation (Tm)** (C) Pale brown to reddish brown silty fine to medium SANDSTONE/ SILTSTONE, moist to very moist, medium dense, well bedded.			
10				(D) Fault: olive brown, clay-filled, roots, very plastic, 0.25” thick			
				(E) Fault: dark brown-olive brown, clay-filled, roots, very plastic, 0.25” thick, soft			
15							

Graphic Orientation: North Wall **Trend:** <-N70W- **Scale:** 1”=5’



Notes:
Total Depth: 4 Feet.
Groundwater Not Encountered.
Backfilled with Cuttings and Rolled.

Log Of Test Pit

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01

Appendix B

Date(s)Excavated: 05-07-2024	**Logged By:** AC/AZ
Excavation Method: Backhoe	
Equipment Type: Deere 310 SL	
Sampling Method(s): None	
Approximate Groundwater Depth: Groundwater Not Encountered.	
Comments:	

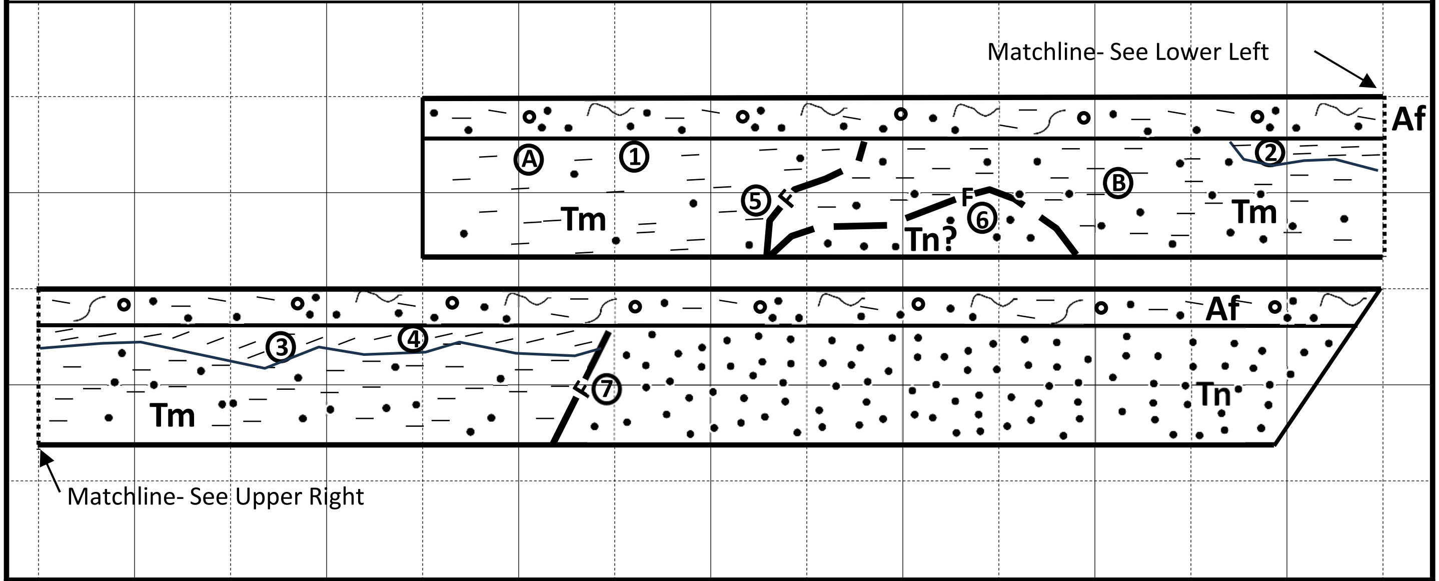
TP-3b

Total Depth (ft): 4

Approximate Ground Surface Elevation (ft): 461.5

Sample Depth (ft)	SAMPLES Type Number	SAMPLES Blows Per Foot	USCS	Log Of Test Pit Surface: Weeds	Moisture Content (%)	Dry Density (pcf)	REMARKS
0			SM	**Artificial Fill (Af)** Pale brown silty fine to coarse SAND with gravel, dry to damp, loose, entrained vegetation and debris.			(1) B: N60W, 6NE (2) B: N18W, 7E (3) B: N12W, 36W (4) B: N3W, 32W (5) F: N2W, 82W (6) F: N3W, 52E (7) F: N5W, 72W
5			SP	**Niguel Formation (Tn)** Pale brown to white fine to coarse SANDSTONE, very moist to wet, medium dense, iron staining, friable, micaceous, caving, mild crossbedding. In fault contact with Monterey. Fault is clay-lined with abundant roots, planar. Bedrock on either side of fault is broken/weathered.			
10			ML	**Monterey Formation (Tm)** (A) Pale bluish gray clayey SILTSTONE, moist, dense, thinly bedded, well bedded.			
			SM	(B) Reddish brown silty SANDSTONE, very moist to wet, medium dense to dense, massive. Notes: Total Depth: 4 Feet. Groundwater Not Encountered. Backfilled with Cuttings and Rolled.			
15							

Graphic Orientation: North Wall **Trend:** <-N34W- **Scale:** 1”=5’



Log Of Test Pit

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01

Appendix B

Date(s)Excavated: 05-03-2024	**Logged By:** AZ
Excavation Method: Backhoe	
Equipment Type: Deere 310 SL	
Sampling Method(s):	
Approximate Groundwater Depth: Groundwater Not Encountered.	
Comments:	

TP-4

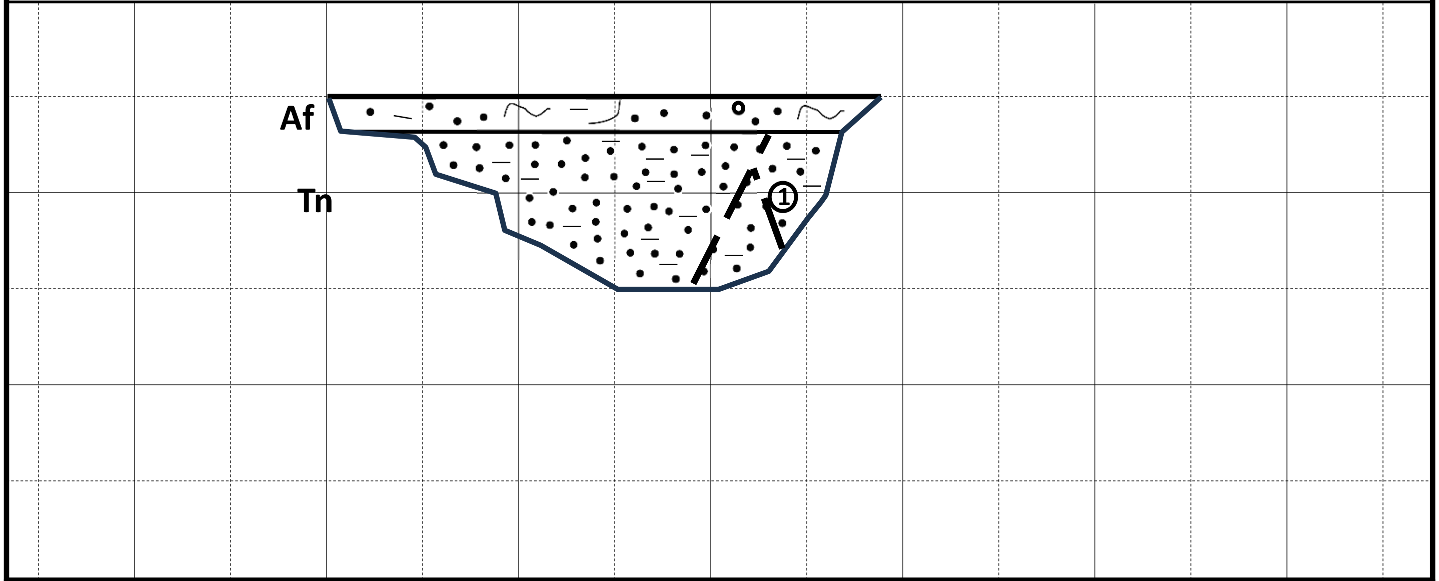
Total Depth (ft): 5

Approximate Ground Surface Elevation (ft): 466.5

Log Of Test Pit

Sample Depth (ft)	SAMPLES Type Number	SAMPLES Blows Per Foot	USCS	Surface: Weeds	Moisture Content (%)	Dry Density (pcf)	REMARKS
0				**Artificial Fill (Af)**			(1) J: N34E, 83W
			SP-SM	@ 0-1’: Yellowish brown fine to medium SAND with silt, moist, medium dense, some roots, trace coarse gravel.			
				Niguel Formation (Tn)			
			SM	@ 1’-5’: Gray and pale yellow silty fine to medium SANDSTONE, damp to moist, medium dense, trace root hairs, iron staining, fractured/conjugate joints, massive.			
5							
				Notes: Total Depth: 5 Feet. Groundwater Not Encountered. Backfilled with Cuttings and Rolled.			
10							
15							

Graphic Orientation: East Wall **Trend:** N-S **Scale:** 1”=5’



Log Of Test Pit

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01

Appendix B

Date(s)Excavated: 05-03-2024
Logged By: AZ
Excavation Method: Backhoe
Equipment Type: Deere 310 SL
Sampling Method(s):
Approximate Groundwater Depth: Groundwater Not Encountered.
Comments:

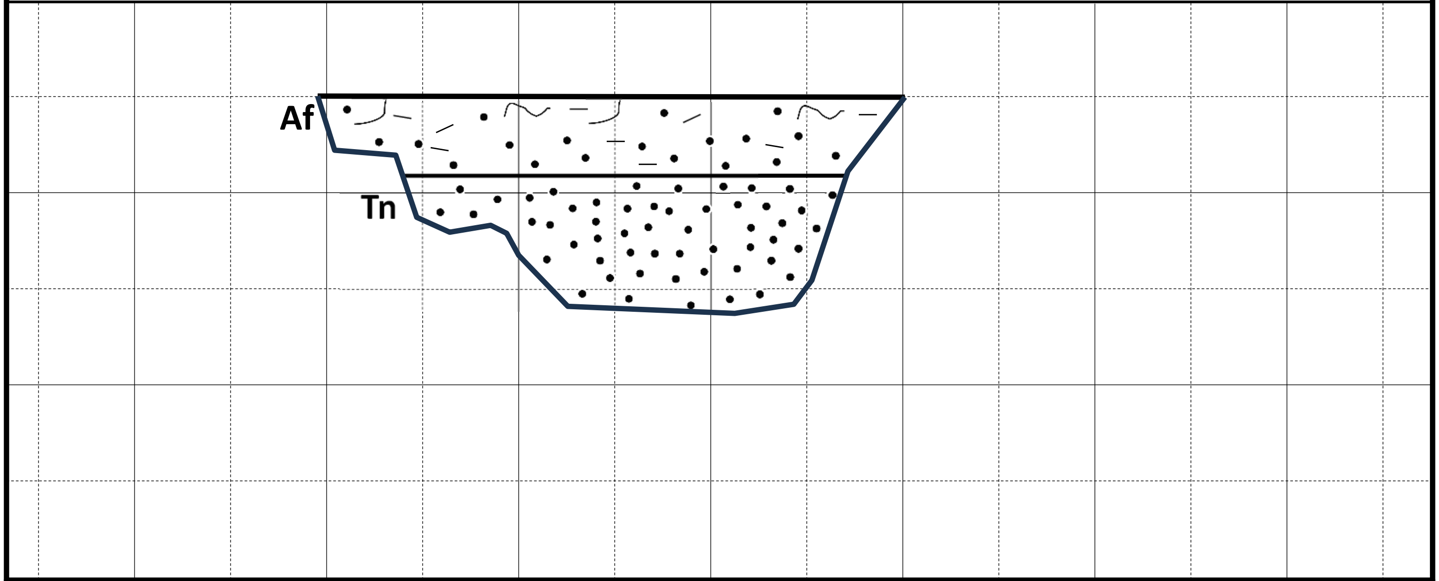
TP-5

Total Depth (ft): 5.5
Approximate Ground Surface Elevation (ft): 466.5

Log Of Test Pit

Sample Depth (ft)	SAMPLES Type Number	SAMPLES Blows Per Foot	USCS	Log Of Test Pit Surface: Weeds	Moisture Content (%)	Dry Density (pcf)	REMARKS
0			SM	**Artificial Fill (Af)** @ 0-2.5’: Yellowish brown silty fine to medium SAND, moist, medium dense, roots in upper 6 inches.			
			SP	**Niguel Formation (Tn)** @ 2.5-5.5’: Light gray fine to medium SANDSTONE, damp to moist, medium dense, friable, massive.			
5				Notes: Total Depth: 5.5 Feet. Groundwater Not Encountered. Backfilled with Cuttings and Rolled.			
10							
15							

Graphic Orientation: East Wall **Trend:** <-N50W- **Scale:** 1”=5’



Log Of Test Pit

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01

Appendix B

Date(s)Excavated: 05-03-2024	**Logged By:** AC/AZ
Excavation Method: Backhoe	
Equipment Type: Deere 310 SL	
Sampling Method(s): Bulk	
Approximate Groundwater Depth: Groundwater Not Encountered.	
Comments:	

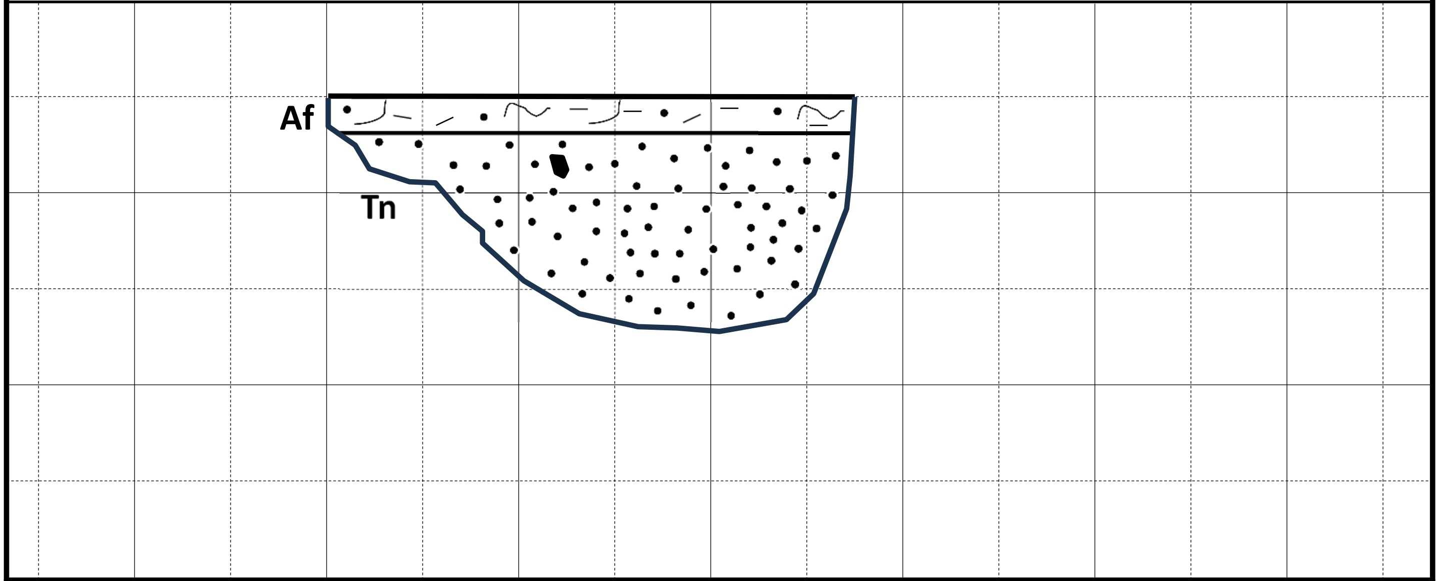
TP-6

Total Depth (ft): 6

Approximate Ground Surface Elevation (ft): 461.5

Sample Depth (ft)	SAMPLES Type Number	 Blows Per Foot	USCS	Log Of Test Pit Surface: Weeds	Moisture Content (%)	Dry Density (pcf)	REMARKS
0	▨ B-1		SM	**Artificial Fill (Af)** @ 0-1’: Pale brown silty fine SAND with gravel, dry, loose, vegetation/debris.			Bulk Bag @ 0-5' @2.5’ B: N5E, 8W
			SP	**Niguel Formation (Tn)** @ 1-6’: Pale yellowish gray and pale reddish brown fine to coarse SANDSTONE, moist to very moist, medium dense, iron staining along bedding. Krotovina @ 1.5’.			
5							
				Notes: Total Depth: 6 Feet. Groundwater Not Encountered. Backfilled with Cuttings and Rolled.			
10							
15							

Graphic Orientation: North Wall **Trend:** <-N16W- **Scale:** 1”=5’



Log Of Test Pit

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

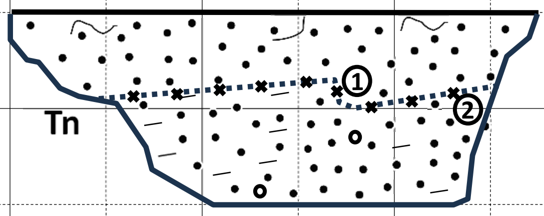
Project Number: 24064-01

Appendix B

Date(s)Excavated: 05-03-2024	**Logged By:** AC/AZ	**TP-7**
Excavation Method: Backhoe		
Equipment Type: Deere 310 SL		
Sampling Method(s):		**Total Depth (ft)**: 5
Approximate Groundwater Depth: Groundwater Not Encountered.		**Approximate Ground Surface Elevation (ft):** 454
Comments:		

Sample Depth (ft)	SAMPLES Type	Number	Blows Per Foot	USCS	Log Of Test Pit Surface: Weeds/Vegetation.	Moisture Content (%)	Dry Density (pcf)	REMARKS
0					**Niguel Formation (Tn)**			(1) B: N68E, 10NW (2) B: N40E, 2NW
				SP	@ 0-2’: Pale yellow fine to medium SANDSTONE, damp to moist, medium dense to dense, friable, massive, root hairs in upper 6”.			
				SM	@ 2-2.5’: Dark reddish brown to dark brown weakly cemented SANDSTONE, iron staining.			
5				SM	@ 2.5-5’: Grayish yellow silty fine SANDSTONE, moist, dense, trace iron staining and jarosite, trace rounded fine gravel.			
					Notes: Total Depth: 5 Feet. Groundwater Not Encountered. Backfilled with Cuttings and Rolled.			
10								
15								

Graphic Orientation: East Wall **Trend:** <-N9E- **Scale:** 1”=5’



Log Of Test Pit

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01

Appendix B

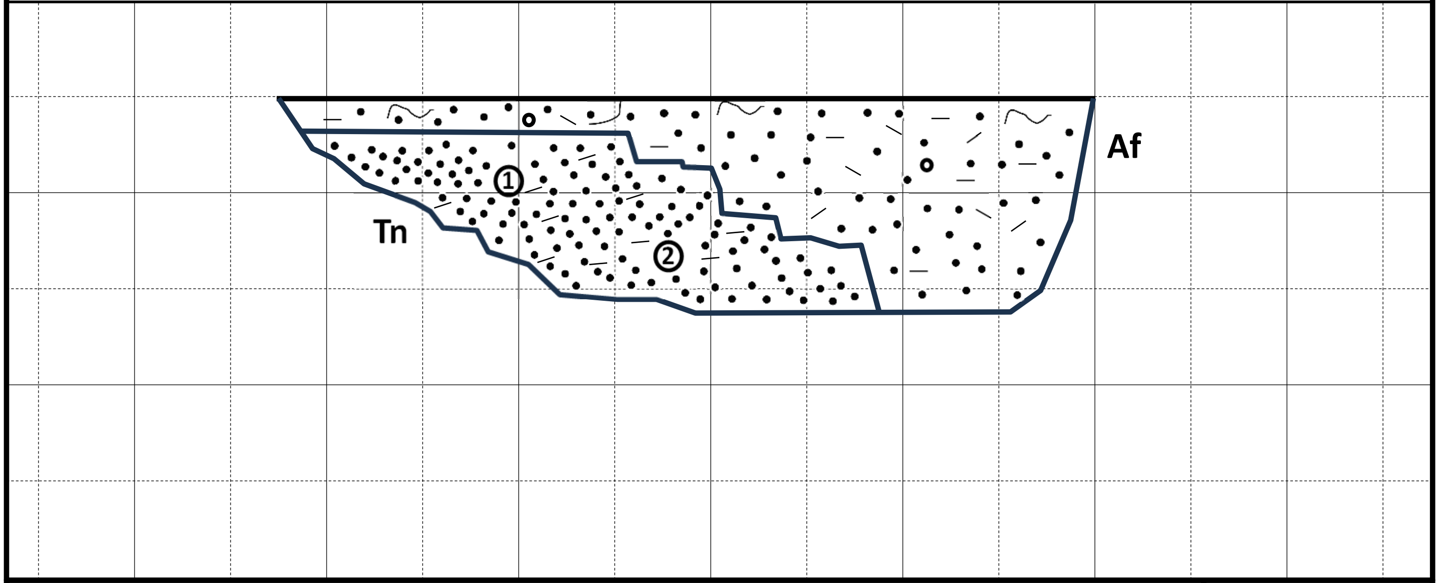
Date(s)Excavated: 05-03-2024
Logged By: AC/AZ
Excavation Method: Backhoe
Equipment Type: Deere 310 SL
Sampling Method(s):
Approximate Groundwater Depth: Groundwater Not Encountered.
Comments:

TP-8

Total Depth (ft): 5.5
Approximate Ground Surface Elevation (ft): 467

Sample Depth (ft)	SAMPLES		USCS	Log Of Test Pit	Moisture Content (%)	Dry Density (pcf)	REMARKS
	Type Number	Blows Per Foot		Surface: Weeds/sand			
0			SM	**Artificial Fill (Af)** Mottled yellowish brown, brown, and grayish brown silty fine to medium SAND, moist to very moist, medium dense, probes firm, trace fine gravel.			(1) B: N80E, 19N (2) B: N28E, 7NW
			SP	**Niguel Formation (Tn)** Pale yellow to reddish yellow SANDSTONE, damp, medium dense to dense, friable, iron staining, cross bedded.			
5							
10				Notes: Total Depth: 5.5 Feet. Groundwater Not Encountered. Backfilled with Cuttings and Rolled.			
15							

Graphic Orientation: North Wall **Trend:** <-N20W- **Scale:** 1”=5’



Log Of Test Pit

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01

Appendix B

Date(s)Excavated: 05-03-2024	**Logged By:** AC/AZ
Excavation Method: Backhoe	
Equipment Type: Deere 310 SL	
Sampling Method(s): Bulk	
Approximate Groundwater Depth: Groundwater Not Encountered.	
Comments:	

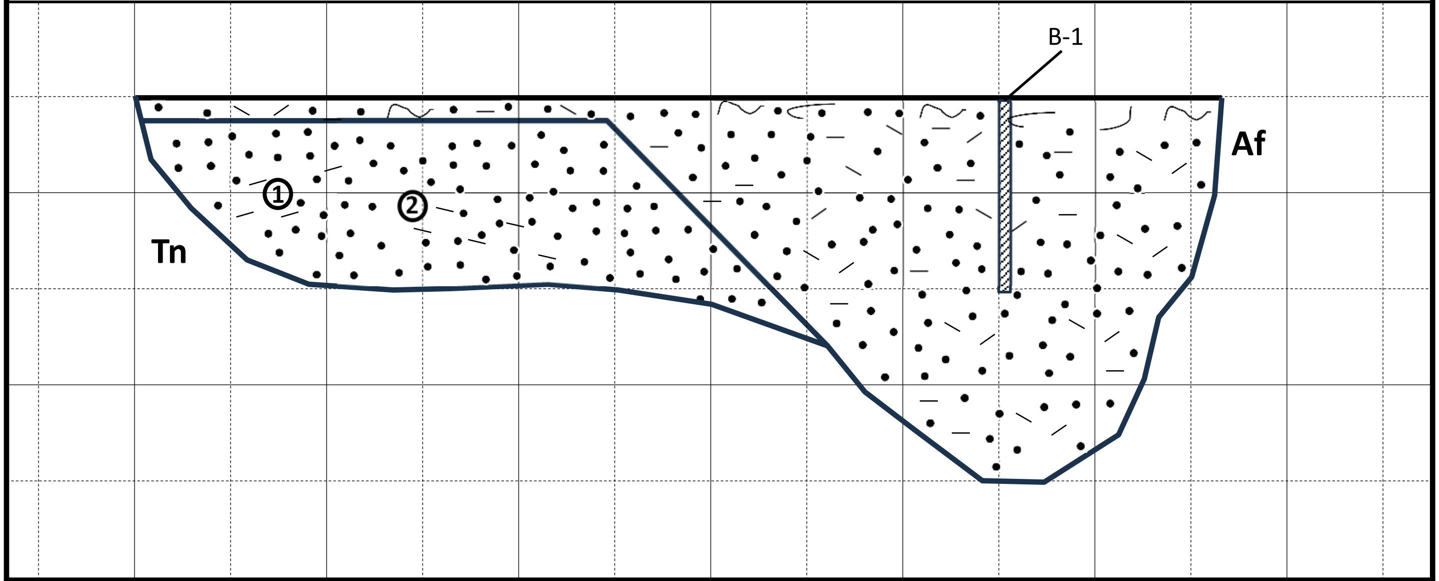
TP-9

Total Depth (ft): 10

Approximate Ground Surface Elevation (ft): 465

Sample Depth (ft)	SAMPLES Type Number	SAMPLES Blows Per Foot	USCS	Log Of Test Pit	Moisture Content (%)	Dry Density (pcf)	REMARKS
0	B-1		SM	**Artificial Fill (Af)** Mottled dark brown and yellowish gray silty fine to medium SAND, damp to moist, medium dense, abundant roots in upper 12”.			Bulk Bag @ 0-5’ GS, MD, EI, CC (1) B: N43E, 18W (2) B: E-W, 13S
			SP	**Niguel Formation (Tn)** Pale yellowish gray to white fine to coarse SANDSTONE, moist to very moist, dense, iron staining, friable, caving, cross bedded.			
5				Notes: Total Depth: 10 Feet. Groundwater Not Encountered. Backfilled with Cuttings and Rolled.			
10							
15							

Graphic Orientation: North Wall **Trend:** <-N20W- **Scale:** 1”=5’



Log Of Test Pit

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01

Appendix B

Date(s)Excavated: 05-03-2024

Logged By: AC/AZ

Excavation Method: Backhoe

Equipment Type: Deere 310 SL

Sampling Method(s):

Approximate Groundwater Depth: Groundwater Not Encountered.

Comments:

TP-10

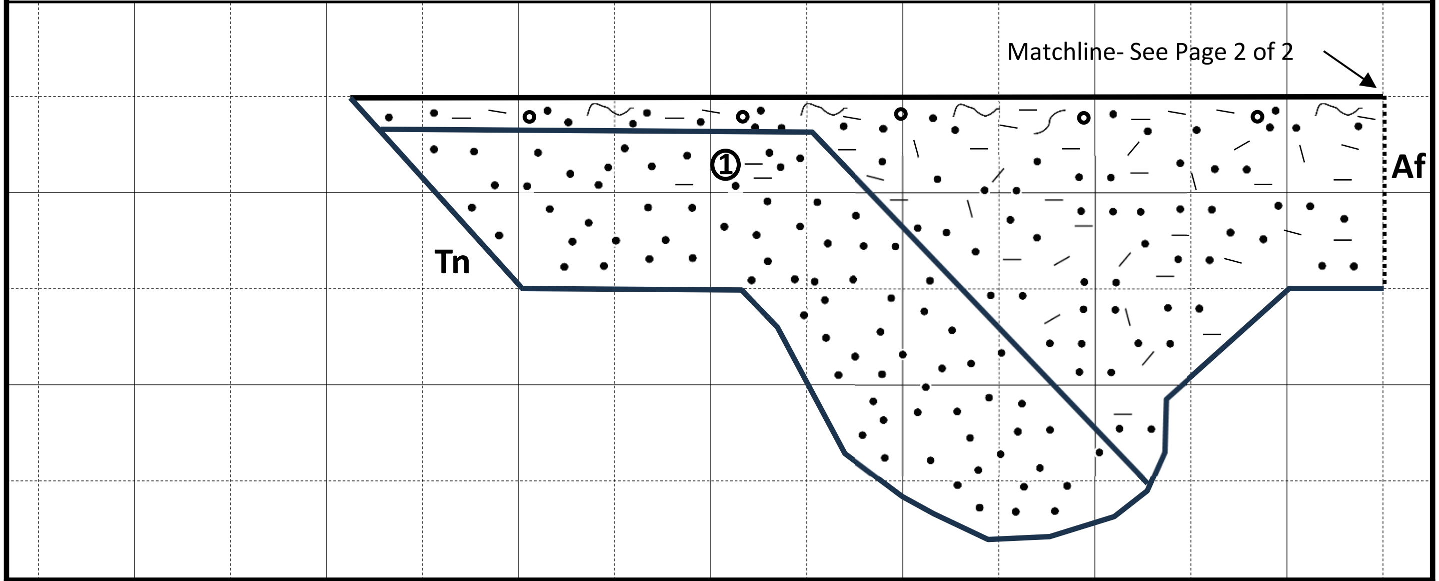
Page 1 of 2

Total Depth (ft): 12

Approximate Ground Surface Elevation (ft): 461

Sample Depth (ft)	SAMPLES Type Number	SAMPLES Blows Per Foot	USCS	Log Of Test Pit Surface: Weeds	Moisture Content (%)	Dry Density (pcf)	REMARKS
0			SM	**Artificial Fill (Af)** Mottled olive brown and dark brown silty fine to medium SAND, moist to very moist, medium dense, predominantly bedrock derived with local lifts of topsoil, lift thickness 2-7”, probes firm throughout, upper 1-1.5’ weathered, roots, damp.			(1) B: N9W, 6NE
5			SP	**Niguel Formation (Tn)** Pale gray and pale reddish brown fine to coarse SANDSTONE, moist to wet, dense, banded iron staining, friable, locally cross bedded, caving. *Continued on Page 2 of 2.			
10				Notes: Total Depth: 12 Feet. Groundwater Not Encountered. Backfilled with Cuttings and Rolled.			
15							

Graphic Orientation: East Wall **Trend:** <-N27W- **Scale:** 1”=5’



Log Of Test Pit

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01

Appendix B

Date(s)Excavated: 05-03-2024

Logged By: AC/AZ

Excavation Method: Backhoe

Equipment Type: Deere 310 SL

Sampling Method(s):

Approximate Groundwater Depth: Groundwater Not Encountered.

Comments:

TP-10

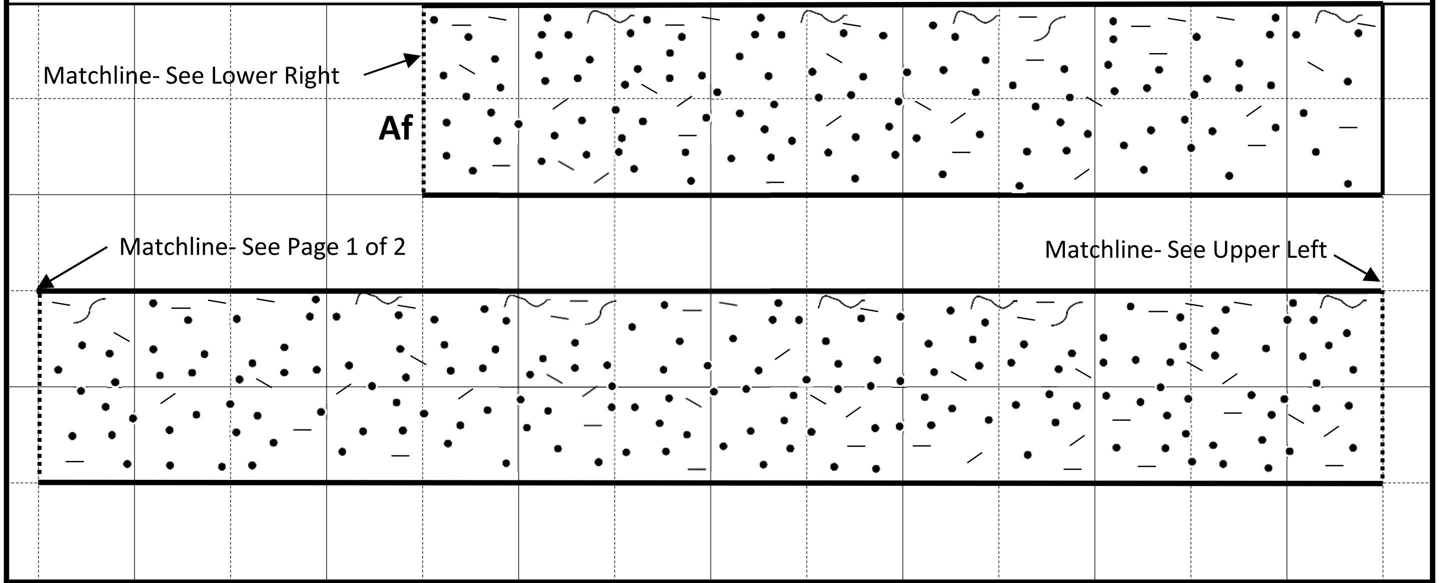
Page 2 of 2

Total Depth (ft): 12

Approximate Ground Surface Elevation (ft): 461

Sample Depth (ft)	SAMPLES Type Number	SAMPLES Blows Per Foot	USCS	Log Of Test Pit Surface: Weeds/Vegetation.	Moisture Content (%)	Dry Density (pcf)	REMARKS
0			SM	**Artificial Fill (Af)** Mottled olive brown and dark brown silty fine to medium SAND, moist to very moist, medium dense, predominantly bedrock (Tn) derived with local lifts topsoil derived, lift thickness 2-7”, probes firm throughout. Upper 1-1.5’ weathered, roots, damp.			
5							
10							
15							

Graphic Orientation: East Wall **Trend:** <-N27W- **Scale:** 1”=5’


Matchline- See Lower Right
Af
Matchline- See Page 1 of 2
Matchline- See Upper Left

Log Of Test Pit

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01

Appendix B

Date(s) Drilled: 05-14-2024	**Logged By:** AC/PA	**HA-1** Page 1 of 1
Drilling Method: Hand Auger	**Drill Bit Size/Type:** 3” Hand Auger	
Drill Rig Type: Manual	**Hammer Type:**	
Sampling Method(s):		**Total Depth Drilled (ft)** 11.5
Approximate Groundwater Depth: Groundwater Not Encountered		**Approximate Ground Surface Elevation (ft)** 445
Comments:		

Depth (ft)	SAMPLES Type Number	 Blows Per Foot	USCS	MATERIAL DESCRIPTION Surface: Grass/weeds.	Moisture Content (%)	Dry Density (pcf)	REMARKS
0			SM	**Artificial Fill (Af)** @ 0-4.5’: Dark brown to brownish black silty fine to medium SAND, moist to very moist, medium dense, trace organics/ vegetation. @ 3.5’: Bedrock fragments.			
5			SM-SP	@ 4.5-8’: Mottled yellowish brown and olive gray fine to coarse SAND with silt, moist to very moist, medium dense, bedrock fragments, trace iron staining.			
			SC	@ 8-9’: Reddish brown clayey fine to coarse SAND, moist to very moist, medium dense.			
			SM	@ 9-10’: Mottled yellowish gray and olive brown silty fine to coarse SAND, moist, medium dense, trace clay.			
10			SP	**Niguel Formation (Tn)** @ 10-11.5’: Pale yellow and yellowish orange fine to medium SAND, damp to moist, dense, banded iron staining.			
15				Notes: Total Depth: 11.5 Feet. Groundwater Not Encountered. Backfilled With Cuttings.			
20							

Log Of Boring

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01

Appendix B

Date(s) Drilled: 05-14-2024	**Logged By:** AC/PA	**HA-2** Page 1 of 1
Drilling Method: Hand Auger	**Drill Bit Size/Type:** 3” Hand Auger	
Drill Rig Type: Manual	**Hammer Type:**	
Sampling Method(s):		**Total Depth Drilled (ft)** 13
Approximate Groundwater Depth: Groundwater Not Encountered		**Approximate Ground Surface Elevation (ft)** 426
Comments:		

Depth (ft)	**SAMPLES** **Type Number**	**SAMPLES** **Blows Per Foot**	**USCS**	**MATERIAL DESCRIPTION** Surface: Grass/weeds	**Moisture Content (%)**	**Dry Density (pcf)**	**REMARKS**
0			SM	**Artificial Fill (Af)** @ 0-1.5’: Brown silty fine to medium SAND, dry, loose, weathered in upper 6”, trace gravel, slight caving, roots.			
			SP-SM	@ 1.5-5’: Mottled yellowish brown and brown slightly silty fine to coarse SAND, moist, medium dense, trace iron staining.			
5			SM	@ 5-13’: Mottled yellowish gray and olive brown silty fine to medium SAND, moist, medium dense, trace clay and coarse gravel, trace bedrock fragments. @ 8.5’: Clean sand layer, 4 inches thick.			
10				@ 10.3’: Pale olive grey siltstone fragment. @ 11-12’: Clean sand, very moist.			
15				Notes: Total Depth: 13 Feet. Groundwater Not Encountered. Backfilled With Cuttings.			
20							

Log Of Boring

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01

Appendix B

Date(s) Drilled: 05-14-2024	**Logged By:** AC/PA	**HA-3** Page 1 of 1
Drilling Method: Hand Auger	**Drill Bit Size/Type:** 3” Hand Auger	
Drill Rig Type: Manual	**Hammer Type:**	
Sampling Method(s):		**Total Depth Drilled (ft)** 10
Approximate Groundwater Depth: Groundwater Not Encountered		**Approximate Ground Surface Elevation (ft)** 429
Comments:		

Depth (ft)	SAMPLES Type Number	SAMPLES Blows Per Foot	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	REMARKS
				Surface: Mulch/pine needles.			
0			SM	**Artificial Fill (Af)** @ 0-5.5: Yellowish brown to brown silty fine to medium SAND, damp to moist, medium dense, some coarse gravel and bedrock fragments, roots/vegetation in upper 2’.			
5			SM	@ 5.5-10’: Mottled yellowish brown, reddish brown, and white silty fine to coarse SAND, moist, medium dense, trace fine gravel, micaceous.			
10				Notes: Total Depth: 10 Feet. Groundwater Not Encountered. Backfilled With Cuttings.			
15							
20							

Log Of Boring

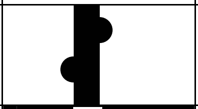
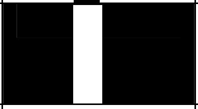
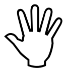
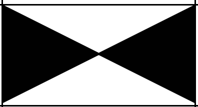
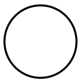
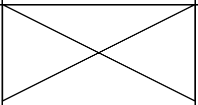
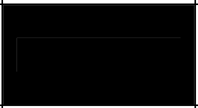
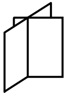
Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01

Appendix B

Boring Logs by
Southern California
Geotechnical (2021)

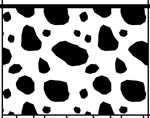
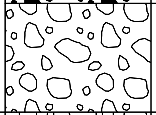
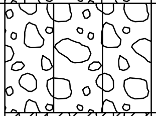
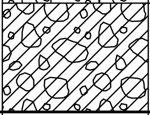
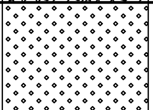
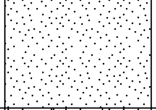
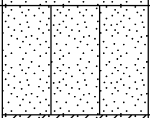
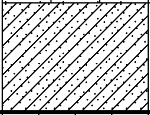
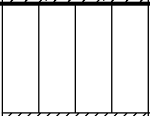
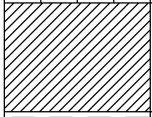
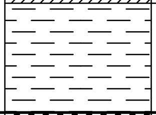
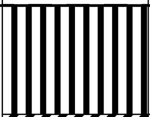
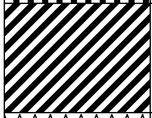
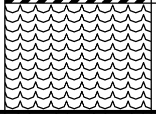
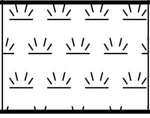
BORING LOG LEGEND

SAMPLE TYPE	GRAPHICAL SYMBOL	SAMPLE DESCRIPTION
AUGER		SAMPLE COLLECTED FROM AUGER CUTTINGS, NO FIELD MEASUREMENT OF SOIL STRENGTH. (DISTURBED)
CORE		ROCK CORE SAMPLE: TYPICALLY TAKEN WITH A DIAMOND-TIPPED CORE BARREL. TYPICALLY USED ONLY IN HIGHLY CONSOLIDATED BEDROCK.
GRAB		SOIL SAMPLE TAKEN WITH NO SPECIALIZED EQUIPMENT, SUCH AS FROM A STOCKPILE OR THE GROUND SURFACE. (DISTURBED)
CS		CALIFORNIA SAMPLER: 2-1/2 INCH I.D. SPLIT BARREL SAMPLER, LINED WITH 1-INCH HIGH BRASS RINGS. DRIVEN WITH SPT HAMMER. (RELATIVELY UNDISTURBED)
NSR		NO RECOVERY: THE SAMPLING ATTEMPT DID NOT RESULT IN RECOVERY OF ANY SIGNIFICANT SOIL OR ROCK MATERIAL.
SPT		STANDARD PENETRATION TEST: SAMPLER IS A 1.4 INCH INSIDE DIAMETER SPLIT BARREL, DRIVEN 18 INCHES WITH THE SPT HAMMER. (DISTURBED)
SH		SHELBY TUBE: TAKEN WITH A THIN WALL SAMPLE TUBE, PUSHED INTO THE SOIL AND THEN EXTRACTED. (UNDISTURBED)
VANE		VANE SHEAR TEST: SOIL STRENGTH OBTAINED USING A 4 BLADED SHEAR DEVICE. TYPICALLY USED IN SOFT CLAYS-NO SAMPLE RECOVERED.

COLUMN DESCRIPTIONS

DEPTH:	Distance in feet below the ground surface.
SAMPLE:	Sample Type as depicted above.
BLOW COUNT:	Number of blows required to advance the sampler 12 inches using a 140 lb hammer with a 30-inch drop. 50/3" indicates penetration refusal (>50 blows) at 3 inches. WH indicates that the weight of the hammer was sufficient to push the sampler 6 inches or more.
POCKET PEN.:	Approximate shear strength of a cohesive soil sample as measured by pocket penetrometer.
GRAPHIC LOG:	Graphic Soil Symbol as depicted on the following page.
DRY DENSITY:	Dry density of an undisturbed or relatively undisturbed sample in lbs/ft^3.
MOISTURE CONTENT:	Moisture content of a soil sample, expressed as a percentage of the dry weight.
LIQUID LIMIT:	The moisture content above which a soil behaves as a liquid.
PLASTIC LIMIT:	The moisture content above which a soil behaves as a plastic.
PASSING #200 SIEVE:	The percentage of the sample finer than the #200 standard sieve.
UNCONFINED SHEAR:	The shear strength of a cohesive soil sample, as measured in the unconfined state.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

SOUTHERN
CALIFORNIA
GEOTECHNICAL
A California Corporation

BORING NO.
B-1

JOB NO.: 21G167-1	DRILLING DATE: 5/13/21	WATER DEPTH: Dry
PROJECT: Proposed C/I Development	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 37 feet
LOCATION: Aliso Viejo, California	LOGGED BY: Daryl Kas	READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: 463 feet MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
					FILL: Brown Silty fine Sand, mottled, dense to very dense-damp							
	☒	78			NIGUEL FORMATION (Tn): Light Gray fine grained Sandstone, trace Silt, trace Iron oxide staining, weakly cemented, medium dense-dry to damp	122	3					EI = 0 0 to 5 feet
	☒	28				99	2					
5	☒	32				102	2					
	☒	25				82	2					
	☒	26				102	3					
10												
					Light Brown fine grained Sandstone, trace to little Silt, trace Iron oxide staining, weakly cemented, dense-damp							
	☒	56				101	5					
15												
	☒	65				113	6					
20												
					Brown fine grained Sandstone, trace medium Sand, trace Silt, trace Iron oxide staining, weakly cemented, dense-damp to moist							
	☒	48				110	6					
25												
					Gray Brown fine to medium grained Sandstone, trace Iron oxide staining, weakly cemented, very dense-damp							
	☒	78/11"				111	6					
30												
	☒	98/11"				112	6					

TBL 21G167-1.GPJ SOCALGEO.GDT 7/2/21

TEST BORING LOG

BORING NO.
B-1

JOB NO.: 21G167-1
PROJECT: Proposed C/I Development
LOCATION: Aliso Viejo, California

DRILLING DATE: 5/13/21
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Daryl Kas

WATER DEPTH: Dry
CAVE DEPTH: 37 feet
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION (Continued)	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
	⧓	79		▨	Gray Brown fine to medium grained Sandstone, trace Iron oxide staining, weakly cemented, very dense-damp	114	6					
40					Boring Terminated at 40'							

TEST BORING LOG

SOUTHERN
CALIFORNIA
GEOTECHNICAL
A California Corporation

BORING NO. B-2

JOB NO.: 21G167-1
PROJECT: Proposed C/I Development
LOCATION: Aliso Viejo, California

DRILLING DATE: 5/13/21
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Daryl Kas

WATER DEPTH: Dry
CAVE DEPTH: 18 feet
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: 466 feet MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
				▨	NIGUEL FORMATION (Tn): Light Brown fine grained Sandstone, trace Iron oxide staining, weakly cemented, medium dense to dense-damp							
	⧗	33		▨		101	5					EI = 0 0 to 5 feet
	⧗	28		▨		103	6					
5	⧗	34		▨		102	4					
	⧗	67		▨	@ 7 to 8 feet, dense	110	5					
	⧗	41		▨		105	7					
10				▨								
				▨	Light Gray fine grained Sandy Siltstone, abundant Iron oxide staining, weakly cemented, dense-very moist							
	⧗	53		▨		100	23					
15				▨								
				▨	Light Gray fine grained Sandstone, trace Iron oxide staining, weakly cemented, very dense-moist							
	⧗	91/10"		▨		102	13					
20												

Boring Terminated at 20'

BORING NO.
B-3

JOB NO.: 21G167-1
PROJECT: Proposed C/I Development
LOCATION: Aliso Viejo, California

DRILLING DATE: 5/13/21
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Daryl Kas

WATER DEPTH: Dry
CAVE DEPTH: 17 feet
READING TAKEN: At Completion

FIELD RESULTS					DESCRIPTION	LABORATORY RESULTS						COMMENTS
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	SURFACE ELEVATION: 461 feet MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	
	☒	23		▨	NIGUEL FORMATION (Tn): Light Gray fine grained Sandstone, weakly cemented, medium dense to dense-damp		3					
	☒	30		▨			5					
5				▨								
	☒	35		▨	Light Gray Silty fine grained Sandstone, trace Iron oxide staining, weakly cemented, dense-moist to very moist		15					
	☒	30		▨	Light Gray fine grained Sandstone, trace Iron oxide staining, weakly cemented, dense to very dense-damp		6					
10				▨								
	☒	46		▨			4					
15				▨								
	☒	70/11"		▨			5					
20					Boring Terminated at 20'							

BORING NO.
B-4

JOB NO.: 21G167-1
PROJECT: Proposed C/I Development
LOCATION: Aliso Viejo, California

DRILLING DATE: 5/13/21
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Daryl Kas

WATER DEPTH: Dry
CAVE DEPTH: 20 feet
READING TAKEN: At Completion

SURFACE ELEVATION: 466 feet MSL

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
					FILL: Brown Silty fine Sand, trace medium Sand, medium dense-damp							
	⧗	27				105	6					
					NIGUEL FORMATIOM (Tn): Light Gray to Light Brown fine grained Sandstone, trace Silt, trace Iron oxide staining, weakly cemented, dense-damp to moist							
	⧗	64				97	8					
5	⧗	55				99	9					
	⧗	55				100	11					
10	⧗	67				111	9					
					Brown Silty fine grained Sandstone, weakly cemented, dense-damp							
					Light Gray fine grained Sandstone, trace Iron oxide staining, weakly cemented, dense-damp							
15	⧗	53				104	8					
					Brown Silty fine grained Sandstone, weakly cemented, very dense-damp							
20	⧗	95/9"				113	7					
					Light Gray fine grained Sandstone, weakly cemented, dense-damp							
25	⧗	63				106	5					
					Gray Brown fine grained Sandy Siltstone, trace Iron oxide staining, weakly cemented, dense-damp							
					Boring Terminated at 25'							

BORING NO.
BA-1

JOB NO.: 21G167-1	DRILLING DATE: 5/13/21	WATER DEPTH: Dry
PROJECT: Proposed C/I Development	DRILLING METHOD: Bucket Auger	CAVE DEPTH: 60 feet
LOCATION: Aliso Viejo, California	LOGGED BY: Daryl Kas	READING TAKEN: At Completion

FIELD RESULTS					DESCRIPTION	LABORATORY RESULTS						COMMENTS
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	SURFACE ELEVATION: 465.5 feet MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	
					NIGUEL FORMATION (Tn): Light Gray fine grained Sandstone, weakly cemented, dense-damp							Kelly Bar Weight @ 0 to 29' = 4,800 lbs
5	⧗	7				98	5					
					@ 8 feet, very moist							
10	⧗	4			@ 10 feet, little Iron oxide staining, moderately cemented, moist	111	12					
	⧗	2										
15					@ 15 feet, no sample recovery							
					Light Gray Silty Claystone, little Iron oxide staining, stiff-moist Bedding: S03W, 30E							
20	⧗	11			Light Gray fine grained Sandstone, moderately cemented, dense-damp	110	7					
25	⧗	12			@ 25 feet, little Iron oxide staining	110	6					
					@ 29 feet, (4) 2- to 7- inch Light Gray Silty fine grained Sandstone lenses with Iron oxide staining							
30	⧗	13			@ 30 to 40 feet, coarsening downward	111	4					Kelly Bar Weight @ 30 to 58' = 3,350 lbs
					@ 32 feet 3 inches, trace Iron oxide staining Bedding: N60E, 5E							

**BORING NO.
BA-1**

JOB NO.: 21G167-1
PROJECT: Proposed C/I Development
LOCATION: Aliso Viejo, California

DRILLING DATE: 5/13/21
DRILLING METHOD: Bucket Auger
LOGGED BY: Daryl Kas

WATER DEPTH: Dry
CAVE DEPTH: 60 feet
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION (Continued)	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
	⊠	11			Light Gray fine grained Sandstone, trace coarse Sand, dense-damp	106	3					
					Light Gray fine grained Sandstone, trace medium Sand, weakly cemented, dense-damp @ 39 feet, Iron oxide layering, Bedding: S0W, 3W							
40	⊠	11				114	6					
					@ 42 feet, gradual color change to Orange Brown @ 43 feet, ¼- inch thick Green Silty fine grained Sandstone lense, Bedding: N40W, 5W							
45	⊠	15				108	6					
50	⊠	20			Light Yellow Brown fine grained Sandstone, weakly cemented, very dense-moist, Bedding: N20W, 4W	105	7					
					Light Orange Brown fine grained Sandstone, weakly cemented, very dense-damp, Bedding: N12W, 6W							
					Light Gray fine grained Sandstone, very dense-damp							
					Yellow fine grained Sandstone, moist, Bedding: N10W, 4W							
55	⊠	21			Interbedded Yellow fine grained Sandstone, and ½- inch Claystone lenses with Iron oxide staining, damp	92	6					
					Light Gray Silty fine grained Sandstone, little Iron oxide staining, very dense-damp							
					Brown to Orange Brown Silty fine grained Sandstone, little Clay, very dense-very moist, Bedding: S40W, 8W							
60	⊠	23				99	21					Kelly Bar Weight @ 59 to 71' = 2,045 lbs
					Light Gray fine grained Sandy Claystone, weakly cemented, dense-very moist							
65	⊠	13				114	25					
					Boring Terminated at 66'							

BORING NO.
BA-2

JOB NO.: 21G167-1	DRILLING DATE: 5/13/21	WATER DEPTH: Dry
PROJECT: Proposed C/I Development	DRILLING METHOD: Bucket Auger	CAVE DEPTH: 28 feet
LOCATION: Aliso Viejo, California	LOGGED BY: Daryl Kas	READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: 466.5 feet MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	COMMENTS
					FILL: Gray Brown fine to medium Sand, trace coarse Sand, little fine root fibers, trace Asphaltic concrete fragments, trace Brick fragments, mottled, loose to medium dense-dry							Kelly Bar Weight @ 0 to 29' = 4,800 lbs
					NIGUEL FORMATION (Tn): Light Gray fine grained Sandstone, trace Silt, trace to little Iron oxide staining dense-dry, Bedding: S20W, 11E							
5					Light Brown fine grained Sandstone, trace medium Sand, trace Iron oxide staining, dense-dry							
	☒	9			Light Gray fine to medium grained Sandstone, little Iron oxide staining, weakly cemented, dense-dry to damp, undulated contact, Bedding: N25W, 4W	104	2					
10	☒	8			@ 10 feet, damp	106	3					
					@ 11 feet 10 inches, Iron oxide staining lense, Bedding: N10E, 5W							
					@ 13 feet, Iron oxide staining lense, Bedding: S35W, 6W							
15	☒	7			@ 15 feet, Light Orange to Light Gray	109	3					
					Orange fine to medium Sandstone, dense-dry to damp Bedding Contact: Horizontal							
20	☒	7			Light Gray fine grained Sandstone, dense-damp	105	3					
25	☒	8			@ 25 to 31 feet, trace medium Sand, trace Iron oxide staining	106	4					
30	☒	10				105	4					Kelly Bar Weight @ 30 - 58' = 3,350 lbs
					Boring Terminated at 31'							

Boring Log by Southern California Geotechnical

(2014)

SOUTHERN
CALIFORNIA
GEOTECHNICAL
A California Corporation

BORING NO.
B-3

JOB NO.: 14G176	DRILLING DATE: 8/1/14	WATER DEPTH: Dry
PROJECT: C/I Development	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 18 feet
LOCATION: Aliso Viejo, California	LOGGED BY: Eric Torres	READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
				▨	NIGUEL FORMATION BEDROCK: Light Brown to White Silty fine grained Sandstone, highly weathered, weakly cemented, Iron oxide staining, dense to very dense-damp							
	☒	51		▨			4					
	☒	51		▨			4					
5				▨								
	☒	56		▨			3					
				▨	Light Brown fine grained Sandstone, trace Silt, highly weathered, weakly cemented, trace Iron oxide staining, dense-damp							
	☒	44		▨			3					
10				▨								
	☒	45		▨			3					
15				▨								
				▨	Orange Brown Silty fine grained Sandstone, highly weathered, weakly cemented, abundant Iron oxide staining, very dense-moist							
	☒	79/11"		▨			15 4					
				▨	Light Gray fine grained Sandstone, weathered, weakly cemented, very dense-damp							
20				▨								
				▨	Brown fine to medium grained Sandstone, weakly cemented, weathered, very dense-damp							
	☒	55		▨			3					
25												
					Boring Terminated at 25'							

