3Roots San Diego Project
Environmental Impact Report

SCH No. 2018041065; Project No. 587128

Appendix S

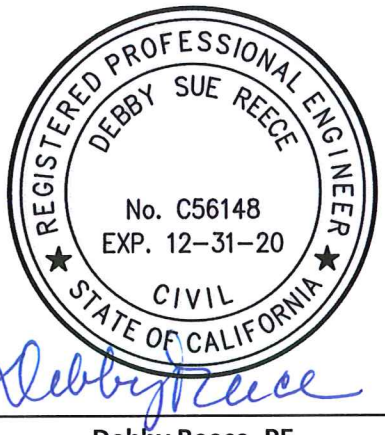
Storm Water Quality Management Plan

June 2019

CITY OF SAN DIEGO

PRIORITY DEVELOPMENT PROJECT (PDP)
STORM WATER QUALITY MANAGEMENT PLAN (SWQMP)
FOR
3 ROOTS
VTM PTS Number 587128

ENGINEER OF WORK:



Debby Reece, PE
RCE 56148, REGISTRATION EXPIRES 12/31/18

PREPARED FOR:

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San Diego, California 92127

PREPARED BY:

PROJECT DESIGN CONSULTANTS

Planning | Landscape Architecture | Engineering | Survey

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February 4, 2019

Job No. 4182.30

Approved by: City of San Diego Date

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ACRONYMS

APN	Assessor's Parcel Number
ASBS	Area of Special Biological Significance
BMP	Best Management Practice
CEQA	California Environmental Quality Act
CGP	Construction General Permit
DCV	Design Capture Volume
DMA	Drainage Management Areas
ESA	Environmentally Sensitive Area
GLU	Geomorphic Landscape Unit
GW	Ground Water
HMP	Hydromodification Management Plan
HSG	Hydrologic Soil Group
HU	Harvest and Use
INF	Infiltration
LID	Low Impact Development
LUP	Linear Underground/Overhead Projects
MS4	Municipal Separate Storm Sewer System
N/A	Not Applicable
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
PDP	Priority Development Project
PE	Professional Engineer
POC	Pollutant of Concern
SC	Source Control
SD	Site Design
SDRWQCB	San Diego Regional Water Quality Control Board
SIC	Standard Industrial Classification
SWPPP	Stormwater Pollutant Protection Plan
SWQMP	Storm Water Quality Management Plan
TMDL	Total Maximum Daily Load
WMAA	Watershed Management Area Analysis
WPCP	Water Pollution Control Program
WQIP	Water Quality Improvement Plan

CERTIFICATION PAGE

Project Name:
Permit Application Number:

I hereby declare that I am the Engineer in Responsible Charge of design of storm water BMPs for this project, and that I have exercised responsible charge over the design of the project as defined in Section 6703 of the Business and Professions Code, and that the design is consistent with the requirements of the Storm Water Standards, which is based on the requirements of SDRWQCB Order No. R9-2013-0001 as amended by R9-2015-0001 and R9-2015-0100 (MS4 Permit).

I have read and understand that the City Engineer has adopted minimum requirements for managing urban runoff, including storm water, from land development activities, as described in the Storm Water Standards. I certify that this PDP SWQMP has been completed to the best of my ability and accurately reflects the project being proposed and the applicable source control and site design BMPs proposed to minimize the potentially negative impacts of this project's land development activities on water quality. I understand and acknowledge that the plan check review of this PDP SWQMP by the City Engineer is confined to a review and does not relieve me, as the Engineer in Responsible Charge of design of storm water BMPs for this project, of my responsibilities for project design.

Debby Reece

Debby Reece, PE, RCE 56148, Registration Expires 12/31/18

Debby Reece
Print Name

Project Design Consultants
Company

3/14/19
Date



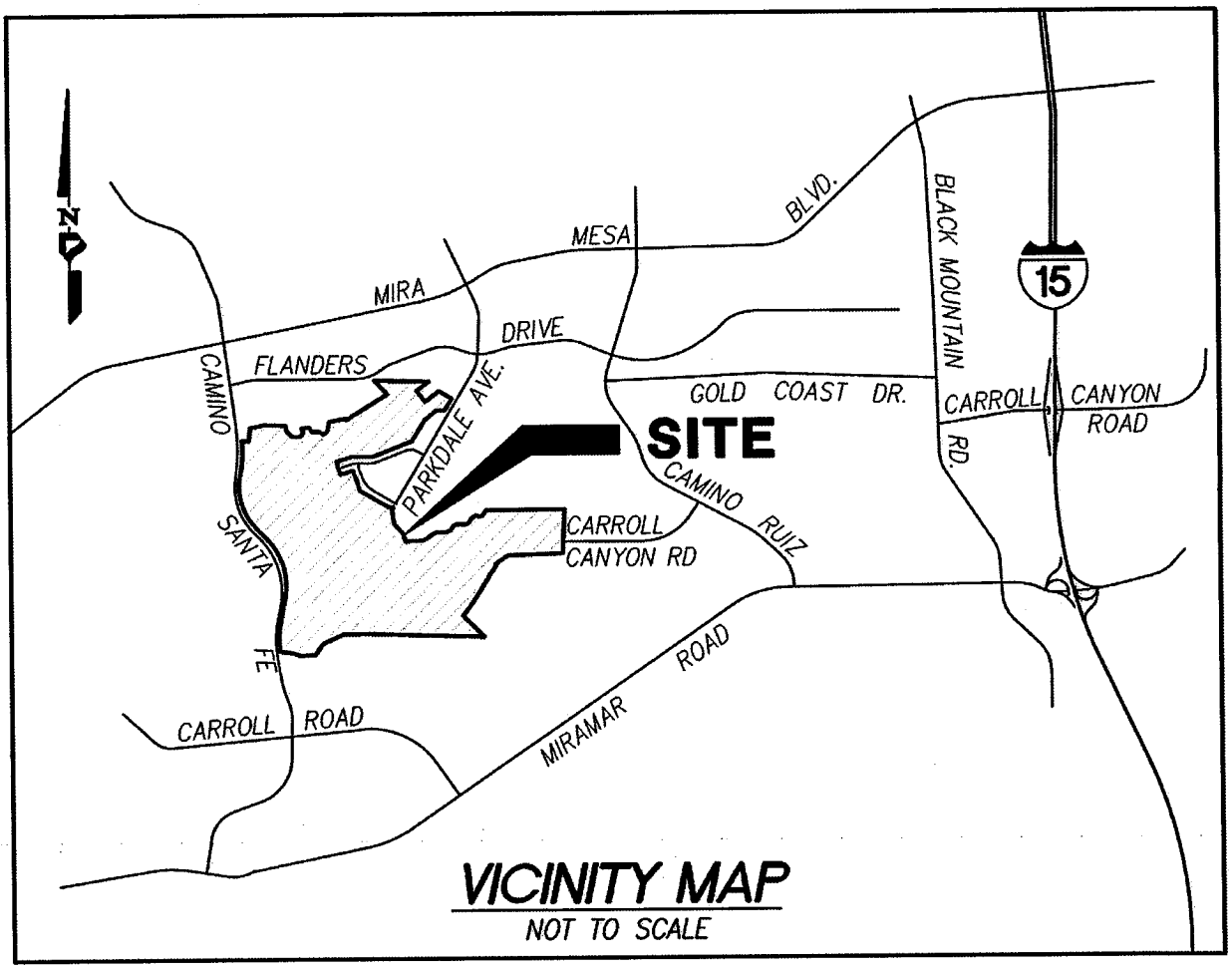
SUBMITTAL RECORD

Use this Table to keep a record of submittals of this PDP SWQMP. Each time the PDP SWQMP is re-submitted, provide the date and status of the project. In last column indicate changes that have been made or indicate if response to plancheck comments is included. When applicable, insert response to plancheck comments.

Submittal Number	Date	Project Status	Summary of Changes
1	11/20/2017	☒ Preliminary Design / Planning / CEQA ☐ Final Design	Initial Submittal
2	07/10/2018	☒ Preliminary Design / Planning / CEQA ☐ Final Design	Second Submittal
3	10/24/2018	☒ Preliminary Design / Planning / CEQA ☐ Final Design	Third Submittal
4		☐ Preliminary Design / Planning / CEQA ☐ Final Design	

PROJECT VICINITY MAP

Project Name: 3 Roots
Permit Application Number: 587128



City of San Diego
Development Services
1222 First Ave., MD-302
San Diego, CA 92101
(619) 446-5000

Storm Water Requirements Applicability Checklist

FORM **DS-560** October 2016

Project Address:	Project Number *(for the City Use Only)*:
Carroll Canyon Road & Camino Santa Fe	Click here to enter project number

SECTION 1. Construction Storm Water BMP Requirements:

All construction sites are required to implement construction BMPs in accordance with the performance standards in the Storm Water Standards Manual. Some sites are additionally required to obtain coverage under the State Construction General Permit (CGP)[1], which is administrated by the State Water Resources Control Board.

For all projects complete PART A: If project is required to submit a SWPPP or WPCP, continue to PART B.

PART A: Determine Construction Phase Storm Water Requirements.

1. Is the project subject to California's statewide General NPDES permit for Storm Water Discharges Associated with construction activities, also known as the State Construction General Permit (CGP)? (Typically projects with land disturbance greater than or equal to 1 acre.)

   ◉ Yes; SWPPP required, skip questions 2-4 ◉ No; next question

2. Does the project propose construction or demolition activity, including but not limited to, clearing, grading, grubbing, excavation, or any other activity that results in ground disturbance and contact with storm water runoff?

   ◉ Yes; WPCP required, skip questions 3-4 ◉ No; next question

3. Does the project propose routine maintenance to maintain original line and grade, hydraulic capacity, or original purpose of the facility? (projects such as pipeline/utility replacement)

   ◉ Yes; WPCP required, skip questions 4 ◉ No; next question

4. Does the project only include the following Permit types listed below?
   - Electrical Permit, Fire Alarm Permit, Fire Sprinkler Permit, Plumbing Permit, Sign Permit, Mechanical Permit, Spa Permit.
   - Individual Right of Way Permits that exclusively include one of the following activities and associated curb/ sidewalk repair: water services, sewer lateral, storm drain lateral, or dry utility service.
   - Right of Way Permits with a project footprint less than 150 linear feet that exclusively include only ONE of the following activities: curb ramp, sidewalk and driveway apron replacement, curb and gutter replacement, and retaining wall encroachments.

   ☐ Yes; no document required

Check one of the boxes to the right, and continue to PART B:

☒ If you checked "Yes" for question 1,
a SWPPP is REQUIRED. Continue to PART B

☐ If you checked "No" for question 1, and checked "Yes" for question 2 or 3,
a WPCP is REQUIRED. If the project processes less than 5,000 square feet of ground disturbance AND has less than a 5-foot elevation change over the entire project area, a Minor WPCP may be required instead. **Continue to PART B.**

☐ If you checked "No" for all question 1-3, and checked "Yes" for question 4
PART B **does not apply and no document is required. Continue to Section 2.**

More information on the City's construction BMP requirements as well as CGP requirements can be found at:
www.sandiego.gov/stormwater/regulations/swguide/constructing.shtml

PART B: Determine Construction Site Priority.

This prioritization must be completed within this form, noted on the plans, and included in the SWPPP or WPCP. The city reserves the right to adjust the priority of projects both before and after construction. Construction projects are assigned an inspection frequency based on if the project has a "high threat to water quality." The City has aligned the local definition of "high threat to water quality" to the risk. Determination approach of the Stat e Construction General Permit (CGP). The CGP determines risk level based on project specific sediment risk and receiving water risk. Additional inspection is required for projects within the Areas of Special Biological Significance (ASBS) watershed. **NOTE:** The construction priority does **NOT** change construction BMP requirements that apply to projects; rather, it determines the frequency of inspections that will be conducted by city staff.

Complete PART B and continued to Section 2

1. ☐ **ASBS**
   a. Projects located in the ASBS watershed. A map of the ASBS watershed can he found here *<placeholder for ASBS map link>*

2. ☒ **High Priority**
   a. Projects 1 acre or more determined to be Risk Level 2 or Risk Level 3 per the Construction General Permit and not located in the ASBS watershed.
   b. Projects 1 acre or more determined to be LUP Type 2 or LUP Type 3 per the Construction General Permit and not located in the ASBS watershed.

3. ☐ **Medium Priority**
   a. Projects 1 acre or more but not subject to an ASBS or high priority designation.
   b. Projects determined to be Risk Level 1 or LUP Type 1 per the Construction General Permit and not located in the ASBS watershed.

4. ☐ **Low Priority**
   a. Projects not subject to ASBS, high or medium priority designation.

SECTION 2. Permanent Storm Water BMP Requirements.

Additional information for determining the requirements is found in the Storm Water Standards Manual.

PART C: Determine if Not Subject to Permanent Storm Water Requirements.

Projects that are considered maintenance, or otherwise not categorized as "new development projects" or "redevelopment projects" according to the Storm Water Standards Manual are not subject to Permanent Storm Water
BMPs.

If "yes" is checked for any number in Part C, proceed to Part F and check "Not Subject to Permanent Storm Water BMP Requirements".

If "no" is checked for all of the numbers in Part C continue to Part D.

1.	Does the project only include interior remodels and/or is the project entirely within an existing enclosed structure and does not have the potential to contact storm water?	◉ Yes ◉ No
2.	Does the project only include the construction of overhead or underground utilities without creating new impervious surfaces?	◉ Yes ◉ No
3.	Does the project fall under routine maintenance? Examples include, but are not limited to: roof or exterior structure surface replacement, resurfacing or reconfiguring surface parking lots or existing roadways without expanding the impervious footprint, and routine replacement of damaged pavement (grinding, overlay, and pothole repair).	◉ Yes ◉ No

PART D: PDP Exempt Requirements.

PDP Exempt projects are required to implement site design and source control BMPs.

If "yes" was checked for any questions in Part D, continue to Part F and check the box labeled "PDP Exempt."
If "no" was checked for all questions in Part D, continue to Part E.

1. Does the project ONLY include new or retrofit sidewalks, bicycle lanes, or trails that:

   • Are designed and constructed to direct storm water runoff to adjacent vegetated areas, or other non-erodible permeable areas? Or;
   • Are designed and constructed to be hydraulically disconnected from paved streets and roads? Or;
   • Are designed and constructed with permeable pavements or surfaces in accordance with the Green Streets guidance in the City's Storm Water Standards manual?

   ○ Yes; PDP exempt requirements apply ◉ No; next question

2. Does the project ONLY include retrofitting or redeveloping existing paved alleys, streets or roads designed and constructed in accordance with the Green Streets guidance in the City's Storm Water Standards Manual?

   ○ Yes; PDP exempt requirements apply ◉ No; PDP not exempt. PDP requirements apply.

PART E: Determine if Project is a Priority Development Project (PDP). Projects that match one of the definitions below are subject to additional requirements including preparation of a Storm Water Quality Management Plan (SWQMP).

If "yes" is checked for any number in PART E, continue to PART F and check the box labeled "Priority Development Project".
If "no" is checked for every number in PART E, continue to PART F and check the box labeled "Standard Project".

1.	**New Development that creates 10,000 square feet or more of impervious surfaces collectively over the project site.** This includes commercial, industrial, residential, mixed-use, and public development projects on public or private land.	○ Yes ◉ No
2.	**Redevelopment project that creates and/or replaces 5,000 square feet or more of impervious surfaces on an existing site of 10,000 square feet or more of impervious surfaces.** This includes commercial, industrial, residential, mixed-use, and public development projects on public or private land.	◉ Yes ○ No
3.	**New development or redevelopment of a restaurant.** Facilities that sell prepared foods and drinks for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption (SIC 5812), and where the land development creates and/or replace 5,000 square feet or more of impervious surface.	◉ Yes ○ No
4.	**New development or redevelopment on a hillside.** The project creates and/or replaces 5,000 square feet or more of impervious surface (collectively over the project site) and where the development will grade on any natural slope that is twenty-five percent or greater.	◉ Yes ○ No

5. **New development or redevelopment of a parking lot that creates and/or replaces 5,000 square feet or more of impervious surface (collectively over the project site).**	◉ Yes ◉ No
6. **New development or redevelopment of streets, roads, highways, freeways, and driveways.** The project creates and/or replaces 5,000 square feet or more of impervious surface (collectively over the project site).	◉ Yes ◉ No
7. **New development or redevelopment discharging directly to an Environmentally Sensitive Area.** The project creates and/or replaces 2,500 square feet of impervious surface (collectively over project site), and discharges directly to an Environmentally Sensitive Area (ESA). "Discharging- directly to" includes flow that is conveyed overland a distance of 200 feet or less from the project to the ESA, or conveyed in a pipe or open channel any distance as an isolated flow from the project to the ESA (i.e. not commingled with flows from adjacent lands).	◉ Yes ◉ No
8. **New development or redevelopment projects of a retail gasoline outlet that creates and/or replaces 5,000 square feet of impervious surface.** The development project meets the following criteria: (a) 5,000 square feet or more or (b) has a projected Average Daily Traffic of 100 or more vehicles per day.	◉ Yes ◉ No
9. **New development or redevelopment projects of an automotive repair shops that creates and/or replaces 5,000 square feet or more of impervious surfaces.** Development projects categorized in any one of Standard Industrial Classification (SIC) codes 5013, 5014, 5541, 7532-7534, or 7536-7539.	◉ Yes ◉ No
10. **Other Pollutant Generating Project.** The project is not covered in the categories above, results in the disturbance of one or more acres of land and is expected to generate pollutants post construction, such as fertilizers and pesticides. This does not include projects creating less than 5,000 sf of impervious surface and where added landscaping does not require regular use of pesticides and fertilizers, such as slope stabilization using native plants. Calculation of the square footage of impervious surface need not include linear pathways that are for infrequent vehicle use, such as emergency maintenance access or bicycle pedestrian use, if they are built with pervious surfaces of if they sheet flow to surrounding pervious surfaces.	◉ Yes ◉ No

PART F: Select the appropriate category based on the outcomes of PART C through PART E.

1. The project is **NOT SUBJECT TO STORM WATER REQUIREMENTS**.	☐
2. The project is a **STANDARD PROJECT**. Site design and source control BMP requirements apply. See the Storm Water Standards Manual for guidance.	☐
3. The project is **PDP EXEMPT**. Site design and source control BMP requirements apply. See the Storm Water Standards Manual for guidance.	☐
4. The project is a **PRIORITY DEVELOPMENT PROJECT**. Site design, source control, and structural pollutant control BMP requirements apply. See the Storm Water Standards Manual for guidance on determining if project requires hydromodification management.	☒

Name of Owner or Agent *(Please Print)*: Click here to enter name.	Title: Click here to enter title
Signature:	Date: Insert Date

Project Name: 3 Roots

Applicability of Permanent, Post-Construction Storm Water BMP Requirements (Storm Water Intake Form for all Development Permit Applications)	Form I-1
Project Identification	
Project Name: **3 ROOTS**	
Permit Application Number: **PTS 587128**	Date: 10/24/2018
Determination of Requirements	
The purpose of this form is to identify permanent, post-construction requirements that apply to the project. This form serves as a short summary of applicable requirements, in some cases referencing separate forms that will serve as the backup for the determination of requirements. Answer each step below, starting with Step 1 and progressing through each step until reaching "Stop". Refer to Part 1 of Storm Water Standards sections and/or separate forms referenced in each step below.	

Step	Answer	Progression
Step 1: Is the project a "development project"? See Section 1.3 of the BMP Design Manual (Part 1 of Storm Water Standards) for guidance.	☒ Yes	Go to Step 2.
	☐ No	Stop. Permanent BMP requirements do not apply. No SWQMP will be required. Provide discussion below.
Discussion / justification if the project is not a "development project" (e.g., the project includes *only* interior remodels within an existing building):		
Step 2: Is the project a Standard Project, Priority Development Project (PDP), or exception to PDP definitions? To answer this item, see Section 1.4 of the BMP Design Manual (Part 1 of Storm Water Standards) in its entirety for guidance, AND complete Storm Water Requirements Applicability Checklist.	☐ Standard Project	Stop. Standard Project requirements apply.
	☒ PDP	PDP requirements apply, including PDP SWQMP. Go to Step 3.
	☐ PDP Exempt	Stop. Standard Project requirements apply. Provide discussion and list any additional requirements below.

Form I-1		
[Step 2 Continued from Page 1] Discussion / justification, and additional requirements for exceptions to PDP definitions, if applicable:		
Step 3: Is the project subject to earlier PDP requirements due to a prior lawful approval? See Section 1.10 of the BMP Design Manual (Part 1 of Storm Water Standards) for guidance.	☐Yes	Consult the City Engineer to determine requirements. Provide discussion and identify requirements below. Go to Step 4.
	☒No	BMP Design Manual PDP requirements apply. Go to Step 4.
Discussion / justification of prior lawful approval, and identify requirements (*not required if prior lawful approval does not apply*):		
Step 4: Do hydromodification control requirements apply? See Section 1.6 of the BMP Design Manual (Part 1 of Storm Water Standards) for guidance.	☒Yes	PDP structural BMPs required for pollutant control (Chapter 5) and hydromodification control (Chapter 6). Go to Step 5.
	☐No	Stop. PDP structural BMPs required for pollutant control (Chapter 5) only. Provide brief discussion of exemption to hydromodification control below.
Discussion / justification if hydromodification control requirements do <u>not</u> apply:		
Step 5: Does protection of critical coarse sediment yield areas apply? See Section 6.2 of the BMP Design Manual (Part 1 of Storm Water Standards) for guidance.	☒Yes	Management measures required for protection of critical coarse sediment yield areas (Chapter 6.2). Stop.
	☐N/A	Management measures not required for protection of critical coarse sediment yield areas. Provide brief discussion below. Stop.
Discussion / justification if protection of critical coarse sediment yield areas does <u>not</u> apply:		

Site Information Checklist For PDPs	Form I-3B
Project Summary Information	
Project Name	3 ROOTS
Project Address	10211 Camino Santa Fe, San Diego, CA
Assessor's Parcel Number(s) (APN(s))	341-050-38-00 THROUGH 341-050-42-00 341-051-17-00 THROUGH 341-060-82-00
Permit Application Number	
Project Watershed	Select One: ☐San Dieguito ☒Penasquitos ☐Mission Bay ☐San Diego River ☐San Diego Bay ☐Tijuana River
Hydrologic subarea name with Numeric Identifier up to two decimal places (9XX.XX)	Miramar Reservoir 906.10
Parcel Area (total area of Assessor's Parcel(s) associated with the project)	412.9 Acres (Square Feet)
Area to be Disturbed by the Project (Project Area)	261.9 Acres (Square Feet)
Project Proposed Impervious Area (subset of Project Area)	149 Acres (Square Feet)
Project Proposed Pervious Area (subset of Project Area)	112.9 Acres (Square Feet)
Note: Proposed Impervious Area + Proposed Pervious Area = Area to be Disturbed by the Project. This may be less than the Parcel Area.	
The proposed increase or decrease in impervious area in the proposed condition as compared to the pre-project condition	205 %

Form I-3B
Description of Existing Site Condition
Current Status of the Site (select all that apply): ☒ Existing development ☒ Previously graded but not built out ☐Demolition completed without new construction ☐ Agricultural or other non-impervious use ☒ Vacant, undeveloped/natural Description / Additional Information: Presently the site is developed as an aggregate quarry.
Existing Land Cover Includes (select all that apply): ☒ Vegetative Cover ☒ Non-Vegetated Pervious Areas ☒ Impervious Areas Description / Additional Information: The site consists predominately of dirt. Paved and unpaved access roads, paved parking lots, and buildings. Also numerous stockpiles of soil and aggregate are still present on site.
Underlying Soil belongs to Hydrologic Soil Group (select all that apply): ☒ NRCS Type A ☐ NRCS Type B ☐ NRCS Type C ☒ NRCS Type D
Approximate Depth to Groundwater (GW): ☐ GW Depth < 5 feet ☒ 5 feet < GW Depth < 10 feet ☒ 10 feet < GW Depth < 20 feet ☒ GW Depth > 20 feet Refer to Geocon's Soils report for more information on groundwater depths.
Existing Natural Hydrologic Features (select all that apply): ☒ Watercourses ☐ Seeps ☐ Springs ☒ Wetlands ☐ None Description / Additional Information: There are two existing natural watercourses running through the work area, Carroll Canyon Creek in the southern part and an unnamed creek in the north.

Form I-3B

Description of Existing Site Drainage Patterns

How is storm water runoff conveyed from the site? At a minimum, this description should answer:

1. *Whether existing drainage conveyance is natural or urban;*
2. *If runoff from offsite is conveyed through the site? If yes, quantification of all offsite drainage areas, design flows, and locations where offsite flows enter the project site and summarize how such flows are conveyed through the site;*
3. *Provide details regarding existing project site drainage conveyance network, including storm drains, concrete channels, swales, detention facilities, storm water treatment facilities, and natural and constructed channels;*
4. *Identify all discharge locations from the existing project along with a summary of the conveyance system size and capacity for each of the discharge locations. Provide summary of the pre-project drainage areas and design flows to each of the existing runoff discharge locations.*

Description/ Additional Information:

1) The existing drainage conveyance is mostly natural. The existing storm drain system in Camino Santa Fe collects the runoff from the western portion of the site.
2) Canyons with steep slopes border the southern and northern edges of the project site, and drain down from project site boundary to downstream creeks. Thus bordered canyons do not generate runon through the project site. There are a couple of fragments of area outside the project boundary at the southern industrial area which drains onto the site, but generally no significant amount of runon from other sides of the project site.
3) The existing drainage conveyance network consists of (North to South):
   -A tributary creek of Carroll Canyon Creek running through the north part of the site.
   -A storm drain system collecting the runoff from the north-western portion of the site. The system consists of a 60inch RCP with design 100 peak flow of 98.4 cfs [per Drawing #31390-6-D]
   - A storm drain system along Camino Santa Fe, which consists of a 24inch RCP with design 100 year peak flow of 24 cfs [per Drawing #31390-9-D]
   - A storm drain system along Camino Santa Fe, which consists of a 30inch RCP with design 100 year peak flow of 41.7 cfs [per Drawing #31390-10-D]
   -A storm drain system along Camino Santa Fe, which consists of a 4-12"x14" box culvert with design 100-year peak flow of 4500 cfs [per Drawing #31390-14-D]
4) In existing conditions, the project runoff discharges into existing natural channels (one running through the north part of the project site, the other south). The northern natural channel runs under Camino Santa Fe and drains into a vacant lot on the east part of El Camino Memorial Park. The southern natural channel runs through the box culvert under Camino Santa Fe and drains to a downstream canyon.

Form I-3B
Description of Proposed Site Development
Project Description / Proposed Land Use and/or Activities: The 3Roots San Diego Project is a proposed mixed-use community located in the City of San Diego. The site is approximately 412 acres in size and is located east of Camino Santa Fe, approximately halfway between Mira Mesa Boulevard and Miramar Road, and west of Carrol Canyon Rd and Parkdale Avenue. The Property was formerly operated as a sand and gravel mining site and was previously owned by Hanson Aggregates Pacific Southwest, Inc. (Hanson). The Proposed Project includes approximately 247 acres of open space (including approximately 178 acres of natural open space, landscaped slopes and 69 acres of parkland), 530 unites of single family residential, 1090 units of multi-family residential and 180 units of affordable housing, by a proposed 1.5-acre on-site Transit Center adjacent to the intersection of Camino Santa Fe and Carroll Canyon Road.
List/describe proposed impervious features of the project (e.g., buildings, roadways, parking lots, courtyards, athletic courts, other impervious features): The project includes the following impervious features: streets, driveways, buildings, parking lots, walkways, hardscape and courtyards.
List/describe proposed pervious features of the project (e.g., landscape areas): The project includes the following pervious features: Parks, landscaped areas and trees placed throughout the development.
Does the project include grading and changes to site topography? ☒ Yes ☐ No Description / Additional Information: Under current conditions, the site is occupied by undeveloped steep slopes, partially graded and ungraded land, paved areas and roads located within the Lehigh Hanson aggregate mine area. All onsite flows generally sheet flow into two existing natural channels (Carroll Canyon Creek to the south and the other to the north). Under proposed conditions, the site will be mass graded in phases to build structures, private homes, and apartment complexes with associated parking lots, walkways, courtyards, and hardscaping and landscaped areas throughout the development. In general, proposed onsite drainage patterns will mimic existing condition drainage patterns. Post-construction drainage patterns and conveyance systems are shown on the DMA Exhibit in Attachment 1.

Form I-3B
Description of Proposed Site Drainage Patterns

Does the project include changes to site drainage (e.g., installation of new storm water conveyance systems)?

☒ Yes

☐ No

If yes, provide details regarding the proposed project site drainage conveyance network, including storm drains, concrete channels, swales, detention facilities, storm water treatment facilities, natural and constructed channels, and the method for conveying offsite flows through or around the proposed project site. Identify all discharge locations from the proposed project site along with a summary of the conveyance system size and capacity for each of the discharge locations. Provide a summary of pre and post-project drainage areas and design flows to each of the runoff discharge locations. Reference the drainage study for detailed calculations.

Describe proposed site drainage patterns:

The existing drainage system consists of four main storm drain systems ranging from 24-inch to 60-inch RCP, and a large box culvert.

Proposed development will not significantly alter ultimate discharge points of onsite and offsite runoff. Flows generated at slopes south and north of the Project site will primarily be collected in inlets, prior to entering the developed area and will be conveyed through storm drain systems to the downstream channels. Generally, proposed onsite drainage patterns will mimic existing drainage patterns. Some local re-direction of runoff occurs onsite, however most flows converge in the storm drain system on the west side of Camino Santa Fe and ultimately discharge into Carroll Canyon Creek.

The major part of the project site will continue to discharge to the downstream channel upstream of Camino Santa Fe public storm drain box culvert. The proposed drainage improvements include private storm drains collecting rooftop and surface drainage and public storm drains in public roads. Refer to the project drainage study for additional information.

Form I-3B

Identify whether any of the following features, activities, and/or pollutant source areas will be present (select all that apply):

- ☒ On-site storm drain inlets
- ☒ Interior floor drains and elevator shaft sump pumps
- ☒ Interior parking garages
- ☒ Need for future indoor & structural pest control
- ☒ Landscape/Outdoor Pesticide Use
- ☒ Pools, spas, ponds, decorative fountains, and other water features
- ☒ Food service
- ☒ Refuse areas
- ☐ Industrial processes
- ☒ Outdoor storage of equipment or materials
- ☐ Vehicle and Equipment Cleaning
- ☐ Vehicle/Equipment Repair and Maintenance
- ☐ Fuel Dispensing Areas
- ☒ Loading Docks
- ☒ Fire Sprinkler Test Water
- ☒ Miscellaneous Drain or Wash Water
- ☒ Plazas, sidewalks, and parking lots
- ☒ Large Trash Generating Facilities
- ☐ Animal Facilities
- ☐ Plant Nurseries and Garden Centers
- ☐ Automotive-related Uses

Description / Additional Information:

Form I-3B
Identification and Narrative of Receiving Water
Narrative describing flow path from discharge location(s), through urban storm conveyance system, to receiving creeks, rivers, and lagoons and ultimate discharge location to Pacific Ocean (or bay, lagoon, lake or reservoir, as applicable) A portion of the project site runoff will be conveyed towards the north of the site into the creek running across the north portion of the site, the creek will eventually converge with Carroll Canyon Creek downstream. The remaining portion will be conveyed towards the south of the site to Carroll Canyon Creek and will eventually drain into the Los Penasquitos Lagoon.
Provide a summary of all beneficial uses of receiving waters downstream of the project discharge locations **Beneficial Uses for Inland Surface Waters (Carroll Canyon Creek):** AGR - Agricultural Supply: Includes use of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing. IND - Industrial Services Supply: Includes use of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well re-pressurization. REC1 - Contact Recreation: Includes use of water for recreational activities involving body contact with water where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and SCUBA diving, surfing, white water activities, fishing, or use of natural hot springs. REC2 - Non-Contact Recreation: Includes use of water for recreation involving proximity to water, but not normally involving body contact with water where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, camping, boating, tide pool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities. COLD - Includes uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish or wildlife, including invertebrates. WARM - Includes uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish or wildlife, including invertebrates. WILD - Wildlife Habitat: Includes uses of water that support terrestrial ecosystems including but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife, (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife and food sources. RARE - Rare, Threatened, or Endangered Species: Includes uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species **Beneficial Uses for Groundwater (Miramar Reservoir):** MUN - Includes uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.

AGR - Agricultural Supply: Includes use of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.

IND - Industrial Services Supply: Includes use of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well re-pressurization.

Identify all ASBS (areas of special biological significance) receiving waters downstream of the project discharge locations.

There is not an ASBS receiving water downstream of 3 ROOTS.

Provide distance from project outfall location to impaired or sensitive receiving waters.

Carroll Canyon Creek is 303(d) listed and it drains through the project site.

Summarize information regarding the proximity of the permanent, post-construction storm water BMPs to the City's Multi-Habitat Planning Area and environmentally sensitive lands.
MHPA locations are adjacent to the site. BMPs are located out of ESL areas.

Form I-3B

Identification of Receiving Water Pollutants of Concern

List any 303(d) impaired water bodies within the path of storm water from the project site to the Pacific Ocean (or bay, lagoon, lake or reservoir, as applicable), identify the pollutant(s)/stressor(s) causing impairment, and identify any TMDLs and/or Highest Priority Pollutants from the WQIP for the impaired water bodies:

303(d) Impaired Water Body	Pollutant(s)/Stressor(s)	TMDLs / WQIP Highest Priority Pollutant
Carroll Canyon	Benthic Community Effects and Toxicity	WQIP Highest Priority Pollutants: hydromodification, siltation, bacteria
Miramar Reservoir	Total Nitrogen as N	Total Nitrogen as N
Pacific Ocean Shoreline, Miramar Reservoir HA, at Los Penasquitos River mouth	Total Coliform	Total Coliform

Identification of Project Site Pollutants*

*Identification of project site pollutants is only required if flow-thru treatment BMPs are implemented onsite in lieu of retention or biofiltration BMPs (note the project must also participate in an alternative compliance program unless prior lawful approval to meet earlier PDP requirements is demonstrated)

Identify pollutants anticipated from the project site based on all proposed use(s) of the site (see BMP Design Manual (Part 1 of Storm Water Standards) Appendix B.6):

Pollutant	Not Applicable to the Project Site	Expected from the Project Site	Also a Receiving Water Pollutant of Concern
Sediment		X	

Nutrients		x	x
Heavy Metals		x	x
Organic Compounds		x	x
Trash & Debris		x	x
Oxygen Demanding Substances		x	
Oil & Grease		x	
Bacteria & Viruses	x		
Pesticides		x	x

Form I-3B

Hydromodification Management Requirements

Do hydromodification management requirements apply (see Section 1.6 of the BMP Design Manual)?

- (●) Yes, hydromodification management flow control structural BMPs required.
- ( ) No, the project will discharge runoff directly to existing underground storm drains discharging directly to water storage reservoirs, lakes, enclosed embayments, or the Pacific Ocean.
- ( ) No, the project will discharge runoff directly to conveyance channels whose bed and bank are concrete-lined all the way from the point of discharge to water storage reservoirs, lakes, enclosed embayments, or the Pacific Ocean.
- ( ) No, the project will discharge runoff directly to an area identified as appropriate for an exemption by the WMAA for the watershed in which the project resides.

Description / Additional Information (to be provided if a 'No' answer has been selected above):

Refer to separate Hydromodification study prepared by Project Design Consultants.

Critical Coarse Sediment Yield Areas*

***This Section only required if hydromodification management requirements apply**

Based on Section 6.2 and Appendix H does CCSYA exist on the project footprint or in the upstream area draining through the project footprint?

- (●) Yes
- ( ) No, No critical coarse sediment yield areas to be protected based on WMAA maps

Discussion / Additional Information:

CCSYAs exist on the project footprint. Detailed analysis can be found in Attachment 2.

Form I-3B

Flow Control for Post-Project Runoff* *This Section only required if hydromodification management requirements apply
List and describe point(s) of compliance (POCs) for flow control for hydromodification management (see Section 6.3.1). For each POC, provide a POC identification name or number correlating to the project's HMP Exhibit and a receiving channel identification name or number correlating to the project's HMP Exhibit. The POCs include POC 1, 6, 7, 8, 9 and 10. Refer to the Hydromodification Study for further information.
Has a geomorphic assessment been performed for the receiving channel(s)? ☐ No, the low flow threshold is 0.1Q2 (default low flow threshold) ☐ Yes, the result is the low flow threshold is 0.1Q2 ☐ Yes, the result is the low flow threshold is 0.3Q2 ☒ Yes, the result is the low flow threshold is 0.5Q2 If a geomorphic assessment has been performed, provide title, date, and preparer: Yes, a geomorphic assessment has been prepared. Downstream Channel Assessment / SWCCP report prepared by Chang Consultants will be submitted with next submittal. Discussion / Additional Information: (optional)

Form I-3B
Other Site Requirements and Constraints
When applicable, list other site requirements or constraints that will influence storm water management design, such as zoning requirements including setbacks and open space, or local codes governing minimum street width, sidewalk construction, allowable pavement types, and drainage requirements.
Optional Additional Information or Continuation of Previous Sections As Needed
This space provided for additional information or continuation of information from previous sections as needed.

Source Control BMP Checklist for All Development Projects (Standard Projects and Priority Development Projects)	Form I-4

Project Identification

Project Name: 3 ROOTS

Permit Application Number: **PTS# 587128**

Source Control BMPs

All development projects must implement source control BMPs SC-1 through SC-6 where applicable and feasible. See Chapter 4 and Appendix E of the Model BMP Design Manual for information to implement source control BMPs shown in this checklist.

Answer each category below pursuant to the following.

- "Yes" means the project will implement the source control BMP as described in Chapter 4 and/or Appendix E of the Model BMP Design Manual. Discussion / justification is not required.
- "No" means the BMP is applicable to the project but it is not feasible to implement. Discussion / justification must be provided.
- "N/A" means the BMP is not applicable at the project site because the project does not include the feature that is addressed by the BMP (e.g., the project has no outdoor materials storage areas). Discussion / justification may be provided.

Source Control Requirement	Applied?		
SC-1 Prevention of Illicit Discharges into the MS4	☒ Yes	☐ No	☐ N/A
Discussion / justification if SC-1 not implemented:			
SC-2 Storm Drain Stenciling or Signage	☒ Yes	☐ No	☐ N/A
Discussion / justification if SC-2 not implemented:			
SC-3 Protect Outdoor Materials Storage Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	☐ Yes	☐No	☒ N/A
Discussion / justification if SC-3 not implemented: No outdoor material storage areas planned.			
SC-4 Protect Materials Stored in Outdoor Work Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	☐ Yes	☐ No	☒ N/A
Discussion / justification if SC-4 not implemented: No outdoor work areas planned.			

Form I-4			
Source Control Requirement	**Applied?**		
SC-5 Protect Trash Storage Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	☒ Yes	☐ No	☐ N/A
Discussion / justification if SC-5 not implemented:			
SC-6 Additional BMPs Based on Potential Sources of Runoff Pollutants (must answer for each source listed below)			
On-site storm drain inlets	☒ Yes	☐ No	☐ N/A
Interior floor drains and elevator shaft sump pumps	☒ Yes	☐ No	☐ N/A
Interior parking garages	☒ Yes	☐ No	☐ N/A
Need for future indoor & structural pest control	☒ Yes	☐ No	☐ N/A
Landscape/Outdoor Pesticide Use	☒ Yes	☐ No	☐ N/A
Pools, spas, ponds, decorative fountains, and other water features	☒ Yes	☐ No	☐ N/A
Food service	☒ Yes	☐ No	☐ N/A
Refuse Areas	☒ Yes	☐ No	☐ N/A
Industrial processes	☐ Yes	☐ No	☒ N/A
Outdoor storage of equipment or materials	☐ Yes	☐ No	☒ N/A
Vehicle/Equipment Repair and Maintenance	☐ Yes	☐ No	☒ N/A
Fuel Dispensing Areas	☐ Yes	☐ No	☒ N/A
Loading Docks	☐ Yes	☐ No	☒ N/A
Fire Sprinkler Test Water	☒ Yes	☐ No	☐ N/A
Miscellaneous Drain or Wash Water	☒ Yes	☐ No	☐ N/A
Plazas, sidewalks, and parking lots	☒ Yes	☐ No	☐ N/A
SC-6A: Large Trash Generating Facilities	☐ Yes	☐ No	☒ N/A
SC-6B: Animal Facilities	☐ Yes	☐ No	☒ N/A
SC-6C: Plant Nurseries and Garden Centers	☐ Yes	☐ No	☒ N/A
SC-6D: Automotive-related Uses	☐ Yes	☐ No	☒ N/A
Discussion / justification if SC-6 not implemented. Clearly identify which sources of runoff pollutants are discussed. Justification must be provided for <u>all</u> "No" answers shown above.			

Site Design BMP Checklist for All Development Projects (Standard Projects and Priority Development Projects)	Form I-5

Project Identification

Project Name: 3 ROOTS

Permit Application Number: PTS# **587128**

Site Design BMPs

All development projects must implement site design BMPs SD-1 through SD-8 where applicable and feasible. See Chapter 4 and Appendix E of the BMP Design Manual (Part 1 of Storm Water Standards) for information to implement site design BMPs shown in this checklist.

Answer each category below pursuant to the following.

- "Yes" means the project will implement the site design BMP as described in Chapter 4 and/or Appendix E of the BMP Design Manual. Discussion / justification is not required.
- "No" means the BMP is applicable to the project but it is not feasible to implement. Discussion / justification must be provided.
- "N/A" means the BMP is not applicable at the project site because the project does not include the feature that is addressed by the BMP (e.g., the project site has no existing natural areas to conserve). Discussion / justification may be provided.

A site map with implemented site design BMPs must be included at the end of this checklist.

Site Design Requirement		Applied?		
SD-1 Maintain Natural Drainage Pathways and Hydrologic Features		☒Yes	☐ No	☐ N/A
Discussion / justification if SD-1 not implemented: No street tree credit applied for conservative purpose.				
1-1	Are existing natural drainage pathways and hydrologic features mapped on the site map?	☒Yes	☐No	☐ N/A
1-2	Are street trees implemented? If yes, are they shown on the site map?	☐Yes	☒ No	☐ N/A
1-3	Implemented street trees meet the design criteria in SD-1 Fact Sheet (e.g. soil volume, maximum credit, etc.)?	☐Yes	☐No	☒ N/A
1-4	Is street tree credit volume calculated using Appendix B.2.2.1 and SD-1 Fact Sheet in Appendix E?	☐Yes	☐No	☒ N/A
SD-2 Have natural areas, soils and vegetation been conserved?		☒Yes	☐No	☐ N/A
Discussion / justification if SD-2 not implemented:				
SD-3 Minimize Impervious Area		☒Yes	☐ No	☐ N/A
Discussion / justification if SD-3 not implemented:				
SD-4 Minimize Soil Compaction		☒ Yes	☐ No	☐ N/A
Discussion / justification if SD-4 not implemented:				
SD-5 Impervious Area Dispersion		☒ Yes	☐ No	☐ N/A

Discussion / justification if SD-5 not implemented:				
Form I-5				
Site Design Requirement		**Applied?**		
SD-6 Runoff Collection		☐Yes	☐ No	☒ N/A
Discussion / justification if SD-6 not implemented: DG trails qualify as permeable pavement, and are shown on the site map.				
6a-1	Are green roofs implemented in accordance with design criteria in SD-6A Fact Sheet? If yes, are they shown on the site map?	☐Yes	☐No	☒ N/A
6a-2	Is green roof credit volume calculated using Appendix B.2.1.2 and SD-6A Fact Sheet in Appendix E?	☐Yes	☐No	☒ N/A
6b-1	Are permeable pavements implemented in accordance with design criteria in SD-6B Fact Sheet? If yes, are they shown on the site map?	☒Yes	☐No	☐ N/A
6b-2	Is permeable pavement credit volume calculated using Appendix B.2.1.3 and SD-6B Fact Sheet in Appendix E?	☐Yes	☐No	☒ N/A
SD-7 Landscaping with Native or Drought Tolerant Species		☒Yes	☐ No	☐ N/A
Discussion / justification if SD-7 not implemented:				
SD-8 Harvesting and Using Precipitation		☐ Yes	☐ No	☒ N/A
Discussion / justification if SD-8 not implemented:				
8-1	Are rain barrels implemented in accordance with design criteria in SD-8 Fact Sheet? If yes, are they shown on the site map?	☐ Yes	☐ No	☒ N/A
8-2	Is rain barrel credit volume calculated using Appendix B.2.2.2 and SD-8 Fact Sheet in Appendix E?	☐ Yes	☐ No	☒ N/A
Insert Site Map with all site design BMPs identified:				
Refer to Attachment 1A for site design BMP notes on the BMP map.				

Summary of PDP Structural BMPs	Form I-6 (PDPs)
Project Identification	
Project Name: 3 ROOTS	
Permit Application Number: **PTS# 587128**	
PDP Structural BMPs	
All PDPs must implement structural BMPs for storm water pollutant control (see Chapter 5 of the BMP Design Manual, Part 1 of Storm Water Standards). Selection of PDP structural BMPs for storm water pollutant control must be based on the selection process described in Chapter 5. PDPs subject to hydromodification management requirements must also implement structural BMPs for flow control for hydromodification management (see Chapter 6 of the BMP Design Manual). Both storm water pollutant control and flow control for hydromodification management can be achieved within the same structural BMP(s). PDP structural BMPs must be verified by the City at the completion of construction. This includes requiring the project owner or project owner's representative to certify construction of the structural BMPs (complete Form DS-563). PDP structural BMPs must be maintained into perpetuity (see Chapter 7 of the BMP Design Manual). Use this form to provide narrative description of the general strategy for structural BMP implementation at the project site in the box below. Then complete the PDP structural BMP summary information sheet (page 3 of this form) for each structural BMP within the project (copy the BMP summary information page as many times as needed to provide summary information for each individual structural BMP). Describe the general strategy for structural BMP implementation at the site. This information must describe how the steps for selecting and designing storm water pollutant control BMPs presented in Section 5.1 of the BMP Design Manual were followed, and the results (type of BMPs selected). For projects requiring hydromodification flow control BMPs, indicate whether pollutant control and flow control BMPs are integrated or separate.	

The site will implement eight onsite biofiltration basins to manage pollutant control requirements for the onsite area and additional BMPs for the offsite extension of Carroll Canyon Road. These basins are distributed fairly uniformly throughout the site to limit the accumulation of pollutants in the storm water prior to treatment. In the geotechnical report prepared by the geotechnical engineer it was found that high cut fill depth and possible historical contamination would preclude infiltration near the front of the site while steep slopes and liquefaction susceptible soils make infiltration near the back of the site unsafe. As the irrigation demand did not justify harvest and use BMPs, lined biofiltration basins were selected as the pollutant control strategy. Refer to Attachment 1e for cross section details for the BMPs. Some of the basins are non-standard and have been sized utilizing the alternative minimum sizing factor. The sizing spreadsheets are based on the January 2018 Storm water Standards. They all meet pollutant control and volume retention requirements for these DMAs.

For the Offsite Carroll Canyon West area, the western end of the offsite road area drains into the 800LF biofiltration median BMP with check dams spaced every 100 feet, to meet the water quality treatment, detention, and hydromodification requirements. The eastern end of the offsite road area flows into two modular wetland units. Outflows from the eastern modular wetland units and the western biofiltration median then drain into an underground hydromodification tank. Runon from hillsides above the proposed road extension is collected through brow ditches and bypassed through the site without entering onsite BMPs. The proposed biofiltration median BMP will meet average annual runoff reduction requirements for offsite Carroll Canyon West area. See Attachment 1e of SWQMP report for details.

Form I-6
Structural BMP Summary Information **(Copy this page as needed to provide information for each individual proposed structural BMP)**
Structural BMP ID No. Basin# 1
Construction Plan Sheet No. TBD
Type of structural BMP: ☐ Retention by harvest and use (HU-1) ☐ Retention by infiltration basin (INF-1) ☐ Retention by bioretention (INF-2) ☐ Retention by permeable pavement (INF-3) ☐ Partial retention by biofiltration with partial retention (PR-1) ☒ Biofiltration (BF-1) ☐ Proprietary Biofiltration (BF-3) meeting all requirements of Appendix F ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below) ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below) ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below) ☐ Detention pond or vault for hydromodification management ☐ Other (describe in discussion section below)
Purpose: ☐ Pollutant control only ☐ Hydromodification control only ☒ Combined pollutant control and hydromodification control ☐ Pre-treatment/forebay for another structural BMP ☐ Other (describe in discussion section below)

Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the BMP Design Manual)	Project Design Consultants 619-235-6471 Debby Reece, PE
Who will be the final owner of this BMP?	3 Roots HOA
Who will maintain this BMP into perpetuity?	3 Roots HOA
What is the funding mechanism for maintenance?	HOA fees

Form I-6
Structural BMP ID No. Basin # 1
Construction Plan Sheet No. TBD
The Bioretention BMP will be located in the landscaping area at the corner of Street A and Street B. See the DMA Exhibit (Attachment 1) for size, treatment area and location of the BMP.

Form I-6
Structural BMP Summary Information **(Copy this page as needed to provide information for each individual proposed structural BMP)**
Structural BMP ID No. Basin # 2
Construction Plan Sheet No. TBD
Type of structural BMP: ☐ Retention by harvest and use (HU-1) ☐ Retention by infiltration basin (INF-1) ☐ Retention by bioretention (INF-2) ☐ Retention by permeable pavement (INF-3) ☐ Partial retention by biofiltration with partial retention (PR-1) ☒ Biofiltration (BF-1) ☐ Proprietary Biofiltration (BF-3) meeting all requirements of Appendix F ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below) ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below) ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below) ☐ Detention pond or vault for hydromodification management ☐ Other (describe in discussion section below)
Purpose: ☐ Pollutant control only ☐ Hydromodification control only ☒ Combined pollutant control and hydromodification control ☐ Pre-treatment/forebay for another structural BMP ☐ Other (describe in discussion section below)

Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the BMP Design Manual)	Project Design Consultants 619-235-6471 Debby Reece, PE
Who will be the final owner of this BMP?	3 Roots HOA
Who will maintain this BMP into perpetuity?	3 Roots HOA
What is the funding mechanism for maintenance?	HOA fees

Form I-6
Structural BMP ID No. Basin # 2
Construction Plan Sheet No. TBD
See the DMA Exhibit (Attachment 1) for size, treatment area and location of the BMP.

Form I-6
Structural BMP Summary Information **(Copy this page as needed to provide information for each individual proposed structural BMP)**
Structural BMP ID No. Basin # 3
Construction Plan Sheet No. TBD
Type of structural BMP: ☐ Retention by harvest and use (HU-1) ☐ Retention by infiltration basin (INF-1) ☐ Retention by bioretention (INF-2) ☐ Retention by permeable pavement (INF-3) ☐ Partial retention by biofiltration with partial retention (PR-1) ☒ Biofiltration (BF-1) ☐ Proprietary Biofiltration (BF-3) meeting all requirements of Appendix F ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below) ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below) ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below) ☐ Detention pond or vault for hydromodification management ☐ Other (describe in discussion section below)
Purpose: ☐ Pollutant control only ☐ Hydromodification control only ☒ Combined pollutant control and hydromodification control ☐ Pre-treatment/forebay for another structural BMP ☐ Other (describe in discussion section below)

Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the BMP Design Manual)	Project Design Consultants 619-235-6471 Debby Reece, PE
Who will be the final owner of this BMP?	3 Roots HOA
Who will maintain this BMP into perpetuity?	3 Roots HOA
What is the funding mechanism for maintenance?	HOA fees

Form I-6
Structural BMP ID No. Basin # 3
Construction Plan Sheet No. TBD
See the DMA Exhibit (Attachment 1) for size, treatment area and location of the BMP.

Form I-6
Structural BMP Summary Information **(Copy this page as needed to provide information for each individual proposed structural BMP)**
Structural BMP ID No. Basin # 5
Construction Plan Sheet No. TBD
Type of structural BMP: ☐ Retention by harvest and use (HU-1) ☐ Retention by infiltration basin (INF-1) ☐ Retention by bioretention (INF-2) ☐ Retention by permeable pavement (INF-3) ☐ Partial retention by biofiltration with partial retention (PR-1) ☒ Biofiltration (BF-1) ☐ Proprietary Biofiltration (BF-3) meeting all requirements of Appendix F ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below) ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below) ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below) ☐ Detention pond or vault for hydromodification management ☐ Other (describe in discussion section below)
Purpose: ☐ Pollutant control only ☐ Hydromodification control only ☒ Combined pollutant control and hydromodification control ☐ Pre-treatment/forebay for another structural BMP ☐ Other (describe in discussion section below)

Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the BMP Design Manual)	Project Design Consultants 619-235-6471 Debby Reece, PE
Who will be the final owner of this BMP?	3 Roots HOA
Who will maintain this BMP into perpetuity?	3 Roots HOA
What is the funding mechanism for maintenance?	HOA fees

Form I-6
Structural BMP ID No. Basin # 5
Construction Plan Sheet No. TBD
See the DMA Exhibit (Attachment 1) for size, treatment area and location of the BMP.

Form I-6
Structural BMP Summary Information **(Copy this page as needed to provide information for each individual proposed structural BMP)**
Structural BMP ID No. Basin # 6
Construction Plan Sheet No. TBD
Type of structural BMP: ☐ Retention by harvest and use (HU-1) ☐ Retention by infiltration basin (INF-1) ☐ Retention by bioretention (INF-2) ☐ Retention by permeable pavement (INF-3) ☐ Partial retention by biofiltration with partial retention (PR-1) ☒ Biofiltration (BF-1) ☐ Proprietary Biofiltration (BF-3) meeting all requirements of Appendix F ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below) ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below) ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below) ☐ Detention pond or vault for hydromodification management ☐ Other (describe in discussion section below)
Purpose: ☐ Pollutant control only ☐ Hydromodification control only ☒ Combined pollutant control and hydromodification control ☐ Pre-treatment/forebay for another structural BMP ☐ Other (describe in discussion section below)

Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the BMP Design Manual)	Project Design Consultants 619-235-6471 Debby Reece, PE
Who will be the final owner of this BMP?	3 Roots HOA
Who will maintain this BMP into perpetuity?	3 Roots HOA
What is the funding mechanism for maintenance?	HOA fees

Form I-6
Structural BMP ID No. Basin # 6
Construction Plan Sheet No. TBD
See the DMA Exhibit (Attachment 1) for size, treatment area and location of the BMP.

Form I-6
Structural BMP Summary Information **(Copy this page as needed to provide information for each individual proposed structural BMP)**
Structural BMP ID No. Basin # 7
Construction Plan Sheet No. TBD
Type of structural BMP: ☐ Retention by harvest and use (HU-1) ☐ Retention by infiltration basin (INF-1) ☐ Retention by bioretention (INF-2) ☐ Retention by permeable pavement (INF-3) ☐ Partial retention by biofiltration with partial retention (PR-1) ☒ Biofiltration (BF-1) ☐ Proprietary Biofiltration (BF-3) meeting all requirements of Appendix F ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below) ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below) ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below) ☐ Detention pond or vault for hydromodification management ☐ Other (describe in discussion section below)
Purpose: ☐ Pollutant control only ☐ Hydromodification control only ☒ Combined pollutant control and hydromodification control ☐ Pre-treatment/forebay for another structural BMP ☐ Other (describe in discussion section below)

Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the BMP Design Manual)	Project Design Consultants 619-235-6471 Debby Reece, PE
Who will be the final owner of this BMP?	3 Roots HOA
Who will maintain this BMP into perpetuity?	3 Roots HOA
What is the funding mechanism for maintenance?	HOA fees

Form I-6
Structural BMP ID No. Basin # 7
Construction Plan Sheet No. TBD
See the DMA Exhibit (Attachment 1) for size, treatment area and location of the BMP.

Form I-6
Structural BMP Summary Information **(Copy this page as needed to provide information for each individual proposed structural BMP)**
Structural BMP ID No. Basin # 8
Construction Plan Sheet No. TBD
Type of structural BMP: ☐ Retention by harvest and use (HU-1) ☐ Retention by infiltration basin (INF-1) ☐ Retention by bioretention (INF-2) ☐ Retention by permeable pavement (INF-3) ☐ Partial retention by biofiltration with partial retention (PR-1) ☒ Biofiltration (BF-1) ☐ Proprietary Biofiltration (BF-3) meeting all requirements of Appendix F ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below) ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below) ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below) ☐ Detention pond or vault for hydromodification management ☐ Other (describe in discussion section below)
Purpose: ☐ Pollutant control only ☐ Hydromodification control only ☒ Combined pollutant control and hydromodification control ☐ Pre-treatment/forebay for another structural BMP ☐ Other (describe in discussion section below)

Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the BMP Design Manual)	Project Design Consultants 619-235-6471 Debby Reece, PE
Who will be the final owner of this BMP?	3 Roots HOA
Who will maintain this BMP into perpetuity?	3 Roots HOA
What is the funding mechanism for maintenance?	HOA fees

Form I-6
Structural BMP ID No. Basin # 8
Construction Plan Sheet No. TBD
See the DMA Exhibit (Attachment 1) for size, treatment area and location of the BMP.

Form I-6
Structural BMP Summary Information **(Copy this page as needed to provide information for each individual proposed structural BMP)**
Structural BMP ID No. Basin # 9
Construction Plan Sheet No. TBD
Type of structural BMP: ☐ Retention by harvest and use (HU-1) ☐ Retention by infiltration basin (INF-1) ☐ Retention by bioretention (INF-2) ☐ Retention by permeable pavement (INF-3) ☐ Partial retention by biofiltration with partial retention (PR-1) ☒ Biofiltration (BF-1) ☐ Proprietary Biofiltration (BF-3) meeting all requirements of Appendix F ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below) ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below) ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below) ☐ Detention pond or vault for hydromodification management ☐ Other (describe in discussion section below)
Purpose: ☐ Pollutant control only ☐ Hydromodification control only ☒ Combined pollutant control and hydromodification control ☐ Pre-treatment/forebay for another structural BMP ☐ Other (describe in discussion section below)

Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the BMP Design Manual)	Project Design Consultants 619-235-6471 Debby Reece, PE
Who will be the final owner of this BMP?	3 Roots HOA
Who will maintain this BMP into perpetuity?	3 Roots HOA
What is the funding mechanism for maintenance?	HOA fees

Form I-6
Structural BMP ID No. Basin # 9
Construction Plan Sheet No. TBD
See the DMA Exhibit (Attachment 1) for size, treatment area and location of the BMP.

Form I-6
Structural BMP Summary Information **(Copy this page as needed to provide information for each individual proposed structural BMP)**
Structural BMP ID No. Pre-treatment BMPs
Construction Plan Sheet No. TBD
Type of structural BMP: ☐ Retention by harvest and use (HU-1) ☐ Retention by infiltration basin (INF-1) ☐ Retention by bioretention (INF-2) ☐ Retention by permeable pavement (INF-3) ☐ Partial retention by biofiltration with partial retention (PR-1) ☐ Biofiltration (BF-1) ☐ Proprietary Biofiltration (BF-3) meeting all requirements of Appendix F ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below) ☒ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below) ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below) ☐ Detention pond or vault for hydromodification management ☐ Other (describe in discussion section below)
Purpose: ☐ Pollutant control only ☐ Hydromodification control only ☐ Combined pollutant control and hydromodification control ☒ Pre-treatment/forebay for another structural BMP ☐ Other (describe in discussion section below)

Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the BMP Design Manual)	Project Design Consultants 619-235-6471 Debby Reece, PE
Who will be the final owner of this BMP?	3 Roots HOA
Who will maintain this BMP into perpetuity?	3 Roots HOA
What is the funding mechanism for maintenance?	HOA fees

Form I-6
Structural BMP ID No. Pretreatment BMPs
Construction Plan Sheet No. TBD
There will be pre-treatment BMPs designed upstream of biofiltration basins to accommodate BMP Manual requirement for large size DMAs. Details will be provided in next submittal.

Structural BMP Summary Information (Copy this page as needed to provide information for each individual proposed structural BMP)	
Structural BMP ID No. MWS10-1	
Construction Plan Sheet No. TBD	
Type of structural BMP: ☐ Retention by harvest and use (HU-1) ☐ Retention by infiltration basin (INF-1) ☐ Retention by bioretention (INF-2) ☐ Retention by permeable pavement (INF-3) ☐ Partial retention by biofiltration with partial retention (PR-1) ☐ Biofiltration (BF-1) ☒ Proprietary Biofiltration (BF-3) meeting all requirements of Appendix F ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below) ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below) ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below) ☐ Detention pond or vault for hydromodification management ☐ Other (describe in discussion section below)	
Purpose: ☒ Pollutant control only ☐ Hydromodification control only ☐ Combined pollutant control and hydromodification control ☐ Pre-treatment/forebay for another structural BMP ☐ Other (describe in discussion section below)	
Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the BMP Design Manual)	Project Design Consultants 619-235-6471 Debby Reece, PE
Who will be the final owner of this BMP?	City of San Diego
Who will maintain this BMP into perpetuity?	City of San Diego Transportation and Stormwater Department
What is the funding mechanism for maintenance?	City of San Diego road maintenance funds

Form I-6
Structural BMP ID No. MWS10-1
Construction Plan Sheet No. TBD
See Attachment 1 for size, treatment area and location of the proprietary BMP.

Structural BMP Summary Information (Copy this page as needed to provide information for each individual proposed structural BMP)	
Structural BMP ID No. MWS10-2	
Construction Plan Sheet No. TBD	
Type of structural BMP: ☐ Retention by harvest and use (HU-1) ☐ Retention by infiltration basin (INF-1) ☐ Retention by bioretention (INF-2) ☐ Retention by permeable pavement (INF-3) ☐ Partial retention by biofiltration with partial retention (PR-1) ☐ Biofiltration (BF-1) ☒ Proprietary Biofiltration (BF-3) meeting all requirements of Appendix F ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below) ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below) ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below) ☐ Detention pond or vault for hydromodification management ☐ Other (describe in discussion section below)	
Purpose: ☒ Pollutant control only ☐ Hydromodification control only ☐ Combined pollutant control and hydromodification control ☐ Pre-treatment/forebay for another structural BMP ☐ Other (describe in discussion section below)	
Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the BMP Design Manual)	Project Design Consultants 619-235-6471 Debby Reece, PE
Who will be the final owner of this BMP?	City of San Diego
Who will maintain this BMP into perpetuity?	City of San Diego Transportation and Stormwater Department
What is the funding mechanism for maintenance?	City of San Diego road maintenance funds

Form I-6
Structural BMP ID No. MWS10-2
Construction Plan Sheet No. TBD
See Attachment 1 for size, treatment area and location of the proprietary BMP.

Structural BMP Summary Information **(Copy this page as needed to provide information for each individual proposed structural BMP)**	
Structural BMP ID No. BMP#11 Biofiltration Median	
Construction Plan Sheet No. TBD	
Type of structural BMP: ☐ Retention by harvest and use (HU-1) ☐ Retention by infiltration basin (INF-1) ☐ Retention by bioretention (INF-2) ☐ Retention by permeable pavement (INF-3) ☐ Partial retention by biofiltration with partial retention (PR-1) ☒ Biofiltration (BF-1) ☐ Proprietary Biofiltration (BF-3) meeting all requirements of Appendix F ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below) ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below) ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below) ☐ Detention pond or vault for hydromodification management ☐ Other (describe in discussion section below)	
Purpose: ☐ Pollutant control only ☐ Hydromodification control only ☒ Combined pollutant control and hydromodification control ☐ Pre-treatment/forebay for another structural BMP ☐ Other (describe in discussion section below)	
Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the BMP Design Manual)	Project Design Consultants 619-235-6471 Debby Reece, PE
Who will be the final owner of this BMP?	City of San Diego
Who will maintain this BMP into perpetuity?	City of San Diego Transportation and Stormwater Department
What is the funding mechanism for maintenance?	City of San Diego road maintenance funds

Form I-6
Structural BMP ID No. BMP#11 Biofiltration Median
Construction Plan Sheet No. TBD
See Attachment 1 for size, treatment area and location of the Biofiltration median BMP.

Structural BMP Summary Information (Copy this page as needed to provide information for each individual proposed structural BMP)	
Structural BMP ID No. BMP#12	
Construction Plan Sheet No. TBD	
Type of structural BMP: ☐ Retention by harvest and use (HU-1) ☐ Retention by infiltration basin (INF-1) ☐ Retention by bioretention (INF-2) ☐ Retention by permeable pavement (INF-3) ☐ Partial retention by biofiltration with partial retention (PR-1) ☐ Biofiltration (BF-1) ☐ Proprietary Biofiltration (BF-3) meeting all requirements of Appendix F ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below) ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below) ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below) ☒ Detention pond or vault for hydromodification management ☐ Other (describe in discussion section below)	
Purpose: ☐ Pollutant control only ☒ Hydromodification control only ☐ Combined pollutant control and hydromodification control ☐ Pre-treatment/forebay for another structural BMP ☐ Other (describe in discussion section below)	
Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the BMP Design Manual)	Project Design Consultants 619-235-6471 Debby Reece, PE
Who will be the final owner of this BMP?	City of San Diego
Who will maintain this BMP into perpetuity?	City of San Diego Transportation and Stormwater Department
What is the funding mechanism for maintenance?	City of San Diego road maintenance funds

Form I-6
Structural BMP ID No. BMP#11 Biorentention Median
Construction Plan Sheet No. TBD
See Attachment 1 for size, treatment area and location of the underground hydromodification tank.

THE CITY OF SAN DIEGO City of San Diego **Development Services** 1222 First Ave., MD-302 San Diego, CA 92101 (619) 446-5000	**Permenant BMP Construction** **Self Certification Form**	FORM DS-563 January 2016

Date Prepared: Click here to enter text.	Project No.: Click here to enter text.
Project Applicant: Click here to enter text.	Phone: Click here to enter text.
Project Address: Click here to enter text.	
Project Engineer: Click here to enter text.	Phone: Click here to enter text.

The purpose of this form is to verify that the site improvements for the project, identified above, have been constructed in conformance with the approved Storm Water Quality Management Plan (SWQMP) documents and drawings.

This form must be completed by the engineer and submitted prior to final inspection of the construction permit. Completion and submittal of this form is required for all new development and redevelopment projects in order to comply with the City's Storm Water ordinances and NDPES Permit Order No. R9-2013-0001 as amended by R9-2015-0001 and R9-2015-0100. Final inspection for occupancy and/or release of grading or public improvement bonds may be delayed if this form is not submitted and approved by the City of San Diego.

CERTIFICATION:

As the professional in responsible charge for the design of the above project, I certify that I have inspected all constructed Low Impact Development (LID) site design, source control and structural BMP's required per the approved SWQMP and Construction Permit No. Click here to enter text.; and that said BMP's have been constructed in compliance with the approved plans and all applicable specifications, permits, ordinances and Order No. R9-2013-0001 as amended by R9-2015-0001 and R9-2015-0100 of the San Diego Regional Water Quality Control Board.

I understand that this BMP certification statement does not constitute an operation and maintenance verification.

Signature: _____

Date of Signature: _Insert Date___

Printed Name: _Click here to enter text.__

Title: _Click here to enter text.__

Phone No. _Click here to enter text.__

Engineer's

DS-563 (12-15)

Project Name: 3 Roots

ATTACHMENT 1

BACKUP FOR PDP POLLUTANT CONTROL BMPS

This is the cover sheet for Attachment 1.

Indicate which Items are Included:

Attachment Sequence	Contents	Checklist
Attachment 1a	DMA Exhibit (Required) See DMA Exhibit Checklist.	☒ Included
Attachment 1b	Tabular Summary of DMAs Showing DMA ID matching DMA Exhibit, DMA Area, and DMA Type (Required)* *Provide table in this Attachment OR on DMA Exhibit in Attachment 1a	☒ Included on DMA Exhibit in Attachment 1a ☐ Included as Attachment 1b, separate from DMA Exhibit
Attachment 1c	Form I-7, Harvest and Use Feasibility Screening Checklist (Required unless the entire project will use infiltration BMPs) Refer to Appendix B.3-1 of the BMP Design Manual to complete Form I-7.	☒ Included ☐ Not included because the entire project will use infiltration BMPs
Attachment 1d	Form I-8, Categorization of Infiltration Feasibility Condition (Required unless the project will use harvest and use BMPs) Refer to Appendices C and D of the BMP Design Manual to complete Form I-8.	☒ Included ☐ Not included because the entire project will use harvest and use BMPs
Attachment 1e	Pollutant Control BMP Design Worksheets / Calculations (Required) Refer to Appendices B and E of the BMP Design Manual for structural pollutant control BMP design guidelines and site design credit calculations	☒ Included

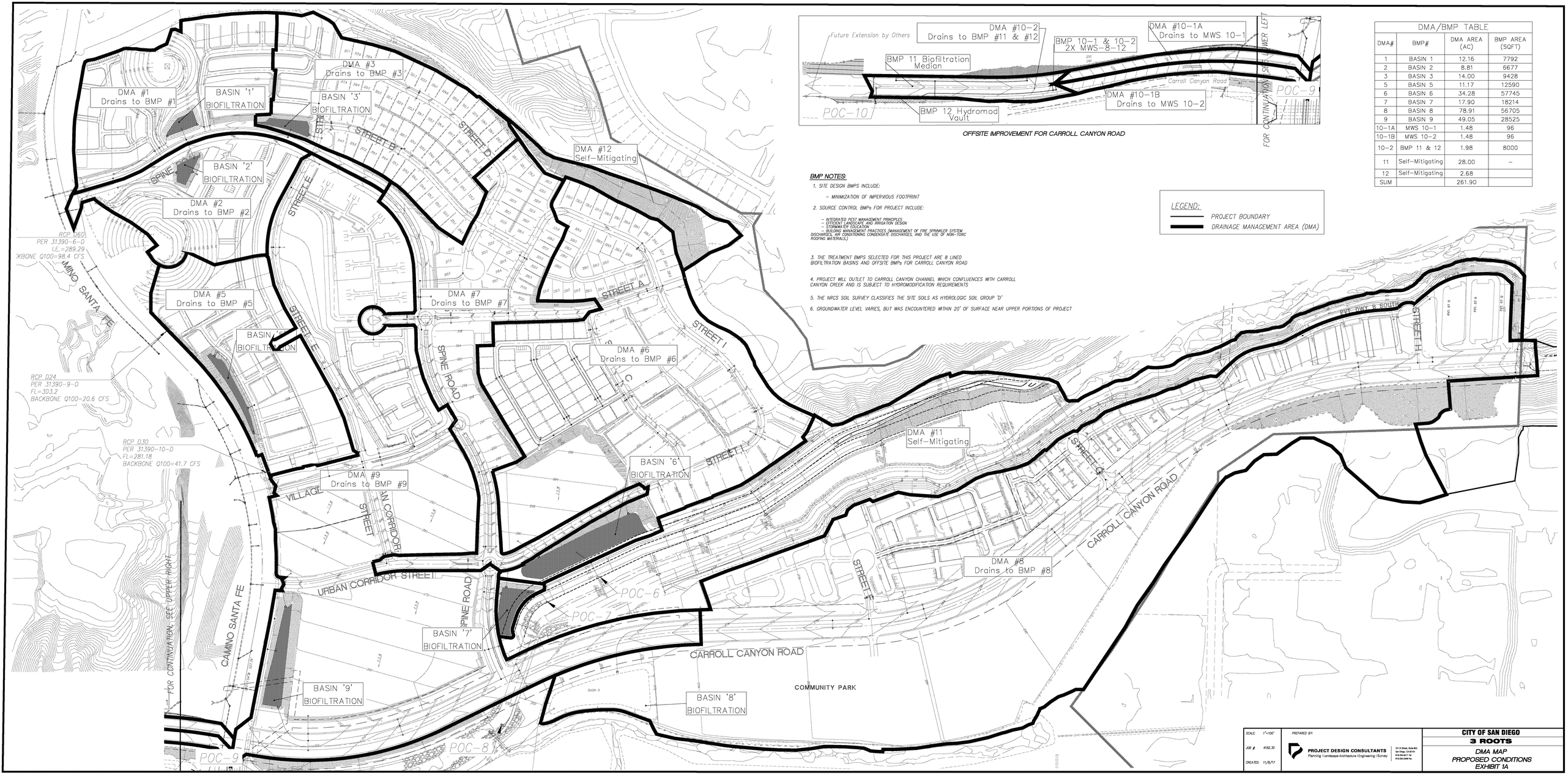
ATTACHMENT 1a,b

DMA Exhibit

Use this checklist to ensure the required information has been included on the DMA Exhibit:

The DMA Exhibit must identify:

- ☐ Underlying hydrologic soil group
- ☐ Approximate depth to groundwater
- ☐ Existing natural hydrologic features (watercourses, seeps, springs, wetlands)
- ☐ Critical coarse sediment yield areas to be protected
- ☐ Existing topography and impervious areas
- ☐ Existing and proposed site drainage network and connections to drainage offsite
- ☐ Proposed demolition
- ☐ Proposed grading
- ☐ Proposed impervious features
- ☐ Proposed design features and surface treatments used to minimize imperviousness
- ☐ Drainage management area (DMA) boundaries, DMA ID numbers, and DMA areas (square footage or acreage), and DMA type (i.e., drains to BMP, self-retaining, or self-mitigating)
- ☐ Potential pollutant source areas and corresponding required source controls (see Chapter 4, Appendix E.1, and Form I-3B)
- ☐ Structural BMPs (identify location, type of BMP, and size/detail)



OFFSITE IMPROVEMENT FOR CARROLL CANYON ROAD

DMA/BMP TABLE			
DMA#	BMP#	DMA AREA (AC)	BMP AREA (SQFT)
1	BASIN 1	12.16	7792
2	BASIN 2	8.81	6677
3	BASIN 3	14.00	9428
5	BASIN 5	11.17	12590
6	BASIN 6	34.28	57745
7	BASIN 7	17.90	18214
8	BASIN 8	78.91	56705
9	BASIN 9	49.05	28525
10-1A	MWS 10-1	1.48	96
10-1B	MWS 10-2	1.48	96
10-2	BMP 11 & 12	1.98	8000
11	Self-Mitigating	28.00	–
12	Self-Mitigating	2.68	
SUM		261.90	

BMP NOTES:

1. *SITE DESIGN BMPS INCLUDE:*
   - *MINIMIZATION OF IMPERVIOUS FOOTPRINT*
2. *SOURCE CONTROL BMPs FOR PROJECT INCLUDE:*
   - *INTEGRATED PEST MANAGEMENT PRINCIPLES*
   - *EFFICIENT LANDSCAPE AND IRRIGATION DESIGN*
   - *STORMWATER EDUCATION*
   - *BUILDING MANAGEMENT PRACTICES (MANAGEMENT OF FIRE SPRINKLER SYSTEM DISCHARGES, AIR CONDITIONING CONDENSATE DISCHARGES, AND THE USE OF NON-TOXIC ROOFING MATERIALS.)*
3. *THE TREATMENT BMPS SELECTED FOR THIS PROJECT ARE 8 LINED BIOFILTRATION BASINS AND OFFSITE BMPs FOR CARROLL CANYON ROAD*
4. *PROJECT WILL OUTLET TO CARROLL CANYON CHANNEL WHICH CONFLUENCES WITH CARROLL CANYON CREEK AND IS SUBJECT TO HYDROMODIFICATION REQUIREMENTS*
5. *THE NRCS SOIL SURVEY CLASSIFIES THE SITE SOILS AS HYDROLOGIC SOIL GROUP 'D'*
6. *GROUNDWATER LEVEL VARIES, BUT WAS ENCOUNTERED WITHIN 20' OF SURFACE NEAR UPPER PORTIONS OF PROJECT*

LEGEND:

PROJECT BOUNDARY

DRAINAGE MANAGEMENT AREA (DMA)

SCALE: 1"=100'	PREPARED BY:	CITY OF SAN DIEGO
JOB #: 4182.30	PROJECT DESIGN CONSULTANTS Planning | Landscape Architecture | Engineering | Survey 10150 Sorrento Valley Rd, Suite 200 San Diego, CA 92121 619.235.6471 Tel 619.234.0349 Fax	3 ROOTS
CREATED: 11/9/17		DMA MAP PROPOSED CONDITIONS EXHIBIT 1A

F:\4182.30\Engr\Reports\DMA\P\4182.30DMA.dwg 12/5/2019 2:33:05 PM

ATTACHMENT 1c

Harvest & Use Feasibility

Harvest and Use Feasibility Checklist	Form I-7

1. Is there a demand for harvested water (check all that apply) at the project site that is reliably present during the wet season?

☒ Toilet and urinal flushing
☒ Landscape irrigation
☐ Other:_____

2. If there is a demand; estimate the anticipated average wet season demand over a period of 36 hours. Guidance for planning level demand calculations for toilet/urinal flushing and landscape irrigation is provided in Section B.3.2.

[Provide a summary of calculations here]

Total Demand = 12578 + 10071 = 22649 CF

Landscape Irrigation:
Assume 64AC of landscaping
Mod. Water Use:
1470 gallon/ac/36hr x 64 AC = 147 gallons (CF/7.48gallons) = 12,578CF

Toilet & urinal flushing:
Expected Total Population: 1800*3
36hr Demand = 9.3 gal/res/day x 1.5days/36hr x 5400pop = 9890.5 gal (CF/7.48 gal) = 10071 CF

3. Calculate the DCV using worksheet B-2.1.
DCV = 246,764 (cubic feet)

3a. Is the 36 hour demand greater than or equal to the DCV?	3b. Is the 36 hour demand greater than 0.25DCV but less than the full DCV?	3c. Is the 36 hour demand less than 0.25DCV?
☐ Yes / ☒ No ⇨ ⇩	☐ Yes / ☒ No ⇨ ⇩ 0.25DCV=61,691 CF	☒ Yes ⇩
Harvest and use appears to be feasible. Conduct more detailed evaluation and sizing calculations to confirm that DCV can be used at an adequate rate to meet drawdown criteria.	Harvest and use may be feasible. Conduct more detailed evaluation and sizing calculations to determine feasibility. Harvest and use may only be able to be used for a portion of the site, or (optionally) the storage may need to be upsized to meet long term capture targets while draining in longer than 36 hours.	Harvest and use is considered to be infeasible.

Is harvest and use feasible based on further evaluation?

☐ Yes, refer to Appendix E to select and size harvest and use BMPs.
☒ No, select alternate BMPs.

ATTACHMENT 1d

Infiltration Feasibility

INFILTRATION FEASIBILITY CONDITION LETTER

3 ROOTS
SAN DIEGO, CALIFORNIA

GEOCON
INCORPORATED

GEOTECHNICAL
ENVIRONMENTAL
MATERIALS

PREPARED FOR

MESA COMMUNITY PARTNERS, LLC, AND CALATLANTIC GROUP, INC., A DELAWARE CORPORATION SAN DIEGO, CALIFORNIA

MARCH 26, 2018
PROJECT NO. G2070-42-02

Project No. G2070-42-01
March 26, 2018

Mesa Community Partners, LLC, and
CalAtlantic Group, Inc., A Delaware Corporation
16465 Via Esprillo, Suite 150
San Diego, California 92127

Attention: Mr. Ryan Green

Subject: INFILTRATION FEASIBILITY CONDITION LETTER
3 ROOTS
SAN DIEGO, CALIFORNIA

References:
1. *Update Geotechnical Investigation for Vesting Tentative Map, 3Roots, San Diego, California,* prepared by Geocon Incorporated, dated November 10, 2017 (Project No. G2070-42-02).
2. *DMA Map, Proposed Conditions, Exhibit 1A, 3 Roots, City of San Diego*, prepared by Project Design Consultants, dated November 8, 2017.

Dear Mr. Green:

To respond to City of San Diego review comments, we have prepared this addendum to the referenced geotechnical investigation to provide additional information relative to storm water management. The City reviewer is asking that we update the storm water management information contained in Appendix C of the referenced report to reflect the recently adopted 2017 City of San Diego guidelines. For this site we are recommending the site be classified as a "No Infiltration" condition.

Site Description

The project site consists of approximately 427 acres of partially graded and ungraded land located within the former Lehigh Hanson aggregate mine. The property has been utilized to mine aggregate (predominately the cobble from the Stadium Conglomerate formation) to produce sand and aggregate products since the early 1950's.

Mining resulted in removal of rock and soil deposits resulting in deep excavations (over 100 feet), as well as relatively steep cut slopes. The excavations were backfilled with waste materials generated during mining activities. Geocon Incorporated has performed compaction testing during excavation

backfill on portions of the site between December 1979 through March 2016. In other areas undocumented fills have been placed. The approximate area of compacted fill and undocumented fills is shown on the geologic maps and cross sections contained in the referenced geotechnical report.

Fill depths are estimated to range from approximately 50 feet to 150 feet across the property. At the completion of grading, maximum fill depths between 50 to 100 feet will exists below finish grades. Some portions of the site will be underlain by shallower fills. The fills are underlain by alluvium and the Stadium Conglomerate Formation.

The site will be graded to support approximately 1,800 residential units, mixed-use areas, parks, and infrastructure. The residential portion of the project will be comprised of both single-family attached and detached products along with multi-family and affordable housing units. The planned mixed-use component is expected to consist of retail and office space with a mobility hub proposed for the project. A 25-acre community park is also planned. Several passive parks will be constructed within the property. Carroll Canyon Road (a 6-lane prime arterial roadway) will be extended from the current terminus west of Camino Ruiz to Camino Santa Fe. The project will also restore Carroll Canyon Creek by constructing drainage features that include a drainage channel, drop structures, and an arch undercrossing below Carroll Canyon Road. A pedestrian bridge across the creek drainage is also planned. Storm water management will be handled with regional basins planned at various locations on the property.

Previous Geotechnical Studies

We prepared the referenced geotechnical investigation in November 2017 (see Reference 1). Geocon Incorporated has also performed compaction testing on reclaimed mining spoils since the late 1970's and early 1980's. The site is currently underlain by undocumented fill, stockpiles of soil, aggregate and asphalt products, compacted fill, alluvium, colluvium, and the Stadium Conglomerate Formation. The soil and geologic units are described in the referenced geotechnical report. Geologic cross sections showing the approximate lateral extent of surficial soils and geologic formational units are also provided in the geotechnical investigation report.

Hydrologic Soil Group

Information with respect to Hydrologic Soil Group was provided in Appendix C of the referenced report. For your convenience, we have included that information below.

The United States Department of Agriculture (USDA), Natural Resources Conservation Services, possesses general information regarding the existing soil conditions for areas within the United States. The USDA website also provides the Hydrologic Soil Group. Table 1 presents the descriptions of the hydrologic soil groups.

TABLE 1
HYDROLOGIC SOIL GROUP DEFINITIONS

Soil Group	Soil Group Definition
A	Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
B	Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
C	Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.
D	Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high-water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

The property is underlain by undocumented fill, compacted fill, alluvium, colluvium, and the Stadium Conglomerate. Table 2 presents the information from the USDA website for the subject property.

TABLE 2
USDA WEB SOIL SURVEY – HYDROLOGIC SOIL GROUP

Map Unit Name	Map Unit Symbol	Approximate Percentage of Property	Hydrologic Soil Group
Altamont Clay, 15 to 30 percent slopes	AtE	0.2	C
Gravel Pits	GP	11.8	NA
Olivenhain cobbly loam, 2 to 9 percent slopes	OhC	3	D
Olivenhain cobbly loam, 9 to 30 percent slopes	OhE	5	D
Redding gravelly loam, 2 to 9 percent slopes	RdC	34	D
Redding cobbly loam, 9 to 30 percent slopes	ReE	10	D
Redding cobbly loam, dissected, 15 to 50 percent slopes	RfF	1	D
Riverwash	Rm	15	D
Terrace Escarpments	TeF	20	NA

Based on the information from the USDA, the majority of the property is underlain by Soil Group D with a saturated hydraulic conductivity rate of 0.00 to 0.06 inches per hour. The alluvial soils near the creek drainage classified as Riverwash have a mapped rate of 6 to 20 inches per hours.

Groundwater Elevations

Groundwater was encountered in several borings and trenches throughout the project, which appears to be perched on the underlying Stadium Conglomerate. Groundwater was also observed flowing across the top of the mined pit bottom. Groundwater elevations are estimated to range between elevations 280 feet Mean Sea Level (MSL) (east end) to 220 feet MSL (west end).

Infiltration Rates

We performed in-place hydraulic conductivity tests to evaluate the infiltration characteristics of the bedrock geologic unit on the property (Stadium Conglomerate) using a Soilmoisture Corp Aardvark Permeameter. The tests were performed in 8-inch-diameter auger borings. The Geologic Map, Figure 2 in the referenced geotechnical investigation shows the approximate locations of the infiltration tests. Table 3 presents the results of the testing. The calculation sheets are appended.

We used the guidelines presented in the Riverside County Low Impact Development BMP Design Handbook, which references the United States Bureau of Reclamation Well Permeameter Test Method (USBR 7300-89). Based on this widely-accepted guideline, the saturated hydraulic conductivity (Ksat) is equal to the infiltration rate.

TABLE 3
UNFACTORED HYDRAULIC CONDUCTIVITY TEST RESULTS

Test No.	Geologic Unit	Infiltration Rate, I (inches/hour)	Factored* Field Infiltration Rate, I (inches/hour)
A-1	Tst	0.015	0.0075
A-2	Tst	0.006	0.003

* Factor of Safety of 2.0 for feasibility determination

Summary of Future Graded Soil Conditions

At the completion of grading, each of the proposed BMP Basins shown on Reference 2 will be underlain by compacted fill that varies from 10 feet to 85 feet. Only a small portion of BMP Basin 7 and the western side of BMP Basin 2 is expected to have native formational bedrock exposed at the basin bottom. Table 4 presents a summary of expected soil conditions at the completion of grading at each proposed basin.

TABLE 4
SUMMARY OF EXISTING AND FUTURE GRADED SOIL CONDITIONS AT EACH PROPOSED BASIN

Basin Number	Expected Soil Conditions at the Completion of Grading
BMP #1	10 to 74 feet of Compacted Fill
BMP #2	0 to 76 feet of Compacted Fill
BMP #3	85 feet of Compacted Fill
BMP #5	20 feet to 80 feet of Compacted Fill
BMP #6	10 feet to 35 feet of Compacted Fill
BMP #7	0 feet to 37 feet of Compacted Fill
BMP #8	20 feet to 28 feet of Compacted Fill
BMP #9	14 feet to 40 feet of Compacted Fill

Storm Water Design Narrative

We evaluated the site for areas of potential infiltration. The majority of the property is underlain by undocumented and compacted fills that are not suitable for infiltration. As previously discussed, the native formational soils have been removed and the resulting mined excavation has been backfilled with fill. Previous mining has resulted in relatively large fill differentials in short distances along the mined pit perimeters (generally along the west, north, and south perimeters). At the completion of grading, all of the basins will be underlain by compacted fill varying from approximately 10 feet to 85 feet thick. A portion of Basins 2 and 7 are expected to have native formational bedrock exposed. The appended DMA figure shows the depth of compacted fill that will be present at each BMP Basin at the completion of grading.

Areas where we expect fills less than 5 feet to be present are the cut slope on the north central portion of the site and at the northwest corner near the existing SDG&E transmission towers. There are small areas of native soils exposed near the west end of Basin 2 and north end of Basin 7. The bedrock consists of a very dense cobble conglomerate and has very slow infiltration characteristics, as is evident by the very low infiltration rates from our previous testing. The native formational bedrock has factored infiltration rates less than 0.05 inches per hour and considered not feasible for infiltration.

Within the central portion of the site alluvium is present underlying the undocumented fill. In areas of structural improvements, the alluvium will be removed and replaced as compacted fill. In the creek drainage along the northeast side of the property, the alluvium will be left in-place. The construction of basins in the protected creek drainage is not feasible due to environmental constraints.

We have also observed over the mining period numerous locations on the property where groundwater is perched on the Stadium Conglomerate Formation. Shallow groundwater exists within the creek drainage area that passes through the central portion of the site.

It is our opinion the site should be considered as a "No Infiltration" condition due to the presence of undocumented and compacted fill throughout the site and the very low infiltration rates of the underlying native bedrock.

DMA Exhibit

We have appended to this report a copy of the DMA map, Reference 2. We have added compacted fill depths listed on Table 4 to each BMP Basin. We have also shaded areas where we expect native formational soil to exist after the completion of grading. All other areas are expected to be underlain by undocumented fill, compacted fill, or colluvium/alluvium.

Storm Water Management Devices

Because of the presence of compacted fill that will exist across the site at the completion of grading, and the very low infiltration rates of the underlying Stadium Conglomerate bedrock, full and partial infiltration in considered infeasible and we recommend the basins be fully lined.

Conclusion

Because of the presence of compacted fill in excess of 5 feet across the site, and the very slow infiltration rates in the underlying Stadium Conglomerate bedrock, full and partial infiltration in considered infeasible and we recommend the site be designated as a "No Infiltration" condition.

If you have any questions regarding this letter, or if we may be of further service, please contact the undersigned at your convenience.

Very truly yours,

GEOCON INCORPORATED

Rodney C. Mikesell
GE 2533



RCM:dmc

(e-mail) Addressee
(e-mail) Project Design Consultants
Attention: Ms. Marina Wurst

LEGEND:

PROJECT BOUNDARY

DRAINAGE MANAGEMENT AREA (DMA)

BMP NOTES:

1. SITE DESIGN BMPS INCLUDE:
   - MINIMIZATION OF IMPERVIOUS FOOTPRINT
2. SOURCE CONTROL BMPs FOR PROJECT INCLUDE:
   - INTEGRATED PEST MANAGEMENT PRINCIPLES
   - EFFICIENT LANDSCAPE AND IRRIGATION DESIGN
   - STORMWATER EDUCATION
   - BUILDING MANAGEMENT PRACTICES (MANAGEMENT OF FIRE SPRINKLER SYSTEM DISCHARGES, AIR CONDITIONING CONDENSATE DISCHARGES, AND THE USE OF NON-TOXIC ROOFING MATERIALS.)
3. THE TREATMENT BMPS SELECTED FOR THIS PROJECT ARE 8 LINED BIOFILTRATION BASINS
4. PROJECT WILL OUTLET TO CARROLL CANYON CHANNEL WHICH CONFLUENCES WITH CARROLL CANYON CREEK AND SUBJECT TO HYDROMODIFICATION REQUIREMENTS
5. THE NRCS SOIL SURVEY CLASSIFIES THE SITE SOILS AS HYDROLOGIC SOIL GROUP 'D'
6. GROUNDWATER LEVEL WARES, BUT WAS ENCOUNTERED WITHIN 25' OF SURFACE NEAR UPPER PORTIONS OF PROJECT

DMA/BMP TABLE			
DMA#	BMP#	DMA AREA (AC)	BMP BOTTOM AREA (SQFT)
1	BASIN 1	10.41	7792
2	BASIN 2	8.77	6836
3	BASIN 3	15.68	6329
5	BASIN 5	11.04	14413
6	BASIN 6	34.81	36287
7	BASIN 7	16.69	18214
8	BASIN 8	78.51	56705
9	BASIN 9	49.22	32944

DMA #1 Drains to BVP #1

DMA #3 Drains to BMP #3

BASIN '1' BIOFILTRATION

BASIN '3' BIOFILTRATION

10 to 74 feet of fill

85 feet of fill

BASIN '2' BIOFILTRATION

DMA #2 Drains to BMP #2

0 to 76 feet of fill

RCP D60
PER 31390-6-D
I.E.=289.29
XBONE Q100=98.4 CFS

DMA #5 Drains to BMP #5

BASIN '5' BIOFILTRATION

DMA #7 Drains to BMP #7

SELF-MITIGATING AREAS

DMA #6 Drains to BMP #6

SPINE ROAD

RCP D24
PER 31390-9-D
FL=303.2
BACKBONE Q100=20.6 CFS

20 to 80 feet of fill

RCP D30
PER 31390-10-D
FL=281.18
BACKBONE Q100=41.7 CFS

DMA #9 Drains to BMP #9

BASIN '6' BIOFILTRATION

10 to 35 feet of fill

0 to 37 feet of fill

URBAN CORRIDOR STREET

CAMINO SANTA FE

BASIN '7' BIOFILTRATION

14 to 40 feet of fill

CARROLL CANYON ROAD

20 to 28 feet of fill

BASIN '9' BIOFILTRATION

BASIN '8' BIOFILTRATION

COMMUNITY PARK

DMA #8 Drains to BMP #8

POC-6

POC-7

POC-8

POC-9

SCALE: 1"=100'	PREPARED BY: PROJECT DESIGN CONSULTANTS Planning | Landscape Architecture | Engineering | Survey	CITY OF SAN DIEGO
JOB #: 4182.30		3 ROOTS
DATED: 11/8/17		DMA MAP PROPOSED CONDITIONS EXHIBIT 1A

APPENDIX A

APPENDIX A

INFILTRATION TEST RESULTS

FOR

3 ROOTS
SAN DIEGO, CALIFORNIA

PROJECT NO. G2070-42-02

GEOCON

Aardvark Permeameter Data Analysis

Project Name: 3Roots
Project Number: G2070-42-02
Test Number: A-1

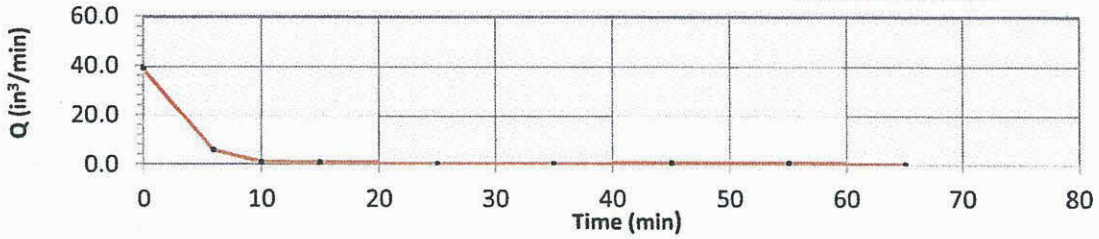
Date: 8/4/2017
By: N. BORJA

Borehole Diameter, d (in.):	8.00
Borehole Depth, H (in):	18.00
Distance Between Reservoir & Top of Borehole (in.):	30.50
Estimated Depth to Water Table, S (feet):	45.00
Height APM Raised from Bottom (in.):	2.00
Pressure Reducer Used:	No

Ref. EL (feet, MSL):	0.0
Bottom EL (feet, MSL):	-1.5

Distance Between Resevoir and APM Float, D (in.):	39.25
Head Height Calculated, h (in.):	5.63
Head Height Measured, h (in.):	5.50
Distance Between Constant Head and Water Table, L (in.):	527.50

Reading	Time Elapsed (min)	Water Weight Consummed (lbs)	Water Volume Consummed (in^3)	Q (in^3/min)
1	0.00	0.000	0.00	0.00
2	6.00	8.445	233.86	38.977
3	4.00	0.825	22.85	5.712
4	5.00	0.170	4.71	0.942
5	10.00	0.270	7.48	0.748
6	10.00	0.235	6.51	0.651
7	10.00	0.225	6.23	0.623
8	10.00	0.205	5.68	0.568
9	10.00	0.205	5.68	0.568
10	10.00	0.200	5.54	0.554
			Steady Flow Rate, Q (in^3/min):	0.563



Soil Matric Flux Potential, Φ_m

Φ_m= 0.010 in^2/min

Field-Saturated Hydraulic Conductivity (Infiltration Rate)

K_{sat} = 2.55E-04 in/min 0.015 in/hr

GEOCON

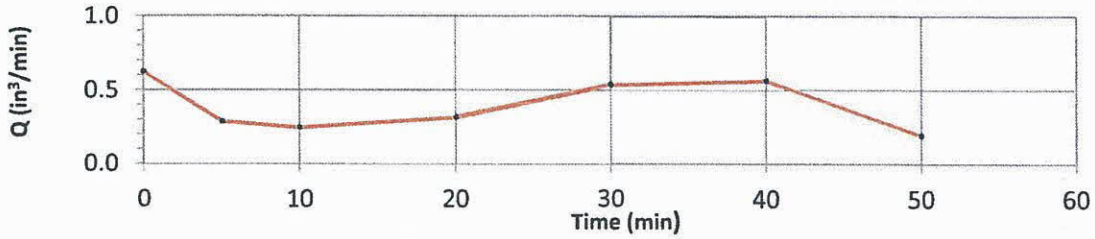
Aardvark Permeameter Data Analysis

Project Name:	3Roots	Date:	8/4/2017
Project Number:	G2070-42-02	By:	N. BORJA
Test Number:	A-2	Ref. EL (feet, MSL):	0.0
		Bottom EL (feet, MSL):	-4.0

Borehole Diameter, d (in.):	8.00
Borehole Depth, **H** (in):	47.75
Distance Between Reservoir & Top of Borehole (in.):	28.00
Estimated Depth to Water Table, **S** (feet):	45.00
Height APM Raised from Bottom (in.):	2.00
Pressure Reducer Used:	No

Distance Between Resevoir and APM Float, **D** (in.):	66.50
Head Height Calculated, **h** (in.):	5.72
Head Height Measured, **h** (in.):	4.88
Distance Between Constant Head and Water Table, **L** (in.):	497.13

Reading	Time Elapsed (min)	Water Weight Consummed (lbs)	Water Volume Consummed (in^3)	Q (in^3/min)
1	0.00	0.000	0.00	0.00
2	5.00	10.045	278.17	55.634
3	5.00	0.600	16.62	3.323
4	10.00	0.225	6.23	0.623
5	10.00	0.105	2.91	0.291
6	10.00	0.090	2.49	0.249
7	10.00	0.115	3.18	0.318
8	10.00	0.195	5.40	0.540
9	10.00	0.205	5.68	0.568
10	10.00	0.070	1.94	0.194
11	10.00	0.075	2.08	0.208
12	10.00	0.070	1.94	0.194
			Steady Flow Rate, Q (in^3/min):	0.198



Soil Matric Flux Potential, Φ_m

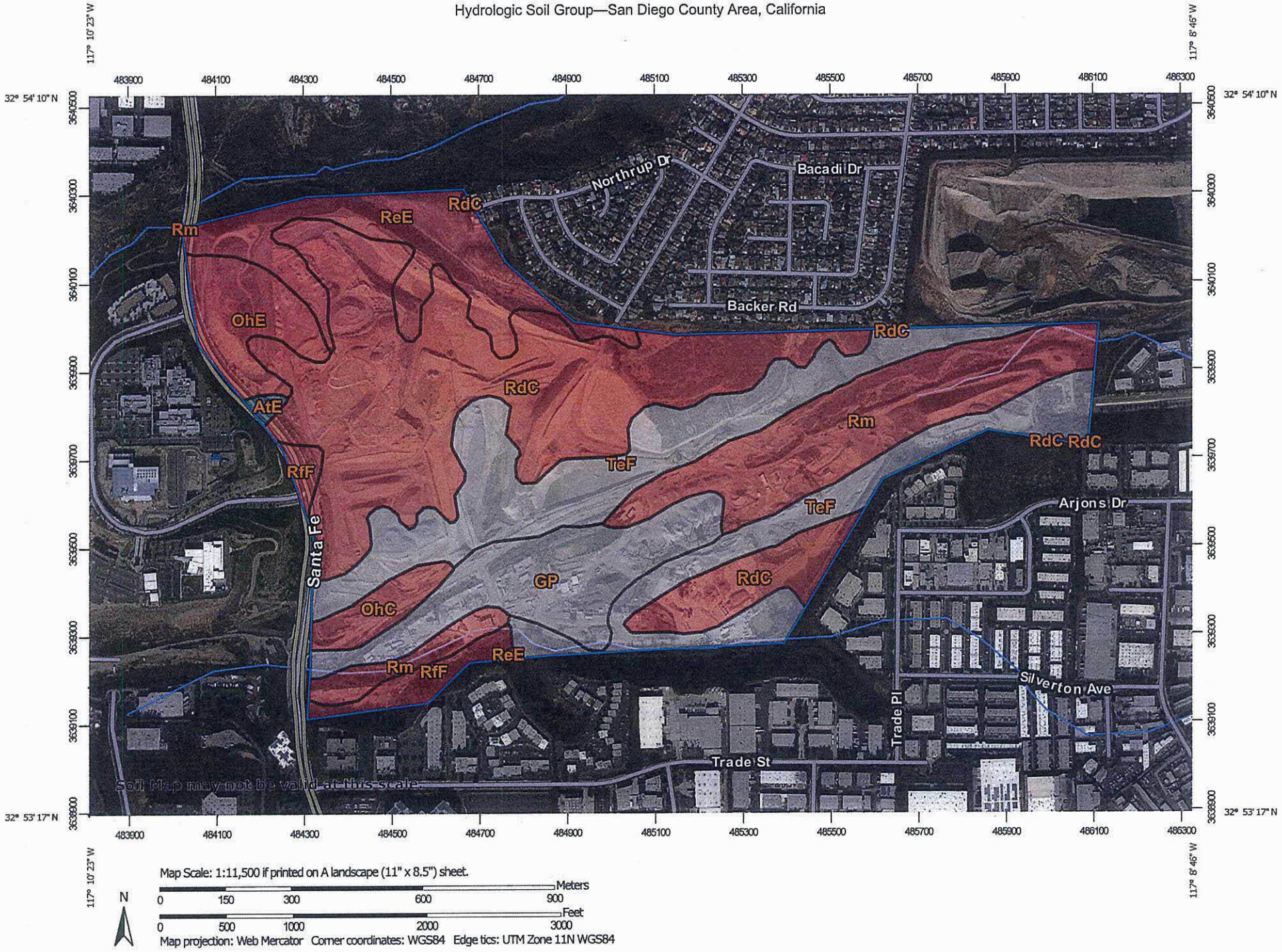
Φ_m= 0.004 in^2/min

Field-Saturated Hydraulic Conductivity (Infiltration Rate)

K_{sat} = 9.53E-05 in/min 0.006 in/hr

ATTACHMENT 1e

BMP Worksheets/Calculations



Map Scale: 1:11,500 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 150 300 600 900

Feet: 0 500 1000 2000 3000

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 Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: San Diego County Area, California
Survey Area Data: Version 10, Sep 12, 2016

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

Date(s) aerial images were photographed: Dec 7, 2014—Jan 4, 2015

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.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — San Diego County Area, California (CA638)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
AtE	Altamont clay, 15 to 30 percent slopes, warm MAAT, MLRA 20	C	1.0	0.3%
GP	Gravel pits		31.8	9.5%
OhC	Olivenhain cobbly loam, 2 to 9 percent slopes	D	6.9	2.1%
OhE	Olivenhain cobbly loam, 9 to 30 percent slopes	D	15.7	4.7%
RdC	Redding gravelly loam, 2 to 9 percent slopes	D	110.9	33.1%
ReE	Redding cobbly loam, 9 to 30 percent slopes	D	31.3	9.4%
RfF	Redding cobbly loam, dissected, 15 to 50 percent slopes	D	8.7	2.6%
Rm	Riverwash	D	48.9	14.6%
TeF	Terrace escarpments		79.5	23.8%
Totals for Area of Interest			**334.7**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

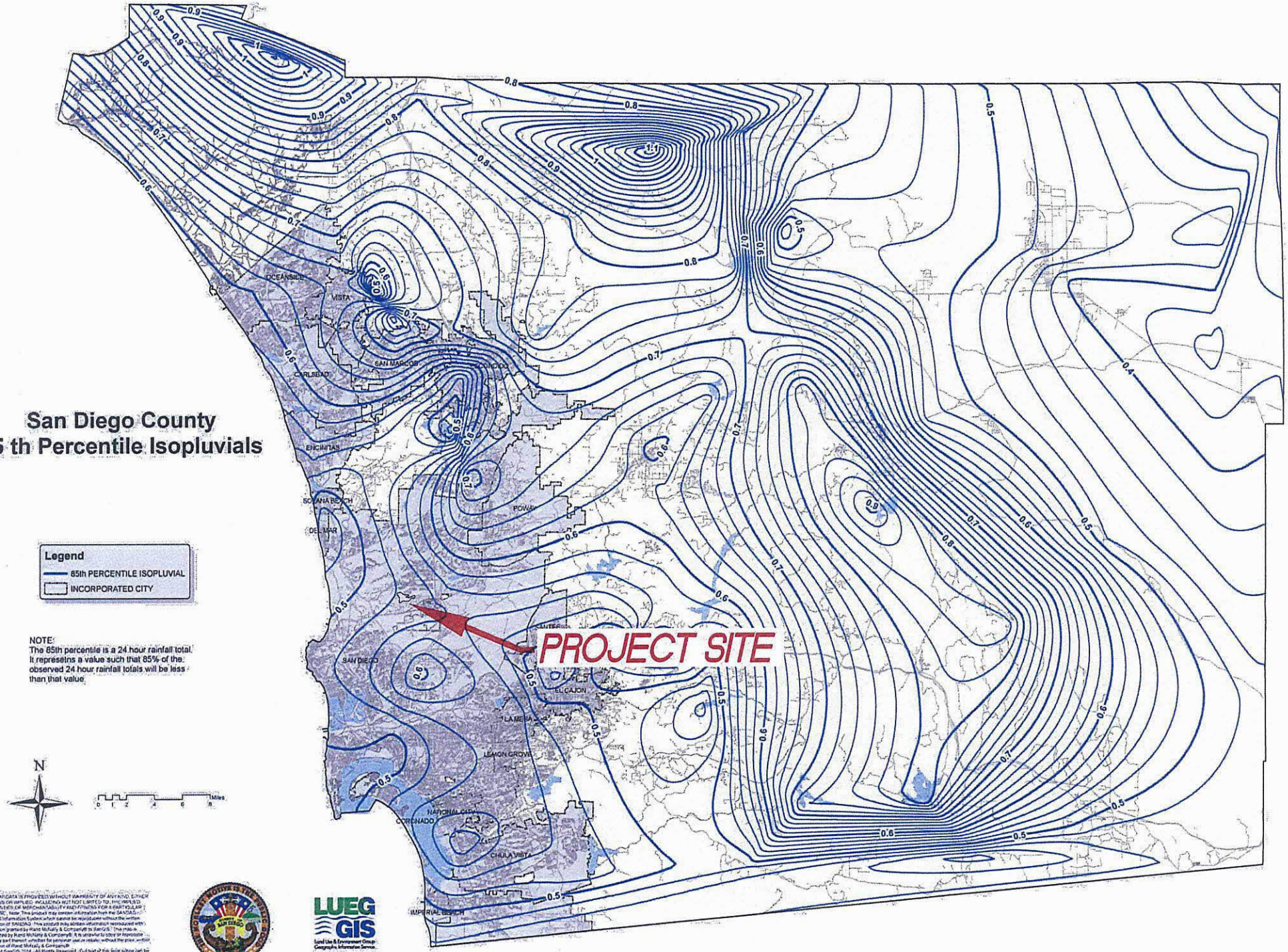
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher


San Diego County
85 th Percentile Isopluvials
Legend
85th PERCENTILE ISOPLUVIAL
INCORPORATED CITY
NOTE:
The 85th percentile is a 24 hour rainfall total. It represetns a value such that 85% of the observed 24 hour rainfall totals will be less than that value.
PROJECT SITE
OCEANSIDE
VISTA
SAN MARCOS
ESCONDIDO
CARLSBAD
ENCINITAS
SOLANA BEACH
DEL MAR
POWAY
SAN DIEGO
EL CAJON
LA MESA
LEMON GROVE
NATIONAL CITY
CORONADO
CHULA VISTA
IMPERIAL BEACH
N
0 1 2 4 6 8 Miles
LUEG GIS

ATTACHMENT 1B: Worksheet B.2-1: DCV

85th percentile 24-hr storm depth from Figure B.1.= 0.52 in

DMA ID	BMP ID (BF #)	BMP Drainage Area (ac)	Impervious Area (ac)	Amended Soils (ac) (C=0.1)	Natural D Soils (ac) (C=0.3)	% Imperviou s	Composit e C[1]	Tree Credit Volume (cf)	Rain Barrels Credit Volume (cf)	Design Capture Volume (DCV) (CF)
1	Basin #1	12.16	7.37	4.79	0	61%	0.58	0	0	13422
2	Basin #2	8.81	4.86	3.95	0	55%	0.54	0	0	8996
3	Basin #3	14.00	10.50	3.50	0	75%	0.70	0	0	18492
5	Basin #5	11.17	8.18	2.99	0	73%	0.69	0	0	14467
6	Basin #6	34.28	25.78	6.22	2.28	75%	0.71	0	0	46255
7	Basin #7	17.90	10.56	7.34	0	59%	0.57	0	0	19322
8	Basin #8	78.91	30.13	33.86	14.92	38%	0.44	0	0	66023
9	Basin #9	49.05	35.65	13.40	0	73%	0.68	0	0	63090
10-1A	MWS10-1	1.48	1.05	0.43	0	71%	0.67	0	0	1862
10-1B	MWS10-2	1.48	1.05	0.43	0	71%	0.67	0	0	1862
10-2	BMP #11 Biofiltration Median	1.98	1.41	0.58	0	71%	0.67	0	0	2502

Notes:

1) Equation for composite C factor = (0.9*Impervious Area +C*Pervious Area)/Total Area per BMP Design Manual.
C factors are from Table B.1-1 of Feb 2016 City BMP Design Manual.

The City of SAN DIEGO	Project Name	3 Roots	
	BMP ID	Basin #1	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	529689.6	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.58	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	13422	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	18	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	18	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	18	inches
15	Total Depth Treated [Line 13 + Line 14]	48	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	20132	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	5033	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	10066	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	6711	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-3)	0.0134355	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	4161	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	5033	sq. ft.
23	Provided BMP Footprint	7792	sq. ft.
24	Is Line 23 > Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	3 Roots	
	BMP ID	BMP #1	
Sizing Method for Volume Retention Criteria		**Worksheet B.5-2**	
1	Area draining to the BMP	529689.6	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.584736842	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	13422	cu. ft.
BMP Parameters			
5	Footprint of the BMP	7792	sq. ft.
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	18	inches
7	Media retained pore space [50% of (FC-WP)]	0.05	in/in
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Porosity of aggregate storage	0.4	in/in
Volume Retention Requirement			
10	Measured infiltration rate in the DMA	0	in/hr.
11	Factor of safety	2	
12	Reliable infiltration rate, for biofiltration BMP sizing [Line 10/ Line 11] Note: This worksheet is not applicable if Line 12 < 0.01 in/hr.	0	in/hr.
13	Average annual volume reduction target (Figure B.5-2) When Line 12 ≥ 0.01 in/hr. = Minimum (40, 166.9 x Line 12 +6.62)	6.6	%
14	Fraction of DCV to be retained (Figure B.5-3) $0.0000013 \times \text{Line } 13^3 - 0.000057 \times \text{Line } 13^2 + 0.0086 \times \text{Line } 13 - 0.014$	0.041	
15	Target volume retention [Line 14 x Line 4]	550	cu. ft.
Evapotranspiration: Average Annual Volume Retention			
16	Effective evapotranspiration depth [Line 6 x Line 7]	0.9	inches
17	Retained Pore Volume [(Line 16 x Line 5)/12]	584	cu. ft.
18	Fraction of DCV retained in pore spaces [Line 17/Line 4]	0.04	
19	Evapotranspiration average annual capture [ET nomographs in Figure B.5-5]	3.1	%
Infiltration: Average Annual Volume Retention			
20	Drawdown for infiltration storage [(Line 8 x Line 9)/Line 12]	0	hours
21	Equivalent DCV fraction from evapotranspiration (use Line 19 and Line 20 in Figure B.4-1; Refer to Appendix B.4.2.2)	0.01	
22	Infiltration volume storage [(Line 5 x Line 8 x Line 9)/12]	779	cu. ft.
23	Infiltration Storage Fraction of DCV [Line 22/Line 4]	0.06	
24	Total Equivalent Fraction of DCV [Line 21 + Line 23]	0.07	
25	Biofiltration BMP average annual capture [use Line 24 and 20 in Figure B.4-1]	24.73	%
Volume retention required from site design and other BMPs			
26	Fraction of DCV retained (Figure B.5-3) $0.0000013 \times \text{Line } 25^3 - 0.000057 \times \text{Line } 25^2 + 0.0086 \times \text{Line } 25 - 0.014$	0.184	
27	Remaining target DCV retention [(Line 14 – Line 26) x Line 4] Note: If Line 27 is equal to or smaller than 0 then the BMP meets the volume retention performance standard. If Line 27 is greater than 0, the applicant must implement site design and/or other BMPs within the DMA that will retain DCV equivalent to or greater than Line 27 to meet the volume retention performance standard	-1919	cu. ft.

Volume Retention Performance Standard is Met

The City of SAN DIEGO	Project Name	3 Roots
	BMP ID	BMP #1
Alternative Minimum Footprint Sizing Factor		Worksheet B.5-3

1	Area draining to the BMP	529689.6	sq. ft.
2	Adjusted Runoff Factor for drainage area (Refer to Appendix B.1 and B.2)	0.584736842	
3	Load to Clog	2	lb/sq. ft.
4	Allowable Period to Accumulate Clogging Load (T_L)	10	years

Volume Weighted EMC Calculation

Land Use	Fraction of Total DCV	TSS EMC (mg/L)	Product
Single Family Residential	0.3	123	36.9
Commercial		128	0
Industrial		125	0
Education (Municipal)		132	0
Transportation		78	0
Multi-family Residential	0.3	40	12
Roof Runoff		14	0
Low Traffic Areas	0.4	50	20
Open Space		216	0
Other, specify:			0
Other, specify:			0
Other, specify:			0

5	Volume Weighted EMC (sum of all products)	68.9	mg/L

Sizing Factor for Clogging

6	Adjustment for pretreatment measures Where: Line 6 = 0 if no pretreatment; Line 6 = 0.25 when pretreatment is included; Line 6 = 0.5 if the pretreatment has an active Washington State TAPE approval rating for "pre-treatment."	0.25	
7	Average Annual Precipitation [Provide documentation of the data source in the discussion box; SanGIS has a GIS layer for average annual precipitation]	10	inches
8	Calculate the Average Annual Runoff (Line 7 x Line 1/12) x Line2	258108	cu-ft/yr
9	Calculate the Average Annual TSS Load (Line 8 x 62.4 x Line 5 x (1 – Line 6))/10^6	832	lb/yr
10	Calculate the BMP Footprint Needed (Line 9 x Line 4)/Line 3	4161	sq. ft.
11	Calculate the Minimum Footprint Sizing Factor for Clogging [Line 10/ (Line 1 x Line 2)]	0.013	

Discussion:

The City of SAN DIEGO	Project Name	3 Roots	
	BMP ID	Basin #2	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	383763.6	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.54	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	8996	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	18	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	18	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	18	inches
15	Total Depth Treated [Line 13 + Line 14]	48	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	13494	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	3373	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	6747	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	4498	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-3)	0.00858	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	1781	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	3373	sq. ft.
23	Provided BMP Footprint	7677	sq. ft.
24	Is Line 23 > Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	3 Roots	
	BMP ID	BMP #2	
Sizing Method for Volume Retention Criteria		**Worksheet B.5-2**	
1	Area draining to the BMP	383763.60	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.540953462	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	8996	cu. ft.
BMP Parameters			
5	Footprint of the BMP	7677	sq. ft.
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	18	inches
7	Media retained pore space [50% of (FC-WP)]	0.05	in/in
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Porosity of aggregate storage	0.4	in/in
Volume Retention Requirement			
10	Measured infiltration rate in the DMA	0	in/hr.
11	Factor of safety	2	
12	Reliable infiltration rate, for biofiltration BMP sizing [Line 10/ Line 11] Note: This worksheet is not applicable if Line 12 < 0.01 in/hr.	0	in/hr.
13	Average annual volume reduction target (Figure B.5-2) When Line 12 ≥ 0.01 in/hr. = Minimum (40, 166.9 x Line 12 +6.62)	6.6	%
14	Fraction of DCV to be retained (Figure B.5-3) $0.0000013 \times \text{Line } 13^3 - 0.000057 \times \text{Line } 13^2 + 0.0086 \times \text{Line } 13 - 0.014$	0.041	
15	Target volume retention [Line 14 x Line 4]	369	cu. ft.
Evapotranspiration: Average Annual Volume Retention			
16	Effective evapotranspiration depth [Line 6 x Line 7]	0.9	inches
17	Retained Pore Volume [(Line 16 x Line 5)/12]	576	cu. ft.
18	Fraction of DCV retained in pore spaces [Line 17/Line 4]	0.06	
19	Evapotranspiration average annual capture [ET nomographs in Figure B.5-5]	4.5	%
Infiltration: Average Annual Volume Retention			
20	Drawdown for infiltration storage [(Line 8 x Line 9)/Line 12]	0	hours
21	Equivalent DCV fraction from evapotranspiration (use Line 19 and Line 20 in Figure B.4-1; Refer to Appendix B.4.2.2)	0.01	
22	Infiltration volume storage [(Line 5 x Line 8 x Line 9)/12]	768	cu. ft.
23	Infiltration Storage Fraction of DCV [Line 22/Line 4]	0.09	
24	Total Equivalent Fraction of DCV [Line 21 + Line 23]	0.10	
25	Biofiltration BMP average annual capture [use Line 24 and 20 in Figure B.4-1]	36.65	%
Volume retention required from site design and other BMPs			
26	Fraction of DCV retained (Figure B.5-3) $0.0000013 \times \text{Line } 25^3 - 0.000057 \times \text{Line } 25^2 + 0.0086 \times \text{Line } 25 - 0.014$	0.289	
27	Remaining target DCV retention [(Line 14 – Line 26) x Line 4] Note: If Line 27 is equal to or smaller than 0 then the BMP meets the volume retention performance standard. If Line 27 is greater than 0, the applicant must implement site design and/or other BMPs within the DMA that will retain DCV equivalent to or greater than Line 27 to meet the volume retention performance standard	-2231	cu. ft.

Volume Retention Performance Standard is Met

The City of SAN DIEGO	Project Name	3 Roots
	BMP ID	BMP #2
Alternative Minimum Footprint Sizing Factor		**Worksheet B.5-3**

1	Area draining to the BMP	383763.6	sq. ft.
2	Adjusted Runoff Factor for drainage area (Refer to Appendix B.1 and B.2)	0.540953462	
3	Load to Clog	2	lb/sq. ft.
4	Allowable Period to Accumulate Clogging Load (T_L)	10	years

Volume Weighted EMC Calculation

Land Use	Fraction of Total DCV	TSS EMC (mg/L)	Product
Single Family Residential		123	0
Commercial		128	0
Industrial		125	0
Education (Municipal)		132	0
Transportation		78	0
Multi-family Residential	0.6	40	24
Roof Runoff		14	0
Low Traffic Areas	0.4	50	20
Open Space		216	0
Other, specify:			0
Other, specify:			0
Other, specify:			0

5	Volume Weighted EMC (sum of all products)	44	mg/L

Sizing Factor for Clogging

6	Adjustment for pretreatment measures Where: Line 6 = 0 if no pretreatment; Line 6 = 0.25 when pretreatment is included; Line 6 = 0.5 if the pretreatment has an active Washington State TAPE approval rating for "pre-treatment."	0.25	
7	Average Annual Precipitation [Provide documentation of the data source in the discussion box; SanGIS has a GIS layer for average annual precipitation]	10	inches
8	Calculate the Average Annual Runoff (Line 7 x Line 1/12) x Line2	172999	cu-ft/yr
9	Calculate the Average Annual TSS Load (Line 8 x 62.4 x Line 5 x (1 – Line 6))/10^6	356	lb/yr
10	Calculate the BMP Footprint Needed (Line 9 x Line 4)/Line 3	1781	sq. ft.
11	Calculate the Minimum Footprint Sizing Factor for Clogging [Line 10/ (Line 1 x Line 2)]	0.009	

Discussion:

The City of SAN DIEGO	Project Name	3 Roots	
	BMP ID	Basin #3	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	609840	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.70	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	18492	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	18	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	18	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	18	inches
15	Total Depth Treated [Line 13 + Line 14]	48	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	27739	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	6935	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	13869	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	9246	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-3)	0.020748	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	8854	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	8854	sq. ft.
23	Provided BMP Footprint	9400	sq. ft.
24	Is Line 23 > Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	3 Roots	
	BMP ID	BMP #3	
Sizing Method for Volume Retention Criteria		**Worksheet B.5-2**	
1	Area draining to the BMP	609840.00	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.699771429	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	18492	cu. ft.
BMP Parameters			
5	Footprint of the BMP	9400	sq. ft.
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	18	inches
7	Media retained pore space [50% of (FC-WP)]	0.05	in/in
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Porosity of aggregate storage	0.4	in/in
Volume Retention Requirement			
10	Measured infiltration rate in the DMA	0	in/hr.
11	Factor of safety	2	
12	Reliable infiltration rate, for biofiltration BMP sizing [Line 10/ Line 11] Note: This worksheet is not applicable if Line 12 < 0.01 in/hr.	0	in/hr.
13	Average annual volume reduction target (Figure B.5-2) When Line 12 ≥ 0.01 in/hr. = Minimum (40, 166.9 x Line 12 +6.62)	6.6	%
14	Fraction of DCV to be retained (Figure B.5-3) $0.0000013 \times \text{Line } 13^3 - 0.000057 \times \text{Line } 13^2 + 0.0086 \times \text{Line } 13 - 0.014$	0.041	
15	Target volume retention [Line 14 x Line 4]	758	cu. ft.
Evapotranspiration: Average Annual Volume Retention			
16	Effective evapotranspiration depth [Line 6 x Line 7]	0.9	inches
17	Retained Pore Volume [(Line 16 x Line 5)/12]	705	cu. ft.
18	Fraction of DCV retained in pore spaces [Line 17/Line 4]	0.04	
19	Evapotranspiration average annual capture [ET nomographs in Figure B.5-5]	3.1	%
Infiltration: Average Annual Volume Retention			
20	Drawdown for infiltration storage [(Line 8 x Line 9)/Line 12]	0	hours
21	Equivalent DCV fraction from evapotranspiration (use Line 19 and Line 20 in Figure B.4-1; Refer to Appendix B.4.2.2)	0.01	
22	Infiltration volume storage [(Line 5 x Line 8 x Line 9)/12]	940	cu. ft.
23	Infiltration Storage Fraction of DCV [Line 22/Line 4]	0.05	
24	Total Equivalent Fraction of DCV [Line 21 + Line 23]	0.06	
25	Biofiltration BMP average annual capture [use Line 24 and 20 in Figure B.4-1]	21.12	%
Volume retention required from site design and other BMPs			
26	Fraction of DCV retained (Figure B.5-3) $0.0000013 \times \text{Line } 25^3 - 0.000057 \times \text{Line } 25^2 + 0.0086 \times \text{Line } 25 - 0.014$	0.154	
27	Remaining target DCV retention [(Line 14 – Line 26) x Line 4] Note: If Line 27 is equal to or smaller than 0 then the BMP meets the volume retention performance standard. If Line 27 is greater than 0, the applicant must implement site design and/or other BMPs within the DMA that will retain DCV equivalent to or greater than Line 27 to meet the volume retention performance standard	-2090	cu. ft.

Volume Retention Performance Standard is Met

The City of SAN DIEGO	Project Name	3 Roots
	BMP ID	BMP #3
Alternative Minimum Footprint Sizing Factor		**Worksheet B.5-3**

1	Area draining to the BMP	609840	sq. ft.
2	Adjusted Runoff Factor for drainage area (Refer to Appendix B.1 and B.2)	0.699771429	
3	Load to Clog	2	lb/sq. ft.
4	Allowable Period to Accumulate Clogging Load (T_L)	10	years

Volume Weighted EMC Calculation

Land Use	Fraction of Total DCV	TSS EMC (mg/L)	Product
Single Family Residential	0.8	123	98.4
Commercial		128	0
Industrial		125	0
Education (Municipal)		132	0
Transportation		78	0
Multi-family Residential	0.2	40	8
Roof Runoff		14	0
Low Traffic Areas		50	0
Open Space		216	0
Other, specify:			0
Other, specify:			0
Other, specify:			0

5	Volume Weighted EMC (sum of all products)	106.4	mg/L

Sizing Factor for Clogging

6	Adjustment for pretreatment measures Where: Line 6 = 0 if no pretreatment; Line 6 = 0.25 when pretreatment is included; Line 6 = 0.5 if the pretreatment has an active Washington State TAPE approval rating for "pre-treatment."	0.25	
7	Average Annual Precipitation [Provide documentation of the data source in the discussion box; SanGIS has a GIS layer for average annual precipitation]	10	inches
8	Calculate the Average Annual Runoff (Line 7 x Line 1/12) x Line2	355624	cu-ft/yr
9	Calculate the Average Annual TSS Load (Line 8 x 62.4 x Line 5 x (1 – Line 6))/10^6	1771	lb/yr
10	Calculate the BMP Footprint Needed (Line 9 x Line 4)/Line 3	8854	sq. ft.
11	Calculate the Minimum Footprint Sizing Factor for Clogging [Line 10/ (Line 1 x Line 2)]	0.021	

Discussion:

The City of SAN DIEGO	Project Name	3 Roots	
	BMP ID	Basin #5	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	486565.2	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.69	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	14467	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	12	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	18	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	18	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	24	inches
15	Total Depth Treated [Line 13 + Line 14]	54	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	21700	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	4822	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	10850	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	5425	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-3)	0.0158925	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	5306	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	5306	sq. ft.
23	Provided BMP Footprint	12590	sq. ft.
24	Is Line 23 > Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	3 Roots	
	BMP ID	BMP #5	
Sizing Method for Volume Retention Criteria		**Worksheet B.5-2**	
1	Area draining to the BMP	486565.2	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.68614145	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	14467	cu. ft.
BMP Parameters			
5	Footprint of the BMP	12590	sq. ft.
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	18	inches
7	Media retained pore space [50% of (FC-WP)]	0.05	in/in
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Porosity of aggregate storage	0.4	in/in
Volume Retention Requirement			
10	Measured infiltration rate in the DMA	0	in/hr.
11	Factor of safety	2	
12	Reliable infiltration rate, for biofiltration BMP sizing [Line 10/ Line 11] Note: This worksheet is not applicable if Line 12 < 0.01 in/hr.	0	in/hr.
13	Average annual volume reduction target (Figure B.5-2) When Line 12 ≥ 0.01 in/hr. = Minimum (40, 166.9 x Line 12 +6.62)	6.6	%
14	Fraction of DCV to be retained (Figure B.5-3) $0.0000013 \times \text{Line } 13^3 - 0.000057 \times \text{Line } 13^2 + 0.0086 \times \text{Line } 13 - 0.014$	0.041	
15	Target volume retention [Line 14 x Line 4]	593	cu. ft.
Evapotranspiration: Average Annual Volume Retention			
16	Effective evapotranspiration depth [Line 6 x Line 7]	0.9	inches
17	Retained Pore Volume [(Line 16 x Line 5)/12]	944	cu. ft.
18	Fraction of DCV retained in pore spaces [Line 17/Line 4]	0.07	
19	Evapotranspiration average annual capture [ET nomographs in Figure B.5-5]	5.2	%
Infiltration: Average Annual Volume Retention			
20	Drawdown for infiltration storage [(Line 8 x Line 9)/Line 12]	0	hours
21	Equivalent DCV fraction from evapotranspiration (use Line 19 and Line 20 in Figure B.4-1; Refer to Appendix B.4.2.2)	0.01	
22	Infiltration volume storage [(Line 5 x Line 8 x Line 9)/12]	1259	cu. ft.
23	Infiltration Storage Fraction of DCV [Line 22/Line 4]	0.09	
24	Total Equivalent Fraction of DCV [Line 21 + Line 23]	0.10	
25	Biofiltration BMP average annual capture [use Line 24 and 20 in Figure B.4-1]	37.10	%
Volume retention required from site design and other BMPs			
26	Fraction of DCV retained (Figure B.5-3) $0.0000013 \times \text{Line } 25^3 - 0.000057 \times \text{Line } 25^2 + 0.0086 \times \text{Line } 25 - 0.014$	0.293	
27	Remaining target DCV retention [(Line 14 – Line 26) x Line 4] Note: If Line 27 is equal to or smaller than 0 then the BMP meets the volume retention performance standard. If Line 27 is greater than 0, the applicant must implement site design and/or other BMPs within the DMA that will retain DCV equivalent to or greater than Line 27 to meet the volume retention performance standard	-3646	cu. ft.

Volume Retention Performance Standard is Met

The City of SAN DIEGO	Project Name	3 Roots	
	BMP ID	BMP #5	
Alternative Minimum Footprint Sizing Factor		**Worksheet B.5-3**	
1	Area draining to the BMP	486565.2	sq. ft.
2	Adjusted Runoff Factor for drainage area (Refer to Appendix B.1 and B.2)	0.68614145	
3	Load to Clog	2	lb/sq. ft.
4	Allowable Period to Accumulate Clogging Load (T_L)	10	years

Volume Weighted EMC Calculation

Land Use	Fraction of Total DCV	TSS EMC (mg/L)	Product
Single Family Residential	0.5	123	61.5
Commercial		128	0
Industrial		125	0
Education (Municipal)		132	0
Transportation		78	0
Multi-family Residential	0.5	40	20
Roof Runoff		14	0
Low Traffic Areas		50	0
Open Space		216	0
Other, specify:			0
Other, specify:			0
Other, specify:			0

5	Volume Weighted EMC (sum of all products)	81.5	mg/L

Sizing Factor for Clogging

6	Adjustment for pretreatment measures Where: Line 6 = 0 if no pretreatment; Line 6 = 0.25 when pretreatment is included; Line 6 = 0.5 if the pretreatment has an active Washington State TAPE approval rating for "pre-treatment."	0.25	
7	Average Annual Precipitation [Provide documentation of the data source in the discussion box; SanGIS has a GIS layer for average annual precipitation]	10	inches
8	Calculate the Average Annual Runoff (Line 7 x Line 1/12) x Line2	278210	cu-ft/yr
9	Calculate the Average Annual TSS Load (Line 8 x 62.4 x Line 5 x (1 – Line 6))/10^6	1061	lb/yr
10	Calculate the BMP Footprint Needed (Line 9 x Line 4)/Line 3	5306	sq. ft.
11	Calculate the Minimum Footprint Sizing Factor for Clogging [Line 10/ (Line 1 x Line 2)]	0.016	

Discussion:

The City of SAN DIEGO	Project Name	3 Roots	
	BMP ID	BMP #6	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	1493236.8	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.71	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	46255	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	18	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	18	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	18	inches
15	Total Depth Treated [Line 13 + Line 14]	48	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	69383	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	17346	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	34691	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	23128	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-3)	0.0231075	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	24666	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	24666	sq. ft.
23	Provided BMP Footprint	57745	sq. ft.
24	Is Line 23 > Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	3 Roots	
	BMP ID	BMP #6	
Sizing Method for Volume Retention Criteria		**Worksheet B.5-2**	
1	Area draining to the BMP	1493236.8	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.714842474	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	46255	cu. ft.
BMP Parameters			
5	Footprint of the BMP	57745	sq. ft.
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	18	inches
7	Media retained pore space [50% of (FC-WP)]	0.05	in/in
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Porosity of aggregate storage	0.4	in/in
Volume Retention Requirement			
10	Measured infiltration rate in the DMA	0	in/hr.
11	Factor of safety	2	
12	Reliable infiltration rate, for biofiltration BMP sizing [Line 10/ Line 11] Note: This worksheet is not applicable if Line 12 < 0.01 in/hr.	0	in/hr.
13	Average annual volume reduction target (Figure B.5-2) When Line 12 ≥ 0.01 in/hr. = Minimum (40, 166.9 x Line 12 +6.62)	6.6	%
14	Fraction of DCV to be retained (Figure B.5-3) $0.0000013 \times \text{Line } 13^3 - 0.000057 \times \text{Line } 13^2 + 0.0086 \times \text{Line } 13 - 0.014$	0.041	
15	Target volume retention [Line 14 x Line 4]	1896	cu. ft.
Evapotranspiration: Average Annual Volume Retention			
16	Effective evapotranspiration depth [Line 6 x Line 7]	0.9	inches
17	Retained Pore Volume [(Line 16 x Line 5)/12]	4331	cu. ft.
18	Fraction of DCV retained in pore spaces [Line 17/Line 4]	0.09	
19	Evapotranspiration average annual capture [ET nomographs in Figure B.5-5]	6.6	%
Infiltration: Average Annual Volume Retention			
20	Drawdown for infiltration storage [(Line 8 x Line 9)/Line 12]	0	hours
21	Equivalent DCV fraction from evapotranspiration (use Line 19 and Line 20 in Figure B.4-1; Refer to Appendix B.4.2.2)	0.02	
22	Infiltration volume storage [(Line 5 x Line 8 x Line 9)/12]	5775	cu. ft.
23	Infiltration Storage Fraction of DCV [Line 22/Line 4]	0.12	
24	Total Equivalent Fraction of DCV [Line 21 + Line 23]	0.14	
25	Biofiltration BMP average annual capture [use Line 24 and 20 in Figure B.4-1]	44.84	%
Volume retention required from site design and other BMPs			
26	Fraction of DCV retained (Figure B.5-3) $0.0000013 \times \text{Line } 25^3 - 0.000057 \times \text{Line } 25^2 + 0.0086 \times \text{Line } 25 - 0.014$	0.374	
27	Remaining target DCV retention [(Line 14 – Line 26) x Line 4] Note: If Line 27 is equal to or smaller than 0 then the BMP meets the volume retention performance standard. If Line 27 is greater than 0, the applicant must implement site design and/or other BMPs within the DMA that will retain DCV equivalent to or greater than Line 27 to meet the volume retention performance standard	-15403	cu. ft.

Volume Retention Performance Standard is Met

The City of SAN DIEGO	Project Name	3 Roots
	BMP ID	BMP #6
Alternative Minimum Footprint Sizing Factor		**Worksheet B.5-3**

1	Area draining to the BMP	1493236.8	sq. ft.
2	Adjusted Runoff Factor for drainage area (Refer to Appendix B.1 and B.2)	0.714842474	
3	Load to Clog	2	lb/sq. ft.
4	Allowable Period to Accumulate Clogging Load (T_L)	10	years

Volume Weighted EMC Calculation

Land Use	Fraction of Total DCV	TSS EMC (mg/L)	Product
Single Family Residential	0.9	123	110.7
Commercial		128	0
Industrial		125	0
Education (Municipal)		132	0
Transportation	0.1	78	7.8
Multi-family Residential		40	0
Roof Runoff		14	0
Low Traffic Areas		50	0
Open Space		216	0
Other, specify:			0
Other, specify:			0
Other, specify:			0

5	Volume Weighted EMC (sum of all products)	118.5	mg/L

Sizing Factor for Clogging

6	Adjustment for pretreatment measures Where: Line 6 = 0 if no pretreatment; Line 6 = 0.25 when pretreatment is included; Line 6 = 0.5 if the pretreatment has an active Washington State TAPE approval rating for "pre-treatment."	0.25	
7	Average Annual Precipitation [Provide documentation of the data source in the discussion box; SanGIS has a GIS layer for average annual precipitation]	10	inches
8	Calculate the Average Annual Runoff (Line 7 x Line 1/12) x Line2	889524	cu-ft/yr
9	Calculate the Average Annual TSS Load (Line 8 x 62.4 x Line 5 x (1 – Line 6))/10^6	4933	lb/yr
10	Calculate the BMP Footprint Needed (Line 9 x Line 4)/Line 3	24666	sq. ft.
11	Calculate the Minimum Footprint Sizing Factor for Clogging [Line 10/ (Line 1 x Line 2)]	0.023	

Discussion:

The City of SAN DIEGO	Project Name	3 Roots	
	BMP ID	BMP #7	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	779724	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.57	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	19322	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	18	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	18	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	18	inches
15	Total Depth Treated [Line 13 + Line 14]	48	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	28983	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	7246	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	14492	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	9661	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-3)	0.0139035	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	6200	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	7246	sq. ft.
23	Provided BMP Footprint	18214	sq. ft.
24	Is Line 23 > Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	3 Roots	
	BMP ID	BMP #7	
Sizing Method for Volume Retention Criteria		**Worksheet B.5-2**	
1	Area draining to the BMP	779724.00	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.571865922	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	19322	cu. ft.
BMP Parameters			
5	Footprint of the BMP	18214	sq. ft.
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	18	inches
7	Media retained pore space [50% of (FC-WP)]	0.05	in/in
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Porosity of aggregate storage	0.4	in/in
Volume Retention Requirement			
10	Measured infiltration rate in the DMA	0	in/hr.
11	Factor of safety	2	
12	Reliable infiltration rate, for biofiltration BMP sizing [Line 10/ Line 11] Note: This worksheet is not applicable if Line 12 < 0.01 in/hr.	0	in/hr.
13	Average annual volume reduction target (Figure B.5-2) When Line 12 ≥ 0.01 in/hr. = Minimum (40, 166.9 x Line 12 +6.62)	6.6	%
14	Fraction of DCV to be retained (Figure B.5-3) $0.0000013 \times \text{Line } 13^3 - 0.000057 \times \text{Line } 13^2 + 0.0086 \times \text{Line } 13 - 0.014$	0.041	
15	Target volume retention [Line 14 x Line 4]	792	cu. ft.
Evapotranspiration: Average Annual Volume Retention			
16	Effective evapotranspiration depth [Line 6 x Line 7]	0.9	inches
17	Retained Pore Volume [(Line 16 x Line 5)/12]	1366	cu. ft.
18	Fraction of DCV retained in pore spaces [Line 17/Line 4]	0.07	
19	Evapotranspiration average annual capture [ET nomographs in Figure B.5-5]	5.2	%
Infiltration: Average Annual Volume Retention			
20	Drawdown for infiltration storage [(Line 8 x Line 9)/Line 12]	0	hours
21	Equivalent DCV fraction from evapotranspiration (use Line 19 and Line 20 in Figure B.4-1; Refer to Appendix B.4.2.2)	0.01	
22	Infiltration volume storage [(Line 5 x Line 8 x Line 9)/12]	1821	cu. ft.
23	Infiltration Storage Fraction of DCV [Line 22/Line 4]	0.09	
24	Total Equivalent Fraction of DCV [Line 21 + Line 23]	0.10	
25	Biofiltration BMP average annual capture [use Line 24 and 20 in Figure B.4-1]	37.10	%
Volume retention required from site design and other BMPs			
26	Fraction of DCV retained (Figure B.5-3) $0.0000013 \times \text{Line } 25^3 - 0.000057 \times \text{Line } 25^2 + 0.0086 \times \text{Line } 25 - 0.014$	0.293	
27	Remaining target DCV retention [(Line 14 – Line 26) x Line 4] Note: If Line 27 is equal to or smaller than 0 then the BMP meets the volume retention performance standard. If Line 27 is greater than 0, the applicant must implement site design and/or other BMPs within the DMA that will retain DCV equivalent to or greater than Line 27 to meet the volume retention performance standard	-4869	cu. ft.

Volume Retention Performance Standard is Met

The City of SAN DIEGO	Project Name	3 Roots
	BMP ID	BMP #7
Alternative Minimum Footprint Sizing Factor		Worksheet B.5-3

1	Area draining to the BMP	779724	sq. ft.
2	Adjusted Runoff Factor for drainage area (Refer to Appendix B.1 and B.2)	0.571865922	
3	Load to Clog	2	lb/sq. ft.
4	Allowable Period to Accumulate Clogging Load (T_L)	10	years

Volume Weighted EMC Calculation

Land Use	Fraction of Total DCV	TSS EMC (mg/L)	Product
Single Family Residential	0.1	123	12.3
Commercial		128	0
Industrial		125	0
Education (Municipal)		132	0
Transportation	0.5	78	39
Multi-family Residential		40	0
Roof Runoff		14	0
Low Traffic Areas	0.4	50	20
Open Space		216	0
Other, specify:			0
Other, specify:			0
Other, specify:			0

5	Volume Weighted EMC (sum of all products)	71.3	mg/L

Sizing Factor for Clogging

6	Adjustment for pretreatment measures Where: Line 6 = 0 if no pretreatment; Line 6 = 0.25 when pretreatment is included; Line 6 = 0.5 if the pretreatment has an active Washington State TAPE approval rating for "pre-treatment."	0.25	
7	Average Annual Precipitation [Provide documentation of the data source in the discussion box; SanGIS has a GIS layer for average annual precipitation]	10	inches
8	Calculate the Average Annual Runoff (Line 7 x Line 1/12) x Line2	371581	cu-ft/yr
9	Calculate the Average Annual TSS Load (Line 8 x 62.4 x Line 5 x (1 – Line 6))/10^6	1240	lb/yr
10	Calculate the BMP Footprint Needed (Line 9 x Line 4)/Line 3	6200	sq. ft.
11	Calculate the Minimum Footprint Sizing Factor for Clogging [Line 10/ (Line 1 x Line 2)]	0.014	

Discussion:

The City of SAN DIEGO	Project Name	3 Roots	
	BMP ID	BMP #8	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	3437319.6	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.44	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	66023	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	18	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	18	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	18	inches
15	Total Depth Treated [Line 13 + Line 14]	48	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	99035	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	24759	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	49518	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	33012	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-3)	0.016536	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	25195	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	25195	sq. ft.
23	Provided BMP Footprint	56705	sq. ft.
24	Is Line 23 > Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	3 Roots	
	BMP ID	BMP #8	
Sizing Method for Volume Retention Criteria		**Worksheet B.5-2**	
1	Area draining to the BMP	3437319.60	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.443256875	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	66023	cu. ft.
BMP Parameters			
5	Footprint of the BMP	56705	sq. ft.
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	18	inches
7	Media retained pore space [50% of (FC-WP)]	0.05	in/in
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Porosity of aggregate storage	0.4	in/in
Volume Retention Requirement			
10	Measured infiltration rate in the DMA	0	in/hr.
11	Factor of safety	2	
12	Reliable infiltration rate, for biofiltration BMP sizing [Line 10/ Line 11] Note: This worksheet is not applicable if Line 12 < 0.01 in/hr.	0	in/hr.
13	Average annual volume reduction target (Figure B.5-2) When Line 12 ≥ 0.01 in/hr. = Minimum (40, 166.9 x Line 12 +6.62)	6.6	%
14	Fraction of DCV to be retained (Figure B.5-3) $0.0000013 \times \text{Line } 13^3 - 0.000057 \times \text{Line } 13^2 + 0.0086 \times \text{Line } 13 - 0.014$	0.041	
15	Target volume retention [Line 14 x Line 4]	2707	cu. ft.
Evapotranspiration: Average Annual Volume Retention			
16	Effective evapotranspiration depth [Line 6 x Line 7]	0.9	inches
17	Retained Pore Volume [(Line 16 x Line 5)/12]	4253	cu. ft.
18	Fraction of DCV retained in pore spaces [Line 17/Line 4]	0.06	
19	Evapotranspiration average annual capture [ET nomographs in Figure B.5-5]	4.5	%
Infiltration: Average Annual Volume Retention			
20	Drawdown for infiltration storage [(Line 8 x Line 9)/Line 12]	0	hours
21	Equivalent DCV fraction from evapotranspiration (use Line 19 and Line 20 in Figure B.4-1; Refer to Appendix B.4.2.2)	0.01	
22	Infiltration volume storage [(Line 5 x Line 8 x Line 9)/12]	5671	cu. ft.
23	Infiltration Storage Fraction of DCV [Line 22/Line 4]	0.09	
24	Total Equivalent Fraction of DCV [Line 21 + Line 23]	0.10	
25	Biofiltration BMP average annual capture [use Line 24 and 20 in Figure B.4-1]	36.65	%
Volume retention required from site design and other BMPs			
26	Fraction of DCV retained (Figure B.5-3) $0.0000013 \times \text{Line } 25^3 - 0.000057 \times \text{Line } 25^2 + 0.0086 \times \text{Line } 25 - 0.014$	0.289	
27	Remaining target DCV retention [(Line 14 – Line 26) x Line 4] Note: If Line 27 is equal to or smaller than 0 then the BMP meets the volume retention performance standard. If Line 27 is greater than 0, the applicant must implement site design and/or other BMPs within the DMA that will retain DCV equivalent to or greater than Line 27 to meet the volume retention performance standard	-16374	cu. ft.

Volume Retention Performance Standard is Met

The City of SAN DIEGO	Project Name	3 Roots
	BMP ID	BMP #8
Alternative Minimum Footprint Sizing Factor		**Worksheet B.5-3**

1	Area draining to the BMP	3437319.6	sq. ft.
2	Adjusted Runoff Factor for drainage area (Refer to Appendix B.1 and B.2)	0.443256875	
3	Load to Clog	2	lb/sq. ft.
4	Allowable Period to Accumulate Clogging Load (T_L)	10	years

Volume Weighted EMC Calculation

Land Use	Fraction of Total DCV	TSS EMC (mg/L)	Product
Single Family Residential	0.4	123	49.2
Commercial		128	0
Industrial		125	0
Education (Municipal)		132	0
Transportation	0.2	78	15.6
Multi-family Residential		40	0
Roof Runoff		14	0
Low Traffic Areas	0.4	50	20
Open Space		216	0
Other, specify:			0
Other, specify:			0
Other, specify:			0

5	Volume Weighted EMC (sum of all products)	84.8	mg/L

Sizing Factor for Clogging

6	Adjustment for pretreatment measures Where: Line 6 = 0 if no pretreatment; Line 6 = 0.25 when pretreatment is included; Line 6 = 0.5 if the pretreatment has an active Washington State TAPE approval rating for "pre-treatment."	0.25	
7	Average Annual Precipitation [Provide documentation of the data source in the discussion box; SanGIS has a GIS layer for average annual precipitation]	10	inches
8	Calculate the Average Annual Runoff (Line 7 x Line 1/12) x Line2	1269680	cu-ft/yr
9	Calculate the Average Annual TSS Load (Line 8 x 62.4 x Line 5 x (1 – Line 6))/10^6	5039	lb/yr
10	Calculate the BMP Footprint Needed (Line 9 x Line 4)/Line 3	25195	sq. ft.
11	Calculate the Minimum Footprint Sizing Factor for Clogging [Line 10/ (Line 1 x Line 2)]	0.017	

Discussion:

The City of SAN DIEGO	Project Name	3 Roots	
	BMP ID	BMP #9	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	2136618	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.68	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	63090	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	18	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	37	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	25.6	inches
15	Total Depth Treated [Line 13 + Line 14]	55.6	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	94635	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	20425	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	47318	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	22180	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-3)	0.011037	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	16069	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	20425	sq. ft.
23	Provided BMP Footprint	28525	sq. ft.
24	Is Line 23 > Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	3 Roots	
	BMP ID	BMP #9	
Sizing Method for Volume Retention Criteria		**Worksheet B.5-2**	
1	Area draining to the BMP	2136618.00	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.681414883	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	63090	cu. ft.
BMP Parameters			
5	Footprint of the BMP	28525	sq. ft.
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	18	inches
7	Media retained pore space [50% of (FC-WP)]	0.05	in/in
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Porosity of aggregate storage	0.4	in/in
Volume Retention Requirement			
10	Measured infiltration rate in the DMA	0	in/hr.
11	Factor of safety	2	
12	Reliable infiltration rate, for biofiltration BMP sizing [Line 10/ Line 11] Note: This worksheet is not applicable if Line 12 < 0.01 in/hr.	0	in/hr.
13	Average annual volume reduction target (Figure B.5-2) When Line 12 ≥ 0.01 in/hr. = Minimum (40, 166.9 x Line 12 +6.62)	6.6	%
14	Fraction of DCV to be retained (Figure B.5-3) $0.0000013 \times \text{Line } 13^3 - 0.000057 \times \text{Line } 13^2 + 0.0086 \times \text{Line } 13 - 0.014$	0.041	
15	Target volume retention [Line 14 x Line 4]	2587	cu. ft.
Evapotranspiration: Average Annual Volume Retention			
16	Effective evapotranspiration depth [Line 6 x Line 7]	0.9	inches
17	Retained Pore Volume [(Line 16 x Line 5)/12]	2139	cu. ft.
18	Fraction of DCV retained in pore spaces [Line 17/Line 4]	0.03	
19	Evapotranspiration average annual capture [ET nomographs in Figure B.5-5]	2.4	%
Infiltration: Average Annual Volume Retention			
20	Drawdown for infiltration storage [(Line 8 x Line 9)/Line 12]	0	hours
21	Equivalent DCV fraction from evapotranspiration (use Line 19 and Line 20 in Figure B.4-1; Refer to Appendix B.4.2.2)	0.01	
22	Infiltration volume storage [(Line 5 x Line 8 x Line 9)/12]	2853	cu. ft.
23	Infiltration Storage Fraction of DCV [Line 22/Line 4]	0.05	
24	Total Equivalent Fraction of DCV [Line 21 + Line 23]	0.06	
25	Biofiltration BMP average annual capture [use Line 24 and 20 in Figure B.4-1]	20.42	%
Volume retention required from site design and other BMPs			
26	Fraction of DCV retained (Figure B.5-3) $0.0000013 \times \text{Line } 25^3 - 0.000057 \times \text{Line } 25^2 + 0.0086 \times \text{Line } 25 - 0.014$	0.149	
27	Remaining target DCV retention [(Line 14 – Line 26) x Line 4] Note: If Line 27 is equal to or smaller than 0 then the BMP meets the volume retention performance standard. If Line 27 is greater than 0, the applicant must implement site design and/or other BMPs within the DMA that will retain DCV equivalent to or greater than Line 27 to meet the volume retention performance standard	-6814	cu. ft.