TEST BORING LOG

Appendix C

HAI
HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

MATERIALS FINER THAN 75-µm (No. 200) SIEVE by WASHING

ASTM D1140

Client: SA Geotechnical, Inc
Project: Freedom Lane
Project No.: 24064-01

HAI Project No.: SAG-24-022
Performed by: GA
Checked by: KL
Date: 5/14/2024

Boring No.	Sample No.	Depth (ft)	Sample Description (USCS)	Dry Soil before Wash + $W_{Container}$	Dry Soil after #200 Wash + $W_{Container}$	$W_{Container}$	Wt of soil retained on # 200 sieve	Initial wt of dry soil	**Soil % passing 200 sieve**
				g	g	g	g	g	**%**
TP-3	B-1	1-4	Olive, Elastic Silt with Sand (MH)	504.87	303.55	223.46	80.09	281.41	**71.54**
TP-9	B-1	0-5	Olive, Clayey Sand (SC)	591.94	494.11	221.45	272.66	370.49	**26.41**
B-2	D-3	20	Olive, Silty Sand (SM)	403.62	377.34	221.13	156.21	182.49	**14.40**

Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM D4318

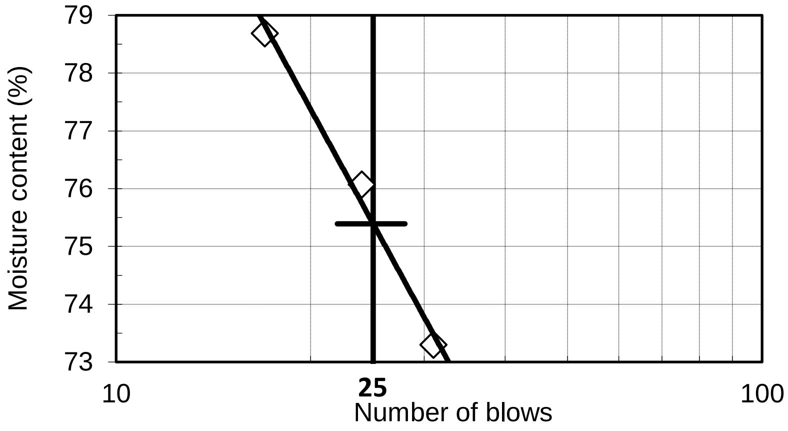
Client: SA Geotechnical, Inc
Project Name: Freedom Lane
Project No.: 24064-01
Boring No.: TP-3
Sample No.: B-1
Depth (ft): 1-4
Soil Description: Olive, Elastic Silt with Sand (MH)

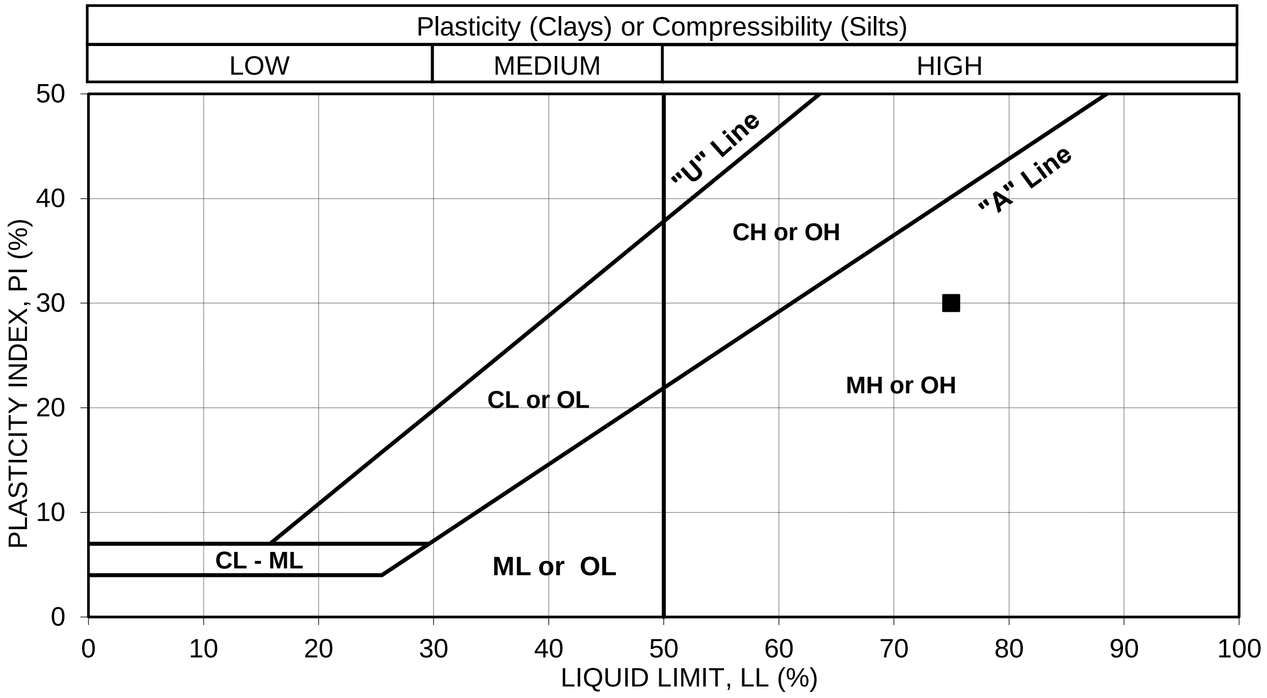
HAI Project No.: SAG-24-022
Tested by: GA
Checked by: KL
Date: 05/14/24

Test		**LL**	**LL**	**LL**	**PL**	**PL**
No. of blows	**-**	**31**	**24**	**17**	-	-
Wt. of Wet Soil + Container	(g)	24.16	24.38	24.6	9.62	9.34
Wt. of Dry soil + Container	(g)	18.67	18.69	18.73	7.02	6.78
Wt. of Container	(g)	11.18	11.21	11.27	1.16	1.1
Water content	**(%)**	**73.3**	**76.1**	**78.7**	**44.4**	**45.1**

Liquid Limit (LL)	**75**
Plastic Limit (PL)	**45**
Plasticity Index (PI)	**30**
USCS	**MH**

Remarks:





Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM D4318

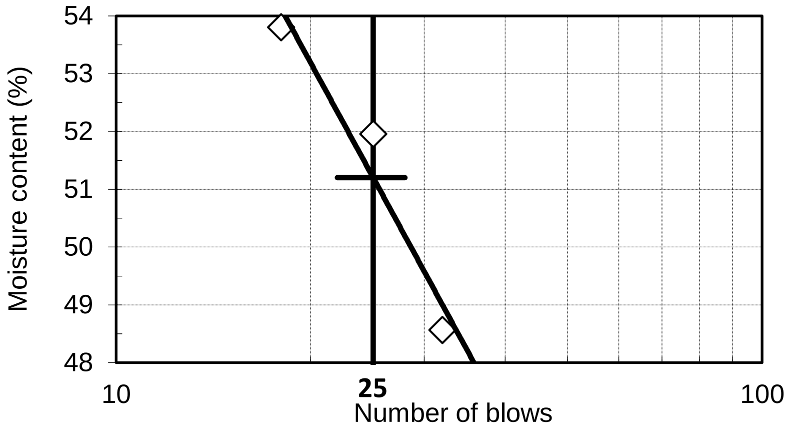
Client:	SA Geotechnical, Inc	*HAI Project No.:*	SAG-24-022
Project Name:	Freedom Lane	*Tested by:*	GA
Project No.:	24064-01	*Checked by:*	KL
Boring No.:	B-2	*Date:*	05/14/24
Sample No.:	D-3		
Depth (ft):	20.0		
Soil Description:	Olive, Silty Sand (SM)		

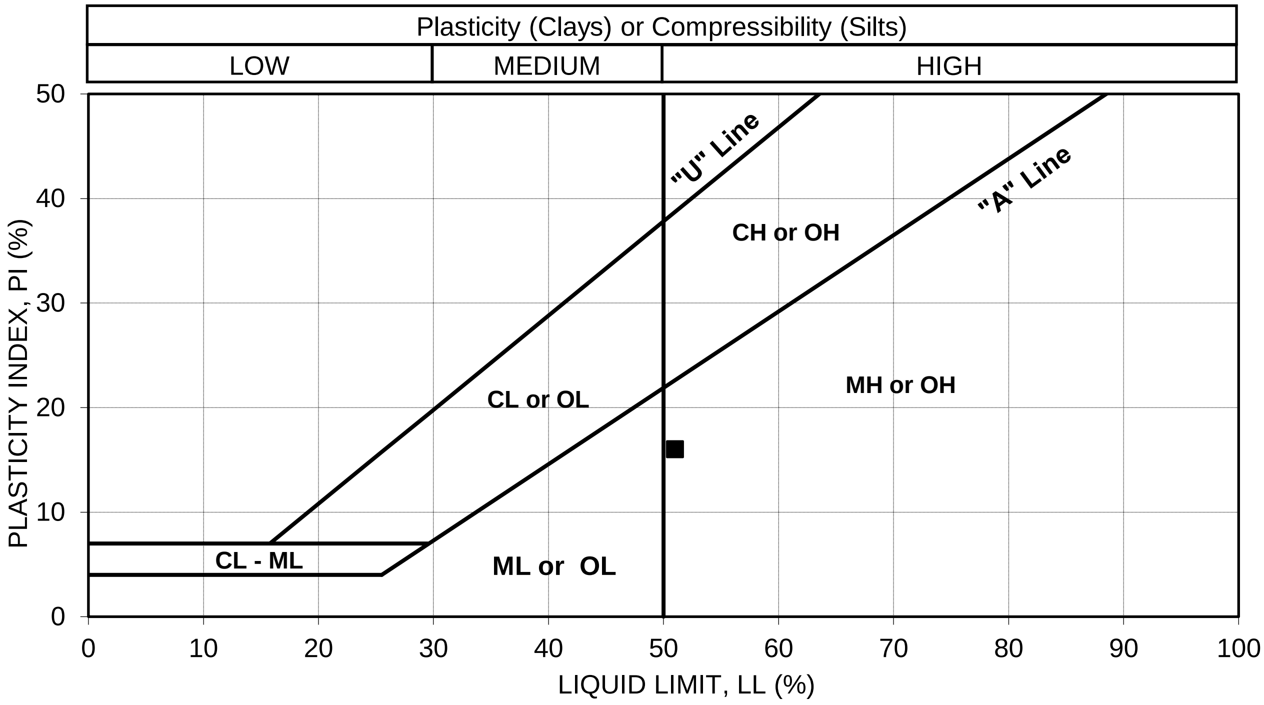
Test		**LL**	**LL**	**LL**	**PL**	**PL**
No. of blows	**-**	**32**	**25**	**18**	**-**	**-**
Wt. of Wet Soil + Container	(g)	25.56	25.68	25.52	9.49	9.6
Wt. of Dry soil + Container	(g)	20.81	20.77	20.36	7.29	7.41
Wt. of Container	(g)	11.03	11.32	10.77	1.09	1.11
Water content	**(%)**	**48.6**	**52.0**	**53.8**	**35.5**	**34.8**

Liquid Limit (LL)	**51**
Plastic Limit (PL)	**35**
Plasticity Index (PI)	**16**
USCS	**MH**

Remarks:

- Fine Sample is Less than 50% of Passing #200)





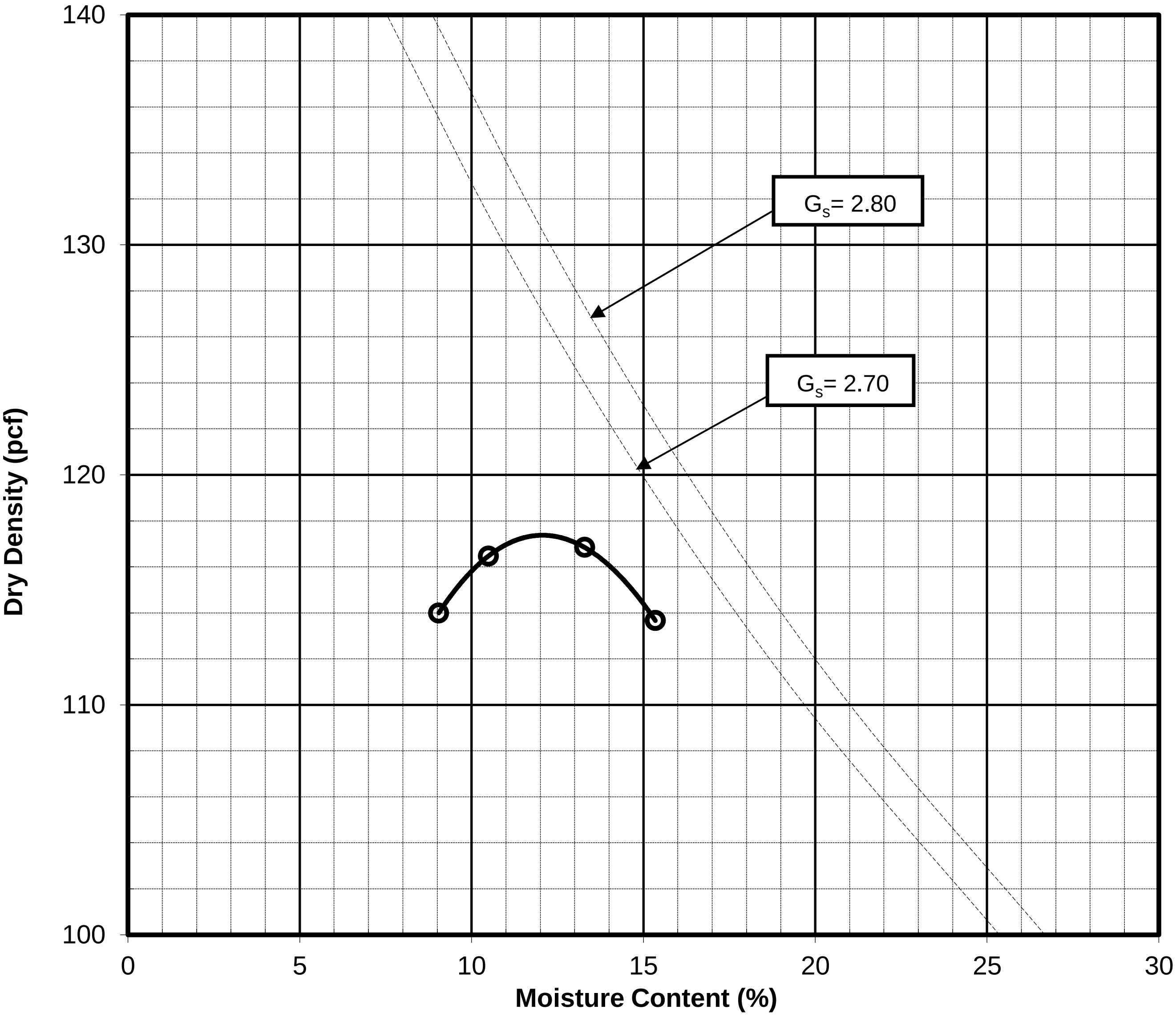
Compaction Characteristics of Soils Using Modified Effort

ASTM D1557

Client:	SA Geotechnical, Inc	*HAI Project No.:*	SAG-24-022
Project:	Freedom Lane	*Tested by:*	GA
Project No.:	24064-01	*Checked by:*	KL
Boring Number:	TP-9	*Date:*	05/14/24
Sample Number:	B-1		
Depth (ft) :	0-5		
Soil Description:	Olive Brown, Clayey Sand (SC)		

Mold size (in)	4"
Procedure	B
Weight Retained on:	0.0
Remarks:	

Maximum Dry Density (pcf)	**117.4**
Optimum Moisture Content (%)	**12.1**
Corrected Maximum Dry Density (pcf)	**-**
Corrected Optimum Moisture Content (%)	**-**



EXPANSION INDEX

ASTM D4829

Client: SA Geotechnical, Inc
Project Name: Freedom Lane
Project No.: 24064-01
Boring No.: TP-3
Sample No.: B-1
Depth (ft): 1-4
Soil Description: Olive, Sandy Silt (MH)

HAI Project No.: SAG-24-022
Tested by: GA
Checked by: KL
Date: 5/14/2024
Apparatus No.: 1

Initial Specimen Info		
Wt. of wet soil + cont.	154.03	g
Wt. of dry soil + cont.	125.48	g
Wt. of container	11.89	g
Wt. of water	28.55	g
Wt. of dry soil	113.59	g
Moisture Content	**25.1**	**%**

Final Specimen Info		
Wt. of wet soil + cont.	580.39	g
Wt. of dry soil + cont.	433.48	g
Wt. of container	206.33	g
Wt. of water	146.91	g
Wt. of dry soil	227.15	g
Moisture Content	**64.7**	**%**

Wt. of wet soil + ring	497.58	g
Wt. of ring	206.33	g
Wt. of wet soil	291.25	g
Wet density of soil	90.7	pcf
Dry density of soil	72.5	pcf
Specific gravity of soil	2.68	-
Saturation	**51.5**	**%**

Date & Time	Elapsed Time (min)	Dial Reading	∆h, Expansion
5/21/2024 9:30	0	0	0
5/21/2024 9:40	10	0.0000	0
Add Distilled Water to Sample			
5/22/2024 9:30	1440	0.1059	0.1059

Expansion Index = **106** **High**

EXPANSION INDEX

ASTM D4829

Client: SA Geotechnical, Inc
Project Name: Freedom Lane
Project No.: 24064-01
Boring No.: TP-9
Sample No.: B-1
Depth (ft): 0-5
Soil Description: Olive Brown, Clayey Sand (SC)

HAI Project No.: SAG-24-022
Tested by: GA
Checked by: KL
Date: 5/14/2024
Apparatus No.: 2

Initial Specimen Info		
Wt. of wet soil + cont.	205.59	g
Wt. of dry soil + cont.	188.15	g
Wt. of container	11.96	g
Wt. of water	17.44	g
Wt. of dry soil	176.19	g
Moisture Content	**9.9**	**%**

Final Specimen Info		
Wt. of wet soil + cont.	629.84	g
Wt. of dry soil + cont.	565.21	g
Wt. of container	206.53	g
Wt. of water	64.63	g
Wt. of dry soil	358.68	g
Moisture Content	**18.0**	**%**

Wt. of wet soil + ring	603.05	g
Wt. of ring	206.53	g
Wt. of wet soil	396.52	g
Wet density of soil	121.6	pcf
Dry density of soil	110.6	pcf
Specific gravity of soil	2.68	-
Saturation	**51.9**	**%**

Date & Time	**Elapsed Time (min)**	**Dial Reading**	**∆h, Expansion**
5/21/2024 10:00	0	0	0
5/21/2024 10:10	10	0.0000	0
Add Distilled Water to Sample			
5/22/2024 10:00	1440	0.0099	0.0099

Expansion Index = **10** **Very Low**

HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

DIRECT SHEAR TEST

ASTM D3080

HAI Project No.: SAG-24-022

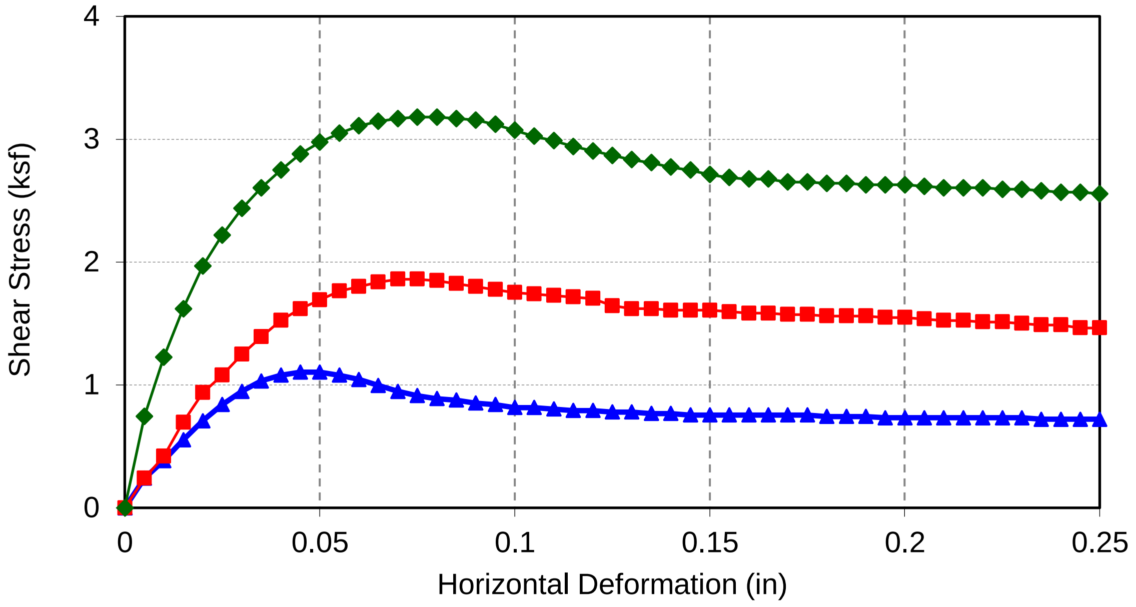
Client:	SA Geotechnical, Inc
Project Name:	Freedom Lane
Project Number:	24064-01
Boring No.:	B-1
Sample No.:	D-1
Sample Type:	Undisturbed Ring
Depth (ft):	5
Soil Description:	Olive Brown, Silty Sand (SM)
Type of test:	**Consolidated, Drained**

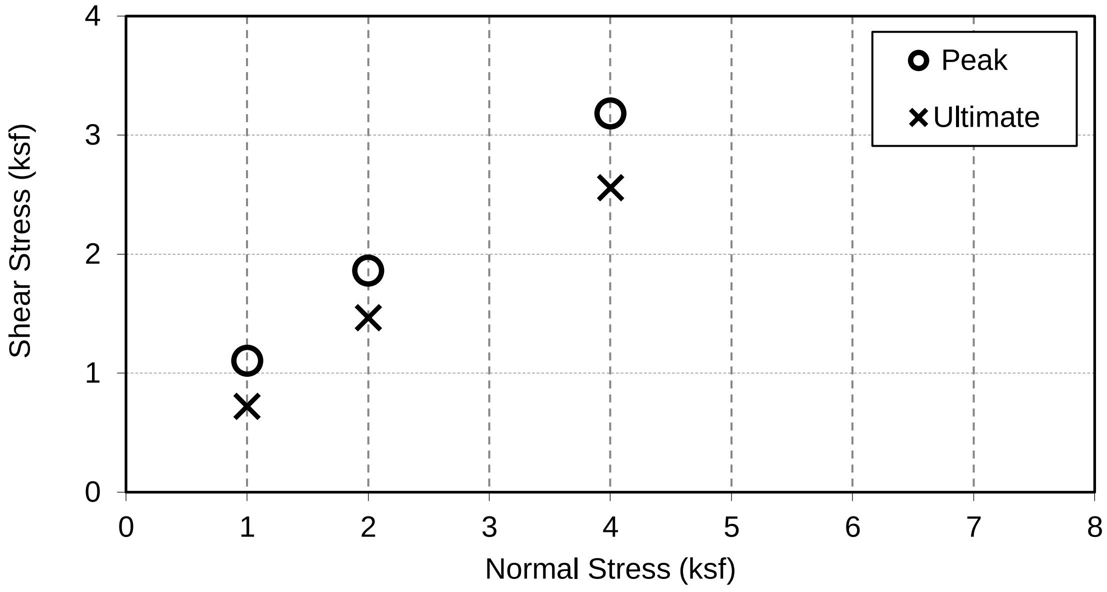
Tested by:	GA
Checked by:	KL
Date:	5/14/2024

Test No.	1	2	3
Symbol	▲	■	◆
Normal Stress (ksf)	**1**	**2**	**4**
Deformation Rate (in/min)	**0.002**	**0.002**	**0.002**

Peak Shear Stress (ksf)	**O**	**1.10**	**1.86**	**3.18**
Shear Stress @ End of Test (ksf)	**X**	**0.72**	**1.46**	**2.56**

Initial Height of Sample (in)	1.000	1.000	1.000
Height of Sample before Shear (in)	0.9967	0.9953	0.9867
Diameter of Sample (in)	2.416	2.416	2.416
Initial Moisture Content (%)	**14.8**	**14.8**	**14.8**
Final Moisture Content (%)	**21.5**	**19.2**	**20.3**
Dry Density (pcf)	**109.6**	**110.6**	**111.3**





HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

DIRECT SHEAR TEST

ASTM D3080

HAI Project No.: SAG-24-022

Client: SA Geotechnical, Inc
Project Name: Freedom Lane
Project Number: 24064-01
Boring No.: B-1
Sample No.: D-2
Sample Type: Undisturbed Ring
Depth (ft): 10
Soil Description: Brown, Clayey Sand (SC)

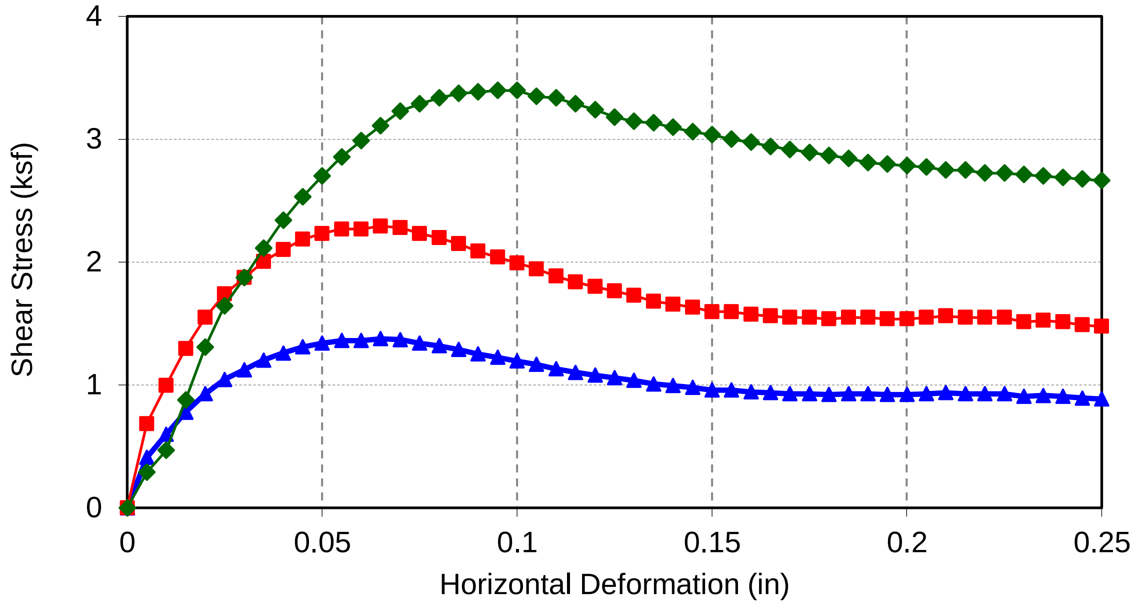
Tested by: GA
Checked by: KL
Date: 5/14/2024

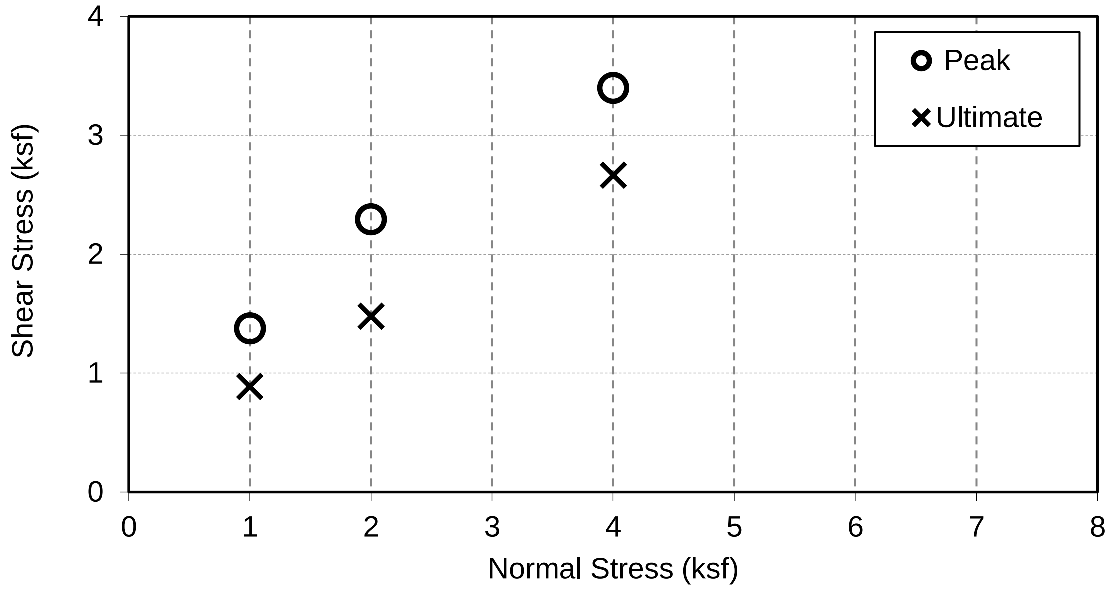
Type of test: **Consolidated, Drained**

Test No.	1	2	3
Symbol	▲	■	◆
Normal Stress (ksf)	**1**	**2**	**4**
Deformation Rate (in/min)	**0.002**	**0.002**	**0.002**

Peak Shear Stress (ksf)	**O**	**1.38**	**2.29**	**3.40**
Shear Stress @ End of Test (ksf)	**X**	**0.89**	**1.48**	**2.66**

Initial Height of Sample (in)	1.000	1.000	1.000
Height of Sample before Shear (in)	0.9916	0.9969	0.9893
Diameter of Sample (in)	2.416	2.416	2.416
Initial Moisture Content (%)	**10.3**	**10.3**	**10.3**
Final Moisture Content (%)	**21.8**	**18.3**	**13.3**
Dry Density (pcf)	**107.8**	**114.2**	**116.9**





HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

DIRECT SHEAR TEST

ASTM D3080

HAI Project No.: SAG-24-022

Client:	SA Geotechnical, Inc
Project Name:	Freedom Lane
Project Number:	24064-01
Boring No.:	B-1
Sample No.:	D-6
Sample Type:	Undisturbed Ring
Depth (ft):	40
Soil Description:	Light Brown, Silty Sand (SM)

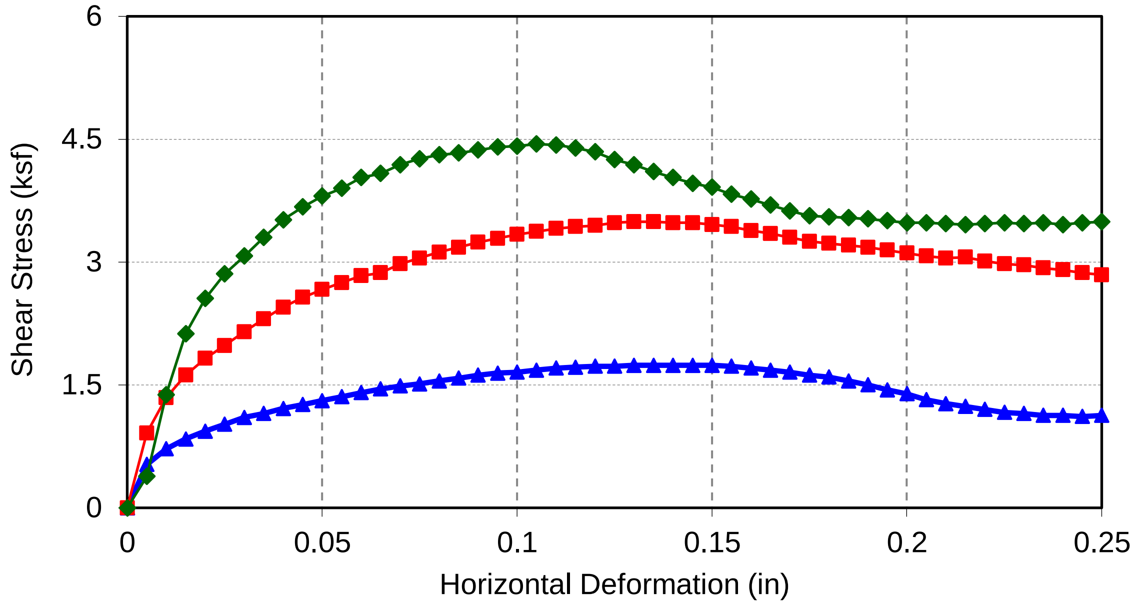
Tested by: GA
Checked by: KL
Date: 5/14/2024

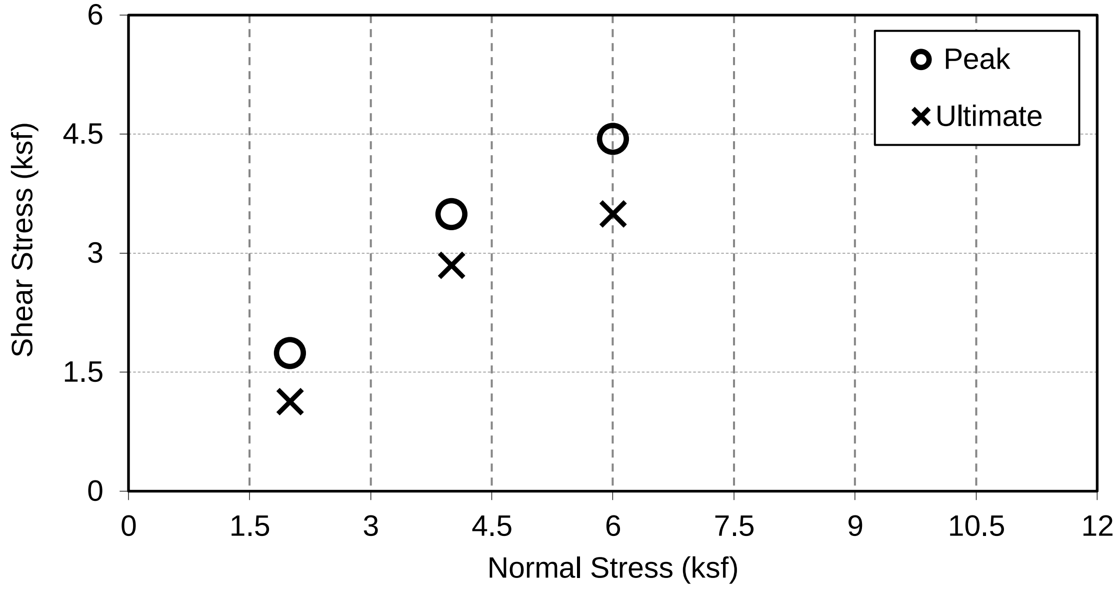
Type of test: **Consolidated, Drained**

Test No.	1	2	3
Symbol	▲	■	◆
Normal Stress (ksf)	**2**	**4**	**6**
Deformation Rate (in/min)	**0.002**	**0.002**	**0.002**

Peak Shear Stress (ksf)	**O**	**1.74**	**3.49**	**4.44**
Shear Stress @ End of Test (ksf)	**X**	**1.13**	**2.84**	**3.49**

Initial Height of Sample (in)	1.000	1.000	1.000
Height of Sample before Shear (in)	0.9919	0.9969	0.9856
Diameter of Sample (in)	2.416	2.416	2.416
Initial Moisture Content (%)	**4.7**	**4.7**	**4.7**
Final Moisture Content (%)	**21.4**	**19.6**	**18.7**
Dry Density (pcf)	**104.4**	**107.2**	**110.9**





HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

DIRECT SHEAR TEST

ASTM D3080

HAI Project No.: SAG-24-022

Tested by: GA
Checked by: KL
Date: 5/14/2024

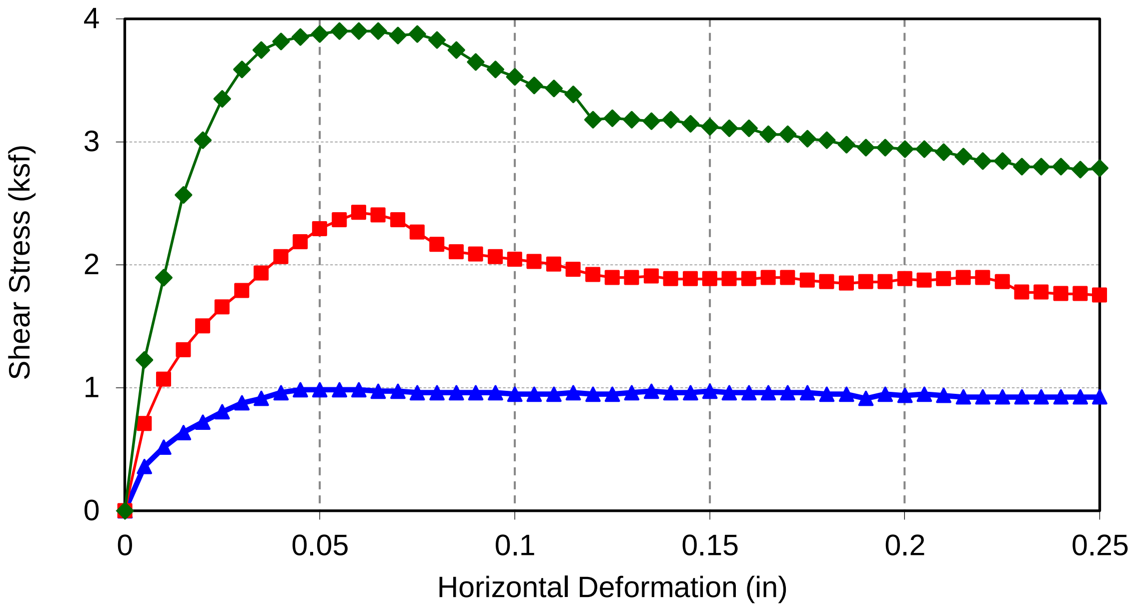
Client: SA Geotechnical, Inc
Project Name: Freedom Lane
Project Number: 24064-01
Boring No.: B-2
Sample No.: D-3
Sample Type: Undisturbed Ring
Depth (ft): 20
Soil Description: Olive, Silty Sand (SM)

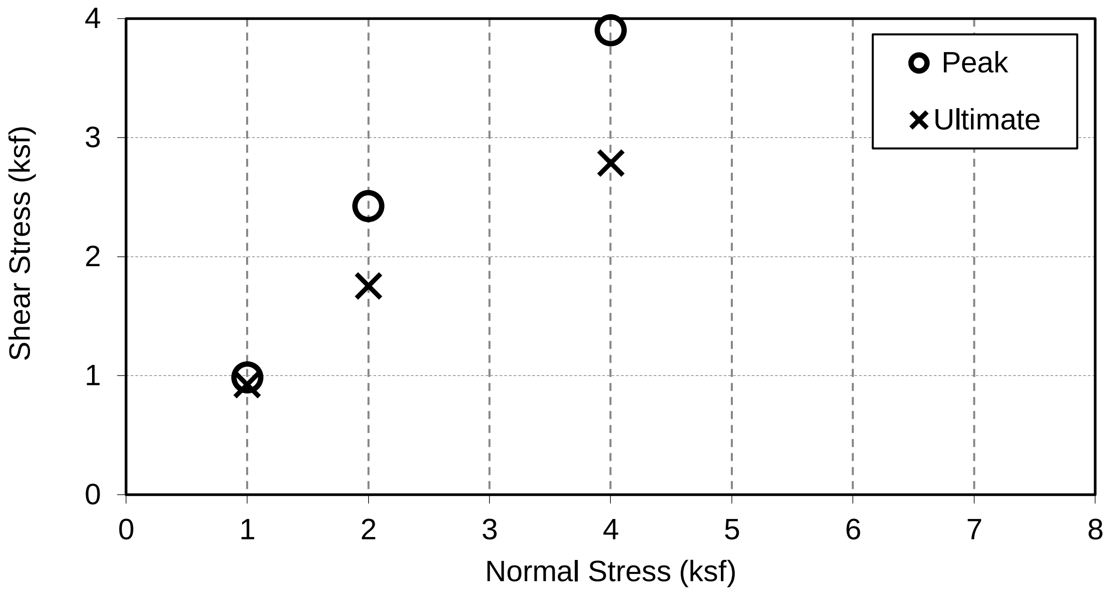
Type of test: **Consolidated, Drained**

Test No.	1	2	3
Symbol	▲	■	◆
Normal Stress (ksf)	**1**	**2**	**4**
Deformation Rate (in/min)	**0.002**	**0.002**	**0.002**

Peak Shear Stress (ksf)	**O**	**0.98**	**2.42**	**3.90**
Shear Stress @ End of Test (ksf)	**X**	**0.92**	**1.75**	**2.78**

Initial Height of Sample (in)	1.000	1.000	1.000
Height of Sample before Shear (in)	0.9976	1.0056	0.9981
Diameter of Sample (in)	2.416	2.416	2.416
Initial Moisture Content (%)	**30.6**	**30.6**	**30.6**
Final Moisture Content (%)	**40.1**	**37.2**	**27.6**
Dry Density (pcf)	**83.6**	**85.6**	**88.8**





HAI
HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

CONSOLIDATION TEST

ASTM D2435

Client :	SA Geotechnical, Inc	*HAI Project No.:*	SAG-24-022
Project Name:	Freedom Lane	*Tested by:*	GA
Project Number:	24064-01	*Checked by:*	KL
Boring No.:	B-1	*Date:*	05/14/24
Sample No.:	D-1		
Type of Sample:	Undisturbed ring		
Depth (ft):	5		
Soil Description:	Yellowish Brown, Clayey Sand (SC)		

Initial Total Weight	Final Total Weight	Final Dry Weight
(g)	(g)	(g)
148.19	149.81	125.11

			Initial Conditions	Final Conditions
Height	H	(in)	1.000	0.952
Height of Solids	H_s	(in)	0.608	0.608
Height of Water	H_w	(in)	0.307	0.329
Height of Air	H_a	(in)	0.085	0.015
Dry Density		**(pcf)**	**103.9**	**114.8**
Water Content		**(%)**	**18.4**	**19.7**
Saturation		**(%)**	**78.3**	**95.6**

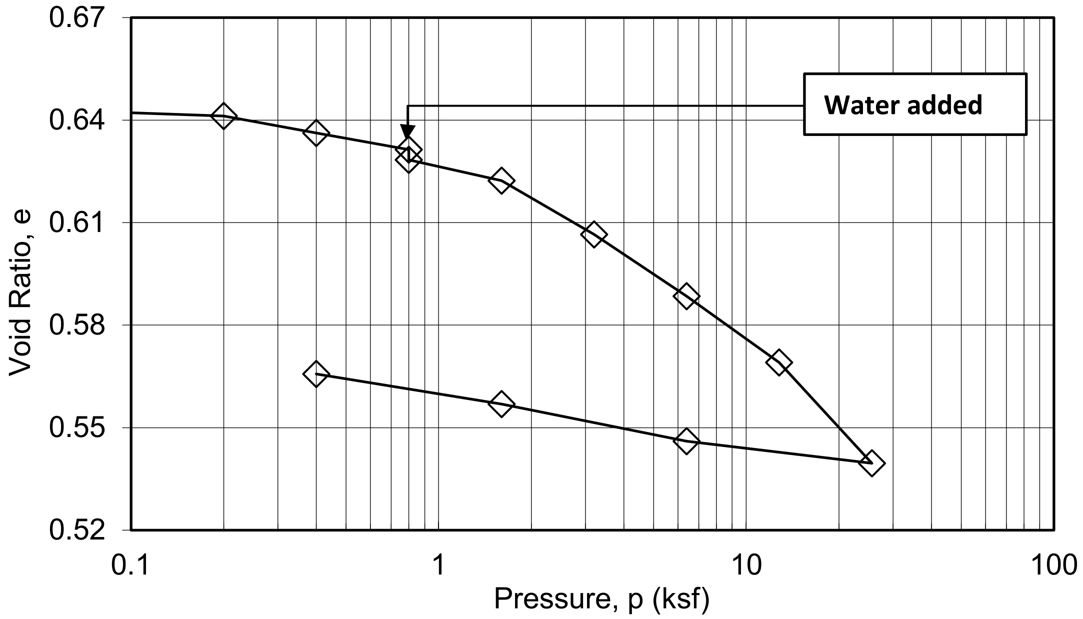
* Saturation is calculated based on Gs= 2.74

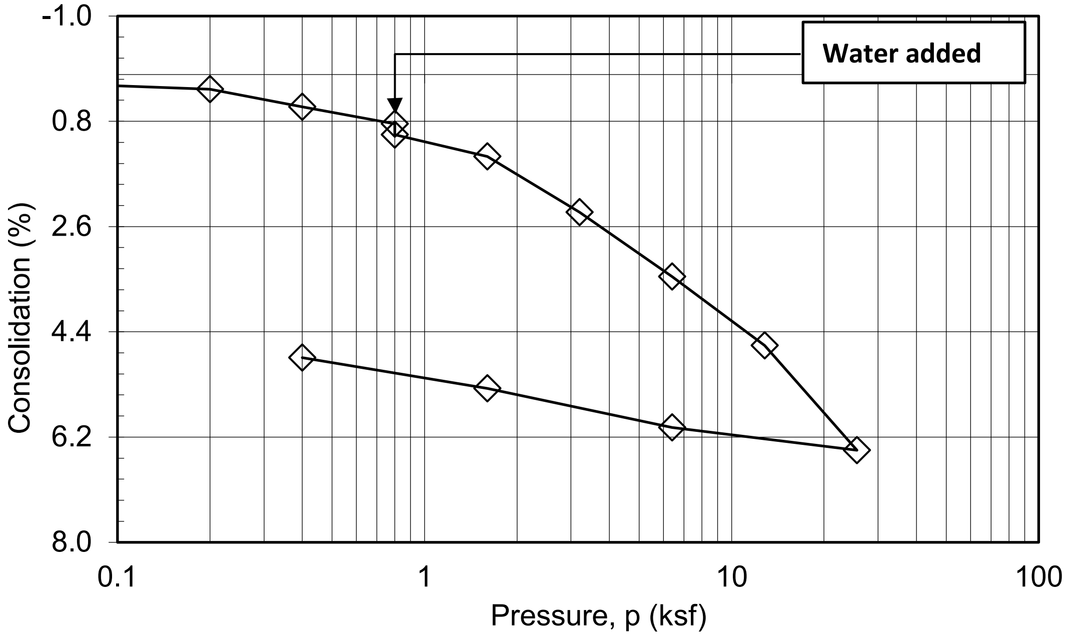
Load (ksf)	**δH (in)**	**H (in)**	**Voids (in)**	**e**	**Consol. (%)**	**a_v (ksf^{-1})**	**M_v (ksf^{-1})**	**Comment**
0.01	-------	1.0000	0.392	0.645	0			
0.2	0.0025	0.9975	0.390	0.641	0.3	2.2E-02	1.3E-02	
0.4	0.0055	0.9945	0.387	0.636	0.6	2.5E-02	1.5E-02	
0.8	0.0084	0.9916	0.384	0.631	0.8	1.2E-02	7.4E-03	
0.8	0.0103	0.9897	0.382	0.628	1.0	Water Added		
1.6	0.0140	0.9860	0.378	0.622	1.4	7.6E-03	4.7E-03	
3.2	0.0236	0.9765	0.369	0.607	2.4	9.8E-03	6.1E-03	
6.4	0.0346	0.9655	0.358	0.588	3.5	5.7E-03	3.6E-03	
12.8	0.0464	0.9537	0.346	0.569	4.6	3.0E-03	1.9E-03	
25.6	0.0643	0.9358	0.328	0.540	6.4	2.3E-03	1.5E-03	
6.4	0.0604	0.9397	0.332	0.546	6.0	Unloaded		
1.6	0.0537	0.9463	0.339	0.557	5.4			
0.4	0.0484	0.9516	0.344	0.566	4.8			

CONSOLIDATION TEST

ASTM D2435

Client :	SA Geotechnical, Inc	*HAI Project No.:*	SAG-24-022
Project Name:	Freedom Lane	*Tested by:*	GA
Project Number:	24064-01	*Checked by:*	KL
Boring No.:	B-1	*Date:*	05/14/24
Sample No.:	D-1		
Type of Sample:	Undisturbed ring		
Depth (ft):	5		
Soil Description:	Yellowish Brown, Clayey Sand (SC)		





CONSOLIDATION TEST

ASTM D2435

Client : SA Geotechnical, Inc
Project Name: Freedom Lane
Project Number: 24064-01
Boring No.: B-1
Sample No.: D-2
Type of Sample: Undisturbed ring
Depth (ft): 10
Soil Description: Yellowish Brown, Clayey Sand (SC)

HAI Project No.: SAG-24-022
Tested by: GA
Checked by: KL
Date: 05/14/24

Initial Total Weight (g)	Final Total Weight (g)	Final Dry Weight (g)
163.25	167.80	150.89

			Initial Conditions	**Final Conditions**
Height	H	(in)	1.000	0.959
Height of Solids	H_s	(in)	0.733	0.733
Height of Water	H_w	(in)	0.165	0.225
Height of Air	H_a	(in)	0.102	0.001
Dry Density		**(pcf)**	**125.3**	**136.3**
Water Content		**(%)**	**8.2**	**11.2**
Saturation		**(%)**	**61.6**	**99.6**

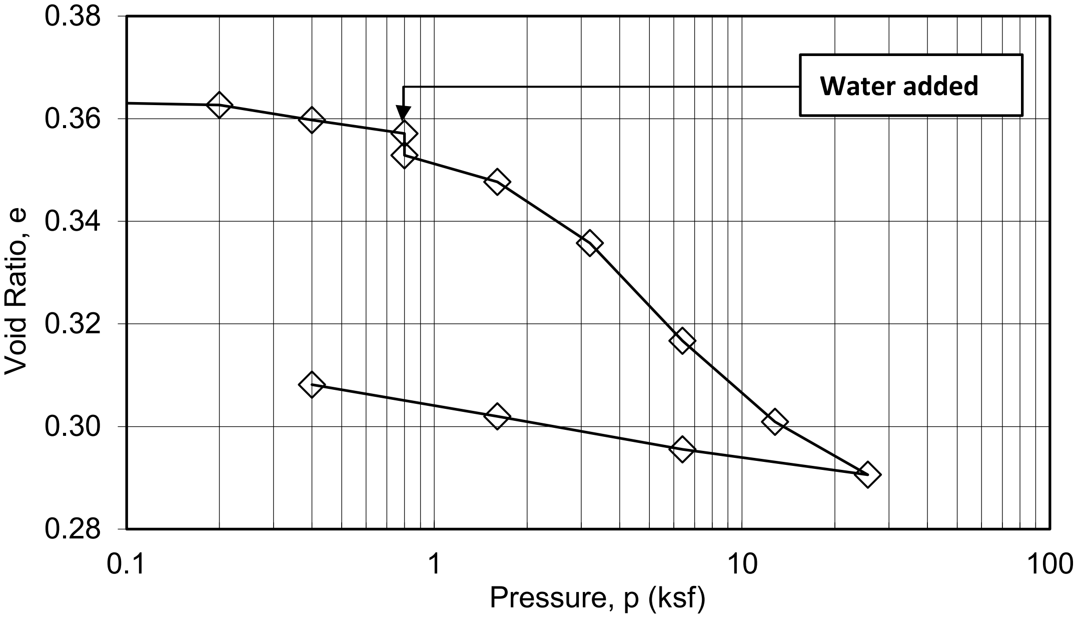
* Saturation is calculated based on Gs= 2.74

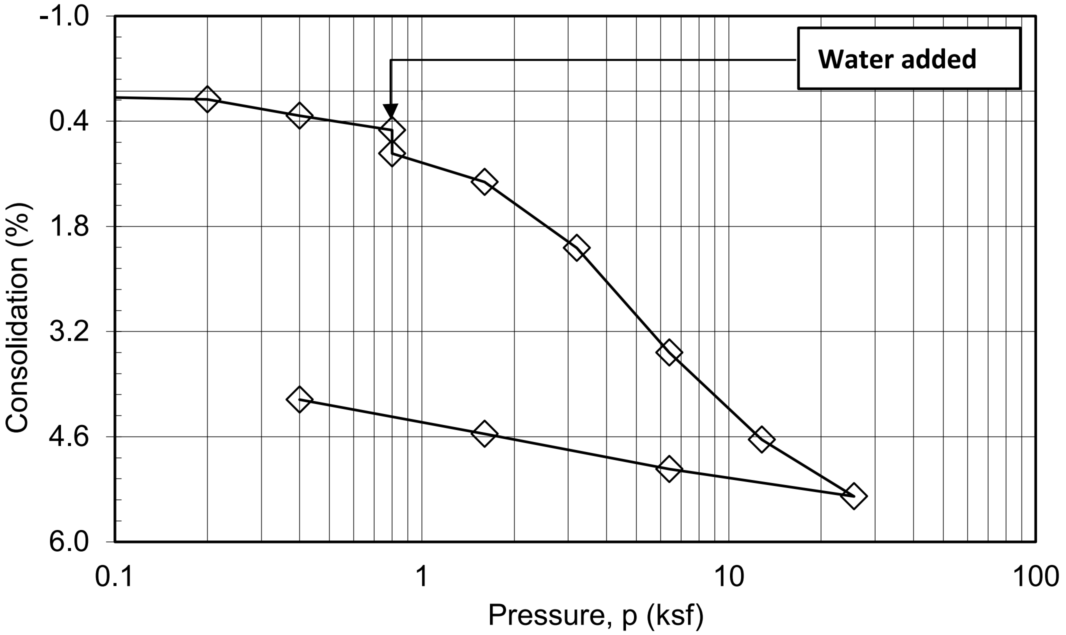
Load (ksf)	**δH (in)**	**H (in)**	**Voids (in)**	**e**	**Consol. (%)**	**a_v (ksf^{-1})**	**M_v (ksf^{-1})**	**Comment**
0.01	-------	1.0000	0.267	0.364	0			
0.2	0.0011	0.9989	0.266	0.363	0.1	7.9E-03	5.8E-03	
0.4	0.0033	0.9968	0.264	0.360	0.3	1.5E-02	1.1E-02	
0.8	0.0052	0.9948	0.262	0.357	0.5	6.7E-03	4.9E-03	
0.8	0.0083	0.9917	0.259	0.353	0.8	Water Added		
1.6	0.0121	0.9879	0.255	0.348	1.2	6.5E-03	4.8E-03	
3.2	0.0209	0.9792	0.246	0.336	2.1	7.5E-03	5.6E-03	
6.4	0.0348	0.9652	0.232	0.317	3.5	5.9E-03	4.5E-03	
12.8	0.0464	0.9536	0.221	0.301	4.6	2.5E-03	1.9E-03	
25.6	0.0540	0.9461	0.213	0.291	5.4	8.0E-04	6.2E-04	
6.4	0.0503	0.9497	0.217	0.296	5.0	Unloaded		
1.6	0.0456	0.9544	0.221	0.302	4.6			
0.4	0.0411	0.9590	0.226	0.308	4.1			

CONSOLIDATION TEST

ASTM D2435

Client :	SA Geotechnical, Inc	*HAI Project No.:*	SAG-24-022
Project Name:	Freedom Lane	*Tested by:*	GA
Project Number:	24064-01	*Checked by:*	KL
Boring No.:	B-1	*Date:*	05/14/24
Sample No.:	D-2		
Type of Sample:	Undisturbed ring		
Depth (ft):	10		
Soil Description:	Yellowish Brown, Clayey Sand (SC)		





Soil Analysis Lab Results

Client: HAI
Job Name: Freedom Lane
Client Job Number: SAG-24-022 / 24064-01
Project X Job Number: S240517E
May 20, 2024

	Method	**ASTM D4327**		**ASTM D4327**	
Bore# / Description	**Depth**	**Sulfates** SO_4^{2-}		**Chlorides** Cl^-	
	(ft)	**(mg/kg)**	**(wt%)**	**(mg/kg)**	**(wt%)**
TP-3 B-1	1-4	107.5	0.0108	199.4	0.0199
TP-9 B-1	0-5	51.3	0.0051	25.2	0.0025

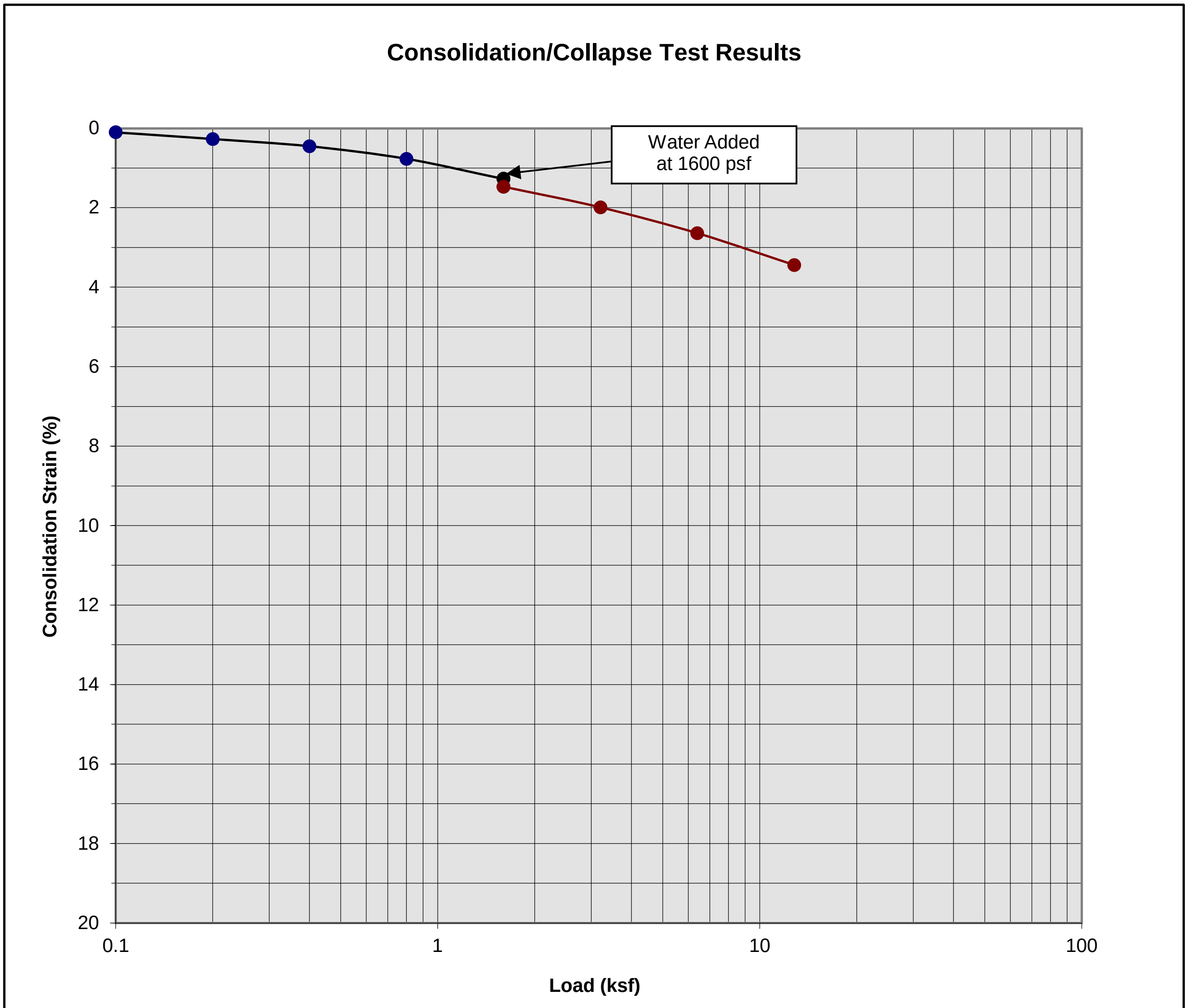
Cations and Anions, except Sulfide and Bicarbonate, tested with Ion Chromatography
mg/kg = milligrams per kilogram (parts per million) of dry soil weight
ND = 0 = Not Detected | NT = Not Tested | Unk = Unknown
Chemical Analysis performed on 1:3 Soil-To-Water extract
PPM = mg/kg (soil) = mg/L (Liquid)

Note: Sometimes a bad sulfate hit is a contaminated spot. Typical fertilizers are Potassium chloride, ammonium sulfate or ammonium sulfate nitrate (ASN). So this is another reason why testing full corrosion series is good because we then have the data to see if those other ingredients are present meaning the soil sample is just fertilizer-contaminated soil. This can happen often when the soil samples collected are simply surface scoops. This is why it's best to dig in a foot, throw away the top and test the deeper stuff. Dairy farms are also notorious for these items.