Volume Retention Performance Standard is Met

The City of SAN DIEGO	Project Name	3 Roots
	BMP ID	BMP #9
Alternative Minimum Footprint Sizing Factor		**Worksheet B.5-3**

1	Area draining to the BMP	2136618	sq. ft.
2	Adjusted Runoff Factor for drainage area (Refer to Appendix B.1 and B.2)	0.681414883	
3	Load to Clog	2	lb/sq. ft.
4	Allowable Period to Accumulate Clogging Load (T_L)	10	years

Volume Weighted EMC Calculation

Land Use	Fraction of Total DCV	TSS EMC (mg/L)	Product
Single Family Residential	0.2	123	24.6
Commercial		128	0
Industrial		125	0
Education (Municipal)		132	0
Transportation		78	0
Multi-family Residential	0.8	40	32
Roof Runoff		14	0
Low Traffic Areas		50	0
Open Space		216	0
Other, specify:			0
Other, specify:			0
Other, specify:			0

5	Volume Weighted EMC (sum of all products)	56.6	mg/L

Sizing Factor for Clogging

6	Adjustment for pretreatment measures Where: Line 6 = 0 if no pretreatment; Line 6 = 0.25 when pretreatment is included; Line 6 = 0.5 if the pretreatment has an active Washington State TAPE approval rating for "pre-treatment."	0.25	
7	Average Annual Precipitation [Provide documentation of the data source in the discussion box; SanGIS has a GIS layer for average annual precipitation]	10	inches
8	Calculate the Average Annual Runoff (Line 7 x Line 1/12) x Line2	1213269	cu-ft/yr
9	Calculate the Average Annual TSS Load (Line 8 x 62.4 x Line 5 x (1 – Line 6))/10^6	3214	lb/yr
10	Calculate the BMP Footprint Needed (Line 9 x Line 4)/Line 3	16069	sq. ft.
11	Calculate the Minimum Footprint Sizing Factor for Clogging [Line 10/ (Line 1 x Line 2)]	0.011	

Discussion:

The City of SAN DIEGO	Project Name	3 Roots	
	BMP ID	BMP #11 Biofiltration Median	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	215034	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.67	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	6225	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	18	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	15.6	inches
15	Total Depth Treated [Line 13 + Line 14]	45.6	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	9337	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	2457	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	4668	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	3591	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-3)	0.02028	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	2913	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	2913	sq. ft.
23	Provided BMP Footprint	8000	sq. ft.
24	Is Line 23 > Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	3 Roots	
	BMP ID	BMP #11 Biofiltration Median	
Sizing Method for Volume Retention Criteria		**Worksheet B.5-2**	
1	Area draining to the BMP	215034.00	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.67	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	6225	cu. ft.
BMP Parameters			
5	Footprint of the BMP	8000	sq. ft.
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	18	inches
7	Media retained pore space [50% of (FC-WP)]	0.05	in/in
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Porosity of aggregate storage	0.4	in/in
Volume Retention Requirement			
10	Measured infiltration rate in the DMA	0	in/hr.
11	Factor of safety	2	
12	Reliable infiltration rate, for biofiltration BMP sizing [Line 10/ Line 11] Note: This worksheet is not applicable if Line 12 < 0.01 in/hr.	0	in/hr.
13	Average annual volume reduction target (Figure B.5-2) When Line 12 ≥ 0.01 in/hr. = Minimum (40, 166.9 x Line 12 +6.62)	6.6	%
14	Fraction of DCV to be retained (Figure B.5-3) $0.0000013 \times \text{Line } 13^3 - 0.000057 \times \text{Line } 13^2 + 0.0086 \times \text{Line } 13 - 0.014$	0.041	
15	Target volume retention [Line 14 x Line 4]	255	cu. ft.
Evapotranspiration: Average Annual Volume Retention			
16	Effective evapotranspiration depth [Line 6 x Line 7]	0.9	inches
17	Retained Pore Volume [(Line 16 x Line 5)/12]	600	cu. ft.
18	Fraction of DCV retained in pore spaces [Line 17/Line 4]	0.10	
19	Evapotranspiration average annual capture [ET nomographs in Figure B.5-5]	7.3	%
Infiltration: Average Annual Volume Retention			
20	Drawdown for infiltration storage [(Line 8 x Line 9)/Line 12]	0	hours
21	Equivalent DCV fraction from evapotranspiration (use Line 19 and Line 20 in Figure B.4-1; Refer to Appendix B.4.2.2)	0.02	
22	Infiltration volume storage [(Line 5 x Line 8 x Line 9)/12]	800	cu. ft.
23	Infiltration Storage Fraction of DCV [Line 22/Line 4]	0.13	
24	Total Equivalent Fraction of DCV [Line 21 + Line 23]	0.15	
25	Biofiltration BMP average annual capture [use Line 24 and 20 in Figure B.4-1]	47.56	%
Volume retention required from site design and other BMPs			
26	Fraction of DCV retained (Figure B.5-3) $0.0000013 \times \text{Line } 25^3 - 0.000057 \times \text{Line } 25^2 + 0.0086 \times \text{Line } 25 - 0.014$	0.406	
27	Remaining target DCV retention [(Line 14 – Line 26) x Line 4] Note: If Line 27 is equal to or smaller than 0 then the BMP meets the volume retention performance standard. If Line 27 is greater than 0, the applicant must implement site design and/or other BMPs within the DMA that will retain DCV equivalent to or greater than Line 27 to meet the volume retention performance standard	-2272	cu. ft.
Volume Retention Performance Standard is Met			

The City of SAN DIEGO	Project Name	3 Roots
	BMP ID	BMP #11 Biofiltration Median

Alternative Minimum Footprint Sizing Factor — **Worksheet B.5-3**

1	Area draining to the BMP	215034	sq. ft.
2	Adjusted Runoff Factor for drainage area (Refer to Appendix B.1 and B.2)	0.67	
3	Load to Clog	2	lb/sq. ft.
4	Allowable Period to Accumulate Clogging Load (T_L)	10	years

Volume Weighted EMC Calculation

Land Use	Fraction of Total DCV	TSS EMC (mg/L)	Product
Single Family Residential		123	0
Commercial		128	0
Industrial		125	0
Education (Municipal)		132	0
Transportation	1	78	78
Multi-family Residential		40	0
Roof Runoff		14	0
Low Traffic Areas		50	0
Open Space		216	0
Other, specify:			0
Other, specify:			0
Other, specify:			0

5	Volume Weighted EMC (sum of all products)	78	mg/L

Sizing Factor for Clogging

6	Adjustment for pretreatment measures Where: Line 6 = 0 if no pretreatment; Line 6 = 0.25 when pretreatment is included; Line 6 = 0.5 if the pretreatment has an active Washington State TAPE approval rating for "pre-treatment."	0	
7	Average Annual Precipitation [Provide documentation of the data source in the discussion box; SanGIS has a GIS layer for average annual precipitation]	10	inches
8	Calculate the Average Annual Runoff (Line 7 x Line 1/12) x Line2	119702	cu-ft/yr
9	Calculate the Average Annual TSS Load (Line 8 x 62.4 x Line 5 x (1 – Line 6))/10^6	583	lb/yr
10	Calculate the BMP Footprint Needed (Line 9 x Line 4)/Line 3	2913	sq. ft.
11	Calculate the Minimum Footprint Sizing Factor for Clogging [Line 10/ (Line 1 x Line 2)]	0.020	

Discussion:

E.13. BF-1 Biofiltration



Location: 43rd Street and Logan Avenue, San Diego, California

MS4 Permit Category

Biofiltration

Manual Category

Biofiltration

Applicable Performance Standard

Pollutant Control
Flow Control

Primary Benefits

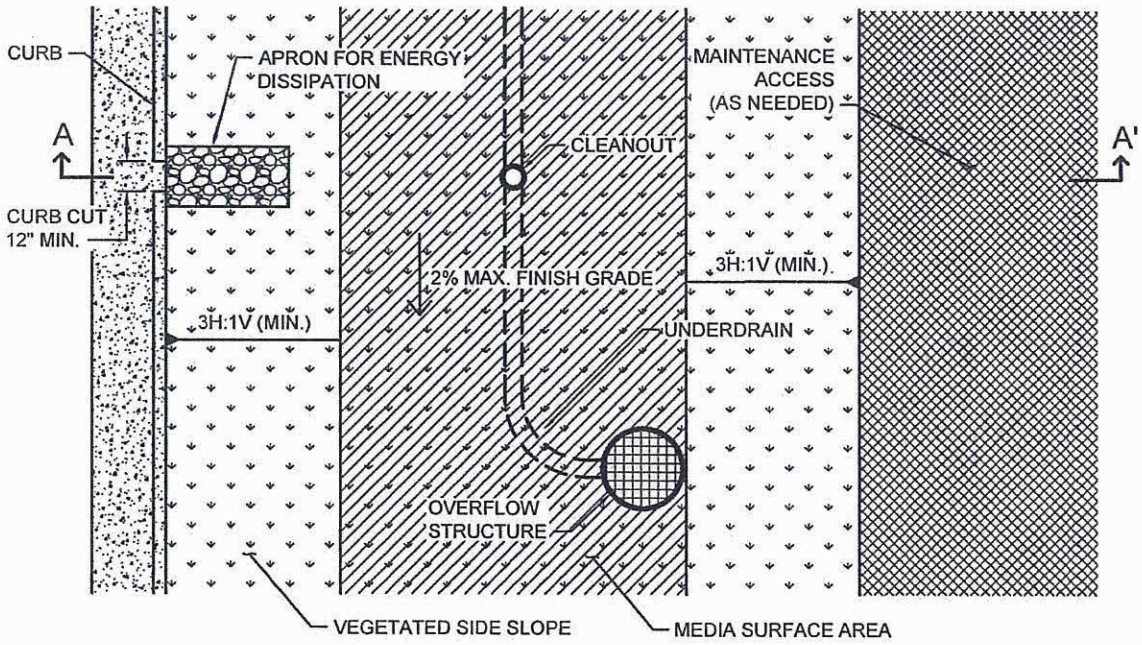
Treatment
Volume Reduction (Incidental)
Peak Flow Attenuation (Optional)

Description

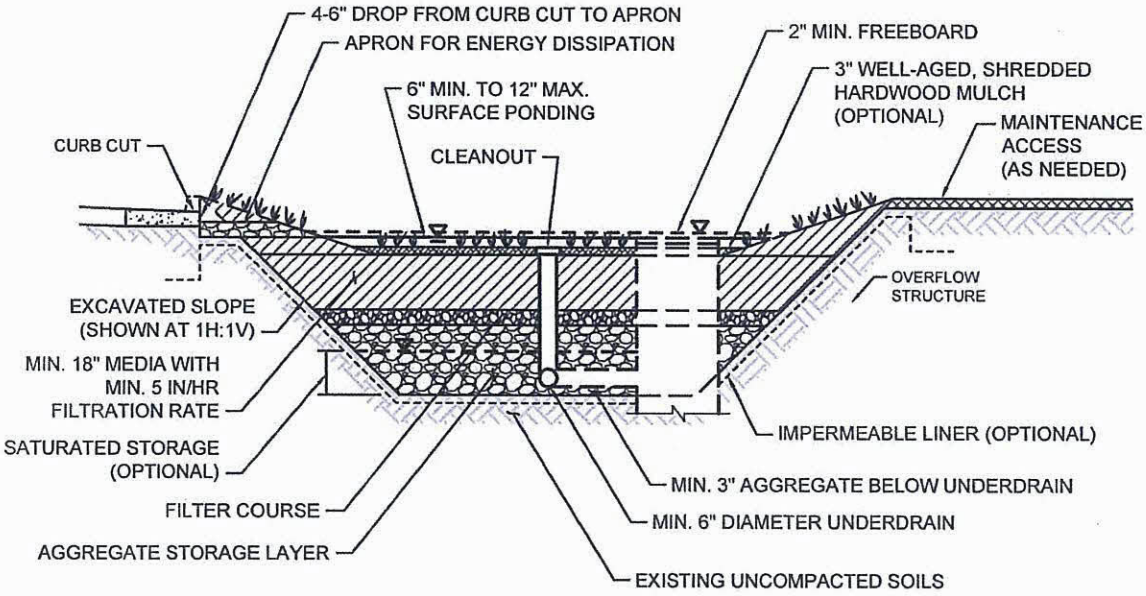
Biofiltration (Bioretention with underdrain) facilities are vegetated surface water systems that filter water through vegetation, and soil or engineered media prior to discharge via underdrain or overflow to the downstream conveyance system. Bioretention with underdrain facilities are commonly incorporated into the site within parking lot landscaping, along roadsides, and in open spaces. Because these types of facilities have limited or no infiltration, they are typically designed to provide enough hydraulic head to move flows through the underdrain connection to the storm drain system. Treatment is achieved through filtration, sedimentation, sorption, biochemical processes and plant uptake.

Typical bioretention with underdrain components include:

- Inflow distribution mechanisms (e.g, perimeter flow spreader or filter strips)
- Energy dissipation mechanism for concentrated inflows (e.g., splash blocks or riprap)
- Shallow surface ponding for captured flows
- Side slope and basin bottom vegetation selected based on expected climate and ponding depth
- Non-floating mulch layer
- Media layer (planting mix or engineered media) capable of supporting vegetation growth
- Filter course layer (aka choking layer) consisting of aggregate to prevent the migration of fines into uncompacted native soils or the aggregate storage layer
- Aggregate storage layer with underdrain(s)
- Impermeable liner or uncompacted native soils at the bottom of the facility
- Overflow structure



PLAN
NOT TO SCALE



SECTION A-A'
NOT TO SCALE

Figure E.13-E.13-1: Typical plan and Section view of a Biofiltration BMP

Design Adaptations for Project Goals

Biofiltration Treatment BMP for storm water pollutant control. The system is lined or un-lined to provide incidental infiltration, and an underdrain is provided at the bottom to carry away filtered runoff. This configuration is considered to provide biofiltration treatment via flow through the media layer. Storage provided above the underdrain within surface ponding, media, and aggregate storage is considered included in the biofiltration treatment volume. Saturated storage within the aggregate storage layer can be added to this design by raising the underdrain above the bottom of the aggregate storage layer or via an internal weir structure designed to maintain a specific water level elevation.

Integrated storm water flow control and pollutant control configuration. The system can be designed to provide flow rate and duration control by primarily providing increased surface ponding and/or having a deeper aggregate storage layer above the underdrain. This will allow for significant detention storage, which can be controlled via inclusion of an outlet structure at the downstream end of the underdrain.

Design Criteria and Considerations

Bioretention with underdrain must meet the following design criteria. Deviations from the below criteria may be approved at the discretion of the City Engineer if it is determined to be appropriate:

	Siting and Design	Intent/Rationale
□	Placement observes geotechnical recommendations regarding potential hazards (e.g., slope stability, landslides, liquefaction zones) and setbacks (e.g., slopes, foundations, utilities).	Must not negatively impact existing site geotechnical concerns.
□	An impermeable liner or other hydraulic restriction layer is included if site constraints indicate that infiltration or lateral flows should not be allowed.	Lining prevents storm water from impacting groundwater and/or sensitive environmental or geotechnical features. Incidental infiltration, when allowable, can aid in pollutant removal and groundwater recharge.
□	Contributing tributary area shall be ≤ 5 acres (≤ 1 acre preferred).	Bigger BMPs require additional design features for proper performance. Contributing tributary area greater than 5 acres may be allowed at the discretion of the City Engineer if the following conditions are met: 1) incorporate design features (e.g. flow spreaders) to minimizing short circuiting of flows in the BMP and 2) incorporate additional design features requested by the City Engineer for proper performance of the regional BMP.
□	Finish grade of the facility is ≤ 2%.	Flatter surfaces reduce erosion and channelization within the facility.
Surface Ponding		

	Siting and Design	Intent/Rationale
□	Surface ponding is limited to a 24-hour drawdown time.	Surface ponding limited to 24 hour for plant health. Surface ponding drawdown time greater than 24-hours but less than 96 hours may be allowed at the discretion of the City Engineer if certified by a landscape architect or agronomist.
□	Surface ponding depth is ≥ 6 and ≤ 12 inches.	Surface ponding capacity lowers subsurface storage requirements. Deep surface ponding raises safety concerns. Surface ponding depth greater than 12 inches (for additional pollutant control or surface outlet structures or flow-control orifices) may be allowed at the discretion of the City Engineer if the following conditions are met: 1) surface ponding depth drawdown time is less than 24 hours; and 2) safety issues and fencing requirements are considered (typically ponding greater than 18" will require a fence and/or flatter side slopes) and 3) potential for elevated clogging risk is considered.
□	A minimum of 2 inches of freeboard is provided.	Freeboard provides room for head over overflow structures and minimizes risk of uncontrolled surface discharge.
□	Side slopes are stabilized with vegetation and are = 3H:1V or shallower.	Gentler side slopes are safer, less prone to erosion, able to establish vegetation more quickly and easier to maintain.
Vegetation		
□	Plantings are suitable for the climate and expected ponding depth. A plant list to aid in selection can be found in Appendix E.20.	Plants suited to the climate and ponding depth are more likely to survive.
□	An irrigation system with a connection to water supply should be provided as needed.	Seasonal irrigation might be needed to keep plants healthy.
Mulch (Mandatory)		
□	A minimum of 3 inches of well-aged, shredded hardwood mulch that has been stockpiled or stored for at least 12 months is provided.	Mulch will suppress weeds and maintain moisture for plant growth. Aging mulch kills pathogens and weed seeds and allows the beneficial microbes to multiply.
Media Layer		

	Siting and Design	Intent/Rationale
□	Media maintains a minimum filtration rate of 5 in/hr over lifetime of facility. Additional Criteria for media hydraulic conductivity described in the bioretention soil media model specification (Appendix F.4)	A filtration rate of at least 5 inches per hour allows soil to drain between events. The initial rate should be higher than long term target rate to account for clogging over time. However an excessively high initial rate can have a negative impact on treatment performance, therefore an upper limit is needed.
□	Media is a minimum 18 inches deep, meeting the following media specifications: Model biorention soil media specification provided in Appendix F.4 or County of San Diego Low Impact Development Handbook: Appendix G - Bioretention Soil Specification (June 2014, unless superseded by more recent edition). Alternatively, for proprietary designs and custom media mixes not meeting the media specifications, the media meets the pollutant treatment performance criteria in Section F.1.	A deep media layer provides additional filtration and supports plants with deeper roots. Standard specifications shall be followed. For non-standard or proprietary designs, compliance with Appendix F.1 ensures that adequate treatment performance will be provided.
□	Media surface area is 3% of contributing area times adjusted runoff factor or greater. Unless demonstrated that the BMP surface area can be smaller than 3%.	Greater surface area to tributary area ratios: a) maximizes volume retention as required by the MS4 Permit and b) decrease loading rates per square foot and therefore increase longevity. Adjusted runoff factor is to account for site design BMPs implemented upstream of the BMP (such as rain barrels, impervious area dispersion, etc.). Refer to Appendix B.2 guidance. Use Worksheet B.5-1 Line 26 to estimate the minimum surface area required per this criteria.
□	Where receiving waters are impaired or have a TMDL for nutrients, the system is designed with nutrient sensitive media design (see fact sheet BF-2).	Potential for pollutant export is partly a function of media composition; media design must minimize potential for export of nutrients, particularly where receiving waters are impaired for nutrients.
Filter Course Layer		
□	A filter course is used to prevent migration of fines through layers of the facility. Filter fabric is not used.	Migration of media can cause clogging of the aggregate storage layer void spaces or subgrade and can result in poor water quality performance for turbidity and suspended solids. Filter fabric is more likely to clog.

	Siting and Design	Intent/Rationale
□	Filter course is washed and free of fines.	Washing aggregate will help eliminate fines that could clog the facility and impede infiltration.
□	To reduce clogging potential, a two-layer filter course (aka choking stone system) is used consisting of one 3" layer of clean and washed ASTM 33 Fine Aggregate Sand overlying a 3" layer of ASTM No 8 Stone (Appendix F.5).	This specification has been developed to maintain permeability while limiting the migration of media material into the stone reservoir and underdrain system.
Aggregate Storage Layer		
□	ASTM #57 open graded stone is used for the storage layer and a two layer filter course (detailed above) is used above this layer	This layer provides additional storage capacity. ASTM #8 stone provides an acceptable choking/bridging interface with the particles in ASTM #57 stone.
□	The depth of aggregate provided (12-inch typical) and storage layer configuration is adequate for providing conveyance for underdrain flows to the outlet structure.	Proper storage layer configuration and underdrain placement will minimize facility drawdown time.
Inflow, Underdrain, and Outflow Structures		
□	Inflow, underdrains and outflow structures are accessible for inspection and maintenance.	Maintenance will prevent clogging and ensure proper operation of the flow control structures.
□	Inflow velocities are limited to 3 ft/s or less or use energy dissipation methods. (e.g., riprap, level spreader) for concentrated inflows.	High inflow velocities can cause erosion, scour and/or channeling.
□	Curb cut inlets are at least 12 inches wide, have a 4-6 inch reveal (drop) and an apron and energy dissipation as needed.	Inlets must not restrict flow and apron prevents blockage from vegetation as it grows in. Energy dissipation prevents erosion.
□	Underdrain outlet elevation should be a minimum of 3 inches above the bottom elevation of the aggregate storage layer.	A minimal separation from subgrade or the liner lessens the risk of fines entering the underdrain and can improve hydraulic performance by allowing perforations to remain unblocked.
□	Minimum underdrain diameter is 8 inches.	Smaller diameter underdrains are prone to clogging.
□	Underdrains should be affixed with an upturned elbow to an elevation at least 9 to 12 inches above the invert of the underdrain.	An upturned elbow reduces velocity in the underdrain pipe and can help reduce mobilization of sediments from the underdrain and media bed.

	Siting and Design	Intent/Rationale
□	Underdrains are made of slotted, PVC pipe conforming to ASTM D 3034 or equivalent or corrugated, HDPE pipe conforming to AASHTO 252M or equivalent.	Slotted underdrains provide greater intake capacity, clog resistant drainage, and reduced entrance velocity into the pipe, thereby reducing the chances of solids migration.
□	An underdrain cleanout with a minimum 8-inch diameter and lockable cap is placed every 50 feet as required based on underdrain length.	Properly spaced cleanouts will facilitate underdrain maintenance.
□	Overflow is safely conveyed to a downstream storm drain system or discharge point Size overflow structure to pass 100-year peak flow for on-line infiltration basins and water quality peak flow for off-line basins.	Planning for overflow lessens the risk of property damage due to flooding.

Conceptual Design and Sizing Approach for Storm Water Pollutant Control Only

To design bioretention with underdrain for storm water pollutant control only (no flow control required), the following steps should be taken:

1. Verify that siting and design criteria have been met, including placement requirements, contributing tributary area, maximum side and finish grade slopes, and the recommended media surface area tributary ratio.
2. Calculate the DCV per Appendix B based on expected site design runoff for tributary areas.
3. Use the sizing worksheet presented in Appendix B.5 to size biofiltration BMPs.

Conceptual Design and Sizing Approach when Storm Water Flow Control is Applicable

Control of flow rates and/or durations will typically require significant surface ponding and/or aggregate storage volumes, and therefore the following steps should be taken prior to determination of storm water pollutant control design. Pre-development and allowable post-project flow rates and durations should be determined as discussed in Chapter 6 of the manual.

1. Verify that siting and design criteria have been met, including placement requirements, contributing tributary area, maximum side and finish grade slopes, and the recommended media surface area tributary ratio.
2. Iteratively determine the facility footprint area, surface ponding and/or aggregate storage layer depth required to provide detention storage to reduce flow rates and durations to allowable limits. Flow rates and durations can be controlled from detention storage by altering outlet structure orifice size(s) and/or water control levels. Multi-level orifices can be used within an outlet structure to control the full range of flows.
3. If bioretention with underdrain cannot fully provide the flow rate and duration control required by this manual, an upstream or downstream structure with significant storage volume such as an underground vault can be used to provide remaining controls.
4. After bioretention with underdrain has been designed to meet flow control requirements, calculations must be completed to verify if storm water pollutant control requirements to treat the DCV have been met.

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E.14. BF-2 Nutrient Sensitive Media Design

Some studies of bioretention with underdrains have observed export of nutrients, particularly inorganic nitrogen (nitrate and nitrite) and dissolved phosphorus. This has been observed to be a short-lived phenomenon in some studies or a long term issue in some studies. The composition of the soil media, including the chemistry of individual elements is believed to be an important factor in the potential for nutrient export. Organic amendments, often compost, have been identified as the most likely source of nutrient export. The quality and stability of organic amendments can vary widely.

The biofiltration media specifications contained in Appendix F.4 and the County of San Diego Low Impact Development Handbook: Appendix G -Bioretention Soil Specification (June 2014, unless superseded by more recent edition) were developed with consideration of the potential for nutrient export. These specifications include criteria for individual component characteristics and quality in order to control the overall quality of the blended mixes.

The City and County specifications noted above were developed for general purposes to meet permeability and treatment goals. In cases where the BMP discharges to receiving waters with nutrient impairments or nutrient TMDLs, the biofiltration media should be designed with the specific goal of minimizing the potential for export of nutrients from the media. Therefore, in addition to adhering to the City or County media specifications, the following guidelines should be followed:

1. **Select plant palette to minimize plant nutrient needs**

   A landscape architect or agronomist should be consulted to select a plant palette that minimizes nutrient needs. Utilizing plants with low nutrient needs results in less need to enrich the biofiltration soil mix. If nutrient quantity is then tailored to plants with lower nutrient needs, these plants will generally have less competition from weeds, which typically need higher nutrient content. The following practices are recommended to minimize nutrient needs of the plant palette:

   - **Utilize native, drought-tolerant plants and grasses where possible.** Native plants generally have a broader tolerance for nutrient content, and can be longer lived in leaner/lower nutrient soils.
   - **Start plants from smaller starts or seed.** Younger plants are generally more tolerant of lower nutrient levels and tend to help develop soil structure as they grow. Given the lower cost of smaller plants, the project should be able to accept a plant mortality rate that is somewhat higher than starting from larger plants and providing high organic content.

2. **Minimize excess nutrients in media mix**

   Once the low-nutrient plant palette is established (item 1), the landscape architect and/or agronomist should be consulted to assist in the design of a biofiltration media to balance the interests of plant establishment, water retention capacity (irrigation demand), and the potential for nutrient export. The following guidelines should be followed:

   - **The mix should not exceed the nutrient needs of plants.** In conventional landscape design, the nutrient needs of plants are often exceeded intentionally in order to provide a factor of safety for plant survival. This practice must be avoided in biofiltration media as excess nutrients will increase the chance of export. The mix designer should keep in mind that nutrients can be added later (through mulching, tilling of amendments into the surface), but it is not possible to remove nutrients, once added.

- **The actual nutrient content and organic content of the selected organic amendment source should be determined when specifying mix proportions.** Nutrient content (i.e., C:N ratio; plant extractable nutrients) and organic content (i.e, % organic material) are relatively inexpensive to measure via standard agronomic methods and can provide important information about mix design. If mix design relies on approximate assumption about nutrient/organic content and this is not confirmed with testing (or the results of prior representative testing), it is possible that the mix could contain much more nutrient than intended.

- **Nutrients are better retained in soils with higher cation exchange capacity.** Cation exchange capacity can be increased through selection of organic material with naturally high cation exchange capacity, such as peat or coconut coir pith, and/or selection of inorganic material with high cation exchange capacity such as some sands or engineered minerals (e.g., low P-index sands, zeolites, rhyolites, etc). Including higher cation exchange capacity materials would tend to reduce the net export of nutrients. Natural silty materials also provide cation exchange capacity; however potential impacts to permeability need to be considered.

- **Focus on soil structure as well as nutrient content.** Soil structure is loosely defined as the ability of the soil to conduct and store water and nutrients as well as the degree of aeration of the soil. Soil structure can be more important than nutrient content in plant survival and biologic health of the system. If a good soil structure can be created with very low amounts of organic amendment, plants survivability should still be provided. While soil structure generally develops with time, biofiltration media can be designed to promote earlier development of soil structure. Soil structure is enhanced by the use of amendments with high humus content (as found in well-aged organic material). In addition, soil structure can be enhanced through the use of organic material with a distribution of particle sizes (i.e., a more heterogeneous mix).

- **Consider alternatives to compost.** Compost, by nature, is a material that is continually evolving and decaying. It can be challenging to determine whether tests previously done on a given compost stock are still representative. It can also be challenging to determine how the properties of the compost will change once placed in the media bed. More stable materials such as aged coco coir pith, peat, biochar, shredded bark, and/or other amendments should be considered.

With these considerations, it is anticipated that less than 10 percent organic amendment by volume could be used, while still balancing plant survivability and water retention. If compost is used, designers should strongly consider utilizing less than 10 percent by volume.

3. Design with partial retention and/or internal water storage

An internal water storage zone, as described in Fact Sheet PR-1 is believed to improve retention of nutrients. For lined systems, an internal water storage zone worked by providing a zone that fluctuates between aerobic and anaerobic conditions, resulting in nitrification/denitrification. In soils that will allow infiltration, a partial retention design (PR-1) allows significant volume reduction and can also promote nitrification/denitrification.

Acknowledgment: This fact sheet has been adapted from the Orange County Technical Guidance Document (May 2011). It was originally developed based on input from: Deborah Deets, City of Los

Angeles Bureau of Sanitation, Drew Ready, Center for Watershed Health, Rick Fisher, ASLA, City of Los Angeles Bureau of Engineering, Dr. Garn Wallace, Wallace Laboratories, Glen Dake, GDML, and Jason Schmidt, Tree People. The guidance provided herein does not reflect the individual opinions of any individual listed above and should not be cited or otherwise attributed to those listed.

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E.15. BF-3 Proprietary Biofiltration Systems

The purpose of this fact sheet is to help explain the potential role of proprietary BMPs in meeting biofiltration requirements, when full retention of the DCV is not feasible. The fact sheet does not describe design criteria like the other fact sheets in this appendix because this information varies by BMP product model.

Criteria for Use of a Proprietary BMP as a Biofiltration BMP

A proprietary BMP may be acceptable as a "biofiltration BMP" under the following conditions:

1. The BMP meets the minimum design criteria listed in Appendix F, including the selection criteria (i.e. only allowed in No Infiltration Condition and where site-specific documentation demonstrates that the use of larger footprint biofiltration BMPs (i.e. minimum sizing factor calculated using Worksheet B.5.2) would be infeasible) and pollutant treatment performance standard in Appendix F.1;
2. The BMP is designed and maintained in a manner consistent with its performance certifications (See explanation in Appendix F.2); and
3. The BMP is acceptable at the discretion of the City Engineer. In determining the acceptability of a BMP, the City Engineer should consider, as applicable, (a) the data submitted; (b) representativeness of the data submitted; (c) consistency of the BMP performance claims with pollutant control objectives; certainty of the BMP performance claims; (d) for projects within the public right of way and/or public projects: maintenance requirements, cost of maintenance activities, relevant previous local experience with operation and maintenance of the BMP type, ability to continue to operate the system in event that the vending company is no longer operating as a business; and (e) other relevant factors. If a proposed BMP is not accepted by the City Engineer, a written explanation/reason will be provided to the applicant.

Guidance for Sizing a Proprietary BMP as a Biofiltration BMP

Proprietary biofiltration BMPs must meet the same sizing guidance as non-proprietary BMPs. Sizing is typically based on capturing and treating 1.50 times the DCV not reliably retained. Guidance for sizing biofiltration BMPs to comply with requirements of this manual is provided in Appendix F.2.

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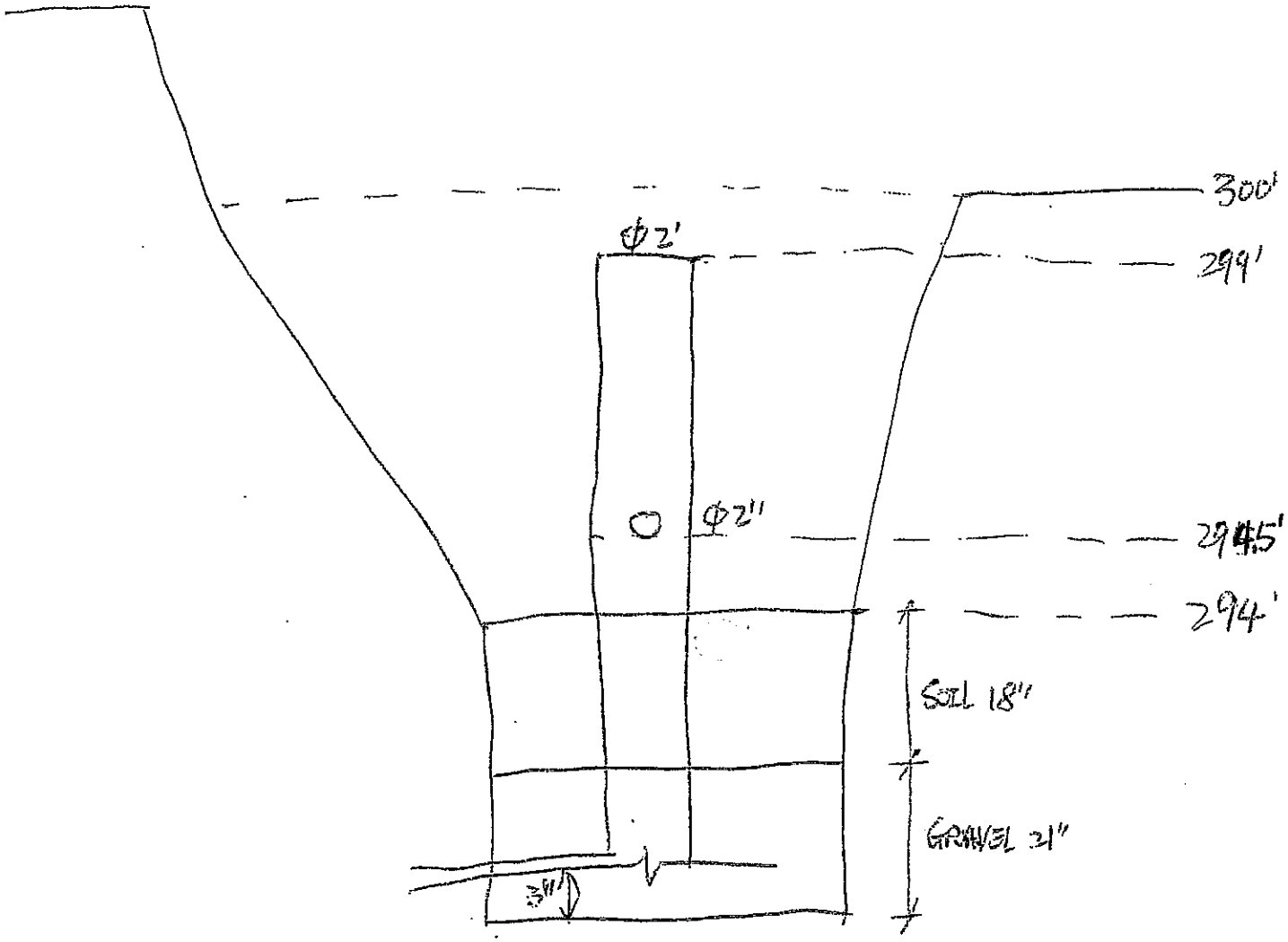

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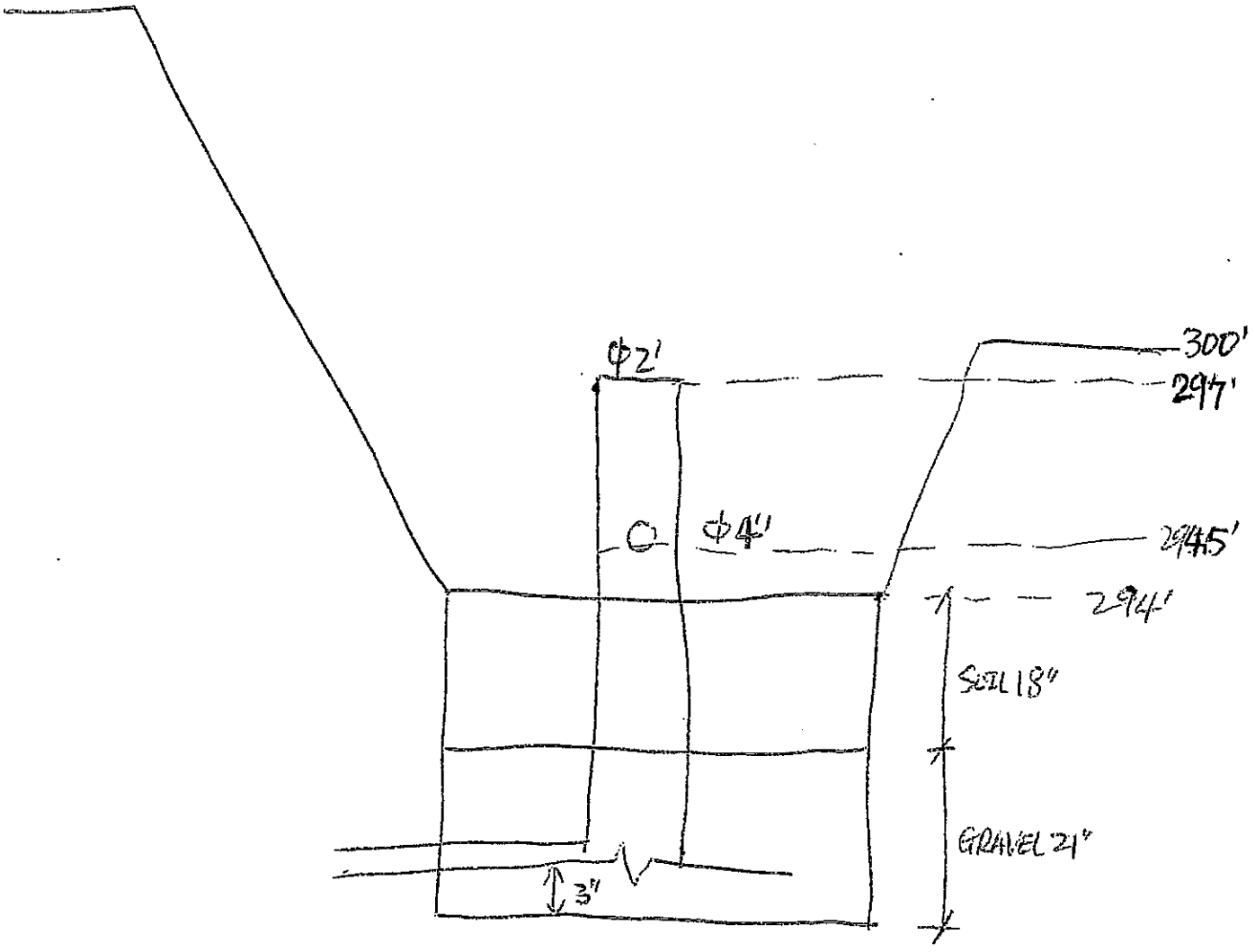

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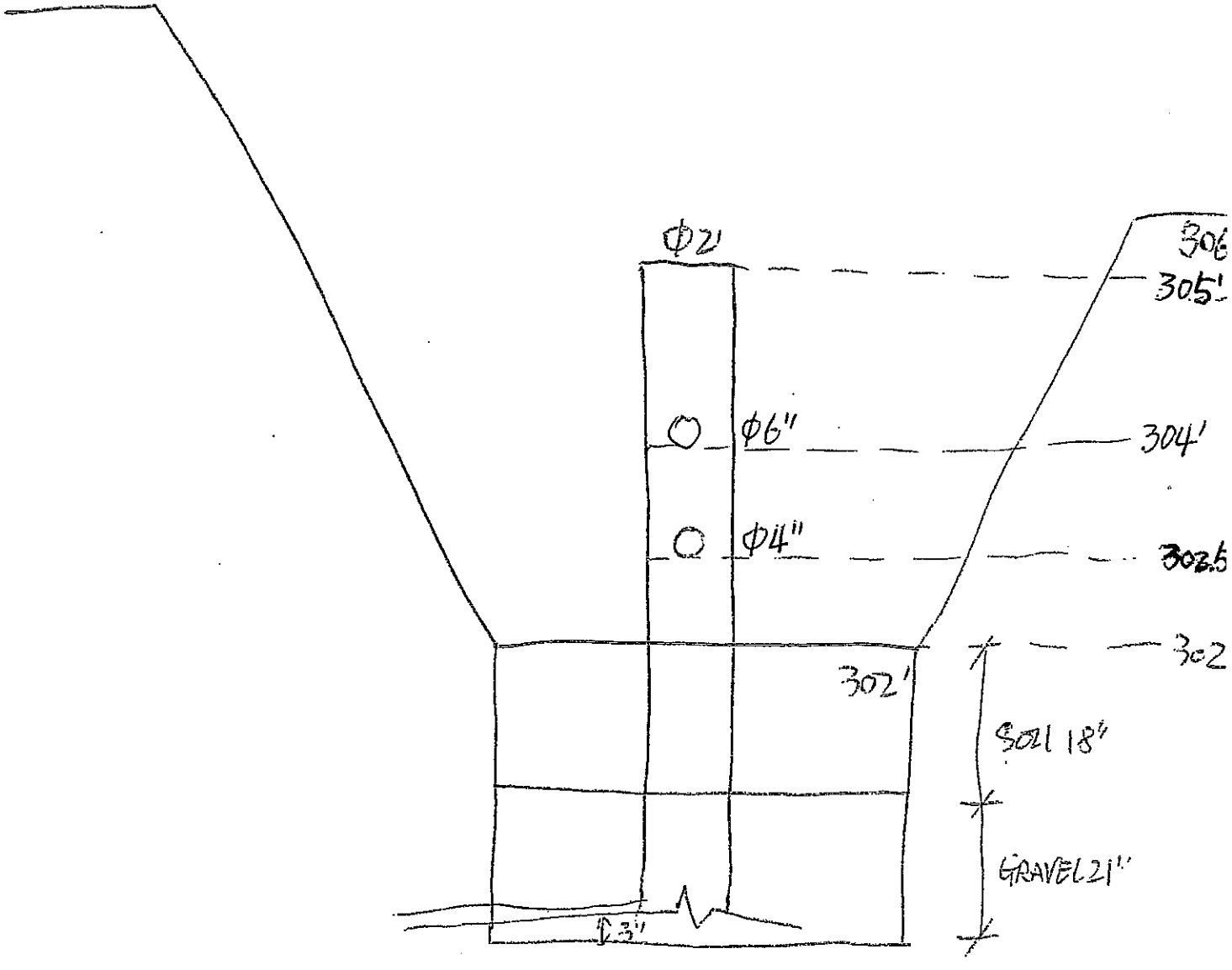

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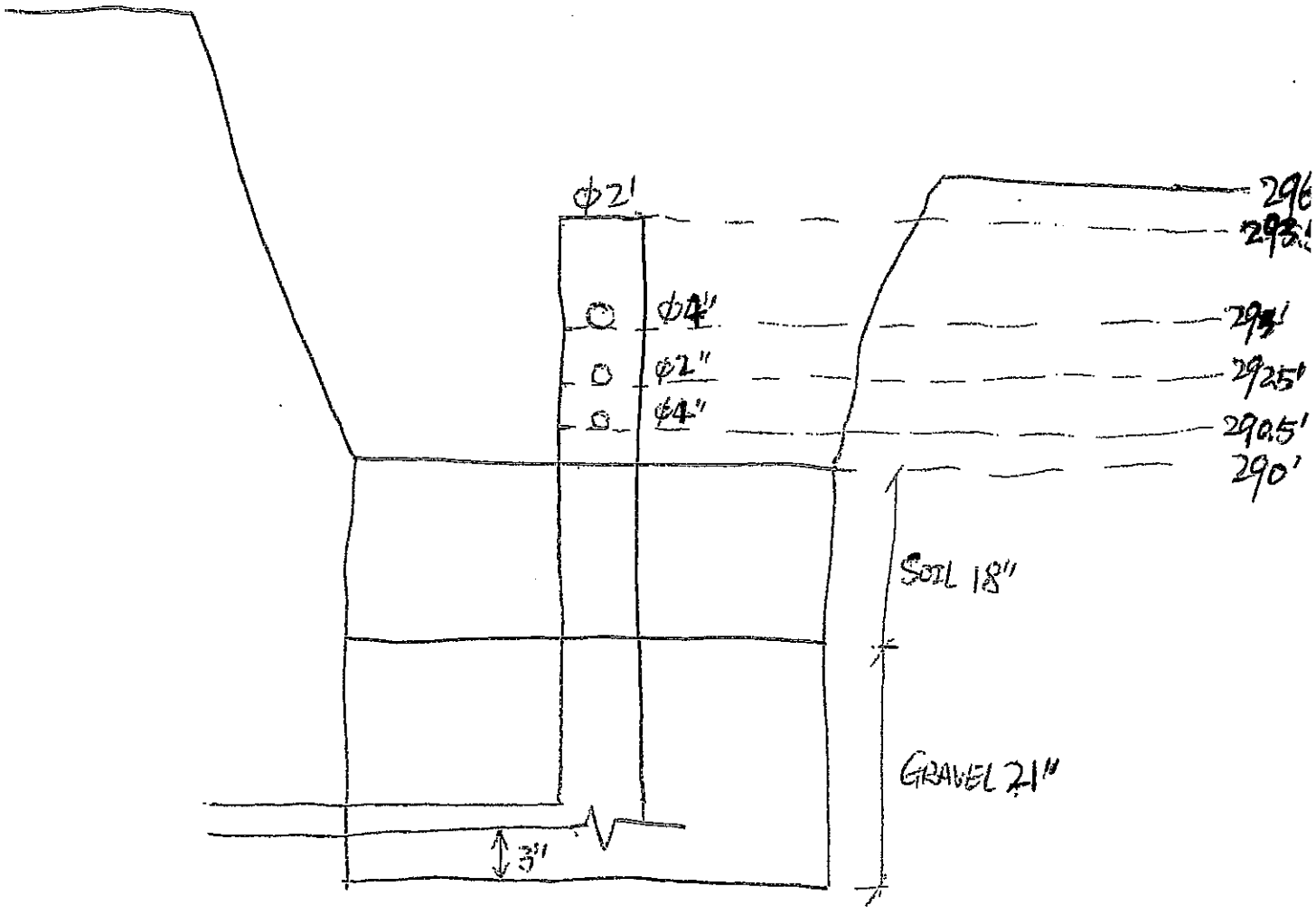

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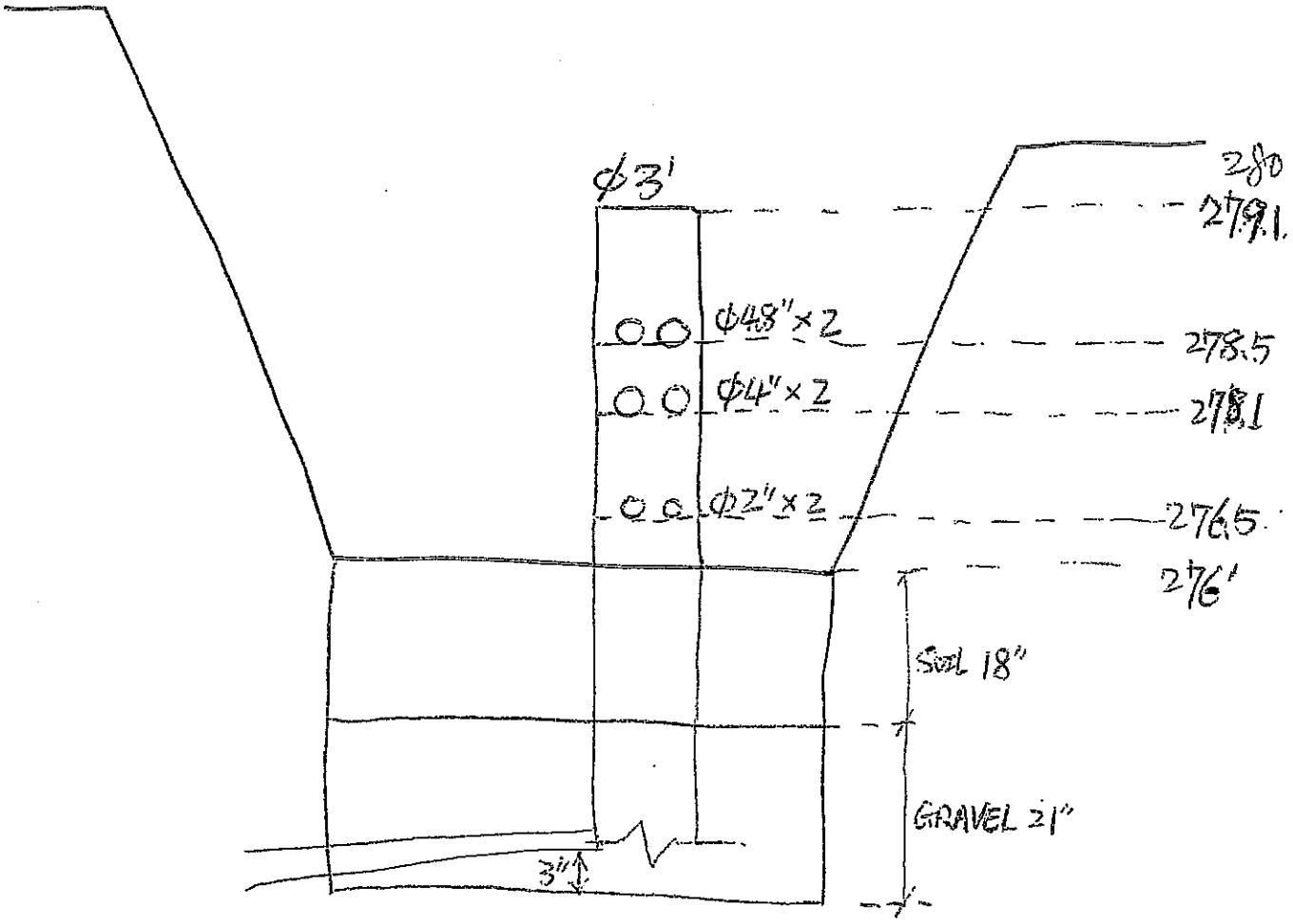

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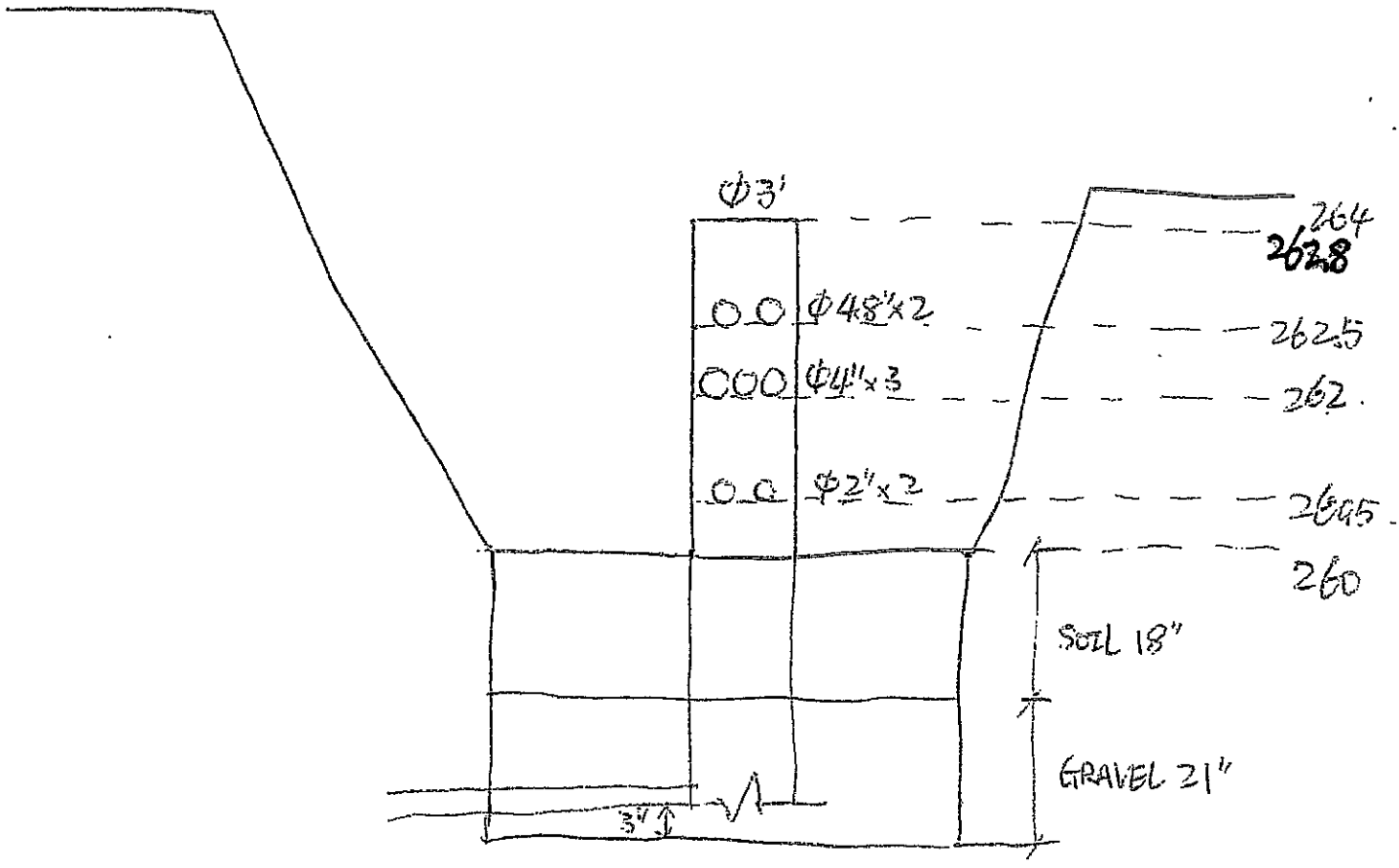

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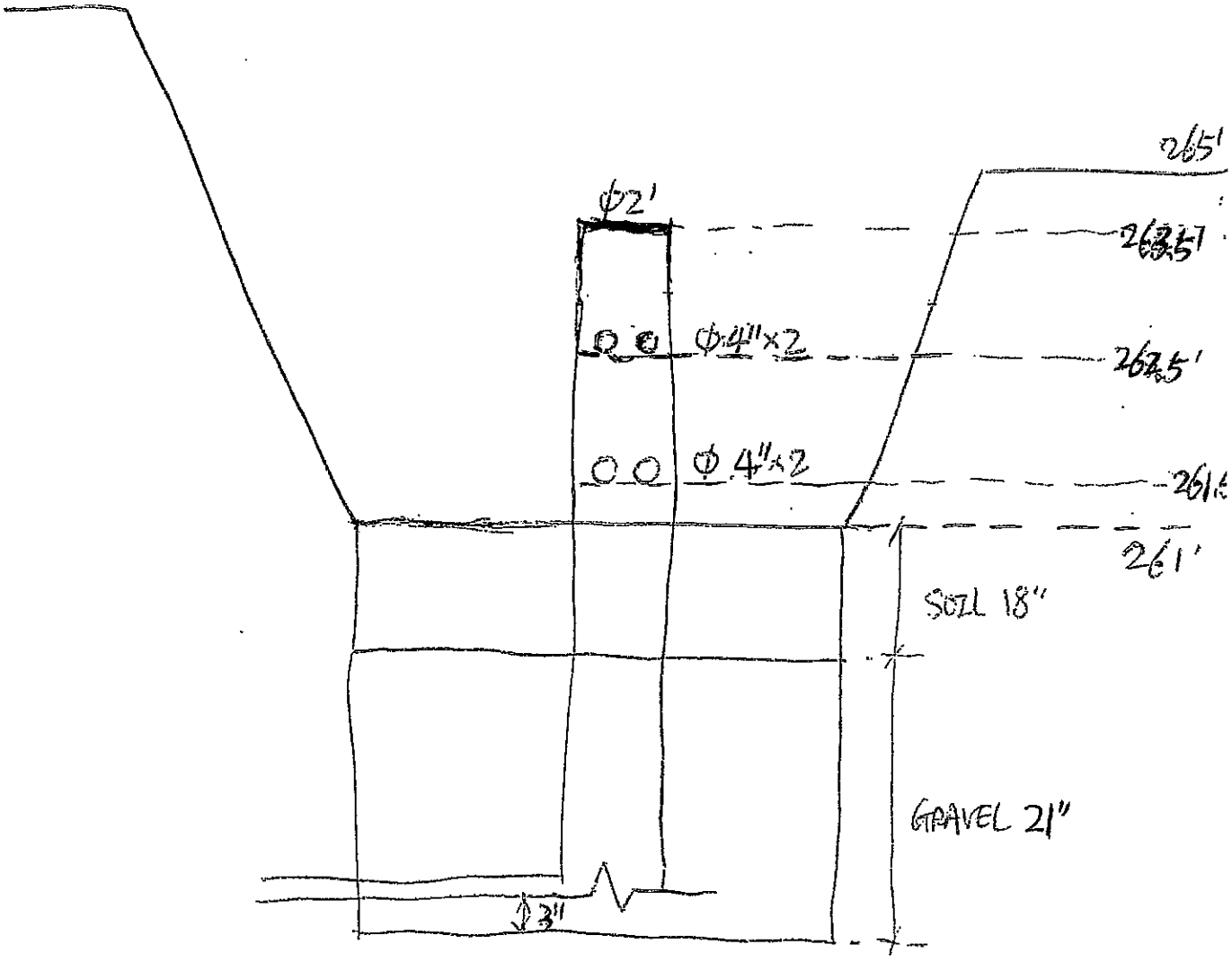

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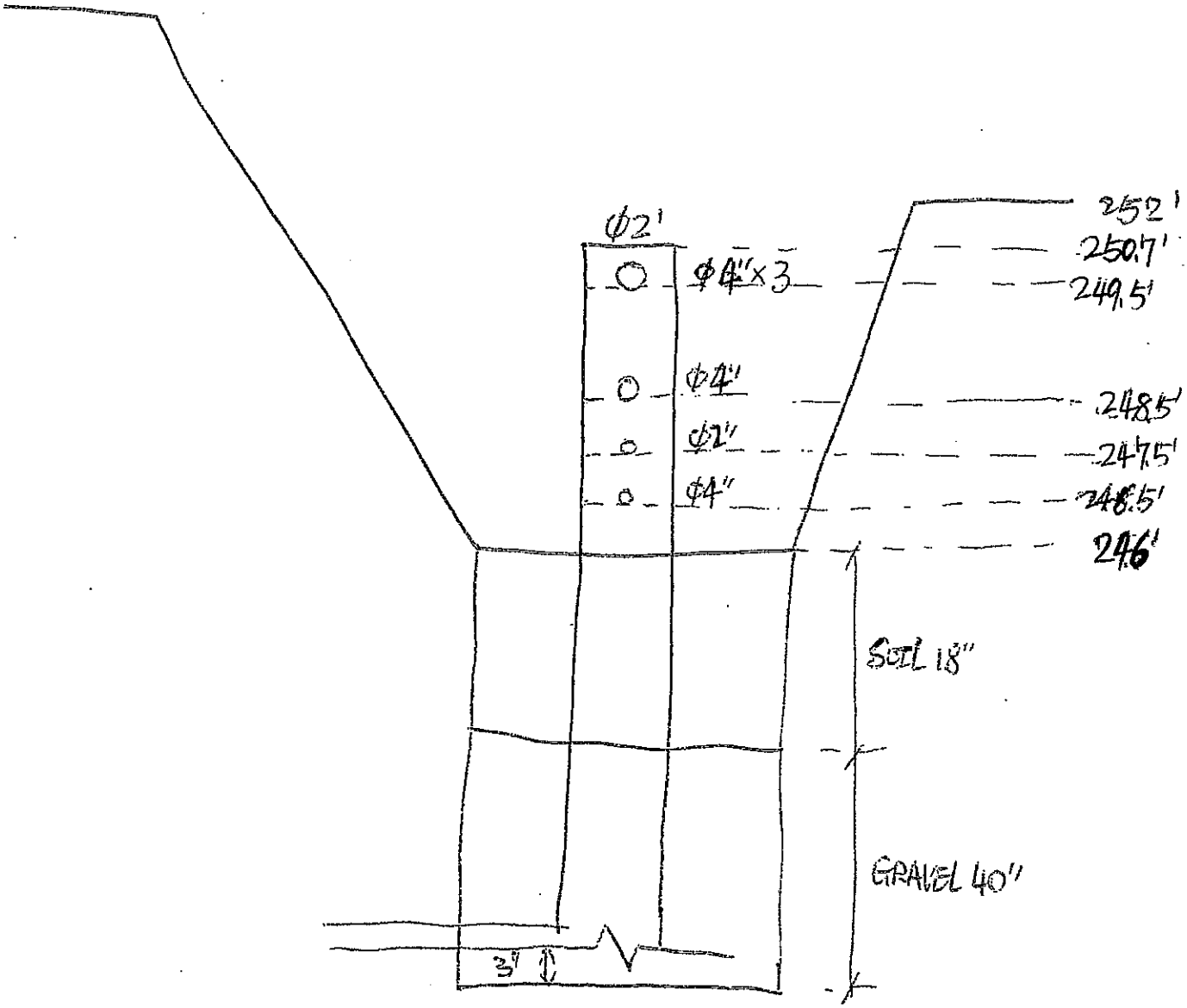


Modular Wetland Sizing Calculations

BMP-ID	A (sf)	Road (sf)	%IMP	C	1.5 x Q (cfs)	Q100 (cfs)	MWS Model	MWS Qdesign (cfs)
BMP-1	64307.5	45658.325	71%	0.67	0.296		MWS-L-8-12	0.346
BMP-2	64307.5	45658.325	71%	0.67	0.296		MWS-L-8-12	0.346

Compact (high rate) Biofiltration BMP Checklist	Form I-10

Compact (high rate) biofiltration BMPs have a media filtration rate greater than 5 in/hr. and a media surface area smaller than 3% of contributing area times adjusted runoff factor. Compact biofiltration BMPs are typically proprietary BMPs that may qualify as biofiltration.

A compact biofiltration BMP may satisfy the pollutant control requirements for a DMA onsite in some cases. This depends on the characteristics of the DMA **and** the performance certification/data of the BMP. If the pollutant control requirements for a DMA are met onsite, then the DMA is not required to participate in an offsite storm water alternative compliance program to meet its pollutant control obligations.

An applicant using a compact biofiltration BMP to meet the pollutant control requirements onsite must complete Section 1 of this form and include it in the PDP SWQMP. A separate form must be completed for each DMA. In instances where the City Engineer does not agree with the applicant's determination, Section 2 of this form will be completed by the City and returned to the applicant.

Section 1: Biofiltration Criteria Checklist (Appendix F)

Refer to Part 1 of the Storm Water Standards to complete this section. When separate forms/worksheets are referenced below, the applicant must also complete these separate forms/worksheets (as applicable) and include in the PDP SWQMP. The criteria numbers below correspond to the criteria numbers in Appendix F.

Criteria	Answer	Progression
Criteria 1 and 3: What is the infiltration condition of the DMA? Refer to Section 5.4.2 and Appendix C of the BMP Design Manual (Part 1 of Storm Water Standards) for guidance. Applicant must complete and include the following in the PDP SWQMP submittal to support the feasibility determination: • Infiltration Feasibility Condition Letter; or • Worksheet C.4-1: Form I-8A and Worksheet C.4-2: Form I-8B. Applicant must complete and include all applicable sizing worksheets in the SWQMP submittal	○ Full Infiltration Condition	**Stop**. Compact biofiltration BMP is not allowed.
	○ Partial Infiltration Condition	Compact biofiltration BMP is only allowed, if the target volume retention is met onsite (Refer to Table B.5-1 in Appendix B.5). Use Worksheet B.5-2 in Appendix B.5 to estimate the target volume retention (Note: retention in this context means reduction). If the required volume reduction is achieved **proceed to Criteria 2**. If the required volume reduction is not achieved, compact biofiltration BMP is not allowed. **Stop**.
	◉ No Infiltration Condition	Compact biofiltration BMP is allowed if volume retention criteria in Table B.5-1 in Appendix B.5 for the no infiltration condition is met. Compliance with this criterion must be documented in the PDP SWQMP. If the criteria in Table B.5-1 is met **proceed to Criteria 2**. If the criteria in Table B.5-1 is not met, compact biofiltration BMP is not allowed. **Stop**.

Compact (high rate) Biofiltration BMP Checklist	Form I-10

Provide basis for Criteria 1 and 3:

Feasibility Analysis:

Summarize findings and include either infiltration feasibility condition letter or Worksheet C.4-1: Form I-8A and Worksheet C.4-2: Form I-8B in the PDP SWQMP submittal.

If Partial Infiltration Condition:

Provide documentation that target volume retention is met (include Worksheet B.5-2 in the PDP SWQMP submittal). Worksheet B.5-7 in Appendix B.5 can be used to estimate volume retention benefits from landscape areas.

If No Infiltration Condition:

Provide documentation that the volume retention performance standard is met (include Worksheet B.5-2 in the PDP SWQMP submittal) in the PDP SWQMP submittal. Worksheet B.5-6 in Appendix B.5 can be used to document that the performance standard is met.

All applicable Appendix B.5 Worksheets including Worksheets B.5-2 are included in the SWQMP Attachment 1e which show that the performance standard has been met.

Criteria	Answer	Progression
Criteria 2: Is the compact biofiltration BMP sized to meet the performance standard from the MS4 Permit? Refer to Appendix B.5 and Appendix F.2 of the BMP Design Manual (Part 1 of Storm Water Standards) for guidance.	◉ Meets Flow based Criteria	Use guidance from **Appendix F.2.2** to size the compact biofiltration BMP to meet the flow based criteria. Include the calculations in the PDP SWQMP. Use parameters for sizing consistent with manufacturer guidelines and conditions of its third party certifications (i.e. a BMP certified at a loading rate of 1 gpm/sq. ft. cannot be designed using a loading rate of 1.5 gpm/sq. ft.) **Proceed to Criteria 4.**
	○ Meets Volume based Criteria	Provide documentation that the compact biofiltration BMP has a total static (i.e. non-routed) storage volume, including pore-spaces and pre-filter detention volume (Refer to Appendix B.5 for a schematic) of at least 0.75 times the portion of the DCV not reliably retained onsite. **Proceed to Criteria 4.**
	○ Does not Meet either criteria	**Stop**. Compact biofiltration BMP is not allowed.

Compact (high rate) Biofiltration BMP Checklist	Form I-10

Provide basis for Criteria 2:

Provide documentation that the BMP meets the numeric criteria and is designed consistent with the manufacturer guidelines and conditions of its third-party certification (i.e., loading rate, etc., as applicable).

Refer to Attachment 1e for standard sheet provided by vendor.

Criteria	Answer	Progression
Criteria 4: Does the compact biofiltration BMP meet the pollutant treatment performance standard for the projects most significant pollutants of concern? Refer to Appendix B.6 and Appendix F.1 of the BMP Design Manual (Part 1 of Storm Water Standards) for guidance.	◉ Yes, meets the TAPE certification.	Provide documentation that the compact BMP has an appropriate TAPE certification for the projects most significant pollutants of concern. **Proceed to Criteria 5.**
	○ Yes, through other third-party documentation	Acceptance of third-party documentation is at the discretion of the City Engineer. The City engineer will consider, (a) the data submitted; (b) representativeness of the data submitted; and (c) consistency of the BMP performance claims with pollutant control objectives in Table F.1-2 and Table F.1-1 while making this determination. If a compact biofiltration BMP is not accepted, a written explanation/ reason will be provided in Section 2. **Proceed to Criteria 5.**
	○ No	**Stop**. Compact biofiltration BMP is not allowed.

Provide basis for Criteria 4:

Provide documentation that identifies the projects most significant pollutants of concern and TAPE certification or other third party documentation that shows that the compact biofiltration BMP meets the pollutant treatment performance standard for the projects most significant pollutants of concern.

See Attachment 1e for Tape Certification and Modular Wetland Calculations, Modular Wetland Brochure, Fact Sheet.

Compact (high rate) Biofiltration BMP Checklist		Form I-10
Criteria	**Answer**	**Progression**
Criteria 5: Is the compact biofiltration BMP designed to promote appropriate biological activity to support and maintain treatment process? Refer to Appendix F of the BMP Design Manual (Part 1 of Storm Water Standards) for guidance.	◉ Yes	Provide documentation that the compact biofiltration BMP support appropriate biological activity. Refer to Appendix F for guidance. **Proceed to Criteria 6.**
	○ No	**Stop**. Compact biofiltration BMP is not allowed.

Provide basis for Criteria 5:

Provide documentation that appropriate biological activity is supported by the compact biofiltration BMP to maintain treatment process.

Modular wetland systems will be utilized for pollutant treatment control. The BMPs will have plants. Refer to the Criteria 5 Checklist from Appendix F and the MWS plant selection included in Attachment 1e.

Criteria	Answer	Progression
Criteria 6: Is the compact biofiltration BMP designed with a hydraulic loading rate to prevent erosion, scour and channeling within the BMP?	◉ Yes	Provide documentation that the compact biofiltration BMP is used in a manner consistent with manufacturer guidelines and conditions of its third-party certification. **Proceed to Criteria 7.**
	○ No	**Stop**. Compact biofiltration BMP is not allowed.

Provide basis for Criteria 6:

Provide documentation that the BMP meets the numeric criteria and is designed consistent with the manufacturer guidelines and conditions of its third-party certification (i.e., maximum tributary area, maximum inflow velocities, etc., as applicable).

Per Appendix B of the City BMP Design Manual, a proposed BMP should meet the performance standard (per Appendix B.6.2.2) as certified through a third party field scale evaluation. The MWS performance standard was conducted by the Washington State Department of Ecology. Their results are provided in the TAPE certification. Refer to Attachment 1e.

Compact (high rate) Biofiltration BMP Checklist		Form I-10
Criteria	**Answer**	**Progression**
Criteria 7: Is the compact biofiltration BMP maintenance plan consistent with manufacturer guidelines and conditions of its third-party certification (i.e., maintenance activities, frequencies)?	○ Yes, and the compact BMP is privately owned, operated and not in the public right of way.	Submit a maintenance agreement that will also include a statement that the BMP will be maintained in accordance with manufacturer guidelines and conditions of third-party certification. **Stop**. The compact biofiltration BMP meets the required criteria.
	◉ Yes, and the BMP is either owned or operated by the City or in the public right of way.	Approval is at the discretion of the City Engineer. The city engineer will consider maintenance requirements, cost of maintenance activities, relevant previous local experience with operation and maintenance of the BMP type, ability to continue to operate the system in event that the vending company is no longer operating as a business or other relevant factors while making the determination. **Stop**. Consult the City Engineer for a determination.
	○ No	**Stop**. Compact biofiltration BMP is not allowed.

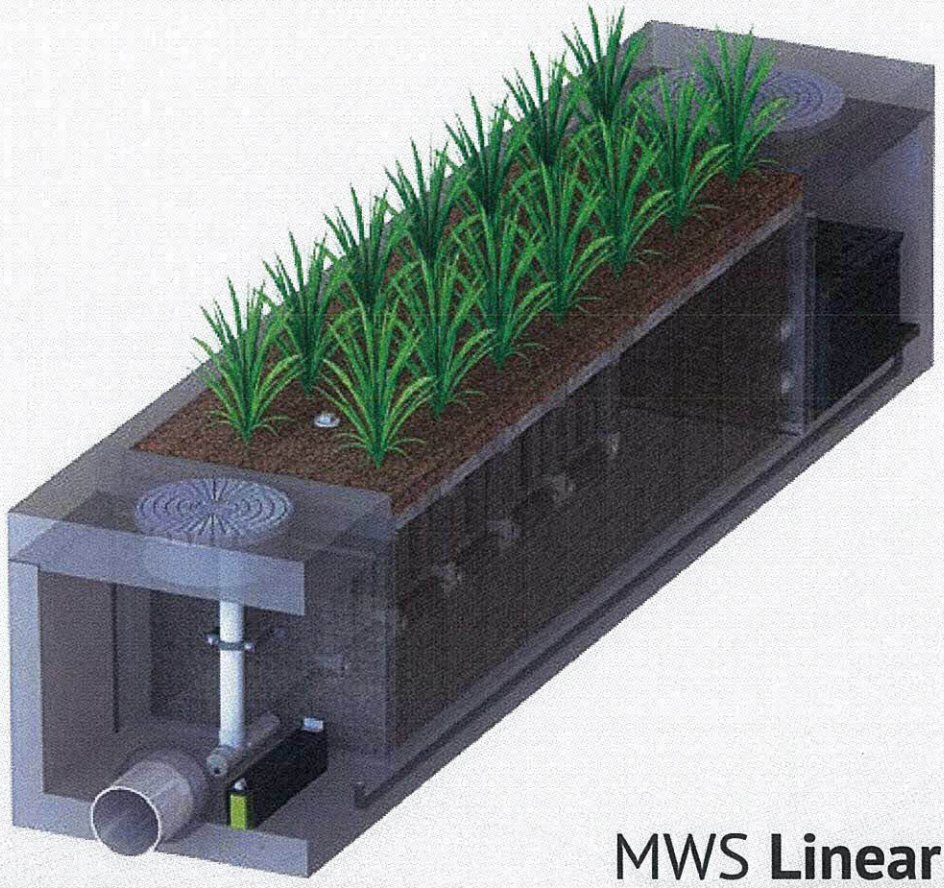
Provide basis for Criteria 7:

Include copy of manufacturer guidelines and conditions of third-party certification in the maintenance agreement. PDP SWQMP must include a statement that the compact BMP will be maintained in accordance with manufacturer guidelines and conditions of third-party certification.
Refer to Attachment 3A for Maintenance Guidelines for the Modular Wetland System.

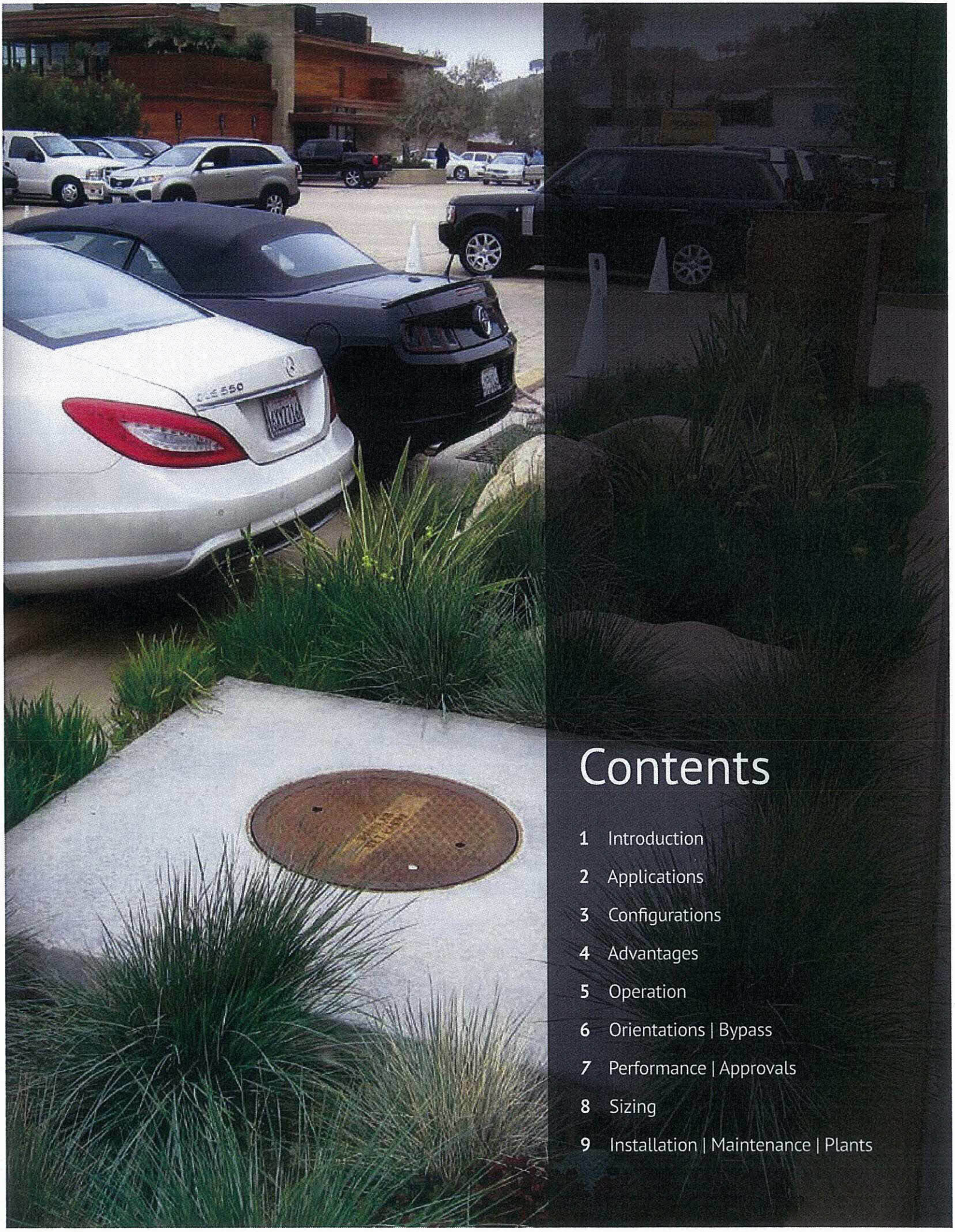
Compact (high rate) Biofiltration BMP Checklist	Form I-10
Section 2: Verification (For City Use Only)	
Is the proposed compact BMP accepted by the City Engineer for onsite pollutant control compliance for the DMA?	○ Yes ○ No, See explanation below
Explanation/reason if the compact BMP is not accepted by the City for onsite pollutant control compliance:	

MODULAR WETLANDS™

*Advanced **Stormwater** Biofiltration*



MWS **Linear**



Contents

1 Introduction

2 Applications

3 Configurations

4 Advantages

5 Operation

6 Orientations | Bypass

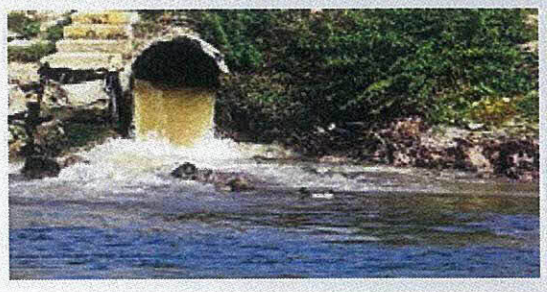
7 Performance | Approvals

8 Sizing

9 Installation | Maintenance | Plants

The Urban Impact

For hundreds of years natural wetlands surrounding our shores have played an integral role as nature's stormwater treatment system. But as our cities grow and develop, these natural wetlands have perished under countless roads, rooftops, and parking lots.



Plant A Wetland

Without natural wetlands our cities are deprived of water purification, flood control, and land stability. Modular Wetlands and the MWS Linear re-establish nature's presence and rejuvenate water ways in urban areas.





MWS **Linear**

The Modular Wetland System Linear represents a pioneering breakthrough in stormwater technology as the only biofiltration system to utilize patented horizontal flow, allowing for a smaller footprint and higher treatment capacity. While most biofilters use little or no pre-treatment, the MWS Linear incorporates an advanced pre-treatment chamber that includes separation and pre-filter cartridges. In this chamber sediment and hydrocarbons are removed from runoff before it enters the biofiltration chamber, in turn reducing maintenance costs and improving performance.

Applications

The MWS Linear has been successfully used on numerous new construction and retrofit projects. The system's superior versatility makes it beneficial for a wide range of stormwater and waste water applications - treating rooftops, streetscapes, parking lots, and industrial sites.



Industrial

Many states enforce strict regulations for discharges from industrial sites. The MWS Linear has helped various sites meet difficult EPA mandated effluent limits for dissolved metals and other pollutants.



Residential

Low to high density developments can benefit from the versatile design of the MWS Linear. The system can be used in both decentralized LID design and cost-effective end-of-the-line configurations.



Streets

Street applications can be challenging due to limited space. The MWS Linear is very adaptable, and offers the smallest footprint to work around the constraints of existing utilities on retrofit projects.



Parking Lots

Parking lots are designed to maximize space and the MWS Linear's 4 ft. standard planter width allows for easy integration into parking lot islands and other landscape medians.



Commercial

Compared to bioretention systems, the MWS Linear can treat far more area in less space - meeting treatment and volume control requirements.



Mixed Use

The MWS Linear can be installed as a raised planter to treat runoff from rooftops or patios, making it perfect for sustainable "live-work" spaces.

More applications are available on our website: www.ModularWetlands.com/Applications

- Agriculture
- Reuse
- Low Impact Development
- Waste Water





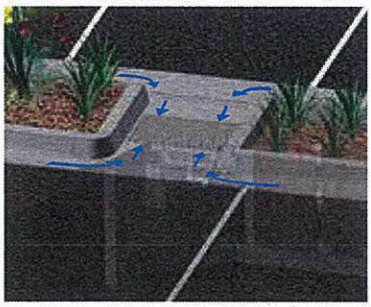
Configurations

The MWS Linear is the preferred biofiltration system of Civil Engineers across the country due to its versatile design. This highly versatile system has available "pipe-in" options on most models, along with built-in curb or grated inlets for simple integration into your stormdrain design.



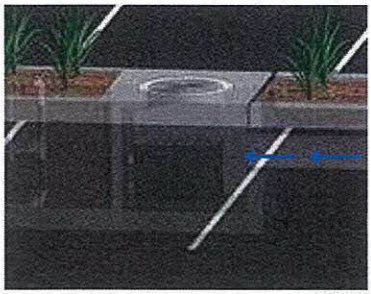
Curb Type

The *Curb Type* configuration accepts sheet flow through a curb opening and is commonly used along road ways and parking lots. It can be used in sump or flow by conditions. Length of curb opening varies based on model and size.



Grate Type

The *Grate Type* configuration offers the same features and benefits as the *Curb Type* but with a grated/drop inlet above the systems pre-treatment chamber. It has the added benefit of allowing for pedestrian access over the inlet. ADA compliant grates are available to assure easy and safe access. The *Grate Type* can also be used in scenarios where runoff needs to be intercepted on both sides of landscape islands.



Vault Type

The system's patented horizontal flow biofilter is able to accept inflow pipes directly into the pre-treatment chamber, meaning the MWS Linear can be used in end-of-the-line installations. This greatly improves feasibility over typical decentralized designs that are required with other biofiltration/bioretention systems. Another benefit of the "pipe in" design is the ability to install the system downstream of underground detention systems to meet water quality volume requirements.



Downspout Type

The *Downspout Type* is a variation of the *Vault Type* and is designed to accept a vertical downspout pipe from roof top and podium areas. Some models have the option of utilizing an internal bypass, simplifying the overall design. The system can be installed as a raised planter and the exterior can be stuccoed or covered with other finishes to match the look of adjacent buildings.

Advantages & Operation

The MWS Linear is the most efficient and versatile biofiltration system on the market, and the only system with horizontal flow which improves performance, reduces footprint, and minimizes maintenance. Figure-1 and Figure-2 illustrate the invaluable benefits of horizontal flow and the multiple treatment stages.

Featured Advantages

- Horizontal Flow Biofiltration
- Greater Filter Surface Area
- Pre-Treatment Chamber
- Patented Perimeter Void Area
- Flow Control
- No Depressed Planter Area

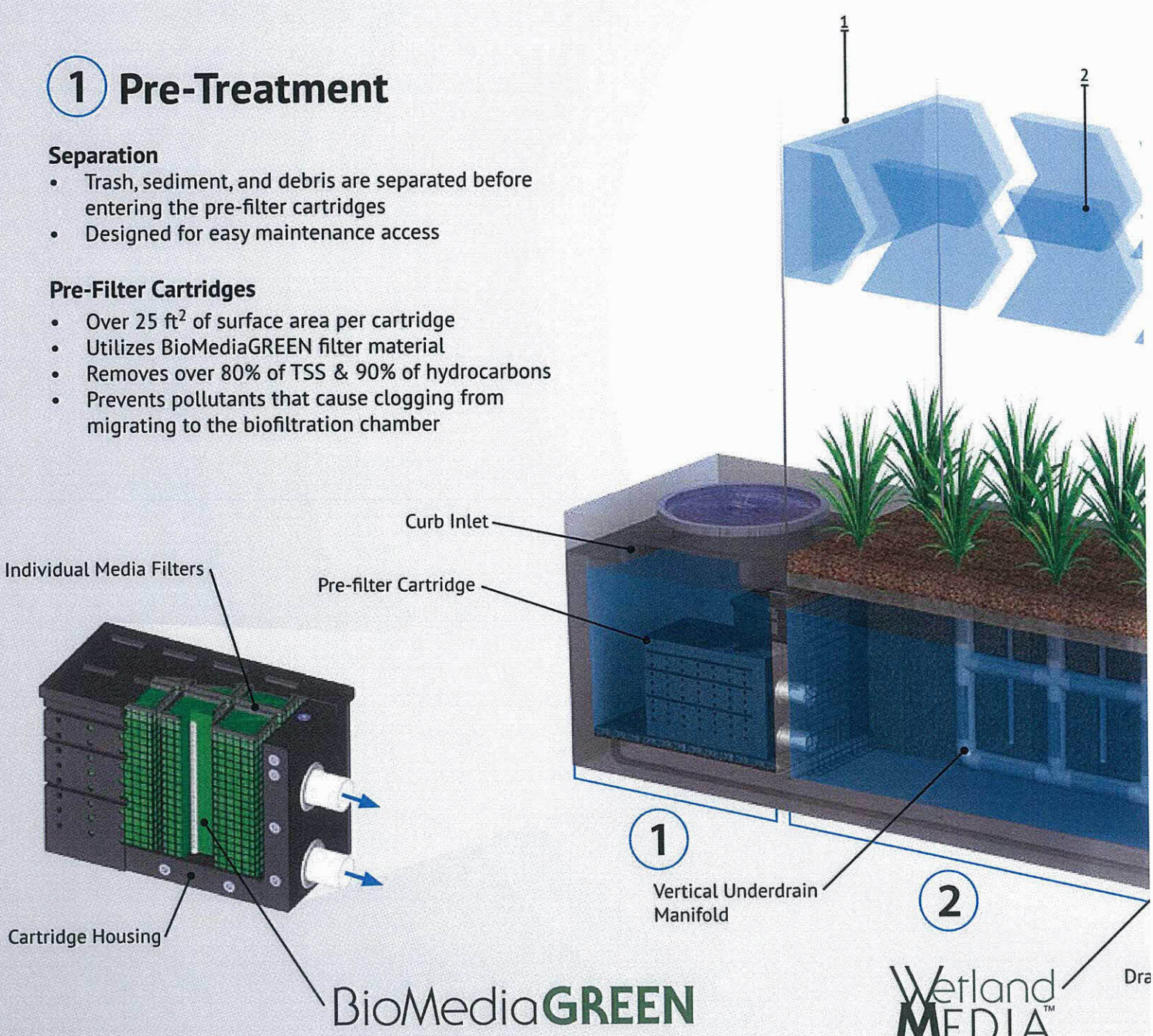
1 Pre-Treatment

Separation

- Trash, sediment, and debris are separated before entering the pre-filter cartridges
- Designed for easy maintenance access

Pre-Filter Cartridges

- Over 25 ft^2 of surface area per cartridge
- Utilizes BioMediaGREEN filter material
- Removes over 80% of TSS & 90% of hydrocarbons
- Prevents pollutants that cause clogging from migrating to the biofiltration chamber



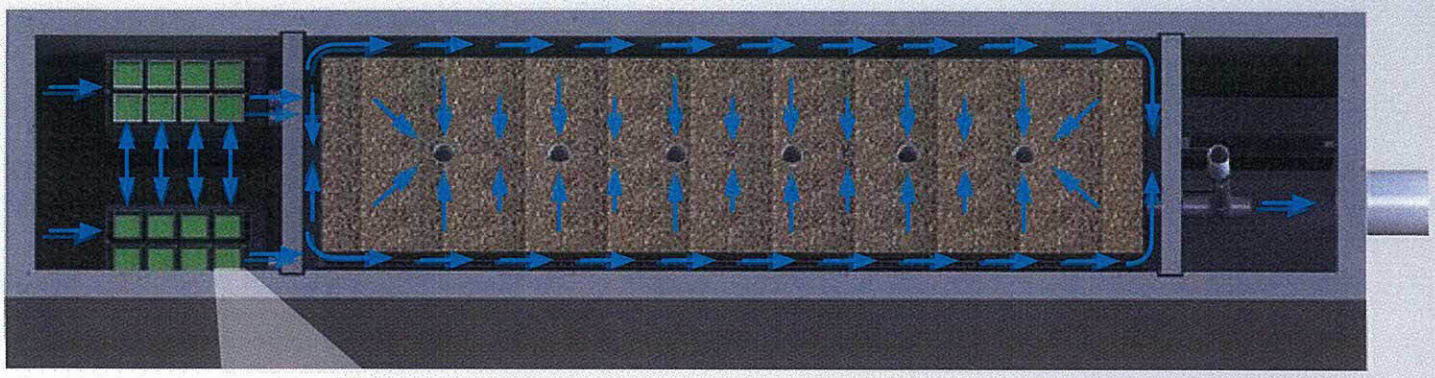


Fig. 2 - Top View



2x to 3x More Surface Area Than Traditional Downward Flow Bioretention Systems.

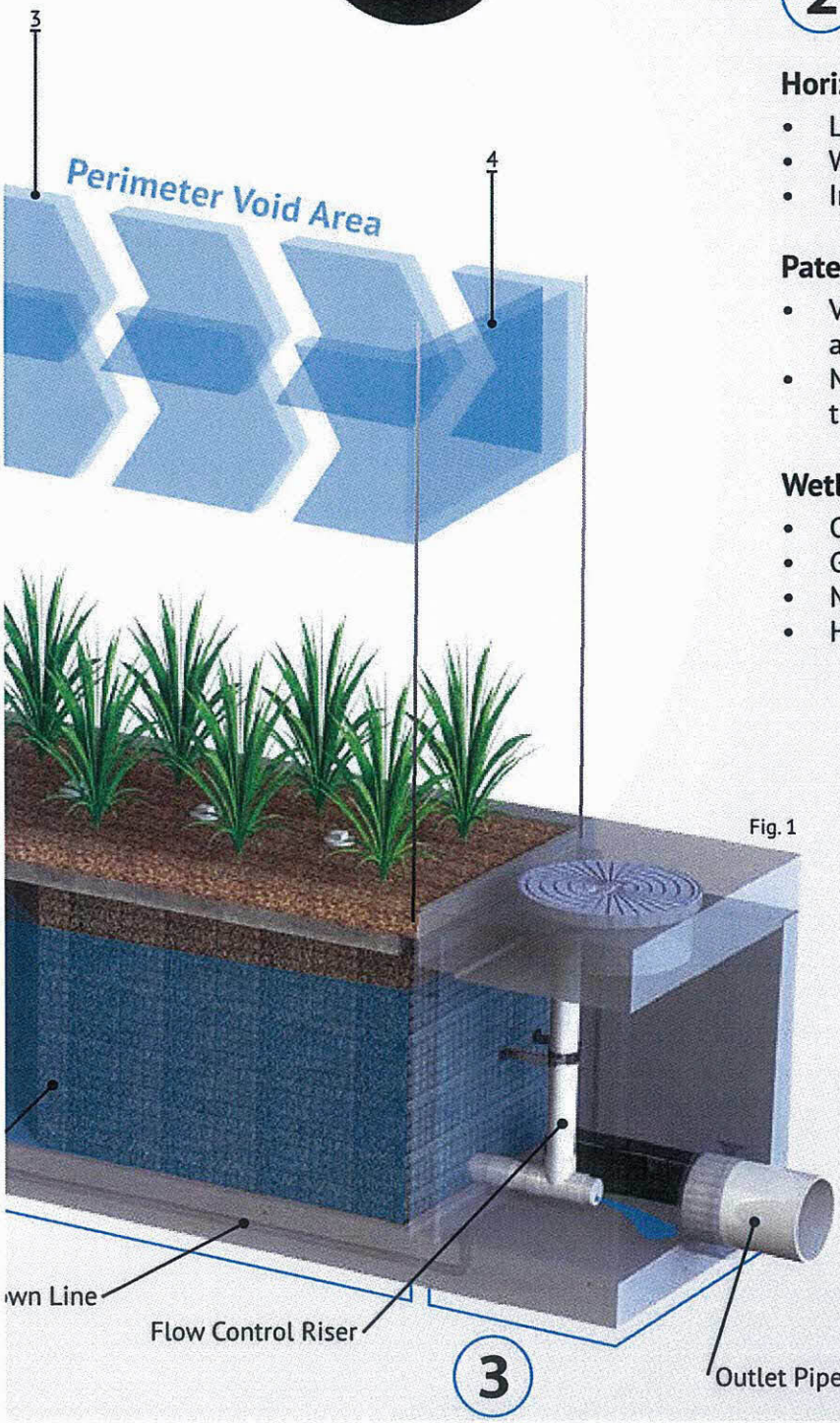


Fig. 1

2 Biofiltration

Horizontal Flow

- Less clogging than downward flow biofilters
- Water flow is subsurface
- Improves biological filtration

Patented Perimeter Void Area

- Vertically extends void area between the walls and the WetlandMEDIA on all four sides.
- Maximizes surface area of the media for higher treatment capacity

WetlandMEDIA

- Contains no organics and removes phosphorus
- Greater surface area and 48% void space
- Maximum evapotranspiration
- High ion exchange capacity and light weight

3 Discharge

Flow Control

- Orifice plate controls flow of water through WetlandMEDIA to a level lower than the media's capacity.
- Extends the life of the media and improves performance

Drain-Down Filter

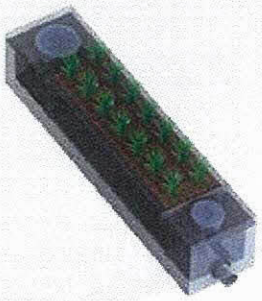
- The Drain-Down is an optional feature that completely drains the pre-treatment chamber
- Water that drains from the pre-treatment chamber between storm events will be treated

Orientations



Side-By-Side

The *Side-By-Side* orientation places the pre-treatment and discharge chamber adjacent to one another with the biofiltration chamber running parallel on either side. This minimizes the system length, providing a highly compact footprint. It has been proven useful in situations such as streets with directly adjacent sidewalks, as half of the system can be placed under that sidewalk. This orientation also offers internal bypass options as discussed below.



End-To-End

The *End-To-End* orientation places the pre-treatment and discharge chambers on opposite ends of the biofiltration chamber therefore minimizing the width of the system to 5 ft (outside dimension). This orientation is perfect for linear projects and street retrofits where existing utilities and sidewalks limit the amount of space available for installation. One limitation of this orientation is bypass must be external.

Bypass

Internal Bypass Weir (Side-by-Side Only)

The *Side-By-Side* orientation places the pre-treatment and discharge chambers adjacent to one another allowing for integration of internal bypass. The wall between these chambers can act as a bypass weir when flows exceed the system's treatment capacity, thus allowing bypass from the pre-treatment chamber directly to the discharge chamber.

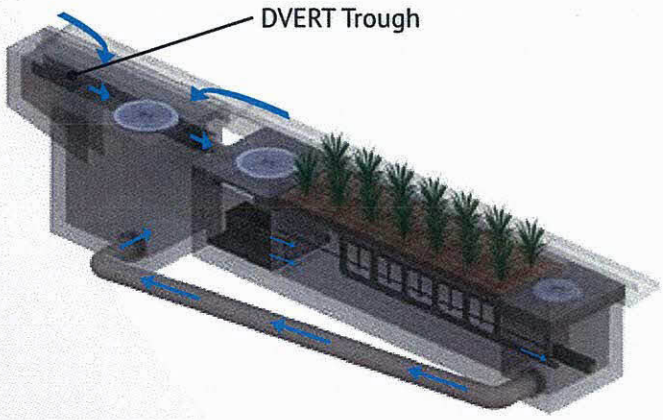
External Diversion Weir Structure

This traditional offline diversion method can be used with the MWS Linear in scenarios where runoff is being piped to the system. These simple and effective structures are generally configured with two outflow pipes. The first is a smaller pipe on the upstream side of the diversion weir - to divert low flows over to the MWS Linear for treatment. The second is the main pipe that receives water once the system has exceeded treatment capacity and water flows over the weir.

Flow By Design

This method is one in which the system is placed just upstream of a standard curb or grate inlet to intercept the first flush. Higher flows simply pass by the MWS Linear and into the standard inlet downstream.

DVERT Low Flow Diversion



This simple yet innovative diversion trough can be installed in existing or new curb and grate inlets to divert the first flush to the MWS Linear via pipe. It works similar to a rain gutter and is installed just below the opening into the inlet. It captures the low flows and channels them over to a connecting pipe exiting out the wall of the inlet and leading to the MWS Linear. The DVERT is perfect for retrofit and green street applications that allows the MWS Linear to be installed anywhere space is available.





Performance

The MWS Linear continues to outperform other treatment methods with superior pollutant removal for TSS, heavy metals, nutrients, hydrocarbons and bacteria. Since 2007 the MWS Linear has been field tested on numerous sites across the country. With it's advanced pre-treatment chamber and innovative horizontal flow biofilter, the system is able to effectively remove pollutants through a combination of physical, chemical, and biological filtration processes. With the same biological processes found in natural wetlands, the MWS Linear harnesses natures ability to process, transform, and remove even the most harmful pollutants.

Approvals

The MWS Linear has successfully met years of challenging technical reviews and testing from some of the most prestigious and demanding agencies in the nation, and perhaps the world.

Washington State TAPE Approved

The MWS Linear is approved for General Use Level Designation (GULD) for Basic, Enhanced, and Phosphorus treatment at 1 gpm/ft^2 loading rate. The highest performing BMP on the market for all main pollutant categories.

TSS	Total Phosphorus	Ortho Phosphorus	Nitrogen	Dissolved Zinc	Dissolved Copper	Total Zinc	Total Copper	Motor Oil
85%	64%	67%	45%	66%	38%	69%	50%	95%

DEQ Assignment

The Virginia Department of Environmental Quality assigned the MWS Linear, the highest phosphorus removal rating for manufactured treatment devices to meet the new Virginia Stormwater Management Program (VSMP) Technical Criteria.

Maryland Department Of The Environment Approved

Granted ESD (Environmental Site Design) status for new construction, redevelopment and retrofitting when designed in accordance with the Design Manual.

MASTEP Evaluation

The University of Massachusetts at Amherst – Water Resources Research Center, issued a technical evaluation report noting removal rates up to 84% TSS, 70% Total Phosphorus, 68.5% Total Zinc, and more.

Rhode Island DEM Approved

Approved as an authorized BMP and noted to achieve the following minimum removal efficiencies: 85% TSS, 60% Pathogens, 30% Total Phosphorus, and 30% Total Nitrogen.

Flow Based Sizing

The MWS Linear can be used in stand alone applications to meet treatment flow requirements. Since the MWS Linear is the only biofiltration system that can accept inflow pipes several feet below the surface it can be used not only in decentralized design applications but also as a large central end-of-the-line application for maximum feasibility.



Treatment Flow Sizing Table

Model #	Dimensions	WetlandMedia Surface Area	Treatment Flow Rate (cfs)
MWS-L-4-4	4' x 4'	23 ft^2	0.052
MWS-L-4-6	4' x 6'	32 ft^2	0.073
MWS-L-4-8	4' x 8'	50 ft^2	0.115
MWS-L-4-13	4' x 13'	63 ft^2	0.144
MWS-L-4-15	4' x 15'	76 ft^2	0.175
MWS-L-4-17	4' x 17'	90 ft^2	0.206
MWS-L-4-19	4' x 19'	103 ft^2	0.237
MWS-L-4-21	4' x 21'	117 ft^2	0.268
MWS-L-8-8	8' x 8'	100 ft^2	0.230
MWS-L-8-12	8' x 12'	151 ft^2	0.346
MWS-L-8-16	8' x 16'	201 ft^2	0.462

Volume Based Sizing

Many states require treatment of a water quality volume and do not offer the option of flow based design. The MWS Linear and its unique horizontal flow makes it the only biofilter that can be used in volume based design installed downstream of ponds, detention basins, and underground storage systems.



Treatment Volume Sizing Table

Model #	Treatment Capacity (cu. ft.) @ 24-Hour Drain Down	Treatment Capacity (cu. ft.) @ 48-Hour Drain Down
MWS-L-4-4	1140	2280
MWS-L-4-6	1600	3200
MWS-L-4-8	2518	5036
MWS-L-4-13	3131	6261
MWS-L-4-15	3811	7623
MWS-L-4-17	4492	8984
MWS-L-4-19	5172	10345
MWS-L-4-21	5853	11706
MWS-L-8-8	5036	10072
MWS-L-8-12	7554	15109
MWS-L-8-16	10073	20145

Installation

The MWS Linear is simple, easy to install, and has a space efficient design that offers lower excavation and installation costs compared to traditional tree-box type systems. The structure of the system resembles pre-cast catch basin or utility vaults and is installed in a similar fashion.

The system is delivered fully assembled for quick installation. Generally, the structure can be unloaded and set in place in 15 minutes. Our experienced team of field technicians are available to supervise installations and provide technical support.



Maintenance

Reduce your maintenance costs, man hours, and materials with the MWS Linear. Unlike other biofiltration systems that provide no pre-treatment, the MWS Linear is a self-contained treatment train which incorporates simple and effective pre-treatment.

Maintenance requirements for the biofilter itself are almost completely eliminated, as the pre-treatment chamber removes and isolates trash, sediments, and hydrocarbons. What's left is the simple maintenance of an easily accessible pre-treatment chamber that can be cleaned by hand or with a standard vac truck. Only periodic replacement of low-cost media in the pre-filter cartridges is required for long term operation and there is absolutely no need to replace expensive biofiltration media.



Plant Selection

Abundant plants, trees, and grasses bring value and an aesthetic benefit to any urban setting, but those in the MWS Linear do even more - they increase pollutant removal. What's not seen, but very important, is that below grade the stormwater runoff/flow is being subjected to nature's secret weapon: a dynamic physical, chemical, and biological process working to break down and remove non-point source pollutants. The flow rate is controlled in the MWS Linear, giving the plants more "contact time" so that pollutants are more successfully decomposed, volatilized and incorporated into the biomass of The MWS Linear's micro/macro flora and fauna.

A wide range of plants are suitable for use in the MWS Linear, but selections vary by location and climate. View suitable plants by selecting the list relative to your project location's hardy zone.

Please visit **www.ModularWetlands.com/Plants** for more information and various plant lists.



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WASHINGTON STATE DEPARTMENT OF ECOLOGY

April 2014

GENERAL USE LEVEL DESIGNATION FOR BASIC, ENHANCED, AND PHOSPHORUS TREATMENT

For the

MWS-Linear Modular Wetland

Ecology's Decision:

Based on Modular Wetland Systems, Inc. application submissions, including the Technical Evaluation Report, dated April 1, 2014, Ecology hereby issues the following use level designation:

1. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Basic treatment
    - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.
2. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Phosphorus treatment
    - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.
3. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Enhanced treatment
    - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.
4. Ecology approves monitoring for the MWS - Linear Modular Wetland Stormwater Treatment System units for Basic, Phosphorus, and Enhanced treatment at the hydraulic

loading rate listed above. Designers shall calculate the water quality design flow rates using the following procedures:

- Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.
- Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.2.5 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.
- Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.

5. These use level designations have no expiration date but may be revoked or amended by Ecology, and are subject to the conditions specified below.

Ecology's Conditions of Use:

Applicants shall comply with the following conditions:

1. Design, assemble, install, operate, and maintain the MWS – Linear Modular Wetland Stormwater Treatment System units, in accordance with Modular Wetland Systems, Inc. applicable manuals and documents and the Ecology Decision.
2. Each site plan must undergo Modular Wetland Systems, Inc. review and approval before site installation. This ensures that site grading and slope are appropriate for use of a MWS – Linear Modular Wetland Stormwater Treatment System unit.
3. MWS – Linear Modular Wetland Stormwater Treatment System media shall conform to the specifications submitted to, and approved by, Ecology.
4. Maintenance: The required maintenance interval for stormwater treatment devices is often dependent upon the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured filter treatment device.

- Typically, Modular Wetland Systems, Inc. designs MWS - Linear Modular Wetland systems for a target prefilter media life of 6 to 12 months.
- Indications of the need for maintenance include effluent flow decreasing to below the design flow rate or decrease in treatment below required levels.
- Owners/operators must inspect MWS - Linear Modular Wetland systems for a minimum of twelve months from the start of post-construction operation to determine site-specific maintenance schedules and requirements. You must conduct inspections monthly during the wet season, and every other month during the dry season. (According to the SWMMWW, the wet season in western Washington is October 1 to April 30. According to SWMMEW, the wet season in eastern Washington is October 1 to June 30). After the first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections.

- Conduct inspections by qualified personnel, follow manufacturer's guidelines, and use methods capable of determining either a decrease in treated effluent flowrate and/or a decrease in pollutant removal ability.
- When inspections are performed, the following findings typically serve as maintenance triggers:
    - Standing water remains in the vault between rain events, or
    - Bypass occurs during storms smaller than the design storm.
    - If excessive floatables (trash and debris) are present (but no standing water or excessive sedimentation), perform a minor maintenance consisting of gross solids removal, not prefilter media replacement.
    - Additional data collection will be used to create a correlation between pretreatment chamber sediment depth and pre-filter clogging (see *Issues to be Addressed by the Company* section below)

6. Discharges from the MWS - Linear Modular Wetland Stormwater Treatment System units shall not cause or contribute to water quality standards violations in receiving waters.

Applicant:	Modular Wetland Systems, Inc.
Applicant's Address:	*PO. Box 869* *Oceanside, CA 92054*

Application Documents:

- *Original Application for Conditional Use Level Designation*, Modular Wetland System, Linear Stormwater Filtration System Modular Wetland Systems, Inc., January 2011
- *Quality Assurance Project Plan*: Modular Wetland system – Linear Treatment System performance Monitoring Project, draft, January 2011.
- *Revised Application for Conditional Use Level Designation*, Modular Wetland System, Linear Stormwater Filtration System Modular Wetland Systems, Inc., May 2011
- *Memorandum: Modular Wetland System-Linear GULD Application Supplementary Data, April 2014*
- *Technical Evaluation Report: Modular Wetland System Stormwater Treatment System Performance Monitoring, April 2014.*

Applicant's Use Level Request:

General use level designation as a Basic, Enhanced, and Phosphorus treatment device in accordance with Ecology's Guidance for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE) January 2011 Revision.

Applicant's Performance Claims:

- The MWS – Linear Modular wetland is capable of removing a minimum of 80-percent of TSS from stormwater with influent concentrations between 100 and 200 mg/l.

- The MWS – Linear Modular wetland is capable of removing a minimum of 50-percent of Total Phosphorus from stormwater with influent concentrations between 0.1 and 0.5 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 30-percent of dissolved Copper from stormwater with influent concentrations between 0.005 and 0.020 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 60-percent of dissolved Zinc from stormwater with influent concentrations between 0.02 and 0.30 mg/l.

Ecology Recommendations:

- Modular Wetland Systems, Inc. has shown Ecology, through laboratory and field-testing, that the MWS - Linear Modular Wetland Stormwater Treatment System filter system is capable of attaining Ecology's Basic, Total phosphorus, and Enhanced treatment goals.

Findings of Fact:

Laboratory Testing

The MWS-Linear Modular wetland has the:

- Capability to remove 99 percent of total suspended solids (using Sil-Co-Sil 106) in a quarter-scale model with influent concentrations of 270 mg/L.
- Capability to remove 91 percent of total suspended solids (using Sil-Co-Sil 106) in laboratory conditions with influent concentrations of 84.6 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 93 percent of dissolved Copper in a quarter-scale model with influent concentrations of 0.757 mg/L.
- Capability to remove 79 percent of dissolved Copper in laboratory conditions with influent concentrations of 0.567 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 80.5-percent of dissolved Zinc in a quarter-scale model with influent concentrations of 0.95 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 78-percent of dissolved Zinc in laboratory conditions with influent concentrations of 0.75 mg/L at a flow rate of 3.0 gpm per square foot of media.

Field Testing

- Modular Wetland Systems, Inc. conducted monitoring of an MWS-Linear (Model # MWS-L-4-13) from April 2012 through May 2013, at a transportation maintenance facility in Portland, Oregon. The manufacturer collected flow-weighted composite samples of the system's influent and effluent during 28 separate storm events. The system treated approximately 75 percent of the runoff from 53.5 inches of rainfall during the monitoring period. The applicant sized the system at 1 gpm/sq ft. (wetland media) and 3gpm/sq ft. (prefilter).

- Influent TSS concentrations for qualifying sampled storm events ranged from 20 to 339 mg/L. Average TSS removal for influent concentrations greater than 100 mg/L (n=7) averaged 85 percent. For influent concentrations in the range of 20-100 mg/L (n=18), the upper 95 percent confidence interval about the mean effluent concentration was 12.8 mg/L.
- Total phosphorus removal for 17 events with influent TP concentrations in the range of 0.1 to 0.5 mg/L averaged 65 percent. A bootstrap estimate of the lower 95 percent confidence limit (LCL95) of the mean total phosphorus reduction was 58 percent.
- The lower 95 percent confidence limit of the mean percent removal was 60.5 percent for dissolved zinc for influent concentrations in the range of 0.02 to 0.3 mg/L (n=11). The lower 95 percent confidence limit of the mean percent removal was 32.5 percent for dissolved copper for influent concentrations in the range of 0.005 to 0.02 mg/L (n=14) at flow rates up to 28 gpm (design flow rate 41 gpm). Laboratory test data augmented the data set, showing dissolved copper removal at the design flow rate of 41 gpm (93 percent reduction in influent dissolved copper of 0.757 mg/L).

Issues to be addressed by the Company:

1. Modular Wetland Systems, Inc. should collect maintenance and inspection data for the first year on all installations in the Northwest in order to assess standard maintenance requirements for various land uses in the region. Modular Wetland Systems, Inc. should use these data to establish required maintenance cycles.
2. Modular Wetland Systems, Inc. should collect pre-treatment chamber sediment depth data for the first year of operation for all installations in the Northwest. Modular Wetland Systems, Inc. will use these data to create a correlation between sediment depth and pre-filter clogging.

Technology Description:
Download at http://www.modularwetlands.com/

Contact Information:

Applicant:
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P.O. Box 869
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Applicant website: http://www.modularwetlands.com/

Ecology web link: http://www.ecy.wa.gov/programs/wg/stormwater/newtech/index.html

Ecology:
Douglas C. Howie, P.E.
Department of Ecology
Water Quality Program
(360) 407-6444
douglas.howie@ecy.wa.gov

Revision History

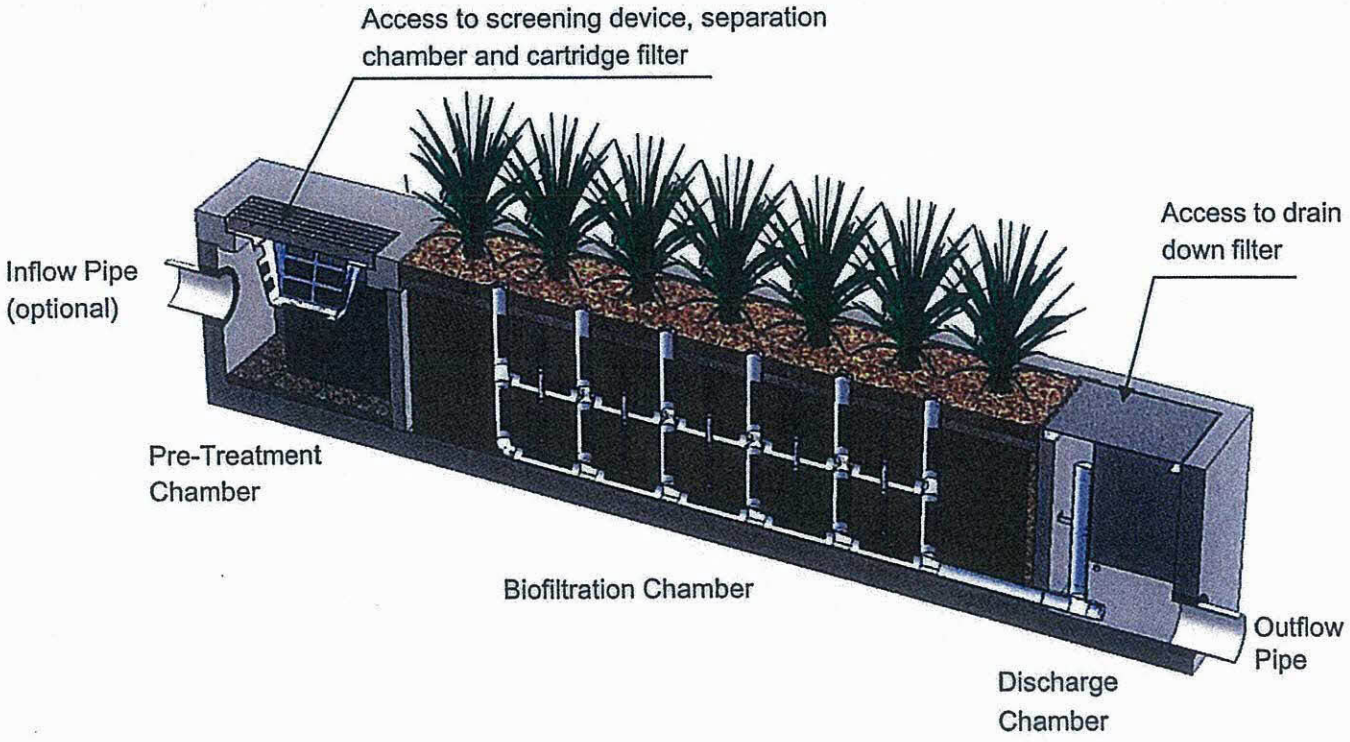
Date	Revision
June 2011	Original use-level-designation document
September 2012	Revised dates for TER and expiration
January 2013	Modified Design Storm Description, added Revision Table, added maintenance discussion, modified format in accordance with Ecology standard
December 2013	Updated name of Applicant
April 2014	Approved GULD designation for Basic, Phosphorus, and Enhanced treatment

Maintenance Guidelines for Modular Wetland System - Linear

Maintenance Summary

- Remove Trash from Screening Device – average maintenance interval is 6 to 12 months.
  - (*5 minute average service time*).
- Remove Sediment from Separation Chamber – average maintenance interval is 12 to 24 months.
  - (*10 minute average service time*).
- Replace Cartridge Filter Media – average maintenance interval 12 to 24 months.
  - (*10-15 minute per cartridge average service time*).
- Replace Drain Down Filter Media – average maintenance interval is 12 to 24 months.
  - (*5 minute average service time*).
- Trim Vegetation – average maintenance interval is 6 to 12 months.
  - (*Service time varies*).

System Diagram



ATTACHMENT 2
BACKUP FOR PDP HYDROMODIFICATION CONTROL MEASURES

This is the cover sheet for Attachment 2.

☐ Mark this box if this attachment is empty because the project is exempt from PDP hydromodification management requirements.

Indicate which Items are Included:

Attachment Sequence	Contents	Checklist
Attachment 2a	Hydromodification Management Exhibit (Required)	☐ Included See Hydromodification Management Exhibit Checklist on the back of this Attachment cover sheet.
Attachment 2b	Management of Critical Coarse Sediment Yield Areas (WMAA Exhibit is required, additional analyses are optional) See Section 6.2 of the BMP Design Manual.	☐ Exhibit showing project drainage boundaries marked on WMAA Critical Coarse Sediment Yield Area Map (Required) Optional analyses for Critical Coarse Sediment Yield Area Determination ☐ 6.2.1 Verification of Geomorphic Landscape Units Onsite ☐ 6.2.2 Downstream Systems Sensitivity to Coarse Sediment ☐ 6.2.3 Optional Additional Analysis of Potential Critical Coarse Sediment Yield Areas Onsite
Attachment 2c	Geomorphic Assessment of Receiving Channels (Optional) See Section 6.3.4 of the BMP Design Manual.	☐ Not performed ☐ Included ☐ Submitted as separate stand-alone document
Attachment 2d	Flow Control Facility Design, including Structural BMP Drawdown Calculations and Overflow Design Summary (Required) See Chapter 6 and Appendix G of the BMP Design Manual	☐ Included ☐ Submitted as separate stand-alone document
Attachment 2e	Vector Control Plan (Required when structural BMPs will not drain in 96 hours)	☐ Included ☐ Not required because BMPs will drain in less than 96 hours

ATTACHMENT 2a

Hydromodification Exhibit

Use this checklist to ensure the required information has been included on the Hydromodification Management Exhibit:

The Hydromodification Management Exhibit must identify:

☐ Underlying hydrologic soil group
☐ Approximate depth to groundwater
☐ Existing natural hydrologic features (watercourses, seeps, springs, wetlands)
☐ Critical coarse sediment yield areas to be protected
☐ Existing topography
☐ Existing and proposed site drainage network and connections to drainage offsite
☐ Proposed grading
☐ Proposed impervious features
☐ Proposed design features and surface treatments used to minimize imperviousness
☐ Point(s) of Compliance (POC) for Hydromodification Management
☐ Existing and proposed drainage boundary and drainage area to each POC (when necessary, create separate exhibits for pre-development and post-project conditions)
☐ Structural BMPs for hydromodification management (identify location, type of BMP, and size/detail)

ATTACHMENT 2b

CCSY Documentation

The new City BMP Design Manual provides methodologies for CCSYAs identification and analyses.

Step 1: Identify CCSYAs

After examination of Regional Watershed Management Area Analysis PCCSYA maps provided in Appendix H.6. of City BMP Design Manual, it is determined that multiple slivers of CCSYAs fall within the 3 Roots project boundary. Some areas are within the project boundary, but are outside of both the onsite drainage areas and project disturbance areas, and these areas do not require analysis. Therefore, the CCSYA analysis is limited to areas within the project's disturbance limits or runon areas.

Step 2: Avoidance of Onsite CCSYAs (Storm Water Manual Appendix H.2)

Based on Appendix H.6 of City BMP Design Manual (Page H-17), the PCCSYAs may be removed from the CCSYA mapping without performing GLU analysis if the areas are under 10% slope or are paved.

As shown on Exhibit 2C-A, there are no CCSYAs with existing flat conditions.

Step 3: Bypass Onsite and Upstream CCSYAs (Storm Water Manual Appendix H.3)

Bypass CCSYAs from Hillslopes

The project's grading design will bypass CCSYA hillslope sediments. These areas will either flow overland into the creek, or will be conveyed to downstream water with the following conditions of:

- Peak velocity from the discrete 2-year, 24-hour runoff event is greater than 3fps. Minimum slope to maintain 3fps is 0.5% based on Manual Table (City BMP Manual, Appendix H Page H-7), which is met on project site.
- The brow ditches or pipes conveying CCSYA sediment runoff are not routed through basins or any other restricted outlets that will trap sediment on project site.

Thus the onsite hillside areas are excluded from WMAA CCSYAs since these areas have been effectively bypassed through the project site. Exhibit 2C-A contains flow arrows which show the direction of flow from hillslope CCSYAs under existing conditions. Exhibit 2C-B shows the proposed condition grading that shows how hillslope CCSYAs will be bypassed from all onsite biofiltration.

De Minimis Upstream CCSYA

Several small slivers of CCSYAs on project site are determined as De Minimis CCSYAs as shown on the CCSYA exhibit. To show that they can be excluded they must be in compliance with section H.3.3 of the Storm Water Manual:

- De minimis upstream CCSYA is not disturbed through the proposed project activities.

Due to their small size, the de minimis CCSYAs would not be practical to bypass to downstream waters. In addition, the CCSYAs are unlikely to make an impact on the downstream waters due to their negligible size.

- De minimis upstream CCSYA is not part of an upstream drainage contributing more than 0.31 total acres to the project site.

As shown on the CCSYA exhibit, all of the drainage areas with corresponding de minimis CCSYAs are less than 0.31 acres. Note that although section H.3.3 identifies this de minimis threshold as applicable to Upstream PCCSYAs, it is determined that the same criteria could be applied to onsite PCCSYAs because the threshold is based on limiting flow energy required to initiate sediment movement. If the flow energy (due to the existing condition drainage area to the PCCSYA) is not enough to be an existing source of bed sediment yield, the PCCSYAs can be omitted from consideration. Thus these areas should be excluded from the CCSYAs.

- Multiple de minimis upstream CCSYAs cannot be adjacent to each other and hydraulically connected.

Flow arrows on Exhibit 2C-A show that none of de minimis CCSYAs are hydraulically connected.

- The SWQMP must document the reason why each de minimis upstream CCSYA could not be bypassed to the downstream waters of the state.

Because of the small size of the de minimis CCSYAs on the project, it would not be practical to bypass every CCSYA because there is a neglible impact on suspension in the downstream waters.

Step 4: No Net Impact (Storm Water Manual Appendix H.4)

All hillslope CCSYAs are bypassed and onsite de minimis CCSYAs are excluded due to size. Therefore, a "No Net Impact" analysis is not required.

***Downstream System Sensitivity* (Storm Water Manual Appendix H.7)**

Because there are no onsite PCCYSAs, Appendix H.7 does not apply to the project.

Conclusions:

The project complies with CCSYA requirements by bypassing hillslope CCSYAs.



LEGEND

DRAINAGE AREA

ONSITE CCSYA

WMAA CCSYA

0 500 1000 1500

GRAPHICAL SCALE

SCALE:	1"=500'
JOB #:	4182.30
CREATED:	9/22/17

PREPARED BY:

PROJECT DESIGN CONSULTANTS
Planning | Engineering | Survey

701 B Street, Suite 800
San Diego, CA 92101
619.235.6471 Tel
619.234.0349 Fax

CITY OF SAN DIEGO

3 ROOTS

CCSYA MAP
EXHIBIT 2C

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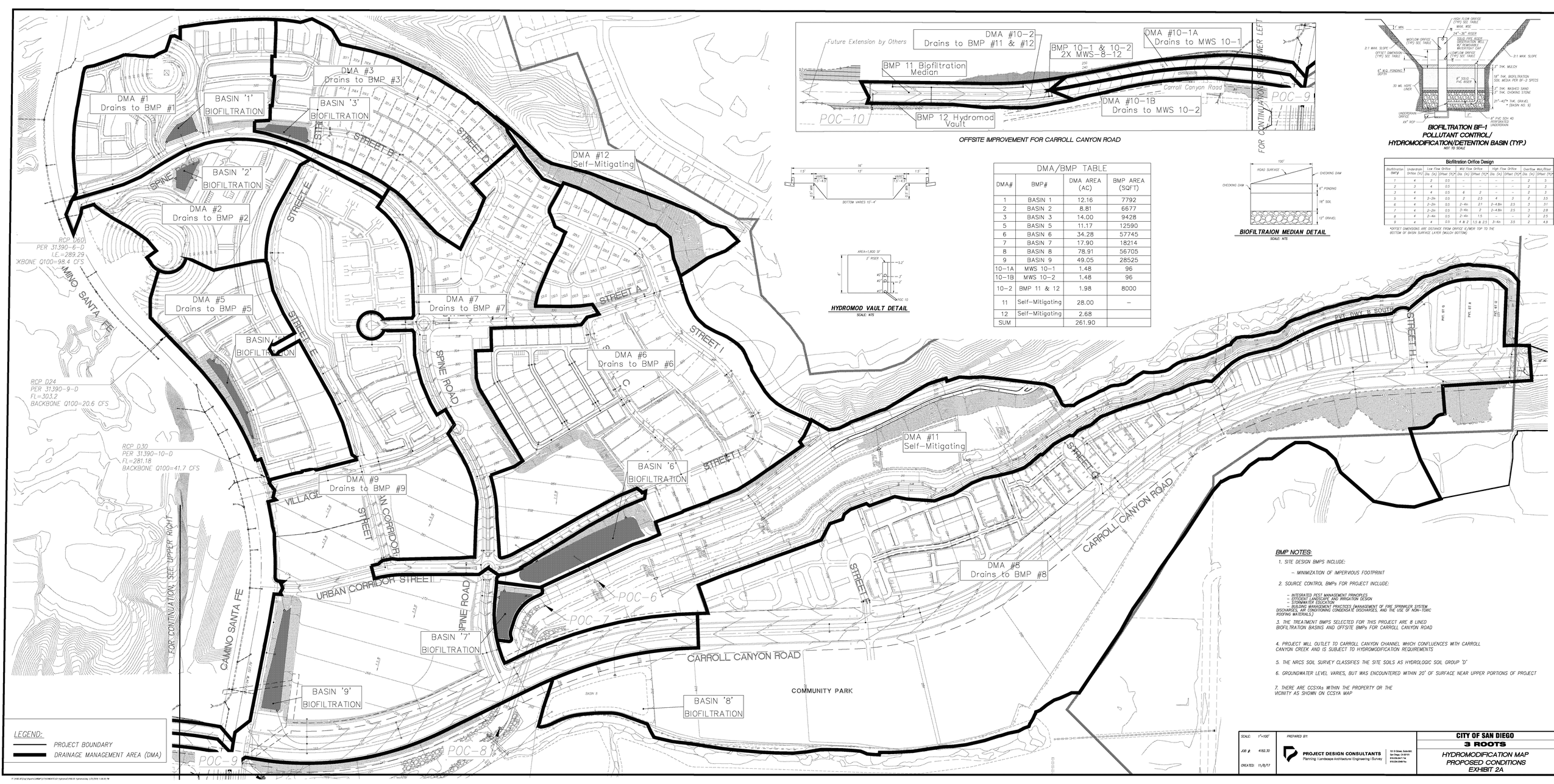

OFFSITE IMPROVEMENT FOR CARROLL CANYON ROAD

BIOFILTRATION BF-1
POLLUTANT CONTROL/
HYDROMODIFICATION/DETENTION BASIN (TYP.)
NOT TO SCALE

HYDROMOD VAULT DETAIL
SCALE: NTS

DMA/BMP TABLE			
DMA#	BMP#	DMA AREA (AC)	BMP AREA (SQFT)
1	BASIN 1	12.16	7792
2	BASIN 2	8.81	6677
3	BASIN 3	14.00	9428
5	BASIN 5	11.17	12590
6	BASIN 6	34.28	57745
7	BASIN 7	17.90	18214
8	BASIN 8	78.91	56705
9	BASIN 9	49.05	28525
10-1A	MWS 10-1	1.48	96
10-1B	MWS 10-2	1.48	96
10-2	BMP 11 & 12	1.98	8000
11	Self-Mitigating	28.00	–
12	Self-Mitigating	2.68	
SUM		261.90	

BIOFILTRAION MEDIAN DETAIL
SCALE: NTS

Biofiltration Orifice Design

Biofiltration BMP #	Underdrain Orifice (in)	Low Flow Orifice		Mid Flow Orifice		High Flow Orifice		Overflow Weir/Riser	
		Dia. (in)	Offset (ft)*	Dia. (in)	Offset (ft)*	Dia. (in)	Offset (ft)*	Dia. (in)	Offset (ft)*
1	4	2	0.5	–	–	–	–	2	5
2	3	4	0.5	–	–	–	–	2	3
3	4	4	0.5	6	2	–	–	2	3
5	4	2-2in	0.5	2	2.5	4	3	2	3.5
6	4	2-2in	0.5	2-4in	2.1	2-4.8in	2.5	3	3.1
7	4	2-2in	0.5	2-4in	2	2-4.8in	2.5	3	2.8
8	4	2-4in	0.5	2-4in	1.5	–	–	2	2.5
9	4	4	0.5	4 & 2	1.5 & 2.5	2-4in	3.5	2	4.9

*OFFSET DIMENSIONS ARE DISTANCE FROM ORIFICE INVERT TOP TO THE BOTTOM OF BASIN SURFACE LAYER (MULCH BOTTOM)

BMP NOTES:

1. SITE DESIGN BMPS INCLUDE:
   - MINIMIZATION OF IMPERVIOUS FOOTPRINT
2. SOURCE CONTROL BMPs FOR PROJECT INCLUDE:
   - INTEGRATED PEST MANAGEMENT PRINCIPLES
   - EFFICIENT LANDSCAPE AND IRRIGATION DESIGN
   - STORMWATER EDUCATION
   - BUILDING MANAGEMENT PRACTICES (MANAGEMENT OF FIRE SPRINKLER SYSTEM DISCHARGES, AIR CONDITIONING CONDENSATE DISCHARGES, AND THE USE OF NON-TOXIC ROOFING MATERIALS.)
3. THE TREATMENT BMPS SELECTED FOR THIS PROJECT ARE B LINED BIOFILTRATION BASINS AND OFFSITE BMPs FOR CARROLL CANYON ROAD
4. PROJECT WILL OUTLET TO CARROLL CANYON CHANNEL WHICH CONFLUENCES WITH CARROLL CANYON CREEK AND IS SUBJECT TO HYDROMODIFICATION REQUIREMENTS
5. THE NRCS SOIL SURVEY CLASSIFIES THE SITE SOILS AS HYDROLOGIC SOIL GROUP 'D'
6. GROUNDWATER LEVEL VARIES, BUT WAS ENCOUNTERED WITHIN 20' OF SURFACE NEAR UPPER PORTIONS OF PROJECT
7. THERE ARE CCSYAs WITHIN THE PROPERTY OR THE VICINITY AS SHOWN ON CCSYA MAP

LEGEND:
- PROJECT BOUNDARY
- DRAINAGE MANAGEMENT AREA (DMA)

SCALE: 1"=100'
JOB #: 4182.30
CREATED: 11/9/17

PREPARED BY:
PROJECT DESIGN CONSULTANTS
Planning | Landscape Architecture | Engineering | Survey
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619.234.0349 fax.

CITY OF SAN DIEGO
3 ROOTS
HYDROMODIFICATION MAP
PROPOSED CONDITIONS
EXHIBIT 2A

HYDROMODIFICATION SCREENING

FOR THE

3ROOTS SAN DIEGO PROJECT

January 15, 2019



Wayne W. Chang, MS, PE 46548

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Civil Engineering ◦ Hydrology ◦ Hydraulics ◦ Sedimentation

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MAP POCKET

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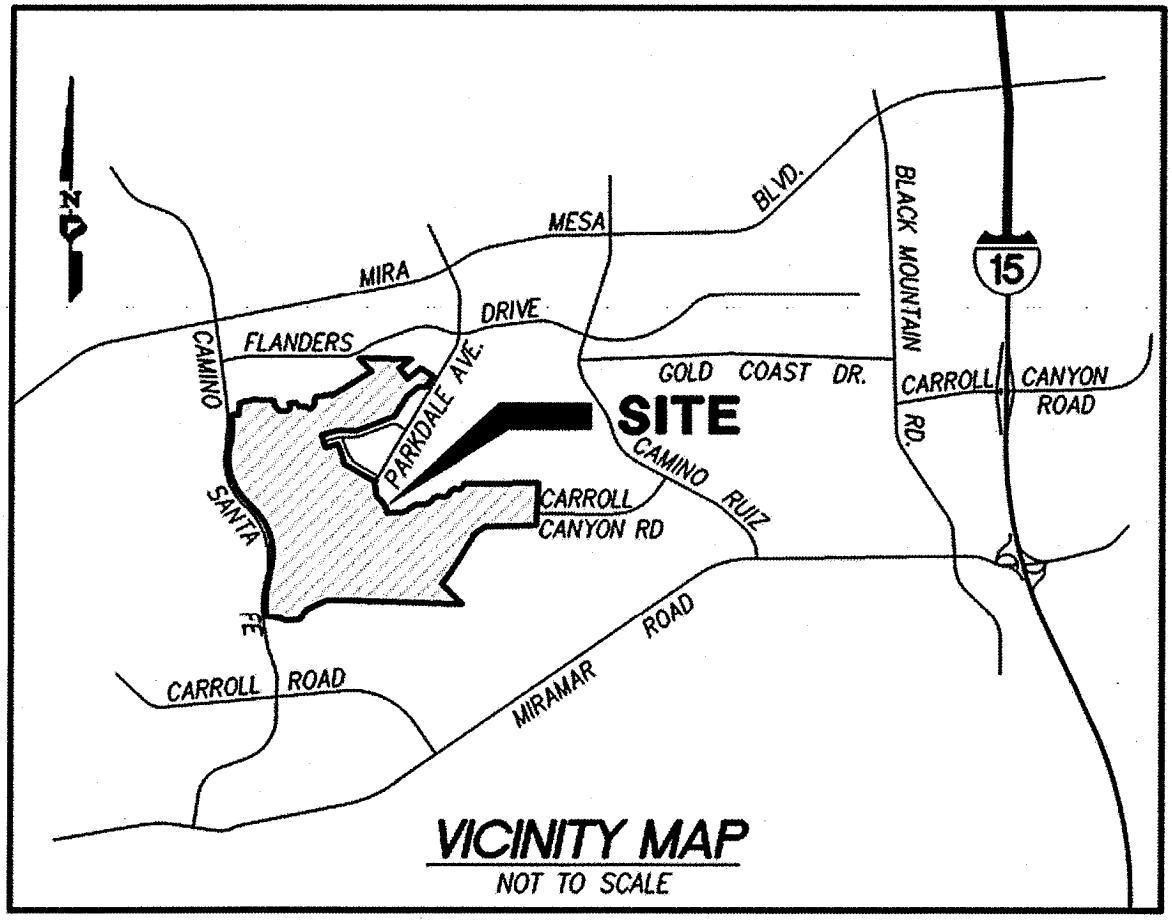
INTRODUCTION

The City of San Diego's October 1, 2018, *Storm Water Standards,* outline low flow thresholds for hydromodification analyses. The thresholds are based on a percentage of the pre-project 2-year flow (Q_2), i.e., $0.1Q_2$ (low flow threshold and high susceptibility to erosion), $0.3Q_2$ (medium flow threshold and medium susceptibility to erosion), or $0.5Q_2$ (high flow threshold and low susceptibility to erosion). A flow threshold of $0.1Q_2$ represents a natural downstream receiving conveyance system with a high susceptibility to bed and/or bank erosion. This is the default value used for hydromodification analyses and will result in the most conservative (largest) on-site facility sizing. A flow threshold of $0.3Q_2$ or $0.5Q_2$ represents downstream receiving conveyance systems with a medium or low susceptibility to erosion, respectively. In order to qualify for a medium or low erosion susceptibility rating, a project must perform a channel screening analysis based on the March 2010, *Hydromodification Screening Tools: Field Manual for Assessing Channel Susceptibility,* developed by the Southern California Coastal Water Research Project (SCCWRP). The SCCWRP results are compared with the critical shear stress results from the County of San Diego to establish the appropriate erosion susceptibility threshold of low, medium, or high.



This report provides a hydromodification screening analysis for the 3Roots San Diego Project (Project) being designed by Project Design Consultants (PDC). The Project proposes a mixed-use community in the city of San Diego. The site covers approximately 412 acres, and is located east

of Camino Santa Fe approximately midway between Mira Mesa Boulevard to the north and Miramar Road to the south. The site is bounded by a natural canyon and residential development to the north, commercial and industrial development to the south, natural areas and commercial development to the west, and commercial and industrial development to the east. Carroll Canyon Creek flows in a westerly direction through the site. The Property was formerly operated as a sand and gravel mining site owned by Hanson Aggregates Pacific Southwest, Inc.

The Project is currently being entitled and will be redeveloped pursuant to Vesting Tentative Map 2069827 by Project Design Consultants. The Project proposes approximately 247 acres of open space (including approximately 178 acres of natural open space, landscaped slopes, and 69 acres of park land), 530 single family residential units, 1,090 multi-family residential units, 180 affordable housing units, and a 1.5 acre transit center adjacent to the intersection of Camino Santa Fe and Carroll Canyon Road.

The redevelopment includes alterations and improvements to Carroll Canyon Creek from existing Camino Santa Fe on the downstream (west) end to the upstream (east) limits of the site. The creek modifications are as follows beginning from downstream. Carroll Canyon Creek will be realigned from Camino Santa Fe to the proposed Carroll Canyon Road crossing. The existing creek will be filled and developed, and the creek flow will be redirected to an existing lateral channel south of Carroll Canyon Creek. Grading will be performed along the lateral channel to create a wetlands area and increase the channel capacity. An arch culvert will be constructed where the realigned creek crosses the proposed Carroll Canyon Road. Upstream of the crossing, Carroll Canyon Creek will generally follow its existing alignment, but will be channelized over an approximately 2,700 foot length with a series of drop structures. The drop structures will lower the channel gradient between the drops in order to reduce the flow velocities. This will minimize the need for erosion protection along the channel. From the upper end of the channelized segment to the upstream project limits, Carroll Canyon Creek will generally remain under its existing condition, except for some grading and bank protection along the southerly bank.

The SCCWRP screening tool requires both office and field work to establish the vertical and lateral susceptibility of a downstream receiving channel to erosion. The vertical and lateral assessments are performed independently of each other although the lateral results can be affected by the vertical rating. A screening analysis was performed to assess the low flow threshold for six of the Project's points of compliance (POC). A POC is the first location where runoff from the Project discharges into a natural system. The channel screening analysis is performed below each POC. The Study Area Exhibit in the map pocket shows that the majority of the POCs outlet into Carroll Canyon Creek along the site. There is one POC that outlets into a tributary watercourse to Carroll Canyon Creek. The tributary watercourse flows in a westerly direction along the northerly portion of the site.

The initial step in performing the SCCWRP screening analysis is to establish the domain of analysis and the study reaches within the domain. This is followed by office and field components of the screening tool along with the associated analyses and results. The following sections cover these procedures in sequence.

DOMAIN OF ANALYSIS

SCCWRP defines an upstream and downstream domain of analysis, which establish the study limits. The County of San Diego's HMP specifies the downstream domain of analysis based on the SCCWRP criteria. The HMP indicates that the downstream domain is the first point where one of these is reached:

- at least one reach downstream of the first grade control point (preferably second grade control location)
- tidal backwater/lentic waterbody
- equal order tributary
- accumulation of 50 percent drainage area for stream systems or 100 percent drainage area for urban conveyance systems (storm drains, hardened channels, etc.)

The upstream limit is defined as:

- proceed upstream for 20 channel top widths or to the first grade control point, whichever comes first. Identify hard points that can check headward migration and evidence of active headcutting.

SCCWRP defines the maximum spatial unit, or reach (a reach is circa 20 channel widths), for assigning a susceptibility rating within the domain of analysis to be 200 meters (656 feet). If the domain of analysis is greater than 200 meters, the study area should be subdivided into smaller reaches of less than 200 meters for analysis, as appropriate. Most of the units in the HMP's SCCWRP analysis are metric. Metric units are used in this report only where given so in the HMP. Otherwise English units are used.

Downstream Domain of Analysis

As mentioned in the Introduction, the majority of the Project POCs covered by this report (identified in PDC's SWQMP as POC 6, 7, 8, 9, and 10) discharge into Carroll Canyon Creek. In addition, PDC's POC 1 discharges into a northerly tributary to Carroll Canyon Creek (see the Study Area Exhibit in the map pocket). Consequently, one channel assessment study area will be along Carroll Canyon Creek and the other will be along the northerly tributary. The downstream domain of analysis for each study area is determined by assessing and comparing the four bullet items above to determine which is closest to each study area's downstream-most point of compliance (POC). The downstream-most POC in Carroll Canyon Creek is POC 10, while the downstream-most (and only) POC in the northerly tributary is POC 1.

Per the first bullet item, the first permanent grade control below each study area's downstream-most POC was sought during a site visit. For Carroll Canyon Creek, a permanent grade control occurs at an existing concrete-lined Arizona crossing of the channel approximately 2,562 feet downstream of POC 10 (see Figure 21). For the northerly tributary, a permanent grade control occurs where the stream enters a culvert just upstream of El Camino Drive within the El Camino Memorial Park (see Figure 10). The grade control criteria requires the channel assessment to extend one reach (656 feet) below the grade control or to the second grade control. For Carroll

Canyon Creek, a second grade control is created by an existing culvert crossing Carroll Canyon Road (see Figure 24 and the Study Area Exhibit), so the downstream domain of analysis location is set at the culvert entrance. For the northerly tributary, a second grade control does not occur in the tributary and the El Camino Memorial Park culvert outlets into Carroll Canyon Creek. Therefore, the downstream domain of analysis location occurs at the culvert entrance. The segment below the culvert entrance is not erodible, so not subject to hydromodification impacts.

The second bullet item is the tidal backwater or lentic (standing or still water such as ponds, pools, marshes, lakes, lagoons, etc.) waterbody location. The nearest tidal backwater to both Carroll Canyon Creek and its northerly tributary is at Los Penasquitos Lagoon. The lagoon is further downstream than each study area's permanent grade control, so the second bullet item criteria will not govern over the first bullet item criteria.

The third bullet item is met when the natural drainage course below a POC confluences with a stream with an equal order or larger tributary area. Carroll Canyon Creek confluences with the larger Los Penasquitos Creek at the upstream end of Los Penasquitos Lagoon. In addition, the northerly tributary confluences with the larger Carroll Canyon Creek just upstream of Carroll Road. Both confluences are further downstream than each stream's permanent grade control, so the third bullet item criteria will not govern over the first bullet item criteria for Carroll Canyon Creek or its northerly tributary.

The fourth bullet item is met when the streams below the downstream-most POCs accumulate 50 percent drainage area (50 percent applies over 100 percent because the downstream drainage is primarily a natural stream system). The drainage areas tributary to POC 1 and 10 were determined using the USGS Streamstats program, which is based on a Digital Elevation Model and digital representation of the stream network. The Streamstats results in Appendix A show that the areas tributary to the POC 1 and 10 cover approximately 1.9504 and 9.0435 square miles, respectively. In comparison, the Streamstats areas tributary to the grade controls downstream of POC 1 and 10 cover approximately 2.5057 and 11.9765 square miles, respectively, so 50 percent area is not accumulated in either stream between their downstream-most POCs and grade controls. Based on this, the fourth bullet item criteria is not met for Carroll Canyon Creek nor its northerly tributary before the first bullet item criteria is met. Therefore, the fourth bullet item criteria will not govern over the first bullet item criteria for either stream.

From the above information, the downstream domain of analysis locations for the Carroll Canyon Creek and northerly tributary study areas are both based the first bullet item. Of the four bullet items, the grade controls are the first points reached below the downstream-most POCs.

Upstream Domain of Analysis

The upstream domain of analysis must be established for each study area. For the northerly tributary, a paved Arizona crossing of the stream exists approximately 1,453 feet upstream of POC 1 (see Figure 1 and the Study Area Exhibit). The Arizona crossing is a grade control that will maintain the upstream stream bed profile, so it establishes the upstream domain of analysis location for the northerly tributary.

For Carroll Canyon Creek, POC 6 and 7 discharge into a proposed engineered channel to be constructed by the Project. The channel will be designed to be stable and non-erosive. In addition, POC 6 and 7 will have riprap-lined drop structures both upstream and downstream. Consequently, the areas tributary to POC 6 and 7 can be designed with a low susceptibility to erosion and further assessment related to these POCs is not necessary.

On the other hand, POC's 8, 9, and 10 contain natural stream areas, so the channel assessment is performed for these POCs. The upstream-most of these three POCs is POC 8. A drop structure will be constructed across Carroll Canyon Creek approximately 478 feet upstream of POC 8. The grade control that will maintain the upstream creek bed profile, so it establishes the upstream domain of analysis location for the Carroll Canyon Creek study area. An arch culvert will be constructed between the drop structure and POC 8. The arch culvert will have a soft-bottom, so will not act as a grade control.

Study Reaches within Domain of Analysis

The entire domain of analysis for the northerly tributary extends approximately 5,337 feet from the upstream domain of analysis location at the Arizona crossing to the downstream domain of analysis at the culvert entrance within the El Camino Memorial Park. The entire domain of analysis was modeled as a single reach, Reach 1.

The entire domain of analysis for Carroll Canyon Creek extends approximately 8,049 feet from the upstream domain of analysis location at the proposed drop structure to the downstream domain of analysis at the culvert entrance within the El Camino Memorial Park. The entire domain of analysis was modeled as two reaches, Reach 2 and 3. Reach 2 is upstream of Camino Santa Fe, within the Project site, and will be partially improved by the Project. Reach 3 is downstream of Camino Santa Fe and the project site.

Reach 1, 2, and 3 are longer than the 656-foot maximum reach length specified by SCCWRP. Review of topographic mapping, aerial photographs, and field conditions reveals that the physical (channel geometry and slope), vegetative, hydraulic, and soil conditions within each reach is relatively uniform. Subdividing Reach 1, 2, and 3 into smaller subreaches of less than 656 feet will not yield varying conclusions within each reach. Although the screening tool was applied across the entire length of the domain of analysis, the results will be identical for shorter subreaches within each reach.

INITIAL DESKTOP ANALYSIS

After the domain of analysis is established, SCCWRP requires an "initial desktop analysis" that involves office work. The initial desktop analysis establishes the watershed area, mean annual precipitation, valley slope, and valley width. These terms are defined in Form 1, which is included in Appendix A. SCCWRP recommends the use of National Elevation Data (NED) to determine the watershed area, valley slope, and valley width. The NED data is similar to USGS quadrangle mapping. For this project, more detailed topographic information was available, so it was used in lieu of USGS mapping to determine the valley slope and valley width.

The watershed areas tributary to Reach 1, 2, and 3 have been determined using Streamstats. The Streamstats output are included in Appendix A and summarized in Table 1.

The valley slopes of Reach 1 and 3 were determined from the Project and SANGIS' 2-foot contour interval topographic mapping. Reach 2 will be partially channelized by the Project, so its valley slope was determined from the Project's topographic mapping and PDC's proposed grading. The valley slope is the longitudinal slope of the channel bed along the flow line, so it is calculated by dividing the elevation difference within the reach by its flow length. The valley slopes of Reach 1, 2, and 3 are summarized in Table 1.

The valley width is the bottom width of the natural drainage course. The average valley widths within Reach 1 and 3 were estimated from the SANGIS topographic mapping, field observations, and review of Google Earth. The average valley slope of Reach 2 was estimated from the same factors as well as the proposed grading. The valley widths for Reach 1, 2, and 3 are summarized in Table 1.

Reach	Tributary Drainage Area, sq. mi.	Valley Slope, m/m	Valley Width, m
1	2.5057	0.0163	12.19
2	8.7464	0.0138	15.24
3	11.9765	0.0109	9.14

Table 1. Summary of Drainage Area, Valley Slope, and Valley Width

The mean annual precipitation was obtained from the rain gages closest to the site. These are the Western Regional Climate Center's Lockwood Mesa gage in Solana Beach and their Sea World gage (see Appendix A). The average annual rainfall measured at the Lockwood Mesa gage for the period of record from 1940 to 1965 is 9.66 inches and at Sea World from 1999 to 2016 is 9.58 inches. These values are almost equivalent. The 9.66 inches was chosen for the analyses because it is slightly higher (and closer to the site) so will predict greater erosion susceptibility.

These values were input to a spreadsheet to calculate the simulated peak flow, screening index, and valley width index outlined in Form 1. The input data and results are tabulated in Appendix A. This completes the initial desktop analysis.

FIELD SCREENING

After the initial desktop analysis is complete, a field assessment must be performed. The field assessment is used to establish a natural channel's vertical and lateral susceptibility to erosion. SCCWRP states that although they are admittedly linked, vertical and lateral susceptibility are assessed separately for several reasons. First, vertical and lateral responses are primarily controlled by different types of resistance, which, when assessed separately, may improve ease of use and lead to increased repeatability compared to an integrated, cross-dimensional assessment. Second, the mechanistic differences between vertical and lateral responses point to different modeling tools

and potentially different management strategies. Having separate screening ratings may better direct users and managers to the most appropriate tools for subsequent analyses.

The field screening tool uses combinations of decision trees and checklists. Decision trees are typically used when a question can be answered fairly definitively and/or quantitatively (e.g., d_{50} < 16 mm). Checklists are used where answers are relatively qualitative (e.g., the condition of a grade control). Low, medium, high, and very high ratings are applied separately to the vertical and lateral analyses. When the vertical and lateral analyses return divergent values, the most conservative value shall be selected as the flow threshold for the hydromodification analyses.

Vertical Stability

The purpose of the vertical stability decision tree (Figure 6-4 in the County of San Diego HMP) is to assess the state of the channel bed with a particular focus on the risk of incision (i.e., down cutting). The decision tree is included in Figure 28. The first step is to assess the channel bed resistance. There are three categories defined as follows:

1. Labile Bed – sand-dominated bed, little resistant substrate.

2. Transitional/Intermediate Bed – bed typically characterized by gravel/small cobble, Intermediate level of resistance of the substrate and uncertain potential for armoring.

3. Threshold Bed (Coarse/Armored Bed) – armored with large cobbles or larger bed material or highly-resistant bed substrate (i.e., bedrock).

Several of the figures contain photographs of the channel material along Reaches 1 through 3. A gravelometer is included in Figures 25, 26, and 27 for reference. Each square on the gravelometer indicates grain size in millimeters (the squares range from 2 mm to 180 mm). Based on the photographs and site investigation, the bed material and resistance is associated with a coarse and armored bed. The photographs show the median (d_{50}) bed material size to be uniformly in the cobble range in Reach 1, 2, and 3. Figure 6-4 in the County HMP indicates that a d_{50} exceeding 16 mm to 128 mm as indicated by the photographs is within the transitional/intermediate bed categories. Therefore, Reach 1 through 3 were analyzed using the transitional/intermediate bed procedure. This requires the most rigorous steps and will generate the appropriate results for the size range.

Transitional/intermediate beds cover a wide susceptibility/potential response range and need to be assessed in greater detail to develop a weight of evidence for the appropriate screening rating. The three primary risk factors used to assess vertical susceptibility for channels with transitional/intermediate bed materials are:

1. Armoring potential – three states (Checklist 1)

2. Grade control – three states (Checklist 2)

3. Proximity to regionally-calibrated incision/braiding threshold (Screening Index Threshold – Probability Diagram)

These three risk factors are assessed using checklists and a diagram (see Appendix B), and the results of each are combined to provide a final vertical susceptibility rating for the intermediate/transitional bed-material group. Each checklist and diagram contains a Category A, B, or C rating. Category A is the most resistant to vertical changes while Category C is the most susceptible.

Checklist 1 determines armoring potential of the channel bed. The natural channel bed along Reaches 1, 2, and 3 are assigned to Category A, which represents a mix course of gravels and cobbles. The soil was probed and penetration was relatively difficult through the underlying cobble layer. The channel bed was mostly covered with a uniform layer of cobbles (see the figures). The cobbles supported mature vegetation in many areas, whose root structure provides channel bed armoring similar to cobbles.

Checklist 2 determines grade control characteristics of the channel bed. This is reliant on the spacing of the grade controls. The categories for Checklist 2 are related to a grade control spacing of $2/S_v$ and $4/S_v$, where S_v is the valley slope from Appendix A. The $2/S_v$ and $4/S_v$ results are in meters, so a factor is applied to convert to feet. A reach is in Category A if it has a maximum grade control spacing of less than $2/S_v$. A reach is in Category B if it has a maximum spacing between $2/S_v$ and $4/S_v$. Finally, a reach is in Category C if it has a maximum spacing greater than $4/S_v$. Table 2 summarizes the S_v, $2/S_v$ and $4/S_v$ values for Reaches 1 through 3 along with the maximum grade control spacing within each reach. The maximum spacing of each reach is greater than the $4/S_v$ values, so each reach is in Category C.

Reach	S_v, feet/feet	$2/S_v$, feet	$4/S_v$, feet	Max. Grade Control Spacing, feet	Category
1	0.0163	403	805	> 805	C
2	0.0138	476	952	> 952	C
3	0.0109	600	1,201	> 1,201	C

Table 2. Checklist 2 Values based on Grade Control Spacing

The Screening Index Threshold in Appendix B is a probability diagram that depicts the risk of incising or braiding based on the potential stream power of the valley relative to the median particle diameter. The threshold was developed from regional data from Dr. Howard Chang of Chang Consultants and others. The probability diagram is based on d_{50} as well as the Screening Index determined in the initial desktop analysis (see Appendix A). The Screening Index values for Reaches 1, 2, and 3 from Appendix A are 0.0418, 0.0608, and 0.0553, respectively. These values correspond to a d_{50} just under 32 mm (32 mm has a value of 0.070). Since the d_{50} in each reach exceeds 32 mm as evidenced by the figures, each reach has less than a 50 percent probability of incision and is in Category A.

The overall vertical rating is determined from the Checklist 1, Checklist 2, and Screening Index Threshold results. The scoring is based on the following values:

Category A = 3, Category B = 6, Category C = 9

The vertical rating score for Reach 1, 2, and 3 are based on these values and the equation:

$$\text{Vertical Rating} = [(\text{armoring} \times \text{grade control})^{1/2} \times \text{screening index score}]^{1/2}$$

Table 3 summarizes the Checklist 1, 2, and 3 values for each reach as well as their vertical rating. The results show the vertical rating for Reaches 1 through 3 is less than 4.5, so these reaches have a low threshold for vertical susceptibility.

Reach	Checklist 1 (armoring)	Checklist 2 (grade control)	Checklist 3 (screening index)	Vertical Rating
1	3	9	3	3.9
2	3	9	3	3.9
3	3	9	3	3.9

Table 3. Overall Vertical Rating

Lateral Stability

The purpose of the lateral decision tree (Figure 6-5 from County of San Diego HMP included in Figure 29) is to assess the state of the channel banks with a focus on the risk of widening. Channels can widen from either bank failure or through fluvial processes such as chute cutoffs, avulsions, and braiding. Widening through fluvial avulsions/active braiding is a relatively straightforward observation. If braiding is not already occurring, the next logical step is to assess the condition of the banks. Banks fail through a variety of mechanisms; however, one of the most important distinctions is whether they fail in mass (as many particles) or by fluvial detachment of individual particles. Although much research is dedicated to the combined effects of weakening, fluvial erosion, and mass failure, SCCWRP found it valuable to segregate bank types based on the inference of the dominant failure mechanism (as the management approach may vary based on the dominant failure mechanism). A decision tree (Form 4 in Appendix B) is used in conducting the lateral susceptibility assessment. Definitions and photographic examples are also provided for terms used in the lateral susceptibility assessment.

The first step in the decision tree is to determine if lateral adjustments are occurring. The adjustments can take the form of extensive mass wasting (greater than 50 percent of the banks are exhibiting planar, slab, or rotational failures and/or scalloping, undermining, and/or tension cracks). The adjustments can also involve extensive fluvial erosion (significant and frequent bank cuts on over 50 percent of the banks). Neither mass wasting nor extensive fluvial erosion was evident within Reach 1 or 3 during a field investigation (see the figures). On the other hand, bank erosion was evident in a portion of Reach 2 just downstream of the proposed culvert. However, this channel segment is being improved by the project, so future erosion will not occur.

The next step in the Form 4 decision tree is to assess the consolidation of the bank material. The banks in Reach 1, 2, and 3 were moderate to well-consolidated. This determination was made because the ground surface was difficult to penetrate with a probe. In addition, the banks showed no evidence of crumbling and were composed of relatively well-packed particles and/or cobbles.

Form 6 (see Appendix B) is used to assess the probability of mass wasting. Form 6 identifies a 10, 50, and 90 percent probability based on the bank angle and bank height. From the site investigation and SANGIS' 2-foot contour interval topographic mapping, the average bank angle in the entire study reach is 1.5:1 (33.7 degrees) or flatter. Form 6 shows that the probably of mass wasting and bank failure has less than 10 percent risk for a 33.7 degree bank angle or less regardless of the bank height.

The final two steps in the Form 4 decision tree are based on the braiding risk determined from the vertical rating as well as the Valley Width Index (VWI) calculated in Appendix A. If the vertical rating is high, the braiding risk is considered to be greater than 50 percent. Excessive braiding can lead to lateral bank failure. For Reach 1, 2, and 3 the vertical rating is low, so the braiding risk is less than 50 percent. Furthermore, a VWI greater than 2 represents channels unconfined by bedrock or hillslope and, hence, subject to lateral migration. The VWI calculation in the spreadsheet in Appendix A shows that the VWI for Reach 1 (0.76), 2 (0.59), and 3 (0.32) are less than 2.

From the above steps, the lateral susceptibility rating is low for Reach 1, 2, and 3 (colored circles are included on the Form 4: Lateral Susceptibility Field Sheet decision tree in Appendix B showing the decision path).

CONCLUSION

The SCCWRP channel screening tools were used to assess the downstream channel susceptibility analyses for 3Roots San Diego Project being designed by Project Design Consultants. The project's storm runoff will be conveyed to Carroll Canyon Creek or a northerly tributary to the creek in hardened, non-erodible drainage facilities. This report assesses five proposed POCs (POC 6, 7, 8, 9, and 10 from PDC's SWMQP) that discharge into Carroll Canyon Creek and one proposed POC (POC 1) that discharges into the northerly tributary. POC 6 and 7 discharge into a proposed channelized segment of Carroll Canyon Creek that will contain a series of drop structures. The channelized segment will be engineered to avoid erosion, so the drainage areas tributary to POC 6 and 7 can be designed for a low susceptibility to erosion. A downstream channel assessment for POC 1, 8, 9, and 10 was performed based on office analyses and field work. The results indicate a low threshold for vertical and lateral susceptibility for the three reaches associated with these POCs.

The HMP requires that these results be compared with the critical flow calculator results outlined in the County of San Diego HMP. The critical flow calculator results are included in Appendix B for Reach 1, 2, and 3 using the spreadsheet provided by the County. The channel dimensions were estimated from the topographic mapping. Based on these values, the critical flow results returned a low threshold for all three reaches. Therefore, the SCCWRP analyses and critical flow calculator demonstrate that the project can be designed assuming a low susceptibility to erosion, i.e., $0.5Q_2$.