If one sample pops up much more corrosive than all others, we would recommend collecting more samples surrounding the problem sample location to determine if the peak is isolated to it. This allows us to conclude it was a contaminated sample and able to declare it an outlier.

Try out our new online forms: SOIL CORROSIVITY & THERMAL RESISTIVITY LAB REQUEST FORM & IN-SITU WENNER 4 PIN QUOTE REQUEST FORM

Laboratory Test Results by Southern California Geotechnical (2021)



Classification: BEDROCK: Light Brown fine-grained Sandstone

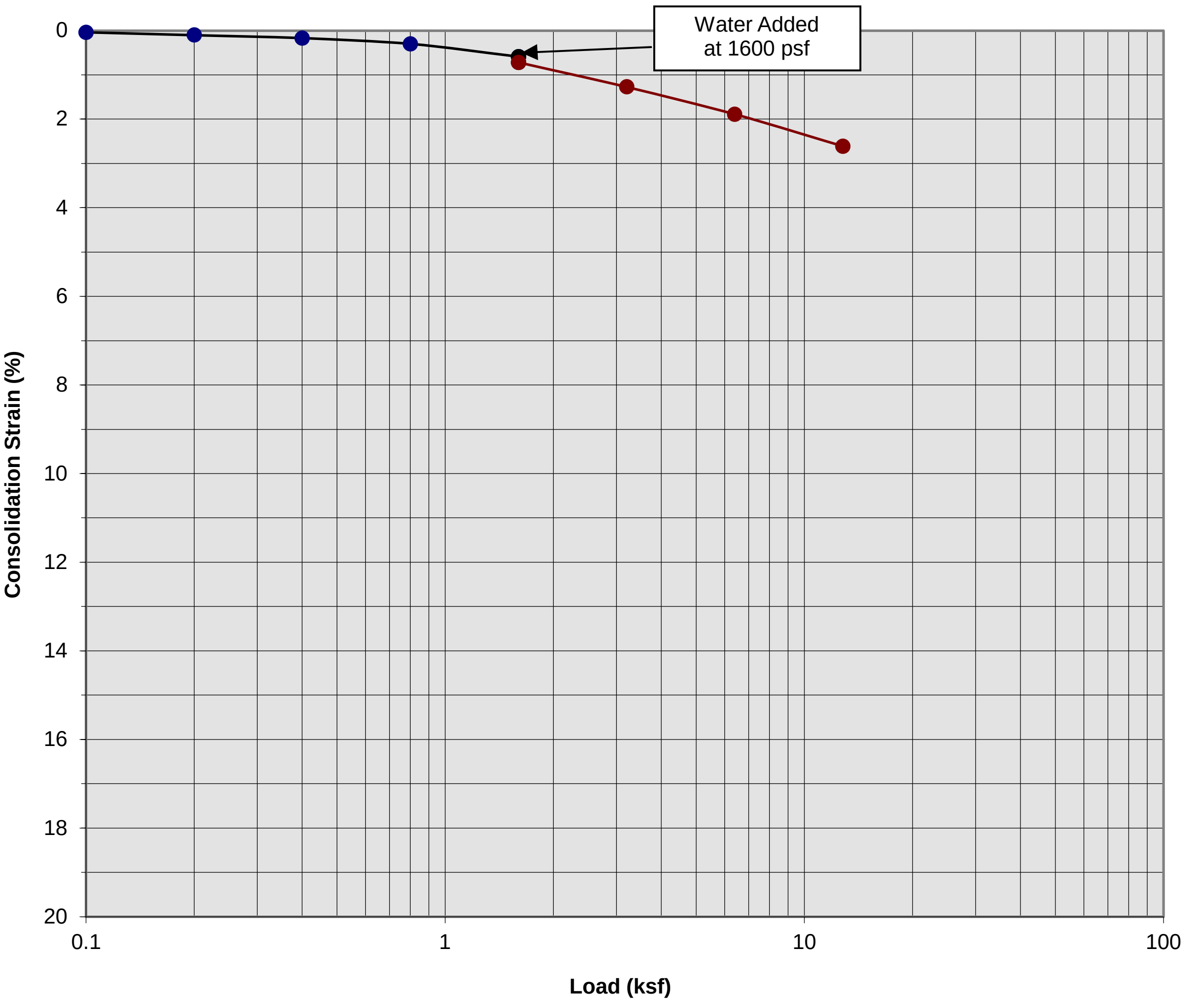
Boring Number:	B-2	Initial Moisture Content (%)	4
Sample Number:	---	Final Moisture Content (%)	20
Depth (ft)	1 to 2	Initial Dry Density (pcf)	102.4
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	104.7
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.20

Proposed Commercial/Industrial Development
Aliso Viejo, California
Project No. 21G167-1

PLATE C- 1

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Consolidation/Collapse Test Results



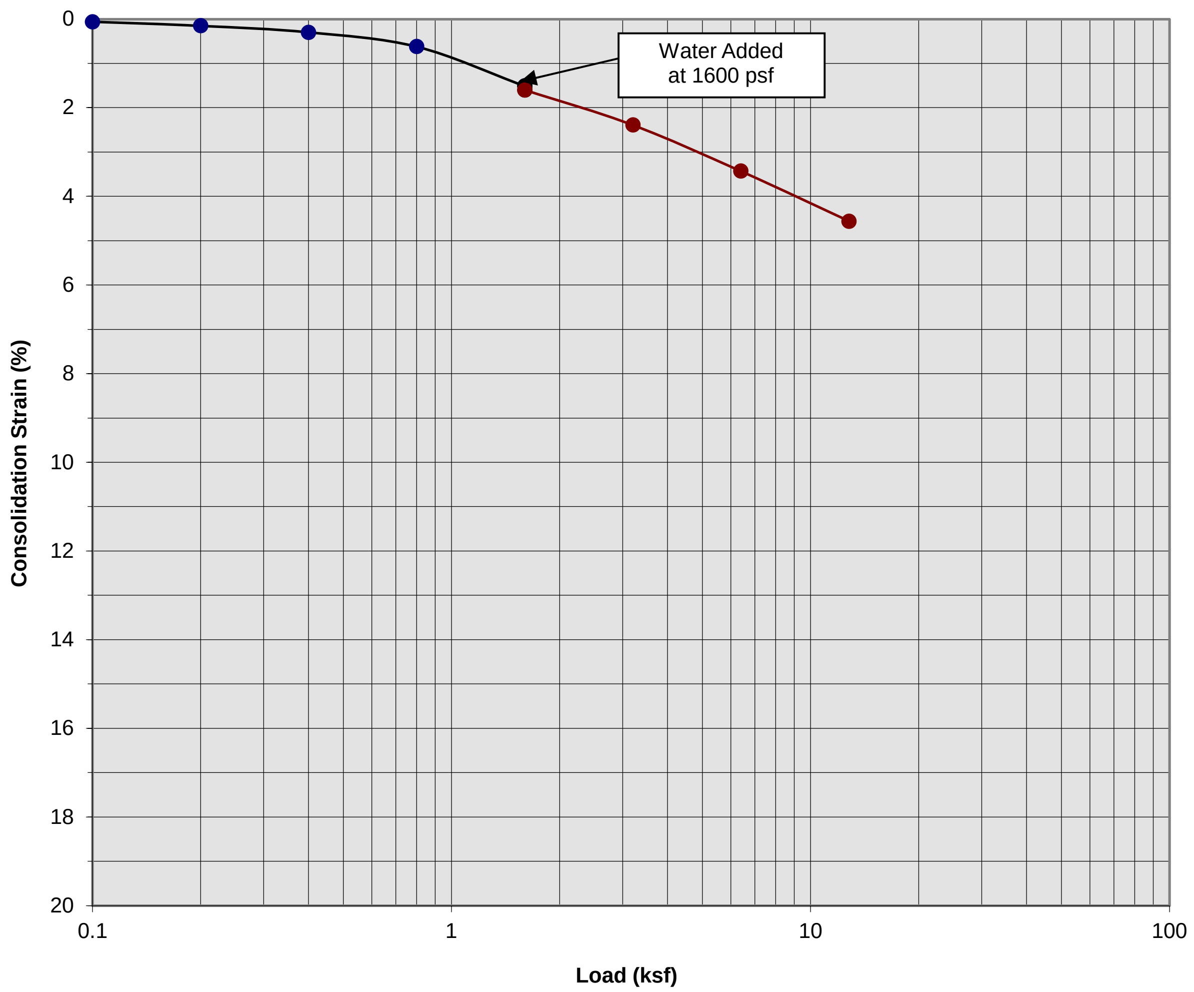
Classification: BEDROCK: Light Brown fine-grained Sandstone

Boring Number:	B-2	Initial Moisture Content (%)	6
Sample Number:	---	Final Moisture Content (%)	21
Depth (ft)	3 to 4	Initial Dry Density (pcf)	103.0
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	101.7
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.13

Proposed Commercial/Industrial Development
Aliso Viejo, California
Project No. 21G167-1
PLATE C- 2

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Consolidation/Collapse Test Results



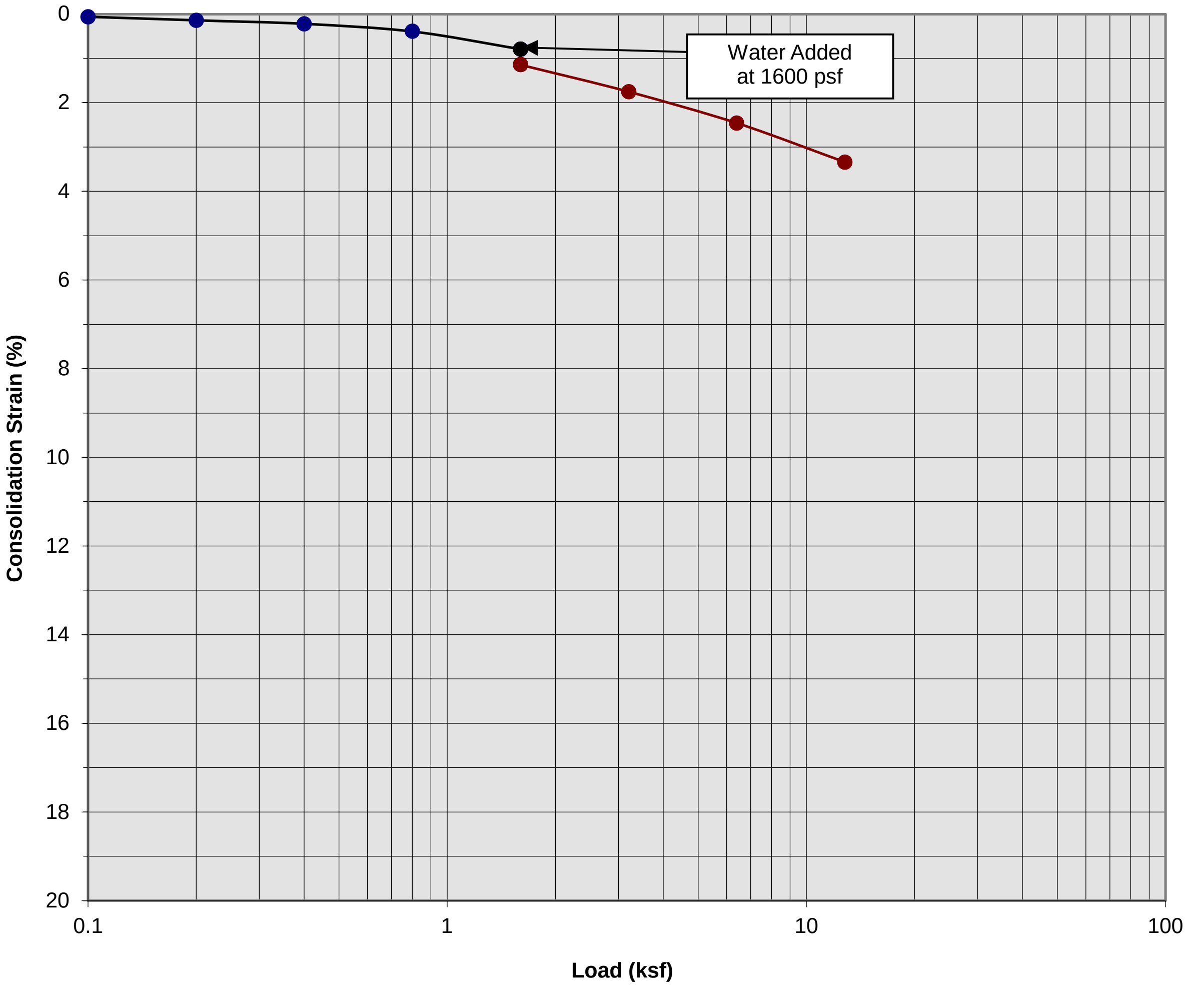
Classification: BEDROCK: Light Brown fine-grained Sandstone

Boring Number:	B-2	Initial Moisture Content (%)	4
Sample Number:	---	Final Moisture Content (%)	19
Depth (ft)	5 to 6	Initial Dry Density (pcf)	102.2
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	106.6
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.09

Proposed Commercial/Industrial Development
Aliso Viejo, California
Project No. 21G167-1
PLATE C- 3

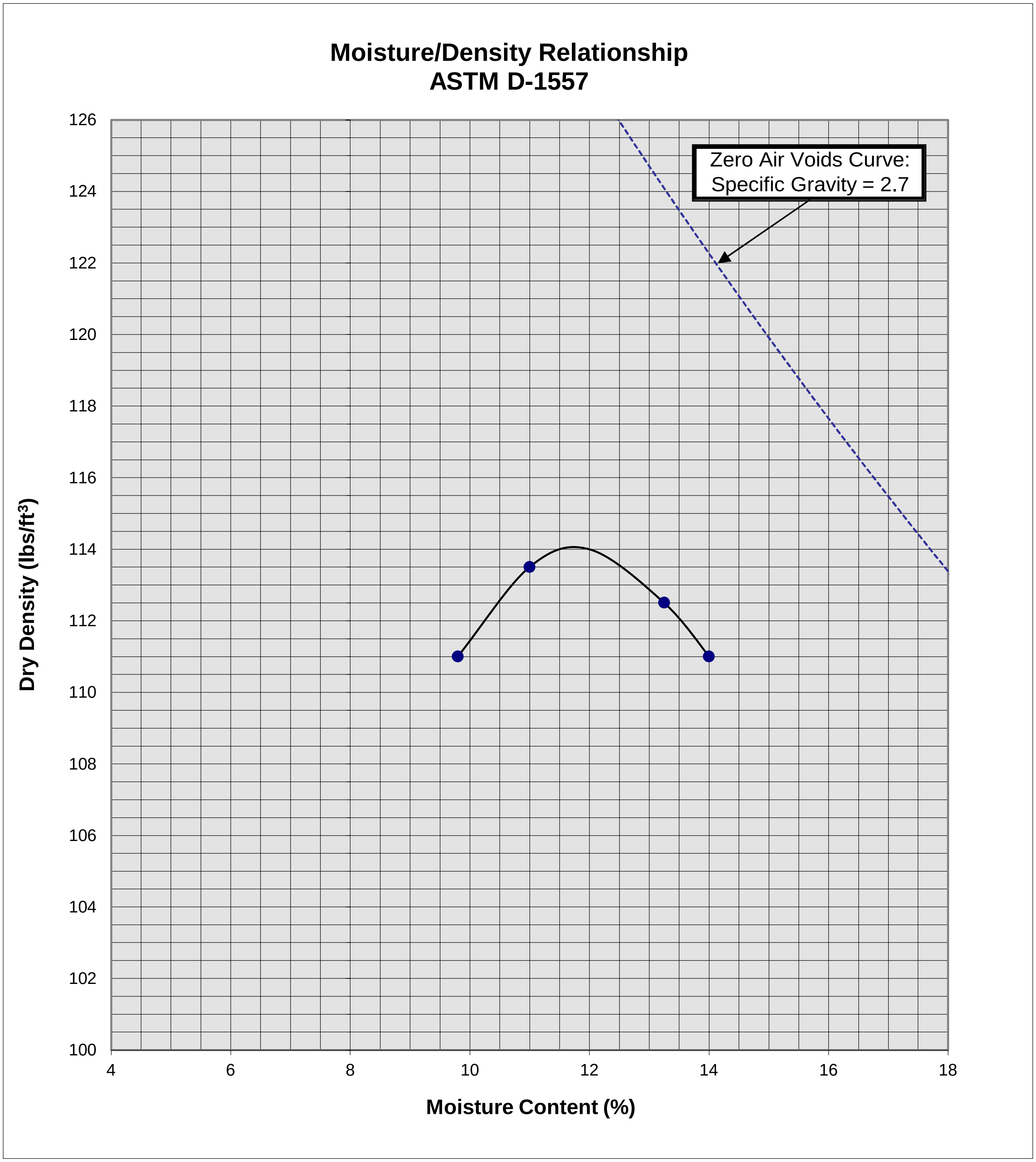
SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Consolidation/Collapse Test Results



Classification: BEDROCK: Light Brown fine-grained Sandstone

Boring Number:	B-2	Initial Moisture Content (%)	5
Sample Number:	---	Final Moisture Content (%)	16
Depth (ft)	7 to 8	Initial Dry Density (pcf)	106.6
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	110.6
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.35



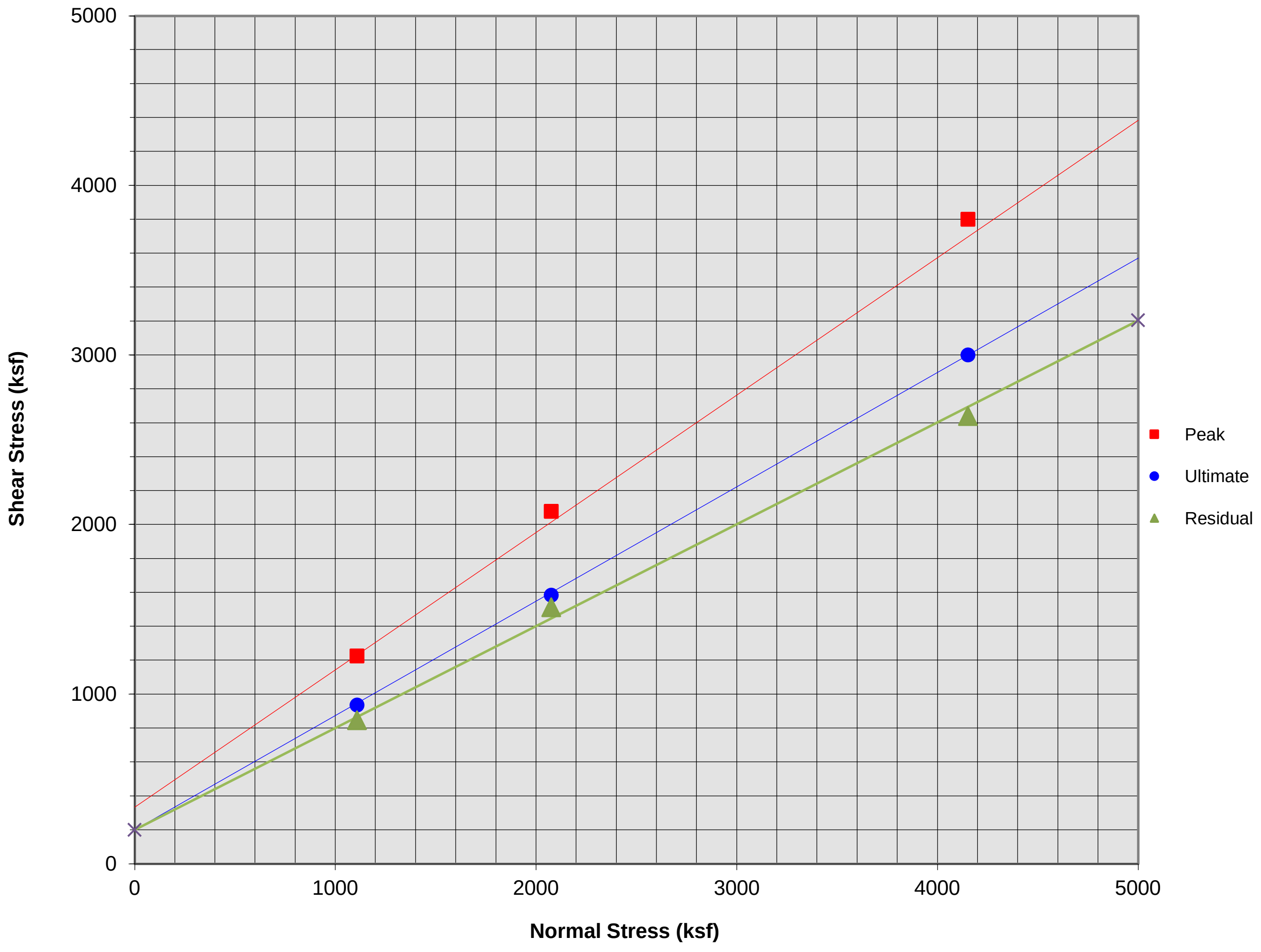
Soil ID Number	B-2 @ 0-5'
Optimum Moisture (%)	12
Maximum Dry Density (pcf)	114
Soil Classification	BEDROCK: Light Brown fine-grained Sandstone

Proposed Commercial/Industrial Development
Aliso Viejo, California
Project No. 21G167-1

PLATE C-5

SoCalGeo
SOUTHERN
CALIFORNIA
GEOTECHNICAL
A California Corporation

Direct Shear Test Results
(Undisturbed)



Sample Description: BA-1 @ 10'

Classification: Bedrock: Light Gray fine grained Sandstone

Sample Data	
Initial Moisture Content	12.0
Final Moisture Content	20.0
Initial Dry Density	111.0
Final Dry Density	--
Specimen Diameter (in)	2.4
Specimen Thickness (in)	1.0

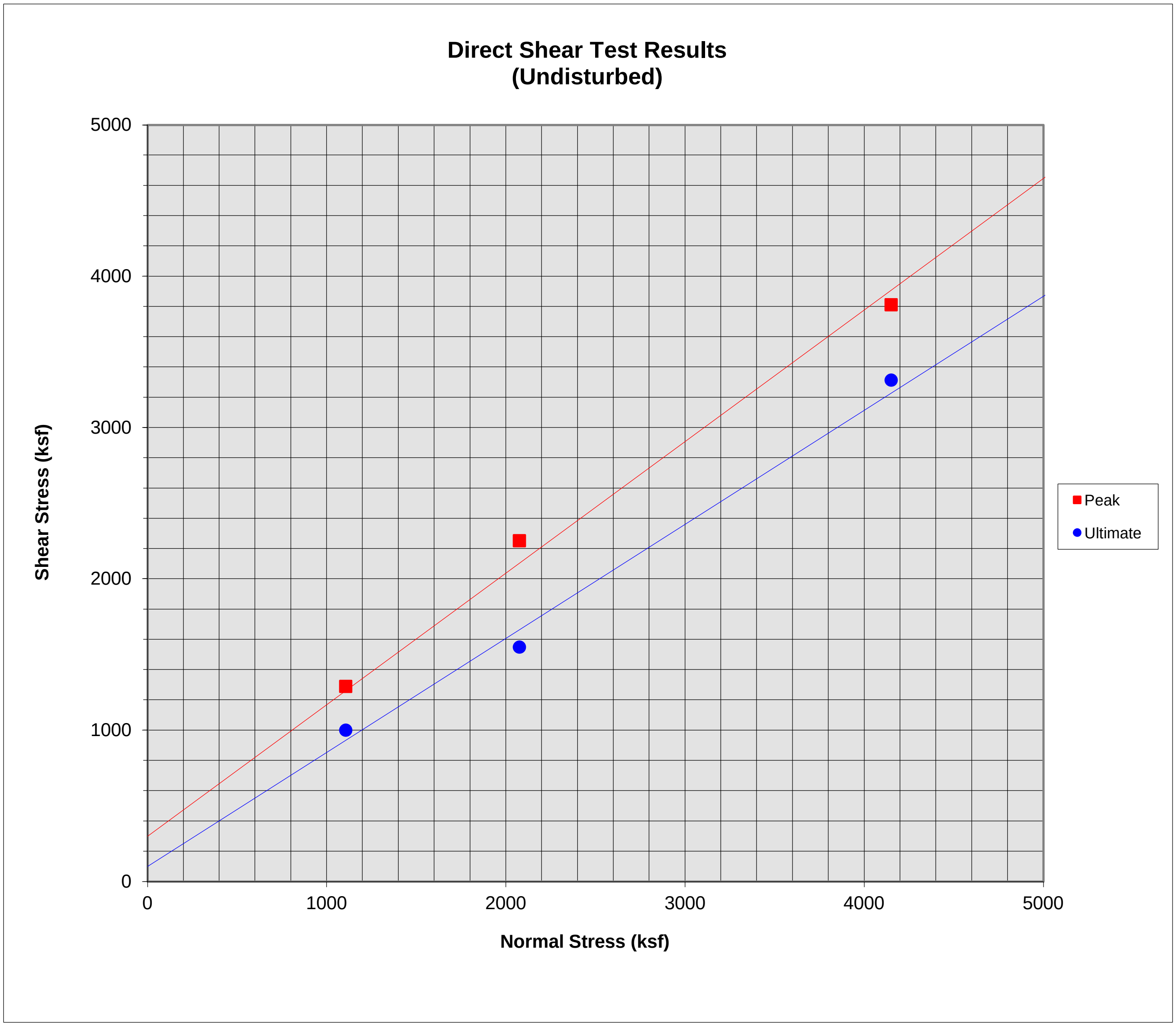
Test Results

	Peak	Ultimate	Residual
ϕ (°)	39.0	34.0	31.0
C (psf)	335	200	200

Proposed Commercial/Industrial Development
Aliso Viejo, California
Project No. 21G167

PLATE C- 6

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation



Sample Description: B-1 @ 24 to 25 feet

Classification: BEDROCK: Brown fine-grained Sandstone

Sample Data	
Initial Moisture Content	6.0
Final Moisture Content	19.0
Initial Dry Density	110.0
Final Dry Density	---
Specimen Diameter (in)	2.4
Specimen Thickness (in)	1.0

Test Results

	Peak	Ultimate
ϕ (°)	41.0	37.0
C (psf)	300	100

Proposed Commercial/Industrial Development
Aliso Viejo, California
Project No. 21G167

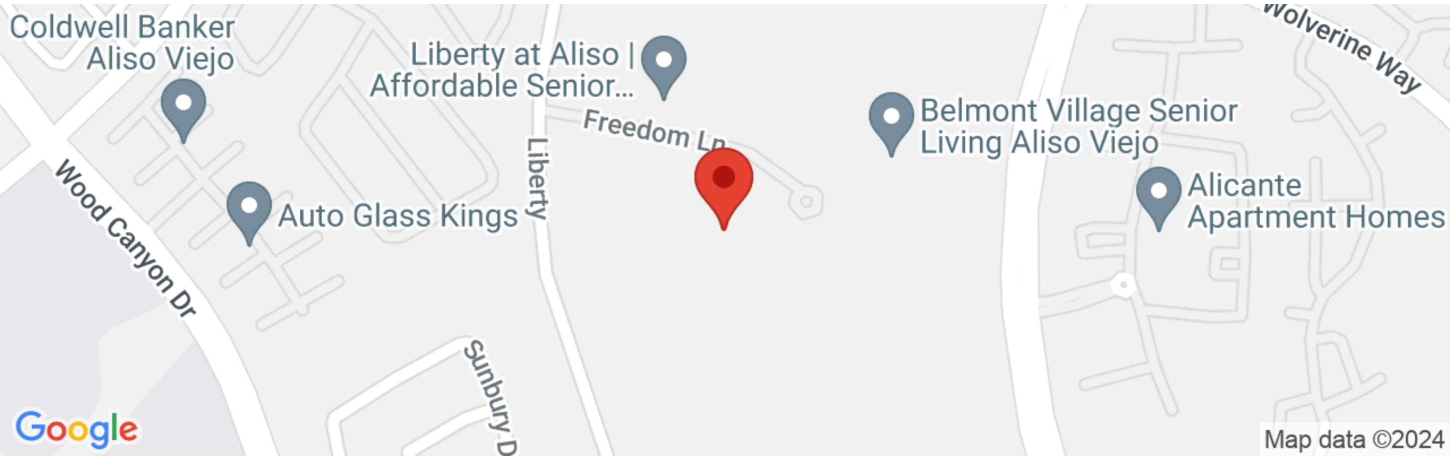
PLATE C-7

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Appendix D

USGS web services were down for some period of time and as a result this tool wasn't operational, resulting in *timeout* error.
USGS web services are now operational so this tool should work as expected.

Latitude, Longitude: 33.56181, -117.72862


Coldwell Banker Aliso Viejo
Liberty at Aliso | Affordable Senior...
Wolverine Way
Freedom Ln
Belmont Village Senior Living Aliso Viejo
Liberty
Wood Canyon Dr
Auto Glass Kings
Alicante Apartment Homes
Sunbury D
Google
Map data ©2024

Date	5/31/2024, 4:29:32 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	C - Very Dense Soil and Soft Rock

Type	Value	Description
S_S	1.244	MCE_R ground motion. (for 0.2 second period)
S_1	0.444	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.493	Site-modified spectral acceleration value
S_{M1}	0.667	Site-modified spectral acceleration value
S_{DS}	0.995	Numeric seismic design value at 0.2 second SA
S_{D1}	0.444	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	1.5	Site amplification factor at 1.0 second
PGA	0.533	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.639	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.244	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.342	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	2.6	Factored deterministic acceleration value. (0.2 second)
S1RT	0.444	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.477	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.869	Factored deterministic acceleration value. (1.0 second)
PGAd	1.061	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.533	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.927	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.932	Mapped value of the risk coefficient at a period of 1 s
C_V	1.149	Vertical coefficient

DISCLAIMER

While the information presented on this website is believed to be correct, SEAOC /OSHPD and its sponsors and contributors assume no responsibility or liability for its accuracy. The material presented in this web application should not be used or relied upon for any specific application without competent examination and verification of its accuracy, suitability and applicability by engineers or other licensed professionals. SEAOC / OSHPD do not intend that the use of this information replace the sound judgment of such competent professionals, having experience and knowledge in the field of practice, nor to substitute for the standard of care required of such professionals in interpreting and applying the results of the seismic data provided by this website. Users of the information from this website assume all liability arising from such use. Use of the output of this website does not imply approval by the governing building code bodies responsible for building code approval and interpretation for the building site described by latitude/longitude location in the search results of this website.

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Please also see the new USGS Earthquake Hazard Toolbox for access to the most recent NSHMs for the conterminous U.S. and Hawaii.

Input

Edition
Dynamic: Conterminous U.S. 2014 (u…

Latitude
Decimal degrees
33.56181

Longitude
Decimal degrees, negative values for western longitudes
-117.72862

Site Class
537 m/s (Site class C)

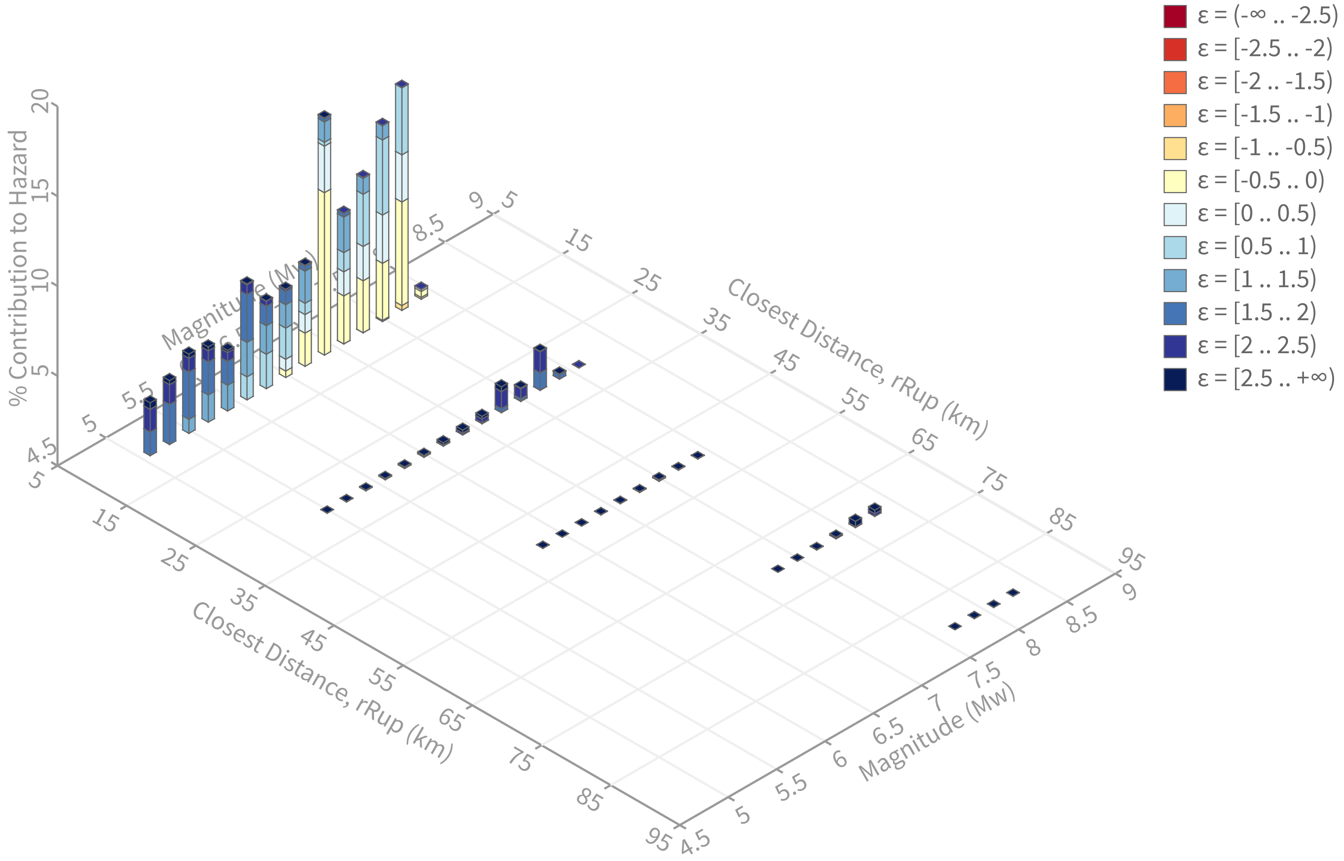
Spectral Period
Peak Ground Acceleration

Time Horizon
Return period in years
2475

^ Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.59756496 g

Recovered targets

Return period: 2750.0871 yrs
Exceedance rate: 0.00036362485 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.07 %

Mean (over all sources)

m: 6.79
r: 9.39 km
ε_0: 0.85 σ

Mode (largest m-r bin)

m: 6.89
r: 5.23 km
ε_0: 0.06 σ
Contribution: 13.2 %

Mode (largest m-r-ε_0 bin)

m: 6.89
r: 4.51 km
ε_0: -0.19 σ
Contribution: 9.04 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
UC33brAvg_FM32	System							34.37
San Joaquin Hills [2]		4.45	7.11	-0.11	117.699°W	33.588°N	42.77	19.34
Newport-Inglewood (Offshore) [3]		8.90	7.29	0.92	117.798°W	33.507°N	226.82	8.25
Oceanside alt2 [12]		5.38	7.53	-0.18	117.802°W	33.515°N	232.65	1.51
Elsinore (Glen Ivy) rev [1]		31.74	7.65	2.07	117.488°W	33.765°N	44.60	1.07
UC33brAvg_FM31	System							31.13
San Joaquin Hills [2]		4.45	7.52	-0.08	117.699°W	33.588°N	42.77	11.47
Newport-Inglewood (Offshore) [3]		8.90	7.29	0.91	117.798°W	33.507°N	226.82	8.56
Oceanside alt1 [6]		5.52	6.98	-0.01	117.802°W	33.514°N	232.26	5.92
Elsinore (Glen Ivy) rev [1]		31.74	7.62	2.10	117.488°W	33.765°N	44.60	1.03
UC33brAvg_FM31 (opt)	Grid							17.31
PointSourceFinite: -117.729, 33.629		8.73	5.73	1.57	117.729°W	33.629°N	0.00	2.88
PointSourceFinite: -117.729, 33.629		8.73	5.73	1.57	117.729°W	33.629°N	0.00	2.88
PointSourceFinite: -117.729, 33.611		7.14	5.83	1.25	117.729°W	33.611°N	0.00	2.41
PointSourceFinite: -117.729, 33.611		7.14	5.83	1.25	117.729°W	33.611°N	0.00	2.41
PointSourceFinite: -117.729, 33.647		10.02	5.82	1.69	117.729°W	33.647°N	0.00	1.05
PointSourceFinite: -117.729, 33.647		10.02	5.82	1.69	117.729°W	33.647°N	0.00	1.05
UC33brAvg_FM32 (opt)	Grid							17.18
PointSourceFinite: -117.729, 33.629		8.73	5.73	1.57	117.729°W	33.629°N	0.00	2.85
PointSourceFinite: -117.729, 33.629		8.73	5.73	1.57	117.729°W	33.629°N	0.00	2.85
PointSourceFinite: -117.729, 33.611		7.15	5.82	1.25	117.729°W	33.611°N	0.00	2.39
PointSourceFinite: -117.729, 33.611		7.15	5.82	1.25	117.729°W	33.611°N	0.00	2.39
PointSourceFinite: -117.729, 33.647		10.02	5.82	1.69	117.729°W	33.647°N	0.00	1.05
PointSourceFinite: -117.729, 33.647		10.02	5.82	1.69	117.729°W	33.647°N	0.00	1.05

Appendix E

Summary of Slope Stability Analysis
Cross-Section B-B'

Filename	**Description**	**Factor of Safety (FS)**	
		Static	***Pseudostatic***
01, 01p	Global Stability of the Existing Slope, Block Search through Bedrock with along-bedding strengths	1.88	1.22
02, 02p	Global Stability of the Existing Slope, Circular Search through Bedrock with along-bedding strengths	1.59	1.11

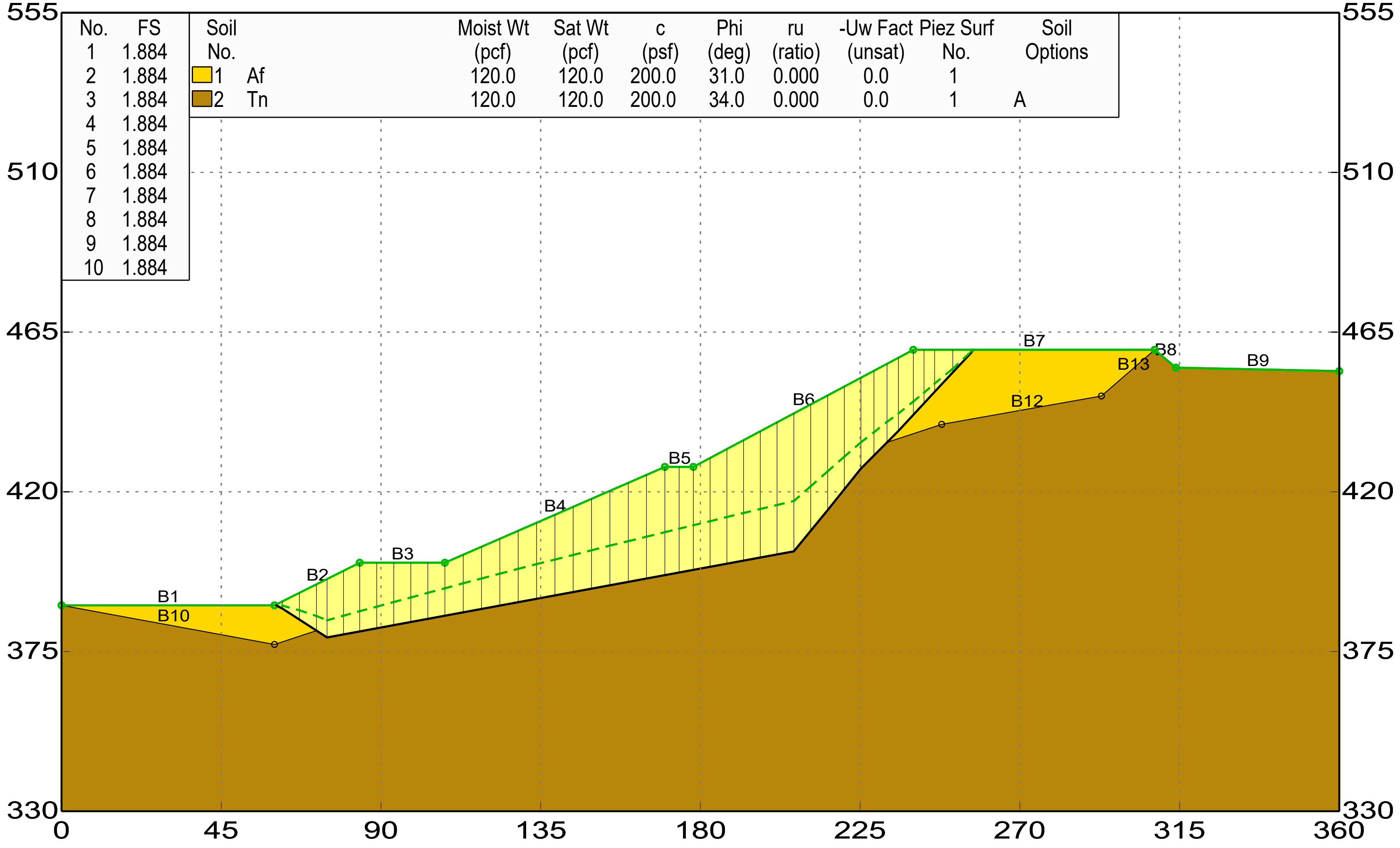
Project No.: 24064-01

Project Name: Meritage/ Freedom Lane, Aliso Viejo

X-Section B-B' - Freedom Lane
Global Stability of Existing Slope

SA Geotechnical, Inc., RS

\01.gsd



No.	FS
1	1.884
2	1.884
3	1.884
4	1.884
5	1.884
6	1.884
7	1.884
8	1.884
9	1.884
10	1.884

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	-Uw Fact (unsat)	Piez Surf No.	Soil Options
🟨 1	Af	120.0	120.0	200.0	31.0	0.000	0.0	1	
🟫 2	Tn	120.0	120.0	200.0	34.0	0.000	0.0	1	A

GEOSTASE FS = 1.884

Spencer Method

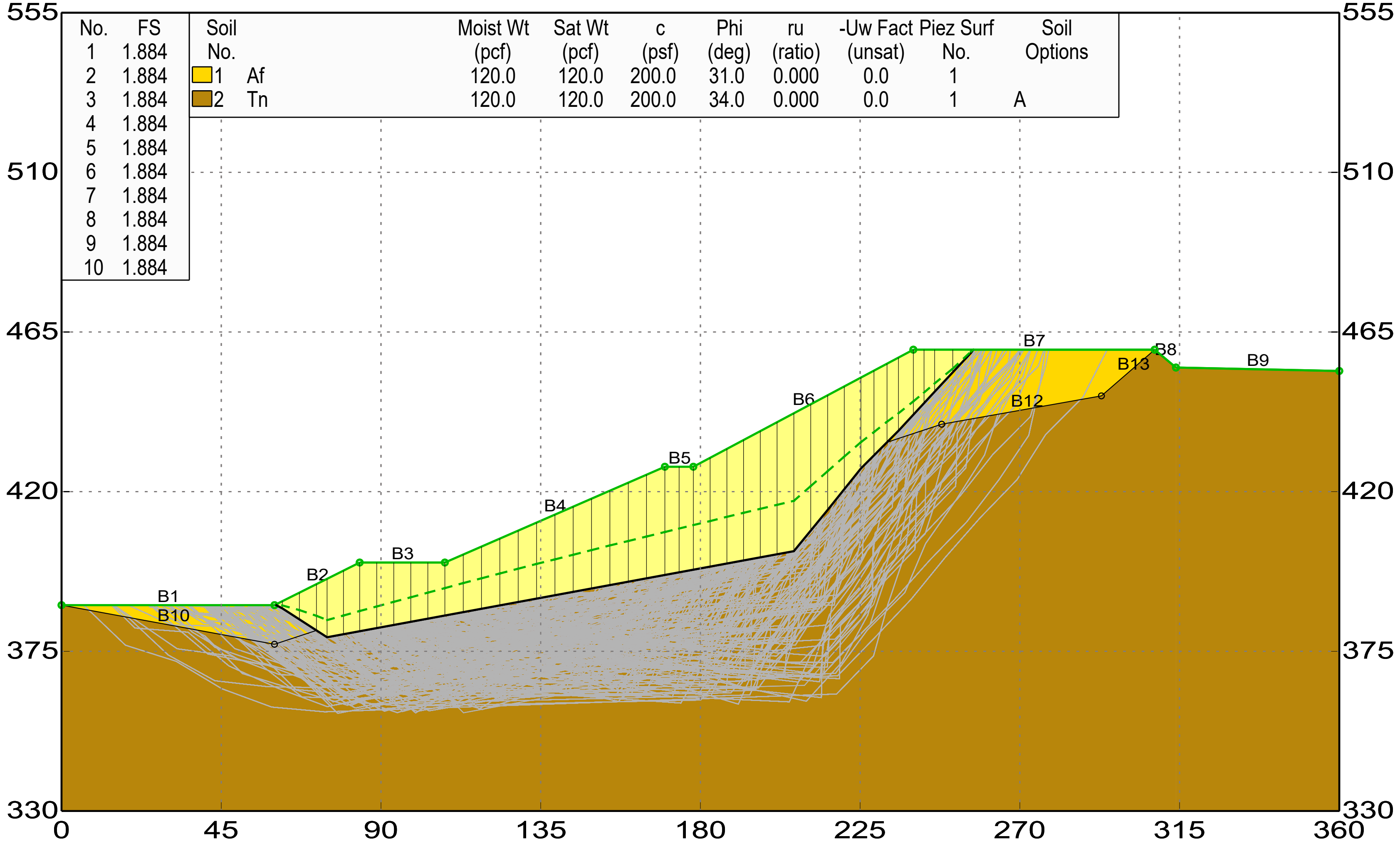
GEOSTASE
Slope Stability
Analysis

GEOSTASE® v4.30.32 by GREGORY GEOTECHNICAL SOFTWARE

X-Section B-B' - Freedom Lane
Global Stability of Existing Slope

SA Geotechnical, Inc., RS

\01.gsd



No.	FS
1	1.884
2	1.884
3	1.884
4	1.884
5	1.884
6	1.884
7	1.884
8	1.884
9	1.884
10	1.884

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	-Uw Fact (unsat)	Piez Surf No.	Soil Options
🟨1	Af	120.0	120.0	200.0	31.0	0.000	0.0	1	
🟫2	Tn	120.0	120.0	200.0	34.0	0.000	0.0	1	A