Figure 1. Paved Arizona Crossing at Upper End of Reach 1



Figure 2. Looking Downstream at Reach 1 from Upper End (cobble-lined bed)



Figure 3. Looking at Upstream End of Reach 1 from Camino Santa Fe



Figure 4. Looking Downstream at Reach 1 from Camino Santa Fe



Figure 5. Cobbles on Reach 1 Channel Bed at Camino Santa Fe



Figure 6. Looking towards POC 1 within Reach 1 (cobble-lined bed)

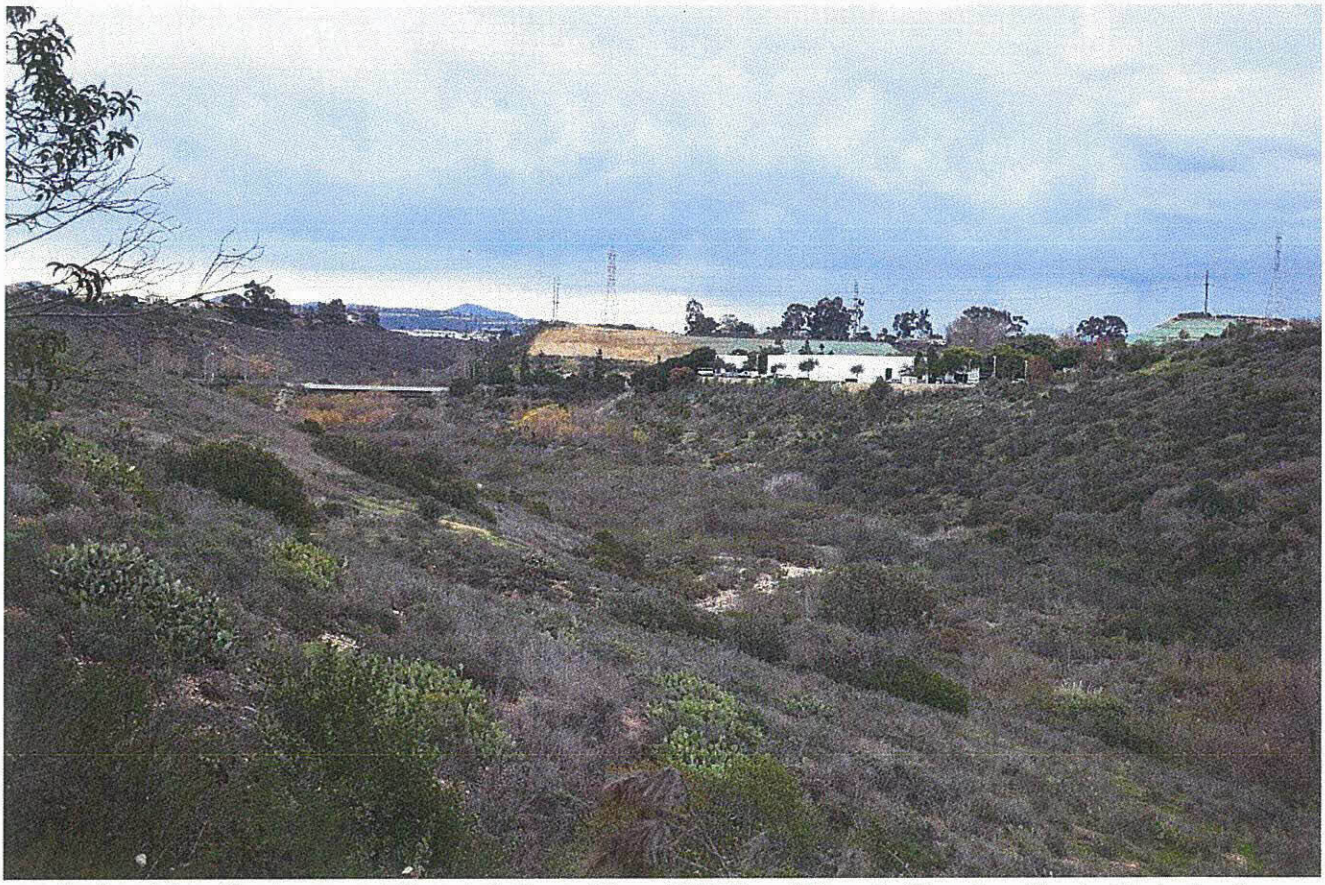


Figure 7. Looking Upstream at Reach 1 from Near Middle of Reach (Camino Santa Fe in background)

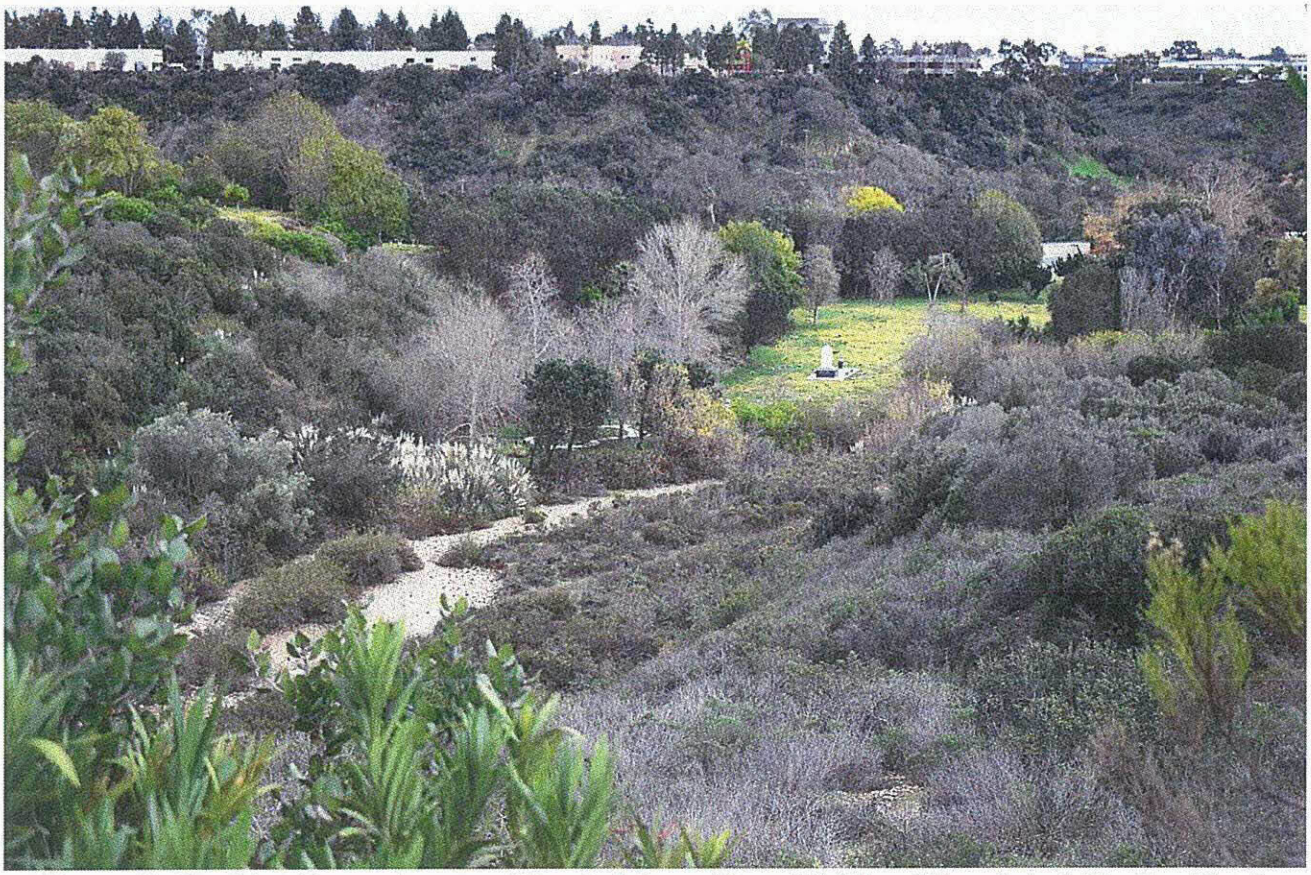


Figure 8. Looking Downstream at Reach 1 from Near Middle of Reach (cobble-lined bed)



Figure 9. Looking Upstream at Reach 1 from Lower End (cobble-lined bed)



Figure 10. Culvert at Lower End of Reach 1 (cobbles on upstream bed)



Figure 11. Looking Downstream from Upper End of Reach 2 (cobble-lined bed)



Figure 12. Cobbles on Reach 2 Channel Bed



Figure 13. Looking Upstream at Reach 2 from Near Middle of Reach (cobble-lined bed)



Figure 14. Looking Downstream at Reach 2 from Near Middle of Reach (cobble-lined bed)



Figure 15. Camino Santa Fe Culvert at Lower End of Reach 2

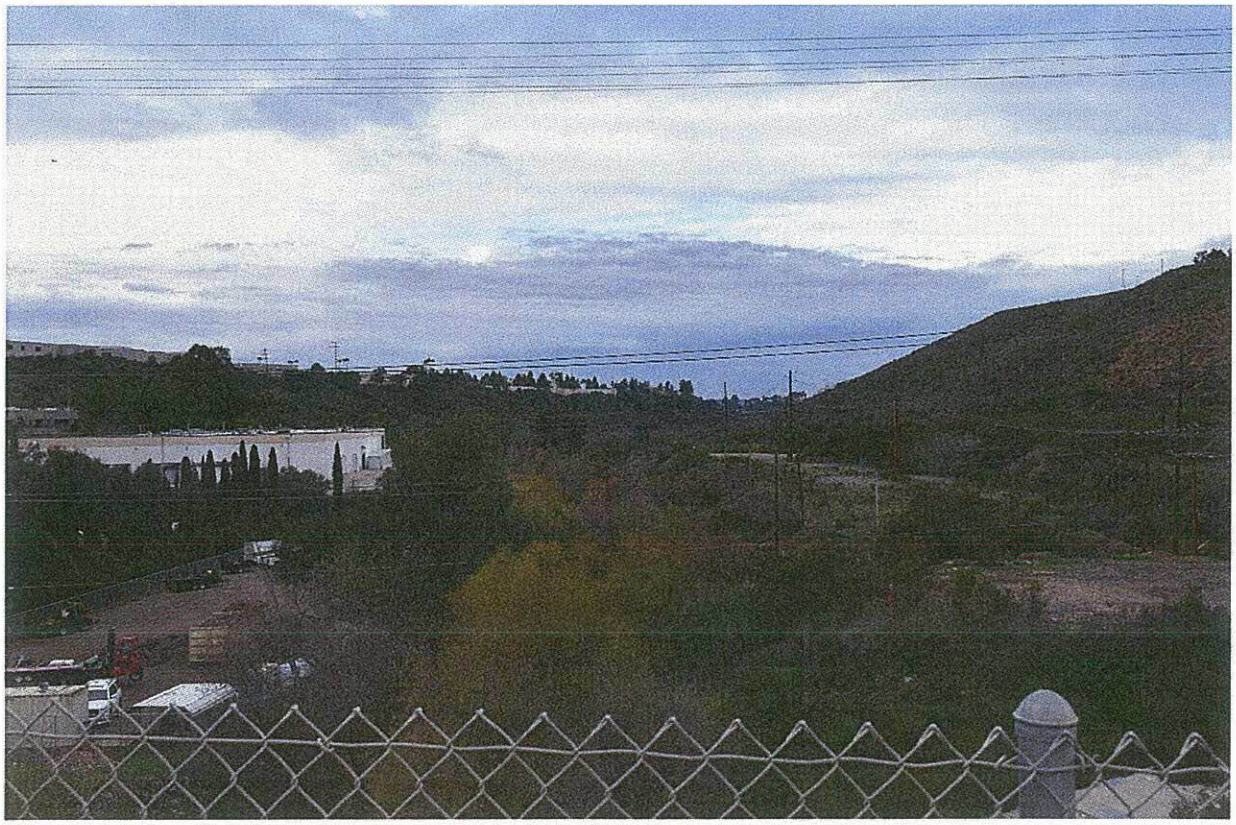


Figure 16. Looking Downstream at Reach 3 from Camino Santa Fe at Upper End

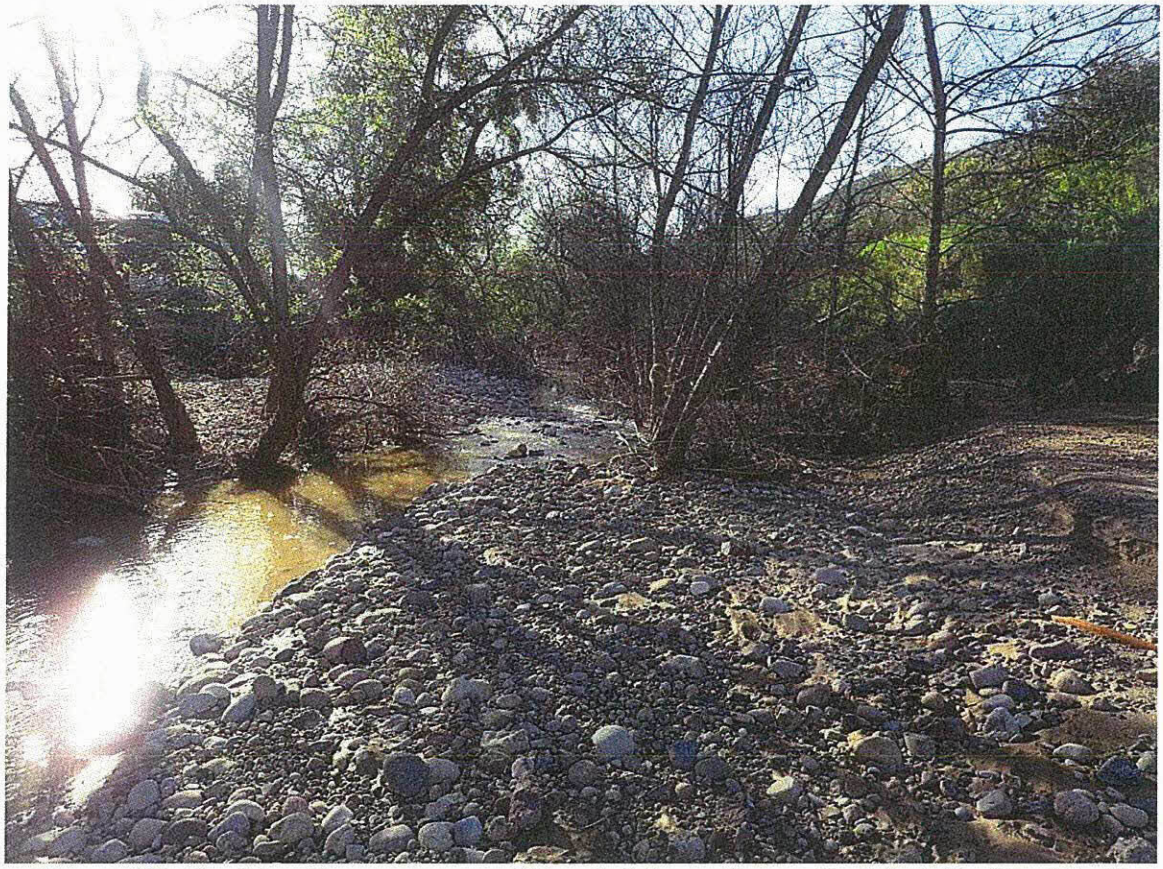


Figure 17. Looking Downstream at Reach 3 from Upper End (cobble-lined bed)



Figure 18. Looking Downstream at Reach 3 from Private Bridge Near Upper Middle of Reach (cobble-lined bed)



Figure 19. Looking Upstream at Reach 3 from Middle of Reach



Figure 20. Looking Downstream at Reach 3 from Middle of Reach 3



Figure 21. Paved Arizona Creek Near Lower End of Reach 3



Figure 22. Cobble-Lined Channel Bed Downstream of Arizona Crossing



Figure 23. Looking Upstream at Reach 3 from Lower End (cobble-lined bed)



Figure 24. Culverts at Lower End of Reach 3 (cobbles on upstream bed)

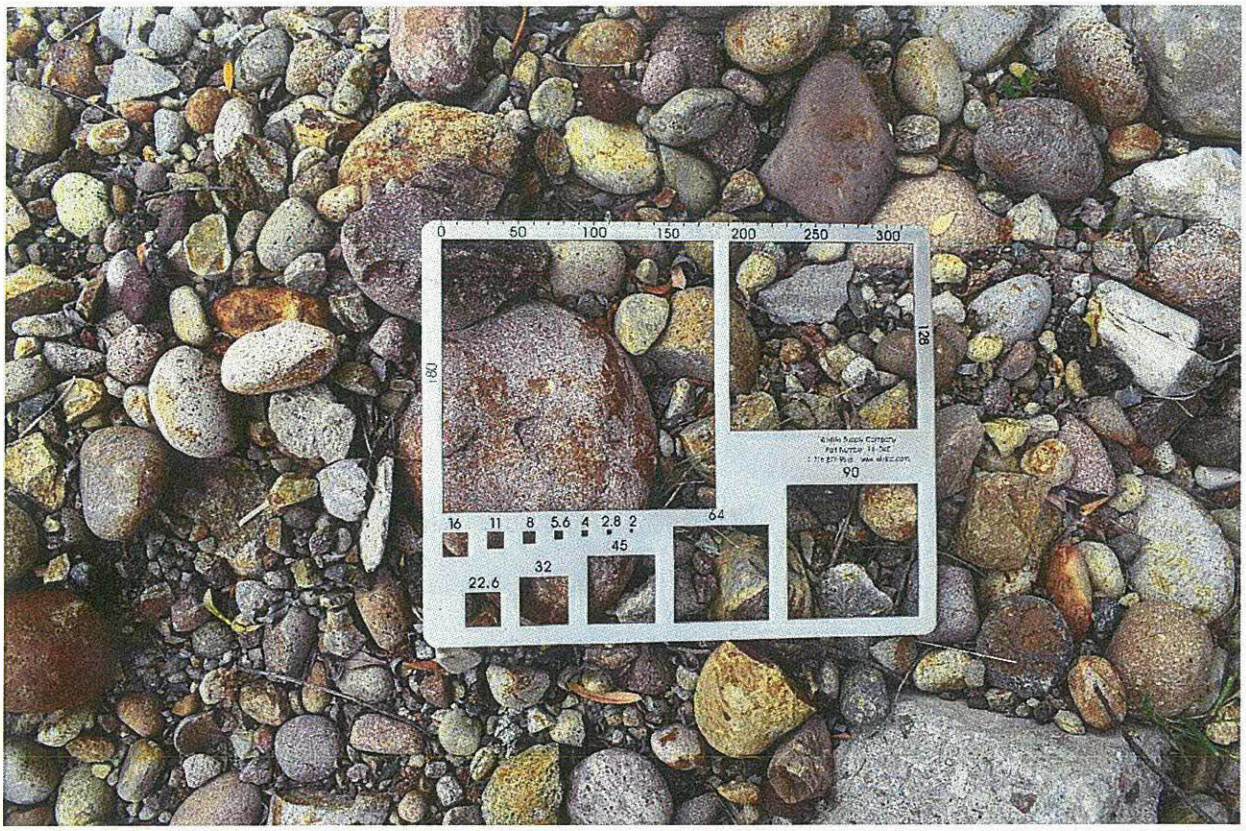


Figure 25. Gravelometer on Reach 1 Channel Bed

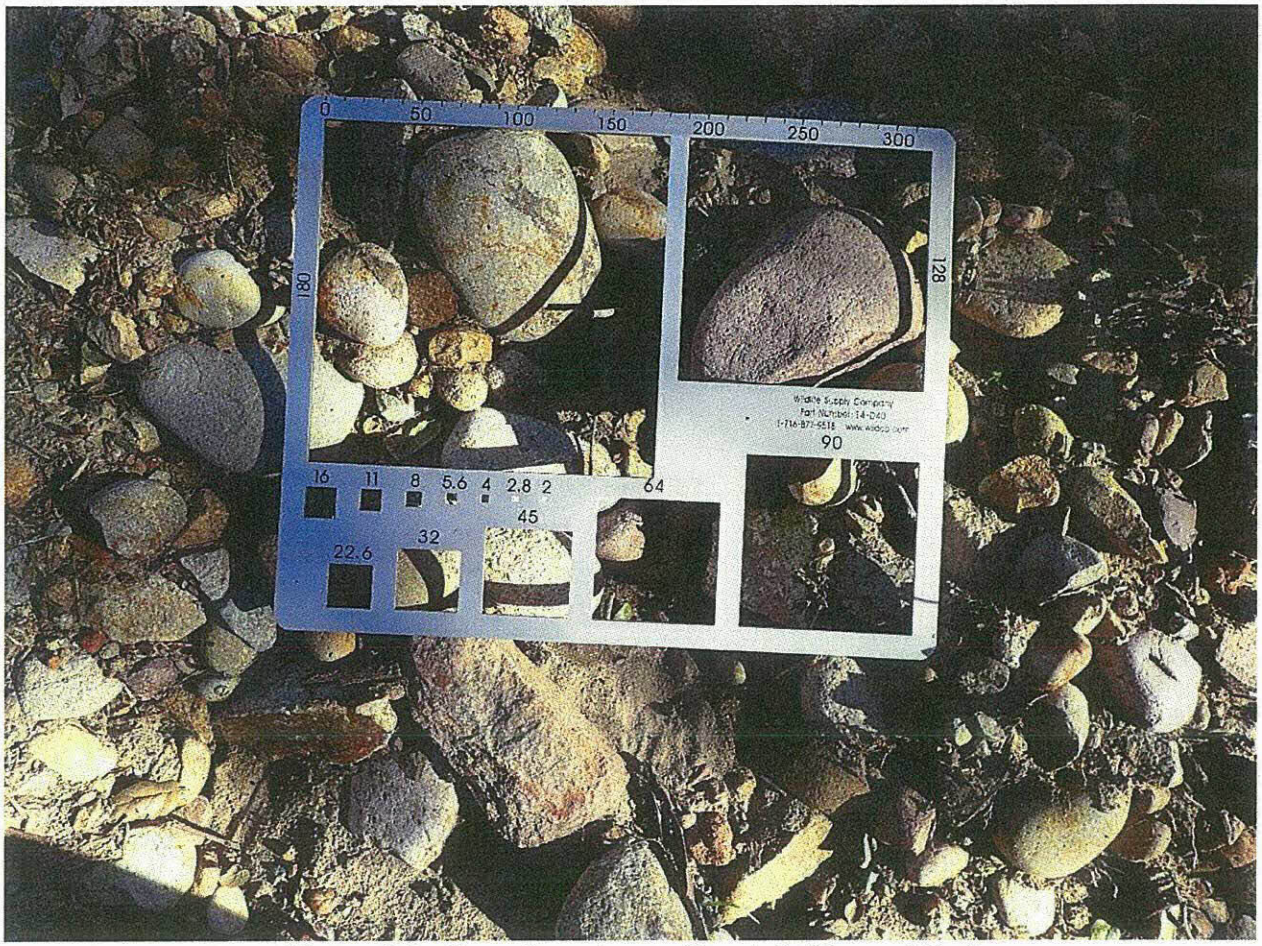


Figure 26. Gravelometer on Reach 2 Channel Bed



Figure 27. Gravelometer on Reach 3 Channel Bed

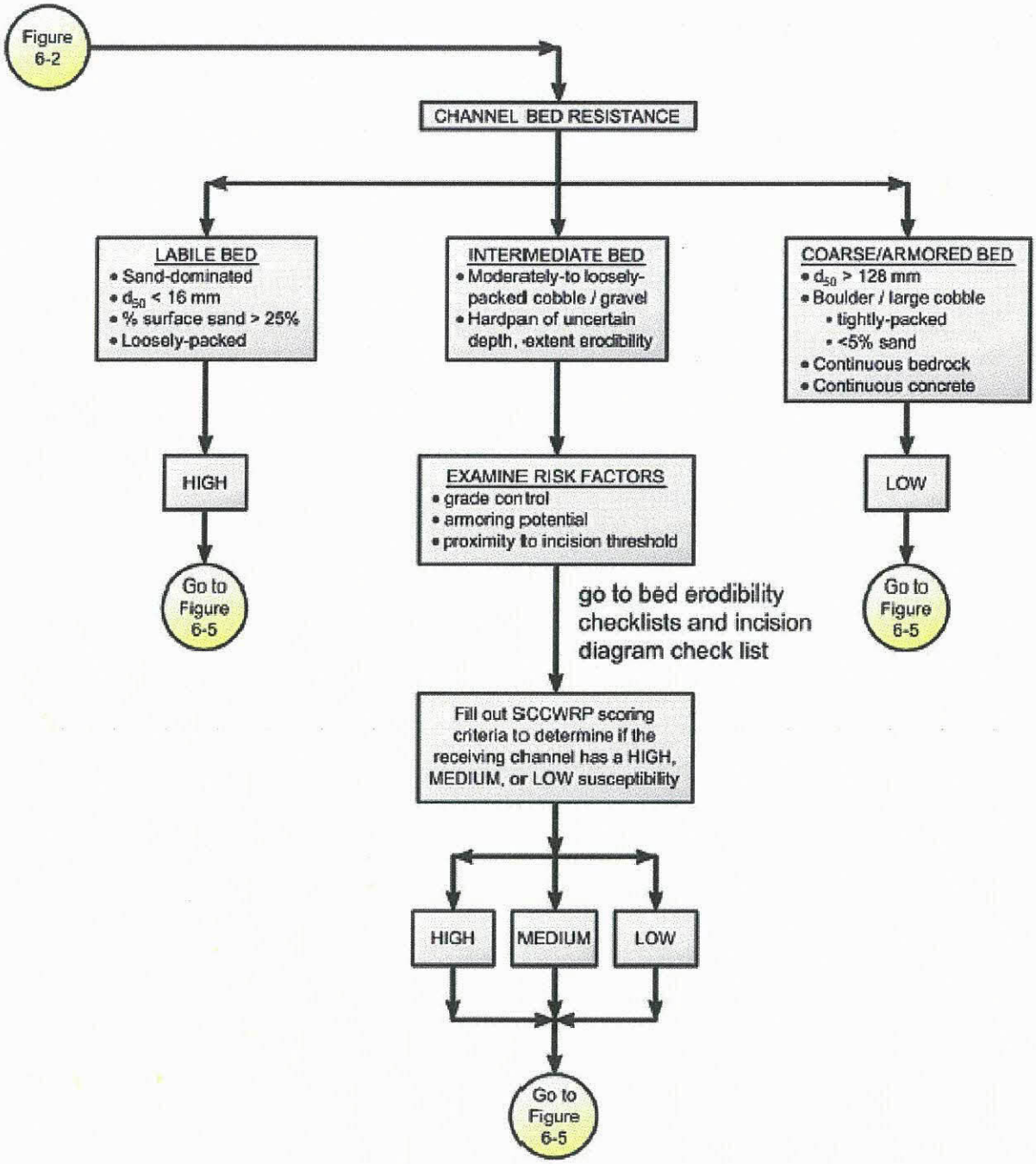


Figure 6-4. SCCWRP Vertical Susceptibility

Figure 28. SCCWRP Vertical Channel Susceptibility Matrix

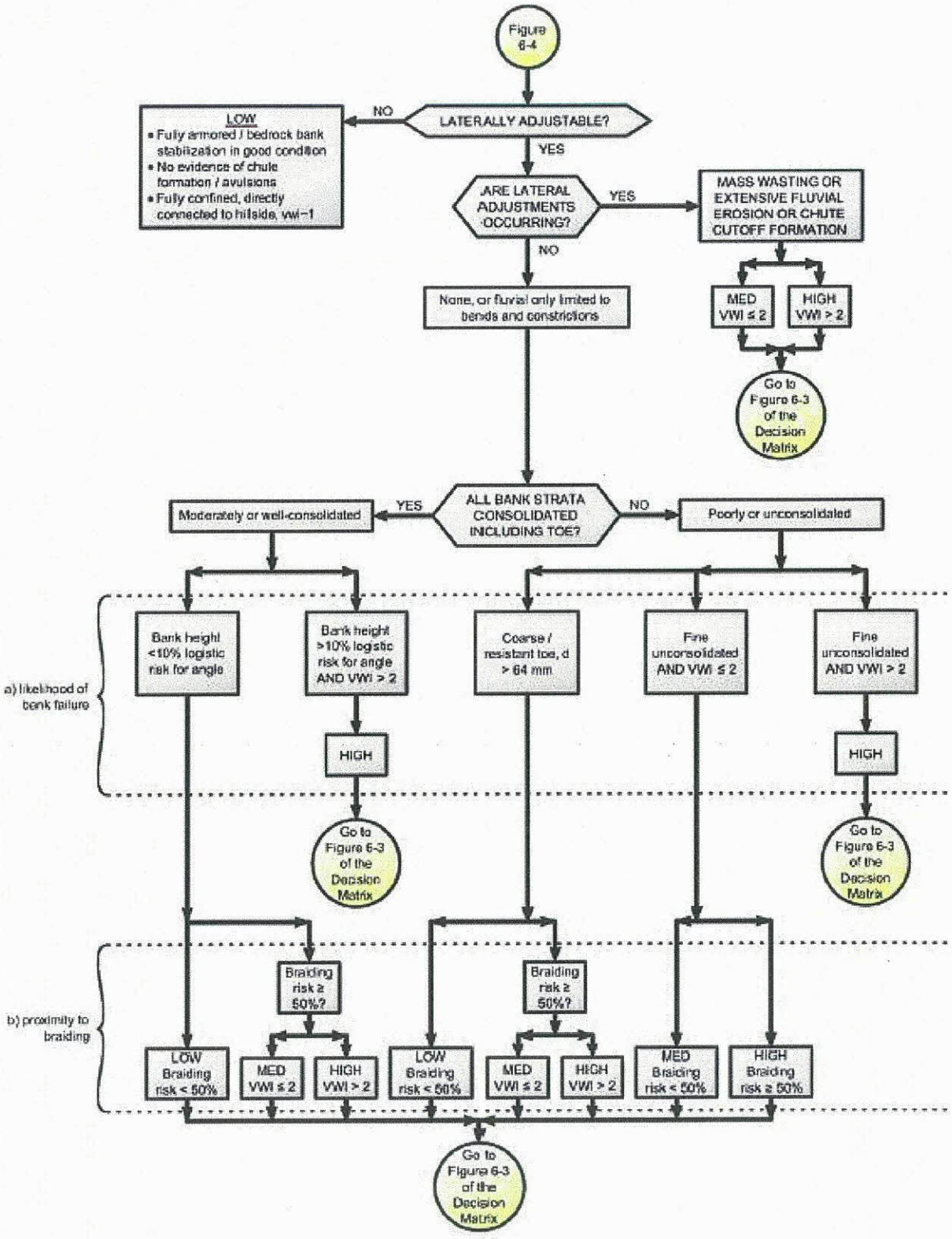


Figure 6-5. Lateral Channel Susceptibility

Figure 29. SCCWRP Lateral Channel Susceptibility Matrix

APPENDIX A

SCCWRP REFERENCE DOCUMENTS AND INITIAL DESKTOP ANALYSIS

FORM 1: INITIAL DESKTOP ANALYSIS

Complete all shaded sections.

IF required at multiple locations, circle one of the following site types:

Applicant Site / Upstream Extent / Downstream Extent

Location: Latitude: 32.8959 Longitude: -117.1661

Description (river name, crossing streets, etc.): 3Roots San Diego Project

GIS Parameters: The International System of Units (SI) is used throughout the assessment as the field standard and for consistency with the broader scientific community. However, as the singular exception, US Customary units are used for contributing drainage area (A) and mean annual precipitation (P) to apply regional flow equations after the USGS. See SCCWRP Technical Report 607 for example measurements and "Screening Tool Data Entry.xls" for automated calculations.

Form 1 Table 1. Initial desktop analysis in GIS.

	Symbol	Variable	Description and Source	Value
Watershed properties (English units)	A	Area (mi^2)	Contributing drainage area to screening location via published Hydrologic Unit Codes (HUCs) and/or ≤ 30 m National Elevation Data (NED), USGS seamless server	
	P	Mean annual precipitation (in)	Area-weighted annual precipitation via USGS delineated polygons using records from 1900 to 1960 (which was more significant in hydrologic models than polygons delineated from shorter record lengths)	See attached Form 1 table on next page for calculated values for each reach.
Site properties (SI units)	S_v	Valley slope (m/m)	Valley slope at site via NED, measured over a relatively homogenous valley segment as dictated by hillslope configuration, tributary confluences, etc., over a distance of up to ~500 m or 10% of the main-channel length from site to drainage divide	
	W_v	Valley width (m)	Valley bottom width at site between natural valley walls as dictated by clear breaks in hillslope on NED raster, irrespective of potential armoring from floodplain encroachment, levees, etc. (imprecise measurements have negligible effect on rating in wide valleys where VWI is >> 2, as defined in lateral decision tree)	

Form 1 Tabl e 2. Simplif ied peak flo w, screening index, and valley width index. Values for this table should be calculated in the sequence shown in this table, using values from Form 1 Table 1.

Symbol	Dependent Variable	Equation	Required Units	Value
Q_{10cfs}	10-yr peak flow (ft^3/s)	$Q_{10cfs} = 18.2 * A^{0.87} * P^{0.77}$	A (mi^2) P (in)	See attached Form 1 table on next page for calculated values for each reach.
Q_{10}	10-yr peak flow (m^3/s)	$Q_{10} = 0.0283 * Q_{10cfs}$	Q_{10cfs} (ft^3/s)	
INDEX	10-yr screening index ($m^{1.5}/s^{0.5}$)	$INDEX = S_v * Q_{10}^{0.5}$	Sv (m/m) Q_{10} (m^3/s)	
W_{ref}	Reference width (m)	$W_{ref} = 6.99 * Q_{10}^{0.438}$	Q_{10} (m^3/s)	
VWI	Valley width index (m/m)	$VWI = W_v/W_{ref}$	W_v (m) W_{ref} (m)	

(Sheet 1 of 1)

SCCWRP FORM 1 ANALYSES

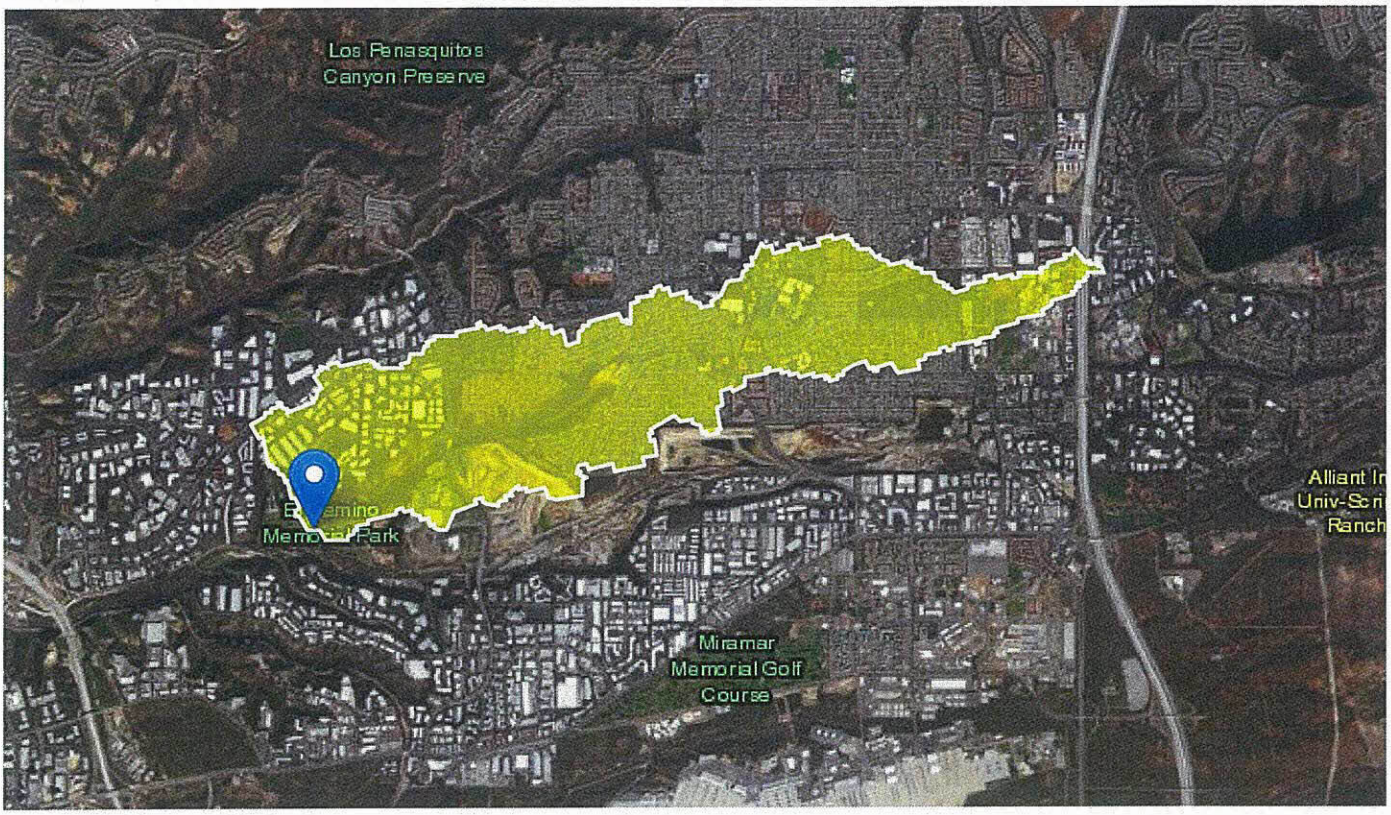
Reach	Area A, sq. mi.	Mean Annual Precip. P, inches	Valley Slope Sv, m/m	Valley Width Wv, m	10-Year Flow Q10cfs, cfs	10-Year Flow Q10, cms
1	2.5057	9.66	0.0163	12.19	232	6.6
2	8.7464	9.66	0.0138	15.24	688	19.5
3	11.9765	9.66	0.0109	9.14	905	25.6

Reach	10-Year Screening Index INDEX	Reference Width Wref, m	Valley Width Index VWI, m/m
1	0.0418	15.9	0.76
2	0.0608	25.7	0.59
3	0.0553	28.9	0.32

Watershed Tributary to Northerly Tributary and Reach 1

StreamStats Report

Region ID: CA
Workspace ID: CA20190115064314751000
Clicked Point (Latitude, Longitude): 32.89397, -117.18236
Time: 2019-01-14 22:43:28 -0800



Basin Characteristics

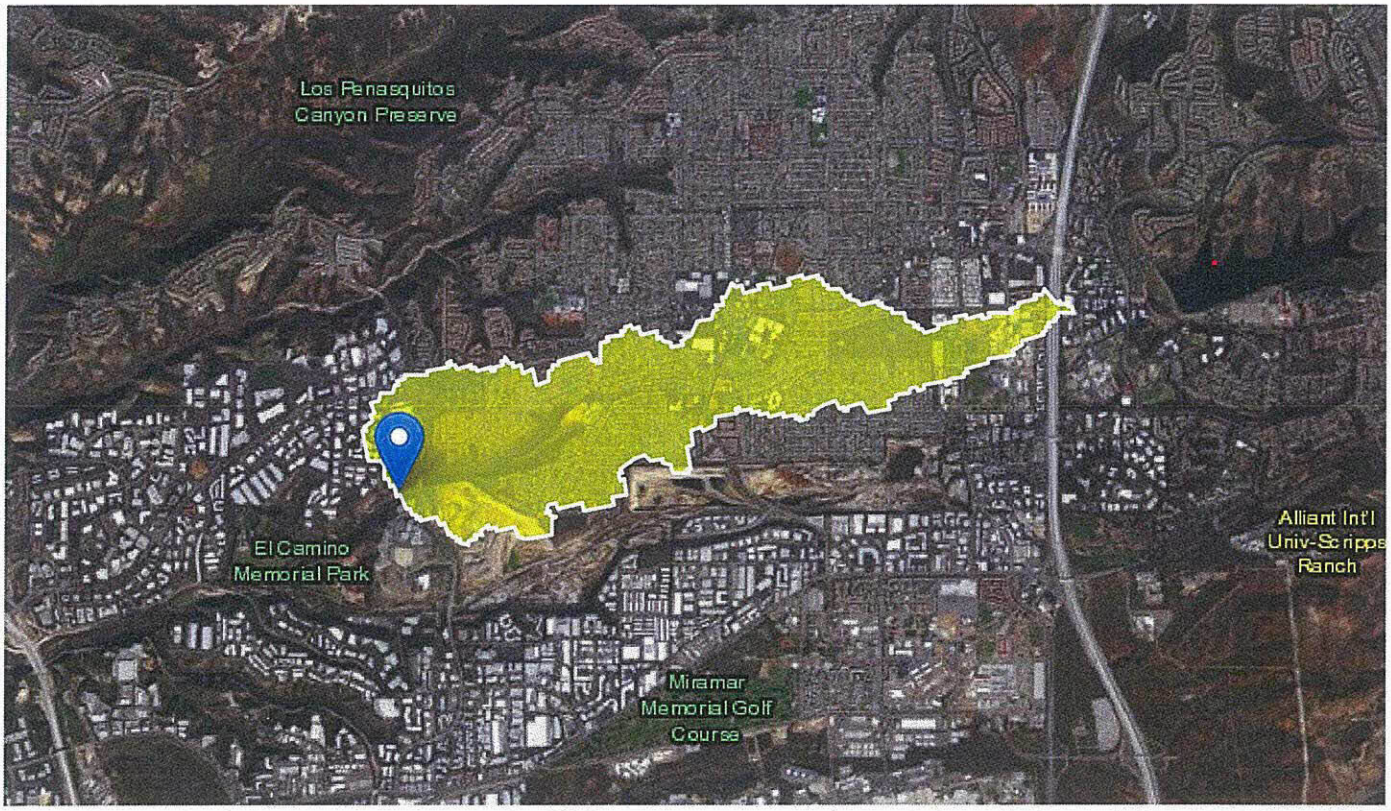
Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	2.5057	square miles

USGS Data Disclaimer: Unless otherwise stated, all data, metadata and related materials are considered to satisfy the quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty.

Watershed Tributary to POC 1

StreamStats Report

Region ID: CA
Workspace ID: CA20190115063839618000
Clicked Point (Latitude, Longitude): 32.89959, -117.17256
Time: 2019-01-14 22:38:53 -0800



Basin Characteristics

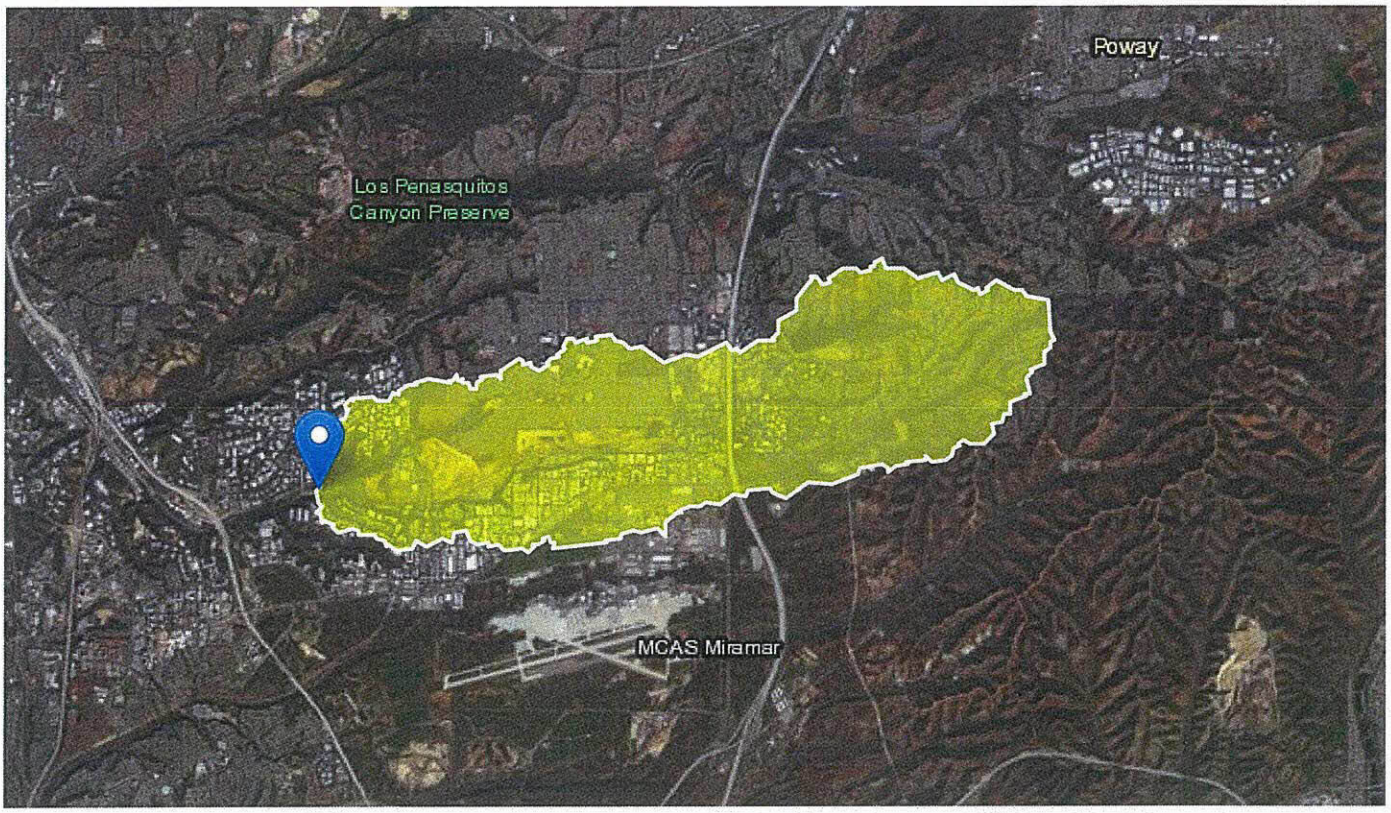
Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	1.9504	square miles

USGS Data Disclaimer: Unless otherwise stated, all data, metadata and related materials are considered to satisfy the quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty.

Watershed Tributary to Carroll Canyon Creek and Reach 3

StreamStats Report

Region ID: CA
Workspace ID: CA20190115065027126000
Clicked Point (Latitude, Longitude): 32.89271, -117.18687
Time: 2019-01-14 22:50:41 -0800



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	11.9765	square miles

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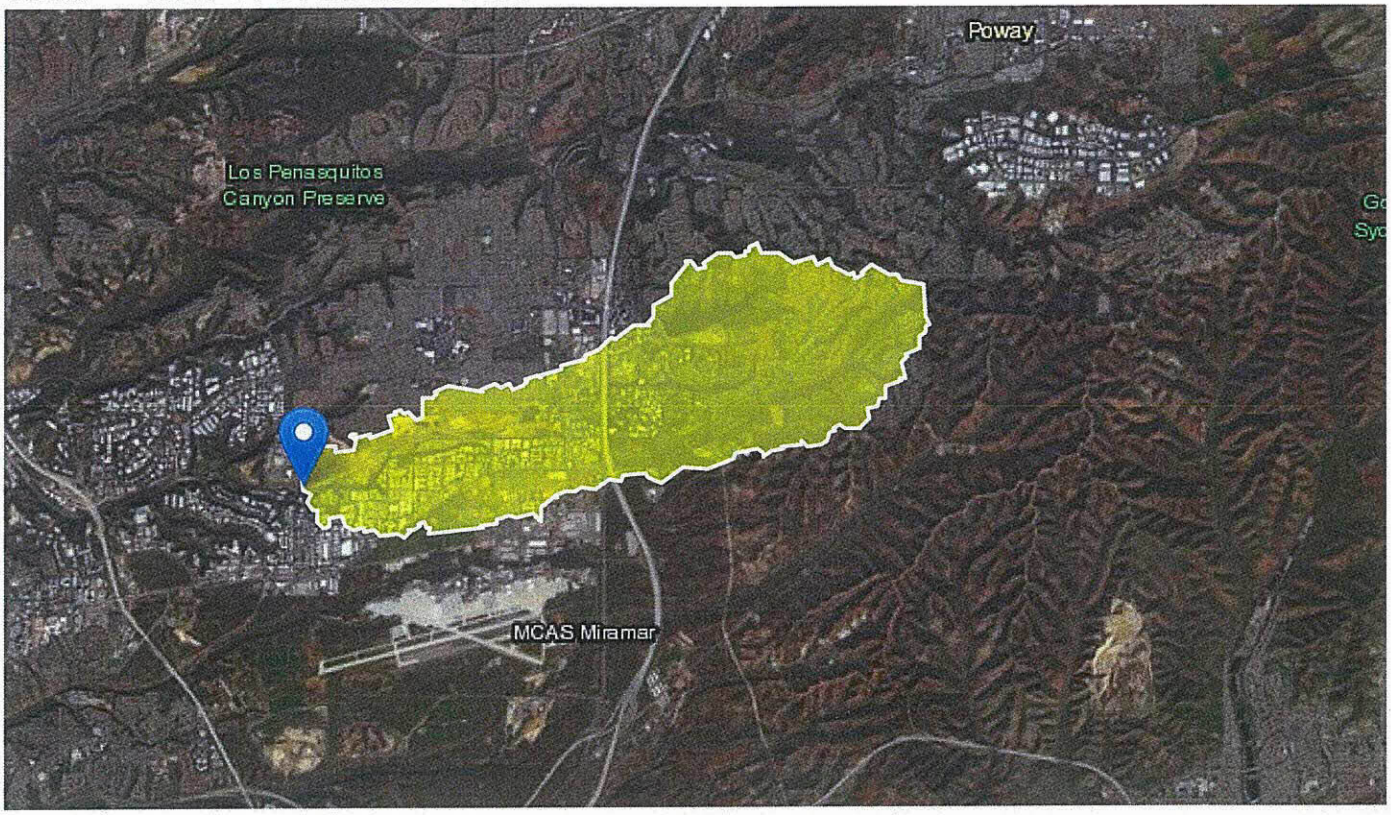
Watershed Tributary to POC 9 and Reach 2

StreamStats Report

Region ID: CA
Workspace ID: CA20190115065245234000
Clicked Point (Latitude, Longitude): 32.89101, -117.16782
Time: 2019-01-14 22:52:59 -0800



Basin Characteristics

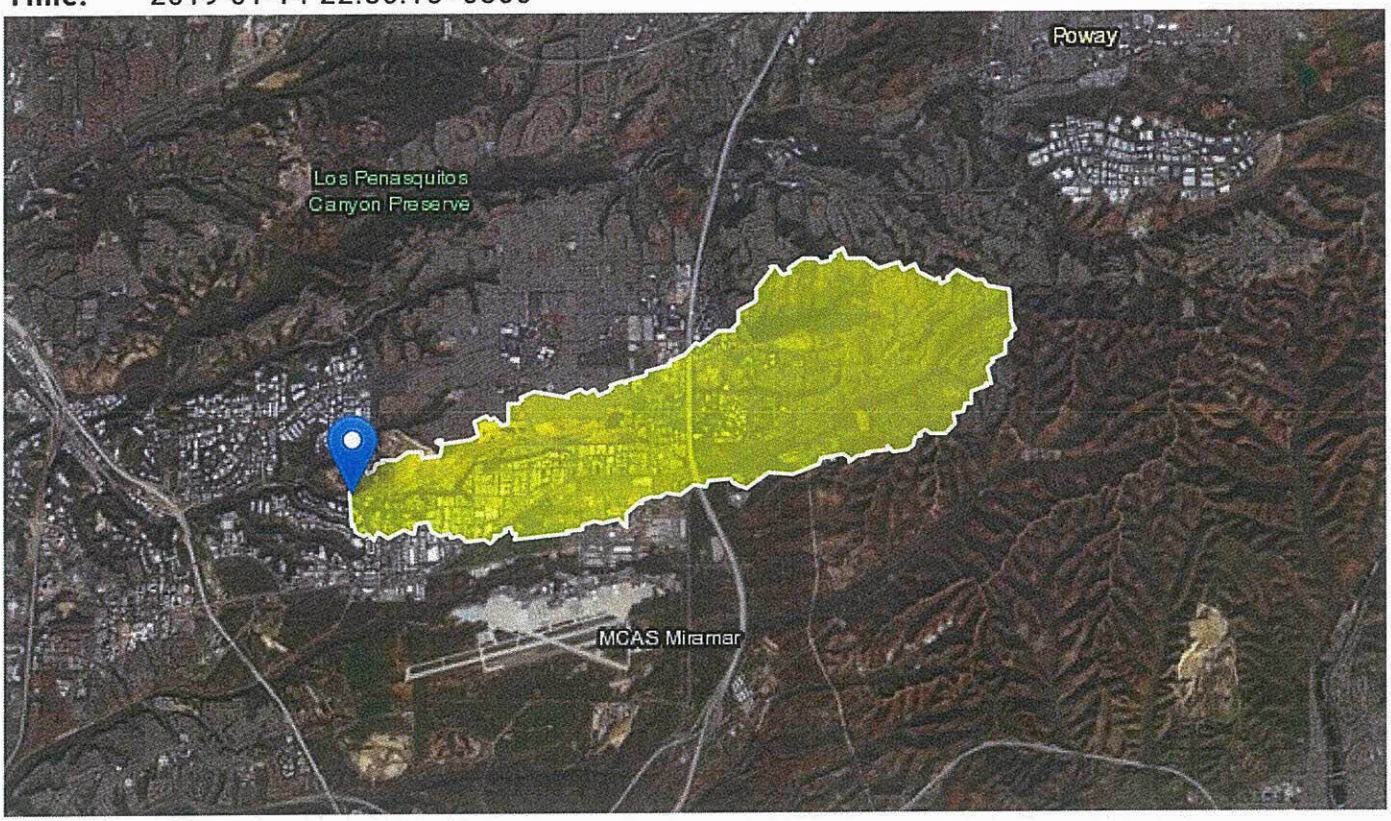
Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	8.7464	square miles

USGS Data Disclaimer: Unless otherwise stated, all data, metadata and related materials are considered to satisfy the quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty.

Watershed Tributary to Reach 10

StreamStats Report

Region ID: CA
Workspace ID: CA20190115065600891000
Clicked Point (Latitude, Longitude): 32.89087, -117.17455
Time: 2019-01-14 22:56:15 -0800

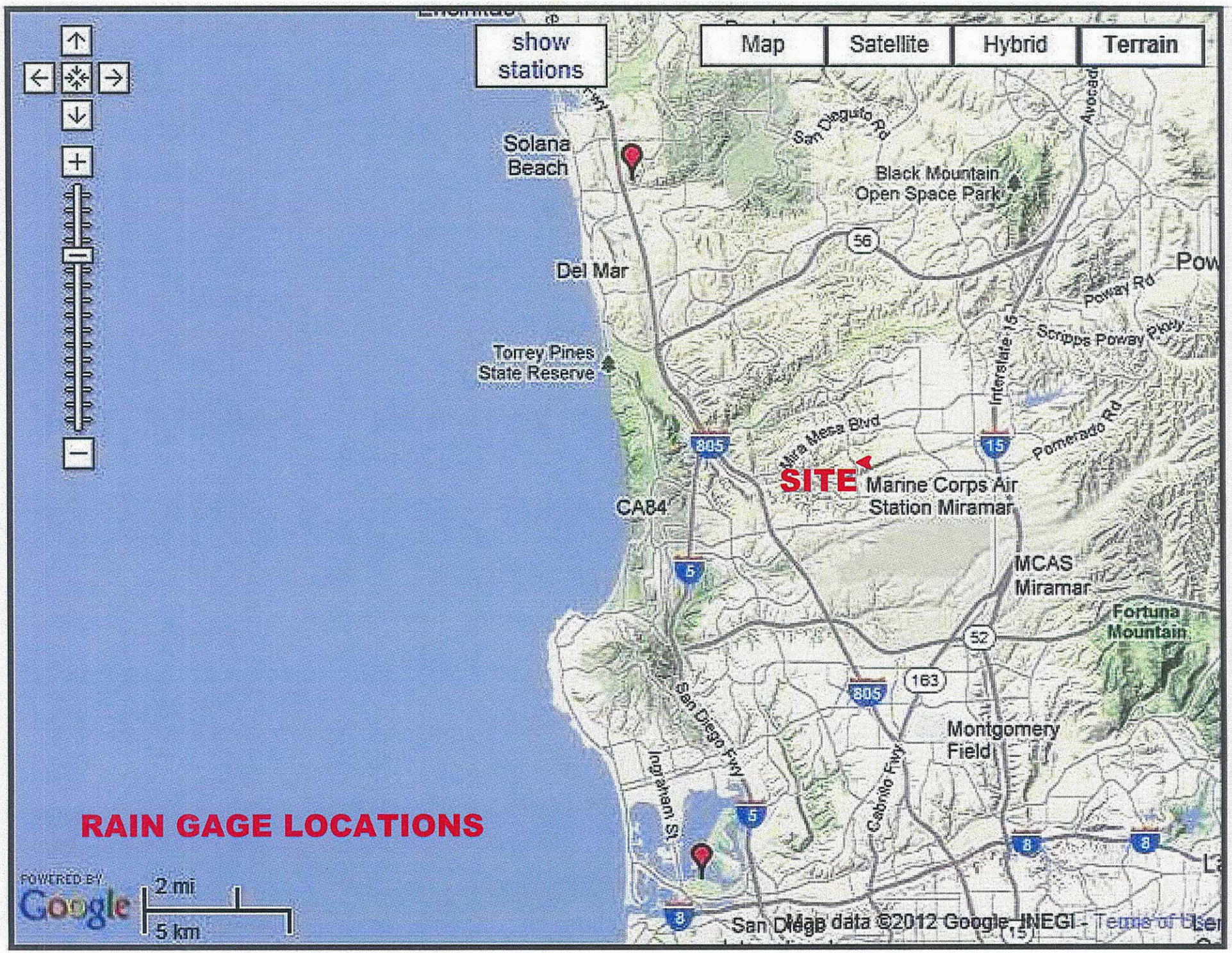


Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	9.0435	square miles

USGS Data Disclaimer: Unless otherwise stated, all data, metadata and related materials are considered to satisfy the quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty.

Western US COOP Station Map



LOCKWOOD MESA, CALIFORNIA (045023)

Period of Record Monthly Climate Summary

Period of Record : 9/ 1/1940 to 7/31/1965

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)					Insuff	icient	Data						
Average Min. Temperature (F)					Insuff	icient	Data						
Average Total Precipitation (in.)	1.84	1.43	1.65	1.06	0.29	0.05	0.01	0.08	0.19	0.45	0.95	1.65	9.66
Average Total SnowFall (in.)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average Snow Depth (in.)	0	0	0	0	0	0	0	0	0	0	0	0	0

Percent of possible observations for period of record.
Max. Temp.: 0% Min. Temp.: 0% Precipitation: 97.5% Snowfall: 97.5% Snow Depth: 97.5%
Check Station Metadata or Metadata graphics for more detail about data completeness.

Western Regional Climate Center, wrcc@dri.edu

SAN DIEGO SEAWORLD, CALIFORNIA (047741)

Period of Record Monthly Climate Summary

Period of Record : 05/01/1999 to 05/15/2016

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	63.0	63.6	64.7	65.2	67.4	68.8	72.0	72.7	71.5	69.0	66.1	62.7	67.2
Average Min. Temperature (F)	48.7	50.0	53.1	54.0	57.7	60.8	64.4	65.3	63.6	58.8	52.8	47.9	56.4
Average Total Precipitation (in.)	2.02	3.00	0.57	0.73	0.20	0.01	0.00	0.00	0.07	0.94	0.79	1.24	9.58
Average Total SnowFall (in.)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average Snow Depth (in.)	0	0	0	0	0	0	0	0	0	0	0	0	0

Percent of possible observations for period of record.
Max. Temp.: 92.3% Min. Temp.: 89.8% Precipitation: 99.8% Snowfall: 100% Snow Depth: 99.6%
Check Station Metadata or Metadata graphics for more detail about data completeness.

Western Regional Climate Center, wrcc@dri.edu

APPENDIX B

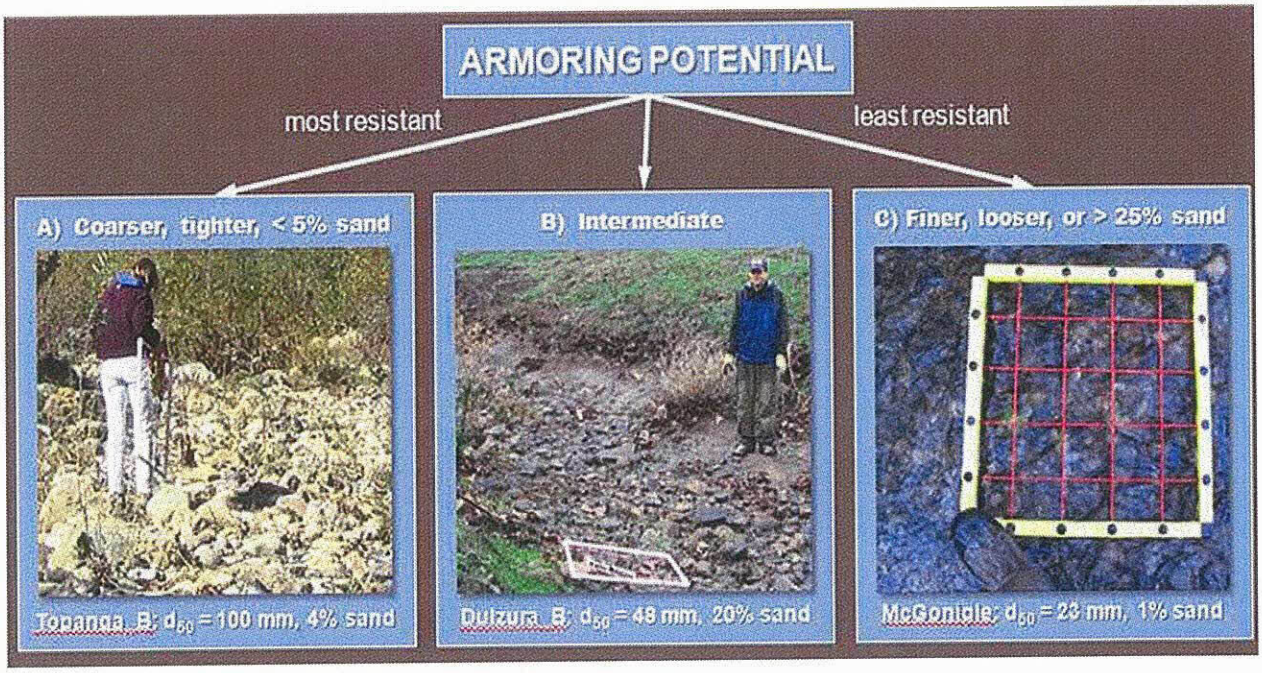
SCCWRP FIELD SCREENING DATA

Form 3 Support Materials

Form 3 Checklists 1 and 2, along with information recording in Form 3 Table 1, are intended to support the decisions pathways illustrated in Form 3 Overall Vertical Rating for Intermediate/Transitional Bed.

Form 3 Checklist 1: Armoring Potential

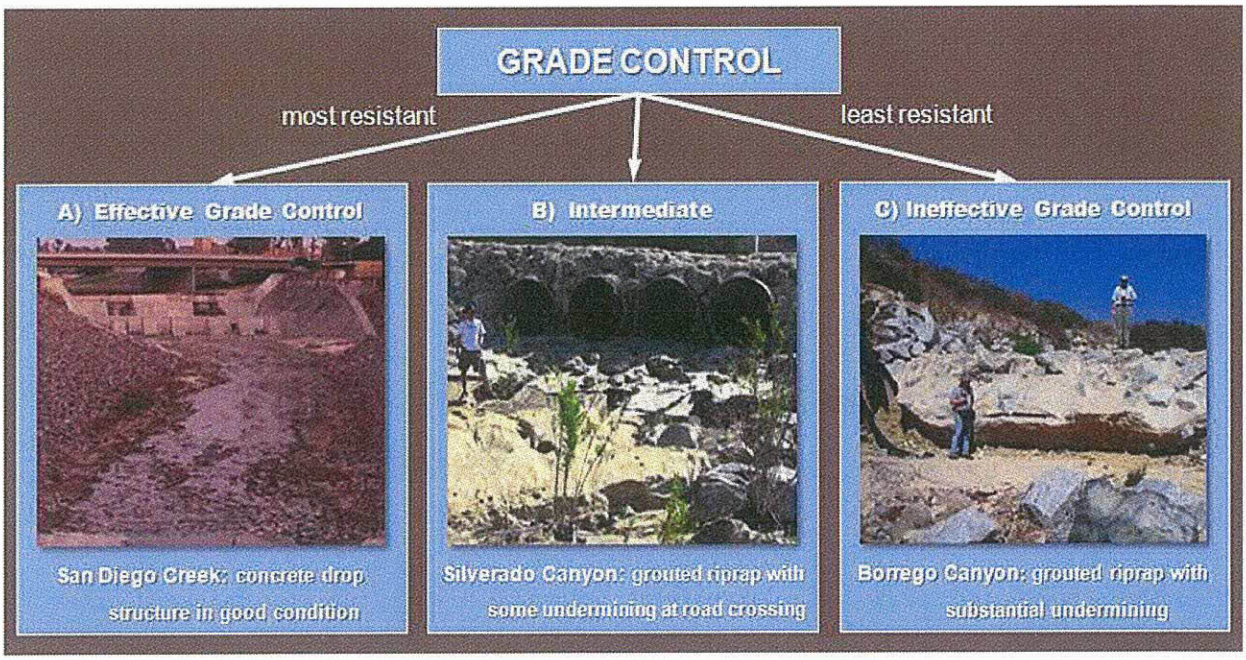
☒	A	A mix of coarse gravels and cobbles that are tightly packed with <5% surface material of diameter <2 mm
☐	B	Intermediate to A and C or hardpan of unknown resistance, spatial extent (longitudinal and depth), or unknown armoring potential due to surface veneer covering gravel or coarser layer encountered with probe
☐	C	Gravels/cobbles that are loosely packed or >25% surface material of diameter <2 mm



Form 3 Figure 2. Armoring potential photographic supplement for assessing intermediate beds ($16 < d_{50} < 128$ mm) to be used in **conjunction with Form 3 Checklist 1.**

Form 3 Checklist 2: Grade Control

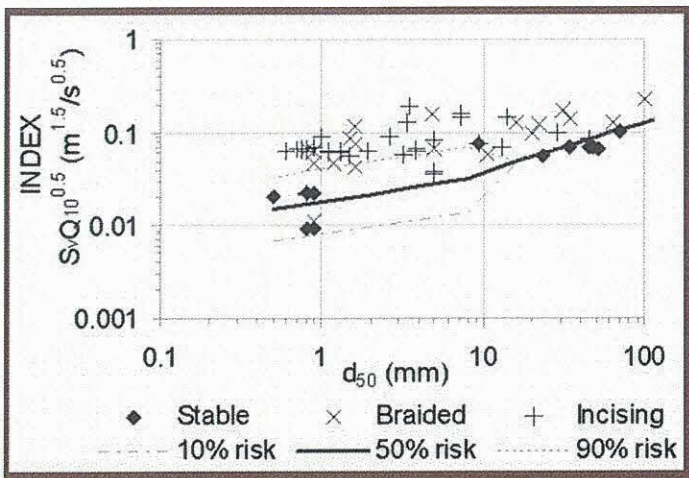
☐	A	Grade control is present with spacing <50 m or $2/S_v$ m • No evidence of failure/ineffectiveness, e.g., no headcutting (>30 cm), no active mass wasting (analyst cannot say grade control sufficient if mass-wasting checklist indicates presence of bank failure), no exposed bridge pilings, no culverts/structures undermined • Hard points in serviceable condition at decadal time scale, e.g., no apparent undermining, flanking, failing grout • If geologic grade control, rock should be resistant igneous and/or metamorphic; For sedimentary/hardpan to be classified as 'grade control', it should be of demonstrable strength as indicated by field testing such as hammer test/borings and/or inspected by appropriate stakeholder
☐	B	Intermediate to A and C – artificial or geologic grade control present but spaced 2/Sv m to 4/Sv m or potential evidence of failure or hardpan of uncertain resistance
☒	C	Grade control absent, spaced >100 m or $>4/S_v$ m, or clear evidence of ineffectiveness



Form 3 Figure 3. Grade-control (condition) photographic supplement for assessing intermediate beds ($16 < d_{50} < 128$ mm) to be used in conjunction with Form 3 Checklist 2.

Regionally-Calibrated Screening Index Threshold for Incising/Braiding

For transitional bed channels (d_{50} between 16 and 128 mm) or labile beds (channel not incised past critical bank height), use Form 3 Figure 3 to determine Screening Index Score and complete Form 3 Table 1.



Model Type	d_{50} (mm)	50% Risk $S_vQ_{10}^{0.5}$ ($m^{1.5}/s^{0.5}$)
Logistic Regression $d_{50} \geq 16$ mm	128	0.145
	96	0.125
	80	0.114
	64	0.101
	48	0.087
	32	0.070
	16	0.049
Logistic Reg. $d_{50} < 16$ mm	8	0.031
	4	0.026
	2	0.022
	1	0.018
	0.5	0.015

Form 3 Figure 4. Probability of incising/braiding based on logistic regression of Screening Index and d_{50} to be used in conjunction with Form 3 Table 1.

Form 3 Table 1. Values for Screening Index Threshold (probability of incising/braiding) to be used in conjunction with Form 3 Figure 4 (above) to complete Form 3 Overall Vertical Rating for Intermediate/Transitional Bed (below).. Screening Index Score: A = <50% probability of incision for current Q_{10}, valley slope, and d_{50}; B = Hardpan/d_{50} indeterminate; and C = ≥50% probability of incising/braiding for current Q_{10}, valley slope, and d_{50}.

d_{50} (mm) *From Form 2*	$S_v{*}Q_{10}^{0.5}$ ($m^{1.5}/s^{0.5}$) *From Form 1*	$S_v{*}Q_{10}^{0.5}$ ($m^{1.5}/s^{0.5}$) *50% risk of incising/braiding from table in Form 3 Figure 3 above*	Screening Index Score (A, B, C)

Overall Vertical Rating for Intermediate/Transitional Bed

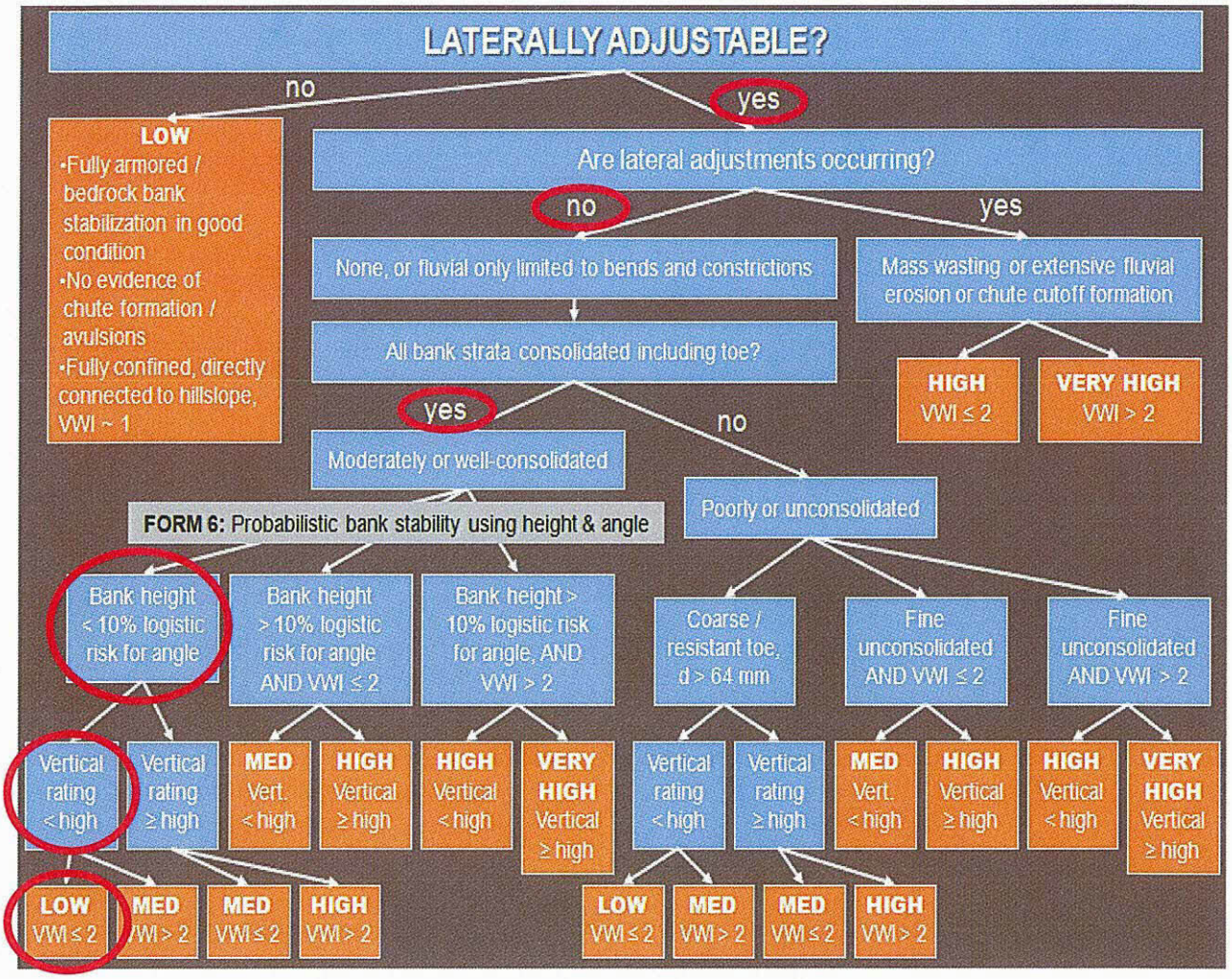
Calculate the overall Vertical Rating for Transitional Bed channels using the formula below. Numeric values for responses to Form 3 Checklists and Table 1 as follows: A = 3, B = 6, C = 9.

$$Vertical\ Rating = \sqrt{\{(\sqrt{armoring} * grade\ control) * screening\ index\ score\}}$$

Vertical Susceptibility based on Vertical Rating: <4.5 = LOW; 4.5 to 7 = MEDIUM; and >7 = HIGH.

FORM 4: LATERAL SUSCEPTIBILTY FIELD SHEET

Circle appropriate nodes/pathway for proposed site
OR use sequence of questions provided in Form 5.



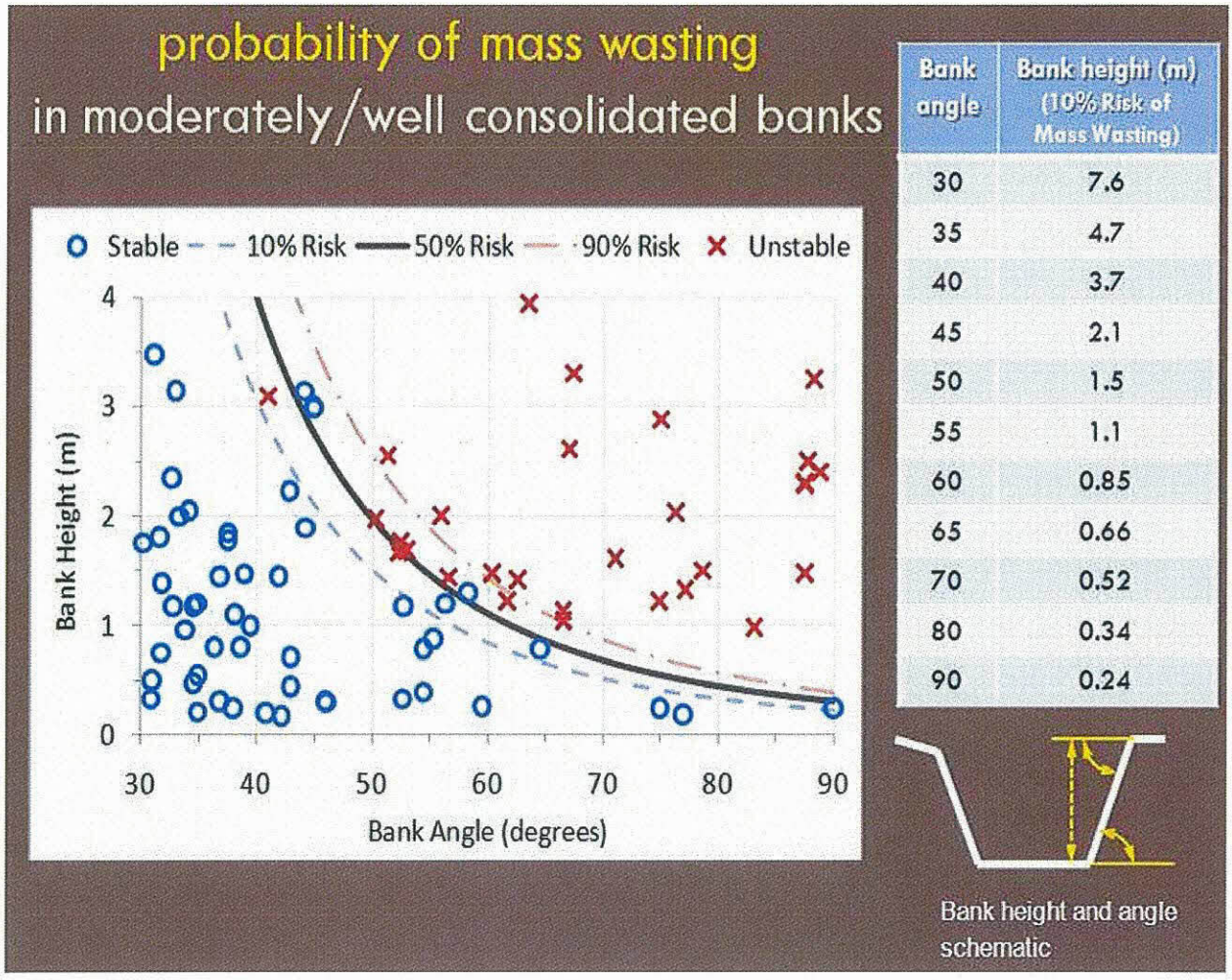
(Sheet 1 of 1)

REACH 1, 2, AND 3 RESULTS

FORM 6: PROBABILITY OF MASS WASTING BANK FAILURE

If mass wasting is not currently extensive and the banks are moderately- to well-consolidated, measure bank height and angle at several locations (i.e., at least three locations that capture the range of conditions present in the study reach) to estimate representative values for the reach. Use Form 6 Figure 1 below to determine if risk of bank failure is >10% and complete Form 6 Table 1. Support your results with photographs that include a protractor/rod/tape/person for scale.

	Bank Angle (degrees) *(from Field)*	Bank Height (m) *(from Field)*	Corresponding Bank Height for 10% Risk of Mass Wasting (m) *(from Form 6 Figure 1 below)*	Bank Failure Risk *(<10% Risk) (>10% Risk)*
Left Bank	<1.5:1 (33.7 deg)	varies	---	<10%
Right Bank	<1.5:1 (33.7 deg)	varies	---	<10%



Form 6 Figure 1. Probability Mass Wasting diagram, Bank Angle:Height/% Risk table, and Band Height:Angle schematic.