GEOSTASE FS = 1.884

Spencer Method

GEOSTASE
Slope Stability Analysis

GEOSTASE® v4.30.32 by GREGORY GEOTECHNICAL SOFTWARE

PLATE C.2

```
                              ***  GEOSTASE(R)  ***

           ** GEOSTASE(R) (c)Copyright by Garry H. Gregory, Ph.D.,P.E.,S.E.,BC.GE **

                  ** Current Version 4.30.32-Double Precision, Sept 2023 **
                      (All Rights Reserved-Unauthorized Use Prohibited)


          *********************************************************************************
                         SLOPE STABILITY ANALYSIS SOFTWARE (2D & 3D)
              Simplified Bishop, Simplified Janbu, or General Equilibrium (GE) Options.
                 (Spencer, Morgenstern-Price, USACE, and Lowe & Karafiath)
                 Including Pier/Pile, Planar Reinf,  Nail, Tieback, Line Loads
                 Applied Forces, Fiber-Reinforced Soil (FRS), Distributed Loads
                 Nonlinear Undrained Shear Strength, Curved Strength Envelope,
                 Anisotropic Strengths, Water Surfaces, 3-Stage Rapid Drawdown
                 2- or 3-Stage Pseudo-Static & Simplified Newmark Seismic Analyses.
          *********************************************************************************


          Analysis Date:              6/  3/ 2024
          Analysis Time:
          Analysis By:               SA Geotechnical, Inc., RS


          Input File Name:           C:\Users\Reza Saberi\SA Geotechnical, Inc\SA Geotechnical -
Projects\2024\24064-01 Meritage - 400-700 Freedom Ln, Aliso Viejo\Engineering\Sted\B-B'\01.gsd

          Output File Name:          C:\Users\Reza Saberi\SA Geotechnical, Inc\SA Geotechnical -
Projects\2024\24064-01 Meritage - 400-700 Freedom Ln, Aliso Viejo\Engineering\Sted\B-B'\01.OUT

          Unit System:               English


          PROJECT: X-Section B-B' - Freedom Lane

          DESCRIPTION: Global Stability of Existing Slope
```

```
 PROFILE BOUNDARY DATA

     9 Surface Boundaries
    13 Total   Boundaries


 Boundary      X - 1       Y - 1       X - 2       Y - 2      Soil Type
    No.        (ft)        (ft)        (ft)        (ft)       Below Bnd

     1          0.000     388.000      60.000     388.000        1
     2         60.000     388.000      84.000     400.000        1
     3         84.000     400.000     108.000     400.000        1
     4        108.000     400.000     170.000     427.000        1
     5        170.000     427.000     178.000     427.000        1
     6        178.000     427.000     240.000     460.000        1
     7        240.000     460.000     308.000     460.000        1
     8        308.000     460.000     314.000     455.000        2
     9        314.000     455.000     360.000     454.000        2
    10          0.000     388.000      60.000     377.000        2
    11         60.000     377.000     248.000     439.000        2
    12        248.000     439.000     293.000     447.000        2
    13        293.000     447.000     308.000     460.000        2

 User Specified X-Origin =         0.000(ft)

 User Specified Y-Origin =       330.000(ft)

 SURFACE BOUNDARY POINT COORDINATES
(Information Only-Not Used Directly)
 Point No.       X-COORD             Y-COORD
    1                0.000              388.000
    2               60.000              388.000
    3               84.000              400.000
    4              108.000              400.000
    5              170.000              427.000
    6              178.000              427.000
    7              240.000              460.000
    8              308.000              460.000
    9              314.000              455.000
```

```
          10              360.000             454.000

        SUBSURFACE BOUNDARY POINT COORDINATES
         (Information Only-Not Used Directly)
        Point No.       X-COORD             Y-COORD
        Surface boundary point    1 and Subsurface boundary point   11 are duplicate points.
          11                0.000             388.000
          12               60.000             377.000
          13              248.000             439.000
          14              293.000             447.000
        Surface boundary point    8 and Subsurface boundary point   15 are duplicate points.
          15              308.000             460.000

     PROFILE BOUNDARY SLOPES AND ANGLES
        BND No.  Slope    Angle(Deg.)
           1      0.000     0.000
           2      0.500    26.565
           3      0.000     0.000
           4      0.435    23.532
           5      0.000     0.000
           6      0.532    28.025
           7      0.000     0.000
           8     -0.833   -39.806
           9     -0.022    -1.245
          10     -0.183   -10.389
          11      0.330    18.252
          12      0.178    10.081
          13      0.867    40.914


       MOHR-COULOMB SOIL PARAMETERS

         2 Type(s) of Soil Defined

     Soil Number           Moist  Saturated  Cohesion Friction   Pore      (-Uw)   Water   Water
         and              Unit Wt. Unit Wt. Intercept   Angle  Pressure    Fact.  Surface  Option
     Description           (pcf)    (pcf)     (psf)     (deg)  Ratio(ru)         No.

1 Af                       120.0    120.0     200.00    31.00    0.000      0.0      1       0
```

```
2 Tn                       120.0    120.0     200.00    34.00    0.000      0.0      1       0


       ANISOTROPIC STRENGTH PARAMETERS

            1 soil type(s)

        Soil Type  2 Is Anisotropic

        Number Of Direction Ranges Specified =  3


        Direction    Counterclockwise     Cohesion     Friction
          Range       Direction Limit    Intercept       Angle
           No.            (deg)            (psf)         (deg)

            1              -5.0             200.00         34.00
            2               8.0             200.00         28.00
            3              90.0             200.00         24.00

        A Non-Circular Zone Search Has Been Selected For Analysis
        Using Random Generation Within Specified Zones.

        2 Zones Defined For Generation Of Non-Circular Surfaces


          4000 Trial Surfaces Have Been Generated.


        Length Of Line Segments For Active And Passive Portions Of
        Non-Circular Zone Search =   15.00(ft)

        Zone       X - 1      Y - 1      X - 2      Y - 2       Height
        No.         (ft)       (ft)       (ft)       (ft)        (ft)

         1          70.00     375.00     125.00     375.00      35.00
         2         140.00     385.00     220.00     385.00      50.00
        The Spencer Method Was Selected for FS Analysis.
```

```
Selected fx function = Constant (1.0)

SELECTED CONVERGENCE PARAMETERS FOR SPENCER METHOD:
Initial estimate of FS =  1.500
FS tolerance =  0.000001000
Initial estimate of theta(deg) =  15.00
Theta tolerance(radians) =  0.0001000
Minimum theta(deg) = -45.00 ; Maximum theta(deg) =  45.00
Theta convergence Step Factor = 5000.00
Maximum number of iterations = 50
Allowable negative side force = -1000.0(lbs)
Maximum force imbalance  = 100.000000(lbs)
Maximum moment imbalance = 100.000000 (ft/lbs)

Selected Lambda Coefficient =  1.00

Specified Tension Crack Water Depth Factor =   0.000

Total Number of Trial Surfaces Attempted = 4000

WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
Did Not Converge in 50 Iterations.


Number of Trial Surfaces with Non-Converged FS = 386

Number of Trial Surfaces With Valid FS = 3614


Percentage of Trial Surfaces With Non-Converged and/or
Non-Valid FS Solutions of the Total Attempted =   9.7 %

Statistical Data On All Valid FS Values:
   FS Max =   9.496   FS Min =   1.884   FS Ave =   3.964
   Standard Deviation =    1.407   Coefficient of Variation =   35.51 %


Critical Surface is Sequence Number     231 of Those Analyzed.
```

```
*****BEGINNING OF DETAILED GEOSTASE OUTPUT FOR CRITICAL SURFACE FROM A SEARCH*****


  Iter.     Theta         FS         FS
   No.      (deg)      (Moment)   (Force)
           (fx=1.0)                            Lambda        Delta FS

    1        15.0000    1.947195   1.841694     0.268      0.1055008E+00
    2        19.9500    1.746420   1.951656     0.363      0.2052360E+00
    3        16.6803    1.898327   1.875861     0.300      0.2246659E-01
    4        17.0035    1.887104   1.882767     0.306      0.4336580E-02
    5        17.0808    1.884320   1.884436     0.307      0.1153620E-03
    6        17.0788    1.884393   1.884393     0.307      0.5047168E-06


Factor Of Safety For The Preceding Specified Surface =  1.884
Theta (fx = 1.0) =  17.08 Deg    Lambda =   0.307


The Spencer Method Has Been Selected For Analysis.

Selected fx function = Constant (1.0)

SELECTED CONVERGENCE PARAMETERS FOR ANALYSIS METHOD:
Initial estimate of FS =  1.500
FS tolerance =  0.000001000
Initial estimate of theta(deg) =  15.00
Theta tolerance(radians) =  0.0001000
Minimum theta(deg) = -45.00 ; Maximum theta(deg) =  45.00
Theta convergence Step Factor = 5000.00
Maximum number of iterations = 50
Maximum force imbalance = 100.000000(lbs)
Maximum moment imbalance(if Applicable) = 100.000000 (ft/lbs)


Selected Lambda Coefficient =  1.00

Tension Crack Water Force =        0.00(lbs)
```

```
Specified Tension Crack Water Depth Factor =  0.000 (  0.00% Filled )

Depth of Tension Crack (zo) at Side of Last Slice =   0.000(ft)

Depth of Water in Tension Crack =   0.000(ft)

Theoretical Tension Crack Depth =   5.892(ft)


NOTE: In Table 1 following, when a tension crack with water is present on the
first slice (right facing slope) or on the last slice (left facing slope), the
"side force" in the tension crack is set equal to the water pressure resultant.


        *** Table 1 - Line of Thrust(if applicable) and Slice Force Data ***

Slice      X         Y              Side Force     fx    Force Angle  Vert. Shear
 No.     Coord.    Coord.    h/H       (lbs)                 (Deg)      Force(lbs)

  1       62.21    387.91    0.406     854.72     1.000       17.08        251.0
  2       67.01    386.62    0.349    7925.95     1.000       17.08       2327.7
  3       71.82    385.00    0.315   21412.46     1.000       17.08       6288.5
  4       74.82    383.82    0.296   34501.64     1.000       17.08      10132.7
  5       79.41    385.09    0.295   35512.75     1.000       17.08      10429.6
  6       84.00    386.34    0.294   36565.89     1.000       17.08      10738.9
  7       88.80    387.64    0.330   37675.41     1.000       17.08      11064.7
  8       93.60    388.93    0.370   38758.07     1.000       17.08      11382.7
  9       98.40    390.23    0.414   39813.85     1.000       17.08      11692.8
 10      103.20    391.52    0.463   40842.77     1.000       17.08      11995.0
 11      108.00    392.81    0.518   41844.81     1.000       17.08      12289.2
 12      113.17    394.20    0.503   42930.11     1.000       17.08      12608.0
 13      118.33    395.57    0.490   44057.75     1.000       17.08      12939.1
 14      123.50    396.93    0.478   45227.71     1.000       17.08      13282.8
 15      128.67    398.27    0.466   46440.00     1.000       17.08      13638.8
 16      133.83    399.60    0.456   47694.63     1.000       17.08      14007.3
 17      139.00    400.92    0.446   48991.59     1.000       17.08      14388.2
 18      144.17    402.23    0.437   50330.88     1.000       17.08      14781.5
 19      149.33    403.53    0.428   51712.50     1.000       17.08      15187.2
```

```
             20     154.50    404.82    0.420    53136.45     1.000       17.08      15605.4
             21     159.67    406.10    0.412    54602.74     1.000       17.08      16036.1
             22     164.83    407.37    0.404    56111.36     1.000       17.08      16479.1
             23     170.00    408.63    0.397    57662.31     1.000       17.08      16934.6
             24     174.00    409.61    0.415    58870.10     1.000       17.08      17289.3
             25     178.00    410.59    0.434    60059.23     1.000       17.08      17638.6
             26     182.72    411.74    0.420    61477.04     1.000       17.08      18055.0
             27     187.45    412.89    0.407    62943.87     1.000       17.08      18485.7
             28     192.17    414.02    0.395    64459.74     1.000       17.08      18930.9
             29     196.90    415.15    0.384    66024.64     1.000       17.08      19390.5
             30     201.62    416.27    0.374    67638.57     1.000       17.08      19864.5
             31     206.34    417.38    0.364    69301.54     1.000       17.08      20352.9
             32     211.09    421.58    0.353    56385.44     1.000       17.08      16559.6
             33     215.84    425.76    0.338    44678.85     1.000       17.08      13121.6
             34     220.53    429.88    0.317    34147.61     1.000       17.08      10028.7
             35     225.22    433.93    0.288    24862.88     1.000       17.08       7301.9
             36     228.89    436.74    0.273    19490.75     1.000       17.08       5724.2
             37     232.56    439.65    0.260    14532.06     1.000       17.08       4267.9
             38     235.82    442.07    0.238    11109.58     1.000       17.08       3262.7
             39     240.00    445.44    0.204     6805.32     1.000       17.08       1998.6
             40     242.99    447.92    0.198     4229.29     1.000       17.08       1242.1
             41     245.99    450.45    0.192     2243.42     1.000       17.08        658.9
             42     251.11    454.69    0.162      233.37     1.000       17.08         68.5
             43     256.24    459.48    0.390      -94.45     1.000       17.08        -27.7
             44     256.90    460.00    0.000        0.02     1.000       17.08         -0.0

            NOTE: A value of 0.000- for h/H indicates that the line of thrust is at or below
            the lower boundary of the sliding mass. A value of 1.000+ for h/H indicates that
            the line of thrust is at or above the upper boundary of the sliding mass.


                 ***Table 2 - Geometry Data on the   44 Slices***


     Slice    Width    Height    X-Cntr     Y-Cntr-Base  Y-Cntr-Top     Alpha   Beta     Base Length
      No.      (ft)     (ft)      (ft)         (ft)         (ft)        (deg)   (deg)       (ft)

       1       1.95     1.01      61.23       387.61       388.62      -27.92   26.57       2.21
```

2	4.80	4.76	64.61	385.54	390.31	-32.82	26.57	5.72
3	4.80	10.26	69.42	382.45	392.71	-32.82	26.57	5.72
4	3.00	14.73	73.32	379.93	394.66	-32.82	26.57	3.57
5	4.59	17.17	77.11	379.39	396.56	10.46	26.57	4.67
6	4.59	18.62	81.70	380.23	398.85	10.46	26.57	4.67
7	4.80	18.90	86.40	381.10	400.00	10.46	0.00	4.88
8	4.80	18.01	91.20	381.99	400.00	10.46	0.00	4.88
9	4.80	17.13	96.00	382.87	400.00	10.46	0.00	4.88
10	4.80	16.24	100.80	383.76	400.00	10.46	0.00	4.88
11	4.80	15.36	105.60	384.64	400.00	10.46	0.00	4.88
12	5.17	15.56	110.58	385.56	401.12	10.46	23.53	5.25
13	5.17	16.86	115.75	386.52	403.38	10.46	23.53	5.25
14	5.17	18.16	120.92	387.47	405.62	10.46	23.53	5.25
15	5.17	19.45	126.08	388.42	407.88	10.46	23.53	5.25
16	5.17	20.75	131.25	389.38	410.12	10.46	23.53	5.25
17	5.17	22.04	136.42	390.33	412.38	10.46	23.53	5.25
18	5.17	23.34	141.58	391.28	414.62	10.46	23.53	5.25
19	5.17	24.64	146.75	392.24	416.88	10.46	23.53	5.25
20	5.17	25.93	151.92	393.19	419.12	10.46	23.53	5.25
21	5.17	27.23	157.08	394.14	421.38	10.46	23.53	5.25
22	5.17	28.53	162.25	395.10	423.62	10.46	23.53	5.25
23	5.17	29.82	167.42	396.05	425.88	10.46	23.53	5.25
24	4.00	30.10	172.00	396.90	427.00	10.46	0.00	4.07
25	4.00	29.37	176.00	397.63	427.00	10.46	0.00	4.07
26	4.72	29.82	180.36	398.44	428.26	10.46	28.02	4.80
27	4.72	31.46	185.09	399.31	430.77	10.46	28.02	4.80
28	4.72	33.10	189.81	400.18	433.29	10.46	28.02	4.80
29	4.72	34.75	194.53	401.05	435.80	10.46	28.02	4.80
30	4.72	36.39	199.26	401.93	438.31	10.46	28.02	4.80
31	4.72	38.03	203.98	402.80	440.83	10.46	28.02	4.80
32	4.75	37.21	208.72	406.14	443.35	50.70	28.02	7.50
33	4.75	33.94	213.47	411.94	445.88	50.70	28.02	7.50
34	4.69	30.62	218.19	417.77	448.39	51.32	28.02	7.50
35	4.69	27.26	222.87	423.62	450.88	51.32	28.02	7.50
36	3.67	24.72	227.05	428.39	453.11	45.05	28.02	5.20
37	3.67	22.99	230.73	432.07	455.06	45.05	28.02	5.20
38	3.25	21.37	234.19	435.54	456.91	45.05	28.02	4.60
39	4.18	19.45	237.91	439.43	458.89	47.29	28.02	6.17
40	2.99	16.68	241.50	443.32	460.00	47.29	0.00	4.42

```
  41      2.99    13.43    244.49      446.57      460.00      47.29    0.00       4.42
  42      5.12     9.07    248.55      450.93      460.00      46.92    0.00       7.50
  43      5.12     3.59    253.67      456.41      460.00      46.92    0.00       7.50
  44      0.66     0.43    256.57      459.57      460.00      52.24    0.00       1.08
↑


 ***Table 2A - Coordinates of Slice Points Defining the Slip Surface***


 Point           X-Pt            Y-Pt
  No.            (ft)            (ft)

   1           60.257545       388.128772
   2           62.211895       387.093284
   3           67.014846       383.995322
   4           71.817798       380.897359
   5           74.817200       378.962708
   6           79.408600       379.809998
   7           84.000000       380.657289
   8           88.800000       381.543074
   9           93.600000       382.428859
  10           98.400000       383.314645
  11          103.200000       384.200430
  12          108.000000       385.086215
  13          113.166667       386.039665
  14          118.333333       386.993114
  15          123.500000       387.946563
  16          128.666667       388.900013
  17          133.833333       389.853462
  18          139.000000       390.806912
  19          144.166667       391.760361
  20          149.333333       392.713811
  21          154.500000       393.667260
  22          159.666667       394.620709
  23          164.833333       395.574159
  24          170.000000       396.527608
  25          174.000000       397.265763
  26          178.000000       398.003917
 27          182.723796        398.875640
 28          187.447591        399.747362
 29          192.171387        400.619085
 30          196.895182        401.490808
 31          201.618978        402.362530
 32          206.342773        403.234253
 33          211.093152        409.038037
 34          215.843530        414.841821
 35          220.531029        420.696508
 36          225.218527        426.551195
 37          228.891303        430.230313
 38          232.564078        433.909430
 39          235.815976        437.166943
 40          240.000000        441.700130
 41          242.994790        444.944839
 42          245.989579        448.189548
 43          251.112358        453.667426
 44          256.235137        459.145303
 45          256.897193        460.000000


 ***Table 3 - Force and Pore Pressure Data On The   44 Slices (Excluding Reinforcement)***

                      Ubeta   Ubeta      Ualpha                             Earthquake
                      Force   Stress     Force      Pore                      Force        Distributed
Slice      Weight      Top     Top        Bot     Pressure       -Uw     Horiz     Vert       Load
  No.      (lbs)      (lbs)   (psf)      (lbs)      (psf)        (psf)   (lbs)     (lbs)      (psf)
  1         236.0       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
  2        2744.8       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
  3        5914.4       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
  4        5301.3       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
  5        9460.2       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
  6       10258.2       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
  7       10886.3       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
  8       10376.1       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
  9        9865.9       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 10        9355.7       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 11        8845.4       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
```

```
12        9648.5       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
13       10452.3       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
14       11256.2       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
15       12060.1       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
16       12863.9       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
17       13667.8       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
18       14471.6       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
19       15275.5       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
20       16079.4       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
21       16883.2       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
22       17687.1       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
23       18491.0       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
24       14449.6       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
25       14095.3       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
26       16902.1       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
27       17833.2       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
28       18764.3       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
29       19695.4       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
30       20626.5       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
31       21557.6       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
32       21213.5       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
33       19346.4       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
34       17224.2       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
35       15334.4       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
36       10894.5       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
37       10134.6       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
38        8338.9       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
39        9767.0       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
40        5993.5       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
41        4827.4       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
42        5576.6       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
43        2209.1       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
44          34.0       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00

        TOTAL WEIGHT OF SLIDING MASS =  526899.03(lbs)

        EFFECTIVE WEIGHT OF SLIDING MASS =  526899.03(lbs)

        TOTAL AREA OF SLIDING MASS =  4390.83(ft2)
```

```
***TABLE 4 - SOIL STRENGTH & SOIL OPTIONS DATA ON THE   44 SLICES***

Slice  Soil   Cohesion   Phi(Deg)   Options
 No.   Type     (psf)
  1      1     200.00     31.00
  2      1     200.00     31.00
  3      1     200.00     31.00
  4      2     200.00     34.00     A
  5      2     200.00     24.00     A
  6      2     200.00     24.00     A
  7      2     200.00     24.00     A
  8      2     200.00     24.00     A
  9      2     200.00     24.00     A
 10      2     200.00     24.00     A
 11      2     200.00     24.00     A
 12      2     200.00     24.00     A
 13      2     200.00     24.00     A
 14      2     200.00     24.00     A
 15      2     200.00     24.00     A
 16      2     200.00     24.00     A
 17      2     200.00     24.00     A
 18      2     200.00     24.00     A
 19      2     200.00     24.00     A
 20      2     200.00     24.00     A
 21      2     200.00     24.00     A
 22      2     200.00     24.00     A
 23      2     200.00     24.00     A
 24      2     200.00     24.00     A
 25      2     200.00     24.00     A
 26      2     200.00     24.00     A
 27      2     200.00     24.00     A
 28      2     200.00     24.00     A
 29      2     200.00     24.00     A
 30      2     200.00     24.00     A
 31      2     200.00     24.00     A
 32      2     200.00     24.00     A
 33      2     200.00     24.00     A
 34      2     200.00     24.00     A
 35      2     200.00     24.00     A
 36      2     200.00     24.00     A
 37      2     200.00     24.00     A
 38      1     200.00     31.00
 39      1     200.00     31.00
 40      1     200.00     31.00
 41      1     200.00     31.00
 42      1     200.00     31.00
 43      1     200.00     31.00
 44      1     200.00     31.00

 SOIL OPTIONS:
 A = ANISOTROPIC SHEAR STRENGTH
 C = CURVED STRENGTH ENVELOPE (TANGENT PHI & C)
 F = FIBER-REINFORCED SOIL (FRS)
 M = INDEPENDENT MULTI-STAGE SHEAR STRENGTH
 N = NONLINEAR UNDRAINED SHEAR STRENGTH
 R = RAPID DRAWDOWN OR RAPID LOADING (SEISMIC) SHEAR STRENGTH
 S = SHANSEP UNDRAINED SHEAR STRENGTH
 NOTE: Phi and C in Table 4 are modified values based on specified
 Soil Options (if any).

↑


        ***TABLE 5 - Total Base Stress Data on the   44 Slices***

Slice   Alpha     X-Coord.      Base         Total            Total           Total
 No.    (deg)    Slice Cntr     Leng.     Normal Stress    Vert. Stress    Normal/Vert.
  *                 (ft)        (ft)          (psf)           (psf)        Stress Ratio

  1    -27.92      61.23        2.21          367.53          120.76           3.043
  2    -32.82      64.61        5.72         1349.98          571.49           2.362
  3    -32.82      69.42        5.72         2674.63         1231.42           2.172
  4    -32.82      73.32        3.57         4053.37         1767.45           2.293
  5     10.46      77.11        4.67         2017.53         2060.41           0.979
  6     10.46      81.70        4.67         2186.66         2234.22           0.979
  7     10.46     86.40        4.88          2219.50          2267.98          0.979
  8     10.46     91.20        4.88          2116.08          2161.68          0.979
  9     10.46     96.00        4.88          2012.65          2055.39          0.979
 10     10.46    100.80        4.88          1909.22          1949.10          0.980
 11     10.46    105.60        4.88          1805.79          1842.80          0.980
 12     10.46    110.58        5.25          1829.77          1867.45          0.980
 13     10.46    115.75        5.25          1981.16          2023.03          0.979
 14     10.46    120.92        5.25          2132.55          2178.62          0.979
 15     10.46    126.08        5.25          2283.95          2334.21          0.978
 16     10.46    131.25        5.25          2435.34          2489.79          0.978
 17     10.46    136.42        5.25          2586.73          2645.38          0.978
 18     10.46    141.58        5.25          2738.12          2800.96          0.978
 19     10.46    146.75        5.25          2889.51          2956.55          0.977
 20     10.46    151.92        5.25          3040.90          3112.14          0.977
 21     10.46    157.08        5.25          3192.30          3267.72          0.977
 22     10.46    162.25        5.25          3343.69          3423.31          0.977
 23     10.46    167.42        5.25          3495.08          3578.89          0.977
 24     10.46    172.00        4.07          3527.68          3612.40          0.977
 25     10.46    176.00        4.07          3441.49          3523.82          0.977
 26     10.46    180.36        4.80          3494.29          3578.08          0.977
 27     10.46    185.09        4.80          3686.08          3775.19          0.976
 28     10.46    189.81        4.80          3877.87          3972.30          0.976
 29     10.46    194.53        4.80          4069.67          4169.40          0.976
 30     10.46    199.26        4.80          4261.46          4366.51          0.976
 31     10.46    203.98        4.80          4453.25          4563.62          0.976
 32     50.70    208.72        7.50          2745.05          4465.65          0.615
 33     50.70    213.47        7.50          2498.08          4072.61          0.613
 34     51.32    218.19        7.50          2225.40          3674.50          0.606
 35     51.32    222.87        7.50          1974.40          3271.33          0.604
 36     45.05    227.05        5.20          1965.27          2966.29          0.663
 37     45.05    230.73        5.20          1824.69          2759.38          0.661
 38     45.05    234.19        4.60          1628.69          2564.33          0.635
 39     47.29    237.91        6.17          1424.96          2334.36          0.610
 40     47.29    241.50        4.42          1214.21          2001.30          0.607
 41     47.29    244.49        4.42           967.84          1611.94          0.600
 42     46.92    248.55        7.50           641.22          1088.58          0.589
 43     46.92    253.67        7.50           222.94           431.24          0.517
 44     52.24    256.57        1.08           -31.06            51.28         -0.606
```

```
        ***TABLE 5A - Total Base Force Data on the   44 Slices***

 Slice   Alpha     X-Coord.      Base        Total          Total          Total
  No.    (deg)    Slice Cntr     Leng.    Normal Force   Vert. Force    Normal/Vert.
   *                 (ft)        (ft)        (lbs)          (lbs)       Force Ratio

   1    -27.92      61.23        2.21         812.87         236.01         3.444
   2    -32.82      64.61        5.72        7715.66        2744.82         2.811
   3    -32.82      69.42        5.72       15286.54        5914.44         2.585
   4    -32.82      73.32        3.57       14467.33        5301.28         2.729
   5     10.46      77.11        4.67        9419.71        9460.17         0.996
   6     10.46      81.70        4.67       10209.34       10258.20         0.995
   7     10.46      86.40        4.88       10833.51       10886.30         0.995
   8     10.46      91.20        4.88       10328.67       10376.08         0.995
   9     10.46      96.00        4.88        9823.83        9865.87         0.996
  10     10.46     100.80        4.88        9318.99        9355.66         0.996
  11     10.46     105.60        4.88        8814.15        8845.45         0.996
  12     10.46     110.58        5.25        9613.45        9648.48         0.996
  13     10.46     115.75        5.25       10408.84       10452.34         0.996
  14     10.46     120.92        5.25       11204.24       11256.20         0.995
  15     10.46     126.08        5.25       11999.64       12060.06         0.995
  16     10.46     131.25        5.25       12795.03       12863.92         0.995
  17     10.46     136.42        5.25       13590.43       13667.78         0.994
  18     10.46     141.58        5.25       14385.82       14471.65         0.994
  19     10.46     146.75        5.25       15181.22       15275.51         0.994
  20     10.46     151.92        5.25       15976.62       16079.37         0.994
  21     10.46     157.08        5.25       16772.01       16883.23         0.993
  22     10.46     162.25        5.25       17567.41       17687.09         0.993
  23     10.46     167.42        5.25       18362.81       18490.95         0.993
  24     10.46     172.00        4.07       14348.97       14449.59         0.993
  25     10.46     176.00        4.07       13998.39       14095.28         0.993
  26     10.46     180.36        4.80       16785.01       16902.13         0.993
  27     10.46     185.09        4.80       17706.30       17833.23         0.993
  28     10.46     189.81        4.80       18627.59       18764.32         0.993
  29     10.46     194.53        4.80       19548.87       19695.41         0.993
  30     10.46     199.26        4.80       20470.16       20626.50         0.992
  31     10.46     203.98        4.80       21391.45       21557.59         0.992
  32     50.70     208.72        7.50        20587.91        21213.52          0.971
  33     50.70     213.47        7.50        18735.61        19346.42          0.968
  34     51.32     218.19        7.50        16690.50        17224.22          0.969
  35     51.32     222.87        7.50        14808.01        15334.37          0.966
  36     45.05     227.05        5.20        10216.58        10894.53          0.938
  37     45.05     230.73        5.20         9485.78        10134.60          0.936
  38     45.05     234.19        4.60         7496.64         8338.94          0.899
  39     47.29     237.91        6.17         8790.48         9767.00          0.900
  40     47.29     241.50        4.42         5361.40         5993.48          0.895
  41     47.29     244.49        4.42         4273.52         4827.41          0.885
  42     46.92     248.55        7.50         4809.16         5576.56          0.862
  43     46.92     253.67        7.50         1672.03         2209.13          0.757
  44     52.24     256.57        1.08          -33.58           33.95         -0.989


         ***TABLE 6 - Effective and Base Shear Stress Data on the   44 Slices***

 Slice    Alpha     X-Coord.       Base       Effective       Available        Mobilized
  No.     (deg)    Slice Cntr      Leng.    Normal Stress   Shear Strength   Shear Stress
   *                  (ft)         (ft)         (psf)           (psf)            (psf)

   1     -27.92      61.23        2.21          367.53          420.83           223.33
   2     -32.82      64.61        5.72         1349.98         1011.15           536.59
   3     -32.82      69.42        5.72         2674.63         1807.08           958.97
   4     -32.82      73.32        3.57         4053.37         2934.03          1557.02
   5      10.46      77.11        4.67         2017.53         1098.26           582.82
   6      10.46      81.70        4.67         2186.66         1173.56           622.78
   7      10.46      86.40        4.88         2219.50         1188.19           630.54
   8      10.46      91.20        4.88         2116.08         1142.14           606.10
   9      10.46      96.00        4.88         2012.65         1096.09           581.67
  10      10.46     100.80        4.88         1909.22         1050.04           557.23
  11      10.46     105.60        4.88         1805.79         1003.99           532.79
  12      10.46     110.58        5.25         1829.77         1014.67           538.46
  13      10.46     115.75        5.25         1981.16         1082.07           574.23
  14      10.46     120.92        5.25         2132.55         1149.47           610.00
  15      10.46     126.08        5.25         2283.95         1216.88           645.77
  16      10.46     131.25        5.25         2435.34         1284.28           681.54
  17      10.46     136.42        5.25         2586.73         1351.69           717.31
  18      10.46    141.58      5.25         2738.12        1419.09         753.08
  19      10.46    146.75      5.25         2889.51        1486.49         788.84
  20      10.46    151.92      5.25         3040.90        1553.90         824.61
  21      10.46    157.08      5.25         3192.30        1621.30         860.38
  22      10.46    162.25      5.25         3343.69        1688.71         896.15
  23      10.46    167.42      5.25         3495.08        1756.11         931.92
  24      10.46    172.00      4.07         3527.68        1770.62         939.63
  25      10.46    176.00      4.07         3441.49        1732.25         919.26
  26      10.46    180.36      4.80         3494.29        1755.76         931.74
  27      10.46    185.09      4.80         3686.08        1841.15         977.05
  28      10.46    189.81      4.80         3877.87        1926.54        1022.37
  29      10.46    194.53      4.80         4069.67        2011.93        1067.68
  30      10.46    199.26      4.80         4261.46        2097.32        1113.00
  31      10.46    203.98      4.80         4453.25        2182.72        1158.31
  32      50.70    208.72      7.50         2745.05        1422.18         754.71
  33      50.70    213.47      7.50         2498.08        1312.22         696.36
  34      51.32    218.19      7.50         2225.40        1190.81         631.93
  35      51.32    222.87      7.50         1974.40        1079.06         572.63
  36      45.05    227.05      5.20         1965.27        1074.99         570.47
  37      45.05    230.73      5.20         1824.69        1012.40         537.26
  38      45.05    234.19      4.60         1628.69        1178.62         625.46
  39      47.29    237.91      6.17         1424.96        1056.20         560.50
  40      47.29    241.50      4.42         1214.21         929.57         493.30
  41      47.29    244.49      4.42          967.84         781.54         414.74
  42      46.92    248.55      7.50          641.22         585.28         310.60
  43      46.92    253.67      7.50          222.94         333.95         177.22
  44      52.24    256.57      1.08          -31.06         181.34          96.23


        ***TABLE 6A - Effective and Base Shear Force Data on the   44 Slices***

 Slice    Alpha     X-Coord.      Base       Effective       Available          Mobilized
  No.     (deg)    Slice Cntr     Leng.     Normal Force    Shear Force        Shear Force
   *                  (ft)         (ft)        (lbs)           (lbs)              (lbs)

   1     -27.92      61.23      2.21          812.87         930.76          493.93
   2     -32.82      64.61      5.72         7715.66        5779.11         3066.83
   3     -32.82      69.42      5.72        15286.54       10328.16         5480.90
```

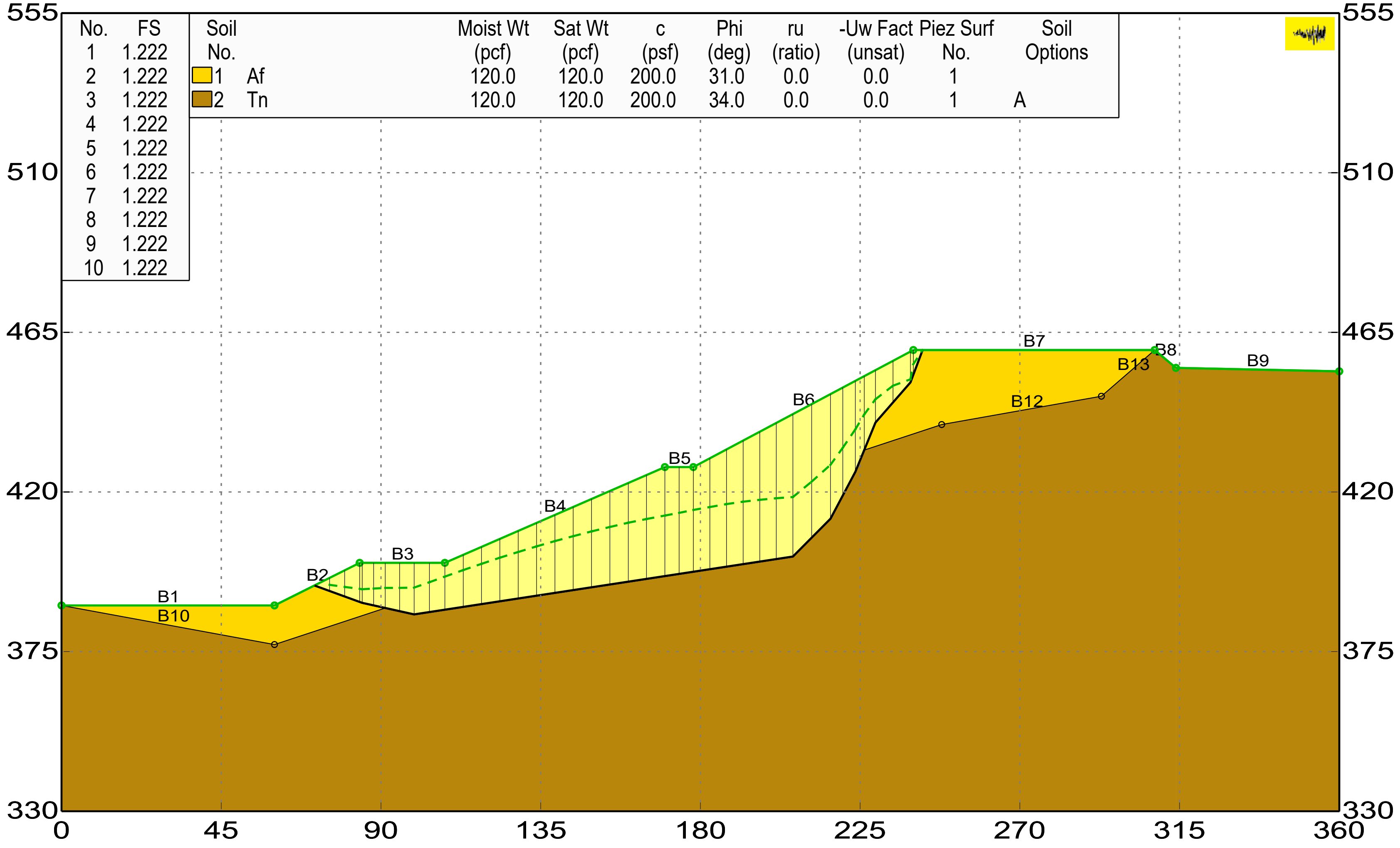
4	-32.82	73.32	3.57	14467.33	10472.18	5557.32
5	10.46	77.11	4.67	9419.71	5127.71	2721.15
6	10.46	81.70	4.67	10209.34	5479.27	2907.71
7	10.46	86.40	4.88	10833.51	5799.60	3077.70
8	10.46	91.20	4.88	10328.67	5574.83	2958.42
9	10.46	96.00	4.88	9823.83	5350.06	2839.14
10	10.46	100.80	4.88	9318.99	5125.29	2719.86
11	10.46	105.60	4.88	8814.15	4900.52	2600.58
12	10.46	110.58	5.25	9613.45	5330.96	2829.01
13	10.46	115.75	5.25	10408.84	5685.10	3016.94
14	10.46	120.92	5.25	11204.24	6039.23	3204.87
15	10.46	126.08	5.25	11999.64	6393.36	3392.80
16	10.46	131.25	5.25	12795.03	6747.50	3580.73
17	10.46	136.42	5.25	13590.43	7101.63	3768.66
18	10.46	141.58	5.25	14385.82	7455.76	3956.59
19	10.46	146.75	5.25	15181.22	7809.90	4144.52
20	10.46	151.92	5.25	15976.62	8164.03	4332.45
21	10.46	157.08	5.25	16772.01	8518.16	4520.37
22	10.46	162.25	5.25	17567.41	8872.30	4708.30
23	10.46	167.42	5.25	18362.81	9226.43	4896.23
24	10.46	172.00	4.07	14348.97	7202.08	3821.96
25	10.46	176.00	4.07	13998.39	7045.99	3739.13
26	10.46	180.36	4.80	16785.01	8433.88	4475.65
27	10.46	185.09	4.80	17706.30	8844.06	4693.32
28	10.46	189.81	4.80	18627.59	9254.25	4911.00
29	10.46	194.53	4.80	19548.87	9664.43	5128.67
30	10.46	199.26	4.80	20470.16	10074.61	5346.34
31	10.46	203.98	4.80	21391.45	10484.80	5564.02
32	50.70	208.72	7.50	20587.91	10666.33	5660.35
33	50.70	213.47	7.50	18735.61	9841.63	5222.71
34	51.32	218.19	7.50	16690.50	8931.09	4739.51
35	51.32	222.87	7.50	14808.01	8092.95	4294.73
36	45.05	227.05	5.20	10216.58	5588.43	2965.64
37	45.05	230.73	5.20	9485.78	5263.05	2792.97
38	45.05	234.19	4.60	7496.64	5425.00	2878.91
39	47.29	237.91	6.17	8790.48	6515.64	3457.69
40	47.29	241.50	4.42	5361.40	4104.56	2178.19
41	47.29	244.49	4.42	4273.52	3450.90	1831.30
42	46.92	248.55	7.50	4809.16	4389.63	2329.47

```
43      46.92     253.67       7.50          1672.03          2504.66          1329.16
44      52.24     256.57       1.08           -33.58           196.05           104.04

   Average Effective Normal Stress = 2381.3459(psf)
   Average Available Shear Strength = 1313.3673(psf)
   Total Length of Failure Surface = 227.0392(ft)


   INPUT PARAMETERS FOR SIMPLIFIED 3D ANALYSIS

        Composite Phi (deg)=  28.878
        3D Depth (Vertical difference between ends of Slip Surface) =   71.87(ft)
        L/D(1): L = 71.87(ft) L/D(2): L = 143.74(ft) L/D(3): L = 215.61(ft)
        L/D(4): L = 287.48(ft) L/D(5): L = 359.36(ft) L/D(6): L = 431.23(ft)

   SUM OF MOMENTS =  -0.709305E-01 (ft/lbs);Imbalance (Fraction of Total Weight) =  -0.1346188E-06
   SUM OF FORCES = -.138636E-03 (lbs);Imbalance (Fraction of Total Weight) =   -0.2631160E-09

   Sum of Available Shear Forces =  298185.85(lbs)

   Sum of Mobilized Shear Forces =  158239.76(lbs)

   FS Balance Check: FS =  1.884393

                    **** END OF GEOSTASE OUTPUT ****
```

X-Section B-B' - Freedom Lane
Global Stability of Existing Slope - Pseudo Static

SA Geotechnical, Inc., RS

\01p.gsd



No.	FS
1	1.222
2	1.222
3	1.222
4	1.222
5	1.222
6	1.222
7	1.222
8	1.222
9	1.222
10	1.222

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	-Uw Fact (unsat)	Piez Surf No.	Soil Options
1	Af	120.0	120.0	200.0	31.0	0.0	0.0	1	
2	Tn	120.0	120.0	200.0	34.0	0.0	0.0	1	A

GEOSTASE FS = 1.222

Spencer Method

kh = 0.22000

GEOSTASE
Slope Stability
Analysis

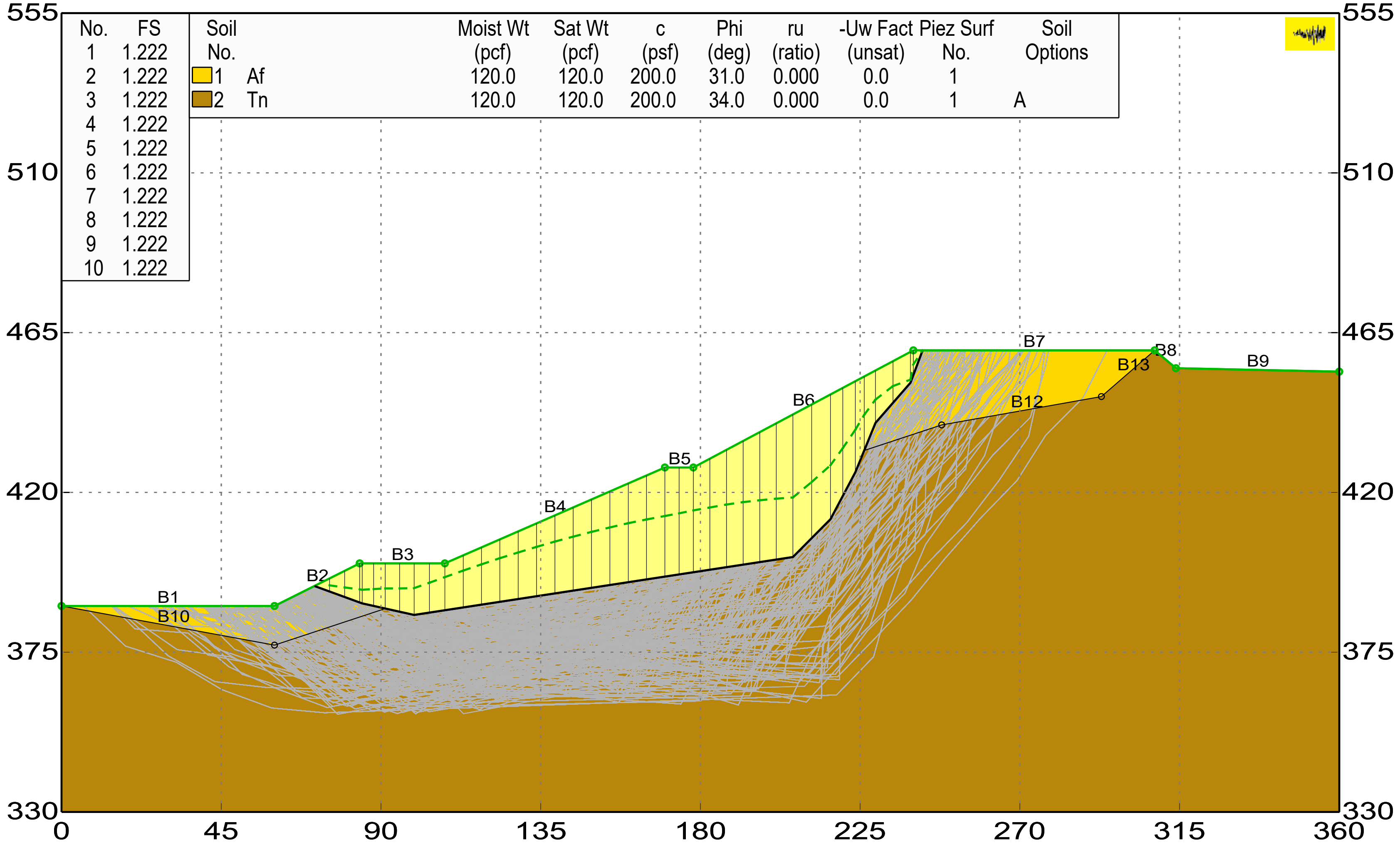
GEOSTASE® v4.30.32 by GREGORY GEOTECHNICAL SOFTWARE

PLATE C.1

X-Section B-B' - Freedom Lane
Global Stability of Existing Slope - Pseudo Static

SA Geotechnical, Inc., RS

\01p.gsd



No.	FS
1	1.222
2	1.222
3	1.222
4	1.222
5	1.222
6	1.222
7	1.222
8	1.222
9	1.222
10	1.222

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	-Uw Fact (unsat)	Piez Surf No.	Soil Options
🟨 1	Af	120.0	120.0	200.0	31.0	0.000	0.0	1	
🟫 2	Tn	120.0	120.0	200.0	34.0	0.000	0.0	1	A

GEOSTASE FS = 1.222

Spencer Method

kh = 0.22000

GEOSTASE
Slope Stability
Analysis

GEOSTASE® v4.30.32 by GREGORY GEOTECHNICAL SOFTWARE

PLATE C.2

```
                    ***  GEOSTASE(R)  ***

     ** GEOSTASE(R) (c)Copyright by Garry H. Gregory, Ph.D.,P.E.,S.E.,BC.GE **

            ** Current Version 4.30.32-Double Precision, Sept 2023 **
                (All Rights Reserved-Unauthorized Use Prohibited)


    *********************************************************************************
                   SLOPE STABILITY ANALYSIS SOFTWARE (2D & 3D)
        Simplified Bishop, Simplified Janbu, or General Equilibrium (GE) Options.
           (Spencer, Morgenstern-Price, USACE, and Lowe & Karafiath)
           Including Pier/Pile, Planar Reinf,  Nail, Tieback, Line Loads
           Applied Forces, Fiber-Reinforced Soil (FRS), Distributed Loads
           Nonlinear Undrained Shear Strength, Curved Strength Envelope,
           Anisotropic Strengths, Water Surfaces, 3-Stage Rapid Drawdown
           2- or 3-Stage Pseudo-Static & Simplified Newmark Seismic Analyses.
    *********************************************************************************


    Analysis Date:             6/  3/ 2024
    Analysis Time:
    Analysis By:              SA Geotechnical, Inc., RS


    Input File Name:          C:\Users\Reza Saberi\SA Geotechnical, Inc\SA Geotechnical -
Projects\2024\24064-01 Meritage - 400-700 Freedom Ln, Aliso Viejo\Engineering\Sted\B-B'\01p.gsd

    Output File Name:         C:\Users\Reza Saberi\SA Geotechnical, Inc\SA Geotechnical -
Projects\2024\24064-01 Meritage - 400-700 Freedom Ln, Aliso Viejo\Engineering\Sted\B-B'\01p.OUT

    Unit System:              English


    PROJECT: X-Section B-B' - Freedom Lane

    DESCRIPTION: Global Stability of Existing Slope - Pseudo Static
```

```
 PROFILE BOUNDARY DATA

     9 Surface Boundaries
    13 Total   Boundaries


 Boundary      X - 1       Y - 1       X - 2       Y - 2      Soil Type
    No.        (ft)        (ft)        (ft)        (ft)       Below Bnd

     1          0.000     388.000      60.000     388.000        1
     2         60.000     388.000      84.000     400.000        1
     3         84.000     400.000     108.000     400.000        1
     4        108.000     400.000     170.000     427.000        1
     5        170.000     427.000     178.000     427.000        1
     6        178.000     427.000     240.000     460.000        1
     7        240.000     460.000     308.000     460.000        1
     8        308.000     460.000     314.000     455.000        2
     9        314.000     455.000     360.000     454.000        2
    10          0.000     388.000      60.000     377.000        2
    11         60.000     377.000     248.000     439.000        2
    12        248.000     439.000     293.000     447.000        2
    13        293.000     447.000     308.000     460.000        2

 User Specified X-Origin =         0.000(ft)

 User Specified Y-Origin =       330.000(ft)

 SURFACE BOUNDARY POINT COORDINATES
(Information Only-Not Used Directly)
 Point No.       X-COORD             Y-COORD
    1               0.000             388.000
    2              60.000             388.000
    3              84.000             400.000
    4             108.000             400.000
    5             170.000             427.000
    6             178.000             427.000
    7             240.000             460.000
    8             308.000             460.000
    9             314.000             455.000
```

```
       10             360.000             454.000

     SUBSURFACE BOUNDARY POINT COORDINATES
      (Information Only-Not Used Directly)
     Point No.       X-COORD             Y-COORD
     Surface boundary point    1 and Subsurface boundary point   11 are duplicate points.
       11               0.000             388.000
       12              60.000             377.000
       13             248.000             439.000
       14             293.000             447.000
     Surface boundary point    8 and Subsurface boundary point   15 are duplicate points.
       15             308.000             460.000

  PROFILE BOUNDARY SLOPES AND ANGLES
     BND No.  Slope    Angle(Deg.)
        1      0.000     0.000
        2      0.500    26.565
        3      0.000     0.000
        4      0.435    23.532
        5      0.000     0.000
        6      0.532    28.025
        7      0.000     0.000
        8     -0.833   -39.806
        9     -0.022    -1.245
       10     -0.183   -10.389
       11      0.330    18.252
       12      0.178    10.081
       13      0.867    40.914


    MOHR-COULOMB SOIL PARAMETERS

      2 Type(s) of Soil Defined

  Soil Number           Moist  Saturated  Cohesion Friction   Pore      (-Uw)   Water   Water
      and             Unit Wt. Unit Wt. Intercept   Angle  Pressure    Fact.  Surface  Option
  Description           (pcf)    (pcf)     (psf)     (deg)  Ratio(ru)            No.

1 Af                    120.0    120.0     200.00    31.00    0.000      0.0      1       0
```

```
2 Tn                       120.0    120.0     200.00    34.00    0.000      0.0      1       0


       ANISOTROPIC STRENGTH PARAMETERS

            1 soil type(s)

        Soil Type  2 Is Anisotropic

        Number Of Direction Ranges Specified =  3


        Direction    Counterclockwise     Cohesion     Friction
          Range       Direction Limit    Intercept       Angle
           No.             (deg)           (psf)         (deg)

            1              -5.0             200.00         34.00
            2               8.0             200.00         28.00
            3              90.0             200.00         24.00

       SEISMIC (EARTHQUAKE) DATA

        Specified Peak Ground Acceleration Coefficient (PGA) =   0.220(g)
        Default Velocity =   1.100(ft) per second
        Specified Horizontal Earthquake Coefficient (kh) =  0.22000(g)
        Specified Vertical Earthquake Coefficient (kv) =   0.000(g)
        (NOTE:Input Velocity = 0.0 will result in default Peak
        Velocity = 2 times(PGA) times 2.5 fps or 0.762 mps)
        Specified Seismic Pore-Pressure Factor =   0.000
        Horizontal Seismic Force is Applied at Center of Gravity of Slices

        A Non-Circular Zone Search Has Been Selected For Analysis
        Using Random Generation Within Specified Zones.

        2 Zones Defined For Generation Of Non-Circular Surfaces


          4000 Trial Surfaces Have Been Generated.
```

```
Length Of Line Segments For Active And Passive Portions Of
Non-Circular Zone Search =   15.00(ft)

Zone       X - 1      Y - 1      X - 2      Y - 2       Height
No.         (ft)       (ft)       (ft)       (ft)        (ft)

 1          70.00     375.00     125.00     375.00      35.00
 2         140.00     385.00     220.00     385.00      50.00
The Spencer Method Was Selected for FS Analysis.

Selected fx function = Constant (1.0)

SELECTED CONVERGENCE PARAMETERS FOR SPENCER METHOD:
Initial estimate of FS =  1.500
FS tolerance =  0.000001000
Initial estimate of theta(deg) =  15.00
Theta tolerance(radians) =  0.0001000
Minimum theta(deg) = -45.00 ; Maximum theta(deg) =  45.00
Theta convergence Step Factor = 5000.00
Maximum number of iterations = 50
Allowable negative side force = -1000.0(lbs)
Maximum force imbalance  = 100.000000(lbs)
Maximum moment imbalance = 100.000000 (ft/lbs)

Selected Lambda Coefficient =  1.00

Specified Tension Crack Water Depth Factor =   0.000

Total Number of Trial Surfaces Attempted = 4000

WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
Did Not Converge in 50 Iterations.


Number of Trial Surfaces with Non-Converged FS = 957

Number of Trial Surfaces With Valid FS = 3043
```

```
Percentage of Trial Surfaces With Non-Converged and/or
Non-Valid FS Solutions of the Total Attempted =  23.9 %

Statistical Data On All Valid FS Values:
   FS Max =   7.305   FS Min =   1.222   FS Ave =   2.338
   Standard Deviation =    0.719   Coefficient of Variation =   30.74 %


Critical Surface is Sequence Number     148 of Those Analyzed.


*****BEGINNING OF DETAILED GEOSTASE OUTPUT FOR CRITICAL SURFACE FROM A SEARCH*****


  Iter.     Theta         FS         FS
   No.      (deg)      (Moment)   (Force)
           (fx=1.0)                          Lambda        Delta FS

    1        15.0000    1.348413   1.141704     0.268      0.2067092E+00
    2        19.9500    1.304609   1.185213     0.363      0.1193963E+00
    3        26.7175    1.017047   1.258643     0.503      0.2415957E+00
    4        22.1879    1.261483   1.207332     0.408      0.5415105E-01
    5        23.0180    1.238678   1.216021     0.425      0.2265762E-01
    6        23.6151    1.218998   1.222450     0.437      0.3452577E-02
    7        23.5362    1.221783   1.221591     0.436      0.1919497E-03
    8        23.5403    1.221638   1.221637     0.436      0.9067323E-06


Factor Of Safety For The Preceding Specified Surface =  1.222
Theta (fx = 1.0) =  23.54 Deg    Lambda =   0.436


The Spencer Method Has Been Selected For Analysis.

Selected fx function = Constant (1.0)

SELECTED CONVERGENCE PARAMETERS FOR ANALYSIS METHOD:
Initial estimate of FS =  1.500
```

```
FS tolerance =  0.000001000
Initial estimate of theta(deg) =  15.00
Theta tolerance(radians) =  0.0001000
Minimum theta(deg) = -45.00 ; Maximum theta(deg) =  45.00
Theta convergence Step Factor = 5000.00
Maximum number of iterations = 50
Maximum force imbalance = 100.000000(lbs)
Maximum moment imbalance(if Applicable) = 100.000000 (ft/lbs)


Selected Lambda Coefficient =  1.00

Tension Crack Water Force =        0.00(lbs)

Specified Tension Crack Water Depth Factor =  0.000 (  0.00% Filled )

Depth of Tension Crack (zo) at Side of Last Slice =   0.000(ft)

Depth of Water in Tension Crack =   0.000(ft)

Theoretical Tension Crack Depth =   5.892(ft)


NOTE: In Table 1 following, when a tension crack with water is present on the
first slice (right facing slope) or on the last slice (left facing slope), the
"side force" in the tension crack is set equal to the water pressure resultant.


        *** Table 1 - Line of Thrust(if applicable) and Slice Force Data ***

Slice      X         Y               Side Force     fx    Force Angle  Vert. Shear
 No.     Coord.    Coord.    h/H        (lbs)                (Deg)      Force(lbs)

  1      75.53    393.80    0.463     3467.86     1.000       23.54       1385.0
  2      79.77    393.23    0.366    10025.50     1.000       23.54       4004.1
  3      84.00    392.67    0.334    19672.93     1.000       23.54       7857.3
  4      84.70    392.57    0.340    21530.95     1.000       23.54       8599.3
  5      87.95    392.76    0.396    27021.23     1.000       23.54      10792.1
  6      91.20    392.94    0.444    32788.51     1.000       23.54      13095.6
  7      95.27    392.96    0.483    41776.30     1.000        23.54       16685.2
  8      99.34    393.04    0.521    51286.26     1.000        23.54       20483.5
  9     103.67    394.58    0.609    51934.85     1.000        23.54       20742.5
 10     108.00    396.14    0.708    52591.52     1.000        23.54       21004.8
 11     113.17    397.97    0.708    53368.93     1.000        23.54       21315.3
 12     118.33    399.74    0.705    54125.11     1.000        23.54       21617.3
 13     123.50    401.45    0.698    54860.08     1.000        23.54       21910.8
 14     128.67    403.08    0.689    55573.82     1.000        23.54       22195.9
 15     133.83    404.64    0.678    56266.34     1.000        23.54       22472.5
 16     139.00    406.13    0.665    56937.64     1.000        23.54       22740.6
 17     144.17    407.55    0.650    57587.71     1.000        23.54       23000.2
 18     149.33    408.88    0.633    58216.56     1.000        23.54       23251.4
 19     154.50    410.13    0.616    58824.19     1.000        23.54       23494.1
 20     159.67    411.30    0.597    59410.60     1.000        23.54       23728.3
 21     164.83    412.37    0.577    59975.78     1.000        23.54       23954.0
 22     170.00    413.36    0.556    60519.74     1.000        23.54       24171.3
 23     174.00    414.11    0.572    60936.10     1.000        23.54       24337.5
 24     178.00    414.90    0.590    61359.34     1.000        23.54       24506.6
 25     182.68    415.79    0.562    61846.69     1.000        23.54       24701.2
 26     187.36    416.57    0.534    62310.68     1.000        23.54       24886.5
 27     192.03    417.24    0.505    62751.32     1.000        23.54       25062.5
 28     196.71    417.80    0.476    63168.59     1.000        23.54       25229.2
 29     201.39    418.24    0.447    63562.50     1.000        23.54       25386.5
 30     206.07    418.55    0.417    63933.06     1.000        23.54       25534.5
 31     211.35    422.91    0.420    49676.74     1.000        23.54       19840.6
 32     216.63    427.65    0.433    36416.11     1.000        23.54       14544.4
 33     220.15    432.46    0.441    25509.51     1.000        23.54       10188.4
 34     223.66    437.63    0.466    16364.77     1.000        23.54        6536.0
 35     226.15    441.89    0.485    10711.62     1.000        23.54        4278.2
 36     229.33    446.13    0.444     6091.67     1.000        23.54        2433.0
 37     234.26    449.98    0.405     2583.29     1.000        23.54        1031.8
 38     239.18    451.77    0.100      134.16     1.000        23.54          53.6
 39     240.00    455.99    0.420     -189.13     1.000        23.54         -75.5
 40     242.58    460.00    0.000        0.09     1.000        23.54          -0.0

NOTE: A value of 0.000- for h/H indicates that the line of thrust is at or below
the lower boundary of the sliding mass. A value of 1.000+ for h/H indicates that
the line of thrust is at or above the upper boundary of the sliding mass.
```

```
              ***Table 2 - Geometry Data on the   40 Slices***


 Slice    Width    Height    X-Cntr    Y-Cntr-Base  Y-Cntr-Top    Alpha   Beta    Base Length
  No.      (ft)     (ft)      (ft)        (ft)         (ft)        (deg)   (deg)       (ft)

   1       4.23      1.83     73.41      392.87       394.71      -20.12   26.57       4.51
   2       4.23      5.50     77.65      391.32       396.82      -20.12   26.57       4.51
   3       4.23      9.17     81.88      389.77       398.94      -20.12   26.57       4.51
   4       0.70     11.13     84.35      388.87       400.00      -20.12    0.00       0.74
   5       3.25     11.62     86.32      388.38       400.00      -12.58    0.00       3.33
   6       3.25     12.35     89.57      387.65       400.00      -12.58    0.00       3.33
   7       4.07     13.16     93.23      386.84       400.00      -12.58    0.00       4.17
   8       4.07     14.07     97.30      385.93       400.00      -12.58    0.00       4.17
   9       4.33     14.19    101.50      385.81       400.00        8.69    0.00       4.38
  10       4.33     13.53    105.83      386.47       400.00        8.69    0.00       4.38
  11       5.17     13.93    110.58      387.19       401.12        8.69   23.53       5.23
  12       5.17     15.39    115.75      387.98       403.38        8.69   23.53       5.23
  13       5.17     16.85    120.92      388.77       405.62        8.69   23.53       5.23
  14       5.17     18.31    126.08      389.56       407.88        8.69   23.53       5.23
  15       5.17     19.77    131.25      390.35       410.12        8.69   23.53       5.23
  16       5.17     21.23    136.42      391.14       412.38        8.69   23.53       5.23
  17       5.17     22.69    141.58      391.93       414.62        8.69   23.53       5.23
  18       5.17     24.15    146.75      392.72       416.88        8.69   23.53       5.23
  19       5.17     25.61    151.92      393.51       419.12        8.69   23.53       5.23
  20       5.17     27.07    157.08      394.30       421.38        8.69   23.53       5.23
  21       5.17     28.53    162.25      395.09       423.62        8.69   23.53       5.23
  22       5.17     29.99    167.42      395.88       425.88        8.69   23.53       5.23
  23       4.00     30.42    172.00      396.58       427.00        8.69    0.00       4.05
  24       4.00     29.80    176.00      397.20       427.00        8.69    0.00       4.05
  25       4.68     30.39    180.34      397.86       428.25        8.69   28.02       4.73
  26       4.68     32.16    185.02      398.57       430.74        8.69   28.02       4.73
  27       4.68     33.93    189.70      399.29       433.23        8.69   28.02       4.73
  28       4.68     35.71    194.37      400.01       435.72        8.69   28.02       4.73
  29       4.68     37.48    199.05      400.72       438.21        8.69   28.02       4.73
  30       4.68     39.26    203.73      401.44       440.70        8.69   28.02       4.73
  31       5.28     38.89    208.71      404.46       443.35       45.23   28.02       7.50
  32      5.28    36.38    213.99      409.78      446.16      45.23   28.02      7.50
  33      3.51    32.74    218.39      415.76      448.50      62.08   28.02      7.50
  34      3.51    27.98    221.90      422.38      450.37      62.08   28.02      7.50
  35      2.49    23.22    224.90      428.75      451.96      67.76   28.02      6.59
  36      3.18    17.79    227.74      435.69      453.48      67.76   28.02      8.41
  37      4.92    13.22    231.80      442.41      455.63      48.98   28.02      7.50
  38      4.92    10.19    236.72      448.07      458.25      48.98   28.02      7.50
  39      0.82     7.79    239.59      451.99      459.78      69.51   28.02      2.34
  40      2.58     3.45    241.29      456.55      460.00      69.51    0.00      7.38


 ***Table 2A - Coordinates of Slice Points Defining the Slip Surface***


 Point           X-Pt            Y-Pt
  No.            (ft)            (ft)

   1           71.297267       393.648634
   2           75.531512       392.097592
   3           79.765756       390.546550
   4           84.000000       388.995508
   5           84.696237       388.740470
   6           87.948087       388.014906
   7           91.199937       387.289341
   8           95.268090       386.381639
   9           99.336243       385.473938
  10          103.668121       386.136298
  11          108.000000       386.798659
  12          113.166667       387.588661
  13          118.333333       388.378664
  14          123.500000       389.168666
  15          128.666667       389.958668
  16          133.833333       390.748671
  17          139.000000       391.538673
  18          144.166667       392.328676
  19          149.333333       393.118678
  20          154.500000       393.908681
  21          159.666667       394.698683
 22          164.833333        395.488686
 23          170.000000        396.278688
 24          174.000000        396.890303
 25          178.000000        397.501918
 26          182.678223        398.217235
 27          187.356445        398.932553
 28          192.034668        399.647871
 29          196.712891        400.363188
 30          201.391113        401.078506
 31          206.069336        401.793823
 32          211.351608        407.118070
 33          216.633881        412.442317
 34          220.145225        419.069568
 35          223.656570        425.696820
 36          226.150332        431.794259
 37          229.334806        439.580538
 38          234.257473        445.238927
 39          239.180140        450.897315
 40          240.000000        453.090994
 41          242.582156        460.000000
↑


 ***Table 3 - Force and Pore Pressure Data On The   40 Slices (Excluding Reinforcement)***

                      Ubeta   Ubeta      Ualpha                              Earthquake
                      Force   Stress     Force       Pore                      Force        Distributed
Slice      Weight      Top     Top        Bot     Pressure       -Uw     Horiz     Vert       Load
  No.      (lbs)      (lbs)   (psf)      (lbs)      (psf)        (psf)   (lbs)     (lbs)      (psf)
  1         931.9       0.0     0.0        0.0       0.00         0.00   205.0       0.0       0.00
  2        2795.7       0.0     0.0        0.0       0.00         0.00   615.1       0.0       0.00
  3        4659.6       0.0     0.0        0.0       0.00         0.00  1025.1       0.0       0.00
  4         930.1       0.0     0.0        0.0       0.00         0.00   204.6       0.0       0.00
  5        4535.3       0.0     0.0        0.0       0.00         0.00   997.8       0.0       0.00
  6        4818.4       0.0     0.0        0.0       0.00         0.00  1060.1       0.0       0.00
  7        6426.6       0.0     0.0        0.0       0.00         0.00  1413.9       0.0       0.00
  8        6869.7       0.0     0.0        0.0       0.00         0.00  1511.3       0.0       0.00
  9        7378.9       0.0     0.0        0.0       0.00         0.00  1623.3       0.0       0.00
 10        7034.5       0.0     0.0        0.0       0.00         0.00  1547.6       0.0       0.00
```

```
11        8637.4       0.0     0.0        0.0       0.00         0.00  1900.2       0.0       0.00
12        9542.6       0.0     0.0        0.0       0.00         0.00  2099.4       0.0       0.00
13       10447.8       0.0     0.0        0.0       0.00         0.00  2298.5       0.0       0.00
14       11353.0       0.0     0.0        0.0       0.00         0.00  2497.7       0.0       0.00
15       12258.2       0.0     0.0        0.0       0.00         0.00  2696.8       0.0       0.00
16       13163.4       0.0     0.0        0.0       0.00         0.00  2896.0       0.0       0.00
17       14068.6       0.0     0.0        0.0       0.00         0.00  3095.1       0.0       0.00
18       14973.8       0.0     0.0        0.0       0.00         0.00  3294.2       0.0       0.00
19       15879.0       0.0     0.0        0.0       0.00         0.00  3493.4       0.0       0.00
20       16784.2       0.0     0.0        0.0       0.00         0.00  3692.5       0.0       0.00
21       17689.4       0.0     0.0        0.0       0.00         0.00  3891.7       0.0       0.00
22       18594.6       0.0     0.0        0.0       0.00         0.00  4090.8       0.0       0.00
23       14599.4       0.0     0.0        0.0       0.00         0.00  3211.9       0.0       0.00
24       14305.9       0.0     0.0        0.0       0.00         0.00  3147.3       0.0       0.00
25       17058.0       0.0     0.0        0.0       0.00         0.00  3752.8       0.0       0.00
26       18054.3       0.0     0.0        0.0       0.00         0.00  3971.9       0.0       0.00
27       19050.6       0.0     0.0        0.0       0.00         0.00  4191.1       0.0       0.00
28       20046.9       0.0     0.0        0.0       0.00         0.00  4410.3       0.0       0.00
29       21043.2       0.0     0.0        0.0       0.00         0.00  4629.5       0.0       0.00
30       22039.5       0.0     0.0        0.0       0.00         0.00  4848.7       0.0       0.00
31       24651.3       0.0     0.0        0.0       0.00         0.00  5423.3       0.0       0.00
32       23058.5       0.0     0.0        0.0       0.00         0.00  5072.9       0.0       0.00
33       13796.1       0.0     0.0        0.0       0.00         0.00  3035.1       0.0       0.00
34       11791.1       0.0     0.0        0.0       0.00         0.00  2594.0       0.0       0.00
35        6948.4       0.0     0.0        0.0       0.00         0.00  1528.6       0.0       0.00
36        6797.6       0.0     0.0        0.0       0.00         0.00  1495.5       0.0       0.00
37        7811.5       0.0     0.0        0.0       0.00         0.00  1718.5       0.0       0.00
38        6016.7       0.0     0.0        0.0       0.00         0.00  1323.7       0.0       0.00
39         766.2       0.0     0.0        0.0       0.00         0.00   168.6       0.0       0.00
40        1070.4       0.0     0.0        0.0       0.00         0.00   235.5       0.0       0.00

        TOTAL WEIGHT OF SLIDING MASS =  458678.54(lbs)

        EFFECTIVE WEIGHT OF SLIDING MASS =  458678.54(lbs)

        TOTAL AREA OF SLIDING MASS =  3822.32(ft2)
```

```
***TABLE 4 - SOIL STRENGTH & SOIL OPTIONS DATA ON THE   40 SLICES***

Slice  Soil   Cohesion   Phi(Deg)   Options
 No.   Type     (psf)
  1      1     200.00     31.00
  2      1     200.00     31.00
  3      1     200.00     31.00
  4      1     200.00     31.00
  5      1     200.00     31.00
  6      1     200.00     31.00
  7      2     200.00     34.00     A
  8      2     200.00     34.00     A
  9      2     200.00     24.00     A
 10      2     200.00     24.00     A
 11      2     200.00     24.00     A
 12      2     200.00     24.00     A
 13      2     200.00     24.00     A
 14      2     200.00     24.00     A
 15      2     200.00     24.00     A
 16      2     200.00     24.00     A
 17      2     200.00     24.00     A
 18      2     200.00     24.00     A
 19      2     200.00     24.00     A
 20      2     200.00     24.00     A
 21      2     200.00     24.00     A
 22      2     200.00     24.00     A
 23      2     200.00     24.00     A
 24      2     200.00     24.00     A
 25      2     200.00     24.00     A
 26      2     200.00     24.00     A
 27      2     200.00     24.00     A
 28      2     200.00     24.00     A
 29      2     200.00     24.00     A
 30      2     200.00     24.00     A
 31      2     200.00     24.00     A
 32      2     200.00     24.00     A
 33      2     200.00     24.00     A
 34      2     200.00     24.00     A
 35      2     200.00     24.00     A
```

```
  36      1     200.00     31.00
  37      1     200.00     31.00
  38      1     200.00     31.00
  39      1     200.00     31.00
  40      1     200.00     31.00

  SOIL OPTIONS:
  A = ANISOTROPIC SHEAR STRENGTH
  C = CURVED STRENGTH ENVELOPE (TANGENT PHI & C)
  F = FIBER-REINFORCED SOIL (FRS)
  M = INDEPENDENT MULTI-STAGE SHEAR STRENGTH
  N = NONLINEAR UNDRAINED SHEAR STRENGTH
  R = RAPID DRAWDOWN OR RAPID LOADING (SEISMIC) SHEAR STRENGTH
  S = SHANSEP UNDRAINED SHEAR STRENGTH
  NOTE: Phi and C in Table 4 are modified values based on specified
  Soil Options (if any).

↑


         ***TABLE 5 - Total Base Stress Data on the   40 Slices***

 Slice   Alpha     X-Coord.      Base        Total          Total          Total
  No.    (deg)    Slice Cntr     Leng.    Normal Stress   Vert. Stress   Normal/Vert.
   *                 (ft)        (ft)        (psf)          (psf)        Stress Ratio

   1    -20.12      73.41        4.51         740.60         220.09          3.365
   2    -20.12      77.65        4.51        1633.00         660.27          2.473
   3    -20.12      81.88        4.51        2525.41        1100.45          2.295
   4    -20.12      84.35        0.74        3002.64        1335.84          2.248
   5    -12.58      86.32        3.33        2365.08        1394.68          1.696
   6    -12.58      89.57        3.33        2501.09        1481.75          1.688
   7    -12.58      93.23        4.17        2849.72        1579.74          1.804
   8    -12.58      97.30        4.17        3032.42        1688.67          1.796
   9      8.69     101.50        4.38        1646.40        1703.39          0.967
  10      8.69     105.83        4.38        1571.82        1623.90          0.968
  11      8.69     110.58        5.23        1616.73        1671.76          0.967
  12      8.69     115.75        5.23        1781.13        1846.96          0.964
  13      8.69     120.92        5.23        1945.53        2022.16          0.962
 14      8.69     126.08        5.23         2109.92         2197.36           0.960
 15      8.69     131.25        5.23         2274.32         2372.56           0.959
 16      8.69     136.42        5.23         2438.72         2547.76           0.957
 17      8.69     141.58        5.23         2603.12         2722.96           0.956
 18      8.69     146.75        5.23         2767.51         2898.16           0.955
 19      8.69     151.92        5.23         2931.91         3073.36           0.954
 20      8.69     157.08        5.23         3096.31         3248.56           0.953
 21      8.69     162.25        5.23         3260.71         3423.76           0.952
 22      8.69     167.42        5.23         3425.11         3598.96           0.952
 23      8.69     172.00        4.05         3472.87         3649.86           0.952
 24      8.69     176.00        4.05         3404.00         3576.47           0.952
 25      8.69     180.34        4.73         3469.49         3646.25           0.952
 26      8.69     185.02        4.73         3669.32         3859.22           0.951
 27      8.69     189.70        4.73         3869.15         4072.18           0.950
 28      8.69     194.37        4.73         4068.99         4285.15           0.950
 29      8.69     199.05        4.73         4268.82         4498.11           0.949
 30      8.69     203.73        4.73         4468.66         4711.07           0.949
 31     45.23     208.71        7.50         2504.01         4666.79           0.537
 32     45.23     213.99        7.50         2338.55         4365.27           0.536
 33     62.08     218.39        7.50         1409.74         3929.01           0.359
 34     62.08     221.90        7.50         1190.18         3358.01           0.354
 35     67.76     224.90        6.59          782.93         2786.30           0.281
 36     67.76     227.74        8.41          524.33         2134.62           0.246
 37     48.98     231.80        7.50          711.67         1586.84           0.448
 38     48.98     236.72        7.50          533.66         1222.25           0.437
 39     69.51     239.59        2.34          146.36          934.52           0.157
 40     69.51     241.29        7.38            2.47          414.54           0.006


        ***TABLE 5A - Total Base Force Data on the   40 Slices***

Slice   Alpha     X-Coord.      Base         Total            Total           Total
 No.    (deg)    Slice Cntr     Leng.     Normal Force    Vert. Force      Normal/Vert.
  *                 (ft)        (ft)          (lbs)           (lbs)        Force Ratio

  1    -20.12      73.41        4.51         3339.64          931.91           3.584
  2    -20.12      77.65        4.51         7363.85         2795.74           2.634
  3    -20.12      81.88        4.51        11388.05         4659.57           2.444
  4    -20.12      84.35         0.74         2226.39          930.06          2.394
  5    -12.58      86.32         3.33         7879.99         4535.28          1.737
  6    -12.58      89.57         3.33         8333.17         4818.41          1.729
  7    -12.58      93.23         4.17        11878.19         6426.63          1.848
  8    -12.58      97.30         4.17        12639.69         6869.75          1.840
  9      8.69     101.50         4.38         7214.92         7378.86          0.978
 10      8.69     105.83         4.38         6888.08         7034.55          0.979
 11      8.69     110.58         5.23         8450.18         8637.43          0.978
 12      8.69     115.75         5.23         9309.45         9542.63          0.976
 13      8.69     120.92         5.23        10168.71        10447.83          0.973
 14      8.69     126.08         5.23        11027.97        11353.03          0.971
 15      8.69     131.25         5.23        11887.23        12258.22          0.970
 16      8.69     136.42         5.23        12746.49        13163.42          0.968
 17      8.69     141.58         5.23        13605.75        14068.62          0.967
 18      8.69     146.75         5.23        14465.01        14973.82          0.966
 19      8.69     151.92         5.23        15324.27        15879.02          0.965
 20      8.69     157.08         5.23        16183.53        16784.22          0.964
 21      8.69     162.25         5.23        17042.79        17689.42          0.963
 22      8.69     167.42         5.23        17902.05        18594.61          0.963
 23      8.69     172.00         4.05        14052.93        14599.44          0.963
 24      8.69     176.00         4.05        13774.26        14305.87          0.963
 25      8.69     180.34         4.73        16419.66        17057.98          0.963
 26      8.69     185.02         4.73        17365.40        18054.27          0.962
 27      8.69     189.70         4.73        18311.13        19050.57          0.961
 28      8.69     194.37         4.73        19256.87        20046.87          0.961
 29      8.69     199.05         4.73        20202.60        21043.16          0.960
 30      8.69     203.73         4.73        21148.34        22039.46          0.960
 31     45.23     208.71         7.50        18780.07        24651.28          0.762
 32     45.23     213.99         7.50        17539.12        23058.54          0.761
 33     62.08     218.39         7.50        10573.09        13796.10          0.766
 34     62.08     221.90         7.50         8926.34        11791.13          0.757
 35     67.76     224.90         6.59         5157.72         6948.38          0.742
 36     67.76     227.74         8.41         4410.83         6797.64          0.649
 37     48.98     231.80         7.50         5337.50         7811.50          0.683
 38     48.98     236.72         7.50         4002.42         6016.74          0.665
 39     69.51     239.59         2.34          342.76          766.17          0.447
 40     69.51     241.29         7.38           18.25         1070.41          0.017
```

```
        ***TABLE 6 - Effective and Base Shear Stress Data on the   40 Slices***

Slice    Alpha     X-Coord.      Base       Effective       Available         Mobilized
 No.     (deg)   Slice Cntr      Leng.    Normal Stress   Shear Strength     Shear Stress
  *                 (ft)          (ft)        (psf)           (psf)             (psf)

  1     -20.12      73.41       4.51          740.60          645.00          527.98
  2     -20.12      77.65       4.51         1633.00         1181.21          966.91
  3     -20.12      81.88       4.51         2525.41         1717.42         1405.84
  4     -20.12      84.35       0.74         3002.64         2004.17         1640.56
  5     -12.58      86.32       3.33         2365.08         1621.08         1326.98
  6     -12.58      89.57       3.33         2501.09         1702.81         1393.87
  7     -12.58      93.23       4.17         2849.72         2122.16         1737.15
  8     -12.58      97.30       4.17         3032.42         2245.39         1838.02
  9       8.69     101.50       4.38         1646.40          933.03          763.75
 10       8.69     105.83       4.38         1571.82          899.82          736.57
 11       8.69     110.58       5.23         1616.73          919.81          752.94
 12       8.69     115.75       5.23         1781.13          993.01          812.85
 13       8.69     120.92       5.23         1945.53         1066.20          872.77
 14       8.69     126.08       5.23         2109.92         1139.40          932.68
 15       8.69     131.25       5.23         2274.32         1212.59          992.60
 16       8.69     136.42       5.23         2438.72         1285.79         1052.51
 17       8.69     141.58       5.23         2603.12         1358.98         1112.43
 18       8.69     146.75       5.23         2767.51         1432.18         1172.34
 19       8.69     151.92       5.23         2931.91         1505.37         1232.26
 20       8.69     157.08       5.23         3096.31         1578.57         1292.17
 21       8.69     162.25       5.23         3260.71         1651.76         1352.09
 22       8.69     167.42       5.23         3425.11         1724.96         1412.00
 23       8.69     172.00       4.05         3472.87         1746.22         1429.41
 24       8.69     176.00       4.05         3404.00         1715.56         1404.31
 25       8.69     180.34       4.73         3469.49         1744.71         1428.18
 26       8.69     185.02       4.73         3669.32         1833.69         1501.01
 27       8.69     189.70       4.73         3869.15         1922.66         1573.84
 28       8.69     194.37       4.73         4068.99         2011.63         1646.67
 29       8.69     199.05       4.73         4268.82         2100.60         1719.50
 30       8.69     203.73       4.73         4468.66         2189.57         1792.33
 31      45.23     208.71       7.50         2504.01         1314.86         1076.31
 32      45.23     213.99       7.50         2338.55         1241.19         1016.00
 33      62.08     218.39       7.50         1409.74          827.66          677.50
 34      62.08     221.90       7.50         1190.18          729.90          597.48
 35      67.76     224.90       6.59          782.93          548.58          449.06
 36      67.76     227.74       8.41          524.33          515.05          421.61
 37      48.98     231.80       7.50          711.67          627.61          513.75
 38      48.98     236.72       7.50          533.66          520.65          426.19
 39      69.51     239.59       2.34          146.36          287.94          235.70
 40      69.51     241.29       7.38            2.47          201.49          164.93


        ***TABLE 6A - Effective and Base Shear Force Data on the   40 Slices***

Slice    Alpha     X-Coord.     Base       Effective       Available         Mobilized
 No.     (deg)   Slice Cntr     Leng.     Normal Force    Shear Force       Shear Force
  *                 (ft)         (ft)        (lbs)           (lbs)             (lbs)

  1     -20.12      73.41       4.51         3339.64         2908.53         2380.85
  2     -20.12      77.65       4.51         7363.85         5326.52         4360.15
  3     -20.12      81.88       4.51        11388.05         7744.51         6339.45
  4     -20.12      84.35       0.74         2226.39         1486.05         1216.44
  5     -12.58      86.32       3.33         7879.99         5401.14         4421.23
  6     -12.58      89.57       3.33         8333.17         5673.44         4644.13
  7     -12.58      93.23       4.17        11878.19         8845.57         7240.75
  8     -12.58      97.30       4.17        12639.69         9359.22         7661.21
  9       8.69     101.50       4.38         7214.92         4088.73         3346.93
 10       8.69     105.83       4.38         6888.08         3943.21         3227.81
 11       8.69     110.58       5.23         8450.18         4807.61         3935.38
 12       8.69     115.75       5.23         9309.45         5190.18         4248.54
 13       8.69     120.92       5.23        10168.71         5572.74         4561.70
 14       8.69     126.08       5.23        11027.97         5955.31         4874.86
 15       8.69     131.25       5.23        11887.23         6337.88         5188.02
 16       8.69     136.42       5.23        12746.49         6720.45         5501.18
 17       8.69     141.58       5.23        13605.75         7103.01         5814.34
 18       8.69     146.75       5.23        14465.01         7485.58         6127.50
 19       8.69     151.92       5.23        15324.27         7868.15         6440.66
 20       8.69     157.08       5.23        16183.53         8250.72         6753.82
 21       8.69     162.25       5.23        17042.79         8633.28         7066.98
 22       8.69     167.42       5.23        17902.05         9015.85         7380.14
```

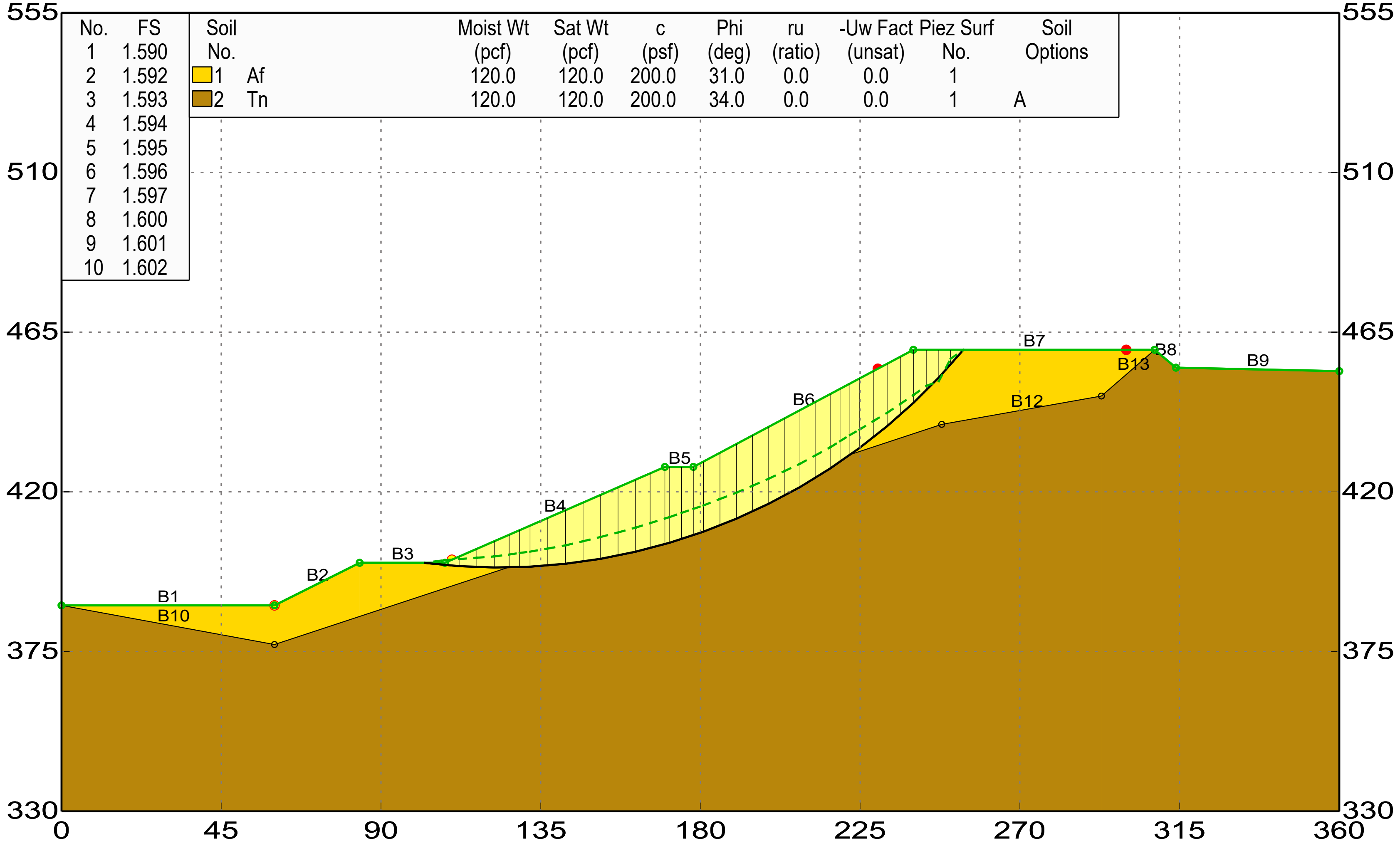
```
23       8.69     172.00       4.05        14052.93          7066.07          5784.10
24       8.69     176.00       4.05        13774.26          6941.99          5682.53
25       8.69     180.34       4.73        16419.66          8257.02          6758.98
26       8.69     185.02       4.73        17365.40          8678.09          7103.66
27       8.69     189.70       4.73        18311.13          9099.16          7448.33
28       8.69     194.37       4.73        19256.87          9520.23          7793.01
29       8.69     199.05       4.73        20202.60          9941.30          8137.68
30       8.69     203.73       4.73        21148.34         10362.37          8482.36
31      45.23     208.71       7.50        18780.07          9861.43          8072.30
32      45.23     213.99       7.50        17539.12          9308.92          7620.04
33      62.08     218.39       7.50        10573.09          6207.44          5081.25
34      62.08     221.90       7.50         8926.34          5474.26          4481.09
35      67.76     224.90       6.59         5157.72          3613.90          2958.24
36      67.76     227.74       8.41         4410.83          4332.76          3546.68
37      48.98     231.80       7.50         5337.50          4707.09          3853.10
38      48.98     236.72       7.50         4002.42          3904.90          3196.44
39      69.51     239.59       2.34          342.76           674.33           551.99
40      69.51     241.29       7.38           18.25          1486.12          1216.50

   Average Effective Normal Stress = 2188.2627(psf)
   Average Available Shear Strength = 1242.5299(psf)
   Total Length of Failure Surface = 206.9608(ft)


   INPUT PARAMETERS FOR SIMPLIFIED 3D ANALYSIS

        Composite Phi (deg)=  29.589
        3D Depth (Vertical difference between ends of Slip Surface) =   66.35(ft)
        L/D(1): L = 66.35(ft) L/D(2): L = 132.70(ft) L/D(3): L = 199.05(ft)
        L/D(4): L = 265.41(ft) L/D(5): L = 331.76(ft) L/D(6): L = 398.11(ft)

        Average Elevation of Point of Application of kh on Sliding Mass =  412.883(ft)

   SUM OF MOMENTS =  -0.740419E-01 (ft/lbs);Imbalance (Fraction of Total Weight) =  -0.1614244E-06
   SUM OF FORCES = 0.338929E-03 (lbs);Imbalance (Fraction of Total Weight) =    0.7389253E-09

   Sum of Available Shear Forces =  257155.05(lbs)

   Sum of Mobilized Shear Forces =  210500.36(lbs)
```

```
FS Balance Check: FS =  1.221637

                    **** END OF GEOSTASE OUTPUT ****
```

X-Section B-B' - Freedom Lane
Global Stability of Existing Slope

SA Geotechnical, Inc., RS

\02.gsd



No.	FS
1	1.590
2	1.592
3	1.593
4	1.594
5	1.595
6	1.596
7	1.597
8	1.600
9	1.601
10	1.602

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	-Uw Fact (unsat)	Piez Surf No.	Soil Options
1	Af	120.0	120.0	200.0	31.0	0.0	0.0	1	
2	Tn	120.0	120.0	200.0	34.0	0.0	0.0	1	A

GEOSTASE FS = 1.590

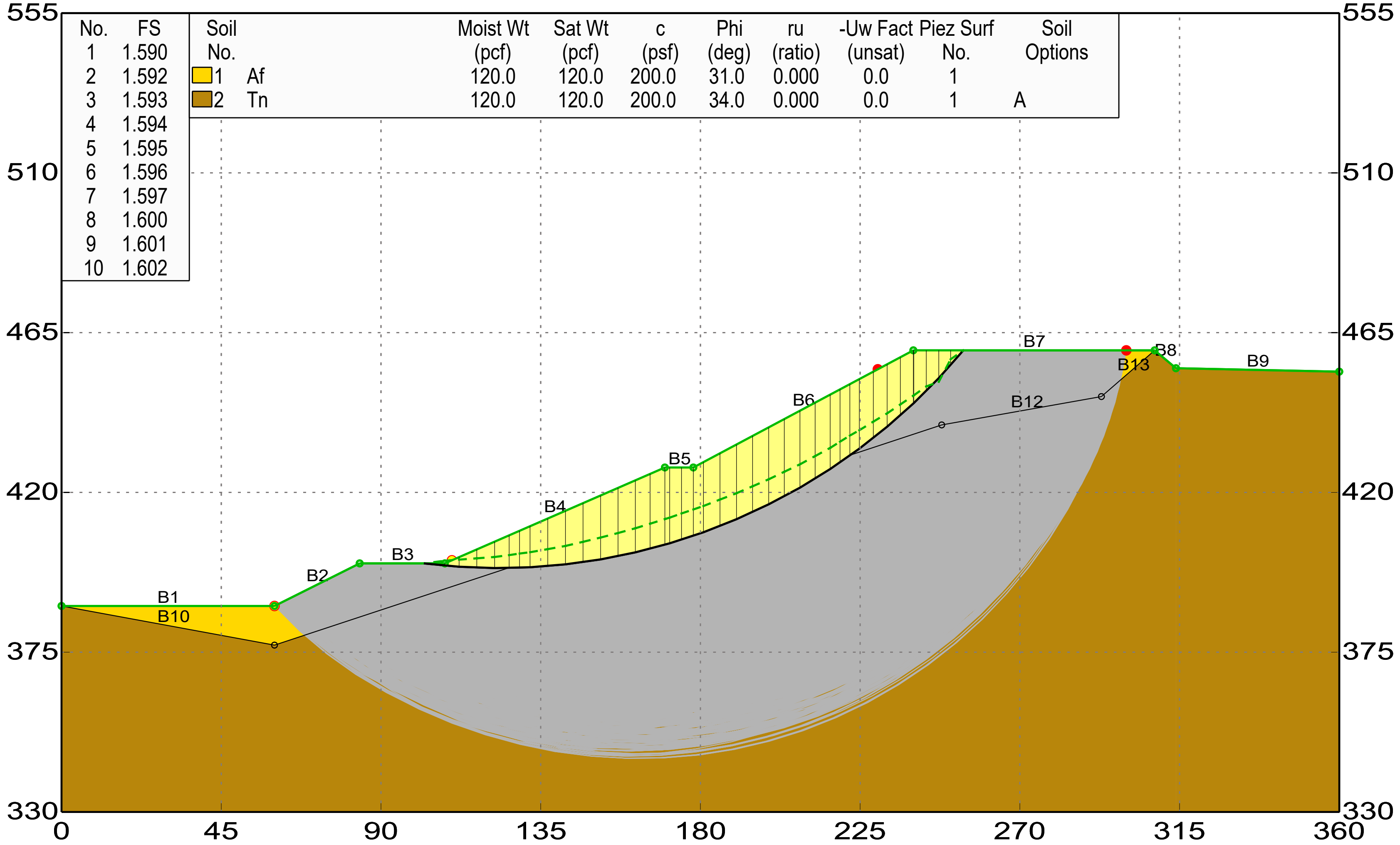
Spencer Method

GEOSTASE
Slope Stability
Analysis

X-Section B-B' - Freedom Lane
Global Stability of Existing Slope

SA Geotechnical, Inc., RS

\02.gsd



No.	FS
1	1.590
2	1.592
3	1.593
4	1.594
5	1.595
6	1.596
7	1.597
8	1.600
9	1.601
10	1.602

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	-Uw Fact (unsat)	Piez Surf No.	Soil Options
🟨 1	Af	120.0	120.0	200.0	31.0	0.000	0.0	1	
🟫 2	Tn	120.0	120.0	200.0	34.0	0.000	0.0	1	A

GEOSTASE FS = 1.590

Spencer Method

GEOSTASE
Slope Stability Analysis

GEOSTASE® v4.30.32 by GREGORY GEOTECHNICAL SOFTWARE

PLATE C.2

```
                    ***  GEOSTASE(R)  ***

           ** GEOSTASE(R) (c)Copyright by Garry H. Gregory, Ph.D.,P.E.,S.E.,BC.GE **

                  ** Current Version 4.30.32-Double Precision, Sept 2023 **
                      (All Rights Reserved-Unauthorized Use Prohibited)


          *********************************************************************************
                         SLOPE STABILITY ANALYSIS SOFTWARE (2D & 3D)
              Simplified Bishop, Simplified Janbu, or General Equilibrium (GE) Options.
                 (Spencer, Morgenstern-Price, USACE, and Lowe & Karafiath)
                 Including Pier/Pile, Planar Reinf,  Nail, Tieback, Line Loads
                 Applied Forces, Fiber-Reinforced Soil (FRS), Distributed Loads
                 Nonlinear Undrained Shear Strength, Curved Strength Envelope,
                 Anisotropic Strengths, Water Surfaces, 3-Stage Rapid Drawdown
                 2- or 3-Stage Pseudo-Static & Simplified Newmark Seismic Analyses.
          *********************************************************************************


          Analysis Date:              6/  3/ 2024
          Analysis Time:
          Analysis By:               SA Geotechnical, Inc., RS


          Input File Name:           C:\Users\Reza Saberi\SA Geotechnical, Inc\SA Geotechnical -
Projects\2024\24064-01 Meritage - 400-700 Freedom Ln, Aliso Viejo\Engineering\Sted\B-B'\02.gsd

          Output File Name:          C:\Users\Reza Saberi\SA Geotechnical, Inc\SA Geotechnical -
Projects\2024\24064-01 Meritage - 400-700 Freedom Ln, Aliso Viejo\Engineering\Sted\B-B'\02.OUT

          Unit System:               English


          PROJECT: X-Section B-B' - Freedom Lane

          DESCRIPTION: Global Stability of Existing Slope
```

```
 PROFILE BOUNDARY DATA

     9 Surface Boundaries
    13 Total   Boundaries


 Boundary      X - 1       Y - 1       X - 2       Y - 2      Soil Type
    No.        (ft)        (ft)        (ft)        (ft)       Below Bnd

    1          0.000     388.000      60.000     388.000        1
    2         60.000     388.000      84.000     400.000        1
    3         84.000     400.000     108.000     400.000        1
    4        108.000     400.000     170.000     427.000        1
    5        170.000     427.000     178.000     427.000        1
    6        178.000     427.000     240.000     460.000        1
    7        240.000     460.000     308.000     460.000        1
    8        308.000     460.000     314.000     455.000        2
    9        314.000     455.000     360.000     454.000        2
   10          0.000     388.000      60.000     377.000        2
   11         60.000     377.000     248.000     439.000        2
   12        248.000     439.000     293.000     447.000        2
   13        293.000     447.000     308.000     460.000        2

 User Specified X-Origin =         0.000(ft)

 User Specified Y-Origin =       330.000(ft)

 SURFACE BOUNDARY POINT COORDINATES
(Information Only-Not Used Directly)
 Point No.       X-COORD             Y-COORD
   1               0.000             388.000
   2              60.000             388.000
   3              84.000             400.000
   4             108.000             400.000
   5             170.000             427.000
   6             178.000             427.000
   7             240.000             460.000
   8             308.000             460.000
   9             314.000             455.000
```

```
          10             360.000             454.000

        SUBSURFACE BOUNDARY POINT COORDINATES
         (Information Only-Not Used Directly)
        Point No.       X-COORD             Y-COORD
        Surface boundary point    1 and Subsurface boundary point   11 are duplicate points.
          11               0.000             388.000
          12              60.000             377.000
          13             248.000             439.000
          14             293.000             447.000
        Surface boundary point    8 and Subsurface boundary point   15 are duplicate points.
          15             308.000             460.000

     PROFILE BOUNDARY SLOPES AND ANGLES
        BND No.  Slope    Angle(Deg.)
           1      0.000     0.000
           2      0.500    26.565
           3      0.000     0.000
           4      0.435    23.532
           5      0.000     0.000
           6      0.532    28.025
           7      0.000     0.000
           8     -0.833   -39.806
           9     -0.022    -1.245
          10     -0.183   -10.389
          11      0.330    18.252
          12      0.178    10.081
          13      0.867    40.914


       MOHR-COULOMB SOIL PARAMETERS

         2 Type(s) of Soil Defined

     Soil Number           Moist  Saturated  Cohesion Friction   Pore      (-Uw)   Water   Water
         and              Unit Wt. Unit Wt. Intercept   Angle  Pressure    Fact.  Surface  Option
     Description           (pcf)    (pcf)     (psf)     (deg)  Ratio(ru)            No.

1 Af                       120.0    120.0     200.00    31.00    0.000      0.0      1       0
```

```
  2 Tn                       120.0    120.0     200.00    34.00    0.000      0.0      1       0


         ANISOTROPIC STRENGTH PARAMETERS

              1 soil type(s)

          Soil Type  2 Is Anisotropic

          Number Of Direction Ranges Specified =  3


          Direction    Counterclockwise     Cohesion     Friction
            Range       Direction Limit    Intercept       Angle
             No.            (deg)            (psf)         (deg)

              1              -5.0             200.00         34.00
              2               8.0             200.00         28.00
              3              90.0             200.00         24.00
↑


          TRIAL FAILURE SURFACE DATA

          Circular Trial Failure Surfaces Have Been Generated Using A Random Procedure.


↑
            3000 Trial Surfaces Have Been Generated.

            3000 Surfaces Generated at Increments of 0.2001(in) Equally Spaced Within the Start Range

          Along The Specified Surface Between  X =  60.00(ft)
                                          and  X = 110.00(ft)

          Each Surface ends within a Range Between   X = 230.00(ft)
                                                 and   X = 300.00(ft)

          All surfaces are generated left to right for both a left and right sliding slope.
```

```
Unless XCLUDE Lines Were Specified, The Minimum Elevation
To Which A Surface Extends Is  Y =     330.00(ft)


Specified Maximum Radius = 100000.000(ft)

10.000(ft) Line Segments Were Used For Each Trial Failure Surface.


The Spencer Method Was Selected for FS Analysis.

Selected fx function = Constant (1.0)

SELECTED CONVERGENCE PARAMETERS FOR SPENCER METHOD:
Initial estimate of FS =  1.500
FS tolerance =  0.000001000
Initial estimate of theta(deg) =  15.00
Theta tolerance(radians) =  0.0001000
Minimum theta(deg) = -45.00 ; Maximum theta(deg) =  45.00
Theta convergence Step Factor = 5000.00
Maximum number of iterations = 50
Allowable negative side force = -1000.0(lbs)
Maximum force imbalance  = 100.000000(lbs)
Maximum moment imbalance = 100.000000 (ft/lbs)

Selected Lambda Coefficient =  1.00

Specified Tension Crack Water Depth Factor =   0.000

Total Number of Trial Surfaces Attempted = 3000

WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
Did Not Converge in 50 Iterations.


Number of Trial Surfaces with Non-Converged FS = 22

Number of Trial Surfaces With Valid FS = 2978
```

```
Percentage of Trial Surfaces With Non-Converged and/or
Non-Valid FS Solutions of the Total Attempted =   0.7 %

Statistical Data On All Valid FS Values:
   FS Max =   3.586   FS Min =   1.590   FS Ave =   2.272
   Standard Deviation =    0.392   Coefficient of Variation =   17.25 %


Critical Surface is Sequence Number    2511 of Those Analyzed.


*****BEGINNING OF DETAILED GEOSTASE OUTPUT FOR CRITICAL SURFACE FROM A SEARCH*****

BACK-CALCULATED CIRCULAR SURFACE PARAMETERS:

Circle Center At X =    123.076892(ft) ; Y =    569.335713(ft); and Radius =    170.634476(ft)

Circular Trial Failure Surface Generated With 19 Coordinate Points

  Point      X-Coord.      Y-Coord.
   No.        (ft)          (ft)

    1        102.06402      400.00000
    2        112.01973      399.05987
    3        122.01342      398.70455
    4        132.01075      398.93527
    5        141.97741      399.75124
    6        151.87915      401.14964
    7        161.68197      403.12569
    8        171.35220      405.67258
    9        180.85662      408.78159
   10        190.16260      412.44202
   11        199.23817      416.64130
   12        208.05217      421.36502
   13        216.57431      426.59694
   14        224.77534      432.31911
   15        232.62708      438.51186
   16        240.10257      445.15393
   17        247.17613      452.22250
   18        253.82347      459.69330
   19        254.06571      460.00000


  Iter.     Theta         FS         FS
   No.      (deg)      (Moment)   (Force)
           (fx=1.0)                              Lambda        Delta FS

    1        15.0000    1.697190   1.569875     0.268      0.1273156E+00
    2        19.9500    1.573454   1.592315     0.363      0.1886023E-01
    3        19.3115    1.594540   1.589299     0.350      0.5241175E-02
    4        19.4504    1.590117   1.589952     0.353      0.1656185E-03
    5        19.4550    1.589971   1.589973     0.353      0.1493052E-05
    6        19.4549    1.589973   1.589973     0.353      0.3546542E-08


Factor Of Safety For The Preceding Specified Surface =  1.590
Theta (fx = 1.0) =  19.45 Deg    Lambda =   0.353


The Spencer Method Has Been Selected For Analysis.

Selected fx function = Constant (1.0)

SELECTED CONVERGENCE PARAMETERS FOR ANALYSIS METHOD:
Initial estimate of FS =  1.500
FS tolerance =  0.000001000
Initial estimate of theta(deg) =  15.00
Theta tolerance(radians) =  0.0001000
Minimum theta(deg) = -45.00 ; Maximum theta(deg) =  45.00
Theta convergence Step Factor = 5000.00
Maximum number of iterations = 50
Maximum force imbalance = 100.000000(lbs)
Maximum moment imbalance(if Applicable) = 100.000000 (ft/lbs)


Selected Lambda Coefficient =  1.00
```

```
Tension Crack Water Force =        0.00(lbs)

Specified Tension Crack Water Depth Factor =  0.000 (  0.00% Filled )

Depth of Tension Crack (zo) at Side of Last Slice =   0.000(ft)

Depth of Water in Tension Crack =   0.000(ft)

Theoretical Tension Crack Depth =   5.892(ft)


NOTE: In Table 1 following, when a tension crack with water is present on the
first slice (right facing slope) or on the last slice (left facing slope), the
"side force" in the tension crack is set equal to the water pressure resultant.


        *** Table 1 - Line of Thrust(if applicable) and Slice Force Data ***

Slice      X         Y                Side Force     fx    Force Angle  Vert. Shear
 No.     Coord.    Coord.    h/H         (lbs)                (Deg)      Force(lbs)

  1     105.03    400.38    1.000+     532.28      1.000       19.45         177.3
  2     108.00    400.73    1.000+    1127.27      1.000       19.45         375.5
  3     112.02    401.03    0.734     2298.27      1.000       19.45         765.5
  4     117.02    401.43    0.505     4302.21      1.000       19.45        1432.9
  5     122.01    401.82    0.422     7042.44      1.000       19.45        2345.6
  6     126.10    402.32    0.388     9381.26      1.000       19.45        3124.6
  7     129.06    402.75    0.377    11085.03      1.000       19.45        3692.0
  8     132.01    403.16    0.367    12947.80      1.000       19.45        4312.5
  9     136.99    404.04    0.354    15778.48      1.000       19.45        5255.3
 10     141.98    404.91    0.343    18910.00      1.000       19.45        6298.3
 11     146.93    406.10    0.342    20982.74      1.000       19.45        6988.6
 12     151.88    407.26    0.340    23184.09      1.000       19.45        7721.8
 13     156.78    408.59    0.338    24727.01      1.000       19.45        8235.7
 14     161.68    409.91    0.335    26324.47      1.000       19.45        8767.8
 15     165.84    411.19    0.332    27050.14      1.000       19.45        9009.5
 16     170.00    412.47    0.330    27781.73      1.000       19.45        9253.1
 17     171.35    412.89    0.338    28020.06      1.000       19.45        9332.5
 18     174.68    414.04    0.360    28089.43      1.000       19.45        9355.6
```

```
           19     178.00    415.19    0.384    28178.34     1.000        19.45        9385.2
           20     180.86    416.18    0.375    28258.62     1.000        19.45        9412.0
           21     185.51    417.97    0.361    27711.34     1.000        19.45        9229.7
           22     190.16    419.77    0.348    27126.35     1.000        19.45        9034.8
           23     194.70    421.72    0.336    25869.76     1.000        19.45        8616.3
           24     199.24    423.68    0.325    24585.28     1.000        19.45        8188.5
           25     203.65    425.79    0.314    22689.75     1.000        19.45        7557.2
           26     208.05    427.93    0.304    20796.09     1.000        19.45        6926.4
           27     212.31    430.22    0.293    18390.84     1.000        19.45        6125.3
           28     216.57    432.56    0.285    16034.43     1.000        19.45        5340.5
           29     219.35    434.26    0.280    14172.42     1.000        19.45        4720.3
           30     222.12    436.01    0.277    12360.71     1.000        19.45        4116.9
           31     224.78    437.49    0.264    11187.46     1.000        19.45        3726.2
           32     228.70    439.88    0.241     9063.36     1.000        19.45        3018.7
           33     232.63    442.28    0.215     7082.45     1.000        19.45        2358.9
           34     236.31    444.75    0.182     4991.48     1.000        19.45        1662.5
           35     240.00    447.25    0.146     3108.02     1.000        19.45        1035.2
           36     240.10    447.32    0.146     3058.70     1.000        19.45        1018.7
           37     243.64    449.84    0.102     1358.70     1.000        19.45         452.5
           38     247.18    451.13    0.000-     277.63     1.000        19.45          92.5
           39     250.50    457.51    0.383    -232.57     1.000        19.45         -77.5
           40     253.82    459.80    0.360     -44.59     1.000        19.45         -14.9
           41     254.07    460.00    0.000       0.00     1.000        19.45           0.0

          NOTE: A value of 0.000- for h/H indicates that the line of thrust is at or below
          the lower boundary of the sliding mass. A value of 1.000+ for h/H indicates that
          the line of thrust is at or above the upper boundary of the sliding mass.
↑


             ***Table 2 - Geometry Data on the   41 Slices***


 Slice   Width   Height   X-Cntr    Y-Cntr-Base  Y-Cntr-Top    Alpha   Beta    Base Length
  No.     (ft)    (ft)     (ft)        (ft)         (ft)       (deg)   (deg)       (ft)

   1      2.97     0.14   103.55      399.86       400.00      -5.39    0.00       2.98
   2      2.97     0.42   106.52      399.58       400.00      -5.39    0.00       2.98
   3      4.02     1.63   110.01      399.25       400.88      -5.39   23.53       4.04
   4      5.00     3.87    114.52      398.97      402.84      -2.04   23.53      5.00
   5      5.00     6.22    119.51      398.79      405.01      -2.04   23.53      5.00
   6      4.09     8.24    124.06      398.75      406.99       1.32   23.53      4.09
   7      2.96     9.69    127.58      398.83      408.53       1.32   23.53      2.96
   8      2.96    10.91    130.53      398.90      409.81       1.32   23.53      2.96
   9      4.98    12.40    134.50      399.14      411.54       4.68   23.53      5.00
  10      4.98    14.16    139.49      399.55      413.71       4.68   23.53      5.00
  11      4.95    15.77    144.45      400.10      415.87       8.04   23.53      5.00
  12      4.95    17.23    149.40      400.80      418.03       8.04   23.53      5.00
  13      4.90    18.53    154.33      401.64      420.18      11.40   23.53      5.00
  14      4.90    19.68    159.23      402.63      422.31      11.40   23.53      5.00
  15      4.16    20.61    163.76      403.67      424.28      14.76   23.53      4.30
  16      4.16    21.33    167.92      404.77      426.09      14.76   23.53      4.30
  17      1.35    21.51    170.68      405.49      427.00      14.76    0.00      1.40
  18      3.32    20.78    173.01      406.22      427.00      18.11    0.00      3.50
  19      3.32    19.70    176.34      407.30      427.00      18.11    0.00      3.50
  20      2.86    19.45    179.43      408.31      427.76      18.11   28.02      3.01
  21      4.65    20.06    183.18      409.70      429.76      21.47   28.02      5.00
  22      4.65    20.71    187.84      411.53      432.24      21.47   28.02      5.00
  23      4.54    21.19    192.43      413.49      434.68      24.83   28.02      5.00
  24      4.54    21.51    196.97      415.59      437.10      24.83   28.02      5.00
  25      4.41    21.65    201.44      417.82      439.48      28.19   28.02      5.00
  26      4.41    21.64    205.85      420.18      441.82      28.19   28.02      5.00
  27      4.26    21.46    210.18      422.67      444.13      31.55   28.02      5.00
  28      4.26    21.11    214.44      425.29      446.40      31.55   28.02      5.00
  29      2.77    20.71    217.96      427.56      448.27      34.90   28.02      3.38
  30      2.77    20.25    220.73      429.50      449.74      34.90   28.02      3.38
  31      2.66    19.80    223.45      431.39      451.19      34.90   28.02      3.24
  32      3.93    19.07    226.74      433.87      452.94      38.26   28.02      5.00
  33      3.93    18.07    230.66      436.96      455.03      38.26   28.02      5.00
  34      3.69    16.91    234.47      440.15      457.06      41.62   28.02      4.93
  35      3.69    15.59    238.16      443.43      459.02      41.62   28.02      4.93
  36      0.10    14.89    240.05      445.11      460.00      41.62    0.00      0.14
  37      3.54    13.08    241.87      446.92      460.00      44.98    0.00      5.00
  38      3.54     9.54    245.41      450.46      460.00      44.98    0.00      5.00
  39      3.32     5.91    248.84      454.09      460.00      48.34    0.00      5.00
  40      3.32     2.17    252.16      457.83      460.00      48.34    0.00      5.00
  41      0.24     0.15    253.94      459.85      460.00      51.70    0.00      0.39
```

```
***Table 2A - Coordinates of Slice Points Defining the Slip Surface***


Point           X-Pt            Y-Pt
 No.            (ft)            (ft)

  1          102.064021        400.000000
  2          105.032011        399.719728
  3          108.000000        399.439457
  4          112.019731        399.059867
  5          117.016574        398.882209
  6          122.013416        398.704551
  7          126.099758        398.798856
  8          129.055256        398.867064
  9          132.010754        398.935271
 10          136.994082        399.343254
 11          141.977409        399.751236
 12          146.928279        400.450439
 13          151.879149        401.149642
 14          156.780558        402.137665
 15          161.681967        403.125687
 16          165.840984        404.221069
 17          170.000000        405.316450
 18          171.352196        405.672585
 19          174.676098        406.759870
 20          178.000000        407.847155
 21          180.856621        408.781587
 22          185.509611        410.611802
 23          190.162601        412.442016
 24          194.700387        414.541658
 25          199.238173        416.641300
 26          203.645170        419.003158
 27          208.052168        421.365017
 28          212.313240        423.980979
 29          216.574313        426.596942
 30          219.345430        428.530455
 31          222.116547        430.463968
```

```
  32          224.775339        432.319107
  33          228.701209        435.415483
  34          232.627079        438.511859
  35          236.313540        441.787327
  36          240.000000        445.062795
  37          240.102567        445.153928
  38          243.639347        448.688215
  39          247.176128        452.222502
  40          250.499797        455.957903
  41          253.823466        459.693304
  42          254.065711        460.000000


  ***Table 3 - Force and Pore Pressure Data On The   41 Slices (Excluding Reinforcement)***

                      Ubeta   Ubeta      Ualpha                                Earthquake
                      Force   Stress     Force      Pore                         Force        Distributed
 Slice       Weight    Top     Top        Bot     Pressure         -Uw     Horiz      Vert        Load
   No.       (lbs)    (lbs)   (psf)      (lbs)     (psf)          (psf)    (lbs)      (lbs)       (psf)
   1           49.9     0.0     0.0        0.0      0.00           0.00     0.0        0.0        0.00
   2          149.7     0.0     0.0        0.0      0.00           0.00     0.0        0.0        0.00
   3          784.1     0.0     0.0        0.0      0.00           0.00     0.0        0.0        0.00
   4         2319.0     0.0     0.0        0.0      0.00           0.00     0.0        0.0        0.00
   5         3730.4     0.0     0.0        0.0      0.00           0.00     0.0        0.0        0.00
   6         4040.9     0.0     0.0        0.0      0.00           0.00     0.0        0.0        0.00
   7         3437.6     0.0     0.0        0.0      0.00           0.00     0.0        0.0        0.00
   8         3869.9     0.0     0.0        0.0      0.00           0.00     0.0        0.0        0.00
   9         7416.5     0.0     0.0        0.0      0.00           0.00     0.0        0.0        0.00
  10         8470.2     0.0     0.0        0.0      0.00           0.00     0.0        0.0        0.00
  11         9371.3     0.0     0.0        0.0      0.00           0.00     0.0        0.0        0.00
  12        10236.8     0.0     0.0        0.0      0.00           0.00     0.0        0.0        0.00
  13        10900.1     0.0     0.0        0.0      0.00           0.00     0.0        0.0        0.00
  14        11574.4     0.0     0.0        0.0      0.00           0.00     0.0        0.0        0.00
  15        10286.0     0.0     0.0        0.0      0.00           0.00     0.0        0.0        0.00
  16        10643.2     0.0     0.0        0.0      0.00           0.00     0.0        0.0        0.00
  17         3489.6     0.0     0.0        0.0      0.00           0.00     0.0        0.0        0.00
  18         8290.0     0.0     0.0        0.0      0.00           0.00     0.0        0.0        0.00
  19         7856.3     0.0     0.0        0.0      0.00           0.00     0.0        0.0        0.00
 20        6665.9       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 21       11201.8       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 22       11562.7       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 23       11538.4       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 24       11710.3       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 25       11451.9       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 26       11443.3       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 27       10971.3       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 28       10793.4       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 29        6885.2       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 30        6732.7       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 31        6316.5       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 32        8985.9       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 33        8511.6       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 34        7479.3       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 35        6898.3       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 36         183.3       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 37        5550.9       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 38        4050.9       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 39        2357.1       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 40         867.2       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00
 41           4.5       0.0     0.0        0.0       0.00         0.00     0.0       0.0       0.00

         TOTAL WEIGHT OF SLIDING MASS =  279078.37(lbs)

         EFFECTIVE WEIGHT OF SLIDING MASS =  279078.37(lbs)

         TOTAL AREA OF SLIDING MASS =  2325.65(ft2)
↑


***TABLE 4 - SOIL STRENGTH & SOIL OPTIONS DATA ON THE   41 SLICES***

Slice  Soil   Cohesion   Phi(Deg)   Options
 No.   Type     (psf)
  1      1     200.00     31.00
  2      1     200.00     31.00
  3      1     200.00     31.00
  4      1     200.00     31.00
 5      1     200.00     31.00
 6      1     200.00     31.00
 7      2     200.00     28.00     A
 8      2     200.00     28.00     A
 9      2     200.00     28.00     A
10      2     200.00     28.00     A
11      2     200.00     24.00     A
12      2     200.00     24.00     A
13      2     200.00     24.00     A
14      2     200.00     24.00     A
15      2     200.00     24.00     A
16      2     200.00     24.00     A
17      2     200.00     24.00     A
18      2     200.00     24.00     A
19      2     200.00     24.00     A
20      2     200.00     24.00     A
21      2     200.00     24.00     A
22      2     200.00     24.00     A
23      2     200.00     24.00     A
24      2     200.00     24.00     A
25      2     200.00     24.00     A
26      2     200.00     24.00     A
27      2     200.00     24.00     A
28      2     200.00     24.00     A
29      2     200.00     24.00     A
30      2     200.00     24.00     A
31      1     200.00     31.00
32      1     200.00     31.00
33      1     200.00     31.00
34      1     200.00     31.00
35      1     200.00     31.00
36      1     200.00     31.00
37      1     200.00     31.00
38      1     200.00     31.00
39      1     200.00     31.00
40      1     200.00     31.00
41      1     200.00     31.00

SOIL OPTIONS:
  A = ANISOTROPIC SHEAR STRENGTH
  C = CURVED STRENGTH ENVELOPE (TANGENT PHI & C)
  F = FIBER-REINFORCED SOIL (FRS)
  M = INDEPENDENT MULTI-STAGE SHEAR STRENGTH
  N = NONLINEAR UNDRAINED SHEAR STRENGTH
  R = RAPID DRAWDOWN OR RAPID LOADING (SEISMIC) SHEAR STRENGTH
  S = SHANSEP UNDRAINED SHEAR STRENGTH
  NOTE: Phi and C in Table 4 are modified values based on specified
  Soil Options (if any).



         ***TABLE 5 - Total Base Stress Data on the   41 Slices***

 Slice   Alpha     X-Coord.      Base         Total            Total           Total
  No.    (deg)    Slice Cntr     Leng.     Normal Stress    Vert. Stress    Normal/Vert.
   *                 (ft)        (ft)         (psf)            (psf)        Stress Ratio

   1     -5.39     103.55        2.98           91.70           16.82           5.453
   2     -5.39     106.52        2.98          133.87           50.45           2.654
   3     -5.39     110.01        4.04          315.23          195.07           1.616
   4     -2.04     114.52        5.00          610.35          464.10           1.315
   5     -2.04     119.51        5.00          946.38          746.55           1.268
   6      1.32     124.06        4.09         1166.44          988.88           1.180
   7      1.32     127.58        2.96         1341.87         1163.13           1.154
   8      1.32     130.53        2.96         1504.80         1309.39           1.149
   9      4.68     134.50        5.00         1622.72         1488.25           1.090
  10      4.68     139.49        5.00         1848.12         1699.71           1.087
  11      8.04     144.45        5.00         1937.89         1892.85           1.024
  12      8.04     149.40        5.00         2114.38         2067.67           1.023
  13     11.40     154.33        5.00         2180.29         2223.87           0.980
  14     11.40     159.23        5.00         2314.02         2361.45           0.980
  15     14.76     163.76        4.30         2326.58         2473.18           0.941
  16     14.76     167.92        4.30         2407.02         2559.08           0.941
  17     14.76     170.68        1.40         2427.22         2580.66           0.941
  18     18.11     173.01        3.50         2253.44         2494.05           0.904
  19     18.11     176.34        3.50         2135.71         2363.58           0.904
  20     18.11     179.43        3.01         2108.57         2333.50           0.904
  21     21.47     183.18        5.00         2088.73        2407.45          0.868
  22     21.47     187.84        5.00         2156.17        2485.01          0.868
  23     24.83     192.43        5.00         2117.89        2542.73          0.833
  24     24.83     196.97        5.00         2149.61        2580.61          0.833
  25     28.19     201.44        5.00         2076.30        2598.57          0.799
  26     28.19     205.85        5.00         2074.74        2596.63          0.799
  27     31.55     210.18        5.00         1970.75        2574.78          0.765
  28     31.55     214.44        5.00         1938.38        2533.02          0.765
  29     34.90     217.96        3.38         1817.88        2484.63          0.732
  30     34.90     220.73        3.38         1776.91        2429.60          0.731
  31     34.90     223.45        3.24         1694.22        2375.69          0.713
  32     38.26     226.74        5.00         1548.06        2288.89          0.676
  33     38.26     230.66        5.00         1464.34        2168.07          0.675
  34     41.62     234.47        4.93         1293.77        2028.86          0.638
  35     41.62     238.16        4.93         1189.82        1871.26          0.636
  36     41.62     240.05        0.14         1134.24        1787.00          0.635
  37     44.98     241.87        5.00          931.80        1569.47          0.594
  38     44.98     245.41        5.00          666.25        1145.36          0.582
  39     48.34     248.84        5.00          362.65         709.18          0.511
  40     48.34     252.16        5.00           97.14         260.93          0.372
  41     51.70     253.94        0.39          -53.80          18.40         -2.924


        ***TABLE 5A - Total Base Force Data on the   41 Slices***

 Slice   Alpha     X-Coord.      Base        Total          Total            Total
  No.    (deg)    Slice Cntr     Leng.     Normal Force   Vert. Force      Normal/Vert.
   *                 (ft)        (ft)         (lbs)          (lbs)         Force Ratio

   1     -5.39     103.55        2.98          273.37          49.91          5.477
   2     -5.39     106.52        2.98          399.10         149.73          2.665
   3     -5.39     110.01        4.04         1272.76         784.14          1.623
   4     -2.04     114.52        5.00         3051.73        2319.04          1.316
   5     -2.04     119.51        5.00         4731.92        3730.37          1.268
   6      1.32     124.06        4.09         4767.73        4040.91          1.180
   7      1.32     127.58        2.96         3966.96        3437.62          1.154
   8      1.32     130.53        2.96         4448.61        3869.90          1.150
   9      4.68     134.50        5.00         8113.59        7416.45          1.094
 10      4.68     139.49        5.00         9240.58         8470.23           1.091
 11      8.04     144.45        5.00         9689.46         9371.28           1.034
 12      8.04     149.40        5.00        10571.92        10236.78           1.033
 13     11.40     154.33        5.00        10901.45        10900.10           1.000
 14     11.40     159.23        5.00        11570.11        11574.41           1.000
 15     14.76     163.76        4.30        10006.26        10286.00           0.973
 16     14.76     167.92        4.30        10352.20        10643.25           0.973
 17     14.76     170.68        1.40         3394.01         3489.55           0.973
 18     18.11     173.01        3.50         7880.78         8289.99           0.951
 19     18.11     176.34        3.50         7469.05         7856.30           0.951
 20     18.11     179.43        3.01         6337.47         6665.93           0.951
 21     21.47     183.18        5.00        10443.66        11201.83           0.932
 22     21.47     187.84        5.00        10780.85        11562.74           0.932
 23     24.83     192.43        5.00        10589.45        11538.38           0.918
 24     24.83     196.97        5.00        10748.05        11710.25           0.918
 25     28.19     201.44        5.00        10381.52        11451.91           0.907
 26     28.19     205.85        5.00        10373.69        11443.35           0.907
 27     31.55     210.18        5.00         9853.77        10971.33           0.898
 28     31.55     214.44        5.00         9691.91        10793.40           0.898
 29     34.90     217.96        3.38         6142.61         6885.21           0.892
 30     34.90     220.73        3.38         6004.15         6732.72           0.892
 31     34.90     223.45        3.24         5492.71         6316.47           0.870
 32     38.26     226.74        5.00         7740.29         8985.87           0.861
 33     38.26     230.66        5.00         7321.71         8511.56           0.860
 34     41.62     234.47        4.93         6380.08         7479.32           0.853
 35     41.62     238.16        4.93         5867.48         6898.34           0.851
 36     41.62     240.05        0.14          155.62          183.29           0.849
 37     44.98     241.87        5.00         4658.98         5550.88           0.839
 38     44.98     245.41        5.00         3331.25         4050.88           0.822
 39     48.34     248.84        5.00         1813.26         2357.07           0.769
 40     48.34     252.16        5.00          485.69          867.24           0.560
 41     51.70     253.94        0.39          -21.03            4.46          -4.717


        ***TABLE 6 - Effective and Base Shear Stress Data on the   41 Slices***

Slice    Alpha     X-Coord.     Base       Effective       Available         Mobilized
 No.     (deg)   Slice Cntr     Leng.    Normal Stress   Shear Strength    Shear Stress
 *                 (ft)        (ft)        (psf)          (psf)           (psf)

 1      -5.39     103.55       2.98          91.70         255.10          160.44
 2      -5.39     106.52       2.98         133.87         280.44          176.38
 3      -5.39     110.01       4.04         315.23         389.41          244.91
 4      -2.04     114.52       5.00         610.35         566.73          356.44
 5      -2.04     119.51       5.00         946.38         768.64          483.43
 6       1.32     124.06       4.09        1166.44         900.87          566.59
 7       1.32     127.58       2.96        1341.87         913.49          574.53
 8       1.32     130.53       2.96        1504.80        1000.11          629.01
 9       4.68     134.50       5.00        1622.72        1062.81          668.45
10       4.68     139.49       5.00        1848.12        1182.66          743.82
11       8.04     144.45       5.00        1937.89        1062.81          668.44
12       8.04     149.40       5.00        2114.38        1141.38          717.86
13      11.40     154.33       5.00        2180.29        1170.73          736.32
14      11.40     159.23       5.00        2314.02        1230.27          773.77
15      14.76     163.76       4.30        2326.58        1235.86          777.28
16      14.76     167.92       4.30        2407.02        1271.67          799.81
17      14.76     170.68       1.40        2427.22        1280.67          805.47
18      18.11     173.01       3.50        2253.44        1203.30          756.80
19      18.11     176.34       3.50        2135.71        1150.88          723.84
20      18.11     179.43       3.01        2108.57        1138.80          716.24
21      21.47     183.18       5.00        2088.73        1129.96          710.68
22      21.47     187.84       5.00        2156.17        1159.99          729.57
23      24.83     192.43       5.00        2117.89        1142.95          718.85
24      24.83     196.97       5.00        2149.61        1157.07          727.73
25      28.19     201.44       5.00        2076.30        1124.43          707.20
26      28.19     205.85       5.00        2074.74        1123.73          706.76
27      31.55     210.18       5.00        1970.75        1077.44          677.64
28      31.55     214.44       5.00        1938.38        1063.02          668.58
29      34.90     217.96       3.38        1817.88        1009.37          634.84
30      34.90     220.73       3.38        1776.91         991.13          623.36
31      34.90     223.45       3.24        1694.22        1217.99          766.05
32      38.26     226.74       5.00        1548.06        1130.17          710.81
33      38.26     230.66       5.00        1464.34        1079.87          679.17
34      41.62     234.47       4.93        1293.77         977.37          614.71
35      41.62     238.16       4.93        1189.82         914.92          575.43
36      41.62     240.05       0.14        1134.24         881.52          554.42
37      44.98     241.87       5.00         931.80         759.88          477.92
```