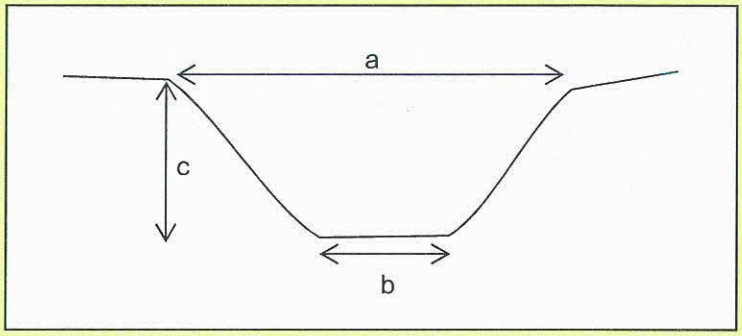
(Sheet 1 of 1)

REACH 1, 2, AND 3 RESULTS

Critical Flow Calculator

Reach 1

enter all values in green cells
and drop down boxes



Inputs

a) Receiving channel width at top of bank (ft) - see figure on right	80.0
b) Channel width at bed (ft)	40.0
c) Bank height at top of bank (ft)	5.0
Channel gradient (ft/ft)	0.0163
Receiving channel roughness	Light brush and trees, leaves not present n=0.06

Channel materials (use weakest of bed or banks). If materials are varied use weakest material covering more than 20% of channel.

- unconsolidated sandy loam 0.035 lb/sq ft
- alluvial silt (non coloidal) 0.045 lb/sq ft
- medium gravel 0.12 lb/sq ft
- alluvial silt/clay 0.26 lb/sq ft
- 2.5 inch cobble 1.1 lb/sq ft
- enter own d50 (variable)
- vegetation (bed and banks) 0.6 lb/sq ft

Select method of calculating Q2

- Input own Q2
- Calculate Q2 using USGS regression

Receiving water watershed annual precip (inches)	9.66	Receiving water watershed area at PoC (sq mi)	2.5057
Project watershed annual precipitation (inches)	9.66	Project watershed area draining to PoC (sq mi)	2.5057

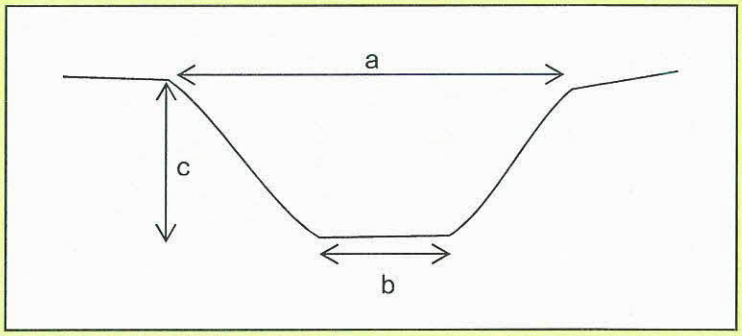
Outputs - Flow control range

Receiving water Q2	10.7	**Point of Compliance low flow rate (cfs)**	5.3
Project site Q2	10.7	**Low flow class**	0.5Q2
		Channel vulnerability	Low

Critical Flow Calculator

Reach 2

enter all values in green cells
and drop down boxes



Inputs

a) Receiving channel width at top of bank (ft) - see figure on right	75.0
b) Channel width at bed (ft)	50.0
c) Bank height at top of bank (ft)	5.0
Channel gradient (ft/ft)	0.0138
Receiving channel roughness	Light brush and trees, leaves not present n=0.06

Channel materials (use weakest of bed or banks). If materials are varied use weakest material covering more than 20% of channel.

unconsolidated sandy loam 0.035 lb/sq ft
alluvial silt (non coloidal) 0.045 lb/sq ft
medium gravel 0.12 lb/sq ft
alluvial silt/clay 0.26 lb/sq ft
2.5 inch cobble 1.1 lb/sq ft
enter own d50 (variable)
vegetation (bed and banks) 0.6 lb/sq ft

Select method of calculating Q2

Input own Q2
Calculate Q2 using USGS regression

Receiving water watershed annual precip (inches)	9.66	Receiving water watershed area at PoC (sq mi)	8.7464
Project watershed annual precipitation (inches)	9.66	Project watershed area draining to PoC (sq mi)	8.7464

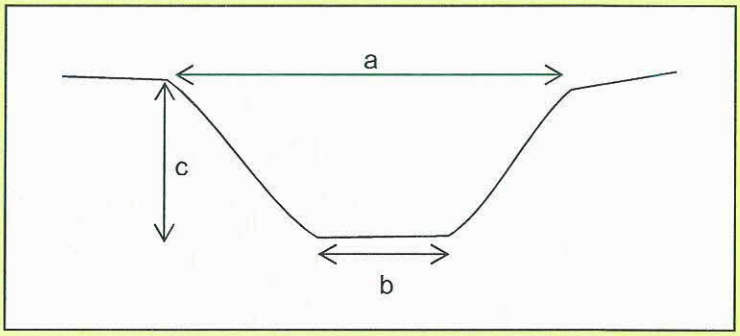
Outputs - Flow control range

Receiving water Q2	26.3	**Point of Compliance low flow rate (cfs)**	13.1
Project site Q2	26.3	**Low flow class**	0.5Q2
		Channel vulnerability	Low

Critical Flow Calculator

Reach 3

enter all values in green cells
and drop down boxes



Inputs

a) Receiving channel width at top of bank (ft) - see figure on right	55.0
b) Channel width at bed (ft)	30.0
c) Bank height at top of bank (ft)	5.0
Channel gradient (ft/ft)	0.0163
Receiving channel roughness	Light brush and trees, leaves not present n=0.06

Channel materials (use weakest of bed or banks). If materials are varied use weakest material covering more than 20% of channel.

- unconsolidated sandy loam 0.035 lb/sq ft
- alluvial silt (non coloidal) 0.045 lb/sq ft
- medium gravel 0.12 lb/sq ft
- alluvial silt/clay 0.26 lb/sq ft
- 2.5 inch cobble 1.1 lb/sq ft
- enter own d50 (variable)
- vegetation (bed and banks) 0.6 lb/sq ft

Select method of calculating Q2

- Input own Q2
- Calculate Q2 using USGS regression

Receiving water watershed annual precip (inches)	9.66	Receiving water watershed area at PoC (sq mi)	11.9765
Project watershed annual precipitation (inches)	9.66	Project watershed area draining to PoC (sq mi)	11.9765

Outputs - Flow control range

Receiving water Q2	33.0	**Point of Compliance low flow rate (cfs)**	16.5
Project site Q2	33.0	**Low flow class**	0.5Q2
		Channel vulnerability	Low

LEGEND:

- STUDY REACH
- EXISTING DRAINAGE FACILITIES
- PROPOSED DRAINAGE FACILITIES
- PROPOSED PROJECT

GRAPHIC SCALE

400 0 400 800

1 INCH = 400 FEET

EXISTING CAMINO SANTA FE BRIDGE

UPSTREAM DOMAIN OF ANALYSIS LOCATION FOR REACH 1 AT EXISTING ARIZONA CROSSING OF NORTHERLY TRIBUTARY

POC 1

REACH 1 (L=5,337')

CAMINO SANTA FE

PROPOSED DROP STRUCTURES

PROPOSED DROP STRUCTURES

DOWNSTREAM DOMAIN OF ANALYSIS LOCATION FOR REACH 3 AT EXISTING CULVERT ENTRANCE

DOWNSTREAM DOMAIN OF ANALYSIS LOCATION FOR REACH 1 AT EXISTING ARCH CULVERT ENTRANCE

EXISTING ARCH CULVERT IN EL CAMINO MEMORIAL PARK

EXISTING ARIZONA CROSSING OF CARROLL CANYON CREEK

CARROLL CANYON ROAD

EXISTING BOX CULVERTS

CARROLL ROAD

CONFLUENCE OF NORTHERLY TRIBUTARY AND CARROLL CANYON CREEK

REACH 3 (L=6,131')

POC 10

UPSTREAM DOMAIN OF ANALYSIS LOCATION FOR REACH 3 AT EXISTING BOX CULVERT OUTLET

EXISTING PRIVATE BRIDGE

EXISTING CAMINO SANTA FE BOX CULVERTS

POC 9

REACH 2 (L=1,633')

DOWNSTREAM DOMAIN OF ANALYSIS LOCATION FOR REACH 2 AT EXISTING CULVERT ENTRANCE

POC 8

POC 7

POC 6

PROPOSED ARCH CULVERT

UPSTREAM DOMAIN OF ANALYSIS LOCATION FOR REACH 2 AT PROPOSED DROP STRUCTURE IN CARROLL CANYON CREEK

3ROOTS SAN DIEGO PROJECT – STUDY AREA EXHIBIT

ATTACHMENT 3

STRUCTURAL BMP MAINTENANCE INFORMATION

This is the cover sheet for Attachment 3.

Indicate which Items are Included behind this cover sheet:

Attachment Sequence	Contents	Checklist
Attachment 3a	Structural BMP Maintenance Thresholds and Actions (Required)	☒ Included See Structural BMP Maintenance Information Checklist.
Attachment 3b	Draft Maintenance Agreement (when applicable)	☐ Included ☐ Not Applicable

Use this checklist to ensure the required information has been included in the Structural BMP Maintenance Information Attachment:

Preliminary Design / Planning / CEQA level submittal:

- Attachment 3a must identify:
  - ☐ Typical maintenance indicators and actions for proposed structural BMP(s) based on Section 7.7 of the BMP Design Manual
- Attachment 3b is not required for preliminary design / planning / CEQA level submittal.

Final Design level submittal:

Attachment 3a must identify:

- ☐ Specific maintenance indicators and actions for proposed structural BMP(s). This shall be based on Section 7.7 of the BMP Design Manual and enhanced to reflect actual proposed components of the structural BMP(s)
- ☐ How to access the structural BMP(s) to inspect and perform maintenance
- ☐ Features that are provided to facilitate inspection (e.g., observation ports, cleanouts, silt posts, or other features that allow the inspector to view necessary components of the structural BMP and compare to maintenance thresholds)
- ☐ Manufacturer and part number for proprietary parts of structural BMP(s) when applicable
- ☐ Maintenance thresholds specific to the structural BMP(s), with a location-specific frame of reference (e.g., level of accumulated materials that triggers removal of the materials, to be identified based on viewing marks on silt posts or measured with a survey rod with respect to a fixed benchmark within the BMP)
- ☐ When applicable, frequency of bioretention soil media replacement
- ☐ Recommended equipment to perform maintenance
- ☐ When applicable, necessary special training or certification requirements for inspection and maintenance personnel such as confined space entry or hazardous waste management

Attachment 3b: For private entity operation and maintenance, Attachment 3b must include a Storm Water Management and Discharge Control Maintenance Agreement (Form DS-3247). The following information must be included in the exhibits attached to the maintenance agreement:

- ☐ Vicinity map
- ☐ Site design BMPs for which DCV reduction is claimed for meeting the pollutant control obligations.
- ☐ BMP and HMP location and dimensions
- ☐ BMP and HMP specifications/cross section/model
- ☐ Maintenance recommendations and frequency
- ☐ LID features such as (permeable paver and LS location, dim, SF).

Attachment 3A: Structural BMP Maintenance Information Checklist

BMP Type: Biofiltration (Lined)

Inspection. Perform inspections monthly (or as needed) of the basins for sediment/trash accumulation, inlet and outlet structures, vegetation health, basin erosion and standing water in basins.

Inspection Items	Typical Maintenance Indicator(s)	Maintenance Actions
Mulch	Insufficient cover or patchy in appearance. Areas of bare earth are exposed, or mulch layer is less than 3 inches in depth.	Remove and replace with fresh mulch every 3 months, or as needed.
Trash and Debris	Trash and debris accumulated in area.	Remove and dispose of properly.
Sedimentation	Accumulation of sediment. (Overflow inlets should be at least 6 inches above bottom of basin).	Remove and properly dispose of accumulated materials, without damage to the vegetation. Maintain integrity of side slopes.
Vegetation	Poor vegetation establishment	Re-seed, re-plant, or re-establish vegetation per original plans. Maintain vegetation health.
	Overgrown vegetation	Mow or trim as appropriate.
	Presence of weeds	Remove weeds.
Erosion	Erosion due to concentrated irrigation flow or storm water flow	Inspect soil and repair/re-seed/re-plant eroded areas after big storm events or as needed
		Repair energy dissipation (riprap or splashblock).
Inlet and outlet structures	Check for clogging.	Clear obstructions.
Standing water (beyond 96 hours after a rain event)	Inspect perforated underdrain pipe using cleanout riser and inspect downstream connection	Make appropriate corrective measures such as adjusting irrigation system, removing obstructions of debris or invasive vegetation, unclogging perforated underdrain, loosening or replacing top soil to allow for better infiltration, or minor re-grading for proper drainage. If the issue is not corrected by restoring the BMP to the original plan and grade, the City Engineer shall be contacted prior to any additional repairs or reconstruction.

Maintenance Procedures

Screening Device

1. Remove grate or manhole cover to gain access to the screening device in the Pre-Treatment Chamber. Vault type units do not have screening device. Maintenance can be performed without entry.
2. Remove all pollutants collected by the screening device. Removal can be done manually or with the use of a vacuum truck. The hose of the vacuum truck will not damage the screening device.
3. Screening device can easily be removed from the Pre-Treatment Chamber to gain access to separation chamber and media filters below. Replace grate or manhole cover when completed.

Separation Chamber

1. Perform maintenance procedures of screening device listed above before maintaining the separation chamber.
2. With a pressure washer spray down pollutants accumulated on walls and cartridge filters.
3. Vacuum out Separation Chamber and remove all accumulated pollutants. Replace screening device, grate or manhole cover when completed.

Cartridge Filters

1. Perform maintenance procedures on screening device and separation chamber before maintaining cartridge filters.
2. Enter separation chamber.
3. Unscrew the two bolts holding the lid on each cartridge filter and remove lid.
4. Remove each of 4 to 8 media cages holding the media in place.
5. Spray down the cartridge filter to remove any accumulated pollutants.
6. Vacuum out old media and accumulated pollutants.
7. Reinstall media cages and fill with new media from manufacturer or outside supplier. Manufacturer will provide specification of media and sources to purchase.
8. Replace the lid and tighten down bolts. Replace screening device, grate or manhole cover when completed.

Drain Down Filter

1. Remove hatch or manhole cover over discharge chamber and enter chamber.
2. Unlock and lift drain down filter housing and remove old media block. Replace with new media block. Lower drain down filter housing and lock into place.
3. Exit chamber and replace hatch or manhole cover.

Maintenance Notes

1. Following maintenance and/or inspection, it is recommended the maintenance operator prepare a maintenance/inspection record. The record should include any maintenance activities performed, amount and description of debris collected, and condition of the system and its various filter mechanisms.

2. The owner should keep maintenance/inspection record(s) for a minimum of five years from the date of maintenance. These records should be made available to the governing municipality for inspection upon request at any time.

3. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.

4. Entry into chambers may require confined space training based on state and local regulations.

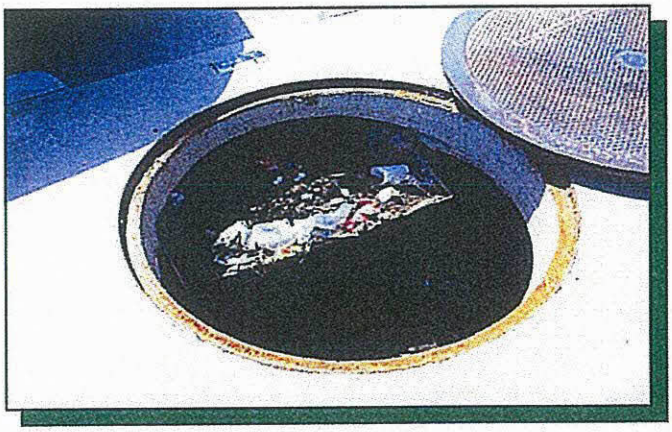
5. No fertilizer shall be used in the Biofiltration Chamber.

6. Irrigation should be provided as recommended by manufacturer and/or landscape architect. Amount of irrigation required is dependent on plant species. Some plants may require irrigation.

Maintenance Procedure Illustration

Screening Device

The screening device is located directly under the manhole or grate over the Pre-Treatment Chamber. It's mounted directly underneath for easy access and cleaning. Device can be cleaned by hand or with a vacuum truck.



Separation Chamber

The separation chamber is located directly beneath the screening device. It can be quickly cleaned using a vacuum truck or by hand. A pressure washer is useful to assist in the cleaning process.

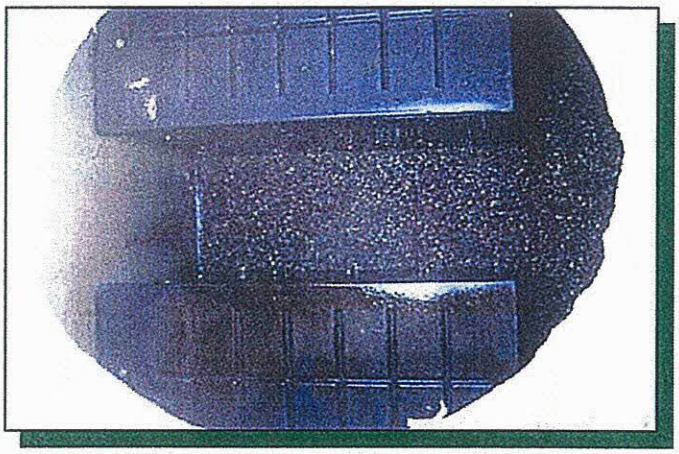


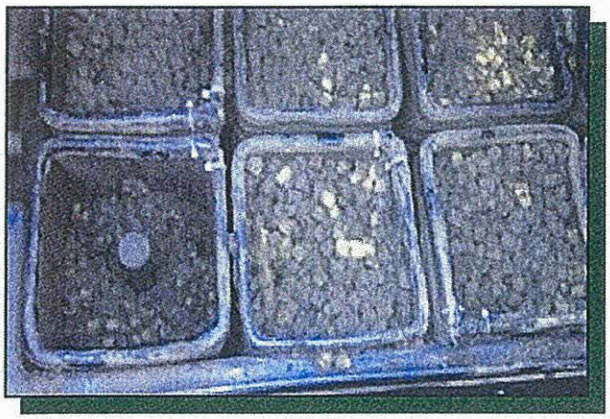




Cartridge Filters

The cartridge filters are located in the Pre-Treatment chamber connected to the wall adjacent to the biofiltration chamber. The cartridges have removable tops to access the individual media filters. Once the cartridge is open media can be easily removed and replaced by hand or a vacuum truck.







Drain Down Filter

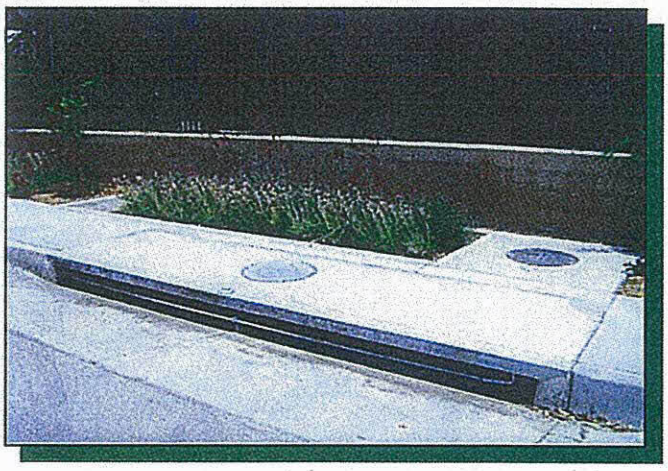
The drain down filter is located in the Discharge Chamber. The drain filter unlocks from the wall mount and hinges up. Remove filter block and replace with new block.

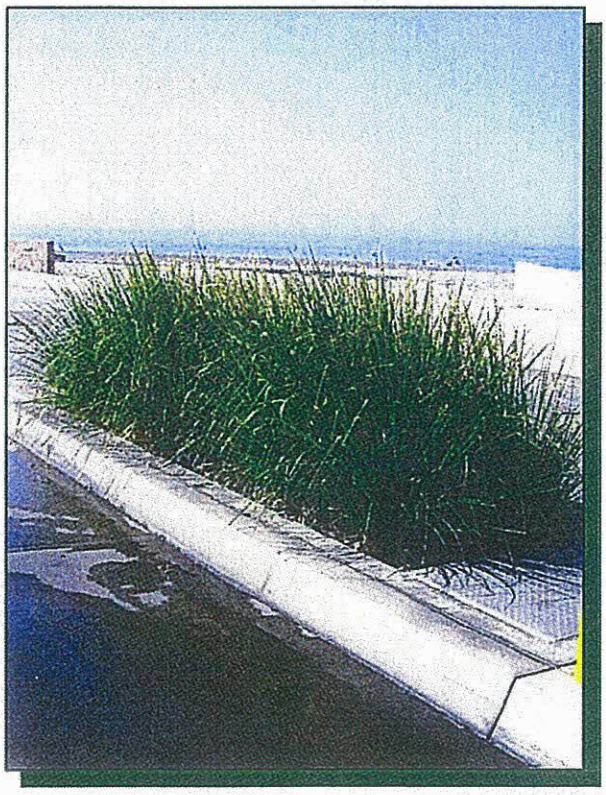


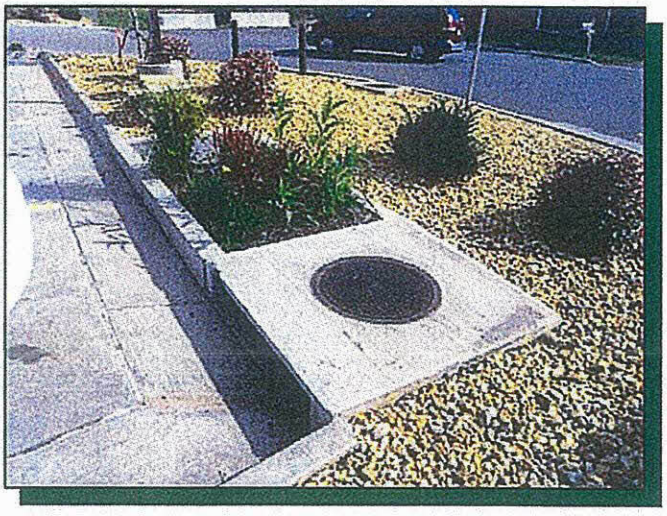
Trim Vegetation

Vegetation should be maintained in the same manner as surrounding vegetation and trimmed as needed. No fertilizer shall be used on the plants. Irrigation per the recommendation of the manufacturer and or landscape architect. Different types of vegetation requires different amounts of irrigation.

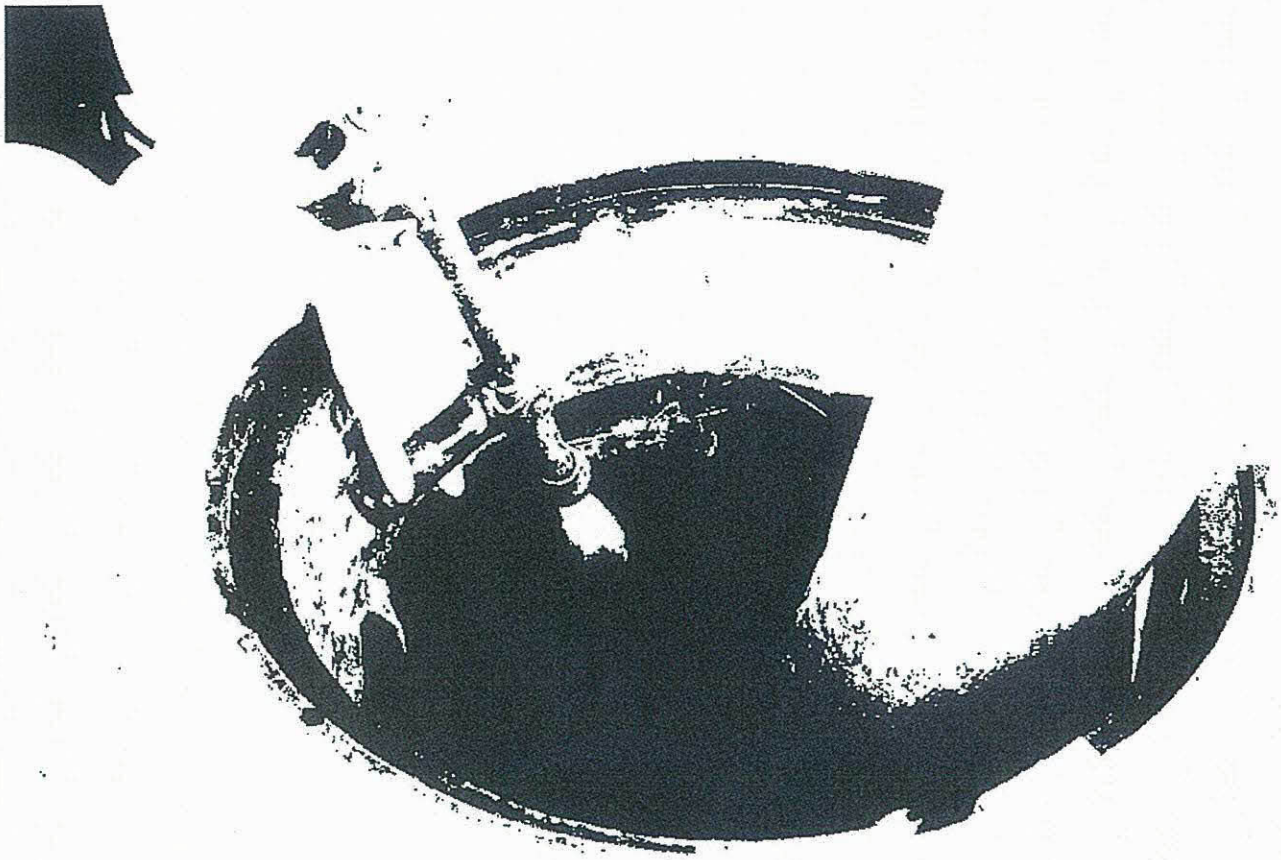








Inspection Form



Modular Wetland System, Inc.
P. 760.433-7640
F. 760-433-3176
E. Info@modularwetlands.com

www.modularwetlands.com

BIO CLEAN ENVIRONMENTAL SERVICES, INC.

Inspection Report
Modular Wetlands System

MODULAR WETLANDS

Project Name _____

Project Address _____
(city) (Zip Code)

Owner / Management Company _____

Contact _____ Phone ( ) –

Inspector Name _____ Date ____/____/____ Time _____ AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition _____ Additional Notes _____

For Office Use Only
(Reviewed By)
(Date)
Office personnel to complete section to the left.

Inspection Checklist

Modular Wetland System Type (Curb, Grate or UG Vault): _____ Size (22', 14' or etc.): _____

Structural Integrity:	Yes	No	Comments
Damage to pre-treatment access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?			
Damage to discharge chamber access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?			
Does the MWS unit show signs of structural deterioration (cracks in the wall, damage to frame)?			
Is the inlet/outlet pipe or drain down pipe damaged or otherwise not functioning properly?			
Working Condition:			
Is there evidence of illicit discharge or excessive oil, grease, or other automobile fluids entering and clogging the unit?			
Is there standing water in inappropriate areas after a dry period?			
Is the filter insert (if applicable) at capacity and/or is there an accumulation of debris/trash on the shelf system?			
Does the depth of sediment/trash/debris suggest a blockage of the inflow pipe, bypass or cartridge filter? If yes specify which one in the comments section. Note depth of accumulation in in pre-treatment chamber.			Depth:
Does the cartridge filter media need replacement in pre-treatment chamber and/or discharge chamber?			Chamber:
Any signs of improper functioning in the discharge chamber? Note issues in comments section.			
Other Inspection Items:			
Is there an accumulation of sediment/trash/debris in the wetland media (if applicable)?			
Is it evident that the plants are alive and healthy (if applicable)? Please note Plant Information below.			
Is there a septic or foul odor coming from inside the system?			

Waste:	Yes	No
Sediment / Silt / Clay		
Trash / Bags / Bottles		
Green Waste / Leaves / Foliage		

Recommended Maintenance	
No Cleaning Needed	
Schedule Maintenance as Planned	
Needs Immediate Maintenance	

Plant Information	
Damage to Plants	
Plant Replacement	
Plant Trimming	

Additional Notes: _____

2972 San Luis Rey Road, Oceanside, CA 92058 P (760) 433-7640 F (760) 433-3176

MODULAR WETLANDS

Maintenance Report



Modular Wetland System, Inc.
P. 760.433-7640
F. 760-433-3176
E. Info@modularwetlands.com

www.modularwetlands.com

Cleaning and Maintenance Report
Modular Wetlands System

Project Name _____

Project Address _____
(city) (Zip Code)

Owner / Management Company _____

Contact _____ Phone ( ) –

Inspector Name _____ Date ____/____/____ Time _____ AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition _____ Additional Notes _____

For Office Use Only
(Reviewed By)
(Date)
Office personnel to complete section to the left.

Site Map #	GPS Coordinates of Insert	Manufacturer / Description / Sizing	Trash Accumulation	Foliage Accumulation	Sediment Accumulation	Total Debris Accumulation	Condition of Media 25/50/75/100 (will be changed @ 75%)	Operational Per Manufactures' Specifications (If not, why?)
	Lat: Long:	MWS Catch Basins						
		MWS Sedimentation Basin						
		Media Filter Condition						
		Plant Condition						
		Drain Down Media Condition						
		Discharge Chamber Condition						
		Drain Down Pipe Condition						
		Inlet and Outlet Pipe Condition						

Comments:

2972 San Luis Rey Road, Oceanside, CA 92058 P. 760.433.7640 F. 760.433.3176

THE CITY OF SAN DIEGO
RECORDING REQUESTED BY:
THE CITY OF SAN DIEGO
AND WHEN RECORDED MAIL TO:

Click or tap here to enter text.
Click or tap here to enter text.
Click or tap here to enter text.

(THIS SPACE IS FOR THE RECORDER'S USE ONLY)

STORM WATER MANAGEMENT AND DISCHARGE CONTROL MAINTENANCE AGREEMENT

APPROVAL NUMBER:	ASSESSOR'S PARCEL NUMBER:	PROJECT NUMBER:
Click or tap here to enter text.	Click or tap here to enter text.	Click or tap here to enter text.

This agreement is made by and between the City of San Diego, a municipal corporation [City] and Click or tap here to enter text.

the owner or duly authorized representative of the owner [Property Owner] of property located at:
Click or tap here to enter text.

(PROPERTY ADDRESS)

and more particularly described as: Click or tap here to enter text.

(LEGAL DESCRIPTION OF PROPERTY)

in the City of San Diego, County of San Diego, State of California.

Property Owner is required pursuant to the City of San Diego Municipal Code, Chapter 4, Article 3, Division 3, Chapter 14, Article 2, Division 2, and the Land Development Manual, Storm Water Standards to enter into a Storm Water Management and Discharge Control Maintenance Agreement [Maintenance Agreement] for the installation and maintenance of Permanent Storm Water Best Management Practices [Permanent Storm Water BMP's] prior to the issuance of construction permits. The Maintenance Agreement is intended to ensure the establishment and maintenance of Permanent Storm Water BMP's onsite, as described in the attached exhibit(s), the project's Storm Water Quality Management Plan [SWQMP] and Grading and/or Improvement Plan Drawing No(s), or Building Plan Project No(s): Click or tap here to enter text.

Property Owner wishes to obtain a building or engineering permit according to the Grading and/or Improvement Plan Drawing No(s) or Building Plan Project No(s): Click or tap here to enter text.

Continued on Page 2

NOW, THEREFORE, the parties agree as follows:

1. Property Owner shall have prepared, or if qualified, shall prepare an Operation and Maintenance Procedure [OMP] for Permanent Storm Water BMP's, satisfactory to the City, according to the attached exhibit(s), consistent with the Grading and/or Improvement Plan Drawing No(s), or Building Plan Project No(s):Click or tap here to enter text..

2. Property Owner shall install, maintain and repair or replace all Permanent Storm Water BMP's within their property, according to the OMP guidelines as described in the attached exhibit(s), the project's WQTR and Grading and/or Improvement Plan Drawing No(s), or Building Plan Project No(s)Click or tap here to enter text..

3. Property Owner shall maintain operation and maintenance records for at least five (5) years. These records shall be made available to the City for inspection upon request at any time.

This Maintenance Agreement shall commence upon execution of this document by all parties named hereon, and shall run with the land.

Executed by the City of San Diego and by Property Owner in San Diego, California.

See Attached Exhibits(s):Click or tap here to enter text.

(Owner Signature)

Click or tap here to enter text.

(Print Name and Title)

Click or tap here to enter text.

(Company/Organization Name)

Click or tap to enter a date.

(Date)

THE CITY OF SAN DIEGO

APPROVED:

(City Control engineer Signature

(Print Name)

(Date)

NOTE: ALL SIGNATURES MUST INCLUDE NOTARY ACKNOWLEDMENTS PER CIVIL CODE SEC. 1180 ET.SEQ

ATTACHMENT 4
COPY OF PLAN SHEETS SHOWING PERMANENT STORM WATER BMPS

This is the cover sheet for Attachment 4.

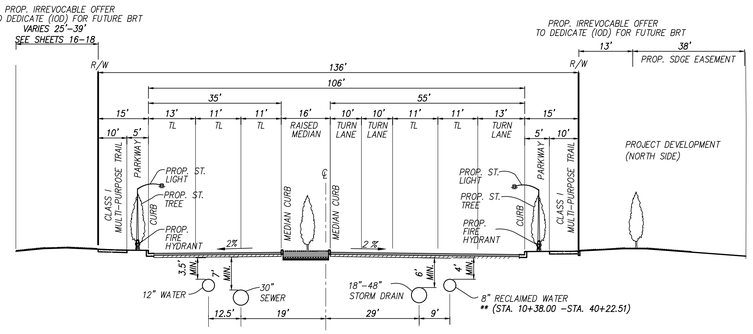
Use this checklist to ensure the required information has been included on the plans:

The plans must identify:

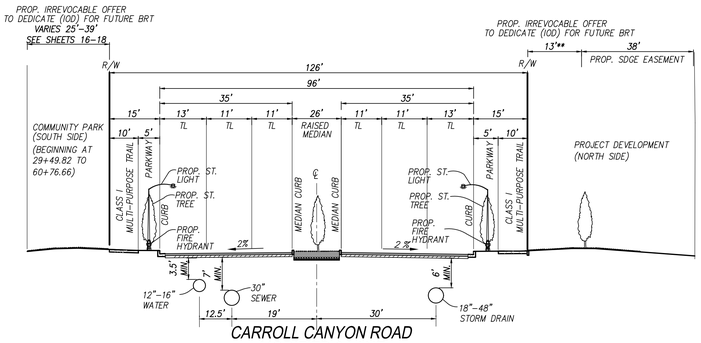
- ☐ Structural BMP(s) with ID numbers matching Form I-6 Summary of PDP Structural BMPs
- ☐ The grading and drainage design shown on the plans must be consistent with the delineation of DMAs shown on the DMA exhibit
- ☐ Details and specifications for construction of structural BMP(s)
- ☐ Signage indicating the location and boundary of structural BMP(s) as required by the City Engineer
- ☐ How to access the structural BMP(s) to inspect and perform maintenance
- ☐ Features that are provided to facilitate inspection (e.g., observation ports, cleanouts, silt posts, or other features that allow the inspector to view necessary components of the structural BMP and compare to maintenance thresholds)
- ☐ Manufacturer and part number for proprietary parts of structural BMP(s) when applicable
- ☐ Maintenance thresholds specific to the structural BMP(s), with a location-specific frame of reference (e.g., level of accumulated materials that triggers removal of the materials, to be identified based on viewing marks on silt posts or measured with a survey rod with respect to a fixed benchmark within the BMP)
- ☐ Recommended equipment to perform maintenance
- ☐ When applicable, necessary special training or certification requirements for inspection and maintenance personnel such as confined space entry or hazardous waste management
- ☐ Include landscaping plan sheets showing vegetation requirements for vegetated structural BMP(s)
- ☐ All BMPs must be fully dimensioned on the plans
- ☐ When propritery BMPs are used, site specific cross section with outflow, inflow and model number shall be provided. Broucher photocopies are not allowed.

3 ROOTS VTM EXHIBIT 'A'

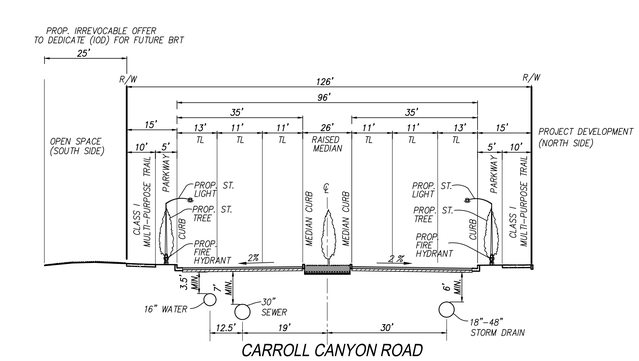
REZONE NO. 2069822/VESTING TENTATIVE MAP NO. 2069827/SITE DEVELOPMENT PERMIT NO. 2069825/ LAND USE PLAN NO. 2069831/PLANNED DEVELOPMENT PERMIT NO. 2068725/AMENDED CUP 87-2069822/PROJ. NO. 587128



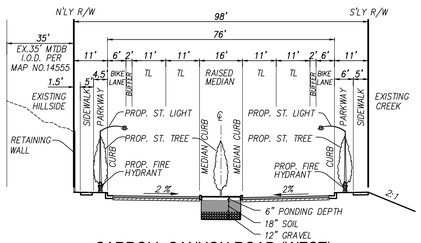
CARROLL CANYON ROAD
MODIFIED 6 LANE
PRIMARY ARTERIAL
(55 MPH) PUBLIC
(STA. 10+94.83 – STA. 15+79.15) NOT TO SCALE
*NOTE: NO PARKING WILL BE ALLOWED WITHIN ROADWAY



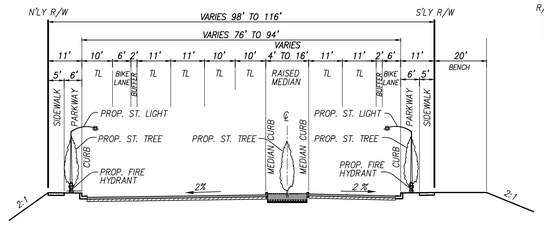
CARROLL CANYON ROAD
MODIFIED 6 LANE
PRIMARY ARTERIAL
(55 MPH) PUBLIC
(STA. 20+43.02 – STA. 60+76.66) NOT TO SCALE
*NOTE: NO PARKING WILL BE ALLOWED WITHIN ROADWAY
**PROPOSED 13FT BRT-IOD ENDS AT STATION 31+40



CARROLL CANYON ROAD
MODIFIED 6 LANE
PRIMARY ARTERIAL
(55 MPH) PUBLIC
(STA. 60+76.66 – STA. 73+07.22) NOT TO SCALE
*NOTE: NO PARKING WILL BE ALLOWED WITHIN ROADWAY



CARROLL CANYON ROAD (WEST)
FOUR LANE MAJOR
(55 MPH) PUBLIC
NOT TO SCALE
STA.45+82.67 TO 60+00.00
SECTION A-A, SEE SHEET 24



CARROLL CANYON ROAD (WEST)
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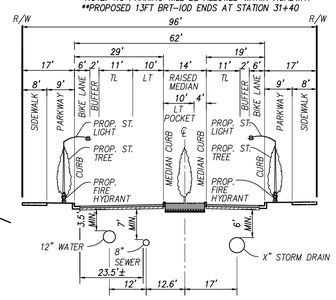
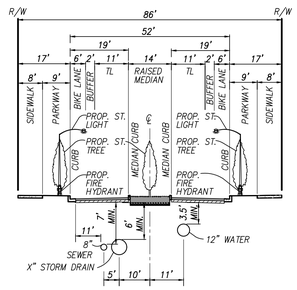
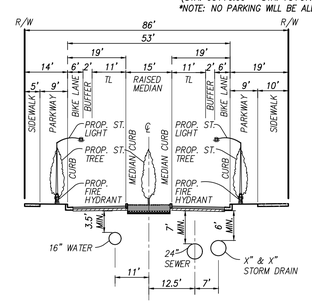
(55 MPH) PUBLIC
NOT TO SCALE
STA. 60+00 TO 65+99.20
SECTION B-B, SEE SHEET 24



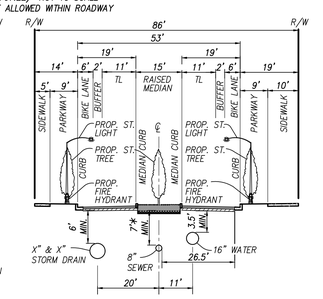
VILLAGE ENTRY
MODIFIED 2 LANE COLLECTOR
WITH 2 WAY LEFT TURN
(35 MPH) PUBLIC
(STA. 10+00.00 – STA. 12+81.78) NOT TO SCALE



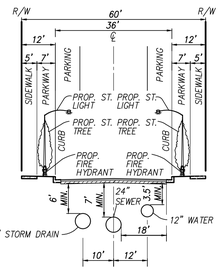
VILLAGE ENTRY
MODIFIED 2 LANE COLLECTOR
WITH 2 WAY LEFT TURN
(35 MPH) PUBLIC
(STA. 15+24.71 – STA. 19+93.34) NOT TO SCALE



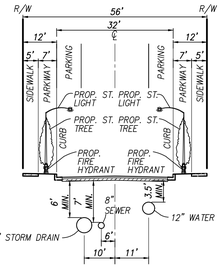
SPINE ROAD
MODIFIED 2 LANE COLLECTOR
WITH 2 WAY LEFT TURN
(35 MPH) PUBLIC
(STA. 30+04.72 – STA. 49+60.67) NOT TO SCALE



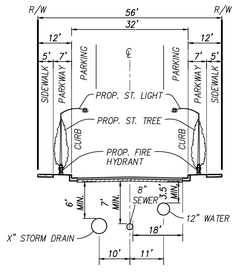
SPINE ROAD
MODIFIED 2 LANE COLLECTOR
WITH 2 WAY LEFT TURN
(35 MPH) PUBLIC
(STA. 10+00.00 – STA. 30+04.72) NOT TO SCALE
* 5' MIN ENTERING FROM CARROLL CANYON ROAD



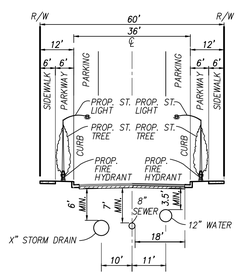
STREET A
RESIDENTIAL LOCAL
COLLECTOR ENTRY STREET
(30 MPH) PUBLIC
(STA. 12+92.35 – STA. 23+28.33) NOT TO SCALE



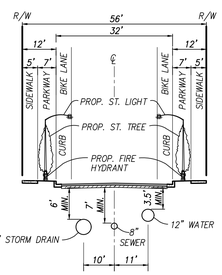
STREET A
RESIDENTIAL LOCAL
COLLECTOR ENTRY STREET
(30 MPH) PUBLIC
(STA. 10+00.00 – STA. 11+87.32) NOT TO SCALE



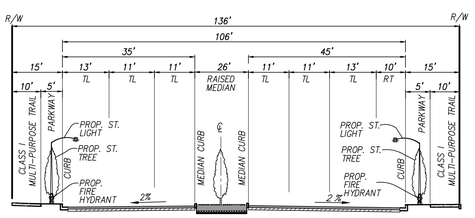
RESIDENTIAL LOCAL STREET
STREETS B THROUGH J
(25 MPH) PUBLIC
NOT TO SCALE



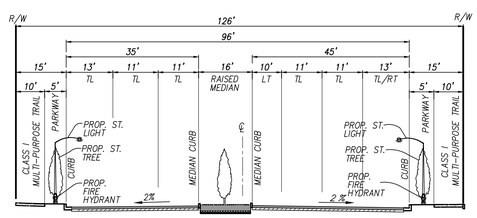
URBAN CORRIDOR STREET
MODIFIED 2 LANE COLLECTOR
(25 MPH) PUBLIC
NOT TO SCALE



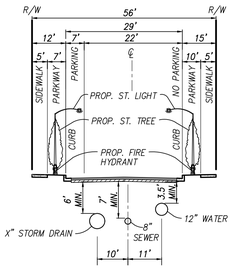
RESIDENTIAL LOCAL
ENTRY STREET
(25 MPH) PUBLIC
NOT TO SCALE



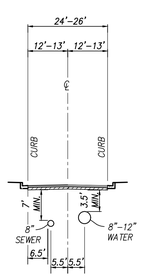
CARROLL CANYON ROAD
AT SPINE ROAD
NOT TO SCALE



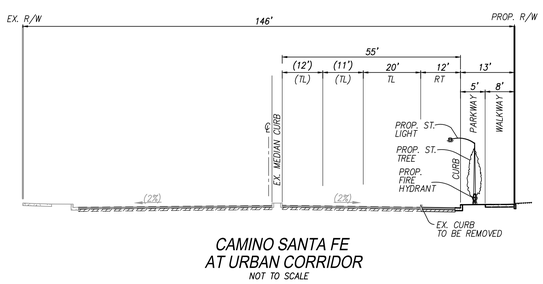
CARROLL CANYON ROAD
AT STREETS F, G, AND H
NOT TO SCALE



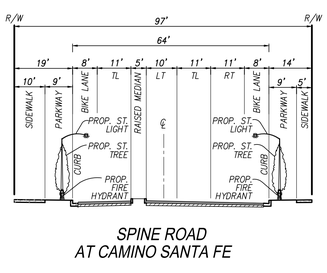
RESIDENTIAL LOCAL
GREEN STREET
(25 MPH) PUBLIC
NOT TO SCALE



PRIVATE DRIVE
(15 MPH)
NOT TO SCALE



CAMINO SANTA FE
AT URBAN CORRIDOR
NOT TO SCALE



SPINE ROAD
AT CAMINO SANTA FE

3 ROOTS by Mesa Canyon Community Partners

PROJECT DESIGN CONSULTANTS
Planning | Landscape Architecture | Engineering | Survey

701 B Street, Suite 800
San Diego, CA 92101
619.235.6471 Tel
619.234.0349 Fax

PREPARED BY:
NAME: PROJECT DESIGN CONSULTANTS
ADDRESS: 701 'B' STREET, SUITE 800
SAN DIEGO, CALIFORNIA 92101
PHONE #: (619) 235-6471

PROJECT ADDRESS:
SAN DIEGO, CALIFORNIA

PROJECT NAME:
3 ROOTS

SHEET TITLE:
DETAILS AND STREET CROSS SECTIONS

REVISION 14:
REVISION 13:
REVISION 12:
REVISION 11:
REVISION 10:
REVISION 09:
REVISION 08:
REVISION 07:
REVISION 06:
REVISION 05:
REVISION 04: 02/08/2019
REVISION 03: 10/08/2018
REVISION 02: 07/10/2018
REVISION 01: 03/26/2018
ORIGINAL DATE: 11/28/2017

SHEET 2 OF 327

DEP #

P:\4182.20\ENGR\DWG_PLANS\TENTATIVE MAP\4182.20_TM 02.DWG 2/8/2019 12:39 PM

3 ROOTS VTM EXHIBIT 'A'

REZONE NO. 2069822/VESTING TENTATIVE MAP NO. 2069827/SITE DEVELOPMENT PERMIT NO. 2069825/ LAND USE PLAN NO. 2069831/PLANNED DEVELOPMENT PERMIT NO. 2068725/AMENDED CUP 87-2069822/PROJ. NO. 587128

Deviations for RX-1-2 Zone

- *Front Setback: Changed from 15 feet to 6 feet.*
- *Side Setback for detached: Changed from 3 feet to 4 feet. Minimum side setback may be 0 feet when adjacent to common open space, park, or landscaped HOA lot.*
- *Rear Setback: Rear setbacks of 5 feet are allowed for up to 50% of the width of the building envelope on the ground floor, the remaining portion of the building envelope on the first floor shall have a minimum rear setback of 10 feet. Upper stories shall observe the standard minimum rear setback of 10 feet.*
- *Max Structure Height - §131.0444(c): Does not apply; no angled building envelope plane is required.*
- *Architectural Projections and Encroachments - §142.0520(a): Architectural projections and encroachments, including eaves and canopies, may extend to the property line for up to 60% of the length of the street frontage. Architectural projections many not conflict with the height of mature trees.*

Deviations for RM-2-6 Zone

- *Minimum Front Setback: Changed from 15 feet to 5 feet.*
- *Standard Front Setback: Changed from 20 feet to 5 feet.*

Side Setback: Minimum side setback may be 0 feet when adjacent to common open ***Deviations for RX-1-2 Zone***

- *Front Setback: Changed from 15 feet to 6 feet.*
- *Side Setback for detached: Changed from 3 feet to 4 feet. Minimum side setback may be 0 feet when adjacent to common open space, park, or landscaped HOA lot.*
- *Rear Setback: Rear setbacks of 5 feet are allowed for up to 50% of the width of the building envelope on the ground floor, the remaining portion of the building envelope on the first floor shall have a minimum rear setback of 10 feet. Upper stories shall observe the standard minimum rear setback of 10 feet.*
- *Max Structure Height - §131.0444(c): Does not apply; no angled building envelope plane is required.*
- *Architectural Projections and Encroachments - §142.0520(a): Architectural projections and encroachments, including eaves and canopies, may extend to the property line for up to 60% of the length of the street frontage. Architectural projections many not conflict with the height of mature trees.*

Deviations for RM-2-6 Zone

- *Minimum Front Setback: Changed from 15 feet to 5 feet.*
- *Standard Front Setback: Changed from 20 feet to 5 feet.*
- *Side Setback: Minimum side setback may be 0 feet when adjacent to common open space, park, or landscaped HOA lot. In this condition, plaza and paseo areas may be calculated towards remaining yard landscape area and point requirements.*
- *Minimum Street Side Setback: Changed from 10 feet to 5 feet.*
- *Minimum Rear Setback: Changed from 15 feet to 5 feet.*
- *Maximum Structure Height: 3-story structures may be up to 45 feet tall. 2-story structures have a maximum structure height of 40 feet.*
- *Max Structure Height - §131.0444(f): At the side setback lines, the maximum height of the building envelope above 40 feet in height is established by a 60-degree angled building envelope plane sloping inward from the side setback lines to the maximum permitted 45-foot structure height.*
- *Architectural Projections and Encroachments - §131.0461(c): Architectural projections and encroachments, including eaves and canopies, may extend to the property line for up to 60% of the length of the street frontage. Architectural projections may not conflict with the height of mature trees.*
- *Private Exterior Open Space - §131.0455(b): At least 75 percent of the dwelling units shall be provided with at least 60 square feet of usable, private, exterior open space abutting the unit with a minimum dimension of 5 feet, including a porch or patio at ground level or balcony or roof deck on upper floors of the building. The open space may be located in required front and rear yards, but shall be no closer than 6 feet to the front property line.*
- *Vehicle Use Area - §142.0407(b): For multifamily with internal streets that are calculated as vehicular use areas, all areas within 10 feet of the curb are included in the planting area and plant point calculations in order to mitigate the minimal amount of parking stalls and associated eligible compliant landscape area.*

Deviations for RM-3-9 Zone

- *Minimum Front Setback: Changed from 10 feet to 5 feet.*
- *Standard Front Setback: Changed from 20 feet to 5 feet.*
- *Side Setback: Minimum side setback may be 0 feet when adjacent to common open space, park, or landscaped HOA lot. In this condition, plaza and paseo areas may be calculated towards remaining yard landscape area and point requirements.*
- *Minimum Street Side Setback: Changed from 10 feet to 5 feet.*
- *Maximum Structure Height: Changed from 60 feet to 65 feet.*
- *Architectural Projections and Encroachments - §131.0461(c): Architectural projections and encroachments, including eaves and canopies, may extend to the property line for up to 60% of the length of the street frontage. Architectural projections may not conflict with the height of mature trees.*
- *Street Yard and Remaining Yard Planting Area and Point Requirements - §142.0404: The required street yard planting area for PA-12 is 40%.*
- *Storage Requirements - §131.0454: Each dwelling unit shall have a fully enclosed, personal storage area outside the unit that is at least 100 cubic feet; no minimum horizontal dimension is required.*
- *Exterior Open Space - §131.0455(c): At least 75 percent of the dwelling units shall be provided with at least 60 square feet of usable, private, exterior open space abutting the unit with a minimum dimension of 5 feet, including a porch or patio at ground level or balcony or roof deck on upper floors of the building. The open space may be located in required front and rear yards, but shall be no closer than 6 feet to the front property line.*

Deviations for CC-2-4 Zone

- *Minimum Side Setback: Changed from 10 feet to 0 feet.*
- *Maximum Street Side Setback: Changed from 10 feet to 0 feet.*
- *Minimum Rear Setback: Changed from 10 feet to 0 feet.*
- *Architectural Projections and Encroachments - §142.0520(a): Architectural projections and encroachments, including eaves and canopies, may extend to the property line.*
- *Setback Requirements for Commercial Zones - §131.0543(a)(2) - The maximum setback requirement in Municipal Code Table 131-05B shall not apply. A maximum setback of 40 feet from the property line abutting Urban Corridor and Spine Road shall be allowed. Maximum setback intended to accommodate lettered lots. Street frontage shall substantially conform to the site plan shown in Figure 8-13 which illustrates an approximate street frontage of 64% along the Spine Road and the Urban Corridor streets.*
- *Parking structures shall have a maximum structure height of 65 feet to accommodate 4 levels with roof parking and solar panels overhead.*
- *Per §143.0460(c), at least 50% of the gross ground floor area of commercial development shall be used for retail sales and commercial services.*
- *A minimum lot coverage of less than 35% is acceptable on PA-20 (Mobility Hub) to the primary function of that parcel.*

space, park, or landscaped HOA lot. In this condition, plaza and paseo areas may be calculated towards remaining yard landscape area and point requirements.

- *Minimum Street Side Setback: Changed from 10 feet to 5 feet.*
- *Minimum Rear Setback: Changed from 15 feet to 5 feet.*
- *Maximum Structure Height: 3-story structures may be up to 45 feet tall. 2-story structures have a maximum structure height of 40 feet.*
- *Max Structure Height - §131.0444(f): At the side setback lines, the maximum height of the building envelope above 40 feet in height is established by a 60-degree angled building envelope plane sloping inward from the side setback lines to the maximum permitted 45-foot structure height.*
- *Architectural Projections and Encroachments - §131.0461(c): Architectural projections and encroachments, including eaves and canopies, may extend to the property line for up to 60% of the length of the street frontage. Architectural projections may not conflict with the height of mature trees.*
- *Private Exterior Open Space - §131.0455(b): At least 75 percent of the dwelling units shall be provided with at least 60 square feet of usable, private, exterior open space abutting the unit with a minimum dimension of 5 feet, including a porch or patio at ground level or balcony or roof deck on upper floors of the building. The open space may be located in required front and rear yards, but shall be no closer than 6 feet to the front property line.*
- *Vehicle Use Area - §142.0407(b): For multifamily with internal streets that are calculated as vehicular use areas, all areas within 10 feet of the curb are included in the planting area and plant point calculations in order to mitigate the minimal amount of parking stalls and associated eligible compliant landscape area.*

Deviations for RM-3-9 Zone

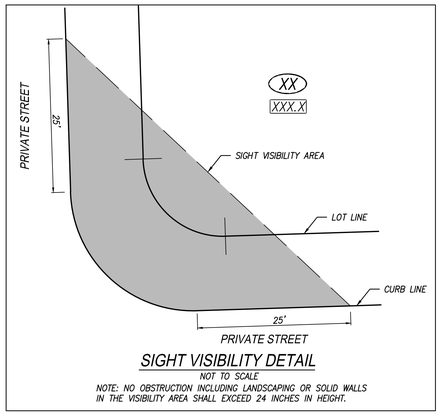
- *Minimum Front Setback: Changed from 10 feet to 5 feet.*
- *Standard Front Setback: Changed from 20 feet to 5 feet.*
- *Side Setback: Minimum side setback may be 0 feet when adjacent to common open space, park, or landscaped HOA lot. In this condition, plaza and paseo areas may be calculated towards remaining yard landscape area and point requirements.*
- *Minimum Street Side Setback: Changed from 10 feet to 5 feet.*
- *Maximum Structure Height: Changed from 60 feet to 65 feet.*
- *Architectural Projections and Encroachments - §131.0461(c): Architectural projections and encroachments, including eaves and canopies, may extend to the property line for up to 60% of the length of the street frontage. Architectural projections may not conflict with the height of mature trees.*
- *Street Yard and Remaining Yard Planting Area and Point Requirements - §142.0404: The required street yard planting area for PA-12 is 40%.*
- *Storage Requirements - §131.0454: Each dwelling unit shall have a fully enclosed, personal storage area outside the unit that is at least 100 cubic feet; no minimum horizontal dimension is required.*
- *Exterior Open Space - §131.0455(c): At least 75 percent of the dwelling units shall be provided with at least 60 square feet of usable, private, exterior open space abutting the unit with a minimum dimension of 5 feet, including a porch or patio at ground level or balcony or roof deck on upper floors of the building. The open space may be located in required front and rear yards, but shall be no closer than 6 feet to the front property line.*

Deviations for CC-2-4 Zone

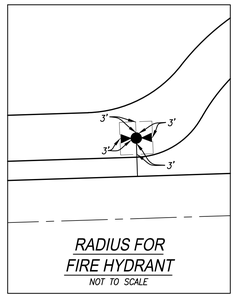
- *Minimum Side Setback: Changed from 10 feet to 0 feet.*
- *Maximum Street Side Setback: Changed from 10 feet to 0 feet.*
- *Minimum Rear Setback: Changed from 10 feet to 0 feet.*
- *Architectural Projections and Encroachments - §142.0520(a): Architectural projections and encroachments, including eaves and canopies, may extend to the property line.*
- *Setback Requirements for Commercial Zones - §131.0543(a)(2) - The maximum setback requirement in Municipal Code Table 131-05B shall not apply. A maximum setback of 40 feet from the property line abutting Urban Corridor and Spine Road shall be allowed. Maximum setback intended to accommodate lettered lots. Street frontage shall substantially conform to the site plan shown in Figure 8-13 which illustrates an approximate street frontage of 64% along the Spine Road and the Urban Corridor streets.*
- *Parking structures shall have a maximum structure height of 65 feet to accommodate 4 levels with roof parking and solar panels overhead.*
- *Per §143.0460(c), at least 50% of the gross ground floor area of commercial development shall be used for retail sales and commercial services.*
- *A minimum lot coverage of less than 35% is acceptable on PA-20 (Mobility Hub) to the primary function of that parcel.*

PLANNING AREA YIELD ANALYSIS

PLANNING AREA	LOT NO.	AREA (AC)	UNIT COUNT (DU)	PROP.ZONING	LAND USE
1	1	3.5	56	RM-2-6	
2	2	6.4	78	RM-2-6	
3	3-80, PPP	13.7	78	RX-1-2	
4	81-134, OO	8.1	54	RX-1-2	
5	135-141	12.1	141	RM-2-6	
6	142-194, QQQ	6.3	53	RX-1-2	
7	195	4.1	66	RM-2-6	
8	196, II-3	5.1	118	RM-2-6	
9	197, II, II-1, II-2	4.6	68	RM-2-6	
10	198	4.5	61	RM-2-6	
11	199	4.0	85	RM-2-6	
12	200, JJ, JJ-1, KK-4	4.2	180	RM-3-9	
13	201, JJ-2, JJ-3	4.1	243	RM-3-9	
14	202	4.5	186	RM-3-9	
15	203, XX-1, XX-2, XX-3	4.5	76	RM-2-6	
16	204, WW-1, WW-2	6.1	80	RM-2-6	
17	205, 206	4.8	94	RM-2-6	
18	207, 208	6.5	83	RM-2-6	
19	209, KK-1, KK-2, KK-3,,LL	10.9	–	CC-2-4	
20	210, NN	1.7	–	CC-2-4	
		TOTAL 119.7	TOTAL 1800		



SIGHT VISIBILITY DETAIL
NOT TO SCALE
NOTE: NO OBSTRUCTION INCLUDING LANDSCAPING OR SOLID WALLS IN THE VISIBILITY AREA SHALL EXCEED 24 INCHES IN HEIGHT.



RADIUS FOR FIRE HYDRANT
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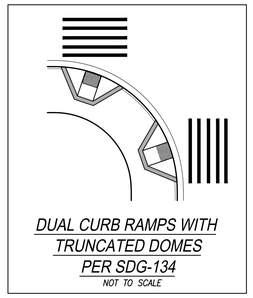
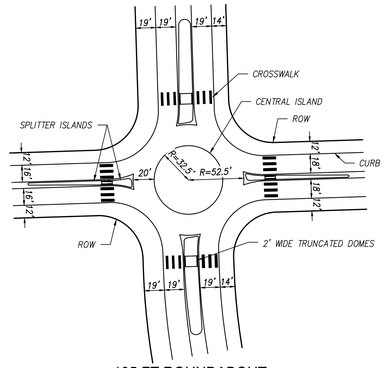


DUAL CURB RAMPS WITH TRUNCATED DOMES PER SDG-134
NOT TO SCALE



105 FT ROUNDABOUT
SOURCE: NCHRP REPORT 672

PARK TABLE

Lot	Description	Area(sf)	Area(ac)
A	PARK	5,613	0.13
B	PARK	7,760	0.18
C	PARK	3,871	0.09
D	PARK	5,059	0.12
E	PARK	39,882	0.92
F	PARK	3,471	0.08
G	PARK	1,791	0.04
H	PARK	49,865	1.15
I	PARK	14,487	0.33
J	PARK	20,284	0.47
K	PARK	49,576	1.14
K-1	PARK	75,290	1.73
L	PARK	17,489	0.40
M	PARK	144,909	3.33
M-1	PARK	14,069	0.32
N	PARK	21,012	0.48
O	PARK	36,295	0.83
P	PARK	25,530	0.59
Q	PARK	5,316	0.12
R	PARK	491,234	11.28
S	PARK	571,956	13.13
T	PARK	46,021	1.02
U	PARK	29,642	0.68
V	PARK	2,564	0.06
SUBTOTAL			38.62

HOA TABLE

Lot	Description	Area(sf)	Area(ac)
AA	HOA	235,218	5.40
BB	HOA	50,919	1.17
BB-1	HOA	6,912	0.16
CC	HOA	97,317	2.23
DD	HOA	45,045	1.03
EE	HOA	80,956	1.86
FF	HOA	124,341	2.85
GG	HOA	35,146	0.81
HH	HOA	2,442	0.06
II	HOA	2,212	0.05
II-1	HOA	370	0.01
II-2	HOA	578	0.01
II-3	HOA	7,341	0.17
JJ	HOA	2,855	0.07
JJ-1	HOA	4,610	0.11
JJ-2	HOA	1,784	0.04
JJ-3	HOA	2,366	0.05
KK	HOA	1,552	0.04
KK-1	HOA	10,018	0.23
KK-2	HOA	11,611	0.27
KK-3	HOA	5,794	0.13
KK-4	HOA	593	0.01
LL	HOA	35,820	0.82
MM	HOA	30,056	0.69
NN	HOA	14,739	0.34
OO	HOA	26,161	0.60
PP	HOA	34,782	0.80
QQ	HOA	156,762	3.60
SS	HOA	13,238	0.30
TT	HOA	131,358	3.01
UU	HOA	28,861	0.66
VV	HOA	14,390	0.33
WW	HOA	45,153	1.04
WW-1	HOA	6,948	0.16
WW-2	HOA	1,982	0.05
WW-3	HOA	2,550	0.06
XX	HOA	61,025	1.41
XX-1	HOA	3,525	0.08
XX-2	HOA	3,232	0.07
XX-3	HOA	3,852	0.09
YY	HOA	7,646	0.18
SUBTOTAL			31.05

BMP BASIN TABLE

Lot	Description	Area(sf)	Area(ac)
AAA	BASIN	27,061	0.62
BBB	BASIN	25,469	0.58
CCC	BASIN	36,993	0.85
DDD	BASIN	74,761	1.72
EEE	BASIN	106,535	2.45
FFF	BASIN	30,946	0.71
GGG	BASIN	93,746	2.15
SUBTOTAL			9.08

OPEN SPACE TABLE

Lot	Description	Area(sf)	Area(ac)
HHH	OS	4,254,583	97.67
III	OS	628,627	14.43
JJJ	OS	515,787	11.84
KKK	OS	1,258,606	28.89
LLL	OS	334,887	7.69
MMM	OS	225,442	5.18
NNN	OS	43,497	1.00
ZZ	OS W/BMZ	242,490	5.57
ZZ-1	OS W/BMZ	19,915	0.46
ZZ-2	OS W/BMZ	309,388	7.10
ZZ-3	OS W/BMZ	6,698	0.15
ZZ-4	OS W/BMZ	12,226	0.28
SUBTOTAL			180.26

PRIVATE DRIVE TABLE

Lot	Description	Area(sf)	Area(ac)
OOO	PVT DRIVE	20,432	0.47
PPP	PVT DRIVE	2,385	0.05
QQQ	PVT DRIVE	60,414	1.39
SUBTOTAL		83,231	1.91

COMMERCIAL TABLE

Lot	Description	Area(sf)	Area(ac)
209	COMMERCIAL	408,794	9.39
SUBTOTAL		408,794	9.39

MULTIMODAL TABLE

Lot	Description	Area(sf)	Area(ac)
210	MULTIMODAL	58,842	1.35
SUBTOTAL		58,842	1.35

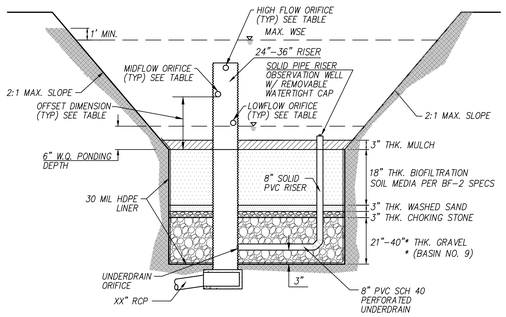
PUBLIC ROADS

	Description	Area(sf)	Area(ac)
ONSITE	PUBLIC ROW		54.96
COR-WEST	PUBLIC ROW		4.62
SUBTOTAL			59.58

Biofiltraion Orifice Design

Biofiltraion BMP#	Underdrain Orifice (in)	Low Flow Orifice		Mid Flow Orifice		High Flow Orifice		Overflow Weir/Riser	
		Dia. (in)	Offset (ft)*	Dia. (in)	Offset (ft)*	Dia. (in)	Offset (ft)*	Dia. (in)	Offset (ft)*
1	4	2	0.5	–	–	–	–	2	5
2	3	4	0.5	–	–	–	–	2	3
3	4	4	0.5	6	2	–	–	2	3
5	4	2-2in	0.5	2	2.5	4	3	2	3.5
6	4	2-2in	0.5	2-4in	2.1	2-4.8in	2.5	3	3.1
7	4	2-2in	0.5	3-4in	2	2-4.8in	2.5	3	2.8
8	4	2-4in	0.5	2-4in	1.5	–	–	2	2.5
9	4	4	0.5	4 & 2	1.5 & 2.5	3-4in	3.5	2	4.9

*OFFSET DIMENSIONS ARE DISTANCE FROM ORIFICE IE/WEIR TOP TO THE BOTTOM OF BASIN SURFACE LAYER (MULCH BOTTOM)



BIOFILTRATION BF-1
POLLUTANT CONTROL/
HYDROMODIFICATION/DETENTION BASIN (TYP.)
NOT TO SCALE

Stormwater Structural Pollutant Control & Hydromodification Control BMPs* (List all from SWQMP)

Description/Type of Structural BMP	Plan Sheet #	Structural BMP ID#	Bottom Area (S.F.)
BIOFILTRATION BF-1 POLLUTANT CONTROL/ HYDROMOD BASIN	4	BASIN 1	7,790
BIOFILTRATION BF-1 POLLUTANT CONTROL/ HYDROMOD BASIN	4	BASIN 2	7,670
BIOFILTRATION BF-1 POLLUTANT CONTROL/ HYDROMOD BASIN	4	BASIN 3	9,430
BIOFILTRATION BF-1 POLLUTANT CONTROL/ HYDROMOD DETENTION BASIN	4	BASIN 5	13,015
BIOFILTRATION BF-1 POLLUTANT CONTROL/ HYDROMOD DETENTION BASIN	5	BASIN 6	57,750
BIOFILTRATION BF-1 POLLUTANT CONTROL/ HYDROMOD DETENTION BASIN	5	BASIN 7	18,210
BIOFILTRATION BF-1 POLLUTANT CONTROL/ HYDROMOD DETENTION BASIN	5	BASIN 8	56,700
BIOFILTRATION BF-1 POLLUTANT CONTROL/ HYDROMOD DETENTION BASIN	5	BASIN 9	28,525

Stormwater Structural Pollutant Control & Hydromodification Control BMPs* (List all from SWQMP)

Description/Type of Structural BMP	Plan Sheet #	Structural BMP ID#
PROPRIETARY BMP MODULAR WTLAND SYSTEM	24	MWS 10-1
PROPRIETARY BMP MODULAR WTLAND SYSTEM	24	MWS 10-2
BIOFILTRATION MEDIAN	2, 24	BMP 11
HYDROMOD VAULT	24	BMP 12

3 ROOTS by Mesa Canyon Community Partners

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PROJECT NAME:
3 ROOTS

SHEET TITLE:
PARCEL SUMMARY

REVISION 14:
REVISION 13:
REVISION 12:
REVISION 11:
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REVISION 09:
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REVISION 07:
REVISION 06:
REVISION 05:
REVISION 04: 02/08/2019
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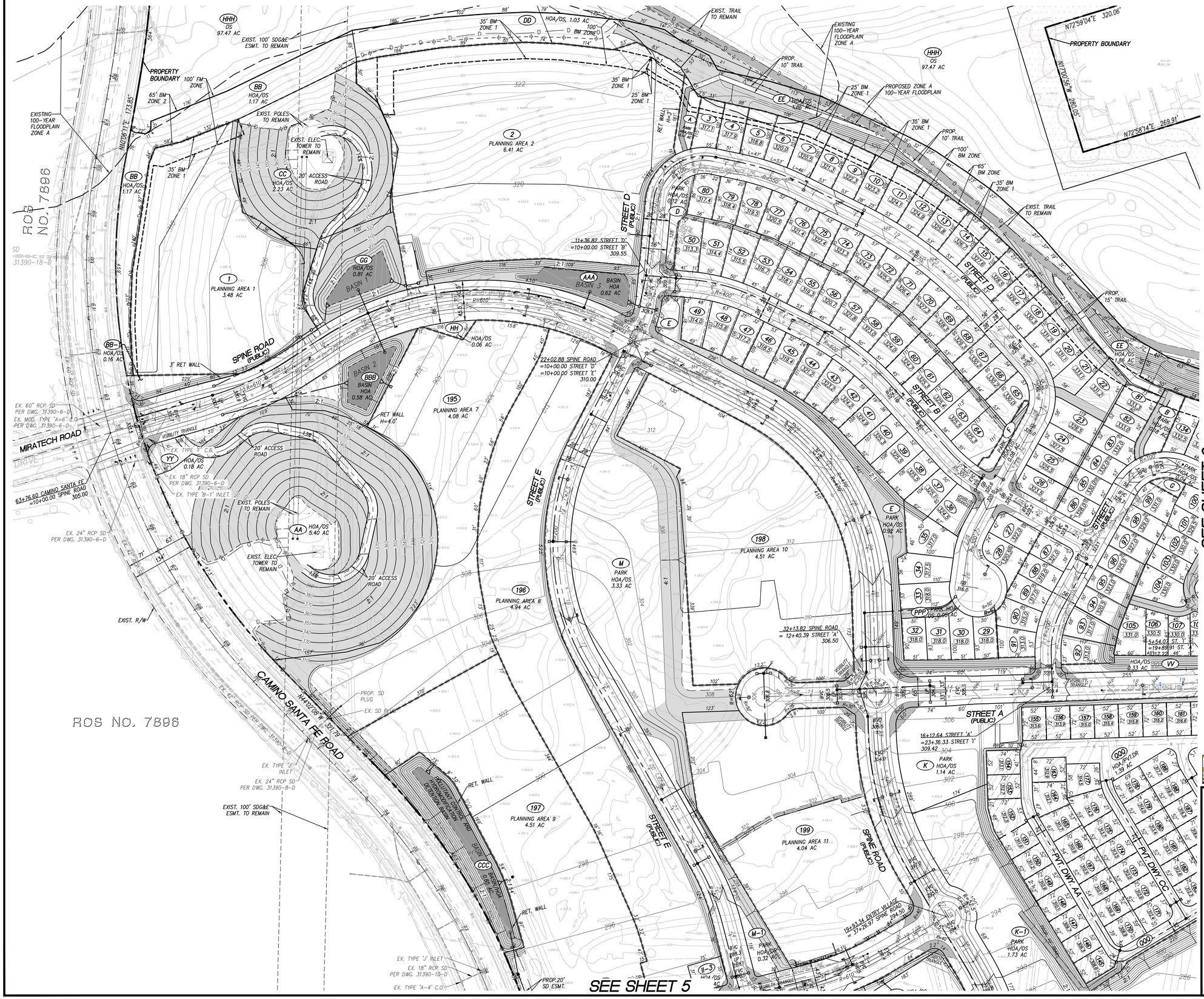
3 ROOTS VTM EXHIBIT 'A'

REZONE NO. 2069822/VESTING TENTATIVE MAP NO. 2069827/SITE DEVELOPMENT PERMIT NO. 2069825/ LAND USE PLAN NO. 2069831/PLANNED DEVELOPMENT PERMIT NO. 2068725/AMENDED CUP 87-2069822/PROJ. NO. 587128

NOTE: FOR WATER AND SEWER, SEE SHEETS 11-15.





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PROJECT ADDRESS:
SAN DIEGO, CALIFORNIA

PROJECT NAME:
3 ROOTS

SHEET TITLE:
SITE GRADING AND STORM DRAIN PLANS

REVISION 14:
REVISION 13:
REVISION 12:
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3 ROOTS VTM EXHIBIT 'A'

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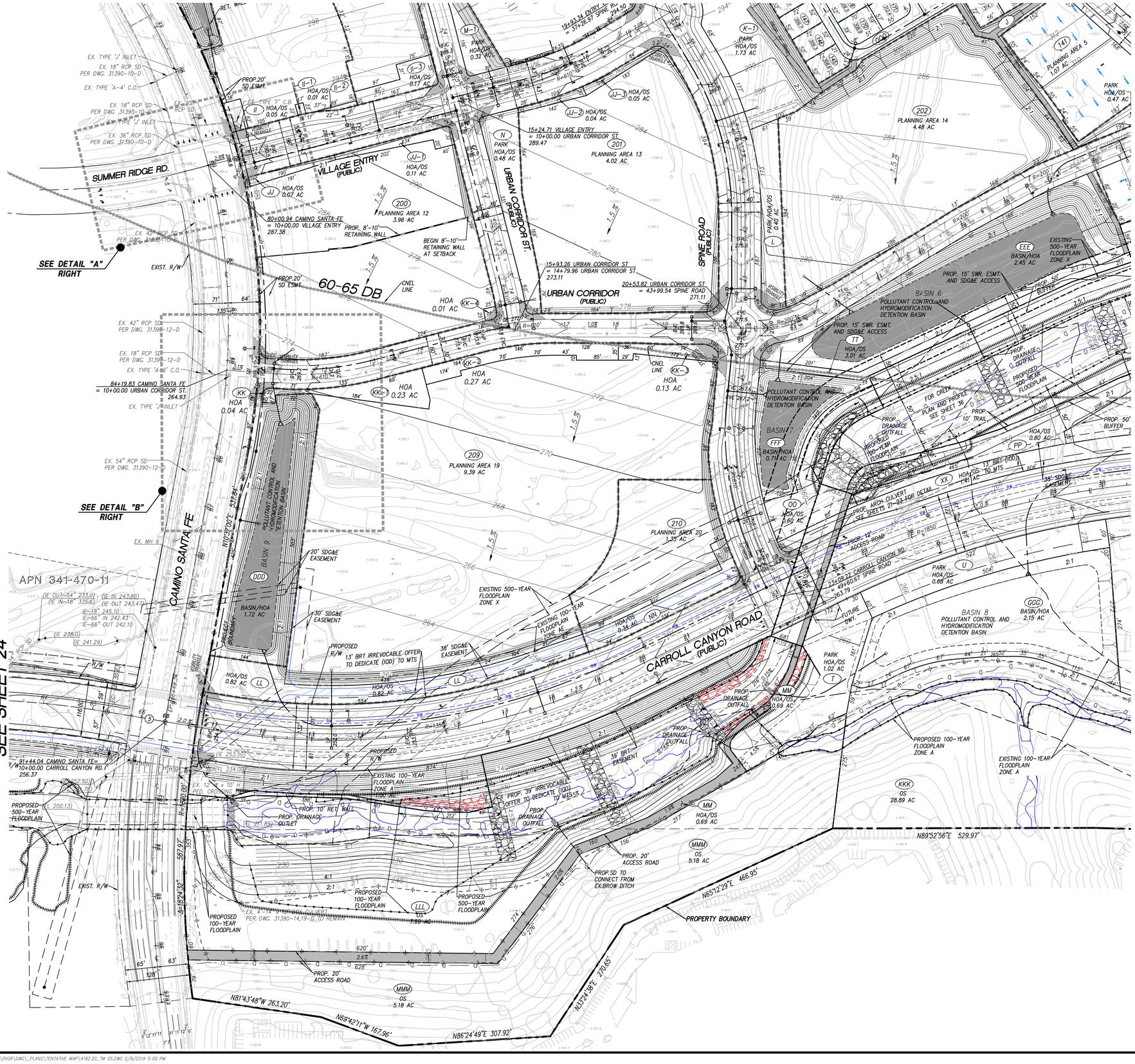
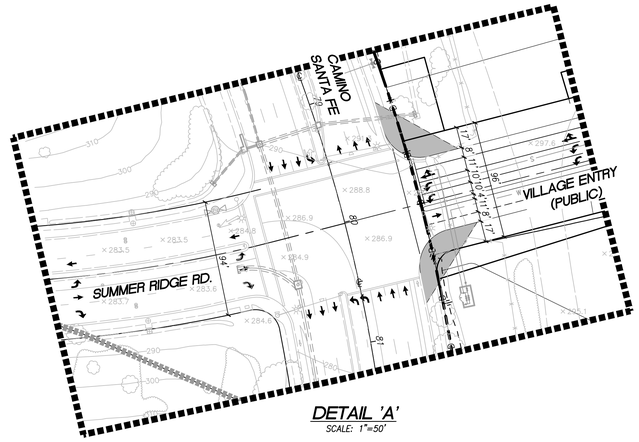
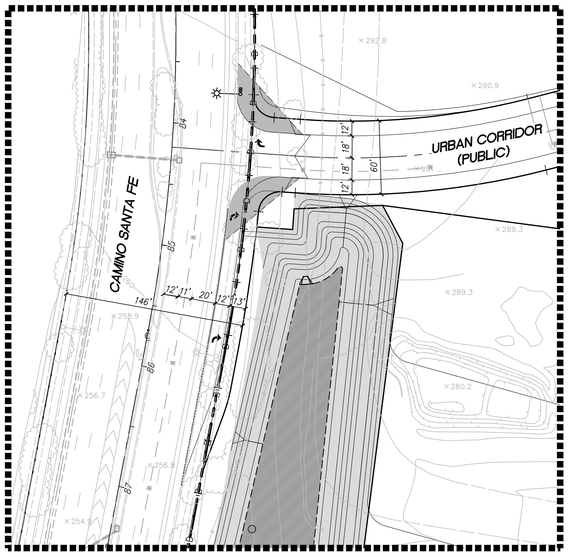
SEE SHEET 4





DETAIL 'A'
SCALE: 1"=50'



DETAIL 'B'
SCALE: 1"=50'

N

0 40 80 160 240

GRAPHICAL SCALE
SCALE: 1" = 80'

NOTE: FOR WATER AND SEWER, SEE SHEETS 11-15.