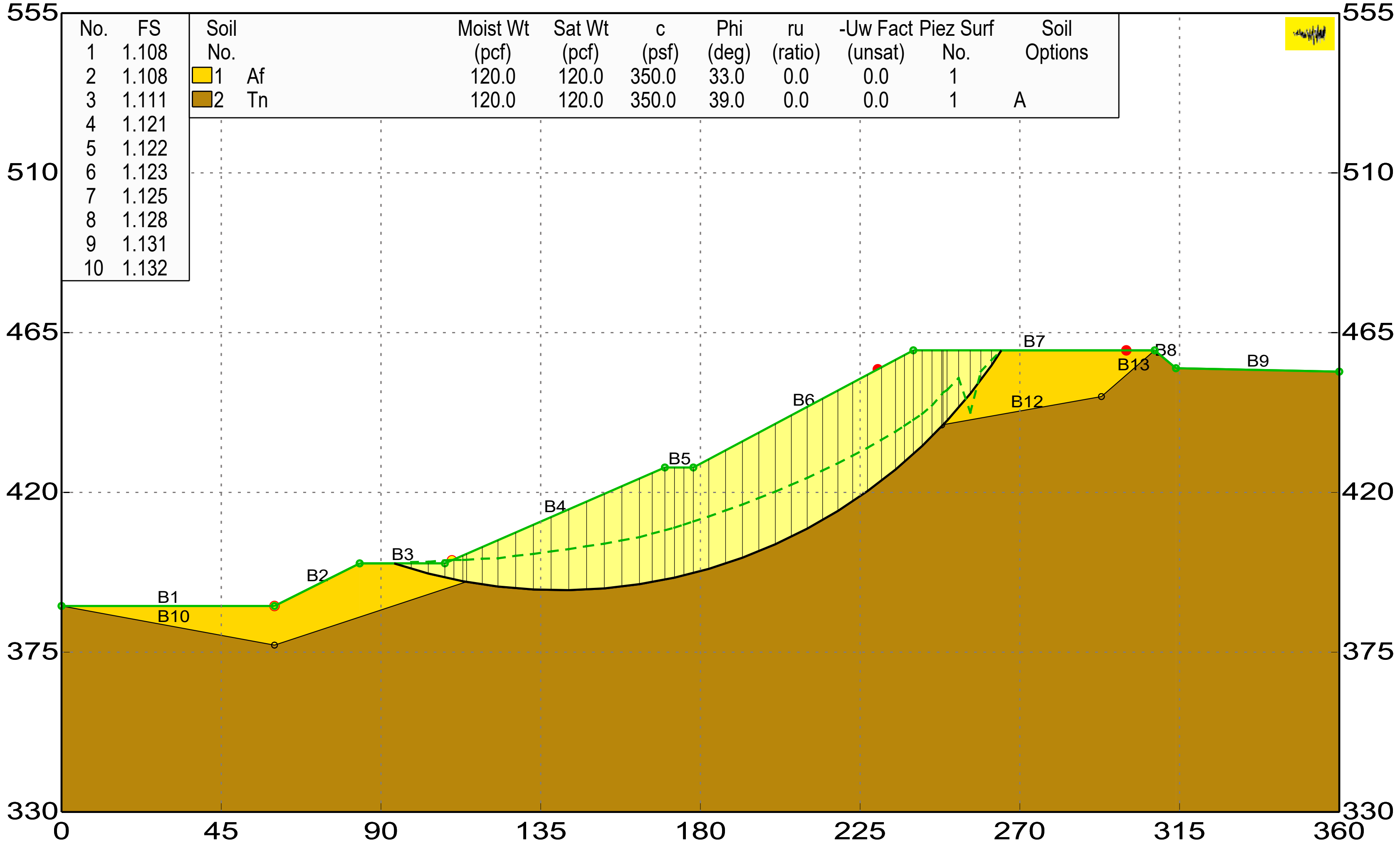
```
   38      44.98     245.41       5.00          666.25          600.32          377.57
   39      48.34     248.84       5.00          362.65          417.90          262.84
   40      48.34     252.16       5.00           97.14          258.37          162.50
   41      51.70     253.94       0.39          -53.80          167.67          105.46


          ***TABLE 6A - Effective and Base Shear Force Data on the   41 Slices***

  Slice     Alpha     X-Coord.      Base       Effective       Available         Mobilized
   No.      (deg)    Slice Cntr     Leng.     Normal Force    Shear Force       Shear Force
    *                   (ft)         (ft)        (lbs)          (lbs)              (lbs)

    1      -5.39     103.55       2.98          273.37          760.50          478.31
    2      -5.39     106.52       2.98          399.10          836.04          525.82
    3      -5.39     110.01       4.04         1272.76         1572.28          988.87
    4      -2.04     114.52       5.00         3051.73         2833.67         1782.21
    5      -2.04     119.51       5.00         4731.92         3843.22         2417.16
    6       1.32     124.06       4.09         4767.73         3682.22         2315.90
    7       1.32     127.58       2.96         3966.96         2700.53         1698.47
    8       1.32     130.53       2.96         4448.61         2956.62         1859.54
    9       4.68     134.50       5.00         8113.59         5314.07         3342.24
   10       4.68     139.49       5.00         9240.58         5913.30         3719.12
   11       8.04     144.45       5.00         9689.46         5314.03         3342.21
   12       8.04     149.40       5.00        10571.92         5706.92         3589.32
   13      11.40     154.33       5.00        10901.45         5853.64         3681.60
   14      11.40     159.23       5.00        11570.11         6151.34         3868.84
   15      14.76     163.76       4.30        10006.26         5315.24         3342.98
   16      14.76     167.92       4.30        10352.20         5469.27         3439.85
   17      14.76     170.68       1.40         3394.01         1790.77         1126.29
   18      18.11     173.01       3.50         7880.78         4208.19         2646.71
   19      18.11     176.34       3.50         7469.05         4024.88         2531.41
   20      18.11     179.43       3.01         6337.47         3422.74         2152.70
   21      21.47     183.18       5.00        10443.66         5649.82         3553.40
   22      21.47     187.84       5.00        10780.85         5799.94         3647.83
   23      24.83     192.43       5.00        10589.45         5714.73         3594.23
   24      24.83     196.97       5.00        10748.05         5785.34         3638.64
   25      28.19     201.44       5.00        10381.52         5622.15         3536.00
   26      28.19     205.85       5.00        10373.69         5618.66         3533.81
```

```
27      31.55     210.18       5.00         9853.77         5387.18         3388.22
28      31.55     214.44       5.00         9691.91         5315.11         3342.90
29      34.90     217.96       3.38         6142.61         3410.66         2145.11
30      34.90     220.73       3.38         6004.15         3349.02         2106.34
31      34.90     223.45       3.24         5492.71         3948.75         2483.54
32      38.26     226.74       5.00         7740.29         5650.83         3554.04
33      38.26     230.66       5.00         7321.71         5399.33         3395.86
34      41.62     234.47       4.93         6380.08         4819.82         3031.39
35      41.62     238.16       4.93         5867.48         4511.82         2837.67
36      41.62     240.05       0.14          155.62          120.95           76.07
37      44.98     241.87       5.00         4658.98         3799.40         2389.60
38      44.98     245.41       5.00         3331.25         3001.61         1887.84
39      48.34     248.84       5.00         1813.26         2089.52         1314.18
40      48.34     252.16       5.00          485.69         1291.83          812.49
41      51.70     253.94       0.39          -21.03           65.53           41.22

   Average Effective Normal Stress = 1565.0769(psf)
   Average Available Shear Strength = 962.6192(psf)
   Total Length of Failure Surface = 170.3908(ft)


   INPUT PARAMETERS FOR SIMPLIFIED 3D ANALYSIS

        Composite Phi (deg)=  31.594
        3D Depth (Vertical difference between ends of Slip Surface) =   60.00(ft)
        L/D(1): L = 60.00(ft) L/D(2): L = 120.00(ft) L/D(3): L = 180.00(ft)
        L/D(4): L = 240.00(ft) L/D(5): L = 300.00(ft) L/D(6): L = 360.00(ft)

   SUM OF MOMENTS =  -0.217357E-03 (ft/lbs);Imbalance (Fraction of Total Weight) =  -0.7788389E-09
   SUM OF FORCES = -.431746E-07 (lbs);Imbalance (Fraction of Total Weight) =   -0.1547042E-12

   Sum of Available Shear Forces =  164021.48(lbs)

   Sum of Mobilized Shear Forces =  103159.93(lbs)

   FS Balance Check: FS =  1.589973

                       **** END OF GEOSTASE OUTPUT ****
```

X-Section B-B' - Freedom Lane
Global Stability of Existing Slope - Pseudo Static

SA Geotechnical, Inc., RS

\02p.gsd



No.	FS
1	1.108
2	1.108
3	1.111
4	1.121
5	1.122
6	1.123
7	1.125
8	1.128
9	1.131
10	1.132

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	-Uw Fact (unsat)	Piez Surf No.	Soil Options
🟨 1	Af	120.0	120.0	350.0	33.0	0.0	0.0	1	
🟫 2	Tn	120.0	120.0	350.0	39.0	0.0	0.0	1	A

GEOSTASE FS = 1.108

Spencer Method

kh = 0.22000

GEOSTASE
Slope Stability
Analysis

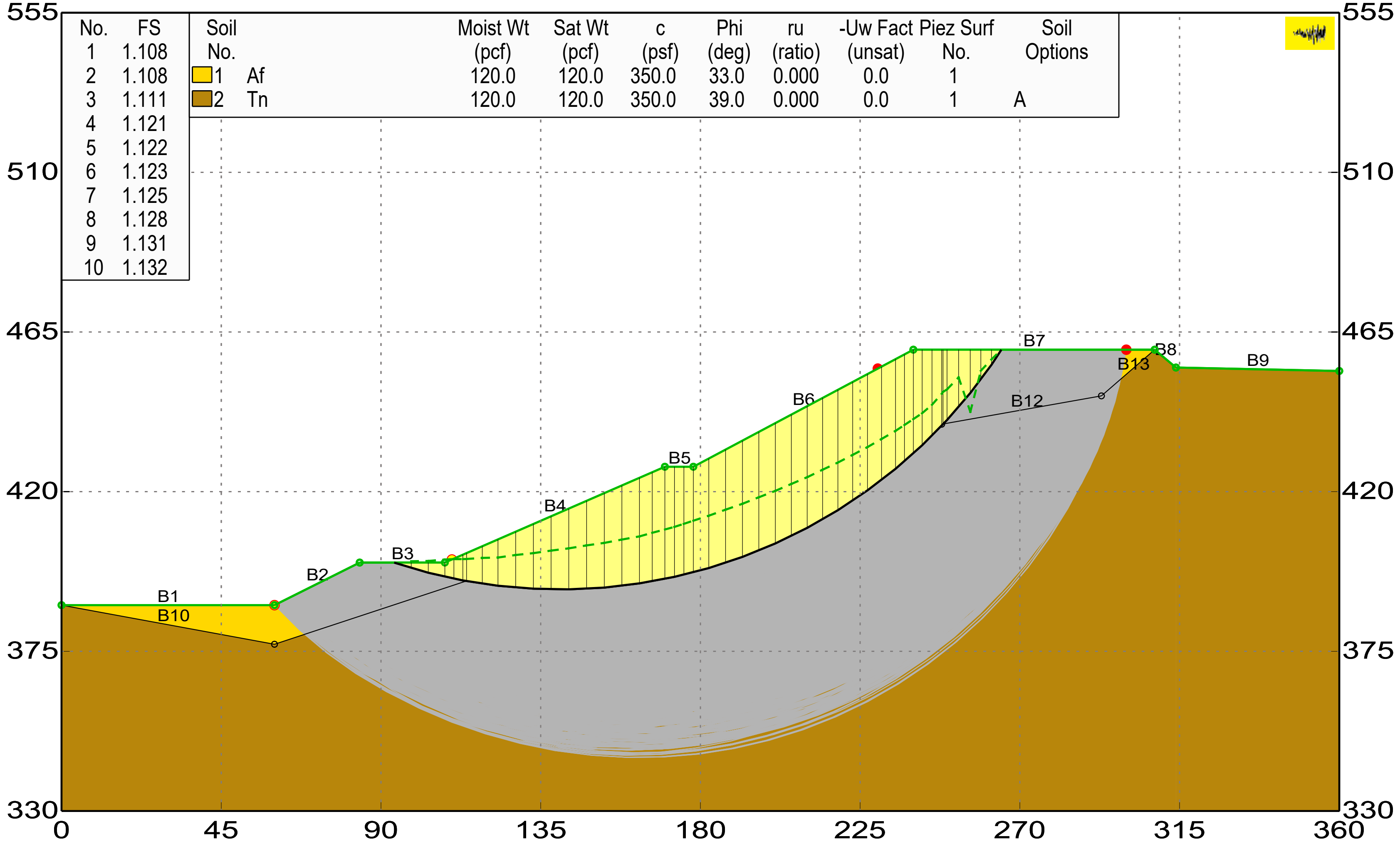
GEOSTASE® v4.30.32 by GREGORY GEOTECHNICAL SOFTWARE

PLATE C.1

X-Section B-B' - Freedom Lane
Global Stability of Existing Slope - Pseudo Static

SA Geotechnical, Inc., RS

\02p.gsd



No.	FS
1	1.108
2	1.108
3	1.111
4	1.121
5	1.122
6	1.123
7	1.125
8	1.128
9	1.131
10	1.132

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	-Uw Fact (unsat)	Piez Surf No.	Soil Options
1	Af	120.0	120.0	350.0	33.0	0.000	0.0	1	
2	Tn	120.0	120.0	350.0	39.0	0.000	0.0	1	A

GEOSTASE FS = 1.108

Spencer Method

kh = 0.22000

GEOSTASE Slope Stability Analysis

```
                              ***  GEOSTASE(R)  ***

           ** GEOSTASE(R) (c)Copyright by Garry H. Gregory, Ph.D.,P.E.,S.E.,BC.GE **

                  ** Current Version 4.30.32-Double Precision, Sept 2023 **
                      (All Rights Reserved-Unauthorized Use Prohibited)


          *********************************************************************************
                         SLOPE STABILITY ANALYSIS SOFTWARE (2D & 3D)
              Simplified Bishop, Simplified Janbu, or General Equilibrium (GE) Options.
                 (Spencer, Morgenstern-Price, USACE, and Lowe & Karafiath)
                 Including Pier/Pile, Planar Reinf,  Nail, Tieback, Line Loads
                 Applied Forces, Fiber-Reinforced Soil (FRS), Distributed Loads
                 Nonlinear Undrained Shear Strength, Curved Strength Envelope,
                 Anisotropic Strengths, Water Surfaces, 3-Stage Rapid Drawdown
                 2- or 3-Stage Pseudo-Static & Simplified Newmark Seismic Analyses.
          *********************************************************************************


          Analysis Date:              6/  3/ 2024
          Analysis Time:
          Analysis By:               SA Geotechnical, Inc., RS


          Input File Name:           C:\Users\Reza Saberi\SA Geotechnical, Inc\SA Geotechnical -
Projects\2024\24064-01 Meritage - 400-700 Freedom Ln, Aliso Viejo\Engineering\Sted\B-B'\02p.gsd

          Output File Name:          C:\Users\Reza Saberi\SA Geotechnical, Inc\SA Geotechnical -
Projects\2024\24064-01 Meritage - 400-700 Freedom Ln, Aliso Viejo\Engineering\Sted\B-B'\02p.OUT

          Unit System:               English


          PROJECT: X-Section B-B' - Freedom Lane

          DESCRIPTION: Global Stability of Existing Slope - Pseudo Static
```

```
 PROFILE BOUNDARY DATA

     9 Surface Boundaries
    13 Total   Boundaries


 Boundary      X - 1       Y - 1       X - 2       Y - 2      Soil Type
    No.        (ft)        (ft)        (ft)        (ft)       Below Bnd

     1           0.000     388.000      60.000     388.000        1
     2          60.000     388.000      84.000     400.000        1
     3          84.000     400.000     108.000     400.000        1
     4         108.000     400.000     170.000     427.000        1
     5         170.000     427.000     178.000     427.000        1
     6         178.000     427.000     240.000     460.000        1
     7         240.000     460.000     308.000     460.000        1
     8         308.000     460.000     314.000     455.000        2
     9         314.000     455.000     360.000     454.000        2
    10           0.000     388.000      60.000     377.000        2
    11          60.000     377.000     248.000     439.000        2
    12         248.000     439.000     293.000     447.000        2
    13         293.000     447.000     308.000     460.000        2

 User Specified X-Origin =         0.000(ft)

 User Specified Y-Origin =       330.000(ft)

 SURFACE BOUNDARY POINT COORDINATES
(Information Only-Not Used Directly)
 Point No.       X-COORD             Y-COORD
    1              0.000               388.000
    2             60.000               388.000
    3             84.000               400.000
    4            108.000               400.000
    5            170.000               427.000
    6            178.000               427.000
    7            240.000               460.000
    8            308.000               460.000
    9            314.000               455.000
```

```
          10             360.000             454.000

        SUBSURFACE BOUNDARY POINT COORDINATES
         (Information Only-Not Used Directly)
        Point No.       X-COORD             Y-COORD
        Surface boundary point    1 and Subsurface boundary point   11 are duplicate points.
          11               0.000             388.000
          12              60.000             377.000
          13             248.000             439.000
          14             293.000             447.000
        Surface boundary point    8 and Subsurface boundary point   15 are duplicate points.
          15             308.000             460.000

     PROFILE BOUNDARY SLOPES AND ANGLES
        BND No.  Slope    Angle(Deg.)
           1      0.000     0.000
           2      0.500    26.565
           3      0.000     0.000
           4      0.435    23.532
           5      0.000     0.000
           6      0.532    28.025
           7      0.000     0.000
           8     -0.833   -39.806
           9     -0.022    -1.245
          10     -0.183   -10.389
          11      0.330    18.252
          12      0.178    10.081
          13      0.867    40.914


       MOHR-COULOMB SOIL PARAMETERS

         2 Type(s) of Soil Defined

     Soil Number           Moist  Saturated  Cohesion Friction    Pore      (-Uw)   Water   Water
         and              Unit Wt. Unit Wt. Intercept   Angle  Pressure    Fact.  Surface  Option
     Description           (pcf)    (pcf)     (psf)     (deg)  Ratio(ru)            No.

1 Af                       120.0    120.0     350.00    33.00    0.000      0.0      1       0
```

```
  2 Tn                       120.0    120.0     350.00    39.00    0.000      0.0      1       0

         ANISOTROPIC STRENGTH PARAMETERS

              1 soil type(s)

          Soil Type  2 Is Anisotropic

          Number Of Direction Ranges Specified =  3


          Direction    Counterclockwise     Cohesion     Friction
            Range       Direction Limit    Intercept       Angle
             No.            (deg)            (psf)         (deg)

              1              -5.0             200.00         34.00
              2               8.0             200.00         28.00
              3              90.0             200.00         24.00

         SEISMIC (EARTHQUAKE) DATA

          Specified Peak Ground Acceleration Coefficient (PGA) =   0.220(g)
          Default Velocity =   1.100(ft) per second
          Specified Horizontal Earthquake Coefficient (kh) =  0.22000(g)
          Specified Vertical Earthquake Coefficient (kv) =   0.000(g)
          (NOTE:Input Velocity = 0.0 will result in default Peak
          Velocity = 2 times(PGA) times 2.5 fps or 0.762 mps)
          Specified Seismic Pore-Pressure Factor =   0.000
          Horizontal Seismic Force is Applied at Center of Gravity of Slices
↑


          TRIAL FAILURE SURFACE DATA

          Circular Trial Failure Surfaces Have Been Generated Using A Random Procedure.

↑
            3000 Trial Surfaces Have Been Generated.
  3000 Surfaces Generated at Increments of 0.2001(in) Equally Spaced Within the Start Range

Along The Specified Surface Between  X =  60.00(ft)
                                and  X = 110.00(ft)

Each Surface ends within a Range Between   X = 230.00(ft)
                                       and   X = 300.00(ft)

All surfaces are generated left to right for both a left and right sliding slope.

Unless XCLUDE Lines Were Specified, The Minimum Elevation
To Which A Surface Extends Is  Y =     330.00(ft)


Specified Maximum Radius = 100000.000(ft)

10.000(ft) Line Segments Were Used For Each Trial Failure Surface.


The Spencer Method Was Selected for FS Analysis.

Selected fx function = Constant (1.0)

SELECTED CONVERGENCE PARAMETERS FOR SPENCER METHOD:
Initial estimate of FS =  1.500
FS tolerance =  0.000001000
Initial estimate of theta(deg) =  15.00
Theta tolerance(radians) =  0.0001000
Minimum theta(deg) = -45.00 ; Maximum theta(deg) =  45.00
Theta convergence Step Factor = 5000.00
Maximum number of iterations = 50
Allowable negative side force = -1000.0(lbs)
Maximum force imbalance  = 100.000000(lbs)
Maximum moment imbalance = 100.000000 (ft/lbs)

Selected Lambda Coefficient =  1.00

Specified Tension Crack Water Depth Factor =   0.000
```

```
Total Number of Trial Surfaces Attempted = 3000

WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
Did Not Converge in 50 Iterations.


Number of Trial Surfaces with Non-Converged FS = 1290

Number of Trial Surfaces With Valid FS = 1710


Percentage of Trial Surfaces With Non-Converged and/or
Non-Valid FS Solutions of the Total Attempted =  43.0 %

Statistical Data On All Valid FS Values:
   FS Max =   1.992   FS Min =   1.108   FS Ave =   1.529
   Standard Deviation =    0.231   Coefficient of Variation =   15.12 %


Critical Surface is Sequence Number    1164 of Those Analyzed.


*****BEGINNING OF DETAILED GEOSTASE OUTPUT FOR CRITICAL SURFACE FROM A SEARCH*****

BACK-CALCULATED CIRCULAR SURFACE PARAMETERS:

Circle Center At X =    140.459292(ft) ; Y =    540.808412(ft); and Radius =    148.360476(ft)

Circular Trial Failure Surface Generated With 21 Coordinate Points

  Point      X-Coord.      Y-Coord.
   No.        (ft)          (ft)

    1         93.72791      400.00000
    2        103.31964      397.17180
    3        113.08010      394.99617
    4        122.96495      393.48299
    5        132.92929      392.63915
    6        142.92783      392.46847
    7        152.91516      392.97174
    8        162.84590      394.14666
    9        172.67493      395.98789
   10        182.35760      398.48707
   11        191.84991      401.63286
   12        201.10875      405.41094
   13        210.09204      409.80417
   14        218.75898      414.79258
   15        227.07018      420.35350
   16        234.98789      426.46168
   17        242.47614      433.08936
   18        249.50090      440.20643
   19        256.03027      447.78056
   20        262.03457      455.77734
   21        264.78078      460.00000


  Iter.     Theta         FS         FS
   No.      (deg)      (Moment)   (Force)
           (fx=1.0)                           Lambda        Delta FS

    1        15.0000    1.291645   1.044096     0.268      0.2475488E+00
    2        19.9500    1.246158   1.076049     0.363      0.1701093E+00
    3        30.8214    0.000000   1.174142     0.597      0.1174142E+01
    4        21.3254    1.218683   1.086005     0.390      0.1326779E+00
    5        22.2912    1.191824   1.093328     0.410      0.9849529E-01
    6        25.0736    1.035421   1.116179     0.468      0.8075842E-01
    7        23.8203    1.127785   1.105543     0.441      0.2224254E-01
    8        24.0912    1.112154   1.107791     0.447      0.4362695E-02
    9        24.1572    1.108064   1.108344     0.449      0.2804869E-03
   10        24.1532    1.108314   1.108311     0.448      0.3299130E-05
   11        24.1533    1.108311   1.108311     0.448      0.4713012E-07


Factor Of Safety For The Preceding Specified Surface =  1.108
Theta (fx = 1.0) =  24.15 Deg    Lambda =   0.448
```

```
The Spencer Method Has Been Selected For Analysis.

Selected fx function = Constant (1.0)

SELECTED CONVERGENCE PARAMETERS FOR ANALYSIS METHOD:
Initial estimate of FS =  1.500
FS tolerance =  0.000001000
Initial estimate of theta(deg) =  15.00
Theta tolerance(radians) =  0.0001000
Minimum theta(deg) = -45.00 ; Maximum theta(deg) =  45.00
Theta convergence Step Factor = 5000.00
Maximum number of iterations = 50
Maximum force imbalance = 100.000000(lbs)
Maximum moment imbalance(if Applicable) = 100.000000 (ft/lbs)


Selected Lambda Coefficient =  1.00

Tension Crack Water Force =        0.00(lbs)

Specified Tension Crack Water Depth Factor =  0.000 (  0.00% Filled )

Depth of Tension Crack (zo) at Side of Last Slice =   0.000(ft)

Depth of Water in Tension Crack =   0.000(ft)

Theoretical Tension Crack Depth =  10.744(ft)


NOTE: In Table 1 following, when a tension crack with water is present on the
first slice (right facing slope) or on the last slice (left facing slope), the
"side force" in the tension crack is set equal to the water pressure resultant.


        *** Table 1 - Line of Thrust(if applicable) and Slice Force Data ***

Slice      X         Y               Side Force     fx    Force Angle  Vert. Shear
 No.     Coord.    Coord.    h/H        (lbs)                (Deg)      Force(lbs)
```

```
  1      98.52    400.37    1.000+    4894.84      1.000        24.15        2002.9
  2     103.32    400.48    1.000+   11231.63      1.000        24.15        4595.8
  3     108.00    400.86    1.000+   17100.76      1.000        24.15        6997.3
  4     110.54    400.96    0.973    20838.81      1.000        24.15        8526.8
  5     113.08    400.94    0.824    25257.79      1.000        24.15       10335.0
  6     114.10    401.01    0.789    26815.38      1.000        24.15       10972.3
  7     118.53    401.31    0.685    33691.61      1.000        24.15       13785.9
  8     122.96    401.39    0.607    42081.26      1.000        24.15       17218.8
  9     127.95    402.15    0.582    48184.21      1.000        24.15       19716.0
 10     132.93    402.70    0.552    55136.77      1.000        24.15       22560.8
 11     137.93    403.41    0.530    61031.69      1.000        24.15       24972.9
 12     142.93    404.01    0.507    67465.54      1.000        24.15       27605.5
 13     147.92    404.82    0.491    72475.38      1.000        24.15       29655.4
 14     152.92    405.55    0.473    77795.07      1.000        24.15       31832.1
 15     157.88    406.51    0.460    81484.57      1.000        24.15       33341.8
 16     162.85    407.41    0.446    85322.29      1.000        24.15       34912.1
 17     166.42    408.40    0.444    85748.77      1.000        24.15       35086.6
 18     170.00    409.36    0.440    86165.79      1.000        24.15       35257.3
 19     172.67    410.07    0.454    86476.10      1.000        24.15       35384.2
 20     175.34    410.92    0.470    85991.47      1.000        24.15       35185.9
 21     178.00    411.79    0.487    85529.81      1.000        24.15       34997.0
 22     182.36    413.20    0.477    84760.36      1.000        24.15       34682.2
 23     187.10    414.92    0.467    82530.99      1.000        24.15       33770.0
 24     191.85    416.59    0.457    80204.95      1.000        24.15       32818.2
 25     196.48    418.42    0.447    76598.27      1.000        24.15       31342.4
 26     201.11    420.22    0.437    72912.87      1.000        24.15       29834.4
 27     205.60    422.17    0.427    68108.16      1.000        24.15       27868.4
 28     210.09    424.09    0.417    63270.93      1.000        24.15       25889.1
 29     214.43    426.16    0.407    57524.76      1.000        24.15       23537.9
 30     218.76    428.20    0.396    51814.92      1.000        24.15       21201.6
 31     222.91    430.39    0.384    45441.37      1.000        24.15       18593.7
 32     227.07    432.55    0.372    39190.11      1.000        24.15       16035.8
 33     231.03    434.85    0.360    32541.06      1.000        24.15       13315.1
 34     234.99    437.13    0.346    26111.82      1.000        24.15       10684.4
 35     237.49    438.77    0.336    21688.83      1.000        24.15        8874.6
 36     240.00    440.42    0.327    17410.69      1.000        24.15        7124.1
 37     242.48    442.10    0.335    13432.57      1.000        24.15        5496.3
 38     245.24    444.48    0.356     9014.69      1.000        24.15        3688.6
 39     248.00    447.58    0.417     5153.60      1.000        24.15        2108.7
```

```
          40     248.38    448.13    0.433     4670.87     1.000        24.15        1911.2
          41     249.50    448.87    0.438     3800.36     1.000        24.15        1555.0
          42     252.77    452.21    0.514     1424.88     1.000        24.15         583.0
          43     256.03    442.52    0.000-    -158.57     1.000        24.15         -64.9
          44     259.03    454.07    0.278     -966.33     1.000        24.15        -395.4
          45     262.03    457.27    0.354     -924.93     1.000        24.15        -378.5
          46     264.78    460.00    0.000        0.01     1.000        24.15           0.0

         NOTE: A value of 0.000- for h/H indicates that the line of thrust is at or below
         the lower boundary of the sliding mass. A value of 1.000+ for h/H indicates that
         the line of thrust is at or above the upper boundary of the sliding mass.



              ***Table 2 - Geometry Data on the   46 Slices***


 Slice   Width   Height   X-Cntr    Y-Cntr-Base  Y-Cntr-Top    Alpha   Beta   Base Length
  No.     (ft)    (ft)     (ft)        (ft)         (ft)        (deg)   (deg)      (ft)

   1      4.80     0.71     96.13      399.29       400.00      -16.43    0.00       5.00
   2      4.80     2.12    100.92      397.88       400.00      -16.43    0.00       5.00
   3      4.68     3.35    105.66      396.65       400.00      -12.57    0.00       4.80
   4      2.54     4.71    109.27      395.85       400.55      -12.57   23.53       2.60
   5      2.54     6.38    111.81      395.28       401.66      -12.57   23.53       2.60
   6      1.02     7.52    113.59      394.92       402.43       -8.70   23.53       1.03
   7      4.43     9.12    116.31      394.50       403.62       -8.70   23.53       4.49
   8      4.43    11.73    120.75      393.82       405.55       -8.70   23.53       4.49
   9      4.98    14.33    125.46      393.27       407.60       -4.84   23.53       5.00
  10      4.98    16.92    130.44      392.85       409.77       -4.84   23.53       5.00
  11      5.00    19.35    135.43      392.60       411.94       -0.98   23.53       5.00
  12      5.00    21.61    140.43      392.51       414.12       -0.98   23.53       5.00
  13      4.99    23.70    145.42      392.59       416.30        2.88   23.53       5.00
  14      4.99    25.63    150.42      392.85       418.47        2.88   23.53       5.00
  15      4.97    27.38    155.40      393.27       420.64        6.75   23.53       5.00
  16      4.97    28.95    160.36      393.85       422.80        6.75   23.53       5.00
  17      3.58    30.18    164.63      394.48       424.66       10.61   23.53       3.64
  18      3.58    31.07    168.21      395.15       426.22       10.61   23.53       3.64
  19      2.67    31.26    171.34      395.74       427.00       10.61    0.00       2.72
 20      2.66    30.67    174.01      396.33      427.00      14.47    0.00      2.75
 21      2.66    29.98    176.67      397.02      427.00      14.47    0.00      2.75
 22      4.36    30.23    180.18      397.92      428.16      14.47   28.02      4.50
 23      4.75    31.31    184.73      399.27      430.58      18.34   28.02      5.00
 24      4.75    32.26    189.48      400.85      433.11      18.34   28.02      5.00
 25      4.63    33.03    194.16      402.58      435.60      22.20   28.02      5.00
 26      4.63    33.60    198.79      404.47      438.07      22.20   28.02      5.00
 27      4.49    33.99    203.35      406.51      440.50      26.06   28.02      5.00
 28      4.49    34.18    207.85      408.71      442.89      26.06   28.02      5.00
 29      4.33    34.18    212.26      411.05      445.23      29.92   28.02      5.00
 30      4.33    34.00    216.59      413.55      447.54      29.92   28.02      5.00
 31      4.16    33.62    220.84      416.18      449.80      33.79   28.02      5.00
 32      4.16    33.05    224.99      418.96      452.01      33.79   28.02      5.00
 33      3.96    32.29    229.05      421.88      454.17      37.65   28.02      5.00
 34      3.96    31.34    233.01      424.93      456.28      37.65   28.02      5.00
 35      2.51    30.43    236.24      427.57      458.00      41.51   28.02      3.35
 36      2.51    29.54    238.75      429.79      459.33      41.51   28.02      3.35
 37      2.48    28.01    241.24      431.99      460.00      41.51    0.00      3.31
 38      2.76    25.51    243.86      434.49      460.00      45.37    0.00      3.93
 39      2.76    22.71    246.62      437.29      460.00      45.37    0.00      3.93
 40      0.38    21.12    248.19      438.88      460.00      45.37    0.00      0.54
 41      1.12    20.36    248.94      439.64      460.00      45.37    0.00      1.60
 42      3.26    17.90    251.13      442.10      460.00      49.24    0.00      5.00
 43      3.26    14.11    254.40      445.89      460.00      49.24    0.00      5.00
 44      3.00    10.22    257.53      449.78      460.00      53.10    0.00      5.00
 45      3.00     6.22    260.53      453.78      460.00      53.10    0.00      5.00
 46      2.75     2.11    263.41      457.89      460.00      56.96    0.00      5.04
↑


***Table 2A - Coordinates of Slice Points Defining the Slip Surface***


Point           X-Pt            Y-Pt
 No.            (ft)            (ft)

  1        93.727909      400.000000
  2        98.523774      398.585899
  3       103.319638      397.171797
 4           108.000000        396.128533
 5           110.540051        395.562350
 6           113.080101        394.996167
 7           114.096999        394.840500
 8           118.530976        394.161746
 9           122.964953        393.482993
10           127.947120        393.061072
11           132.929286        392.639151
12           137.928558        392.553812
13           142.927830        392.468474
14           147.921494        392.720105
15           152.915158        392.971737
16           157.880527        393.559196
17           162.845897        394.146655
18           166.422948        394.816730
19           170.000000        395.486805
20           172.674928        395.987889
21           175.337464        396.675114
22           178.000000        397.362339
23           182.357597        398.487075
24           187.103754        400.059966
25           191.849912        401.632857
26           196.479330        403.521900
27           201.108749        405.410944
28           205.600395        407.607557
29           210.092042        409.804171
30           214.425510        412.298375
31           218.758978        414.792579
32           222.914580        417.573042
33           227.070182        420.353505
34           231.029038        423.407594
35           234.987894        426.461683
36           237.493947        428.679734
37           240.000000        430.897786
38           242.476141        433.089363
39           245.238071        435.887586
40           248.000000        438.685808
41           248.376114        439.066865
42           249.500904        440.206435
```

```
  43          252.765586        443.993499
  44          256.030267        447.780563
  45          259.032417        451.778950
  46          262.034566        455.777337
  47          264.780782        460.000000
↑


  ***Table 3 - Force and Pore Pressure Data On The   46 Slices (Excluding Reinforcement)***

                            Ubeta    Ubeta      Ualpha                              Earthquake
                            Force    Stress     Force      Pore                         Force           Distributed
 Slice          Weight       Top      Top        Bot      Pressure        -Uw     Horiz       Vert         Load
   No.          (lbs)       (lbs)    (psf)      (lbs)      (psf)         (psf)    (lbs)      (lbs)        (psf)
   1             406.9        0.0      0.0        0.0       0.00          0.00     89.5        0.0         0.00
   2            1220.7        0.0      0.0        0.0       0.00          0.00    268.6        0.0         0.00
   3            1881.4        0.0      0.0        0.0       0.00          0.00    413.9        0.0         0.00
   4            1434.9        0.0      0.0        0.0       0.00          0.00    315.7        0.0         0.00
   5            1944.7        0.0      0.0        0.0       0.00          0.00    427.8        0.0         0.00
   6             917.1        0.0      0.0        0.0       0.00          0.00    201.8        0.0         0.00
   7            4852.3        0.0      0.0        0.0       0.00          0.00   1067.5        0.0         0.00
   8            6240.8        0.0      0.0        0.0       0.00          0.00   1373.0        0.0         0.00
   9            8567.2        0.0      0.0        0.0       0.00          0.00   1884.8        0.0         0.00
  10           10116.6        0.0      0.0        0.0       0.00          0.00   2225.7        0.0         0.00
  11           11607.3        0.0      0.0        0.0       0.00          0.00   2553.6        0.0         0.00
  12           12964.6        0.0      0.0        0.0       0.00          0.00   2852.2        0.0         0.00
  13           14204.1        0.0      0.0        0.0       0.00          0.00   3124.9        0.0         0.00
  14           15356.5        0.0      0.0        0.0       0.00          0.00   3378.4        0.0         0.00
  15           16311.6        0.0      0.0        0.0       0.00          0.00   3588.5        0.0         0.00
  16           17249.9        0.0      0.0        0.0       0.00          0.00   3795.0        0.0         0.00
  17           12955.4        0.0      0.0        0.0       0.00          0.00   2850.2        0.0         0.00
  18           13336.4        0.0      0.0        0.0       0.00          0.00   2934.0        0.0         0.00
  19           10035.0        0.0      0.0        0.0       0.00          0.00   2207.7        0.0         0.00
  20            9798.7        0.0      0.0        0.0       0.00          0.00   2155.7        0.0         0.00
  21            9579.1        0.0      0.0        0.0       0.00          0.00   2107.4        0.0         0.00
  22           15810.2        0.0      0.0        0.0       0.00          0.00   3478.2        0.0         0.00
  23           17831.7        0.0      0.0        0.0       0.00          0.00   3923.0        0.0         0.00
  24           18374.6        0.0      0.0        0.0       0.00          0.00   4042.4        0.0         0.00
  25           18347.1        0.0      0.0        0.0       0.00          0.00   4036.4        0.0         0.00
 26      18666.6       0.0     0.0        0.0       0.00         0.00  4106.6       0.0       0.00
 27      18318.3       0.0     0.0        0.0       0.00         0.00  4030.0       0.0       0.00
 28      18423.0       0.0     0.0        0.0       0.00         0.00  4053.0       0.0       0.00
 29      17775.8       0.0     0.0        0.0       0.00         0.00  3910.7       0.0       0.00
 30      17678.2       0.0     0.0        0.0       0.00         0.00  3889.2       0.0       0.00
 31      16764.1       0.0     0.0        0.0       0.00         0.00  3688.1       0.0       0.00
 32      16480.5       0.0     0.0        0.0       0.00         0.00  3625.7       0.0       0.00
 33      15340.3       0.0     0.0        0.0       0.00         0.00  3374.9       0.0       0.00
 34      14890.4       0.0     0.0        0.0       0.00         0.00  3275.9       0.0       0.00
 35       9150.6       0.0     0.0        0.0       0.00         0.00  2013.1       0.0       0.00
 36       8884.8       0.0     0.0        0.0       0.00         0.00  1954.6       0.0       0.00
 37       8321.7       0.0     0.0        0.0       0.00         0.00  1830.8       0.0       0.00
 38       8455.3       0.0     0.0        0.0       0.00         0.00  1860.2       0.0       0.00
 39       7527.9       0.0     0.0        0.0       0.00         0.00  1656.1       0.0       0.00
 40        953.4       0.0     0.0        0.0       0.00         0.00   209.7       0.0       0.00
 41       2748.5       0.0     0.0        0.0       0.00         0.00   604.7       0.0       0.00
 42       7012.5       0.0     0.0        0.0       0.00         0.00  1542.8       0.0       0.00
 43       5528.9       0.0     0.0        0.0       0.00         0.00  1216.4       0.0       0.00
 44       3681.9       0.0     0.0        0.0       0.00         0.00   810.0       0.0       0.00
 45       2241.5       0.0     0.0        0.0       0.00         0.00   493.1       0.0       0.00
 46        695.8       0.0     0.0        0.0       0.00         0.00   153.1       0.0       0.00

         TOTAL WEIGHT OF SLIDING MASS =  470885.03(lbs)

         EFFECTIVE WEIGHT OF SLIDING MASS =  470885.03(lbs)

         TOTAL AREA OF SLIDING MASS =  3924.04(ft2)
↑


***TABLE 4 - SOIL STRENGTH & SOIL OPTIONS DATA ON THE   46 SLICES***

Slice  Soil   Cohesion   Phi(Deg)   Options
 No.   Type     (psf)
  1      1     350.00     33.00
  2      1     350.00     33.00
  3      1     350.00     33.00
  4      1     350.00     33.00
  5      1     350.00     33.00
  6       1     350.00     33.00
  7       2     200.00     34.00     A
  8       2     200.00     34.00     A
  9       2     200.00     28.00     A
 10       2     200.00     28.00     A
 11       2     200.00     28.00     A
 12       2     200.00     28.00     A
 13       2     200.00     28.00     A
 14       2     200.00     28.00     A
 15       2     200.00     28.00     A
 16       2     200.00     28.00     A
 17       2     200.00     24.00     A
 18       2     200.00     24.00     A
 19       2     200.00     24.00     A
 20       2     200.00     24.00     A
 21       2     200.00     24.00     A
 22       2     200.00     24.00     A
 23       2     200.00     24.00     A
 24       2     200.00     24.00     A
 25       2     200.00     24.00     A
 26       2     200.00     24.00     A
 27       2     200.00     24.00     A
 28       2     200.00     24.00     A
 29       2     200.00     24.00     A
 30       2     200.00     24.00     A
 31       2     200.00     24.00     A
 32       2     200.00     24.00     A
 33       2     200.00     24.00     A
 34       2     200.00     24.00     A
 35       2     200.00     24.00     A
 36       2     200.00     24.00     A
 37       2     200.00     24.00     A
 38       2     200.00     24.00     A
 39       2     200.00     24.00     A
 40       2     200.00     24.00     A
 41       1     350.00     33.00
 42       1     350.00     33.00
 43       1     350.00     33.00
 44       1     350.00     33.00
```

```
  45      1     350.00     33.00
  46      1     350.00     33.00

  SOIL OPTIONS:
  A = ANISOTROPIC SHEAR STRENGTH
  C = CURVED STRENGTH ENVELOPE (TANGENT PHI & C)
  F = FIBER-REINFORCED SOIL (FRS)
  M = INDEPENDENT MULTI-STAGE SHEAR STRENGTH
  N = NONLINEAR UNDRAINED SHEAR STRENGTH
  R = RAPID DRAWDOWN OR RAPID LOADING (SEISMIC) SHEAR STRENGTH
  S = SHANSEP UNDRAINED SHEAR STRENGTH
  NOTE: Phi and C in Table 4 are modified values based on specified
  Soil Options (if any).



         ***TABLE 5 - Total Base Stress Data on the   46 Slices***

 Slice   Alpha     X-Coord.      Base         Total            Total           Total
  No.    (deg)    Slice Cntr     Leng.     Normal Stress    Vert. Stress    Normal/Vert.
   *                (ft)         (ft)          (psf)           (psf)        Stress Ratio

   1    -16.43      96.13        5.00          719.98           84.85           8.486
   2    -16.43     100.92        5.00         1073.83          254.54           4.219
   3    -12.57     105.66        4.80         1133.53          401.98           2.820
   4    -12.57     109.27        2.60         1423.38          564.92           2.520
   5    -12.57     111.81        2.60         1780.38          765.60           2.325
   6     -8.70     113.59        1.03         1732.31          901.85           1.921
   7     -8.70     116.31        4.49         1936.97         1094.34           1.770
   8     -8.70     120.75        4.49         2436.32         1407.50           1.731
   9     -4.84     125.46        5.00         2330.78         1719.57           1.355
  10     -4.84     130.44        5.00         2727.67         2030.56           1.343
  11     -0.98     135.43        5.00         2830.55         2321.80           1.219
  12     -0.98     140.43        5.00         3148.76         2593.30           1.214
  13      2.88     145.42        5.00         3169.22         2844.43           1.114
  14      2.88     150.42        5.00         3419.33         3075.19           1.112
  15      6.75     155.40        5.00         3376.13         3285.06           1.028
  16      6.75     160.36        5.00         3566.52         3474.05           1.027
  17     10.61     164.63        3.64         3382.26         3621.80           0.934
  18     10.61     168.21        3.64         3480.32         3728.32           0.933
  19     10.61     171.34        2.72         3501.67         3751.52           0.933
  20     14.47     174.01        2.75         3224.79         3680.22           0.876
  21     14.47     176.67        2.75         3153.27         3597.75           0.876
  22     14.47     180.18        4.50         3179.68         3628.20           0.876
  23     18.34     184.73        5.00         3093.26         3757.07           0.823
  24     18.34     189.48        5.00         3186.86         3871.47           0.823
  25     22.20     194.16        5.00         3067.86         3963.16           0.774
  26     22.20     198.79        5.00         3121.16         4032.16           0.774
  27     26.06     203.35        5.00         2969.07         4078.31           0.728
  28     26.06     207.85        5.00         2986.06         4101.60           0.728
  29     29.92     212.26        5.00         2806.62         4101.99           0.684
  30     29.92     216.59        5.00         2791.11         4079.47           0.684
  31     33.79     220.84        5.00         2589.71         4034.09           0.642
  32     33.79     224.99        5.00         2545.42         3965.86           0.642
  33     37.65     229.05        5.00         2327.24         3874.92           0.601
  34     37.65     233.01        5.00         2257.84         3761.29           0.600
  35     41.51     236.24        3.35         2043.10         3651.42           0.560
  36     41.51     238.75        3.35         1982.28         3545.32           0.559
  37     41.51     241.24        3.31         1876.49         3360.77           0.558
  38     45.37     243.86        3.93         1580.71         3061.38           0.516
  39     45.37     246.62        3.93         1400.68         2725.60           0.514
  40     45.37     248.19        0.54         1298.41         2534.84           0.512
  41     45.37     248.94        1.60         1133.87         2443.60           0.464
  42     49.24     251.13        5.00          883.46         2148.00           0.411
  43     49.24     254.40        5.00          672.01         1693.56           0.397
  44     53.10     257.53        5.00          390.78         1226.43           0.319
  45     53.10     260.53        5.00          186.29          746.62           0.250
  46     56.96     263.41        5.04          -49.66          253.36          -0.196
↑


         ***TABLE 5A - Total Base Force Data on the   46 Slices***

 Slice   Alpha     X-Coord.      Base         Total            Total           Total
  No.    (deg)    Slice Cntr     Leng.     Normal Force    Vert. Force      Normal/Vert.
   *                 (ft)        (ft)          (lbs)           (lbs)        Force Ratio
  1    -16.43     96.13        5.00         3599.88         406.91         8.847
  2    -16.43    100.92        5.00         5369.14        1220.73         4.398
  3    -12.57    105.66        4.80         5435.51        1881.41         2.889
  4    -12.57    109.27        2.60         3704.19        1434.92         2.581
  5    -12.57    111.81        2.60         4633.23        1944.65         2.383
  6     -8.70    113.59        1.03         1782.11         917.09         1.943
  7     -8.70    116.31        4.49         8688.54        4852.27         1.791
  8     -8.70    120.75        4.49        10928.41        6240.82         1.751
  9     -4.84    125.46        5.00        11653.90        8567.21         1.360
 10     -4.84    130.44        5.00        13638.36       10116.61         1.348
 11     -0.98    135.43        5.00        14152.76       11607.33         1.219
 12     -0.98    140.43        5.00        15743.80       12964.60         1.214
 13      2.88    145.42        5.00        15846.11       14204.11         1.116
 14      2.88    150.42        5.00        17096.65       15356.46         1.113
 15      6.75    155.40        5.00        16880.63       16311.55         1.035
 16      6.75    160.36        5.00        17832.59       17249.94         1.034
 17     10.61    164.63        3.64        12308.96       12955.37         0.950
 18     10.61    168.21        3.64        12665.83       13336.40         0.950
 19     10.61    171.34        2.72         9529.65       10035.04         0.950
 20     14.47    174.01        2.75         8867.53        9798.72         0.905
 21     14.47    176.67        2.75         8670.86        9579.15         0.905
 22     14.47    180.18        4.50        14309.85       15810.22         0.905
 23     18.34    184.73        5.00        15466.31       17831.66         0.867
 24     18.34    189.48        5.00        15934.30       18374.59         0.867
 25     22.20    194.16        5.00        15339.29       18347.15         0.836
 26     22.20    198.79        5.00        15605.81       18666.58         0.836
 27     26.06    203.35        5.00        14845.33       18318.33         0.810
 28     26.06    207.85        5.00        14930.28       18422.95         0.810
 29     29.92    212.26        5.00        14033.09       17775.84         0.789
 30     29.92    216.59        5.00        13955.56       17678.24         0.789
 31     33.79    220.84        5.00        12948.53       16764.07         0.772
 32     33.79    224.99        5.00        12727.10       16480.52         0.772
 33     37.65    229.05        5.00        11636.22       15340.26         0.759
 34     37.65    233.01        5.00        11289.19       14890.39         0.758
 35     41.51    236.24        3.35         6837.55        9150.65         0.747
 36     41.51    238.75        3.35         6633.99        8884.75         0.747
 37     41.51    241.24        3.31         6204.98        8321.74         0.746
 38     45.37    243.86        3.93         6214.87        8455.32         0.735
 39     45.37    246.62        3.93         5507.05        7527.90         0.732
```

```
  40     45.37     248.19        0.54          695.18          953.39          0.729
  41     45.37     248.94        1.60         1815.52         2748.54          0.661
  42     49.24     251.13        5.00         4417.29         7012.55          0.630
  43     49.24     254.40        5.00         3360.03         5528.92          0.608
  44     53.10     257.53        5.00         1953.92         3681.92          0.531
  45     53.10     260.53        5.00          931.47         2241.47          0.416
  46     56.96     263.41        5.04         -250.15          695.78         -0.360


         ***TABLE 6 - Effective and Base Shear Stress Data on the   46 Slices***

 Slice    Alpha     X-Coord.      Base       Effective       Available         Mobilized
  No.     (deg)    Slice Cntr     Leng.    Normal Stress   Shear Strength    Shear Stress
   *                  (ft)         (ft)        (psf)           (psf)            (psf)

   1     -16.43      96.13        5.00          719.98          817.56          737.66
   2     -16.43     100.92        5.00         1073.83         1047.35          945.00
   3     -12.57     105.66        4.80         1133.53         1086.12          979.98
   4     -12.57     109.27        2.60         1423.38         1274.35         1149.82
   5     -12.57     111.81        2.60         1780.38         1506.19         1359.00
   6      -8.70     113.59        1.03         1732.31         1474.98         1330.83
   7      -8.70     116.31        4.49         1936.97         1506.51         1359.28
   8      -8.70     120.75        4.49         2436.32         1843.32         1663.18
   9      -4.84     125.46        5.00         2330.78         1439.30         1298.64
  10      -4.84     130.44        5.00         2727.67         1650.33         1489.05
  11      -0.98     135.43        5.00         2830.55         1705.03         1538.40
  12      -0.98     140.43        5.00         3148.76         1874.23         1691.06
  13       2.88     145.42        5.00         3169.22         1885.11         1700.88
  14       2.88     150.42        5.00         3419.33         2018.09         1820.87
  15       6.75     155.40        5.00         3376.13         1995.12         1800.14
  16       6.75     160.36        5.00         3566.52         2096.35         1891.48
  17      10.61     164.63        3.64         3382.26         1705.88         1539.17
  18      10.61     168.21        3.64         3480.32         1749.54         1578.56
  19      10.61     171.34        2.72         3501.67         1759.05         1587.14
  20      14.47     174.01        2.75         3224.79         1635.77         1475.91
  21      14.47     176.67        2.75         3153.27         1603.93         1447.18
  22      14.47     180.18        4.50         3179.68         1615.68         1457.79
  23      18.34     184.73        5.00         3093.26         1577.21         1423.07
 24      18.34     189.48       5.00         3186.86         1618.88         1460.67
 25      22.20     194.16       5.00         3067.86         1565.90         1412.87
 26      22.20     198.79       5.00         3121.16         1589.63         1434.28
 27      26.06     203.35       5.00         2969.07         1521.91         1373.18
 28      26.06     207.85       5.00         2986.06         1529.48         1380.01
 29      29.92     212.26       5.00         2806.62         1449.59         1307.92
 30      29.92     216.59       5.00         2791.11         1442.68         1301.70
 31      33.79     220.84       5.00         2589.71         1353.01         1220.79
 32      33.79     224.99       5.00         2545.42         1333.29         1203.00
 33      37.65     229.05       5.00         2327.24         1236.16         1115.35
 34      37.65     233.01       5.00         2257.84         1205.25         1087.47
 35      41.51     236.24       3.35         2043.10         1109.65         1001.21
 36      41.51     238.75       3.35         1982.28         1082.57          976.77
 37      41.51     241.24       3.31         1876.49         1035.47          934.27
 38      45.37     243.86       3.93         1580.71          903.78          815.45
 39      45.37     246.62       3.93         1400.68          823.62          743.13
 40      45.37     248.19       0.54         1298.41          778.09          702.05
 41      45.37     248.94       1.60         1133.87         1086.34          980.18
 42      49.24     251.13       5.00          883.46          923.72          833.45
 43      49.24     254.40       5.00          672.01          786.41          709.55
 44      53.10     257.53       5.00          390.78          603.78          544.77
 45      53.10     260.53       5.00          186.29          470.98          424.95
 46      56.96     263.41       5.04          -49.66          317.75          286.70
↑


        ***TABLE 6A - Effective and Base Shear Force Data on the   46 Slices***

Slice    Alpha     X-Coord.     Base       Effective       Available         Mobilized
 No.     (deg)   Slice Cntr     Leng.     Normal Force    Shear Force       Shear Force
  *                 (ft)         (ft)        (lbs)           (lbs)             (lbs)

  1     -16.43      96.13       5.00         3599.88         4087.79         3688.30
  2     -16.43     100.92       5.00         5369.14         5236.76         4724.99
  3     -12.57     105.66       4.80         5435.51         5208.19         4699.22
  4     -12.57     109.27       2.60         3704.19         3316.36         2992.27
  5     -12.57     111.81       2.60         4633.23         3919.69         3536.64
  6      -8.70     113.59       1.03         1782.11         1517.37         1369.09
  7      -8.70     116.31       4.49         8688.54         6757.62         6097.23
  8     -8.70    120.75      4.49      10928.41       8268.43        7460.39
  9     -4.84    125.46      5.00      11653.90       7196.49        6493.20
 10     -4.84    130.44      5.00      13638.36       8251.64        7445.24
 11     -0.98    135.43      5.00      14152.76       8525.15        7692.02
 12     -0.98    140.43      5.00      15743.80       9371.13        8455.32
 13      2.88    145.42      5.00      15846.11       9425.53        8504.41
 14      2.88    150.42      5.00      17096.65      10090.45        9104.35
 15      6.75    155.40      5.00      16880.63       9975.59        9000.71
 16      6.75    160.36      5.00      17832.59      10481.76        9457.42
 17     10.61    164.63      3.64      12308.96       6208.16        5601.46
 18     10.61    168.21      3.64      12665.83       6367.05        5744.82
 19     10.61    171.34      2.72       9529.65       4787.17        4319.33
 20     14.47    174.01      2.75       8867.53       4498.04        4058.46
 21     14.47    176.67      2.75       8670.86       4410.47        3979.45
 22     14.47    180.18      4.50      14309.85       7271.24        6560.65
 23     18.34    184.73      5.00      15466.31       7886.04        7115.37
 24     18.34    189.48      5.00      15934.30       8094.41        7303.37
 25     22.20    194.16      5.00      15339.29       7829.49        7064.35
 26     22.20    198.79      5.00      15605.81       7948.15        7171.41
 27     26.06    203.35      5.00      14845.33       7609.57        6865.91
 28     26.06    207.85      5.00      14930.28       7647.39        6900.04
 29     29.92    212.26      5.00      14033.09       7247.94        6539.62
 30     29.92    216.59      5.00      13955.56       7213.42        6508.48
 31     33.79    220.84      5.00      12948.53       6765.06        6103.94
 32     33.79    224.99      5.00      12727.10       6666.47        6014.98
 33     37.65    229.05      5.00      11636.22       6180.78        5576.75
 34     37.65    233.01      5.00      11289.19       6026.27        5437.35
 35     41.51    236.24      3.35       6837.55       3713.60        3350.69
 36     41.51    238.75      3.35       6633.99       3622.97        3268.91
 37     41.51    241.24      3.31       6204.98       3423.98        3089.37
 38     45.37    243.86      3.93       6214.87       3553.38        3206.12
 39     45.37    246.62      3.93       5507.05       3238.24        2921.78
 40     45.37    248.19      0.54        695.18        416.60         375.89
 41     45.37    248.94      1.60       1815.52       1739.43        1569.44
 42     49.24    251.13      5.00       4417.29       4618.62        4167.26
 43     49.24    254.40      5.00       3360.03       3932.03        3547.77
 44     53.10    257.53      5.00       1953.92       3018.89        2723.87
 45     53.10    260.53      5.00        931.47       2354.90        2124.77
 46     56.96    263.41      5.04       -250.15       1600.54        1444.13
```

```
Average Effective Normal Stress = 2288.6476(psf)
Average Available Shear Strength = 1371.6376(psf)
Total Length of Failure Surface = 195.0371(ft)


INPUT PARAMETERS FOR SIMPLIFIED 3D ANALYSIS

     Composite Phi (deg)=  30.935
     3D Depth (Vertical difference between ends of Slip Surface) =   60.00(ft)
     L/D(1): L = 60.00(ft) L/D(2): L = 120.00(ft) L/D(3): L = 180.00(ft)
     L/D(4): L = 240.00(ft) L/D(5): L = 300.00(ft) L/D(6): L = 360.00(ft)

     Average Elevation of Point of Application of kh on Sliding Mass =  422.231(ft)

SUM OF MOMENTS =  -0.466948E-02 (ft/lbs);Imbalance (Fraction of Total Weight) =  -0.9916386E-08
SUM OF FORCES = -.116072E-03 (lbs);Imbalance (Fraction of Total Weight) =   -0.2464971E-09

Sum of Available Shear Forces =  267520.24(lbs)

Sum of Mobilized Shear Forces =  241376.51(lbs)

FS Balance Check: FS =  1.108311

                    **** END OF GEOSTASE OUTPUT ****
```