3 ROOTS by Mesa Canyon Community Partners

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PROJECT NAME:
3 ROOTS

SHEET TITLE:
SITE GRADING AND STORM DRAIN PLANS

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3 ROOTS VTM EXHIBIT 'A'

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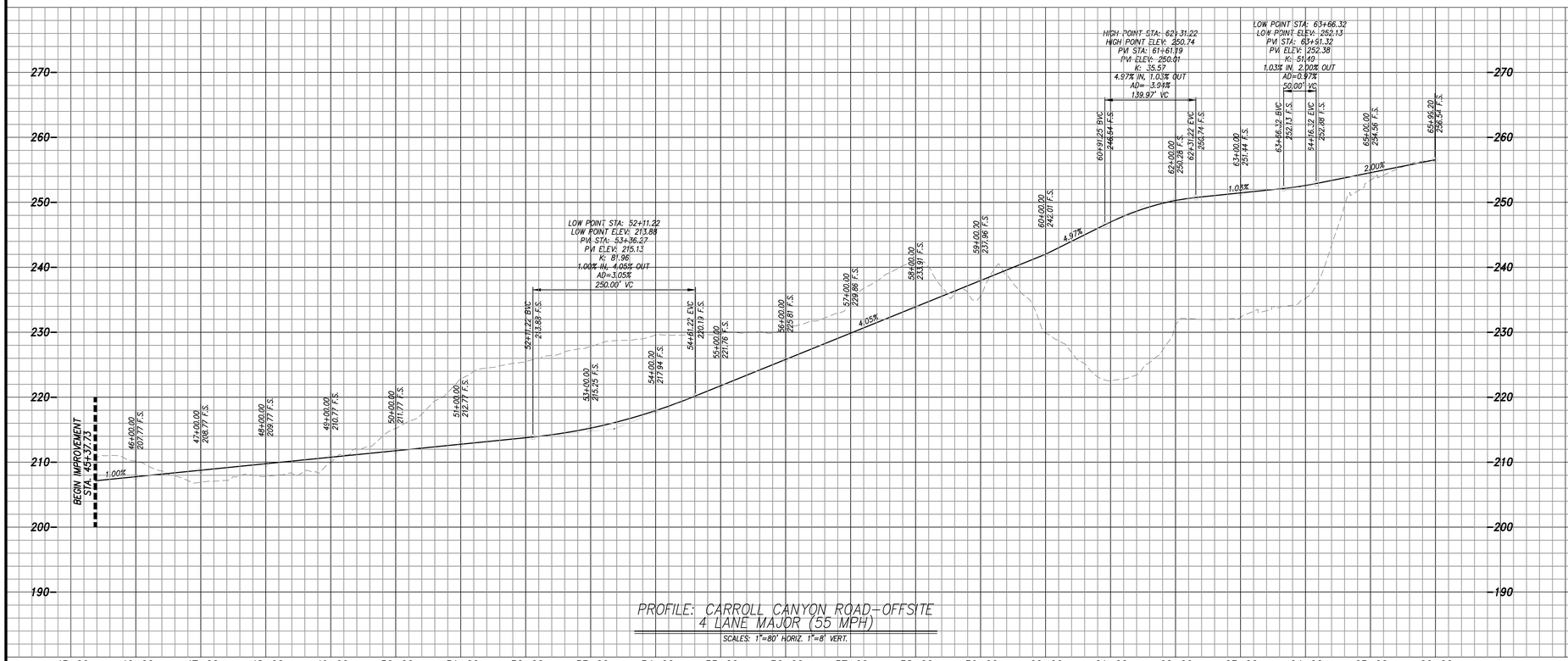
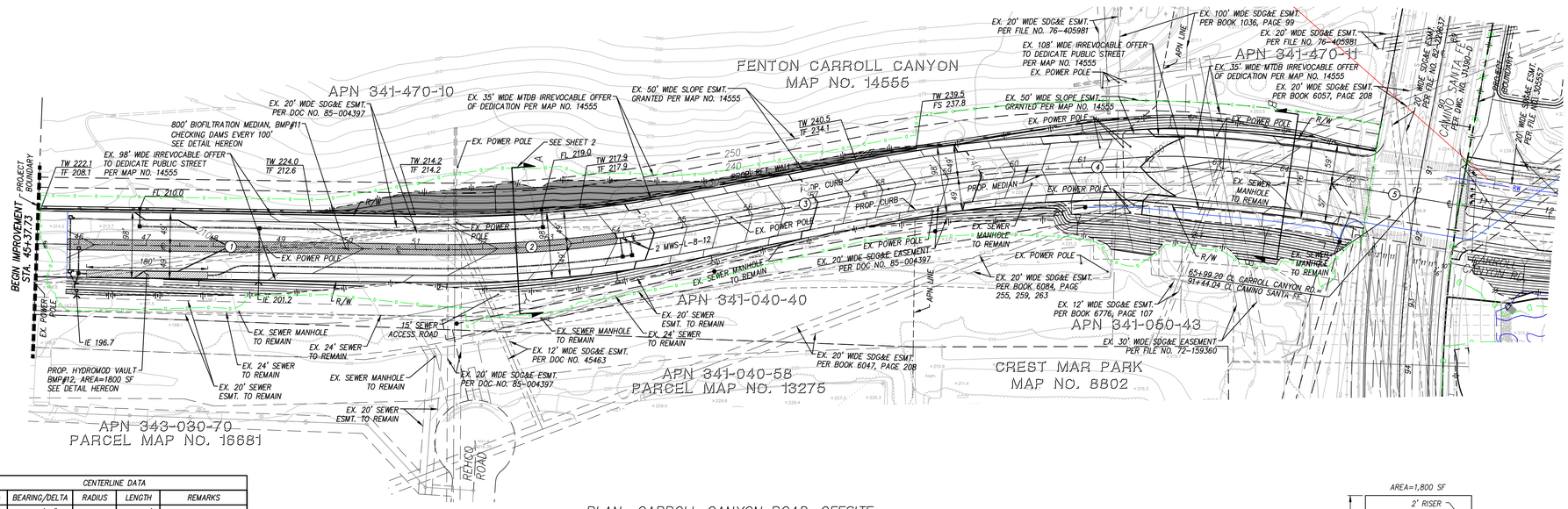


PROFILE: CARROLL CANYON ROAD-OFFSITE
4 LANE MAJOR (55 MPH)

SCALES: 1"=80' HORIZ. 1"=8' VERT.



CENTERLINE DATA				
NO	BEARING/DELTA	RADIUS	LENGTH	REMARKS
1	N 89°07'49" W	--	533.47'	-
2	Δ=11°30'13"	1900.00'	381.47'	-
3	N 79°21'01" E	--	312.16'	-
4	Δ=20°12'37"	1900.00'	670.20'	-
5	N 80°26'22" W	--	118.70'	-

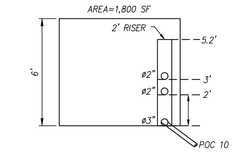
PLAN: CARROLL CANYON ROAD-OFFSITE
4 LANE MAJOR (55 MPH)

SCALE: 1"=80'

N

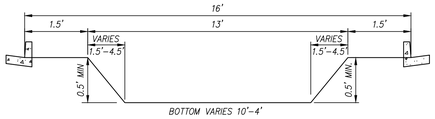
0 40 80 160 240

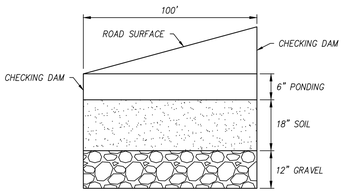
GRAPHICAL SCALE
SCALE: 1" = 80'



HYDROMOD VAULT DETAIL

SCALE: NTS





BIOFILTRATION MEDIAN DETAIL

SCALE: NTS

3ROOTS by Mesa Canyon Community Partners

PROJECT DESIGN CONSULTANTS

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PROJECT ADDRESS:
SAN DIEGO, CALIFORNIA

PROJECT NAME:
3 ROOTS

SHEET TITLE:
CARROLL CANYON ROAD (OFFSITE)
PLAN AND PROFILE

REVISION 14:
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REVISION 01: 03/26/2018
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ATTACHMENT 5
DRAINAGE REPORT

Attach project's drainage report. Refer to Drainage Design Manual to determine the reporting requirements.

ATTACHMENT 6
GEOTECHNICAL AND GROUNDWATER INVESTIGATION REPORT

Attach project's geotechnical and groundwater investigation report. Refer to Appendix C.4 to determine the reporting requirements.

PRELIMINARY GEOTECHNICAL INVESTIGATION FOR VESTING TENTATIVE MAP

3ROOTS
SAN DIEGO, CALIFORNIA

GEOCON
INCORPORATED

GEOTECHNICAL
ENVIRONMENTAL
MATERIALS

PREPARED FOR

LEHIGH HANSON
WEST REGION
SAN DIEGO, CALIFORNIA

AUGUST 31, 2017
PROJECT NO. G2070-42-01

GEOCON
INCORPORATED
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS

Project No. G2070-42-01
August 31, 2017

Lehigh Hanson
West Region
Post Office Box 639069
San Diego, California 92163

Attention: Mr. Marvin Howell

Subject: PRELIMINARY GEOTECHNICAL INVESTIGATION
FOR VESTING TENTATIVE MAP
3ROOTS
SAN DIEGO, CALIFORNIA

Dear Mr. Howell:

In accordance with your authorization, we have prepared this preliminary geotechnical investigation for the Vesting Tentative Map submittal for the subject project. The property is underlain by undocumented and compacted fills, alluvium/colluvium, and the Stadium Conglomerate Formation. The accompanying report presents the results of our limited study and our conclusions and recommendations regarding geotechnical aspects of site development. It is our opinion, based on the results of this study, that the site is suitable for the planned improvements.

Should you have questions regarding this investigation, or if we may be of further service, please contact the undersigned at your convenience.

Very truly yours,

GEOCON INCORPORATED

Rodney C. Mikesell
GE 2533

REGISTERED PROFESSIONAL ENGINEER
RODNEY C. MIKESELL
No.2533
GEOTECHNICAL
STATE OF CALIFORNIA

Troy K. Reist
CEG 2408

PROFESSIONAL GEOLOGIST
TROY K. REIST
No. 2408
CERTIFIED
ENGINEERING
GEOLOGIST
STATE OF CALIFORNIA

RCM:TKR:dmc

(1) Addressee
(3/del) Project Design Consultants
Attention: Ms. Marina Wurst
(1) Nuquest Ventures
Attention: Ms. Allegra Parisi

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PRELIMINARY GEOTECHNICAL INVESTIGATION

1. PURPOSE AND SCOPE

This report presents the results of our geotechnical investigation for the Tentative Map submittal for the 3Roots project within the Lehigh Hanson Carroll Canyon aggregate mine. The project site is generally located northeast of the intersection of Camino Santa Fe and Carroll Canyon Road in the Mira Mesa area of San Diego, California (see *Vicinity Map*, Figure 1). The purpose of the geotechnical investigation was to evaluate the surface and subsurface soil and geologic conditions and provide recommendations regarding the geotechnical aspects of developing the property for residential and commercial uses, including parks and infrastructure.

The scope of this study consisted of a review of readily available published and unpublished geologic literature (see List of References), drilling 10 large-diameter borings and 4 small-diameter borings, 48 backhoe trenches, soil sampling, laboratory testing, engineering analyses, and preparation of this report. The approximate locations of the borings and trenches are shown on the *Geologic Map*, Figure 2. Our scope also included a review of our summary compaction report documenting the placement of compacted fill that has occurred during reclamation grading (Reference No. 7).

Site geologic conditions depicted on the *Geologic Map* were plotted on an AutoCAD base map provided by Project Design Consultants. The plan depicts the proposed grading, existing topography, mapped geologic contacts, base of compacted fill elevations and the approximate locations of the exploratory excavations. *Geologic Cross-Sections* A-A' through K-K' (Figures 3 through 7) represent our interpretation of the geologic conditions across the site.

The conclusions and recommendations presented herein are based on our analysis of the data obtained from the exploratory field investigation, laboratory test results, review of compaction reports associated with reclamation grading which has occurred on the property, and our experience with similar soil and geologic conditions on this and adjacent properties.

2. SITE DESCRIPTION AND PREVIOUS GRADING

The project site consists of approximately 427 acres of partially graded and ungraded land located within the Lehigh Hanson aggregate mine area located in San Diego, California. The property has been utilized to mine aggregate (predominately the cobble from the Stadium Conglomerate formation) to produce sand and aggregate products since the early 1980's. Recently, active mining has ceased; however, a concrete batch plant and other tenants occupy portions of the property. Many of the conveyor belts and equipment along with numerous stockpiles of soil, aggregate, and recycled products are still present on the property.

Mining resulted in removal of rock and soil deposits resulting in deep excavations (over 100 feet), as well as relatively steep cut slopes (0.4:1 horizontal to vertical) within the northern portion of the property. The excavations were backfilled with waste materials generated during mining activities that have created relatively sharp differential fill thicknesses with abrupt near-vertical formational sidewall contacts.

Compaction testing has been performed by Geocon Incorporated on a periodic basis on the waste materials placed throughout the site from the early 1980's through March 2016. Compaction reports were prepared on an approximate quarterly to annual basis during fill placement. These reports were recently summarized into our report titled *Compaction Test Summary Report, Hanson Carroll Canyon Materials Plant, San Diego, California*, dated April 14, 2017. The summary report includes the previously submitted compaction test reports and approximate locations of the density tests taken.

Currently, minor grading is occurring in Area 5 (shown as light blue shaded area on Figure 2), located within the central portion of the site. The grading consists of removal of saturated fill to expose the native formational bedrock contact (Stadium Conglomerate) and placement of compacted fill. Compaction tests in this area will be summarized in a future report.

Fill depths are estimated to range from approximately 50 feet to 150 feet within the northwest portion of the property. Some of the fill is comprised of stockpiles (shown as green shaded areas on Figure 2) and a large undocumented fill berm (also shaded green) constructed along the northern property boundary. The stockpiles and most of the undocumented fill berm will be removed to reach proposed pad grades resulting in fill depths between 50 to 100.

Compacted fill was also placed during the reclamation grading operations along the southern portion of the site. The compacted fill is expected to range from between 20 and 80 feet thick, however, it is overlain by stockpiles approximately 5 to 10 feet thick. At the east end of the property approximately 20 to 30 feet of compacted fill was also placed, which is overlain by up to 70 feet of undocumented fill.

In the southeast portion of the site, previous waste ponds were infilled with undocumented fill (shown as light brown shaded areas on Figure 2). The undocumented fill was placed directly on compressible deposits that had accumulated in the pond area. The areas should be designated for non-structural areas until remedial measures are performed.

Areas located outside where reclamation grading operations where performed consist of compressible surficial deposits (i.e. undocumented fill, alluvium, colluvium) that will require remedial grading. The perimeter slopes to the north and south beyond the mined pit areas consist of native slopes.

A trunk sewer main currently crosses the northwest portion of the site. We expect portions of the sewer main will be left in-place and will need to be protected during grading. Other utility lines (gas, electric, water) that serve the existing tenants on the property and former mining activities exist across the property. We expect many of these utilities will be abandoned and relocated.

3. PROJECT DESCRIPTION

Based on planned finish grades, grading will consist of excavations up to 70 feet with fills up to approximately 80 feet to achieve the current desired grades, which will support approximately 1,800 residential units, mixed-use areas, parks, and infrastructure.

Based on preliminary information, the residential portion of the project will be comprised of both single-family attached and detached products. Some of the product will be multi-story apartments wrapped around parking structures. Affordable housing units are also planned. The mixed-use component is expected to consist of retail and office space. A transit station is also proposed.

Across the southern portion of the site a 25-acre community park is planned. In addition, several passive parks will be constructed within the property. Carroll Canyon Road (a 6-lane prime arterial roadway) will be extended from the current terminus west of Camino Ruiz to Camino Santa Fe. The project will also restore Carroll Canyon Creek by constructing drainage features that include a drainage channel, drop structures, and an arch undercrossing below Carroll Canyon Road. A pedestrian bridge across the creek drainage is also planned. Storm water management will be handled with basins planned at various locations on the property.

The locations and descriptions provided herein are based on a review of available information and preliminary plans prepared by Project Design Consultants. If project details change significantly from those described herein, Geocon Incorporated should be contacted to evaluate potential impacts with respect to the site soil and geologic conditions and to determine if the proposed changes will require revision of this report.

4. SOIL AND GEOLOGIC CONDITIONS

The site is underlain by undocumented fill, stockpiles of soil and aggregate products, compacted fill, alluvium, colluvium, and the Stadium Conglomerate Formation. The soil and geologic units are described below. The approximate lateral extent of surficial soils and geologic formational units are shown on the *Geologic Map*. *Geologic Cross-Sections* A-A′ through K-K′ (Figures 3 through 7) represent our interpretation of the geologic conditions across the site.

4.1 Undocumented Fill (Qudf)

Undocumented fill associated with previous mining and grading activities is present across the majority of the site. The undocumented fill thickness is expected to range from a few feet to 80 feet thick. The thicker undocumented fills exist in the northwest and east corners of the property; however, the majority of these deposits will be removed based on the current proposed pad grades. In some areas, we expect up to 5 to 10 feet of undocumented fill may exist below finish pad grade, which will require removal and recompaction.

Along the south portion of the site, finish grades are currently planned above current grades. Prior to placing fill, the undocumented fill will need to be removed and replaced within building pads roadway areas. Undocumented fill underlying the community park may be left in-place provided the area is designated as non-structural. However, any park improvements such as buildings and parking lots will require remedial measures. Additionally, the infilled pond areas, (shown as light brown shaded areas on Figure 2), will require remedial measures due to the presence of compressible deposits.

4.2 Compacted Fill (Qcf)

Compacted fill placed during reclamation grading is present within the northwest, southern, and eastern potions of the site. The compacted fill was tested during placement periodically by Geocon Incorporated (see Reference No. 7). Based on exploratory borings and laboratory testing performed for this study, the compacted fill has a low potential for loading-induced compression, and has good moisture content and density. The compacted fill is considered suitable for support of planned improvements in its existing condition. Prior to placing fill, the upper 12 inches of compacted fill should be reprocessed by scarifying, moisture conditioning and recompacting prior to placing additional fill or structural improvements.

4.3 Alluvium

Alluvium is present within the drainage area along the northern project perimeter and within the Carroll Canyon Creek drainage area. The alluvium where observed, consists of sand, silts and clays with varying amounts of cobble. The alluvium is considered compressible and should be removed and replaced as compacted fill within structural improvement areas.

4.4 Colluvium

Colluvium was encountered at the base and along the natural hillside at the east end of the property. The colluvium consists of loose, sandy clay with gravel and cobbles. The thickness of the colluvium was undetermined due to caving. The colluvium is compressible and will require removal within structural improvement areas.

4.5 Stadium Conglomerate (Tst)

The Eocene-age Stadium Conglomerate is the predominant formational unit on the site. This unit was the primary material mined to generate aggregate. In general, the Stadium Conglomerate consists of a dense to very dense, yellow to light brown, cobble conglomerate. The deposit contains a relatively high percentage of rounded cobble (up to approximately 60 percent by weight) embedded in a silty to clayey, fine to medium sand soil matrix. The cobble typically ranges in size from approximately 3 inches to 12 inches. The Stadium Conglomerate underlies the surficial soils on the property and is exposed on the north and south perimeter slopes. When excavated, the Stadium Conglomerate typically consists of *low* to *very low* expansive silty/clayey sands that possess good shear strength characteristics in either a natural or properly compacted condition. Cuts slopes within the Stadium Conglomerate typically possess adequate factors of safety. The Stadium Conglomerate is suitable for support of additional fill and structural loading.

5. GROUNDWATER

Groundwater was encountered in several borings within the southern portion of the property, which appears to be perched on the underlying Stadium Conglomerate. It is expected that groundwater will be encountered during remedial grading operations within the southern portion of the property, which may require temporary dewatering techniques. It is not uncommon for groundwater or seepage conditions to develop where none previously existed. Groundwater elevations are dependent on seasonal precipitation, irrigation, land use, among other factors, and vary as a result. Proper surface drainage will be important to future performance of the project.

6. GEOLOGIC HAZARDS

6.1 Faulting and Seismicity

Based on a review of geologic literature and experience with the soil and geologic conditions in the general area, it is our opinion that no known active or potentially active faults are located at the site.

Minor fault traces have been mapped with the northern portion of the site that traverse generally from east to west. The faults were observed during grading of the adjacent Fenton Technology Park project and during the recent mining operations. Undisturbed ferruginous mineral layers caused by long periods of weathering along the fault trace were observed along the faults. These layers are suggestive of ancient (pre-Holocene) pervasive groundwater conditions. The undisturbed character of these layers suggests the faults are inactive.

According to the computer program *EZ-FRISK (Version 7.65)*, six known active faults are located within a search radius of 50 miles from the property. The nearest known active fault is the Newport-Inglewood/Rose Canyon Fault Zone, located approximately 6 miles west of the site. The Newport-

Inglewood/Rose Canyon Fault Zone is the dominant source of potential ground motion. Earthquakes that might occur on the Newport-Inglewood/Rose Canyon Fault Zone or other faults within the southern California and northern Baja California area are potential generators of significant ground motion at the site. The estimated deterministic maximum earthquake magnitude and peak ground acceleration for the Newport-Inglewood/Rose Canyon Fault Zone are 7.5 and 0.36g, respectively. Table 6.1.1 lists the estimated maximum earthquake magnitude and peak ground acceleration for the most dominant faults in relationship to the site location. We calculated peak ground acceleration (PGA) using Boore-Atkinson (2008) NGA USGS 2008, Campbell-Bozorgnia (2008) NGA USGS 2008, and Chiou-Youngs (2007) NGA USGS 2008 acceleration-attenuation relationships.

TABLE 6.1.1
DETERMINISTIC SPECTRA SITE PARAMETERS

Fault Name	Distance from Site (miles)	Maximum Earthquake Magnitude (Mw)	Peak Ground Acceleration		
			Boore-Atkinson 2008 (g)	Campbell-Bozorgnia 2008 (g)	Chiou-Youngs 2007 (g)
Newport-Inglewood/Rose Canyon	6	7.5	0.31	0.28	0.36
Rose Canyon	6	6.9	0.27	0.26	0.30
Coronado Bank	20	7.4	0.19	0.13	0.16
Palos Verdes Connected	20	7.7	0.21	0.14	0.19
Elsinore	32	7.85	0.17	0.11	0.14
Earthquake Valley	39	6.8	0.10	0.06	0.06

We used the computer program *EZ-FRISK* to perform a probablilistic seismic hazard analysis. The computer program *EZ-FRISK* operates under the assumption that the occurrence rate of earthquakes on each mapped Quaternary fault is proportional to the fault slip rate. The program accounts for earthquake magnitude as a function of fault rupture length. Site acceleration estimates are made using the earthquake magnitude and distance from the site to the rupture zone. The program also accounts for uncertainty in each of following: (1) earthquake magnitude, (2) rupture length for a given magnitude, (3) location of the rupture zone, (4) maximum possible magnitude of a given earthquake, and (5) acceleration at the site from a given earthquake along each fault. By calculating the expected accelerations from considered earthquake sources, the program calculates the total average annual expected number of occurrences of site acceleration greater than a specified value. We utilized acceleration-attenuation relationships suggested by Boore-Atkinson (2008), Campbell-Bozorgnia (2008), and Chiou-Youngs (2007) in the analysis. Table 6.1.2 presents the site-specific probabilistic seismic hazard parameters including acceleration-attenuation relationships and the probability of exceedence.

TABLE 6.1.2
PROBABILISTIC SEISMIC HAZARD PARAMETERS

Probability of Exceedence	Peak Ground Acceleration		
	Boore-Atkinson, 2008 (g)	Campbell-Bozorgnia, 2008 (g)	Chiou-Youngs, 2008 (g)
2% in a 50 Year Period	0.47	0.40	0.46
5% in a 50 Year Period	0.34	0.29	0.33
10% in a 50 Year Period	0.26	0.22	0.24

While listing peak accelerations is useful for comparison of potential effects of fault activity in a region, other considerations are important in seismic design, including frequency and duration of motion and soil conditions underlying the site. Seismic design of the structures should be evaluated in accordance with the California Building Code (CBC) guidelines.

6.2 Ground Rupture

The risk associated with ground rupture hazard is very low due to the absence of active faults at the subject site.

6.3 Tsunamis and Seiches

The site is not located near the ocean or downstream of any large bodies of water. Therefore, the risk of tsunamis or seiches associated with the site is low.

6.4 Liquefaction and Seismically Induced Settlement

Provided removal and recompaction of undocumented fill and alluvium is performed as recommended in this report, the risk associated with soil liquefaction hazard at the site is low.

6.5 Landslides

Based on our review of published geologic maps for the site vicinity, it is our opinion landslides are not present at the property or at a location that could impact the site.

6.6 Geologic Hazard Category

Review of the 2008 *City of San Diego Seismic Safety Study, Geologic Hazards and Faults, Sheet 35*, indicates the site is mapped as Geologic Hazard Categories 51, 53, and 32. Category 51 is described as- *level mesas – underlain by terrace deposits and bedrock, nominal risk.* Category 53 is described

as-*level or sloping terrain, unfavorable geologic structure, low to moderate risk.* Category 32 listed under liquefaction is described as- *low potential – fluctuating groundwater, minor drainages.*

At the completion of grading, the site will be underlain by compacted fill overlying the Stadium Conglomerate Formation in structural improvement areas. The natural hillsides and cut slopes to the north and south consist of Stadium Conglomerate and are considered grossly stable.

7. EARTHWORK GRADING FACTORS

Estimates of embankment shrink or swell (bulk/shrink) factors are presented in Table 7 below. A discussion of these factors, and the level of accuracy associated with these estimates, is warranted. Bulk/shrink factors are based on comparing existing soil or rock conditions with expected final fill conditions. Numerous uncertainties are inherent with the analysis and its potential effect on site development costs should be considered when preparing budgets. Variations in natural soil density, as well as in compacted fill, render shrinkage and bulking value estimates very approximate.

For the existing conditions, the density (and moisture content) can vary by 10 to 20 percent. The geometry of differing soil deposits can vary significantly over relatively short distances. The depth and variability of the gravel, cobble, and boulder content can also vary abruptly over short distances. Due to these inherit inaccuracies in estimating bulk/shrink volumes, it is recommended that a site balance area be provided where grades can be adjusted to accommodate these uncertainties.

For fill areas, the degree of compaction that is achieved by the grading contractor may be significantly greater than the minimum required. As an example, the contractor can compact fills to any relative compaction of 90 percent or higher of the laboratory maximum dry density. Thus, the contractor has at least a 10 percent range of control over the fill volume. Overexcavation of the gravel-sand soils to generate capping material often occurs to facilitate the grading contractor's operation. The grading contractor can also undercut/overexcavate areas for *convenience yardage.*

Estimated ranges for percentage of shrinkage or bulking are presented in Table 7. For use in earthwork balancing, the midpoint (average) of these ranges is typically used in determining shrinkage and bulking amounts, and in balancing cut and fill volumes on the site. However, in addition to the use of the average shrinkage/bulking for balancing purposes, it is recommended that the upper and lower bounds of the earthwork factor ranges be used to *bracket* the range of estimated earthwork shrinkage and bulking. By using the upper and lower bounds, an estimate of the maximum deviation of earthwork quantities may be established. The resulting maximum deviation is for inherent errors relating to the variability in earthwork factors and does not include an allowance for variables that occur during construction such as site grading errors, or the other factors discussed above. In this regard, it is suggested that maximum and minimum values also be assigned to other

quantity estimates to permit a *worst-case* and *best-case* evaluation of balance site development costs. In addition, a *balance area* should be implemented as part of the grading plan to adjust final grades based on the final shrinkage/bulking factors.

TABLE 7
BULKING AND SHRINKAGE FACTORS

Soil Unit	Shrink/Bulk Factor
Alluvium and Colluvium	8 to 12 percent shrink
Undocumented fill	10 to 15 percent shrink
Compacted fill	2 percent shrink to 2 percent bulk
Stadium Conglomerate Formation	3 to 5 percent bulk

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 General

8.1.1 No soil or geologic conditions were observed that would preclude the development of the property as presently proposed provided that the recommendations of this report are followed.

8.1.2 The site is underlain by undocumented fill, stockpiles, compacted fill, alluvium and the Stadium Conglomerate formation. The undocumented fill and compacted fill ranges in depths of a few feet to 150 feet. Undocumented fill, stockpile fill, alluvium and colluvium is unsuitable for support of structural improvements and should be removed and replaced as compacted fill. Areas where undocumented fill, stockpile fill, alluvium or colluvium is left in-place should be designated as non-structural.

8.1.3 Based on exploratory borings, trenches, and laboratory testing, the compacted fill was observed to have relatively good moisture content and density. Consolidation curves indicate the fill has a low potential for loading induced compression. The compacted fill appears to be suitable in its present condition for support of new fill and/or structural loading. Additional borings should be performed once grading plans are prepared to further evaluate the suitability of the fill for support of the planned improvements.

8.1.4 Based on our experience and laboratory testing, we expect the majority of on-site soils to possess a very low to medium expansion potential. We also expect the soils to have a negligible sulfate exposure to concrete structures.

8.1.5 The soils are expected to be corrosive to buried metal. The corrosive nature of the soils should be considered in the design of buried metal pipes and underground structures.

8.1.6 We encountered groundwater in several of the borings. We expect removal excavations along the southern portion of the property will encounter groundwater perched on the Stadium Conglomerate. Dewatering methods and possible top-loading techniques may be needed to achieve removals.

8.1.7 With the exception of possible strong seismic shaking, no significant geologic hazards were observed or are known to exist on the site that would adversely affect the site. No special seismic design considerations, other than those recommended herein, are required.

8.1.8 Subsurface conditions observed may be extrapolated to reflect general soil/geologic conditions; however, some variations in subsurface conditions between trench and boring locations should be anticipated.

8.2 Soil and Excavation Characteristics

8.2.1 Excavation of the surficial soils should be possible with moderate to heavy effort using conventional heavy-duty equipment. Excavation of the Stadium Conglomerate may require very heavy effort with conventional heavy-duty grading equipment to excavate and may generate oversized material. Oversized rock (rocks greater than 12 inches in dimension) can be incorporated into deep fill areas.

8.2.2 Temporary slopes should be made in conformance with OSHA requirements. The Stadium Conglomerate can be considered Type A Soil (Type B where groundwater or seepage is encountered) in accordance with OSHA requirements. Compacted fill can be considered Type B soil (Type C were seepage is encountered). Undocumented fill, alluvium, and colluvium should be considered Type C soil.

8.2.3 It is the responsibility of the contractor to provide a safe excavation during the construction of the proposed project. In general, no special shoring requirement will be necessary if temporary excavations will be less than 4 feet high. Temporary excavations greater than 4 feet high should be laid back at an appropriate inclination. Surcharge loads should not be permitted within a distance equal to the height of the excavation from the top of the excavation. The top of the excavation should be at least 15 feet from the edge of existing improvements. Excavations steeper than those recommended or closer than 15 feet from an existing surface improvement should be shored in accordance with applicable OSHA codes and regulations.

8.2.4 Table 8.2.1 presents the allowable slope inclination for different soil types based on information presented by OSHA assuming seepage is not encountered.

TABLE 8.2.1
ALLOWABLE SLOPE INCLINATIONS FOR EXCAVATIONS LESS THAN 20 FEET FOR UNDERGROUND CONTRACTORS

Soil or Rock Type	On-Site Geologic Unit	Maximum Inclination (horizontal: vertical)	Maximum Slope Angle from Horizontal (degrees)
Type A	Stadium Conglomerate	¾:1	53
Type B	Properly Compacted Fill	1:1	45
Type C	Undocumented Fill and Surficial Soil	1½:1	34

8.2.5 The soil encountered in the field investigation is considered to be both "non-expansive" (expansion index [EI] of 20 or less) and "expansive" (EI greater than 20) as defined by 2016 California Building Code (CBC) Section 1803.5.3. Table 8.2.2 presents soil classifications based on the expansion index. Based on the laboratory test results, a majority of the soil encountered is expected to possess a "very low" to "medium" expansion potential.

TABLE 8.2.2
EXPANSION CLASSIFICATION BASED ON EXPANSION INDEX

Expansion Index (EI)	Expansion Classification	2016 CBC Expansion Classification
0 – 20	Very Low	Non-Expansive
21 – 50	Low	Expansive
51 – 90	Medium	
91 – 130	High	
Greater Than 130	Very High	

8.2.6 We performed laboratory tests on samples of the site materials to evaluate the percentage of water-soluble sulfate content. Results from laboratory testing indicate the on-site soils possess "Not Applicable" ("S0") sulfate exposure to concrete structures as defined by 2016 CBC Section 1904 and ACI 318-08 Sections 4.2 and 4.3. Table 8.2.3 presents a summary of concrete requirements set forth by 2016 CBC Section 1904 and ACI 318. Samples of near pad grade soils should be performed after the completion of grading. The presence of water-soluble sulfates is not a visually discernible characteristic; therefore, other soil samples from the site could yield different concentrations. Additionally, over time landscaping activities (i.e., addition of fertilizers and other soil nutrients) may affect the concentration.

TABLE 8.2.3
REQUIREMENTS FOR CONCRETE EXPOSED TO SULFATE-CONTAINING SOLUTIONS

Sulfate Exposure	Exposure Class	Water-Soluble Sulfate Percent by Weight	Cement Type	Maximum Water to Cement Ratio by Weight	Minimum Compressive Strength (psi)
Not Applicable	S0	0.00-0.10	--	--	2,500
Moderate	S1	0.10-0.20	II	0.50	4,000
Severe	S2	0.20-2.00	V	0.45	4,500
Very Severe	S3	> 2.00	V+Pozzolan or Slag	0.45	4,500

8.2.7 Based on our experience with the on-site soils, we expect the soils to be corrosive to buried metal. The corrosive nature of the soils should be considered in the design of buried metal pipes and underground structures. We performed laboratory tests on samples of selected samples to check the corrosion potential. A site is considered corrosive if the chloride concentration is 500 parts per million (ppm) or greater, sulfate concentration is 2,000 ppm (0.2%) or greater, or the pH is 5.5 or less according to Caltrans *Corrosion Guidelines,* dated September 2003. The laboratory test results are presented in Appendix B. Based on the laboratory test results and guidelines listed above, it is our opinion the site is considered corrosive with respect to buried metals.

8.2.8 Geocon Incorporated does not practice in the field of corrosion engineering; therefore, further evaluation by a corrosion engineer may be needed to incorporate the necessary precautions to avoid premature corrosion of underground pipes and buried metal in direct contact with soil.

8.3 Settlement Monitoring

8.3.1 Based on the proposed grading, the majority of the northwest portion of the site will require cuts to achieve pad grade. In the central portion of the site, fills between approximately 50 to 80 feet are planned. Along the southern portion of the property, proposed grading will result in additional fill thicknesses of approximately 10 to 20 feet above existing grades. We recommend settlement monuments be placed in areas where new fill thickness (fill plus remedial removals) exceeds 50 feet. The locations of monuments will be determined once the grading plans are available.

8.3.2 Remedial grading recommendations provided herein specify removal and compaction of undocumented fill, alluvium, and colluvium. As such, adverse settlement associated with compressible deposits will be mitigated where these soils are completely removed. Where groundwater is present, removal of the surficial soils may be limited. Where complete removals cannot be performed, settlement monitoring as discussed herein should be performed.

8.3.3 Figure 8 shows a typical settlement monument. We recommend surface settlement monuments be installed and monitored until the readings indicate settlement, as a result of fill placement, is essentially complete. The recommended locations of settlement monuments will be provided once finalized grading plans are available.

8.3.4 Settlement monuments should be surveyed on a weekly basis. We estimate a settlement period of 3 to 6 months. The surveyed results should be provided to Geocon Incorporated to evaluate when settlement has essentially ceased.

8.4 Subdrains

8.4.1 Canyon subdrains are not required for the project.

8.5 Grading Recommendations

8.5.1 All grading should be performed in accordance with the *Recommended Grading Specifications* contained in Appendix D. Where the recommendations of this section conflict with those of Appendix D, **the recommendations of this section take precedence**. All earthwork should be observed and all fill tested for proper compaction by Geocon Incorporated.

8.5.2 Prior to commencing grading, a preconstruction conference should be held at the site with the owner or developer, grading contractor, civil engineer, City of San Diego representatives, and geotechnical engineer in attendance. Special soil handling and/or the grading plans can be discussed at that time.

8.5.3 Site preparation should begin with the removal of all deleterious material and vegetation. The depth of removal should be such that material exposed in cut and fill areas, or soils to be used as fill are relatively free of organic matter. Material generated during stripping should be exported from the site.

8.5.4 All compressible soil deposits, including undocumented fill, stockpiles, alluvium and colluvium within areas where structural improvements and/or structural fill are planned should be removed to expose the underlying Stadium Conglomerate or compacted fill prior to placing additional fill and/or structural loads. The actual extent of unsuitable soil removals will be determined in the field during grading by the geotechnical engineer and/or engineering geologist. Areas where undocumented fill, alluvium, or colluvium will be left in-place should be identified as non-structural areas.

8.5.5 The upper surface elevation of documented compacted fill was not surveyed during reclamation grading. As such, the elevation at the top of documented fill is unknown. However, the estimated contact between documented and undocumented fill based on information from borings and trenches, and elevations from previous compaction testing is shown on the *Geologic Cross Sections*. For preliminary estimates, within areas of

documented compacted fill, the upper 5 feet of fill below proposed finish grade in cut and fill areas should be removed and recompacted in all structural improvement areas.

8.5.6 In areas outside of the limits of documented compacted fill where structural improvements will be constructed, all compressible surficial deposits should be removed to expose the underlying native Stadium Conglomerate bedrock and replaced as compacted fill. The approximate elevation of the bedrock contact and approximate thickness of remedial grading is shown on Figure 2. The estimated contact is shown on the *Geologic Cross Sections* based on interpolation between borings.

8.5.7 For the community park site along the south side of the project, we recommend the upper 2 feet of soil below proposed pad grade in cut areas and the upper 2 feet of existing soil in fill areas be removed and replaced as compacted fill. The park should be designated as nonstructural. Modified grading recommendations to provide engineered fill for support of structural improvements in the park can be provided in update reports once the location and type of structural improvement for the park is known.

8.5.8 In the pond area where uncompacted fill was placed over compressible pond deposits (shown as light brown shaded area on Figure 2), we expect significant settlement will occur. We recommend the compressible deposits either be completely removed and recompacted or the area surcharged with 10 feet of fill. If surcharging is planned, we recommend the upper 5 feet of soil below proposed finish grade be removed and replaced as compacted fill prior to surcharging. The upper 2 feet of the surcharge fill should also be compacted to 90 percent relative compaction to ensure compacted fill exists at the finish grade surface after settlement and removal of the stockpile. We expect several years of surcharging will be required to adequately compress the soil. Settlement monitoring as recommended in Section 8.3 of this report should be performed.

8.5.9 Removals within drainage areas and near toes of proposed fill slopes should extend horizontally beyond the edge of improvements a distance equal to the depth of removal. A typical detail of remedial grading beyond proposed grading is presented in Figure 9. The anticipated removal limits are shown in green on the *Geologic Map* and *Geologic Cross Sections*. Structural setbacks or modified recommendations may be required if remedial removals cannot extend laterally as recommended due to environmental constraints, especially along Carroll Canyon Creek.

8.5.10 Cut to fill transitions may occur as a result of grading within portions of the property. Additionally, lots with very large differential fill thicknesses will exists near the previous mined cut slope sidewall in the northwest portion of the property. To reduce the amount of

differential settlement, building pads and lots should be undercut at least 3 feet and sloped 1 percent to the adjacent street or deepest fill. Where the thickness of the fill below the building pad or lot exceeds 15 feet, the depth of the undercut should be increased to one-fifth of the maximum fill thickness. Lots requiring undercuts can be determined once grading plans have been prepared.

8.5.11 Prior to placing fill, the base of excavations and surface of compacted fill should be scarified; moisture conditioned as necessary and compacted. Fill soils may then be placed and compacted in layers to the design finish grade elevations. In general, on-site soils are suitable for re-use as fill if free from vegetation, debris and other deleterious material. Layers of fill should be no thicker than will allow for adequate bonding and compaction. All fill, including scarified ground surfaces and backfill, should be compacted to at least 90 percent of laboratory maximum dry density as determined by ASTM Test Procedure D 1557 at or slightly above optimum moisture content. Overly wet materials will require drying and/or mixing with drier soils to facilitate proper compaction.

8.5.12 The upper 3 feet of fill on all lots and streets should be composed of properly compacted *very low* to *low* expansive soils. Highly expansive soils, if encountered, should be placed in deeper fill areas and properly compacted. *Very low* to *low* expansive soils are defined as those soils that have an Expansion Index of 50 or less. Boulders, concretions, concrete chunks greater than 12 inches in maximum dimension should not be placed within 5 feet of finish grade or 3 feet from the deepest utility within streets. Specific recommendations for the placement of oversize rock is contained in the *Grading Specifications* contained in Appendix D.

8.5.13 Import fill (if necessary) should consist of granular materials with a *very low* to *low* expansion potential (EI of 50 or less), be free of deleterious material or stones larger than 3 inches, and should be compacted as recommended herein. Geocon Incorporated should be notified of the import soil source and should be authorized to perform laboratory testing of import soil prior to its arrival at the site to evaluate its suitability as fill material.

8.6 Slopes

8.6.1 Slope stability analyses were performed for proposed and existing cut and fill slopes for slope heights up to 100 feet (cut) and 60 feet (fill). The stability analyses were performed using simplified Janbu analysis. Our analyses utilized average drained direct shear strength parameters based on laboratory tests performed for this project and our experience with similar soils. The analyses indicate existing native perimeter slopes and proposed new cut and fill slopes will have calculated factors of safety in excess of 1.5 under static conditions

for both deep-seated failure and shallow sloughing conditions. A summary of slope stability analyses is presented on Figures 10 through 13.

8.6.2 All cut slope excavations should be observed during grading by an engineering geologist to verify that soil and geologic conditions do not differ significantly from those anticipated.

8.6.3 The outer 15 feet (or a distance equal to the height of the slope, whichever is less) of fill slopes should be composed of properly compacted granular *soil* fill to reduce the potential for surficial sloughing. All slopes should be compacted by backrolling with a loaded sheepsfoot roller at vertical intervals not to exceed 4 feet and should be track-walked at the completion of each slope such that the fill soils are uniformly compacted to at least 90 percent relative compaction to the face of the finished sloped.

8.6.4 All slopes should be landscaped with drought-tolerant vegetation, having variable root depths and requiring minimal landscape irrigation. In addition, all slopes should be drained and properly maintained to reduce erosion.

8.7 Settlement of Existing and Proposed Fills

8.7.1 Engineered fill was placed on the property between 1980 and 2016. The deepest fills are located in the northwest portion of the site in areas that will require cuts to achieve pad grade. Planned grading will result in the placement of up to approximately 80 feet of new fill in the central portion of the site with fills of approximately 10 to 30 feet in other areas. We expect post-grading settlement (hydro-compression) of properly compacted new fill with a thickness of approximately 80 feet to be between 3 to 4 inches. For fills that are approximately 10 to 30 feet thick, we expect post-grading settlement of about 1 to 2 inches. We expect the settlement will occur over 20+ years depending on the influx of rain and irrigation water into the fill mass. This settlement will likely be linear from the time the fill is placed to the end of the settlement period. We do not expect the settlement will impact proposed utilities with proposed gradients of 1 percent or greater. Foundations will need to be designed to accommodate post-construction settlement.

8.7.2 At the completion of grading, we expect some portions of the site will be underlain by approximately 100 feet of compacted fill that was placed during reclamation grading that has occurred over the past 15 years. With respect to post-construction settlement in areas where existing fills have been present for more than 5 years, we expect post-construction settlements as a result of hydro-compression to be on the order of 2.5 inches for fill thicknesses of approximately 100 feet.

8.7.3 Post-construction settlements for specific building pads and lots will be provided in update reports once grading plans have been prepared.

8.8 Seismic Design Criteria

8.8.1 We used the computer program *U.S. Seismic Design Maps*, provided by the USGS. Table 8.8.1 summarizes site-specific design criteria obtained from the 2016 California Building Code (CBC; Based on the 2015 International Building Code [IBC] and ASCE 7-10), Chapter 16 Structural Design, Section 1613 Earthquake Loads. The short spectral response uses a period of 0.2 second. The building structure and improvements should be designed using a Site Class D. We evaluated the Site Class based on the discussion in Section 1613.3.2 of the 2016 CBC and Table 20.3-1 of ASCE 7-10. The values presented in Table 8.8.1 are for the risk-targeted maximum considered earthquake (MCE_R).

TABLE 8.8.1
2016 CBC SEISMIC DESIGN PARAMETERS

Parameter	Value	2016 CBC Reference
Site Class	D	Table 1613.5.2
Spectral Response – Class B (0.2 sec), S_S	0.971 g	Figure 1613.5(3)
Spectral Response – Class B (1 sec), S_1	0.375 g	Figure 1613.5(4)
Site Coefficient, F_a	1.111	Table 1613.5.3(1)
Site Coefficient, F_v	1.651	Table 1613.5.3(2)
Maximum Considered Earthquake Spectral Response Acceleration (0.2 sec), S_{MS}	1.080 g	Section 1613.5.3 (Eqn 16-36)
Maximum Considered Earthquake Spectral Response Acceleration – (1 sec), S_{M1}	0.618 g	Section 1613.5.3 (Eqn 16-37)
5% Damped Design Spectral Response Acceleration (0.2 sec), S_{DS}	0.720 g	Section 1613.5.4 (Eqn 16-38)
5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.412 g	Section 1613.5.4 (Eqn 16-39)

8.8.2 Table 8.8.2 presents additional seismic design parameters for projects located in Seismic Design Categories D through F in accordance with ASCE 7-10 for the mapped maximum considered geometric mean (MCE_G).

TABLE 8.8.2
2016 CBC SEISMIC DESIGN PARAMETERS

Parameter	Value	ASCE 7-10 Reference
Mapped MCE_G Peak Ground Acceleration, PGA	0.387 g	Figure 22-7
Site Coefficient, F_{PGA}	1.113	Table 11.8-1
Site Class Modified MCE_G Peak Ground Acceleration, PGA_M	0.431g	Section 11.8.3 (Eqn 11.8-1)

8.8.3 Conformance to the criteria in Tables 8.8.1 and 8.8.2 for seismic design does not constitute any kind of guarantee or assurance that significant structural damage or ground failure will not occur if a maximum level earthquake occurs. The primary goal of seismic design is to protect life and not to avoid all damage, since such design may be economically prohibitive.

8.9 Foundations

8.9.1 We expect the site, at the completion of grading, will be suitable for the use of shallow post-tensioned or mat slab foundations. Foundation recommendations will be provided in update reports based on proposed structures and final grading plans.

8.9.2 We expect footings may be designed for an allowable soil bearing pressure of 2,000 psf (dead plus live loads). The soil bearing pressure may be increased by 300 psf and 500 psf for each additional foot of foundation width and depth, respectively, up to a maximum allowable soil bearing pressure of 4,000 psf. The allowable bearing pressure may be increased by up to one-third when considering transient loading such as those due to wind or seismic forces.

8.9.3 Foundations will need to be designed to accommodate both static settlement as a result of building loading and hydro-compression. Estimated total and differential fill settlements for specific building pads and project areas will be provided in update reports once grading plans have been prepared.

8.10 Slope Maintenance

8.10.1 Slopes that are steeper than 3:1 (horizontal:vertical) may, under conditions which are both difficult to prevent and predict, be susceptible to near surface (surficial) slope instability. The instability is typically limited to the outer three feet of a portion of the slope and usually does not directly impact the improvements on the pad areas above or below the slope. The occurrence of surficial instability is more prevalent on fill slopes and is

generally preceded by a period of heavy rainfall, excessive irrigation, or the migration of subsurface seepage. The disturbance and/or loosening of the surficial soils, as might result from root growth, soil expansion, or excavation for irrigation lines and slope planting, may also be a significant contributing factor to surficial instability. It is, therefore, recommended that, to the maximum extent practical: (a) disturbed/loosened surficial soils be either removed or properly recompacted, (b) irrigation systems be periodically inspected and maintained to eliminate leaks and excessive irrigation, and (c) surface drains on and adjacent to slopes be periodically maintained to preclude ponding or erosion. It should be noted that although the incorporation of the above recommendations should reduce the potential for surficial slope instability, it will not eliminate the possibility, and, therefore, it may be necessary to rebuild or repair a portion of the project's slopes in the future.

8.11 Storm Water Management

8.11.1 If storm water management devices are not properly designed and constructed, there is a risk for distress to improvements and property located hydrologically down gradient or adjacent to these devices. Factors such as the amount of water being detained, its residence time, and soil permeability have an important effect on seepage transmission and the potential adverse impacts that may occur if the storm water management features are not properly designed and constructed. We have not performed a hydrogeological study at the site. If infiltration of storm water runoff into the subsurface occurs, downstream improvements may be subjected to seeps, springs, slope instability, raised groundwater, movement of foundations and slabs, or other undesirable impacts as a result of water infiltration.

8.11.2 We performed an infiltration study on the property. A summary of our study and storm water management recommendations are provided in Appendix C. Based on the results of our study, full and partial infiltration is considered infeasible due to the presence of deep fills and the dense nature of the Stadium Conglomerate Formation. Basins should utilize a liner to prevent infiltration from causing adverse settlement, migrating to adjacent slopes, utilities, and foundations.

8.12 Site Drainage and Moisture Protection

8.12.1 Adequate site drainage is critical to reduce the potential for differential soil movement, erosion and subsurface seepage. Under no circumstances should water be allowed to pond adjacent to footings. The site should be graded and maintained such that surface drainage is directed away from structures in accordance with 2016 CBC 1803.3 or other applicable standards. In addition, surface drainage should be directed away from the top of slopes into

swales or other controlled drainage devices. Roof and pavement drainage should be directed into conduits that carry runoff away from the proposed structure.

8.12.2 In the case of basement walls or building walls retaining landscaping areas, a water-proofing system should be used on the wall and joints, and a Miradrain drainage panel (or similar) should be placed over the waterproofing. The project architect or civil engineer should provide detailed specifications on the plans for all waterproofing and drainage.

8.12.3 Underground utilities should be leak free. Utility and irrigation lines should be checked periodically for leaks, and detected leaks should be repaired promptly. Detrimental soil movement could occur if water is allowed to infiltrate the soil for prolonged periods of time.

8.12.4 Landscaping planters adjacent to paved areas are not recommended due to the potential for surface or irrigation water to infiltrate the pavement's subgrade and base course. We recommend that subdrains to collect excess irrigation water and transmit it to drainage structures, or impervious above-grade planter boxes be used. In addition, where landscaping is planned adjacent to the pavement, we recommend construction of a cutoff wall along the edge of the pavement that extends at least 6 inches below the bottom of the base material.

8.13 Grading and Foundation Plan Review

8.13.1 Geocon Incorporated should review the grading plans and foundation plans for the project prior to final design submittal to evaluate whether additional analyses and/or recommendations are required.

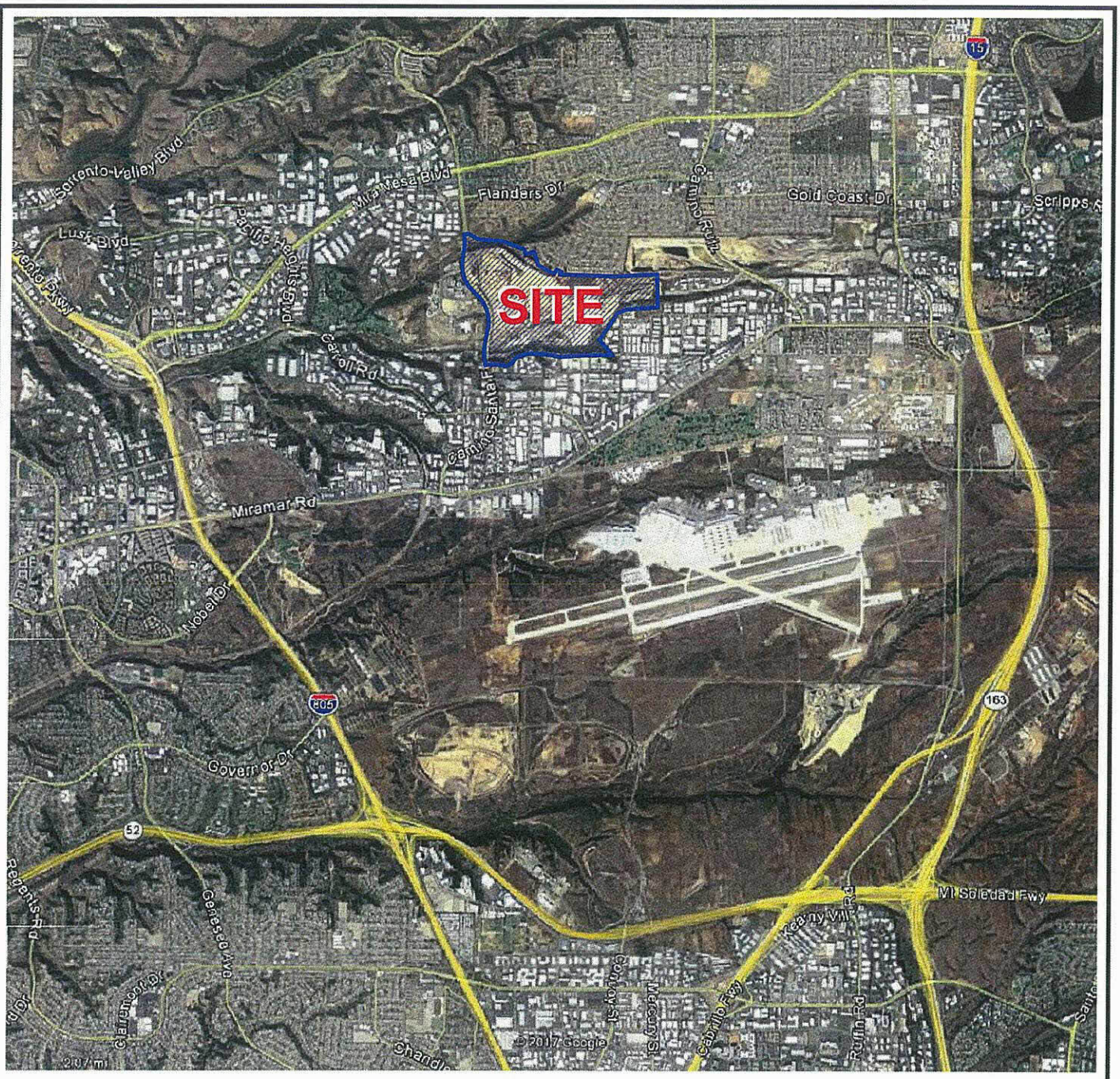
LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The firm that performed the geotechnical investigation for the project should be retained to provide testing and observation services during construction to provide continuity of geotechnical interpretation and to check that the recommendations presented for geotechnical aspects of site development are incorporated during site grading, construction of improvements, and excavation of foundations. If another geotechnical firm is selected to perform the testing and observation services during construction operations, that firm should prepare a letter indicating their intent to assume the responsibilities of project geotechnical engineer of record. A copy of the letter should be provided to the regulatory agency for their records. In addition, that firm should provide revised recommendations concerning the geotechnical aspects of the proposed development, or a written acknowledgement of their concurrence with the recommendations presented in our report. They should also perform additional analyses deemed necessary to assume the role of Geotechnical Engineer of Record.

2. The recommendations of this report pertain only to the site investigated and are based upon the assumption that the soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon Incorporated should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon Incorporated.

3. This report is issued with the understanding that it is the responsibility of the owner or his representative to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

4. The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.



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N

NO SCALE

VICINITY MAP

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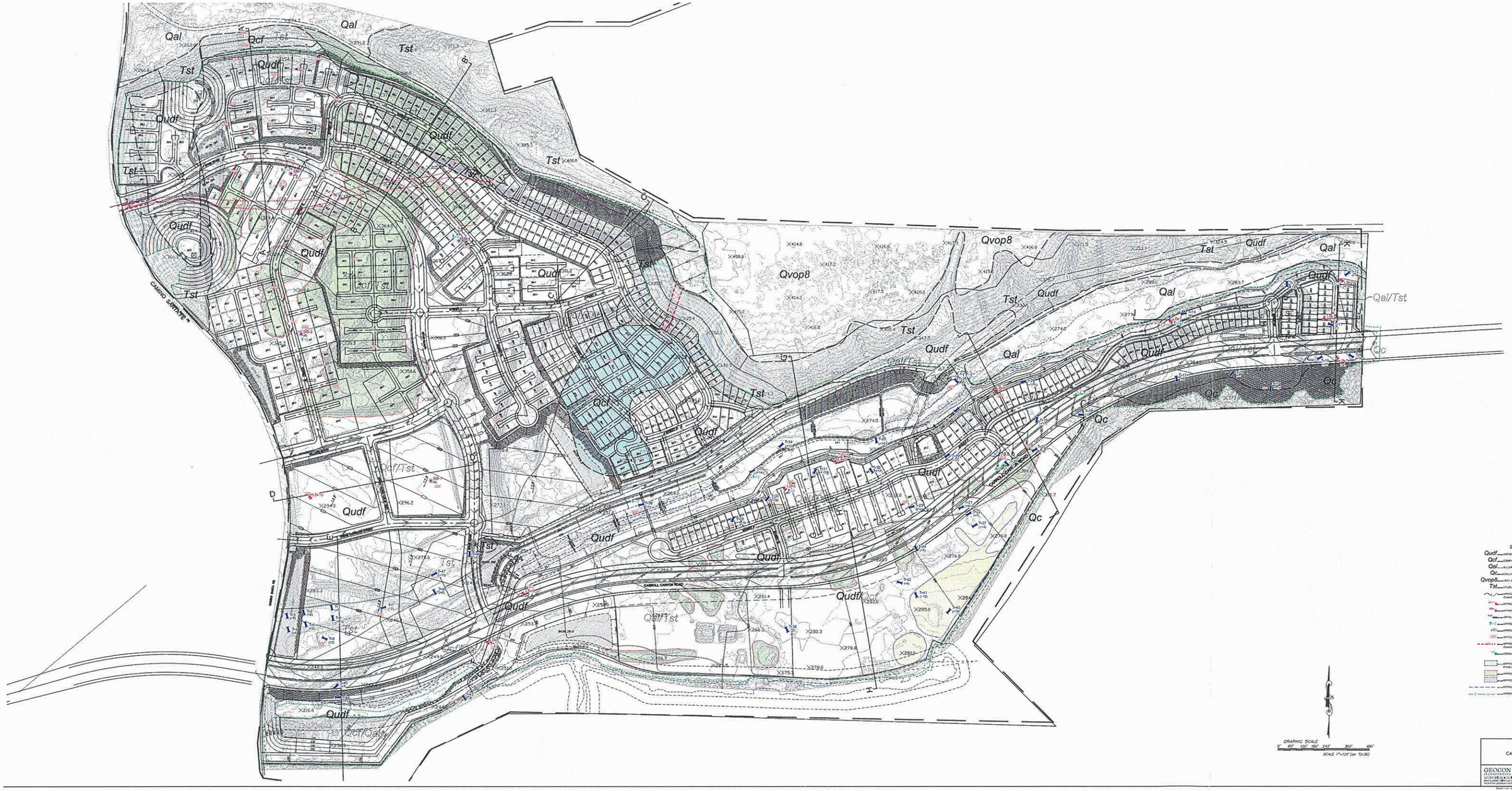
CARROLL CANYON MATERIALS PLANT
SAN DIEGO, CALIFORNIA

RM / AML		DSK/GTYPD

DATE 08 - 31 - 2017	PROJECT NO. G2070 - 42 - 01	FIG. 1

Plotted:08/30/2017 4:30PM | By:ALVIN LADRILLONO | File Location:Y:\PROJECTS\G2070-42-01 (Cantera)\DETAILS\G2070-42-01 Vic Map.dwg



GEOCON LEGEND

Qudf — UNDOCUMENTED FILL

Qcf — COMPACTED FILL

Qal — ALLUVIUM

Qc — COLLUVIUM

Qvop8 — VERY OLD PARALIC DEPOSITS

Tst — STADIUM CONGLOMERATE

APPROX. LOCATION OF GEOLOGIC CONTACT (Dashed Where Buried; Queried Where Uncertain)

APPROX. LOCATION OF EARLIER EXCAVATION BOUNDARY

APPROX. LOCATION OF EARLIER EXPLORATORY BORINGS

APPROX. DEPTH TO BEDROCK/GROUNDWATER (In Feet)

APPROX. THICKNESS OF REMAINING GRADING (In Feet)

APPROX. ELEVATION OF CONTACT BETWEEN CONSOLIDATED

APPROX. LOCATION OF PACIFIC PLANT (Dashed Where Buried; Queried Where Uncertain)

APPROX. LOCATION OF BUTTONWILLOW TEST

APPROX. LIMITS OF OVERLYING ARTIFICIAL FILL, BUT TOO THIN TO SHOW AT THIS SCALE

APPROX. LIMITS OF STOCKPILE

APPROX. AREA OF CURRENT GRADING

APPROX. LIMITS OF ENVIRONMENTAL SENSITIVE AREA

APPROX. LIMITS OF MINERAL CRACKING/SETTLEMENT AREA

GEOLOGIC MAP

CARROLL CANYON MATERIALS PLANT
SAN DIEGO, CALIFORNIA

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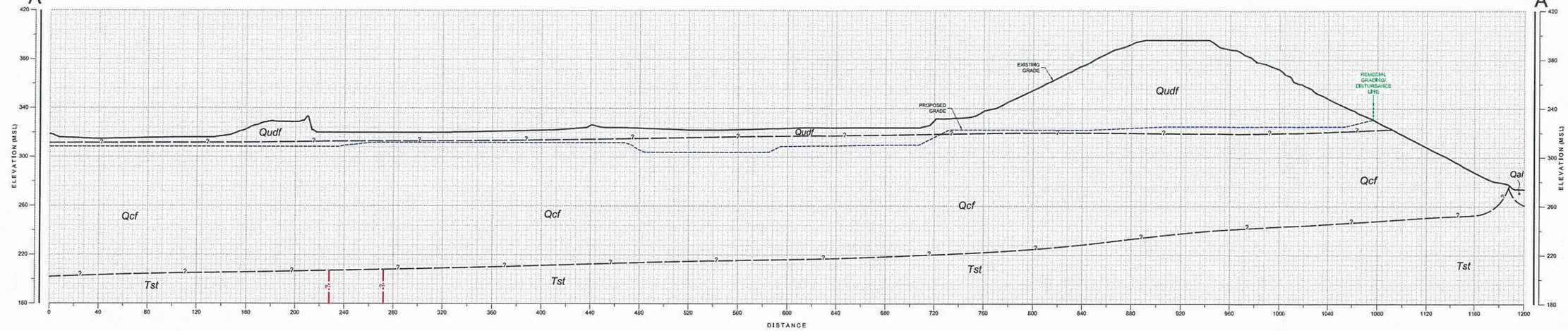
SCALE: 1"= 120' | DATE: 08-31-20

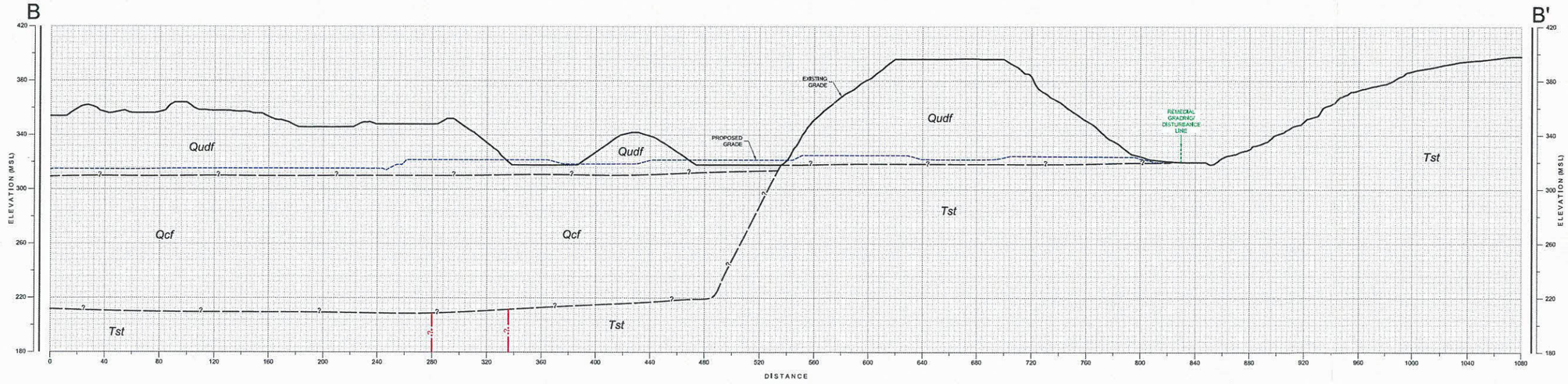
PROJECT NO. 02075-42-21 | REV. 2

SHEET 1 OF 1



GEOLOGIC CROSS-SECTION A-A'

SCALE: 1" = 40' (Vert. = Horiz.)



GEOLOGIC CROSS-SECTION B-B'

SCALE: 1" = 40' (Vert. = Horiz.)

GEOCON LEGEND

- Qudf ..... UNDOCUMENTED FILL
- Qcf ..... COMPACTED FILL
- Qal ..... ALLUVIUM
- Qc ..... COLLUVIUM
- Tst ..... STADIUM CONGLOMERATE
- ..... APPROX. LOCATION OF GEOLOGIC CONTACT (Queried Where Uncertain)
- LB-10 ..... APPROX. LOCATION OF LARGE DIAMETER BORING
- SB-1 ..... APPROX. LOCATION OF SMALL DIAMETER BORING
- T-1 ..... APPROX. LOCATION OF EXPLORATORY TRENCH
- ..... APPROX. LOCATION OF INACTIVE FAULT

GEOLOGIC CROSS SECTION

CARROLL CANYON MATERIALS PLANT
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SCALE	1" = 40'
DATE	08 - 31 - 2017
PROJECT NO.	G2070 - 42 - 01
FIGURE	3
SHEET	1 OF 5

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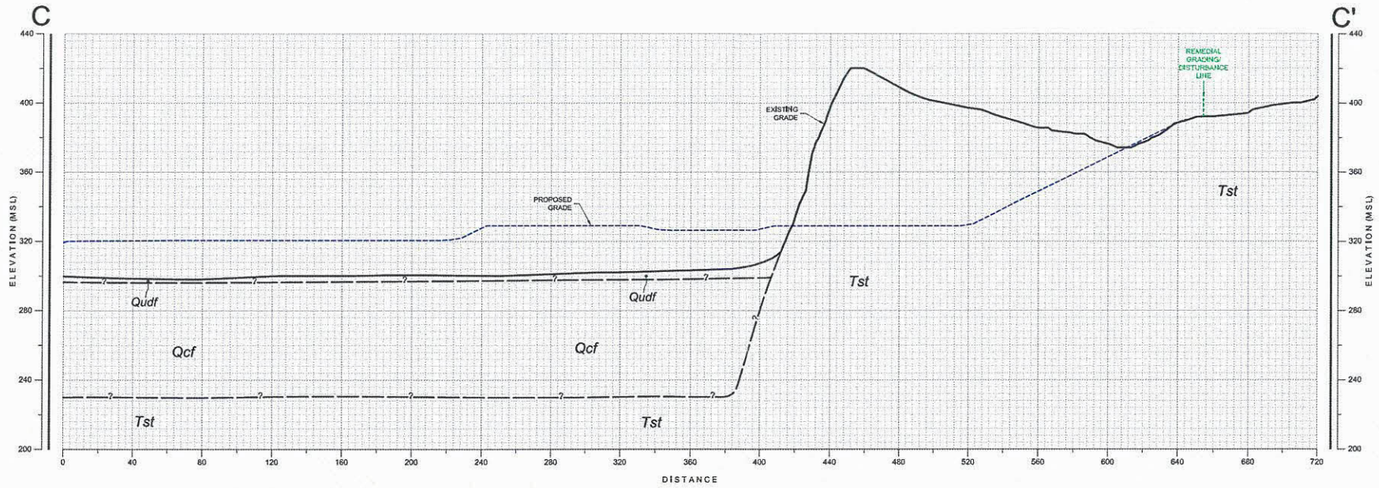
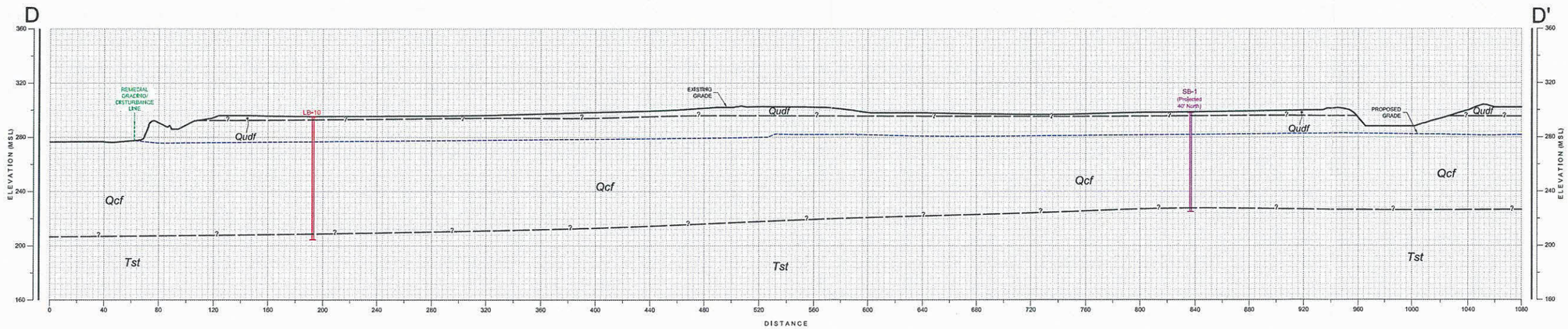


GEOLOGIC CROSS-SECTION C-C'

SCALE: 1" = 40' (Vert. = Horiz.)



GEOLOGIC CROSS-SECTION D-D'

SCALE: 1" = 40' (Vert. = Horiz.)

GEOCON LEGEND

- Qudf ..... UNDOCUMENTED FILL
- Qcf ..... COMPACTED FILL
- Qal ..... ALLUVIUM
- Qc ..... COLLUVIUM
- Tst ..... STADIUM CONGLOMERATE
- ..... APPROX. LOCATION OF GEOLOGIC CONTACT (Queried Where Uncertain)
- LB-10 ..... APPROX. LOCATION OF LARGE DIAMETER BORING
- SB-1 ..... APPROX. LOCATION OF SMALL DIAMETER BORING
- T-34 ..... APPROX. LOCATION OF EXPLORATORY TRENCH
- ..... APPROX. LOCATION OF INACTIVE FAULT

GEOLOGIC CROSS SECTION

CARROLL CANYON MATERIALS PLANT
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SCALE	1" = 40'	DATE	08 - 31 - 2017
PROJECT NO.	G2070 - 42 - 01	FIGURE	4
SHEET	2 OF 5		

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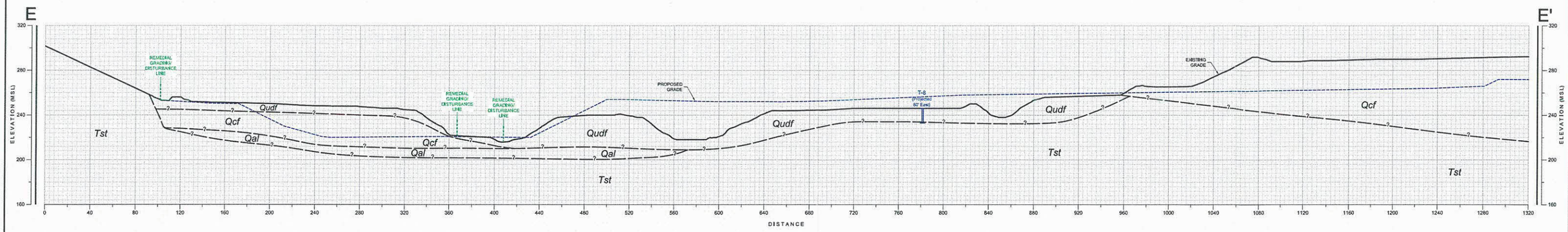
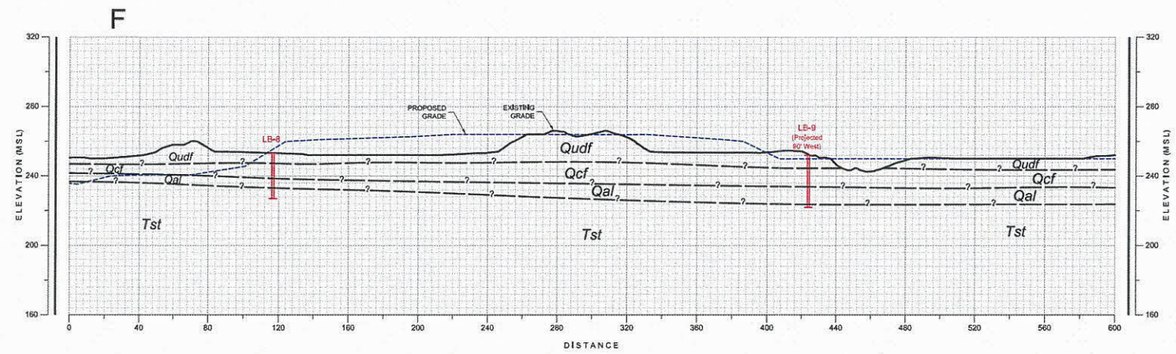


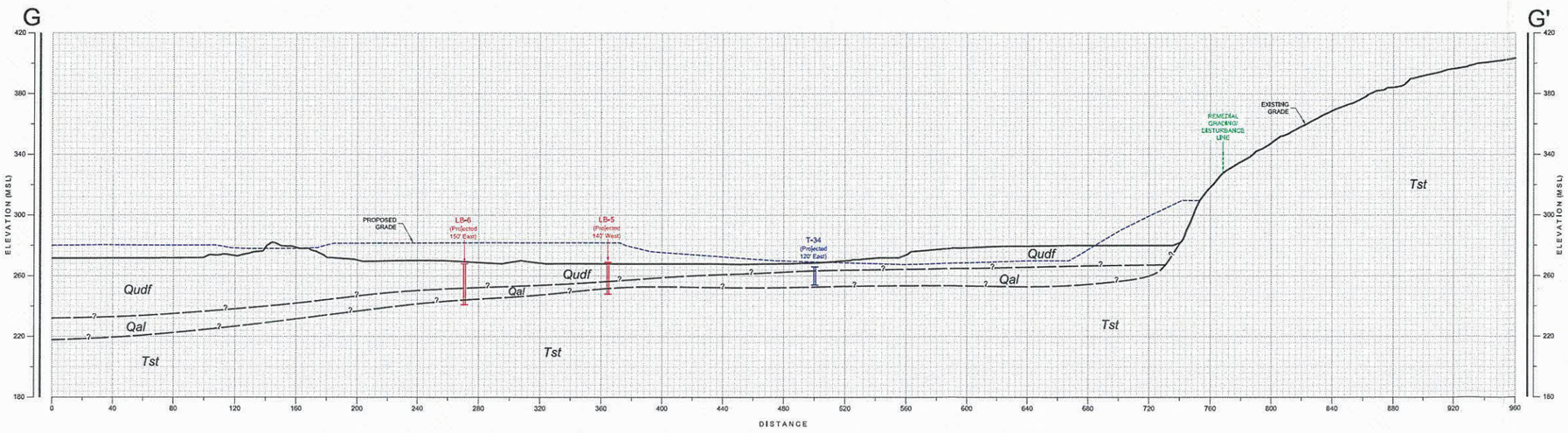
GEOLOGIC CROSS-SECTION E-E'

SCALE: 1" = 40' (Vert. = Horiz.)