Appendix F

APPENDIX F

GENERAL EARTHWORK AND GRADING SPECIFICATIONS

1.0 GENERAL

1.1 **Intent:** These General Earthwork and Grading Specifications are for the grading and earthwork shown on the approved grading plan(s) and/or indicated in the geotechnical report(s). These Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the specific recommendations in the geotechnical report shall supersede these general Specifications. Observations of the earthwork by the project Geotechnical Consultant during grading may result in new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

1.2 **Geotechnical Consultant:** Prior to commencement of work, the project owner shall employ a geotechnical consultant. The geotechnical consultant shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of grading.

Prior to commencement of grading, the Geotechnical Consultant shall review the "work plan" prepared by the Earthwork Contractor (Contractor) and schedule sufficient personnel to perform the appropriate level of observation, mapping, and compaction testing.

During grading and earthwork operations, the Geotechnical Consultant shall observe, map, and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the Geotechnical Consultant shall inform the owner, recommend appropriate changes in design to accommodate the observed conditions, and notify the review agency where required. Subsurface areas to be geotechnically observed, mapped, elevations recorded, and/or tested include natural ground after it has been cleared for receiving fill but before fill is placed, bottoms of all "remedial removal" areas, all keyway bottoms, and benches made on sloping ground to receive fill.

The Geotechnical Consultant shall observe the moisture-conditioning and processing of subgrade and fill materials and perform adequate relative compaction testing of fill to determine the attained level of compaction and assess if, in their opinion, if the work was performed in substantial compliance with the geotechnical report(s) and these specifications. The Geotechnical Consultant shall provide test results to the owner on a routine and frequent basis.

1.3 **The Earthwork Contractor:** The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Specifications prior to commencement of grading. The Contractor shall be solely responsible for performing the grading in accordance with applicable grading codes, the project plans, and these specifications.

The Contractor shall prepare and submit to the owner and the Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "spreads" of work and the estimated quantities of daily earthwork planned for the site prior to commencement of grading. The Contractor shall inform the owner and the Geotechnical Consultant of changes in work schedules and updates to the work plan at least 24 hours in advance of such changes so that appropriate observations and tests can be planned and accomplished. The Contractor shall not assume that the Geotechnical Consultant is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the earthwork in accordance with the applicable grading codes and agency ordinances, these Specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of the Geotechnical Consultant, unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, insufficient buttress key size, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the Geotechnical Consultant shall reject the work and may recommend to the owner that construction be stopped until the conditions are corrected.

2.0 PREPARATION OF FILL AREAS

2.1 **Clearing and Grubbing:** Areas to be excavated and filled shall be cleared and grubbed. Vegetation, such as brush, grass, roots, and other deleterious material, man-made structures, and similar debris shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies, and the Geotechnical Consultant. Borrow areas shall be cleared and grubbed to the extent necessary to provide a suitable fill material.

Concrete fragments that are free of reinforcing street may be placed in fills, provided they are placed in accordance with Section 3 and 4. Earth fill material shall not contain more than 1 percent of organic materials (by volume). No fill lift shall contain more than 5 percent organic matter. Nesting of organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area. As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, etc.) have chemical constituents that are considered hazardous waste. As such, the indiscriminate dumping or spillage of such fluids may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed.

The Geotechnical Consultant shall not be responsible for the identification or analysis of potentially hazardous materials; however, if observations, odors, or soil discoloration are suspect, the Geotechnical Consultant may request from the owner the termination of grading operations until such materials are deemed not hazardous as defined by applicable laws and regulations.

2.2 **Evaluation/Acceptance of Fill Areas:** All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive fill. The Contractor shall obtain a written acceptance from the Geotechnical Consultant prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys, and benches.

2.3 **Processing:** Ground that has been declared satisfactory for support of fill by the Geotechnical Consultant shall be scarified to a minimum depth of 6 inches. Ground that is not satisfactory shall be removed/overexcavated as specified in the following section. Scarification shall continue until soils are broken down and free of large clay lumps or clods and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction. After scarification, the surface should be moisture conditioned, as necessary, to achieve the proper moisture content and compacted in accordance with Section 4 of these specifications.

2.4 **Overexcavation:** In addition to removals and overexcavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured, or otherwise unsuitable ground shall be overexcavated to competent ground as recommended by the Geotechnical Consultant during grading.

2.5 **Benching:** Fills to be placed on ground sloping steeper than 5H:1V (horizontal to vertical units) shall be stepped or benched. The lowest bench or key shall be a minimum of 15 feet wide and at least 2 feet deep, into competent material as evaluated by the Geotechnical Consultant. Other benches shall be excavated a minimum height of 4 feet into competent material or as otherwise recommended by the Geotechnical Consultant. Fill placed on ground sloping flatter than 5:1 shall also be benched or otherwise overexcavated to provide a flat subgrade for fill placement.

3.0 FILL MATERIAL

3.1 **General:** Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by the Geotechnical Consultant prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to the Geotechnical Consultant or mixed with other soils to achieve satisfactory fill material.

3.2 **Oversize:** Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 12 inches, shall not be buried or placed in fill unless location, materials, and placement methods are specifically accepted by the Geotechnical Consultant. Placement operations shall be such that nesting of oversized material does not occur and that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 vertical feet of finish grade or within 2 feet of future utilities or other underground construction.

3.3 **Import:** If importing of fill material is required for grading, proposed import material shall meet the requirements of Section 3.1 and/or requirements defined in the project geotechnical report(s). The potential import source shall be given to the Geotechnical Consultant at least 48 hours (2 working days) before import begins so that suitability can be determined, and appropriate laboratory tests performed.

4.0 FILL PLACEMENT AND COMPACTION

4.1 **Fill Layers:** Approved fill material shall be placed in areas prepared to receive fill (per Section 3.0) in near-horizontal layers not exceeding 8 inches in loose thickness. The Geotechnical Consultant may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

4.2 **Fill Moisture Conditioning:** Fill soils shall be watered, dried back, blended, and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with ASTM International (ASTM Test Method D1557).

4.3 **Compaction of Fill:** After each layer has been moisture-conditioned, mixed, and evenly spread, it shall be uniformly compacted to not less than 90 percent of maximum dry density (ASTM Test Method D1557). Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction and uniformity.

Compaction of Fill Slopes: In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by backrolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet in fill elevation, or by other methods producing satisfactory results acceptable to the Geotechnical Consultant. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of maximum density per ASTM Test Method D1557.

4.4 **Compaction Testing:** Field tests for moisture content and relative compaction of the fill soils shall be performed by the Geotechnical Consultant. Location and frequency of tests shall be at the Consultant's discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

4.5 **Frequency of Compaction Testing:** Tests shall be taken at intervals required by the governing agency and as deemed necessary by the Geotechnical Consultant in order to adequately qualify the fill material. In general, it should be anticipated that tests will be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of compacted fill, unless recommended otherwise by the Geotechnical Consultant. In addition, test(s) shall be taken on slope faces and/or each 10 feet of vertical height of slope as deemed necessary by the Geotechnical Consultant. The Contractor shall assure that fill construction is such that the testing schedule can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork construction if these minimum standards are not met.

4.6 **Compaction Test Locations:** The Geotechnical Consultant shall document the approximate elevation and location of each compaction test. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so the Geotechnical Consultant can determine the test locations with sufficient accuracy. At a minimum, two grade stakes within a horizontal distance of 100 feet and vertically less than 5 feet apart from potential test locations shall be provided. Alternatively, GPS units may be used to determine the approximate location/coordinates of the field density tests.

5.0 SUBDRAIN INSTALLATION

Subdrain systems shall be installed in accordance with the approved geotechnical report(s), the grading plan, and standard details. The Geotechnical Consultant may recommend additional subdrains and/or changes in subdrain extent, location, grade, or material depending on conditions encountered during grading. All subdrains shall be surveyed for line and grade after installation and prior to burial. Sufficient time should be allowed by the Contractor for these surveys. The Contractor should consider videoing the subdrains shortly after burial to check proper installation and functionality. The Contractor is responsible for the performance of subdrains.

6.0 EXCAVATION

Excavations, including over-excavation for remedial purposes, shall be evaluated by the Geotechnical Consultant during grading. Remedial removal depths shown on geotechnical report(s) and plans are estimates. The actual extent of removal shall be determined by the Geotechnical Consultant based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, evaluated, and accepted by the Geotechnical Consultant prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by the Geotechnical Consultant.

7.0 TRENCH BACKFILLS

7.1 Contractor shall follow all OHSA and Cal/OSHA requirements for safety of trench excavations.

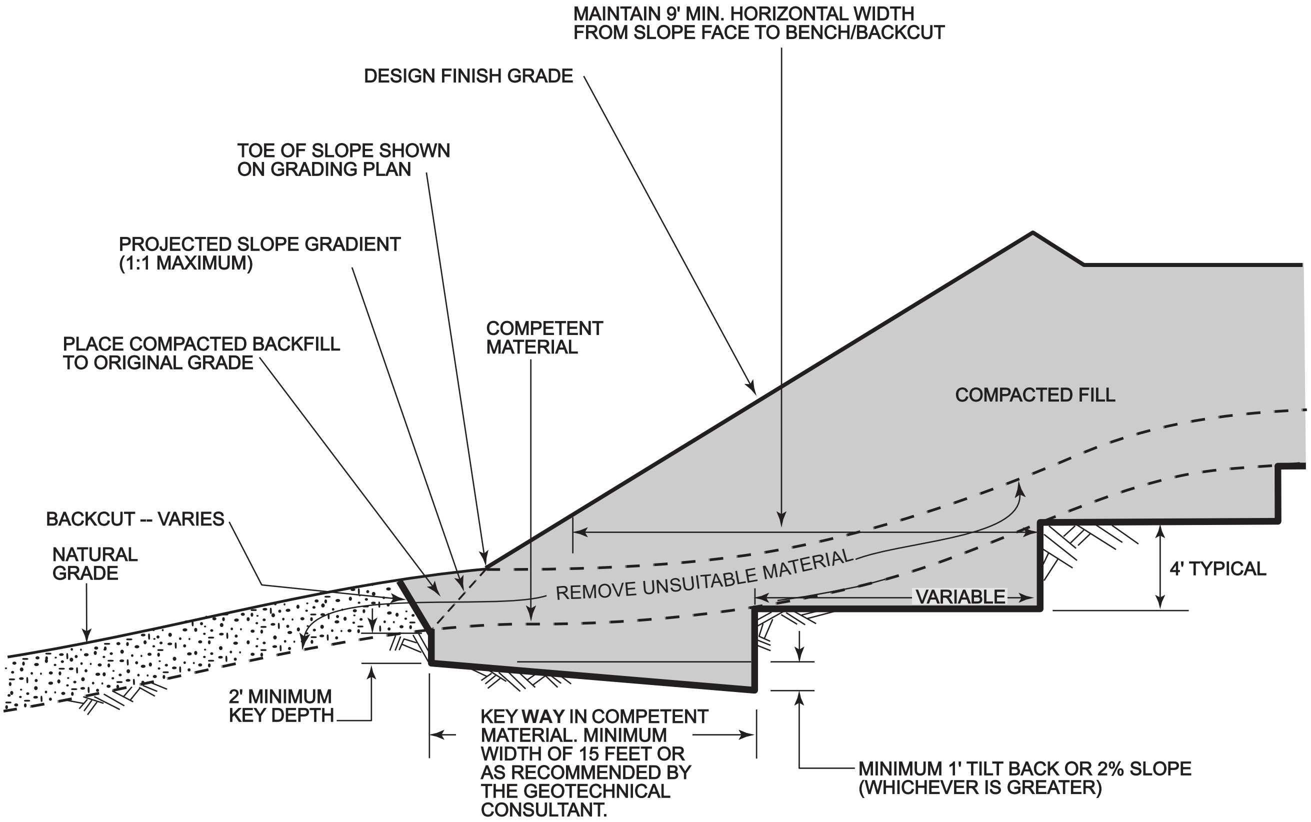
7.2 Bedding and backfill of utility trenches shall be done in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding material shall have a Sand Equivalent greater than 30 (SE>30). The bedding shall be placed to 1 foot over the top of the conduit and densified by jetting. Backfill shall be placed and densified to a minimum 90 percent of maximum from 1 foot above the top of the conduit to the surface, except in traveled ways (see Section 7.6 below).

7.3 Jetting of the bedding around the conduits shall be observed by the Geotechnical Consultant.

7.4 Geotechnical Consultant shall test the trench backfill for relative compaction. At least one test should be made for every 300 feet of trench and 2 feet of fill, unless required differently by the governing agency or the Geotechnical Consultant.

7.5 Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method.

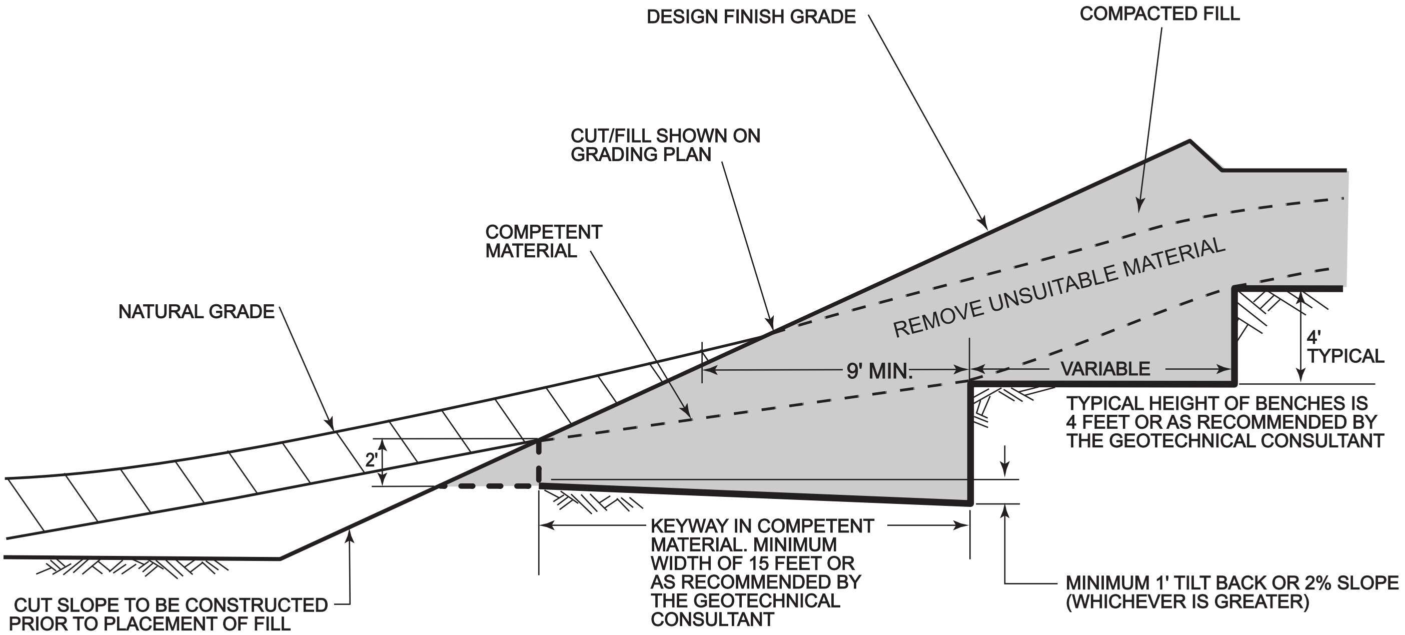
7.6 Trench backfill in the upper foot measured from finish grade within existing or future traveled way, shoulder, and other paved areas (or areas to receive pavement) should be placed to a minimum 95 percent relative compaction.


MAINTAIN 9' MIN. HORIZONTAL WIDTH FROM SLOPE FACE TO BENCH/BACKCUT
DESIGN FINISH GRADE
TOE OF SLOPE SHOWN ON GRADING PLAN
PROJECTED SLOPE GRADIENT (1:1 MAXIMUM)
COMPETENT MATERIAL
PLACE COMPACTED BACKFILL TO ORIGINAL GRADE
COMPACTED FILL
BACKCUT -- VARIES
NATURAL GRADE
REMOVE UNSUITABLE MATERIAL
VARIABLE
4' TYPICAL
2' MINIMUM KEY DEPTH
KEY WAY IN COMPETENT MATERIAL. MINIMUM WIDTH OF 15 FEET OR AS RECOMMENDED BY THE GEOTECHNICAL CONSULTANT.
MINIMUM 1' TILT BACK OR 2% SLOPE (WHICHEVER IS GREATER)

NOTE: BENCHING SHALL BE REQUIRED WHEN SLOPES ARE EQUAL TO OR STEEPER THAN 5H:1V OR WHEN RECOMMENDED BY THE GEOTECHNICAL CONSULTANT. WHERE THE NATURAL SLOPE APPROACHES OR EXCEEDS THE DESIGN SLOPE RATIO, SPECIFIC RECOMMENDATIONS SHOULD BE PROVIDED BY THE GEOTECHNICAL CONSULTANT.

FIGURE 1

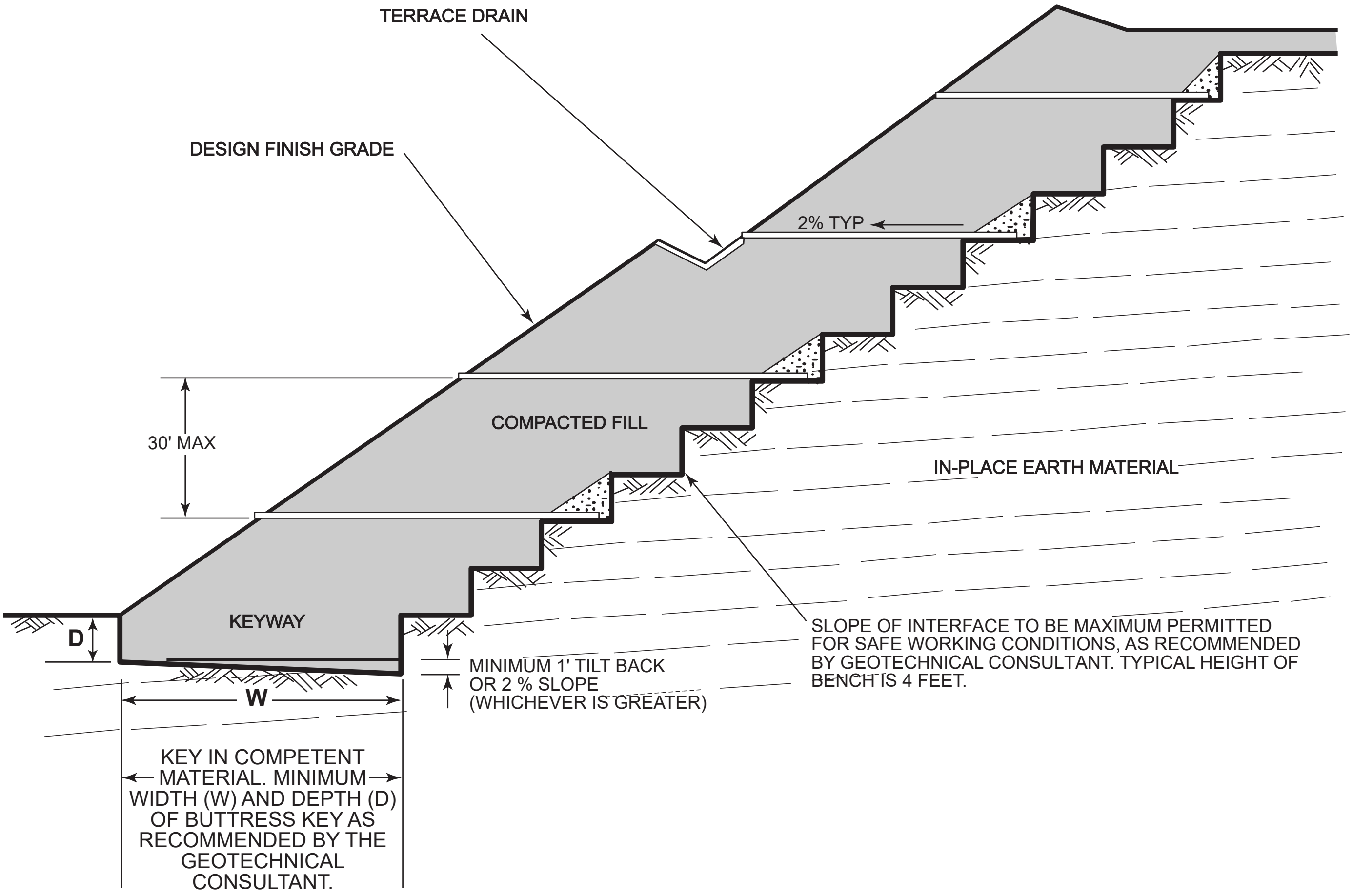
TYPICAL FILL KEY ABOVE NATURAL SLOPE
MINIMUM STANDARD GRADING DETAIL


DESIGN FINISH GRADE
COMPACTED FILL
CUT/FILL SHOWN ON GRADING PLAN
COMPETENT MATERIAL
NATURAL GRADE
REMOVE UNSUITABLE MATERIAL
9' MIN.
VARIABLE
4' TYPICAL
TYPICAL HEIGHT OF BENCHES IS 4 FEET OR AS RECOMMENDED BY THE GEOTECHNICAL CONSULTANT
2'
KEYWAY IN COMPETENT MATERIAL. MINIMUM WIDTH OF 15 FEET OR AS RECOMMENDED BY THE GEOTECHNICAL CONSULTANT
MINIMUM 1' TILT BACK OR 2% SLOPE (WHICHEVER IS GREATER)
CUT SLOPE TO BE CONSTRUCTED PRIOR TO PLACEMENT OF FILL

NOTE: BENCHING SHALL BE REQUIRED WHEN SLOPES ARE EQUAL TO OR STEEPER THAN 5H:1V OR WHEN RECOMMENDED BY THE GEOTECHNICAL CONSULTANT. WHERE THE NATURAL SLOPE APPROACHES OR EXCEEDS THE DESIGN SLOPE RATIO, SPECIFIC RECOMMENDATIONS SHOULD BE PROVIDED BY THE GEOTECHNICAL CONSULTANT.

FIGURE 2

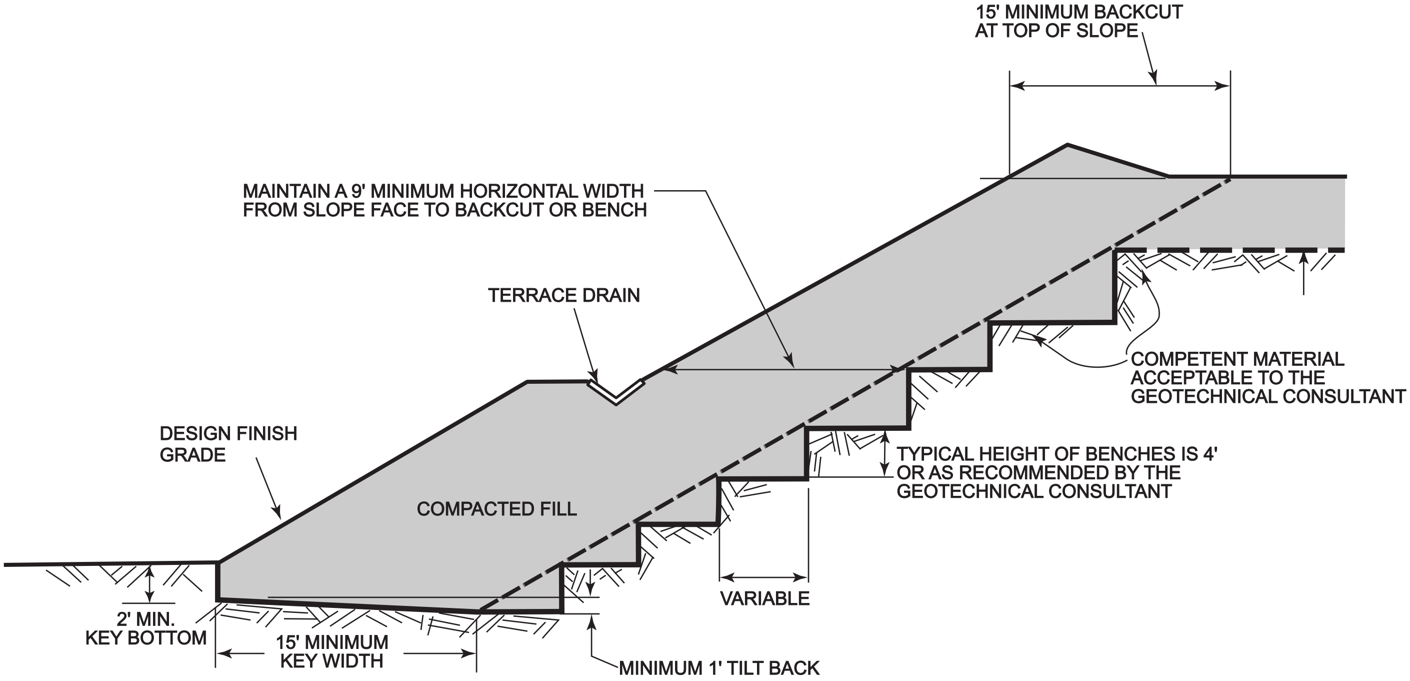
TYPICAL FILL ABOVE CUT SLOPE
MINIMUM STANDARD GRADING DETAIL


TERRACE DRAIN
DESIGN FINISH GRADE
2% TYP
30' MAX
COMPACTED FILL
IN-PLACE EARTH MATERIAL
KEYWAY
D
W
MINIMUM 1' TILT BACK OR 2 % SLOPE (WHICHEVER IS GREATER)
SLOPE OF INTERFACE TO BE MAXIMUM PERMITTED FOR SAFE WORKING CONDITIONS, AS RECOMMENDED BY GEOTECHNICAL CONSULTANT. TYPICAL HEIGHT OF BENCH IS 4 FEET.
KEY IN COMPETENT MATERIAL. MINIMUM WIDTH (W) AND DEPTH (D) OF BUTTRESS KEY AS RECOMMENDED BY THE GEOTECHNICAL CONSULTANT.

NOTE: FOR SUBDRAIN DETAILS, SEE FIGURE 5.

FIGURE 3

TYPICAL BUTTRESS FILL
MINIMUM STANDARD GRADING DETAIL

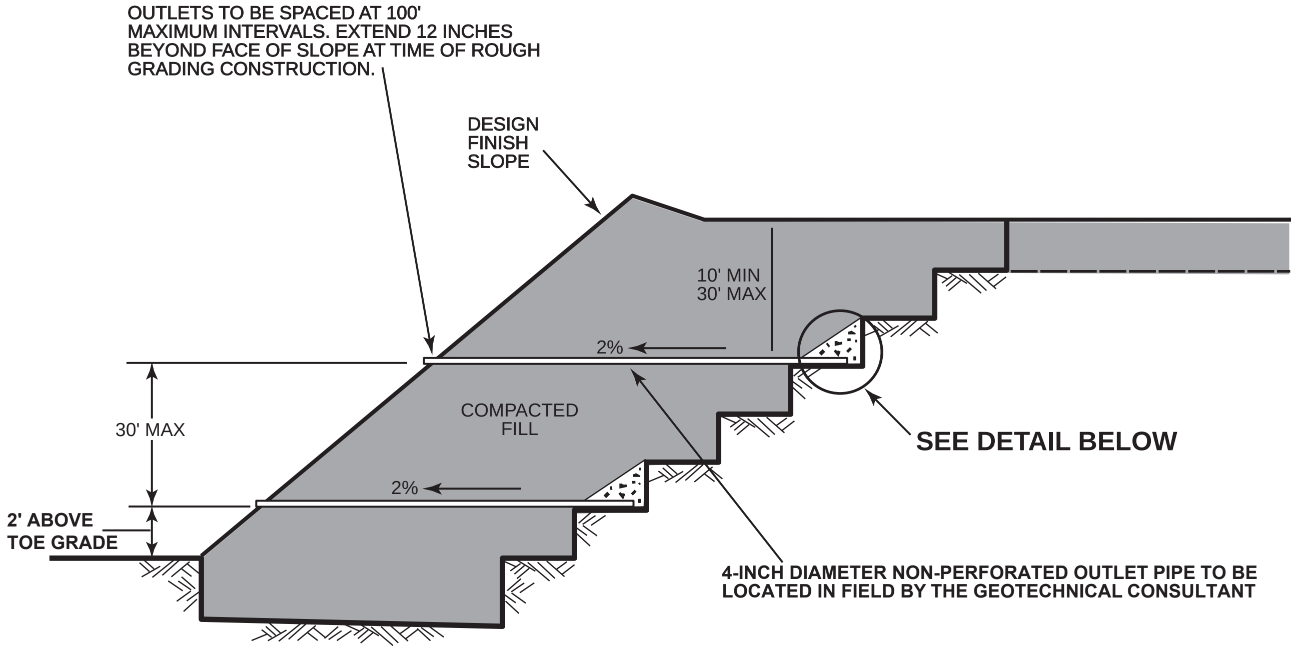

15' MINIMUM BACKCUT
AT TOP OF SLOPE
MAINTAIN A 9' MINIMUM HORIZONTAL WIDTH
FROM SLOPE FACE TO BACKCUT OR BENCH
TERRACE DRAIN
DESIGN FINISH
GRADE
COMPACTED FILL
COMPETENT MATERIAL
ACCEPTABLE TO THE
GEOTECHNICAL CONSULTANT
TYPICAL HEIGHT OF BENCHES IS 4'
OR AS RECOMMENDED BY THE
GEOTECHNICAL CONSULTANT
VARIABLE
2' MIN.
KEY BOTTOM
15' MINIMUM
KEY WIDTH
MINIMUM 1' TILT BACK

NOTE: FOR SUBDRAIN DETAILS, SEE FIGURE 5.

FIGURE 4

TYPICAL STABILIZATION FILL
MINIMUM STANDARD GRADING DETAIL

S/A



OUTLETS TO BE SPACED AT 100' MAXIMUM INTERVALS. EXTEND 12 INCHES BEYOND FACE OF SLOPE AT TIME OF ROUGH GRADING CONSTRUCTION.

4-INCH DIAMETER NON-PERFORATED OUTLET PIPE TO BE LOCATED IN FIELD BY THE GEOTECHNICAL CONSULTANT

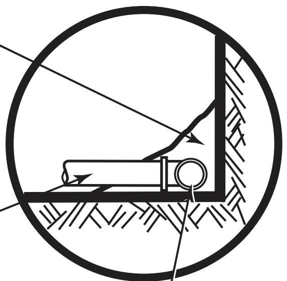
FILTER MATERIAL - MINIMUM OF THREE CUBIC FEET PER FOOT OF PIPE. SEE FILTER MATERIAL SPECIFICATION.

ALTERNATE: IN LIEU OF FILTER MATERIAL, THREE CUBIC FEET OF GRAVEL PER FOOT OF SUBDRAIN (WITHOUT PIPE) MAY BE ENCASED IN FILTER FABRIC.

GRAVEL TO CONSIST OF 1/2" TO 1" CRUSHED ROCK PER STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION. FIGURE 6 FOR FILTER FABRIC SPECIFICATION

FILTER FABRIC SHALL BE LAPPED A MINIMUM OF 12 INCHES ON ALL JOINTS. SEE FIGURE 6 FOR FILTER FABRIC SPECIFICATION

DETAIL



OUTLET PIPE TO BE CONNECTED TO SUBDRAIN PIPE WITH TEE OR ELBOW

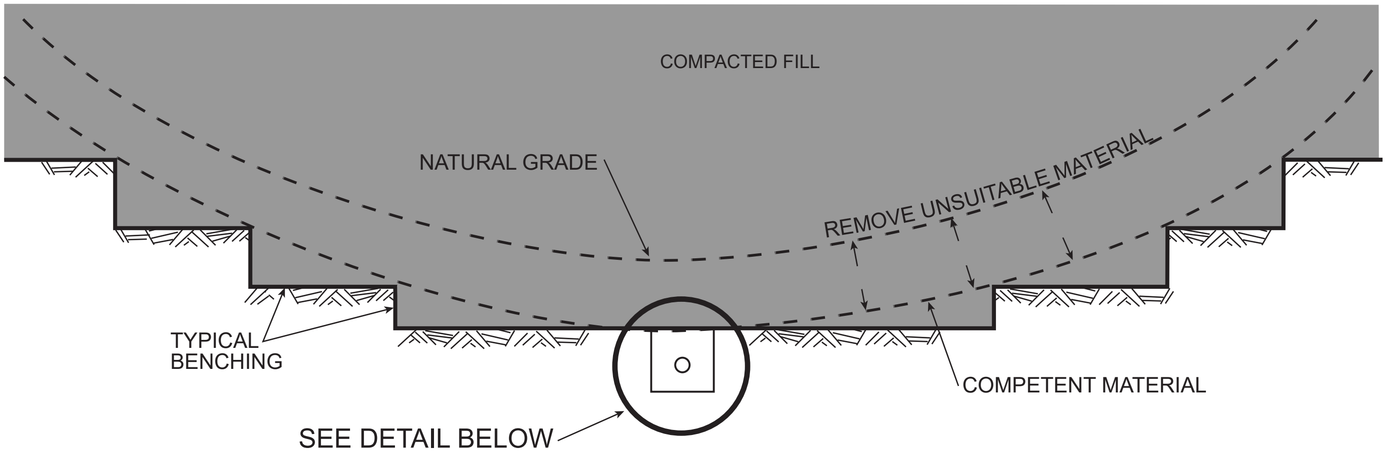
MINIMUM 4-INCH DIAMETER SCHEDULE 40 ASTM D1527 OR D1785 OR SDR 35 ASTM D2751 OR D 3034. FOR FILL DEPTH OF 60 FEET OR GREATER, USE ONLY SCHEDULE 40 OR EQUIVALENT. THERE SHALL BE A MINIMUM OF 8 UNIFORMLY SPACED PERFORATIONS PER FOOT OF PIPE INSTALLED WITH PERFORATIONS ON BOTTOM OF PIPE. PROVIDE CAP AT UPSTREAM END OF PIPE. SLOPE A MINIMUM OF 2 PERCENT TO OUTLET PIPE.

"FILTER MATERIAL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT.

SIEVE SIZE	PERCENTAGE PASSING
1"	100
3/4"	90-100
3/8"	40-100
NO. 4	25-40
NO. 8	18-33
NO. 30	5-15
NO. 50	0-7
NO. 200	0-3

FIGURE 5

TYPICAL STABILIZATION AND BUTTRESS FILL SUBDRAINS MINIMUM STANDARD GRADING DETAIL


COMPACTED FILL
NATURAL GRADE
REMOVE UNSUITABLE MATERIAL
TYPICAL BENCHING
COMPETENT MATERIAL
SEE DETAIL BELOW

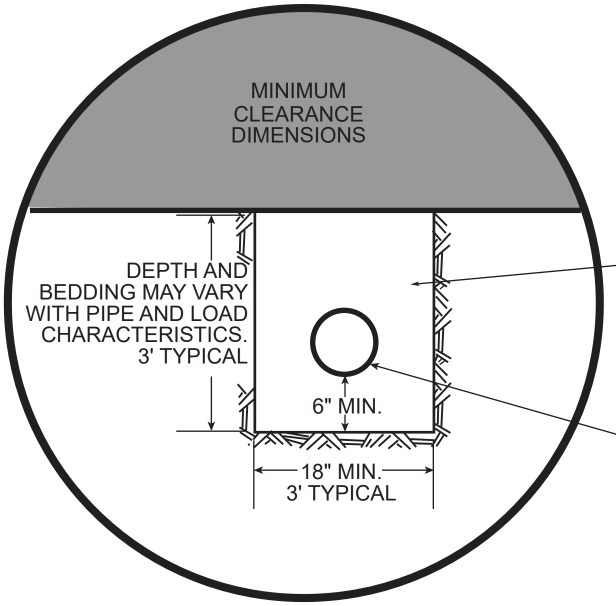
FILTER FABRICS SHALL BE PERMEABLE NON-WOVEN POLYESTER, NYLON, OR POLYPROPYLENE MATERIAL CONFORMING TO THE FOLLOWING:

1) GRAB TENSILE STRENGTH. POUNDS, MIN. ASTM D 4632..90
2) ELONGATION, AT PEAK LOAD, PERCENT, MIN. ASTM D 4632..50
3) PUNCTURE STRENGTH, LBS., MIN. ASTM D 3787..45
4) COEFFICIENT OF WATER PERMITTIVITY, 1/SEC. ASTM D 4491...>0.7
5) BURST STRENGTH, P.S.I., MIN. ASTM D 3786..180

NOTES: DOWNSTREAM 20' OF PIPE AT OUTLET SHALL BE NON-PERFORATED AND BACKFILLED WITH FINE-GRAINED MATERIAL

PIPE SHALL BE A MINIMUM OF 4-INCH DIAMETER. FOR RUNS OF 500 FEET OR MORE, USE 6-INCH DIAMETER PIPE, OR AS RECOMMENDED BY THE GEOTECHNICAL CONSULTANT

DETAIL


MINIMUM CLEARANCE DIMENSIONS
DEPTH AND BEDDING MAY VARY WITH PIPE AND LOAD CHARACTERISTICS. 3' TYPICAL
6" MIN.
18" MIN. 3' TYPICAL

FILTER MATERIAL - MINIMUM OF NINE CUBIC FEET PER FOOT OF PIPE. SEE FIGURE 5 FOR FILTER MATERIAL SPECIFICATIONS.

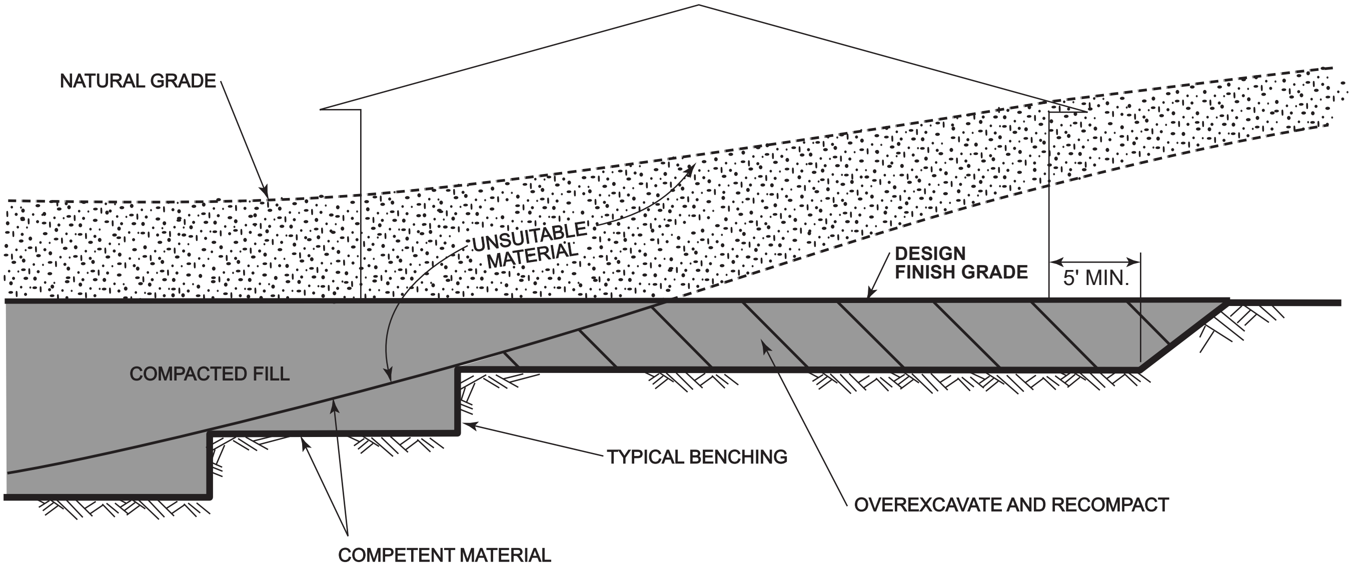
ALTERNATE: IN LIEU OF FILTER MATERIAL, NINE CUBIC FEET OF GRAVEL PER FOOT OF SUBDRAIN (WITHOUT PIPE) MAY BE ENCASED IN FILTER FABRIC. SEE FIGURE 5 TO GRAVEL SPECIFICATION. SEE ABOVE FOR FILTER FABRIC SPECIFICATION. FILTER FABRIC SHALL BE LAPPED MINIMUM OF 12 INCHES ON ALL JOINTS.

MINIMUM 4 INCH DIAMETER SCHEDULE 40 ASTM D 1527, OR D 1785, OR SDR 35 ASTM 2751 OR D 3034. FOR FILL DEPTH OF 60 FEET OR GREATER, USE ONLY SCHEDULE 40 OR APPROVED EQUIVALENT. THERE SHALL BE A MINIMUM OF 8 UNIFORMLY SPACED PERFORATIONS PER FOOT OF PIPE INSTALLED WITH PERFORATIONS ON BOTTOM OF PIPE.

FIGURE 6

TYPICAL CANYON SUBDRAIN
MINIMUM STANDARD GRADING DETAIL

CUT LOT


NATURAL GRADE
UNSUITABLE MATERIAL
DESIGN FINISH GRADE
5' MIN.
COMPACTED FILL
TYPICAL BENCHING
OVEREXCAVATE AND RECOMPACT
COMPETENT MATERIAL

CUT/FILL LOT TRANSITION LOT

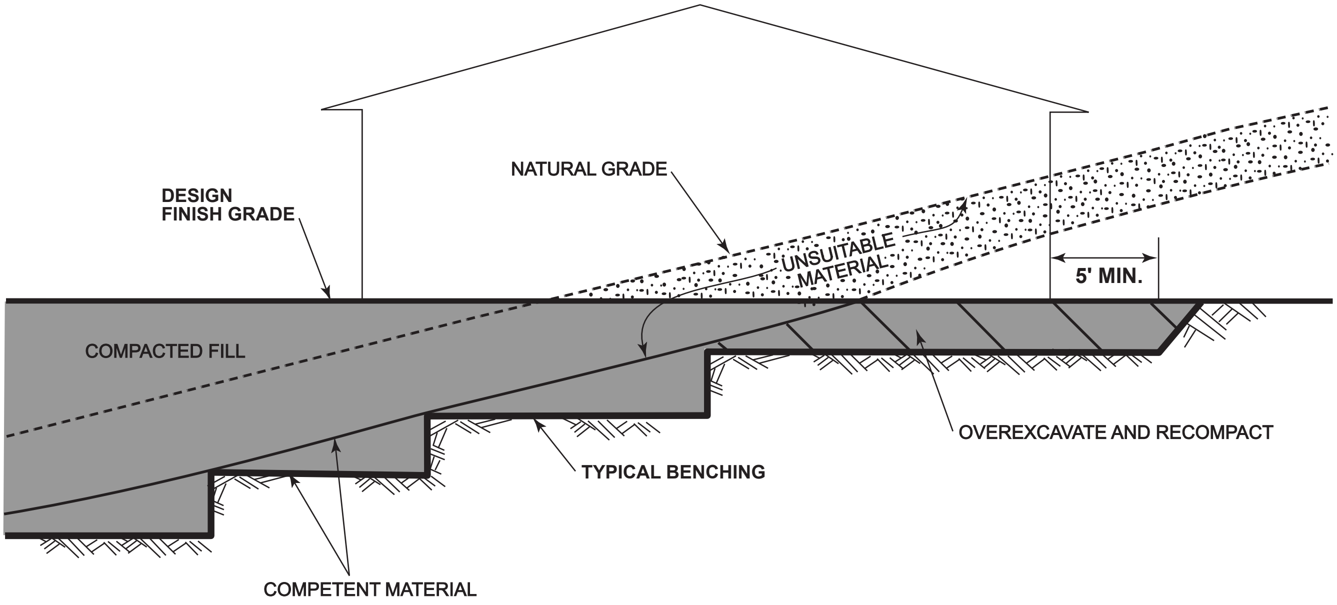
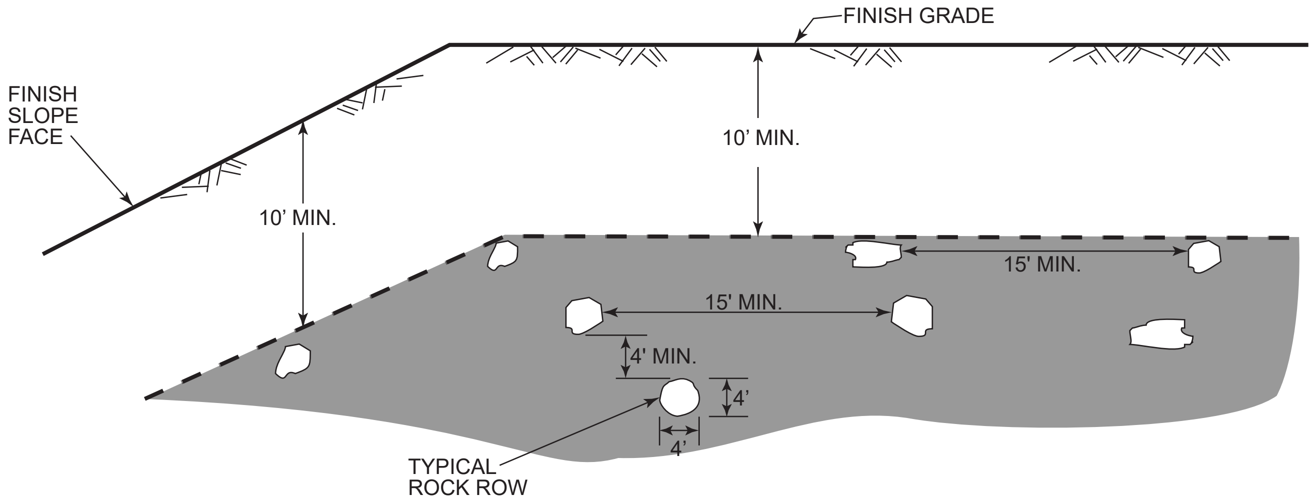
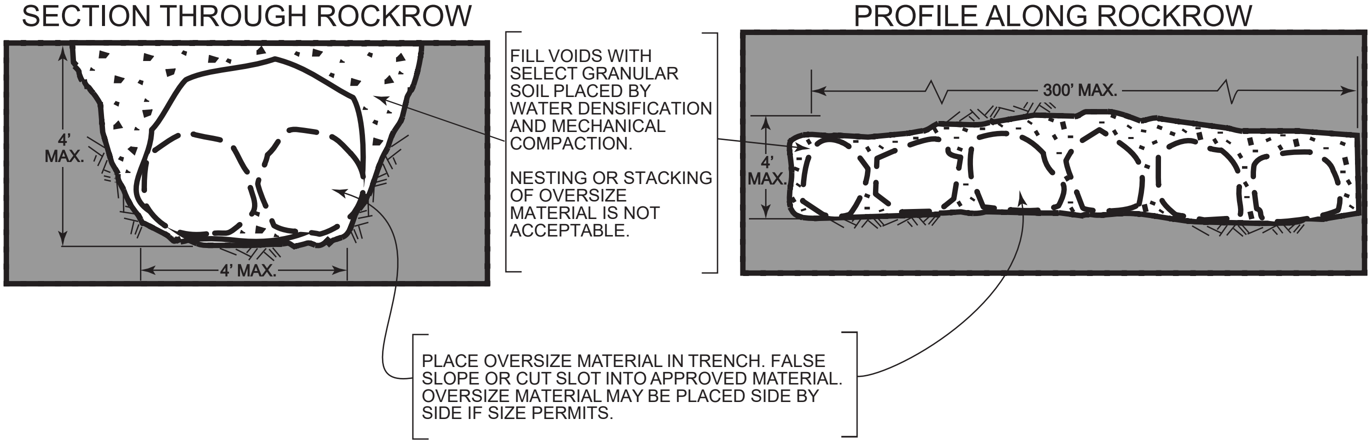

NATURAL GRADE
DESIGN FINISH GRADE
UNSUITABLE MATERIAL
5' MIN.
COMPACTED FILL
OVEREXCAVATE AND RECOMPACT
TYPICAL BENCHING
COMPETENT MATERIAL

FIGURE 7

TYPICAL OVEREXCAVATION OF DAYLIGHT LINE MINIMUM STANDARD GRADING DETAIL





FILL VOIDS WITH SELECT GRANULAR SOIL PLACED BY WATER DENSIFICATION AND MECHANICAL COMPACTION.

NESTING OR STACKING OF OVERSIZE MATERIAL IS NOT ACCEPTABLE.

PLACE OVERSIZE MATERIAL IN TRENCH. FALSE SLOPE OR CUT SLOT INTO APPROVED MATERIAL. OVERSIZE MATERIAL MAY BE PLACED SIDE BY SIDE IF SIZE PERMITS.

NOTES:

A) OVERSIZED ROCK IS DEFINED AS LARGER THAN 12" IN SIZE IN GREATEST DIMENSION.

B) SPACE BETWEEN ROCKROWS SHOULD BE ONE EQUIPMENT WIDTH OR A MINIMUM OF 15 FEET.

C) THE WIDTH AND HEIGHT OF THE ROCKROW SHALL BE LIMITED TO FOUR FEET AND THE LENGTH LIMITED TO 300 FEET UNLESS APPROVED OTHERWISE BY THE GEOTECHNICAL CONSULTANT. OVERSIZE SHOULD BE PLACED WITH FLATEST SIDE ON THE BOTTOM.

D) OVERSIZE MATERIAL EXCEEDING FOUR FEET MAY BE PLACED ON AN INDIVIDUAL BASIS IF APPROVED BY THE GEOTECHNICAL CONSULTANT.

E) FILLING OF VOIDS WILL REQUIRE SELECT GRANULAR SOIL (SE > 20, OR LESS THAN 20 PERCENT FINES) AS APPROVED BY THE GEOTECHNICAL CONSULTANT. VOIDS IN THE ROCKROW TO BE FILLED BY WATER DENSIFYING GRANULAR SOIL INTO PLACE ALONG WITH MECHANICAL COMPACTION EFFORT.

F) IF APPROVED BY THE GEOTECHNICAL CONSULTANT, ROCKROWS MAY BE PLACED DIRECTLY ON COMPETENT MATERIALS OR BEDROCK, PROVIDED ADEQUATE SPACE IS AVAILABLE FOR COMPACTION.

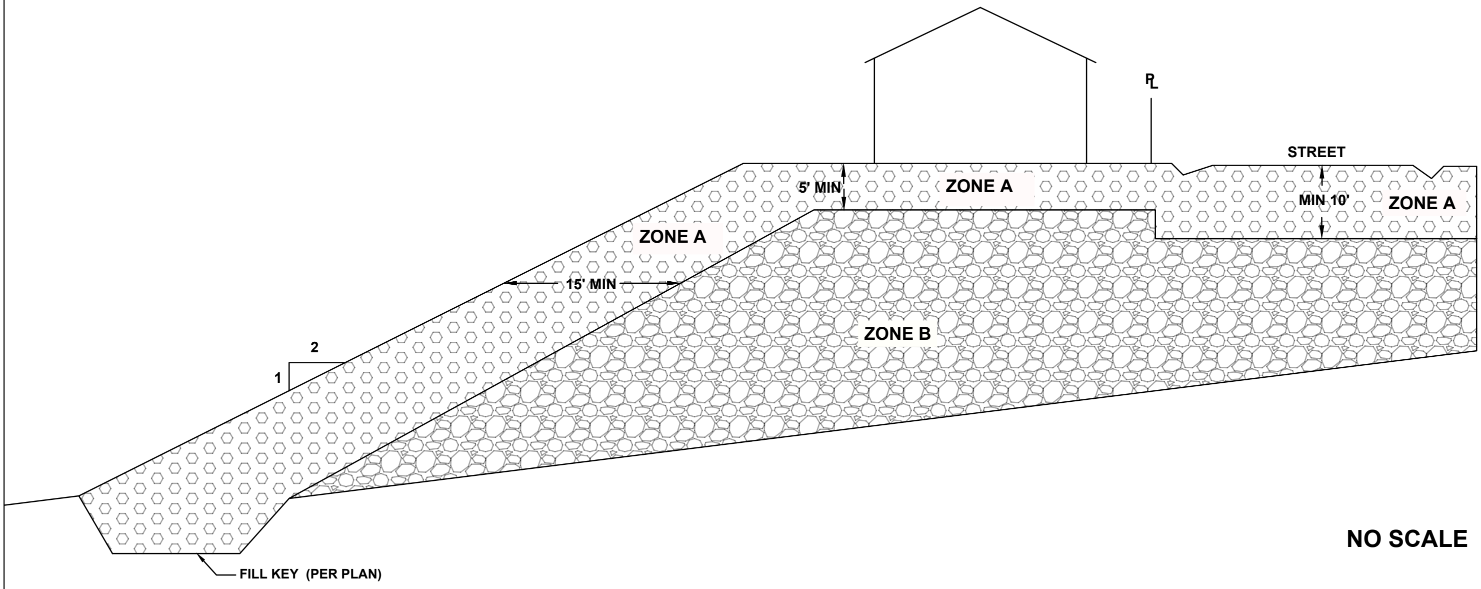
G) THE FIRST LIFT OF MATERIAL ABOVE THE ROCKROW SHALL CONSIST OF GRANULAR MATERIAL AND SHALL BE PROOF-ROLLED WITH A D-8 OR LARGER DOZER OR EQUIVALENT.

H) ROCKROWS NEAR SLOPES SHOULD BE ORIENTED PARALLEL TO SLOPE FACE.

I) NESTING OR STACKING OF ROCKS IS NOT ACCEPTABLE.

FIGURE 8

TYPICAL OVERSIZE ROCK PLACEMENT METHOD
MINIMUM STANDARD GRADING DETAIL



LEGEND

ZONE A:

- THE UPPER 5 FEET OF FILL UNDER PADS SHOULD NOT HAVE ROCKS GREATER THAN 12 INCHES IN THE LARGEST DIMENSION (12-INCH MINUS).
- FILLS IN PUBLIC STREETS, RIGHT OF WAYS AND EASEMENTS SHOULD CONTAIN ONLY 12-INCH MINUS MATERIALS TO A DEPTH OF 10 FEET BELOW FINISH GRADE OR 2 FEET BELOW THE DEEPEST UTILITY, WHICHEVER IS DEEPER.
- FILLS IN SLOPE AREAS MAY HAVE OVERSIZE ROCK PLACED PER ROCK BLANKET DETAIL TO WITHIN 15 FEET OF SLOPE FACE. FILL WITHIN 15 FEET OF SLOPE FACE SHOULD ONLY CONSIST OF 12-INCH MINUS MATERIAL.

ZONE B:

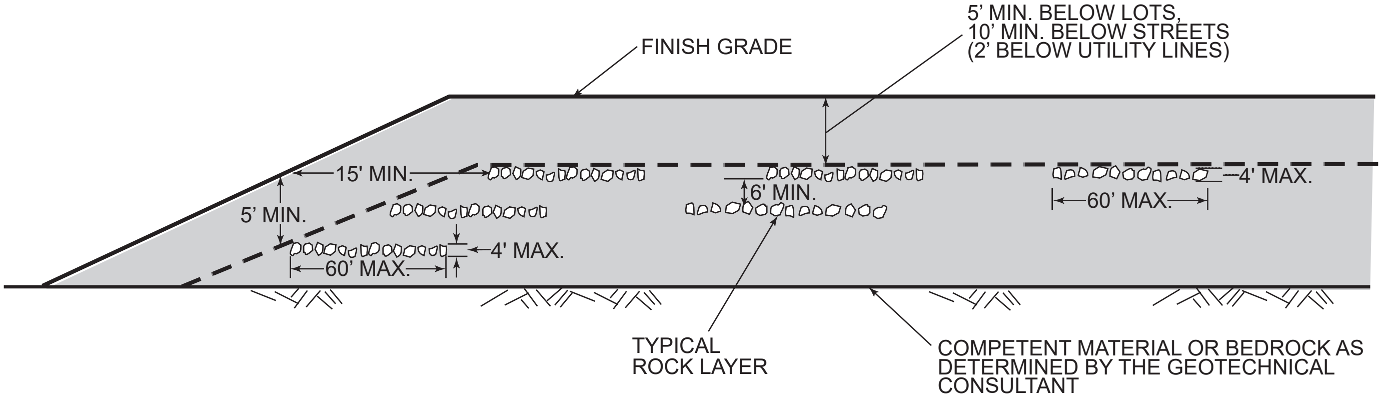
- ROCKS UP TO 2 FEET IN HEIGHT (LYING FLAT) WITH OCCASIONAL INDIVIDUAL FRAGMENTS UP TO 4 FEET MAXIMUM DIMENSION MAY BE PLACED WITHIN ZONE B AREA.
- ROCKS EXCEEDING 2 FEET IN THE SMALLEST DIMENSION MAY BE PLACED IN ROWS WITH THE FLATTEST SIDE DOWN (SEE NEXT PAGE). THE WIDTH OF THE ROWS MAY EXCEED 4 FEET PROVIDED THE FILL OPERATION CAN ACCOMMODATE A MINIMUM OF 15 FEET BETWEEN ROWS, AND PROVIDED THAT THERE IS SUFFICIENT EQUIPMENT TO PLACE FILL AGAINST AND OVER THE ROWS.
- FILL SOILS PLACED AGAINST OR OVER ROCK ROWS SHOULD BE FREE OF ROCKS THAT MAY CAUSE NESTING/VOIDS WITHIN THE ROCK ROWS AND ROCK FILL. THIS CONDITION SHOULD BE CAREFULLY REVIEWED IN THE FIELD BY THE GEOTECHNICAL CONSULTANT TO VERIFY SATISFACTORY OPERATIONS.
- ROCKS UP TO 10 FEET IN THE LEAST DIMENSION MAY BE PLACED AS INDIVIDUAL ROCKS WITHIN THE COMPACTED FILL. THE FILL SOILS NEAR AND AGAINST THESE ROCKS SHOULD BE FREE OF ROCKS THAT MAY CAUSE NESTING/VOIDS WITH THE LARGER ROCKS. THIS CONDITION SHOULD BE CAREFULLY REVIEWED IN THE FIELD BY THE GEOTECHNICAL CONSULTANT TO VERIFY SATISFACTORY OPERATIONS.
- ROCKS, LARGER THAN 10 FEET IN THE SMALLEST DIMENSION, SHOULD BE REDUCED IN SIZE TO MEET THE SPECIFIED DIMENSIONS FOR INDIVIDUAL ROCK PLACEMENT AND/OR FOR PLACEMENT IN ROCK ROWS.

NOTES: CONTINUOUS OBSERVATION IS REQUIRED BY GEOTECHNICAL CONSULTANT DURING ROCK PLACEMENT.

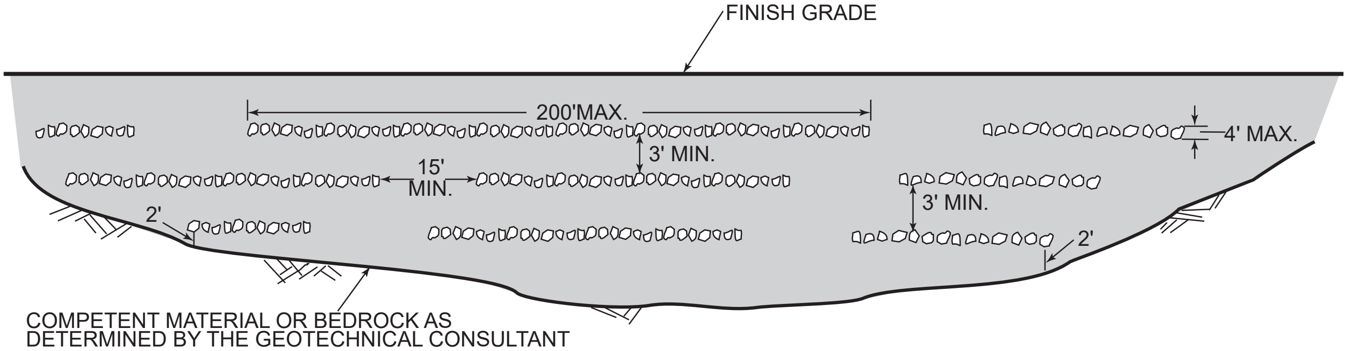
FIGURE 9

STRUCTURAL ROCK FILL PLACEMENT DETAIL

VIEW NORMAL TO SLOPE FACE


5' MIN. BELOW LOTS,
10' MIN. BELOW STREETS
(2' BELOW UTILITY LINES)
FINISH GRADE
15' MIN.
5' MIN.
4' MAX.
60' MAX.
6' MIN.
4' MAX.
60' MAX.
TYPICAL ROCK LAYER
COMPETENT MATERIAL OR BEDROCK AS DETERMINED BY THE GEOTECHNICAL CONSULTANT

VIEW PARALLEL TO SLOPE FACE


FINISH GRADE
200'MAX.
4' MAX.
3' MIN.
15' MIN.
3' MIN.
2'
2'
COMPETENT MATERIAL OR BEDROCK AS DETERMINED BY THE GEOTECHNICAL CONSULTANT

NOTES:

1) ORIENTATION AND STAGGERING MAY VARY, BUT SHALL BE AS RECOMMENDED BY THE GEOTECHNICAL CONSULTANT.

2) ROCK LAYERS SHALL NOT BE MORE THAN 4 FEET IN HEIGHT. ROCK SHALL NOT BE STACKED OR NESTED.

3) EACH ROCK CELL MUST BE COVERED WITH A GRANULAR SOIL WITH A MINIMUM SAND EQUIVALENT (SE) OF 20 OR WITH LESS THAN 10% PASSING THE NO. 200 SIEVE AS DETERMINED BY THE GEOTECHNICAL CONSULTANT. THE GRANULAR SOIL IS TO BE FLUSHED, FLOODED, AND JETTED IN THE ROCK LAYER IN ORDER TO FILL THE VOIDS. ADDITIONAL LIFTS OF GRANULAR SOIL SHALL BE PLACED AS NECESSARY TO ALLOW FOR THE FILLING OF VOIDS BY FLOODING, AND JETTING. THE ROCK LAYER SHALL THEN BE ADEQUATELY COMPACTED WITH HEAVY EARTH MOVING EQUIPMENT.

4) ADEQUACY OF ABOVE PROCEDURE SHALL BE VERIFIED BY THE GEOTECHNICAL CONSULTANT.

5) ROCKS EXCEEDING 2 FEET IN THE SMALLEST DIMENSION MAY BE PLACED IN ROWS AS SHOWN IN THE FIGURE WITH THE FLATTEST SIDE DOWN. THE WIDTH OF THE ROWS MAY EXCEED 4 FEET PROVIDED THE FILL OPERATION CAN ACCOMMODATE A MINIMUM OF 15 FEET BETWEEN ROWS, AND PROVIDED THAT THERE IS SUFFICIENT EQUIPMENT TO PLACE FILL AGAINST AND OVER THE ROWS. THE FILL SOILS SHOULD BE FREE OF ROCKS THAT MAY CAUSE NESTING/VOIDS WITHIN THE ROCK ROWS. THIS CONDITION SHOULD BE CAREFULLY REVIEWED IN THE FIELD BY THE GEOTECHNICAL CONSULTANT TO VERIFY SATISFACTORY OPERATIONS.

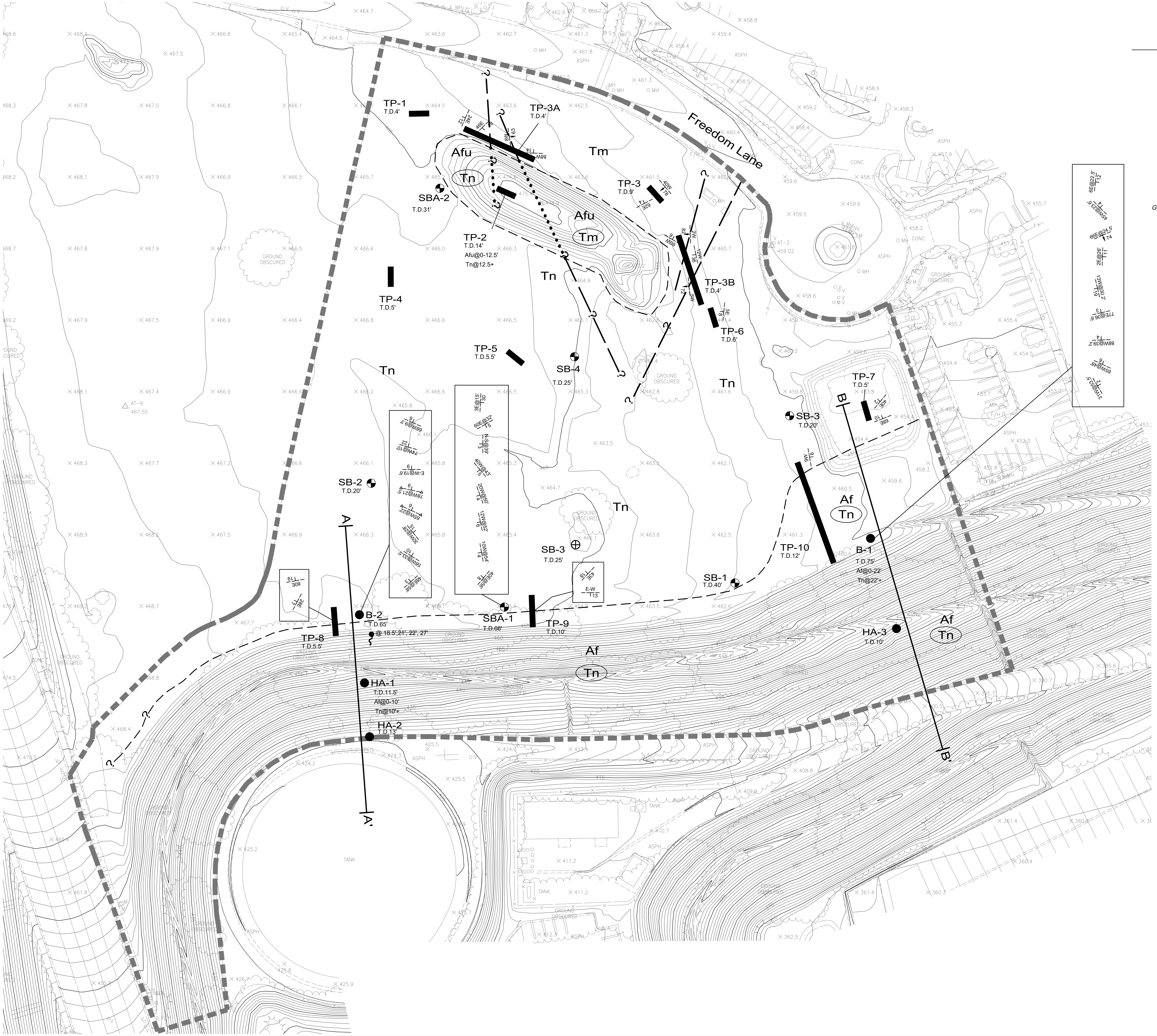
6) ROCKS UP TO 10 FEET IN THE LEAST DIMENSION MAY BE PLACED AS INDIVIDUAL ROCKS WITHIN THE COMPACTED FILL. THE FILL SOILS NEAR AND AGAINST THESE ROCKS SHOULD BE FREE OF ROCKS THAT MAY CAUSE NESTING/VOIDS WITH THE LARGER ROCKS. THIS CONDITION SHOULD BE CAREFULLY REVIEWED IN THE FIELD BY THE GEOTECHNICAL CONSULTANT TO VERIFY SATISFACTORY OPERATIONS.

7) ROCKS, LARGER THAN 10 FEET IN THE SMALLEST DIMENSION, SHOULD BE REDUCED IN SIZE TO MEET THE SPECIFIED DIMENSIONS FOR INDIVIDUAL ROCK PLACEMENT AND/OR FOR PLACEMENT IN ROCK ROWS.

FIGURE 10

OVERSIZE ROCK ROW PLACEMENT FOR ZONE B STRUCTURAL ROCK FILL

S/A


Freedom Lane
Af
Afu
Tn
Tm
TP-1 T.D.4'
TP-2 T.D.14' Afu@0-12.5' Tn@12.5+
TP-3 T.D.9'
TP-3A T.D.4'
TP-3B T.D.4'
TP-4 T.D.5'
TP-5 T.D.5.5'
TP-6 T.D.6'
TP-7 T.D.5'
TP-8 T.D.5.5'
TP-9 T.D.10'
TP-10 T.D.12'
SBA-1 T.D.66'
SBA-2 T.D.31'
SB-1 T.D.40'
SB-2 T.D.20'
SB-3 T.D.25'
SB-3 T.D.20'
SB-4 T.D.25'
B-1 T.D.75' Af@0-22' Tn@22'+
B-2 T.D.65' @ 18.5',21', 22', 27'
HA-1 T.D.11.5' Af@0-10' Tn@10'+
HA-2 T.D.13'
HA-3 T.D.10'
A A'
B B'
AT-6 467.55
AT-2 459.02
GROUND OBSCURED
TANK
ASPH
CONC
MH

LEGEND

EARTH UNITS - CIRCLED WHERE BURIED

Af	ARTIFICIAL FILL
Afu	UNCERTIFIED/UNDOCUMENTED FILL/STOCKPILE
Tn	NIGUEL FORMATION
Tm	MONTEREY FORMATION

SYMBOLS - LOCATIONS ARE APPROXIMATE, QUERIED WHERE UNCERTAIN

— — — —· · · ·	GEOLOGIC CONTACT, DOTTED WHERE BURIED
—— ——● ● ●	FAULT, DOTTED WHERE BURIED

GEOLOGIC ATTITUDES- LOCATIONS ARE APPROXIMATE, DASHED WHERE BURIED

E-W 30	BEDDING
	FAULT ATTITUDE
	CLAY BED

OTHER SYMBOLS - LOCATIONS ARE APPROXIMATE

● B-2 T.D.65'	APPROXIMATE LOCATION OF BUCKET AUGER BORING, SHOWING TOTAL DEPTH AND DEPTH TO EARTH UNITS IN FEET.
▬ T-10 T.D. 11'	APPROXIMATE TEST PIT LOCATION, SHOWING TOTAL DEPTH AND DEPTH TO EARTH UNITS IN FEET
● HA-3 T.D.10'	APPROXIMATE LOCATION OF HAND-AUGER BORING, SHOWING TOTAL DEPTH AND DEPTH TO EARTH UNITS IN FEET
SB-4 SBA-2 T.D.65'	APPROXIMATE HOLLOW STEM AUGER (SB) OR BUCKET AUGER (SBA) BORING LOCATION BY OTHERS (SOUTHERN CALIFORNIA GEOTECHNICAL, 2021), SHOWING TOTAL DEPTH.
⊕ SB-3 T.D.25'	APPROXIMATE HOLLOW STEM AUGER BORING LOCATION BY OTHERS (SOUTHERN CALIFORNIA GEOTECHNICAL, 2014), SHOWING TOTAL DEPTH.
B├─┤B'	GEOTECHNICAL CROSS-SECTION
	SEEPAGE
▬ ▬ ▬	APPROXIMATE SITE BOUDARY

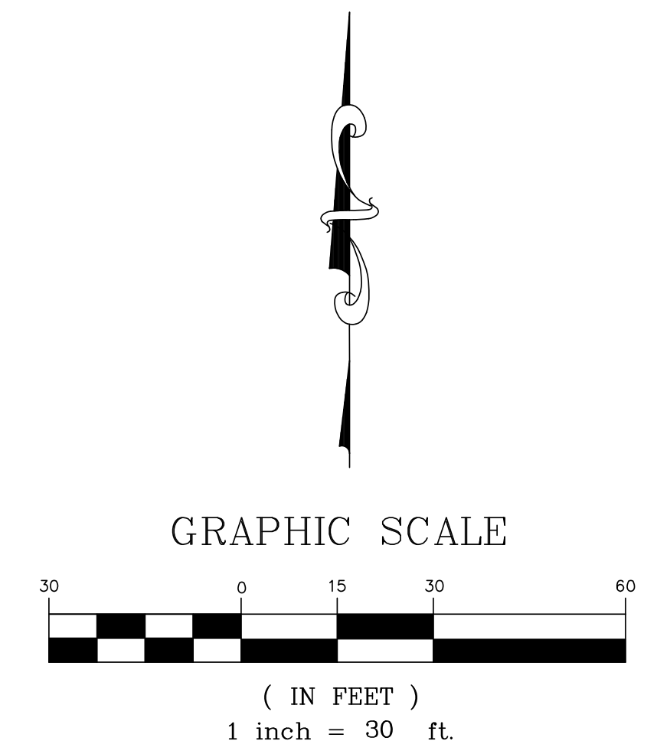

GRAPHIC SCALE
30
0
15
30
60
(IN FEET)
1 inch = 30 ft.

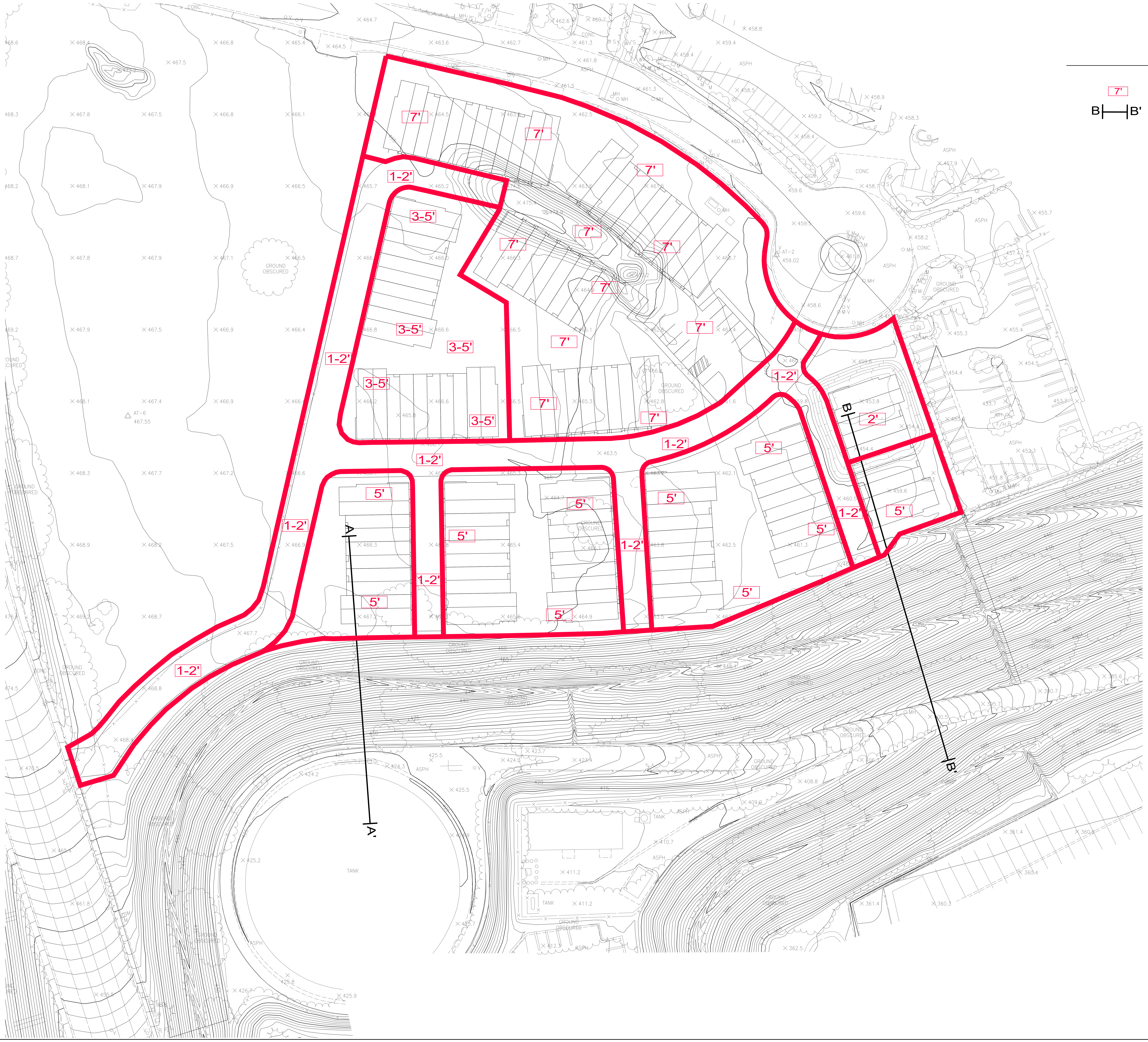
PLATE 1

GEOTECHNICAL MAP
400-700 FREEDOM LANE
CITY OF ALISO VIEJO, CALIFORNIA

Project No.: 24064-01
By: RS/AZ
Project Name: Meritage Homes/Freedom Lane
Date: 6/3/2024
SCALE: 1" = 30'

S/A

Drawing: P:\2024\24064-01 Meritage – 400-700 Freedom Ln, Aliso Viejo\Drafting_WIP\24064-01 Plate.dwg Layout: 1 Last Saved: Tue Jun 04, 2024 – 5:18pm Last Plotted: Tue Jun 04, 2024 – 5:18pm By: Anthony Zepeda


7'
3-5'
1-2'
5'
2'
A
A'
B
B'
AT-2
459.02
AT-6
467.55
GROUND OBSCURED
TANK
ASPH
CONC

LEGEND

7'	RECOMMENDED DEPTH OF REMEDIAL REMOVAL/OVEREXCAVATION, BELOW EXISTING GRADE OR PROPOSED GRADE, WHICHEVER IS LOWER
B├─┤B'	GEOTECHNICAL CROSS-SECTION

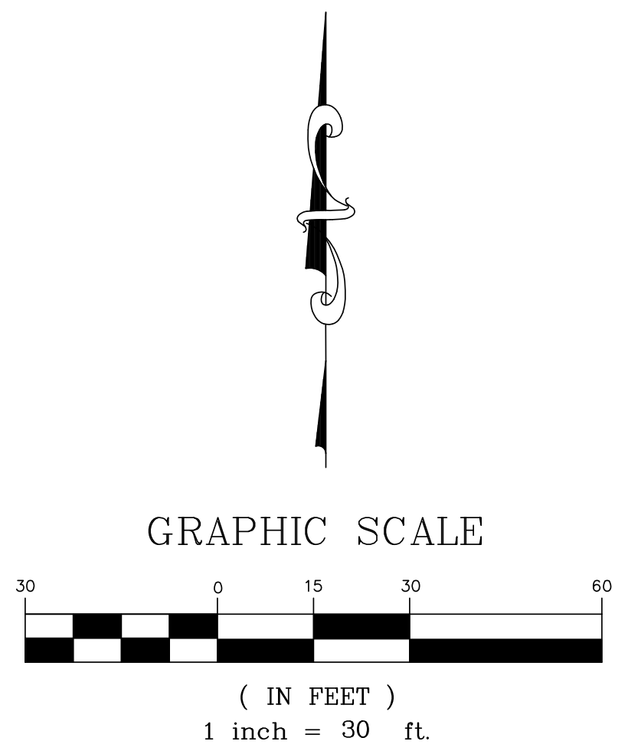

GRAPHIC SCALE
30
0
15
30
60
(IN FEET)
1 inch = 30 ft.

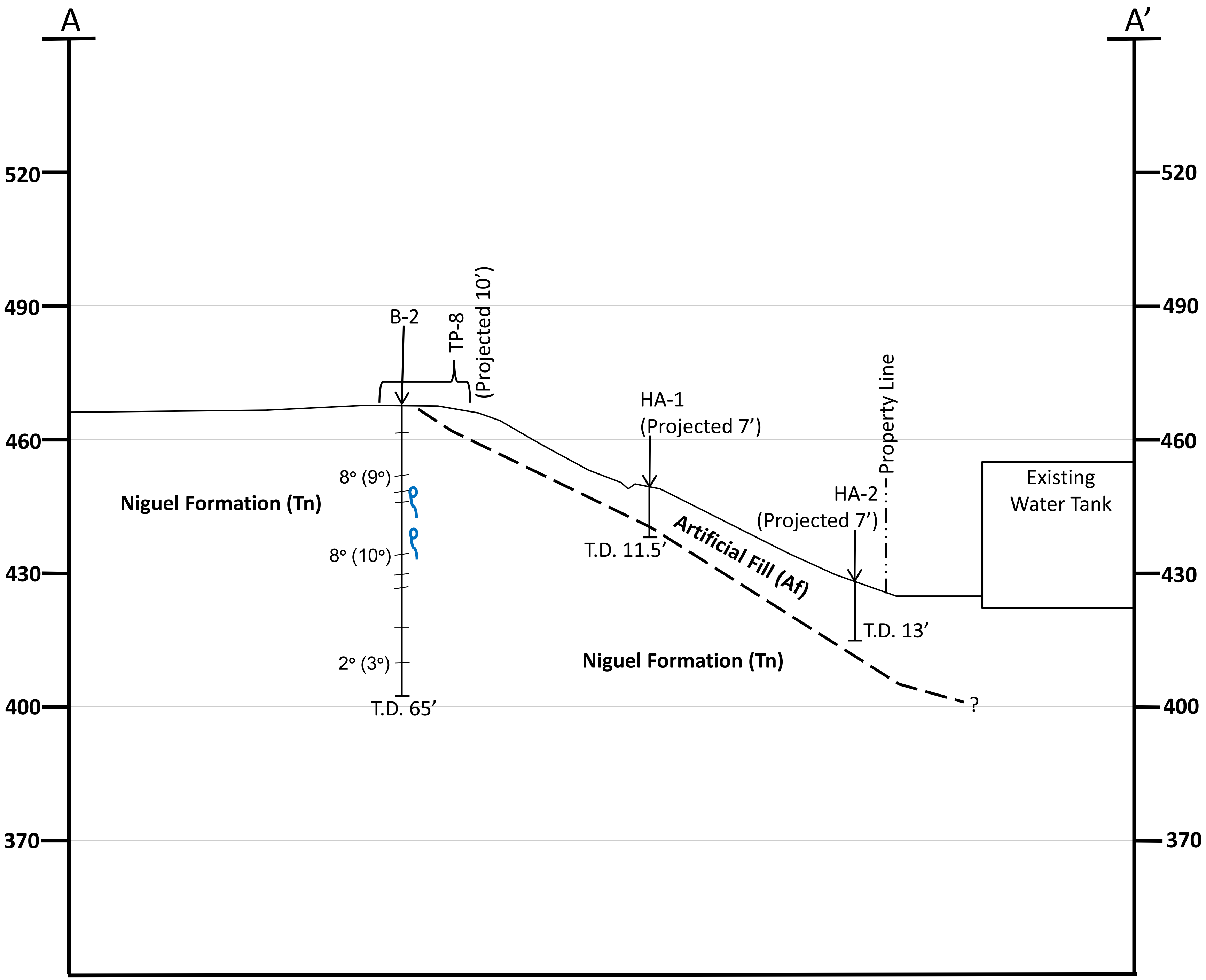
PLATE 2

REMEDIAL MEASURES MAP
400-700 FREEDOM LANE
CITY OF ALISO VIEJO, CALIFORNIA

Project No.: 24064-01 By: RS/AZ
Project Name: Meritage Homes/Freedom Lane
Date: 6/3/2024 SCALE: 1" = 30'

S/A

Drawing: P:\2024\24064-01 Meritage – 400-700 Freedom Ln, Aliso Viejo\Drafting_WIP\24064-01 Plate – Rem.dwg Layout: 2 Last Saved: Tue Jun 04, 2024 – 5:21pm Last Plotted: Tue Jun 04, 2024 – 5:21pm By: Anthony Zepeda


A
A’
520
490
460
430
400
370
520
490
460
430
400
370
B-2
TP-8
(Projected 10’)
HA-1
(Projected 7’)
Property Line
HA-2
(Projected 7’)
Existing
Water Tank
8° (9°)
8° (10°)
2° (3°)
T.D. 65’
T.D. 11.5’
T.D. 13’
Niguel Formation (Tn)
Artificial Fill (Af)
Niguel Formation (Tn)
?

Legend

N3W
←

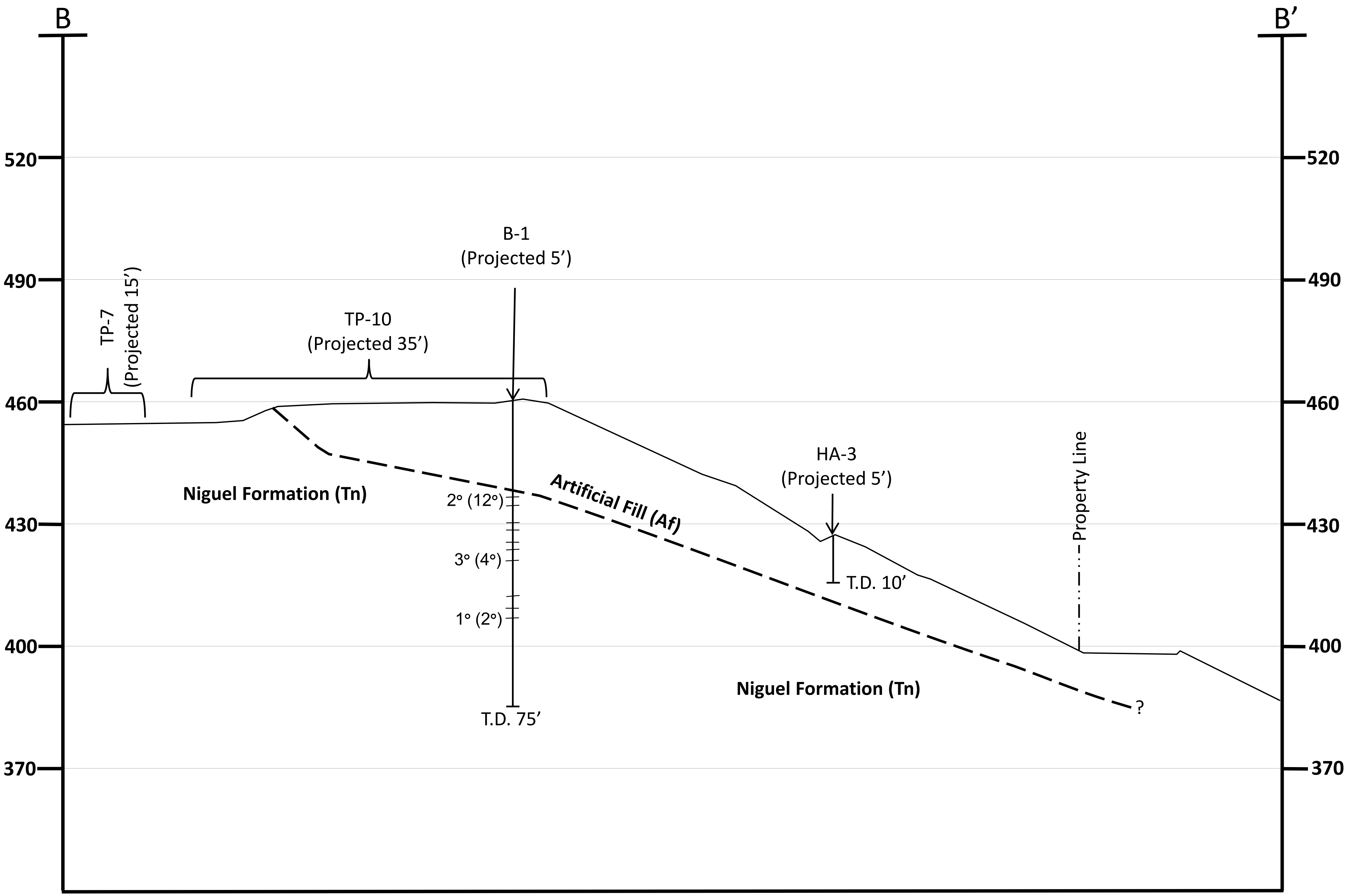
Scale: 1 inch=30 feet

Geotechnical Cross-Section A-A’

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01
Date: June 3, 2024

Plate 3


B
B’
520
490
460
430
400
370
520
490
460
430
400
370
TP-7
(Projected 15’)
TP-10
(Projected 35’)
B-1
(Projected 5’)
HA-3
(Projected 5’)
Property Line
Niguel Formation (Tn)
Artificial Fill (Af)
2° (12°)
3° (4°)
1° (2°)
T.D. 75’
T.D. 10’
Niguel Formation (Tn)
?

Legend

N15W

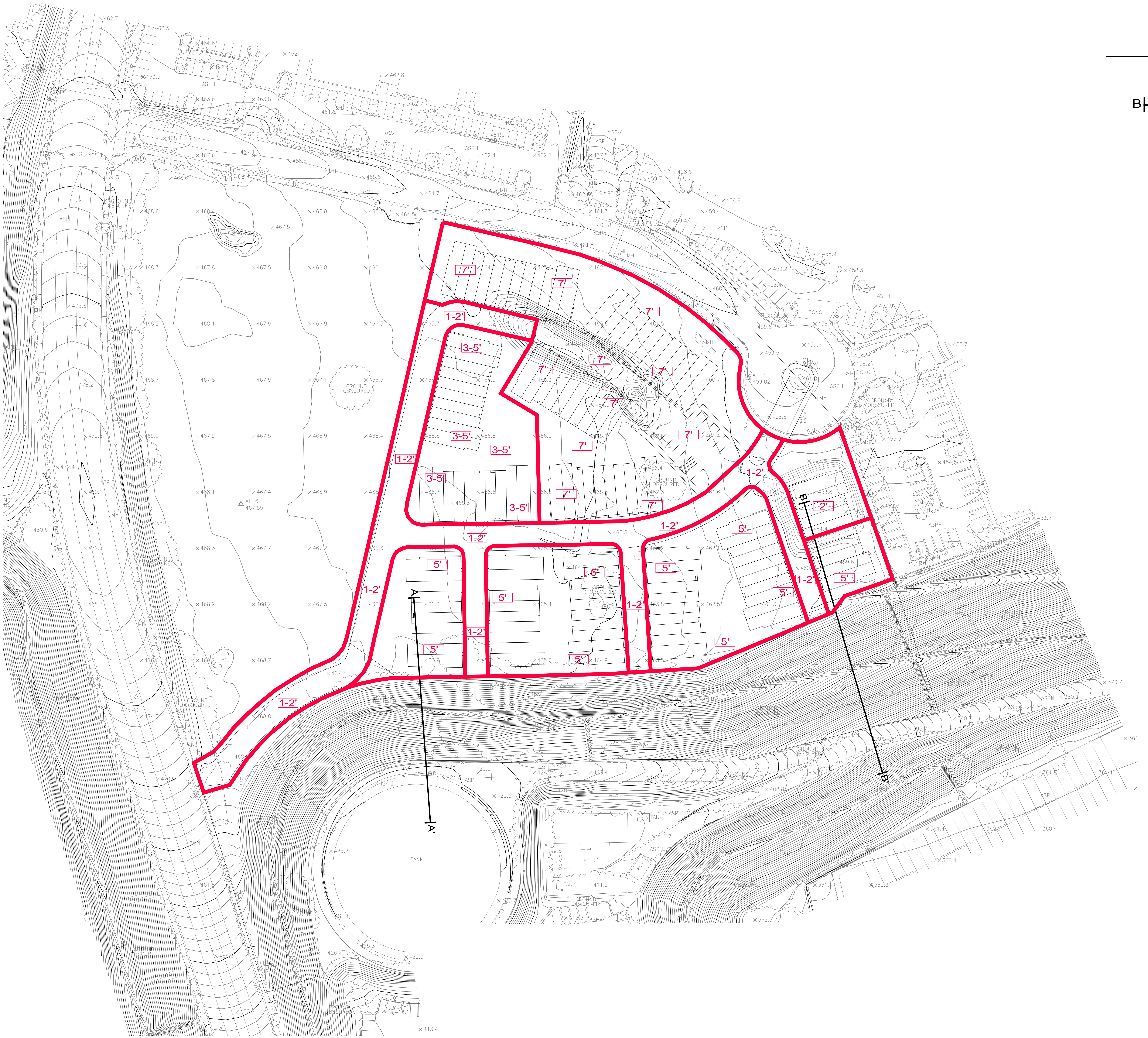
Scale: 1 inch=30 feet

Geotechnical Cross-Section B-B’

Meritage Homes
Proposed Residential Development
400-700 Freedom Lane
Aliso Viejo, California

Project Number: 24064-01
Date: June 3, 2024

Plate 4


7'
1-2'
3-5'
5'
2'
A
A'
B
B'
AT-2
459.02
AT-6
467.55
AT-5
475.40
ASPH
CONC
TANK
GROUND OBSCURED

LEGEND

7'	RECOMMENDED DEPTH OF REMEDIAL REMOVAL/OVEREXCAVATION, BELOW EXISTING GRADE OR PROPOSED GRADE, WHICHEVER IS LOWER
B├─┤B'	GEOTECHNICAL CROSS-SECTION

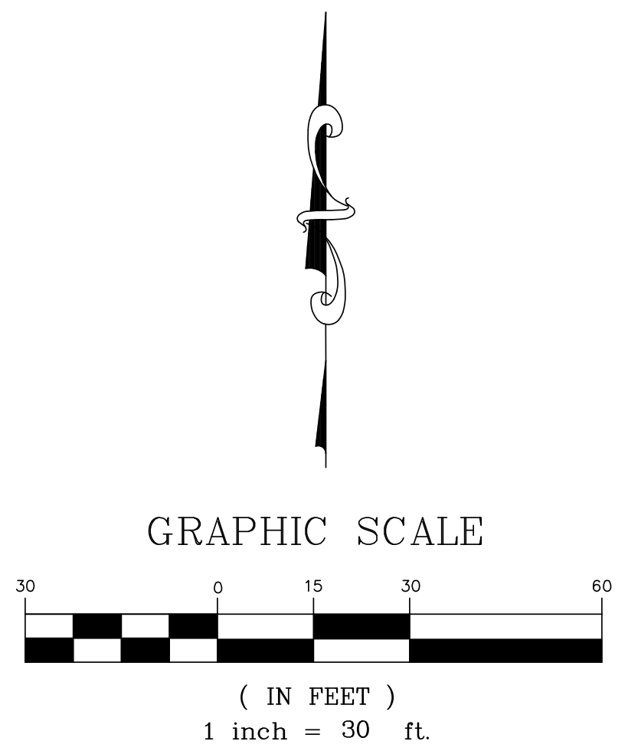

GRAPHIC SCALE
30
0
15
30
60
(IN FEET)
1 inch = 30 ft.

PLATE 2

REMEDIAL MEASURES MAP
400-700 FREEDOM LANE
CITY OF ALISO VIEJO, CALIFORNIA

Project No.: 24064-01
By: RS/AZ
Project Name: Meritage Homes/Freedom Lane
Date: 6/3/2024
SCALE: 1" = 30'

S/A