GEOLOGIC CROSS-SECTION F-F'

SCALE: 1" = 40' (Vert. = Horiz.)



GEOLOGIC CROSS-SECTION G-G'

SCALE: 1" = 40' (Vert. = Horiz.)

GEOCON LEGEND

- Qudf ..... UNDOCUMENTED FILL
- Qcf ..... COMPACTED FILL
- Qal ..... ALLUVIUM
- Qc ..... COLLUVIUM
- Tst ..... STADIUM CONGLOMERATE
- ~?~ ..... APPROX. LOCATION OF GEOLOGIC CONTACT (Queried Where Uncertain)
- LB-10 ..... APPROX. LOCATION OF LARGE DIAMETER BORING
- SB-1 ..... APPROX. LOCATION OF SMALL DIAMETER BORING
- T-34 ..... APPROX. LOCATION OF EXPLORATORY TRENCH
- -?- ..... APPROX. LOCATION OF INACTIVE FAULT

GEOLOGIC CROSS SECTION

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SCALE	1" = 40'	DATE	08 - 31 - 2017
PROJECT NO.	G2070 - 42 - 01	FIGURE	5
SHEET	3 OF 5		

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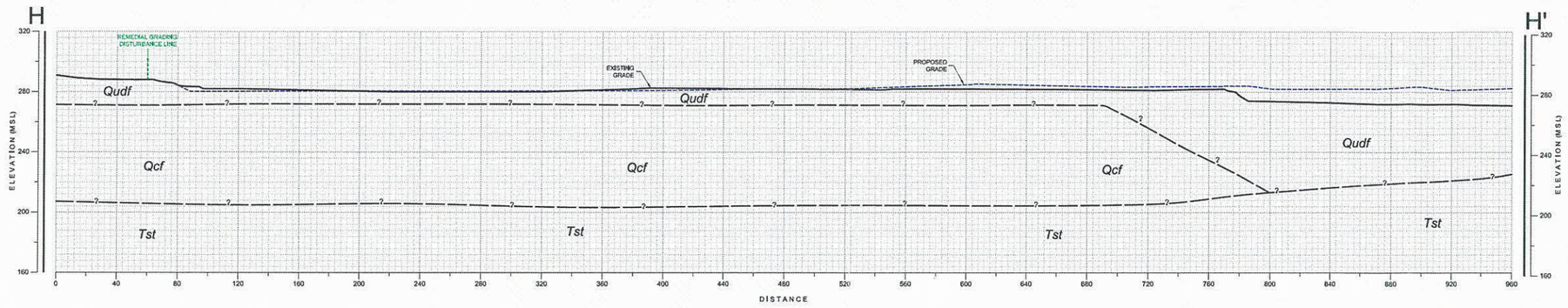
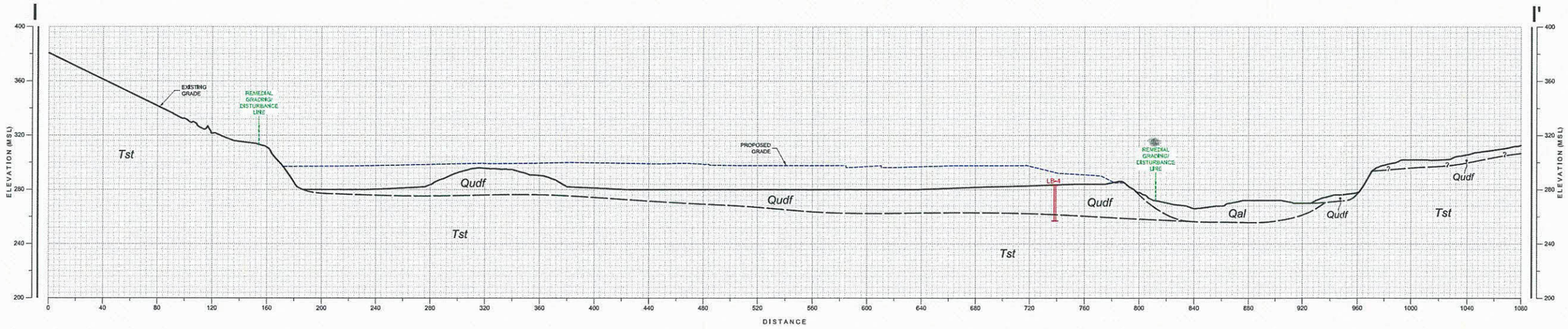


GEOLOGIC CROSS-SECTION H-H'

SCALE: 1" = 40' (Vert. = Horiz.)



GEOLOGIC CROSS-SECTION I-I'

SCALE: 1" = 40' (Vert. = Horiz.)

GEOCON LEGEND

- Qudf ..... UNDOCUMENTED FILL
- Qcf ..... COMPACTED FILL
- Qal ..... ALLUVIUM
- Qc ..... COLLUVIUM
- Tst ..... STADIUM CONGLOMERATE
- ..... APPROX. LOCATION OF GEOLOGIC CONTACT (Queried Where Uncertain)
- LB-10 ..... APPROX. LOCATION OF LARGE DIAMETER BORING
- SB-1 ..... APPROX. LOCATION OF SMALL DIAMETER BORING
- T-34 ..... APPROX. LOCATION OF EXPLORATORY TRENCH
- ..... APPROX. LOCATION OF INACTIVE FAULT

GEOLOGIC CROSS SECTION

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SCALE	1" = 40'
DATE	08 - 31 - 2017
PROJECT NO.	G2070 - 42 - 01
FIGURE	6
SHEET	4 OF 5

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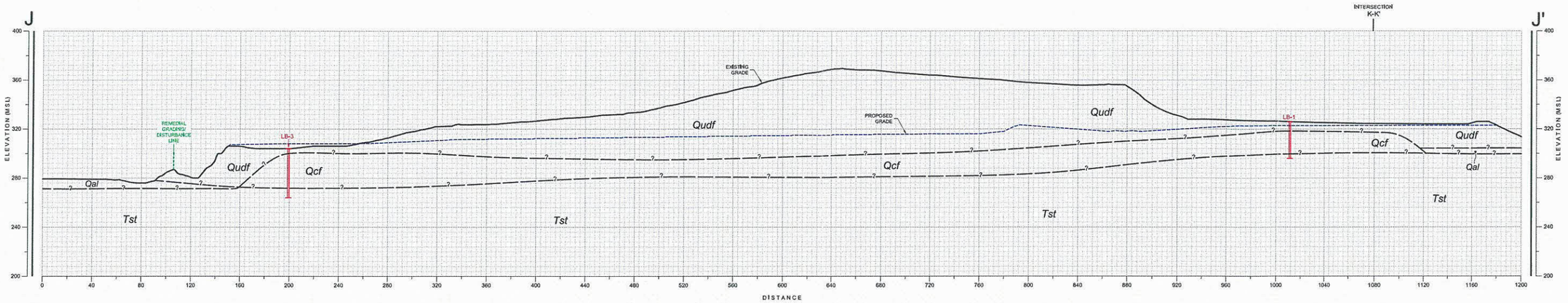
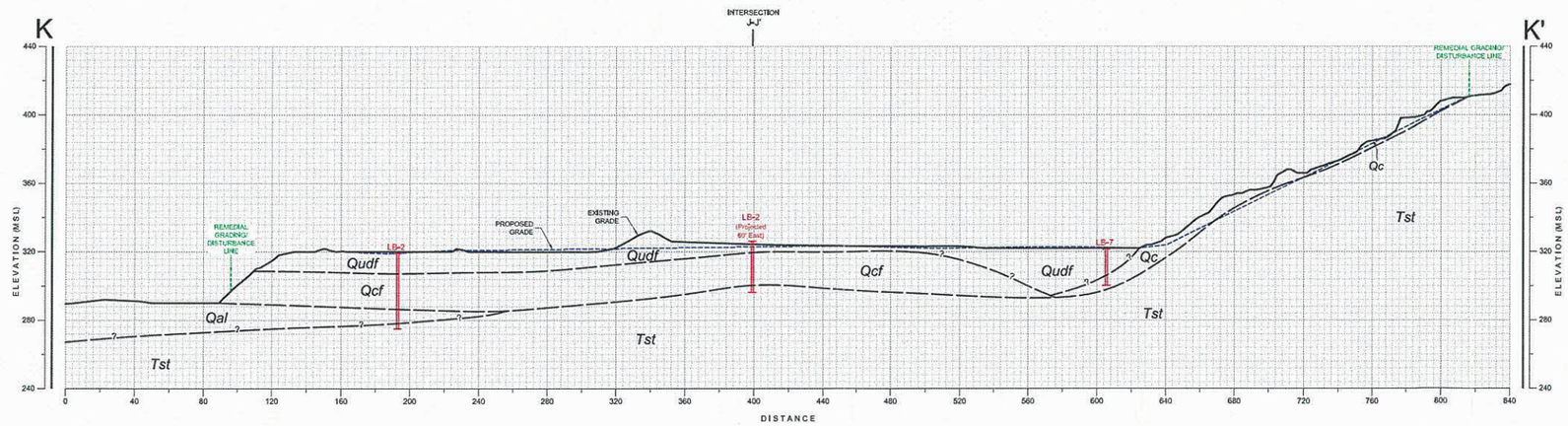


GEOLOGIC CROSS-SECTION J-J'

SCALE: 1" = 40' (Vert. = Horiz.)



GEOLOGIC CROSS-SECTION K-K'

SCALE: 1" = 40' (Vert. = Horiz.)

GEOCON LEGEND

- Qudf ..... UNDOCUMENTED FILL
- Qcf ..... COMPACTED FILL
- Qal ..... ALLUVIUM
- Qc ..... COLLUVIUM
- Tst ..... STADIUM CONGLOMERATE
- ..... APPROX. LOCATION OF GEOLOGIC CONTACT (Queried Where Uncertain)
- LB-10 ..... APPROX. LOCATION OF LARGE DIAMETER BORING
- SB-1 ..... APPROX. LOCATION OF SMALL DIAMETER BORING
- T-34 ..... APPROX. LOCATION OF EXPLORATORY TRENCH
- ..... APPROX. LOCATION OF INACTIVE FAULT

GEOLOGIC CROSS SECTION

CARROLL CANYON MATERIALS PLANT
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SCALE	1" = 40'	DATE	08 - 31 - 2017
PROJECT NO.	G2070 - 42 - 01	FIGURE	7
SHEET	5 OF 5		

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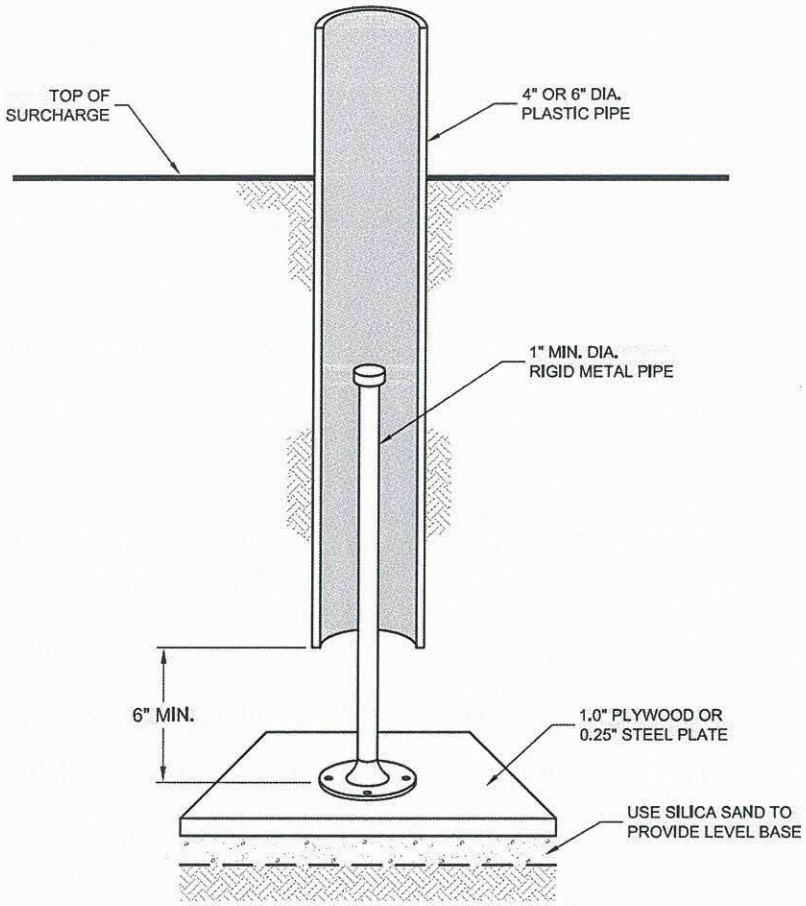

NOTES:

1.....LOCATION OF SETTLEMENT PLATES SHALL BE CLEARLY MARKED AND READILY VISIBLE (RED FLAG) TO EQUIPMENT OPERATORS.

2.....CONTRACTOR SHALL MAINTAIN 10-FOOT HORIZONTAL CLEARANCE FOR HEAVY EQUIPMENT WITHIN 5 FEET (VERTICAL) OF PLATE BASE. FILL WITHIN CLEARANCE AREA SHALL BE HAND COMPACTED TO PROJECT SPECIFICATIONS OR COMPACTED BY ALTERNATIVE APPROVED SOILS ENGINEER.

3.....AFTER 5 FEET (VERTICAL) OF FILL IS IN PLACE, THE CONTRACTOR SHALL MAINTAIN 5 FEET HORIZONTAL EQUIPMENT CLEARANCE. FILL IN CLEARANCE AREA SHALL BE HAND COMPACTED (OR APPROVED ALTERNATIVE) IN VERTICAL INCREMENTS NOT TO EXCEED 2 FEET.

4.....IN THE EVENT OF DAMAGE TO SETTLEMENT PLATE OR EXTENSION RESULTING FROM EQUIPMENT OPERATING WITHIN PRESCRIBED CLEARANCE AREA, CONTRACTORS SHALL IMMEDIATELY NOTIFY SOILS ENGINEER AND SHALL BE RESPONSIBLE FOR RESTORING THE SETTLEMENT PLATES TO WORKING ORDER.

NO SCALE

NO SCALE

SETTLEMENT MONUMENT DETAIL

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CARROLL CANYON MATERIALS PLANT
SAN DIEGO, CALIFORNIA

RM / AML		DSK/GTYPD

DATE 08 - 31 - 2017	PROJECT NO. G2070 - 42 - 01	FIG. 8

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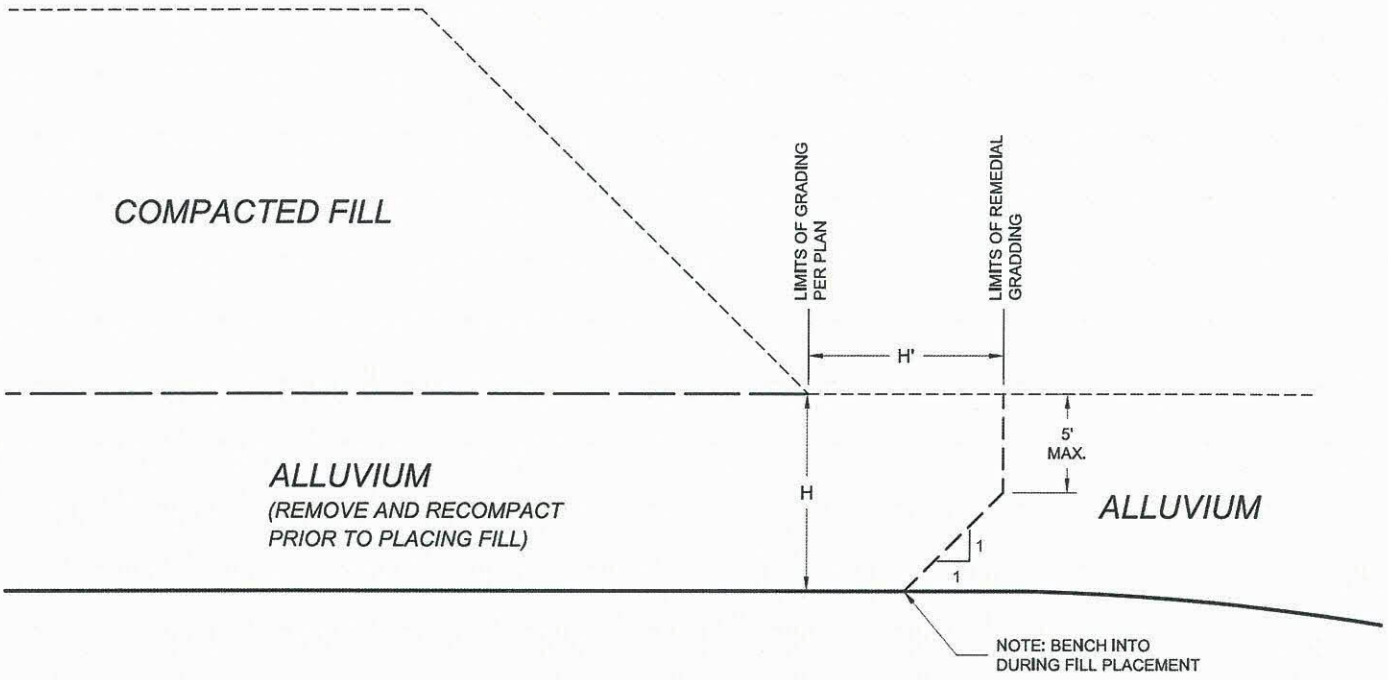

H = THICHNESS OF REMOVAL

H' = HORIZONTAL DISTANCE BEYOND GRADING PER PLAN FOR REMEDIAL GRADING
H = H'

NOTE: WHERE H' IS LIMITED BY PROPERTY BOUNDARIES OR OTHER RESTRICTIONS A SETBACK EQUAL TO THE DISTANCE OF THE RESTRICTIONS TO H' MAY BE REQUIRED.

TYPICAL DETAIL FOR LIMITS OF REMOVAL GRADING

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CARROLL CANYON MATERIALS PLANT
SAN DIEGO, CALIFORNIA

DATE 08 - 31 - 2017	PROJECT NO. G2070 - 42 - 01	FIG. 9

Plotted:08/30/2017 4:43PM | By:ALVIN LADRILLONO | File Location:Y:\PROJECTS\G2070-42-01 (Cantera)\DETAILS\TDLRG.dwg

ASSUMED CONDITIONS :

SLOPE HEIGHT	H	=	100 feet
SLOPE INCLINATION	2 : 1	(Horizontal : Vertical)	
TOTAL UNIT WEIGHT OF SOIL	γ_t	=	135 pounds per cubic foot
ANGLE OF INTERNAL FRICTION	ϕ	=	42 degrees
APPARENT COHESION	C	=	100 pounds per square foot
NO SEEPAGE FORCES			

ANALYSIS :

$\gamma_{c\phi}$	=	$\frac{\gamma_t H \tan\phi}{C}$	EQUATION (3-3), REFERENCE 1
FS	=	$\frac{NcfC}{\gamma_t H}$	EQUATION (3-2), REFERENCE 1
$\gamma_{c\phi}$	=	122	CALCULATED USING EQ. (3-3)
Ncf	=	250	DETERMINED USING FIGURE 10, REFERENCE 2
FS	=	1.85	FACTOR OF SAFETY CALCULATED USING EQ. (3-2)

REFERENCES :

1.....Janbu, N., Stability Analysis of Slopes with Dimensionless Parameters, Harvard Soil Mechanics, Series No. 46, 1954

2.....Janbu, N., Discussion of J.M. Bell, Dimensionless Parameters for Homogeneous Earth Slopes, Journal of Soil Mechanics and Foundation Design, No. SM6, November 1967.

SLOPE STABILITY ANALYSIS - CUT SLOPES

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CARROLL CANYON MATERIALS PLANT
SAN DIEGO, CALIFORNIA

RM / AML		DSK/GTYPD	DATE 08 - 31 - 2017	PROJECT NO. G2070 - 42 - 01	FIG. 10

Plotted:08/30/2017 4:37PM | By:ALVIN LADRILLONO | File Location:Y:\PROJECTS\G2070-42-01 (Cantera)\DETAILS\Slope Stability Analyses-Cut (SSA-C).dwg

ASSUMED CONDITIONS :

SLOPE HEIGHT	H	=	60 feet
SLOPE INCLINATION	2 : 1	(Horizontal : Vertical)	
TOTAL UNIT WEIGHT OF SOIL	γ_t	=	130 pounds per cubic foot
ANGLE OF INTERNAL FRICTION	ϕ	=	30 degrees
APPARENT COHESION	C	=	300 pounds per square foot
NO SEEPAGE FORCES			

ANALYSIS :

$\gamma_{c\phi}$	=	$\frac{\gamma_t H \tan\phi}{C}$	EQUATION (3-3), REFERENCE 1
FS	=	$\frac{NcfC}{\gamma_t H}$	EQUATION (3-2), REFERENCE 1
$\gamma_{c\phi}$	=	15	CALCULATED USING EQ. (3-3)
Ncf	=	43	DETERMINED USING FIGURE 10, REFERENCE 2
FS	=	1.65	FACTOR OF SAFETY CALCULATED USING EQ. (3-2)

REFERENCES :

1.....Janbu, N., Stability Analysis of Slopes with Dimensionless Parameters, Harvard Soil Mechanics, Series No. 46, 1954

2.....Janbu, N., Discussion of J.M. Bell, Dimensionless Parameters for Homogeneous Earth Slopes, Journal of Soil Mechanics and Foundation Design, No. SM6, November 1967.

SLOPE STABILITY ANALYSIS - FILL SLOPES

GEOCON INCORPORATED

GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS

6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974

PHONE 858 558-6900 - FAX 858 558-6159

RM / AML		DSK/GTYPD

CARROLL CANYON MATERIALS PLANT
SAN DIEGO, CALIFORNIA

DATE 08 - 31 - 2017	PROJECT NO. G2070 - 42 - 01	FIG. 11

Plotted:08/30/2017 4:36PM | By:ALVIN LADRILLONO | File Location:Y:\PROJECTS\G2070-42-01 (Cantera)\DETAILS\Slope Stability Analyses-Fill (SSA-F).dwg

ASSUMED CONDITIONS :

SLOPE HEIGHT	H	=	Infinite
DEPTH OF SATURATION	Z	=	3 feet
SLOPE INCLINATION	2 : 1		(Horizontal : Vertical)
SLOPE ANGLE	i	=	26.6 degrees
UNIT WEIGHT OF WATER	γ_w	=	62.4 pounds per cubic foot
TOTAL UNIT WEIGHT OF SOIL	γ_t	=	130 pounds per cubic foot
ANGLE OF INTERNAL FRICTION	ϕ	=	30 degrees
APPARENT COHESION	C	=	300 pounds per square foot

SLOPE SATURATED TO VERTICAL DEPTH Z BELOW SLOPE FACE

SEEPAGE FORCES PARALLEL TO SLOPE FACE

ANALYSIS :

$$FS = \frac{C + (\gamma_t - \gamma_w)\ Z\ cos^2\ i\ tan\ \phi}{\gamma_t\ Z\ sin\ i\ cos\ i} = 2.5$$

REFERENCES :

1.....Haefeli, R. *The Stability of Slopes Acted Upon by Parallel Seepage*, Proc. Second International Conference, SMFE, Rotterdam, 1948, 1, 57-62

2.....Skempton, A. W., and F.A. Delory, *Stability of Natural Slopes in London Clay*, Proc. Fourth International Conference, SMFE, London, 1957, 2, 378-81

SURFICIAL SLOPE STABILITY ANALYSIS

GEOCON INCORPORATED

GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS

6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974

PHONE 858 558-6900 - FAX 858 558-6159

CARROLL CANYON MATERIALS PLANT
SAN DIEGO, CALIFORNIA

RM / AML		DSK/GTYPD	DATE 08 - 31 - 2017	PROJECT NO. G2070 - 42 - 01	FIG. 12

Plotted:08/30/2017 4:35PM | By:ALVIN LADRILLONO | File Location:Y:\PROJECTS\G2070-42-01 (Cantera)\DETAILS\Slope Stability Analyses-Surficial (SSSA).dwg

APPENDIX A

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 1 ELEV. (MSL.) 257' DATE COMPLETED 06-13-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose to medium dense, dry to damp, light brown to yellowish brown, Silty, fine to medium SAND; trace cobble			
2				SC	Loose to medium dense, damp to moist, brown to dark brown, Clayey SAND with 15-20% cobble up to 8-inches			
4								
6								
					TRENCH TERMINATED AT 7 FEET			

Figure A-1,
Log of Trench T 1, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

APPENDIX A

FIELD INVESTIGATION

Fieldwork for our investigation included subsurface exploration and soil sampling. The approximate locations of the exploratory borings and trenches are shown on the *Geologic Map,* Figure 2. We located the borings and trenches in the field based using existing site reference points. Therefore, actual boring and trench locations may deviate slightly.

We performed the field investigation between June 13 and July19, 2017. The exploration consisted of excavating 48 exploratory backhoe test pits, drilling and downhole logging of 10 large-diameter bucket auger borings, and drilling 4 small-diameter borings. The borings were drilled to depths up to 115 feet below the ground surface using a CME 95 drill rig with 8-inch, hollow-stem augers for the small-diameter borings and an EZ Bore bucket auger drill rig equipped with a 30-inch-diameter bucket for the large-diameter borings. The trenches were excavated using a John Deere 410 rubber-tire backhoe equipped with a 2-foot-wide bucket. We obtained bulk and ring samples from the exploratory borings and trenches for laboratory testing.

We obtained relatively undisturbed soil samples from the borings using a California Modified split-spoon sampler. The sampler has an inside diameter of 2.5 inches and an outside diameter of 2.875 inches. Up to 18 rings that are 2.4 inches in diameter and 1.0 inch in height are placed inside the sampler. Soil samples were collected by driving the sampler 12 to 18 inches into the bottom of the excavation using a 140 pound hammer on the small-diameter drill rig and with the weight of the drill rig Kelly bar (1,300 to 3,500 pounds) on the large-diameter drill rig. The number of blows required to drive the sampler 12 inches was recorded. The penetration resistances shown on the boring logs are shown in terms of blows per foot. These values are not to be taken as N-values. Ring samples were retained in moisture-tight containers and transported to our laboratory for testing. Bulk samples were also collected from the borings and trenches for laboratory testing. The type of sample is noted on the exploratory boring and trench logs.

We visually examined, classified and logged the soil conditions encountered in the borings in general accordance with American Society for Testing and Materials (ASTM) practice for Description and Identification of Soils (Visual-Manual Procedure D 2488). Logs of the exploratory borings and trenches are presented on Figures A-1 through A-62. The logs depict the soil and geologic conditions encountered and the depth at which samples were obtained. Elevations shown on the logs were based on existing elevations shown on topographic maps provided for our use.

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 2 ELEV. (MSL.) 254' DATE COMPLETED 06-13-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0	T2-1			SM	**UNDOCUMENTED FILL (Qudf)** Loose, dry, pale yellowish brown, Silty, fine to medium SAND; trace cobble, few small rootlets			
2				SC	Loose to medium dense, damp to moist, brown to dark brown, Clayey SAND with ±20% cobble up to 10-inches, and some organic debris			
4								
6								
8					TRENCH TERMINATED AT 8 FEET			

Figure A-2,
Log of Trench T 2, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 3 ELEV. (MSL.) 252' DATE COMPLETED 06-13-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0	T3-1			SM	**UNDOCUMENTED FILL (Qudf)** Loose, damp, pale yellowish brown to orange brown, Silty, fine to coarse SAND with abundant gravel and cobble up to 10-inches in diameter; trace organic debris and minor caving			
2								
4								
6								
8								
					TRENCH TERMINATED AT 9 FEET			

Figure A-3,
Log of Trench T 3, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 4 ELEV. (MSL.) 251' DATE COMPLETED 06-13-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose, dry and damp, pale yellowish brown, Silty, fine to medium SAND with 15-20% cobble up to 8-inch in diameter; rootlets throughout			
2								
4				SM	Loose to medium dense, damp to moist, brown to dark brown, Silty, fine to medium SAND with clay; 5-10% cobble up to 6-inch in diameter			
6								
8								
				CL&SC	Stiff/loose to medium dense, moist, very dark brown and black, fine, Sandy CLAY and Clayey SAND; trace cobble			
					TRENCH TERMINATED AT 9 FEET			

Figure A-4,
Log of Trench T 4, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 5 ELEV. (MSL.) 253' DATE COMPLETED 06-13-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SC	**UNDOCUMENTED FILL (Qudf)** Loose, dry to damp, brown to yellowish brown, Clayey SAND with silt and <10% cobble up to 8-inches in diameter			
2								
4				CL	Stiff, moist, dark brown, fine, Sandy CLAY with cobble up to 8-inches in diameter			
6	T5-1							
8								
					TRENCH TERMINATED AT 9 FEET			

Figure A-5,
Log of Trench T 5, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 6 ELEV. (MSL.) 254' DATE COMPLETED 06-13-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose to very loose, dry, pale brown, Silty, fine to medium SAND with 20% cobble up to 10-inches in diameter; abundant rootlets			
2								
4				SM	Medium dense, damp, brown, Silty, fine to medium SAND; 10-15% cobble up to 6-inches in diameter			
6								
8				CL	Stiff, damp to moist, dark brown, Sandy CLAY; trace cobble up to 6-inches			
					TRENCH TERMINATED AT 8.5 FEET			

Figure A-6,
Log of Trench T 6, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL | ... STANDARD PENETRATION TEST | ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE | ... CHUNK SAMPLE | ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 7 ELEV. (MSL.) 252' DATE COMPLETED 06-13-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose, dry, light brown, Silty, fine SAND; 2-5% gravel up to 2-inches; abundant rootlets			
2								
4				SP	Loose to medium dense, damp, orange brown to reddish brown, fine to medium SAND with 10-20% cobble up to 12-inches in diameter			
6								
8					-Cobble content increases to 20-30% below 8 feet			
10								
12				SW	**STADIUM CONGLOMERATE (Tst)** Dense to very dense, damp, yellowish/orangish to orange brown, fine to medium SAND with cobble up to 10-inches; difficult trenching due to caving			
14					TRENCH TERMINATED AT 14 FEET			

Figure A-7,
Log of Trench T 7, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 8 ELEV. (MSL.) 246' DATE COMPLETED 06-13-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose, dry to damp, light brown to grayish brown, Silty, fine to medium SAND with abundant cobble and boulders up to 38-inches; concrete debris also present			
2								
4								
6								
8								
10			▽		-Becomes moist to wet below 9 feet -Heavy seepage at 11 feet			
12				SW	**STADIUM CONGLOMERATE (Tst)** Dense, wet, orange brown to yellow/brown, medium SAND with cobble up to 10-inches			
					TRENCH TERMINATED AT 13 FEET			

Figure A-8,
Log of Trench T 8, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 9 ELEV. (MSL.) 321' DATE COMPLETED 06-13-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0	T9-1			SM	**UNDOCUMENTED FILL (Qudf)** Loose to medium dense, dry, pale yellowish brown, Silty, fine to medium SAND with <10% cobble up to 8-inches			
2								
4								
6	T9-2			SC	**COLLUVIUM (Qc)** Loose, moist to wet, black to dark brown, Clayey, fine to coarse SAND with cobble; caving on both sides			
8								
10								
12					-Becomes medium dense, damp to moist and brown to yellowish brown with cobble up to 10-inches in diameter below 12.5 feet			
14					TRENCH TERMINATED AT 14 FEET			

Figure A-9,
Log of Trench T 9, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 10 ELEV. (MSL.) 323' DATE COMPLETED 06-13-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				ML	**UNDOCUMENTED FILL (Qudf)** Loose, dry, pale grayish brown, Sandy SILT; trace gravel			
2				SC	Medium dense, damp, yellowish brown, Clayey SAND with cobble and some rootlets			
4								
6				SW/SP	**COLLUVIUM (Qc)** Loose, moist, black to dark brown, medium to coarse SAND with ±10% gravel and cobble up to 8-inches in diameter; some caving			
8								
10								
12								
14			▽		-Becomes wet with moderate seepage at 14 feet			
16								
					TRENCH TERMINATED AT 17 FEET			

Figure A-10,
Log of Trench T 10, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 11 ELEV. (MSL.) 325' DATE COMPLETED 06-13-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose, dry, pale brown, Silty SAND with gravel			
2	T-11			SM	**COMPACTED FILL (Qcf)** Medium dense, damp to moist, pale yellowish brown, Silty, fine SAND; trace cobble			
4				SM	Medium dense, damp to moist, yellowish brown to orange brown, Silty, fine to medium SAND with ±10-15% cobble up to 8-inches in diameter			
6								
8					-Concrete chunks at 7 feet			
10								
12								
14								
					TRENCH TERMINATED AT 15 FEET			

Figure A-11,
Log of Trench T 11, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 12 ELEV. (MSL.) 320' DATE COMPLETED 06-13-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose to medium dense, dry to damp, Silty, fine SAND with some cobble; several 24-36-inch boulders encountered; abundant roots			
4				SM	Medium dense, damp, brown to pale yellowish brown, Silty, fine to medium SAND with ±10% cobble up to 8-inches -Becomes moist at 11 feet			
14				SC	Medium dense, moist to wet, yellowish brown to orange brown, Clayey fine to medium SAND with ±15-20% cobble up to 10-inch in diameter			
16					TRENCH TERMINATED AT 16 FEET			

Figure A-12,
Log of Trench T 12, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

TRENCH T 13

ELEV. (MSL.) 316' DATE COMPLETED 06-13-2017

EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
				SM	**UNDOCUMENTED FILL (Qudf)** Loose to medium dense, dry, Silty, fine SAND; trace gravel up to 1-inch in diameter; shallow rootlets			
2								
				SC	**COMPACTED FILL (Qcf)** Medium dense to dense, damp to moist, yellowish brown to orange brown, Clayey, fine to coarse SAND with <10% gravel and cobble up to 4-inches			
4								
6	T13-1							
8								
10								
12								
14					TRENCH TERMINATED AT 14 FEET			

Figure A-13,
Log of Trench T 13, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 14 ELEV. (MSL.) 306' DATE COMPLETED 06-13-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose to medium dense, dry, pale grayish brown to brown, Silty, fine SAND; trace gravel			
2								
4				SC	**COMPACTED FILL (Qcf)** Medium dense to dense, damp to moist, orange brown, Clayey, fine to medium SAND with ±10% cobble up to 6-inches in diameter but mostly <1-inch in diameter			
6								
8								
10								
12					TRENCH TERMINATED AT 12 FEET			

Figure A-14,
Log of Trench T 14, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 15 ELEV. (MSL.) 375' DATE COMPLETED 06-13-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**COLLUVIUM (Qc)** Loose, dry, pale brown, Silty, fine SAND; some gravel and cobble			
2								
				SC	Medium dense, damp to moist, brown to dark brown and grayish brown, Clayey SAND with cobble up to 10-inches in diameter			
4								
6								
8				SW	**STADIUM CONGLOMERATE (Tst)** Very dense, damp, mottled grayish brown to orange brown, medium to coarse SANDSTONE with cobble up to 8-inches; moderately cemented			
					TRENCH TERMINATED AT 8 FEET			

Figure A-15,
Log of Trench T 15, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 16 ELEV. (MSL.) 384' DATE COMPLETED 06-13-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0	T16-1			SC	**UNDOCUMENTED FILL (Qudf)** Medium dense, dry to damp, yellowish brown, Clayey, medium SAND; trace cobble up to 2-inches in diameter			
2								
4								
6								
					TRENCH TERMINATED AT 7 FEET			

Figure A-16,
Log of Trench T 16, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 17 ELEV. (MSL.) 386' DATE COMPLETED 06-13-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SC	**UNDOCUMENTED FILL (Qudf)** Medium dense, damp, yellowish brown, Clayey SAND; trace cobble			
2								
4								
6					TRENCH TERMINATED AT 6 FEET			

Figure A-17,
Log of Trench T 17, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 18 ELEV. (MSL.) 288' DATE COMPLETED 06-13-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				GW	**STADIUM CONGLOMERATE (Tst)** Very dense, damp, fine to coarse, Sandy CONGLOMERATE; well cemented			
2					TRENCH TERMINATED AT 3 FEET			

Figure A-18,
Log of Trench T 18, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 19 ELEV. (MSL.) 282' DATE COMPLETED 06-14-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose, dry, pale yellow-brown, Silty, fine SAND; trace gavel			
2	T19-1			GP	Loose, damp to moist, brown to yellow brown, Sandy GRAVEL; 3/4-inch size			
4				SM	Medium dense, damp, orange-brown to whitish brown, Silty, fine to coarse SAND with 8-12% cobble up to 12-inches in diameter			
6								
8								
10				SW	Medium dense, damp, dark brown to gray to black, medium SAND with 10-15% cobble up to 12-inches			
12	T19-2							
14				SW	Medium dense, damp, to moist, dark brown to orange, medium to coarse SAND with ±15% cobble and boulders up to 18-inches in diameter			
16								
					TRENCH TERMINATED AT 17 FEET			

Figure A-19,
Log of Trench T 19, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 20 ELEV. (MSL.) 279' DATE COMPLETED 06-14-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Medium dense, damp, yellowish brown to orange brown, Silty, fine to coarse SAND; some clay and trace angular gravel			
2				GM	**STADIUM CONGLOMERATE (Tst)** Very dense, dry to damp, medium, Sandy CONGLOMERATE; well cemented; difficult excavation			
4					TRENCH TERMINATED AT 4 FEET			

Figure A-20,
Log of Trench T 20, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 21 ELEV. (MSL.) 273' DATE COMPLETED 06-14-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				GW	**UNDOCUMENTED FILL (Qudf)** Medium dense, dry, pale brown, Silty GRAVEL; 3/4-inch			
2				SP	Medium dense, damp to moist, orange brown, fine to medium SAND; trace angular gravel, concrete slag and scrap metal present			
4					REFUSAL AT 4.75 FEET ON CONCRETE			

Figure A-21,
Log of Trench T 21, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 22 ELEV. (MSL.) 274' DATE COMPLETED 06-14-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SC	**UNDOCUMENTED FILL (Qudf)** Medium dense, dry to damp, orange brown, Clayey SAND with ±15% 3/4-inch gravel			
2				SC&SM	Medium dense, damp to moist, orange brown, Clayey, medium to coarse SAND to Silty SAND			
4	T22-1				-Concrete chunks at 5 feet			
6					REFUSAL AT 7 FEET ON CONCRETE			

Figure A-22,
Log of Trench T 22, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 23 ELEV. (MSL.) 273' DATE COMPLETED 06-14-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose to medium dense, dry to damp, Silty, fine to medium SAND with some gravel and cobble			
2				GM	**STADIUM CONGLOMERATE (Tst)** Very dense, damp, pale yellowish brown to gray brown, fine to medium, Sandy CONGLOMERATE; highly cemented			
4					TRENCH TERMINATED AT 5 FEET			

Figure A-23,
Log of Trench T 23, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 24 ELEV. (MSL.) 275' DATE COMPLETED 06-14-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SP	**UNDOCUMENTED FILL (Qudf)** Medium dense, dry to damp, gray to whitish gray, fine to medium SAND; trace silt and gravel			
2	T-24							
4								
					PRACTICAL REFUSAL AT 5 FEET			

Figure A-24,
Log of Trench T 24, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 25 ELEV. (MSL.) 283' DATE COMPLETED 06-14-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SC	**UNDOCUMENTED FILL (Qudf)** Medium dense, damp to moist, orange brown, Clayey SAND with gravel and trace cobble <2-inches in diameter			
2								
4				SM&SC	Medium dense, moist, orange brown to whitish brown, Silty to Clayey, fine to medium SAND with 10% cobble up to 8-inches			
6								
8				GW	**STADIUM CONGLOMERATE (Tst)** Very dense, damp, whitish to yellowish brown, fine, Sandy CONGLOMERATE; highly cemented			
					TRENCH TERMINATED AT 8.5 FEET			

Figure A-25,
Log of Trench T 25, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

TRENCH T 26

ELEV. (MSL.) 286' DATE COMPLETED 06-14-2017

EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose, dry, yellowish-white, Silty, fine SAND with gravel			
2				SC	Loose to medium dense, damp to moist, orange brown, Clayey, fine to coarse SAND with <15% cobble and boulders up to 14-inches in diameter			
4								
6								
8				CL	Medium dense, moist, black, Sandy CLAY with cobble			
10				SC	Medium dense, moist, orange brown to grayish brown, Clayey SAND with <12% cobble up to 8-inches			
12				SM	Medium dense, moist, orange brown, Silty, fine to coarse SAND with <10% cobble <6-inches			
14								
16	T26-1							
					TRENCH TERMINATED AT 17.5 FEET			

Figure A-26,
Log of Trench T 26, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 27 ELEV. (MSL.) 283' DATE COMPLETED 06-14-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				GM	**UNDOCUMENTED FILL (Qudf)** Loose, dry to damp, grayish brown to brown, fine to medium, Sandy GRAVEL with 40-50% cobble and boulders up to 15-inches in diameter			
2					-Caving below 3 feet; voids observed between cobbles			
4								
6								
8				SM	Medium dense, damp, orange brown to grayish brown, Silty, medium SAND with 15% cobble <12-inches			
					TRENCH TERMINATED AT 9 FEET			

Figure A-27,
Log of Trench T 27, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 28 ELEV. (MSL.) 273' DATE COMPLETED 06-14-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose to medium dense, damp to moist, orange brown, Silty, fine to coarse SAND with 15% cobble and boulders up to <18-inches diameter and angular pointed tile fragments present			
2								
4								
6				GM	**STADIUM CONGLOMERATE (Tst)** Very dense, damp, orange brown, fine to coarse, Sandy CONGLOMERATE; moderately cemented			
					TRENCH TERMINATED AT 7 FEET			

Figure A-28,
Log of Trench T 28, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

TRENCH T 29

ELEV. (MSL.) 271' DATE COMPLETED 06-14-2017

EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SC	**UNDOCUMENTED FILL (Qudf)** Medium dense, damp, orange brown, Clayey, medium to coarse SAND with 8% cobble, abundant trash, wood, plastic, rubber, metal and strong odor			
2								
4				SC	Medium dense, damp, dark gray to grayish black, Clayey SAND with ±5% cobble up to <6-inches in diameter; moderate to strong odor; large stump/pole at 5.5 feet			
6								
8				CL	Stiff, moist, grayish brown to orange brown, Sandy CLAY with cobble			
10								
12	T29-1			SC	Medium dense, moist to wet dark reddish brown, Clayey SAND with 10% cobble up to <10-inches in diameter; slight odor -At 13 feet becomes brown to grayish brown			
14				SC	Medium dense, damp to moist, orange brown, Clayey SAND with ±10-12% cobble <10-inches in diameter			
					TRENCH TERMINATED AT 15.5 FEET			

Figure A-29,
Log of Trench T 29, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 30 ELEV. (MSL.) 270' DATE COMPLETED 06-14-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose, dry, gray to pale brown, Silty SAND with gravel			
2				SC	Medium dense, damp to moist, grayish brown to orange brown and black brown, Clayey, medium to coarse SAND with <12% cobble and boulders up to 14-inches in diameter			
4								
6								
8								
10								
12								
14				CL	Stiff, moist, dark brown to black, Sandy CLAY; with cobble and slight odor			
16								
					TRENCH TERMINATED AT 17 FEET			

Figure A-30,
Log of Trench T 30, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 31 ELEV. (MSL.) 269' DATE COMPLETED 06-14-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				GM	**UNDOCUMENTED FILL (Qudf)** Loose to medium dense, dry, gray, Silty GRAVEL; 3/4" rock			
2				SC	Medium dense, damp, orange brown to grayish brown, Clayey, fine to medium SAND with 12% cobble up to 10-inches in diameter			
4								
6								
8					-Becomes black to very dark gray with organic debris; strong odor			
10								
12					-At 11 feet becomes moist to wet with 4-6-inch wood fragments			
14					-At 13 feet 3/4-inch gravel observed			
16			▽		-At 15 feet becomes wet with light seepage in sidewall			
				CL	Medium dense, wet, greenish gray, Sandy CLAY with cobble; slight odor			
					TRENCH TERMINATED AT 17 FEET			

Figure A-31,
Log of Trench T 31, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 32 ELEV. (MSL.) 268' DATE COMPLETED 06-14-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose, dry, whitish gray, Silty, fine SAND with gravel; 3/4" rock			
2				SC	Medium dense, damp, orange brown to brown, Clayey, fine to coarse SAND with <10% cobble up to 8-inches in diameter			
4				SC	Medium dense, damp, black to dark brown, Clayey SAND with cobble up to 6-inches in diameter			
6					-At 7 feet 1-inch electrical conduit observed			
8				SC	Medium dense, damp to moist, brown to orange brown, Clayey, fine to coarse SAND with <10% cobble up to 6-inches in diameter			
10								
12								
14					-At 13 feet, 20-inch concrete chunk present -At 14 feet, asphalt and concrete chunks present			
16					TRENCH TERMINATED AT 16 FEET			

Figure A-32,
Log of Trench T 32, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 33 ELEV. (MSL.) 263' DATE COMPLETED 06-14-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose, dry, grayish white, Silty, fine SAND with 3/4" gravel			
2				SC	Loose to medium dense, damp to moist, orange brown, Clayey, medium to coarse SAND; with some 3/4" gravel and trace cobble			
4								
6	T33-1							
8								
10				CL	**ALLUVIUM (Qal)** Soft, moist to wet, dark brown, Sandy, CLAY; with <8% cobble up to 6-inches in diameter			
12			▽		-At 12 feet light to moderate seepage			
			▼		-At 13 feet heavy seepage and standing water			
14					TRENCH TERMINATED AT 14 FEET			

Figure A-33,
Log of Trench T 33, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 34 ELEV. (MSL.) 266' DATE COMPLETED 06-14-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose, dry, light gray, Silty, fine SAND with gravel			
2								
4	T34-1			ML	**ALLUVIUM (Qal)** Stiff, dry to damp, brown to reddish brown, Sandy SILT; few cobble <8-inches in diameter and concrete chunks			
6								
8					-Becomes soft with 10-25% cobble at 8 feet			
10				SM	Loose, dry, brown to grayish brown, Silty, fine SAND with some cobble up to 12-inches; trench collapsed during excavation			
12					TRENCH TERMINATED AT 12 FEET DUE TO CAVING			

Figure A-34,
Log of Trench T 34, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL | ... STANDARD PENETRATION TEST | ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE | ... CHUNK SAMPLE | ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 35 ELEV. (MSL.) 269' DATE COMPLETED 06-15-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose to medium dense, dry, grayish white, Silty, fine SAND with gravel			
2				SC	Medium dense, dry to damp, brown to grayish brown, Clayey, fine to coarse SAND with <10% cobble up to 10-inches in diameter			
4								
6								
8								
10				SM	Medium dense, moist to wet, brown, Silty, medium to coarse SAND with <15% cobble up to 12-inches and trace clay			
12								
14								
16					TRENCH TERMINATED AT 16.5 FEET			

Figure A-35,
Log of Trench T 35, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 36 ELEV. (MSL.) 253' DATE COMPLETED 06-15-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose to medium dense, dry to moist, brown to pale yellowish brown, Silty, fine to medium SAND with few cobble up to 8-inches in diameter; asphalt and concrete debris present			
2								
4								
6				SM	**ALLUVIUM (Qal)** Loose, damp to wet, pale yellowish brown, Silty, fine to medium SAND with some cobble up to 14-inches in diameter; minor caving			
8								
10			▽		-Seepage at 10 feet			
				GM	**STADIUM CONGLOMERATE (Tst)** Dense, moist to wet, whitish brown to yellow brown, mottled, fine to coarse, Sandy CONGLOMERATE; trace silt; well cemented			
12			▼					
					TRENCH TERMINATED AT 13 FEET			

Figure A-36,
Log of Trench T 36, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 37 ELEV. (MSL.) 274' DATE COMPLETED 06-15-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Medium dense, damp, brown Silty, fine to medium SAND; trace clay and cobble <4-inches and 3/4" gravel			
2				SP	Medium dense, damp to moist, orange brown, medium to coarse SAND; trace clay and angular rock fragments with abundant concrete fragments; possible washout			
4								
6								
8					-1 foot lens of concrete debris at 8 feet			
10								
12					-At 12 feet becomes difficult to excavate			
14					PRACTICAL REFUSAL AT 14 FEET			

Figure A-37,
Log of Trench T 37, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 38 ELEV. (MSL.) 281' DATE COMPLETED 06-15-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose, dry, grayish white, Silty, fine SAND with gravel			
2				SC	**COMPACTED FILL (Qcf)** Medium dense, moist, orange-brown, Clayey, fine to coarse SAND; trace rock fragments			
4								
6								
8								
10								
12								
14								
16								
					TRENCH TERMINATED AT 17 FEET			

Figure A-38,
Log of Trench T 38, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

TRENCH T 39

ELEV. (MSL.) 275' DATE COMPLETED 06-15-2017

EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				ML	**UNDOCUMENTED FILL (Qudf)** Loose, dry, grayish white, Sandy SILT; few cobble up to 6-inches in diameter			
2				SC	Loose to medium dense, damp, brown to reddish brown, Clayey, medium to coarse SAND with 10-15% cobble up to 10-inches in diameter			
4								
6								
8				SC	Medium dense, damp to moist, grayish brown to brown, Clayey, fine to coarse SAND with some cobble up to 12-inches in diameter and trace boulders			
10								
12								
14								
16				SC	**ALLUVIUM (Qal)** Medium dense, damp to moist, orange brown, Clayey, medium to coarse SAND with some cobble up to 8-inches in diameter			
					TRENCH TERMINATED AT 17 FEET			

Figure A-39,
Log of Trench T 39, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 40 ELEV. (MSL.) 285' DATE COMPLETED 06-15-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SC	**UNDOCUMENTED FILL (Qudf)** Medium dense, damp, grayish brown, Clayey, fine to medium SAND; trace gravel			
2				ML	Medium dense, moist, pale yellowish brown to yellow brown, fine, Sandy SILT; trace wood debris and roots			
4								
6								
8				SC	Medium dense, damp to moist, grayish brown, Clayey, fine to medium SAND; trace cobble and some roots			
10					-Becomes gray and moist at 10 feet			
12								
14				CH	Very soft, moist, blackish-gray, Silty, CLAY; abundant organic debris including buried palm tree			
16					-At 16 feet becomes wet			
18					TRENCH TERMINATED AT 18 FEET			

Figure A-40,
Log of Trench T 40, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 41 ELEV. (MSL.) 285' DATE COMPLETED 06-15-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SC	**UNDOCUMENTED FILL (Qudf)** Medium dense, moist, orange brown, Clayey, fine to medium SAND; trace 1/2" gravel; some asphalt chunks and concrete chunks			
2								
4								
6					-At 5 feet extensive caving in bench sidewalls -At 6 feet roots and plant debris noted			
8					-At 7 feet moist to wet			
10				CH	Very soft, wet, brownish gray, plastic CLAY; abundant organics			
12					TRENCH TERMINATED AT 12 FEET DUE TO CAVING			

Figure A-41,
Log of Trench T 41, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 42 ELEV. (MSL.) 281' DATE COMPLETED 06-15-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose, dry, pale brown, Silty, fine to medium SAND; trace gravel and cobble up to 8-inches			
2				SC	Medium dense, damp to moist, Clayey SAND; few cobble up to 8-inches in diameter			
4								
6					-Concrete slab at 6 feet REFUSAL AT 6 FEET ON CONCRETE SLAB			

Figure A-42,
Log of Trench T 42, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 43 ELEV. (MSL.) 247' DATE COMPLETED 06-15-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose, dry, yellowish brown, Silty, fine SAND with wood and metal debris and trace cobble			
2				SC	**ALLUVIUM (Qal)** Medium dense, dry to damp, Clayey, fine to medium SAND; trace clay and few cobble up to 8-inches in diameter			
4					-At 5 feet becomes reddish brown and moist			
6								
8								
10				GM	**STADIUM CONGLOMERATE (Tst)** Dense, moist, whitish brown to yellow orange, fine to medium, Sandy CONGLOMERATE; moderately to well cemented with cobble and boulders up to 18-inches in diameter			
					TRENCH TERMINATED AT 10.5 FEET			

Figure A-43,
Log of Trench T 43, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 44 ELEV. (MSL.) 238' DATE COMPLETED 06-15-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose to medium dense, dry to damp, orange brown, Silty, fine to medium SAND; few cobble up to 14-inches with roots present in upper 2 feet			
2								
4								
6					-Becomes slightly clayey at 6 feet			
8								
10								
					TRENCH TERMINATE AT 11 FEET			

Figure A-44,
Log of Trench T 44, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 45 ELEV. (MSL.) 230' DATE COMPLETED 06-15-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SC	**UNDOCUMENTED FILL (Qudf)** Loose, moist, orange brown, Clayey, fine to medium SAND; trace gravel and cobble			
2								
4								
6								
					TRENCH TERMINATED AT 7 FEET			

Figure A-45,
Log of Trench T 45, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 48 ELEV. (MSL.) 259' DATE COMPLETED 06-15-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SC	**UNDOCUMENTED FILL (Qudf)** Loose to medium dense, dry to damp, Clayey, fine to medium SAND with trace cobble up to 6-inches			
2								
4								
6					TRENCH TERMINATED AT 6 FEET			

Figure A-48,
Log of Trench T 48, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

BORING LB 1

ELEV. (MSL.) 326' DATE COMPLETED 06-26-2017

EQUIPMENT BUCKET RIG BY: BORJA/REIST

DEPTH IN FEET	SAMPLE NO.	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0		ML	**UNDOCUMENTED FILL (Qudf)** Firm to stiff, damp, olive brown to light brown, Sandy SILT; ~10% gravel and cobble			
2						
4						
6	LB1-1		-Becomes very stiff and moist below 5 ft.	1		
8		SM	**COMPACTED FILL (Qcf)** Medium dense, moist, light brown, Silty, fine to medium SAND; 10-20% gravel and cobble; majority of rock 3"-6" diameter with trace boulders -24" concretion observed at 7 ft.			
10	LB1-2		-Gravel and cobble content increase to ~20% below 10 ft.	3		
12						
14			-Increases in moisture content; excavates with some 3/4" gravel and trace cobble			
16	LB1-3			4		
18		SM&SC	Medium dense, moist, brown to olive brown, Silty to Clayey, fine to medium SAND; some gravel 3/4" size; few ±6" cobble			
20	LB1-4			3	124.9	9.5
22			-Observed 6" thick dark brown, Clayey SAND lens at 21 feet			
24			-Becomes saturated below 24.5 ft.; constant seepage			
26	LB1-5		**STADIUM CONGLOMERATE (Tst)** Very dense, moist, mottled brown, olive brown and reddish brown, fine to medium, Sandy CONGLOMERATE	4		
28			-Standing water at 27.5 ft.			
30			BORING TERMINATED AT 30 FEET			

Figure A-49,
Log of Boring LB 1, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

BORING LB 2

ELEV. (MSL.) 319' DATE COMPLETED 06-26-2017

EQUIPMENT BUCKET RIG BY: BORJA/REIST

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				GM	**UNDOCUMENTED FILL (Qudf)** Medium dense, dry to damp, olive brown, Sandy GRAVEL; majority of rock 3/4"-1"			
2				SM	Medium dense, moist, olive brown, Silty, fine to medium SAND; 10-20% grave and cobble			
4								
6	LB2-1				-Becomes loose with ~20%-30% gravel ± 1" size and 10-15% cobble 8" to 10" size from 6 to 8 feet	4		
8					-Geotechnically logged to 8 ft. due to loose caving conditions			
10	LB2-2					4		
12				SM	**COMPACTED FILL (Qcf)** Medium dense, moist, brown to light brown, Silty, fine to medium SAND; ~20%-30% gravel and cobble			
14								
16	LB2-3					5	91.2	9.2
18								
20	LB2-4					5	108.1	14.7
22					-Increase in cobble content; ±12" size			
24								
26	LB2-5					3		8.9
28					-Becomes dark brown			
30	LB2-6					3	112.4	10.6
32								
34				SM&SC	**ALLUVIUM (Qal)** Medium dense, moist, to wet, mottled brown and grayish brown, Silty to			

G2070-42-01.GPJ

Figure A-50,
Log of Boring LB 2, Page 1 of 2

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**BORING LB 2** ELEV. (MSL.) **319'** DATE COMPLETED **06-26-2017** EQUIPMENT **BUCKET RIG** BY: **BORJA/REIST**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
36					Clayey, fine to coarse SAND; ~20%-30% gravel and cobble; ±6"-10" size			
38								
40								
42			▼	GM	**STADIUM CONGLOMERATE (Tst)** Very dense, wet to saturated, yellowish brown to brown, fine to coarse, Sandy CONGLOMERATE			
	LB2-7				-Seepage at 42 feet	10/10"		
44					BORING TERMINATED AT 44 FEET			

Figure A-50,
Log of Boring LB 2, Page 2 of 2

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ■ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 46 ELEV. (MSL.) 297' DATE COMPLETED 06-15-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose, dry, pale yellowish brown, Silty, fine to coarse SAND; trace clay, cobble and gravel			
2				SC	Medium dense, damp to moist, orange brown, Clayey, medium to coarse SAND; trace gravel and cobble up to 6-inches			
4								
6					-At 7 feet becomes moist to wet			
8								
10								
12								
14				GW	**STADIUM CONGLOMERATE (Tst)** Dense, moist, grayish-white to orangish-white, Sandy CONGLOMERATE; weakly cemented			
					TRENCH TERMINATED AT 15 FEET			

Figure A-46,
Log of Trench T 46, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 47 ELEV. (MSL.) 270' DATE COMPLETED 06-15-2017 EQUIPMENT RUBBER TIRE BACKHOE BY: R. ADAMS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				GM	**UNDOCUMENTED FILL (Qudf)** Loose, dry, brown to dark brown, Sandy GRAVEL with 40% gravel, cobble and boulders up to 18-inches in diameter			
2								
4								
6								
8								
10					-Caving at 10 feet limiting excavation progress			
12								
					TRENCH TERMINATED AT 13 FEET			

Figure A-47,
Log of Trench T 47, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

BORING LB 3

ELEV. (MSL.) 304' DATE COMPLETED 06-26-2017

EQUIPMENT BUCKET RIG BY: BORJA/REIST

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				GM	**UNDOCUMENTED FILL (Qudf)** Medium dense, dry to damp, light brown to brown, Sandy GRAVEL; ~±2" size gravel -Becomes moist and tan to brown with few cobble below 2 feet			
4				CL	**COMPACTED FILL (Qcf)** Medium dense, moist to very moist, Gravelly CLAY with 20%-30% gravel up to 1"			
8				SC	Medium dense, moist to very moist, Clayey, fine to coarse SAND; ~10%-15% gravel -Excavates with ~20% cobble ±6" size below 11 feet -Excavates with 5% cobble ±10" size below 12 feet			
14				SM	Medium dense, moist, brown, Silty, fine to medium SAND; ~10%-20% gravel and cobble; ±8" size -Increase in moisture contact; decrease in cobble and boulder content with low cohesion between 16-19 ft.			
30			▽	SC	Medium dense, moist to very moist, gray to grayish brown, Clayey, fine to coarse SAND; ~20% gravel and cobble; ±6" size			
32				SM	-Slight seepage at 30.5 ft.			
34				GM	**STADIUM CONGLOMERATE (Tst)** Dense, moist, mottled light brown and light green, Silty, fine to medium-grained SANDSTONE			

Figure A-51,
Log of Boring LB 3, Page 1 of 2

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**BORING LB 3** ELEV. (MSL.) **304'** DATE COMPLETED **06-26-2017** EQUIPMENT **BUCKET RIG** BY: **BORJA/REIST**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
36				GM	Very dense, wet, yellowish brown to brown, fine to coarse, Sandy CONGLOMERATE			
38								
40					BORING TERMINATED AT 40 FEET			

Figure A-51,
Log of Boring LB 3, Page 2 of 2

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

BORING LB 4

ELEV. (MSL.) 283' DATE COMPLETED 06-28-2017

EQUIPMENT BUCKET RIG BY: BORJA/REIST

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**UNDOCUMENTED FILL (Qudf)** Medium dense, damp to moist, brown, Silty, fine to medium SAND; ~10%-15% gravel and cobble, ±4" size rock			
2								
4					-Becomes moist with a few cobbles ±6" size below 3 feet			
6				SC	Medium dense, moist, brown, Clayey, fine to medium SAND; ~20%-30% gravel and cobble ±6" size			
8					-Becomes fine to coarse and dark brown at 8 ft.			
10				SP	Medium dense, moist, light grayish brown, fine to coarse SAND; some silt; 10% gravel and cobble; trace asphalt chunks			
12				SM	Medium dense, moist, dark brown, Silty, fine to coarse SAND; few gravel and cobble; ±6"; trace asphalt chunks			
14				SC	Medium dense, moist, light brown, Clayey, fine to coarse SAND; ~10%-20% gravel and cobble; ±8" size			
16								
18				CL	Firm to stiff, moist, light gray to grayish brown and dark gray, Sandy CLAY; ~10%-20% gravel and cobble; ±6" in size			
20	LB4-1					3		
22				GM	**STADIUM CONGLOMERATE (Tst)** Dense to very dense, damp, brown to yellowish brown, fine to coarse, Sandy CONGLOMERATE			
24								
26	LB4-2					8/5"		
					BORING TERMINATED AT 26 FEET			

Figure A-52,
Log of Boring LB 4, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

BORING LB 5

ELEV. (MSL.) 269' DATE COMPLETED 06-27-2017

EQUIPMENT BUCKET RIG BY: BORJA/REIST

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				GM	**UNDOCUMENTED FILL (Qudf)** Loose to medium dense, dry, light gray to light brown, Sandy GRAVEL; ~70%-80% ±2" gravel; clast supported			
2								
4					-Geotechnically logged to 4 feet due to unsafe conditions			
6								
8				CL	Stiff, moist to wet, dark brown to dark brown, Sandy CLAY; ~10%-20% gravel and cobble ±6" in size			
10					-Trace asphalt concrete present at 10 feet			
12				SM&SC	Medium dense, moist, brown, Silty to Clayey, fine to medium SAND; 10%-20% gravel and cobble ±6" size			
14				SM	Medium dense, moist, grayish brown to gray, Silty, fine to coarse SAND; ~10%-20% gravel and cobble ±6" size			
16	LB5-1			CL	**ALLUVIUM (Qal)** Stiff, moist, dark gray, Sandy CLAY; ~10% gravel and cobble ±6" size	5		
18				GM	**STADIUM CONGLOMERATE (Tst)** Dense, moist, brown to grayish brown, fine to coarse, Sandy CONGLOMERATE			
20	LB5-2					8		
					BORING TERMINATED AT 21 FEET			

Figure A-53,
Log of Boring LB 5, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**BORING LB 6** ELEV. (MSL.) **268'** DATE COMPLETED **06-28-2017** EQUIPMENT **BUCKET RIG** BY: **BORJA/REIST**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose to medium dense, dry to damp, light brown, Silty, fine to medium SAND; 20% gravel and cobble ±6" size rock			
2								
4					-Becomes damp to moist below 3 feet -Becomes dark gray to grayish brown and black below 4 feet			
6								
8								
10					-Trace organics present at 10 feet			
12					-Slight odor at 12 feet with increase in organic content			
14								
16				SC	**ALLUVIUM (Qal)** Medium dense, moist, dark greenish gray to black, Clayey, fine to coarse SAND; 10%-20% gravel and cobble ±4" size rock			
18				CL	Medium dense, moist, dark gray to black, Sandy CLAY; 10% gravel and cobble			
20								
22			▼	SP	Medium dense, moist, dark gray to black, fine to coarse SAND; little silt; some gravel; trace cobble			
24				ML GM	Firm, wet to saturated, mottled yellowish brown, greenish gray and tan, Sandy to Clayey SILT; seepage at 23 feet **STADIUM CONGLOMERATE (Tst)** Dense, moist, brown, fine to coarse, Sandy CONGLOMERATE			
26					BORING TERMINATED AT 27 FEET			

Figure A-54,
Log of Boring LB 6, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ■ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

BORING LB 7

ELEV. (MSL.) 321' DATE COMPLETED 06-27-2017

EQUIPMENT BUCKET RIG BY: BORJA/REIST

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
				ML	**UNDOCUMENTED FILL (Qudf)** Firm to stiff, dry to damp, light brown, Sandy SILT; ~10%-20% gravel			
2				SM	Medium dense, moist, brown, Silty, fine to medium SAND; ~10%-20% gravel and cobble ±6" size			
4								
6	LB7-1					5		
8					-Trace asphalt concrete present at 8 feet			
10	LB7-2					2		
12								
14					-Geotechnically logged to 14 feet			
				SC	**COLLUVIUM (Qc)**			
16	LB7-3		▼		Loose to medium dense, saturated, dark gray to black, Clayey, fine to medium SAND; ~10%-20% gravel and cobble; hole belled to ~8' below contact	PUSH		
			▼		-Seepage at 15 feet			
18					-Standing water and caving at 17 feet			
20								
					BORING TERMINATED AT 21 FEET DUE TO CAVING CONDITIONS			

Figure A-55,
Log of Boring LB 7, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

BORING LB 8

ELEV. (MSL.) 253' DATE COMPLETED 06-28-2017

EQUIPMENT BUCKET RIG BY: BORJA/REIST

DEPTH IN FEET	SAMPLE NO.	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0		SM	**COMPACTED FILL (Qcf)** Medium dense, moist, tan to brown, Silty, fine to medium SAND; 10% gravel and cobble; little clay			
4		SC	Medium dense, moist, light brown, Clayey, fine to medium SAND; 10% gravel and cobble			
6	LB8-1		-Increase in moisture content below 7 feet	1		
8		SM	Medium dense, moist, light brown, Silty, fine to medium SAND; 10% cobble and gravel			
10	LB8-2			2		
12			-Becomes moist to wet below 12 feet			
14		CL	Firm to stiff, moist, tan brown, Sandy CLAY; 10% cobble and gravel; ±6" size; slight seepage at contact at 16 feet			
16	LB8-3			4		
18		CL	**ALLUVIUM (Qal)** Firm to stiff, moist, wet, black to dark gray, Sandy CLAY; 10%-20% gravel and cobble ±6" size; hole slightly belled between 17-20 feet			
20	LB8-4	GM	**STADIUM CONGLOMERATE (Tst)** Dense, moist, brown to grayish brown, fine to coarse, Sandy CONGLOMERATE	8		
22						
24	LB8-5		-Standing water at 25 feet	8		
26			BORING TERMINATED AT 26 FEET			

Figure A-56,
Log of Boring LB 8, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

BORING LB 9

ELEV. (MSL.) 252' DATE COMPLETED 06-30-2017

EQUIPMENT BUCKET RIG BY: BORJA/REIST

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
0				SM	**COMPACTED FILL (Qcf)** Medium dense, dry, light brown, Silty, fine to medium SAND; ~20%-30% gravel 3/8" to ±2" in diameter -Becomes moist and light brown with decrease in gravel content below 1.5 feet -Excavates with trace cobble ±3" in diameter			
6	LB9-1					2		
8					-Becomes brown with increase in moisture content below 8 ft.			
10	LB9-2					3		
14				SC	Medium dense, moist, Clayey, fine to medium SAND; little gravel and cobble up to ±6" in diameter			
16	LB9-3					4		
18				SM&ML	**ALLUVIUM (Qal)** Medium dense, moist to wet, mottled dark brown to brown and black, Silty, fine to medium SAND to Sandy SILT; ~5%-15% gravel and cobble up to ±6"			
20	LB9-4					3		
22			▼		-Seepage at 22 feet			
				ML	Stiff, moist to wet, dark gray to black, Sandy SILT; little gravel and cobble up to ±6"; interbedded with silty, fine to coarse sand; moderate caving and hole belled out below 22 ft.			
24				SM				
26	LB9-5				Medium dense, wet to saturated, dark gray to black, Silty, fine to coarse SAND; some gravel and cobble up to ±7"; few organics	2		
28				ML	Stiff, wet, dark gray, Sandy SILT; few gravel and cobble up to 10"			
30				GM	**STADIUM CONGLOMERATE (Tst)** Dense, saturated, brown to yellowish brown, fine to medium, Sandy CONGLOMERATE			
					BORING TERMINATED AT 30 FEET Geotechnically logged to 22 feet			

Figure A-57,
Log of Boring LB 9, Page 1 of 1

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

BORING LB 10

ELEV. (MSL.) 295' DATE COMPLETED 06-30-2017

EQUIPMENT BUCKET RIG BY: BORJA/REIST

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose, dry, brown to light brown, Gravely SAND			
2				SM&SC	**COMPACTED FILL (Qcf)** Medium dense, moist, tan brown, Silty to Clayey, fine to medium SAND; few gravel			
4				SM	Medium dense, moist, brown to tan, Silty, fine to medium SAND; trace gravel			
6	LB10-1					4		
8								
10	LB10-2			SC	Medium dense, moist, brown, Clayey, fine to medium SAND; few gravel	3		
12								
14								
16	LB10-3			SM	Medium dense, moist, brown, Silty, fine to medium SAND; trace gravel	4		
18								
20	LB10-4					5	125.0	13.1
22								
24								
26	LB10-5					6		
28								
30	LB10-6					7	105.1	9.2
32								
34								

G2070-42-01.GPJ

Figure A-58,
Log of Boring LB 10, Page 1 of 3

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

BORING LB 10

ELEV. (MSL.) 295' DATE COMPLETED 06-30-2017

EQUIPMENT BUCKET RIG BY: BORJA/REIST

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
36	LB10-7			SM	-Slight increase in moisture below 35 ft.	3		
38								
40	LB10-8			SC	Medium dense, moist, brown, Clayey, fine to medium SAND; trace gravel	3	105.0	14.8
42								
44				SM	Medium dense, moist, brown to olive brown, Silty, fine to medium SAND; few gravel and trace asphalt concrete			
46	LB10-9					7		
48								
50	LB10-10					10	124.8	11.4
52					-Becomes light brown and light gray; little gravel and cobble up to 6" with 6" thick concrete lens at 51.5 ft.			
54								
56	LB10-11					10		
58				SM&SC	Medium dense, moist, tan brown, Silty and Clayey, fine to coarse SAND; trace gravel			
60	LB10-12			SM	Medium dense, moist, brown, Silty, fine to medium SAND: trace gravel and few clay	13	111.7	10.3
62								
64								
66	LB10-13					7		
68								

Figure A-58,
Log of Boring LB 10, Page 2 of 3

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

BORING LB 10

ELEV. (MSL.) 295' DATE COMPLETED 06-30-2017

EQUIPMENT BUCKET RIG BY: BORJA/REIST

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
70	LB10-14			CL	Very stiff, moist, black and dark gray, Sandy CLAY; some gravel and cobble ±4"; slight organic odor	15		12.8
72				SC	Medium dense, moist, mottled light brown and greenish gray, Clayey, fine to medium SAND; little gravel and cobble ±6"			
74			▼		-Increase in moisture content; becomes mottled brown, dark brown, and greenish gray; slight to moderate seepage at 74.5 ft.			
76	LB10-15					14		
78				CL	Very stiff, wet, mottled dark gray, dark brown, and greenish gray, Sandy CLAY; few gravel and cobble ±4"			
80	LB10-16				-Becomes mottled dark brown and dark reddish brown at 79 ft.	25	100.1	20.4
82					-Excavates with pockets of silty clay; slightly odorous at 80.5 ft.			
84								
86	LB10-17				-Becomes dark gray and black at 85 ft.	15		
88			▼	GM/GC	**STADIUM CONGLOMERATE (Tst)** Very dense, moist to wet, mottled light brown and greenish gray, Sandy CLAY CONGLOMERATE; hole belled out below contact -Standing water at 89 feet			
90	LB10-18					25/3"		
					BORING TERMINATED AT 90.5 FEET Geotechnically logged to 87 feet			

Figure A-58,
Log of Boring LB 10, Page 3 of 3

G2070-42-01.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G2070-42-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING SB 1 ELEV. (MSL.) 298' DATE COMPLETED 07-17-2017 EQUIPMENT CME 75 BY: G. CANNON MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SC	**UNDOCUMENTED FILL (Qudf)** Medium dense, moist, dark olive brown, Clayey, fine to coarse SAND with gravel			
2								
4				SC	**COMPACTED FILL (Qcf)** Medium dense, moist, light olive, Clayey, fine to coarse SAND; trace gravel			
6								
8								
10	SB1-1					34		
12								
14								
16								
18								
20	SB1-2				-Becomes dense and dark yellowish brown below 20 feet	58	109.8	12.3
22								
24								
26								
28								

Figure A-59,
Log of Boring SB 1, Page 1 of 3

G2070-42-01.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

BORING SB 1

ELEV. (MSL.) 298' DATE COMPLETED 07-17-2017

EQUIPMENT CME 75 BY: G. CANNON

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	SB1-3			SC	-Becomes dense and olive brown below 30 feet	32	117.0	13.4
32								
34								
36								
38								
40	SB1-4				-Becomes dense and light yellowish brown below 40 feet	67	112.6	9.2
42								
44								
46								
48								
50	SB1-5					76/11"	116.5	10.3
52								
54								
56								
58								

Figure A-59,
Log of Boring SB 1, Page 2 of 3

G2070-42-01.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

BORING SB 1

ELEV. (MSL.) 298' DATE COMPLETED 07-17-2017

EQUIPMENT CME 75 BY: G. CANNON

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
60	SB1-6			SC	-Becomes medium dense below 60 feet	37	115.9	10.3
62								
64								
66								
68								
70	SB1-7			SM	**STADIUM CONGLOMERATE (Tst)** Very dense, moist, mottled gray and red brown, Silty, fine SAND	50/3"		
72					-Cobble present at 72 feet -Refusal on cobble			
					BORING TERMINATED AT 73 FEET Groundwater not encountered			

Figure A-59,
Log of Boring SB 1, Page 3 of 3

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

BORING SB 2

ELEV. (MSL.) 305' DATE COMPLETED 07-17-2017

EQUIPMENT CME 75 BY: G. CANNON

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM/SC	**UNDOCUMENTED FILL (Qudf)** Loose to medium dense, damp, dark yellowish brown, Silty to Clayey, fine to coarse SAND with some gravel			
8				SC	**COMPACTED FILL (Qcf)** Dense to medium dense, moist, dark yellow brown, Clayey, fine to coarse SAND; some gravel			
10	SB2-1					64	119.2	10.0
20	SB2-2				-Becomes brown below 20 feet	84	113.9	9.0

Figure A-60,
Log of Boring SB 2, Page 1 of 4

G2070-42-01.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

BORING SB 2

ELEV. (MSL.) 305' DATE COMPLETED 07-17-2017

EQUIPMENT CME 75 BY: G. CANNON

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	SB2-3			SC		77	121.1	9.5
32								
34								
36								
38								
40	SB2-4				-Becomes very dense below 40 feet	92/10"	119.8	9.9
42								
44								
46								
48								
50	SB2-5				-Becomes medium dense below 50 feet	31	112.6	13.7
52								
54								
56								
58								

Figure A-60,
Log of Boring SB 2, Page 2 of 4

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2070-42-01

BORING SB 2

ELEV. (MSL.) 305' DATE COMPLETED 07-17-2017

EQUIPMENT CME 75 BY: G. CANNON

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
60	SB2-6			SC		79	117.5	10.3
62								
64								
66								
68								
70	SB2-7					76	123.6	10.2
72								
74								
76								
78								
80								
82								
84	SB2-8					56	111.4	14.9
86								
88								

Figure A-60,
Log of Boring SB 2, Page 3 of 4

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

BORING SB 2

ELEV. (MSL.) 305' DATE COMPLETED 07-17-2017

EQUIPMENT CME 75 BY: G. CANNON

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
90	SB2-9			SC	-No recovery	77		
	SB2-10					49		
92								
94								
	SB2-11		▼			88/8"		
96					-Groundwater encountered at 96 feet			
				GM	**STADIUM CONGLOMERATE (Tst)**			
98					Very dense, saturated, brown, fine to coarse, Sandy CONGLOMERATE; difficult drilling below 96.5 feet			
100	SB2-12					50/5"		
					BORING TERMINATED AT 100.5 FEET Groundwater encountered at 96 feet			

Figure A-60,
Log of Boring SB 2, Page 4 of 4

G2070-42-01.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

BORING SB 3

ELEV. (MSL.) 324' DATE COMPLETED 07-18-2017

EQUIPMENT CME 75 BY: N. BORJA

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				GM	**UNDOCUMENTED FILL (Qudf)** Medium dense, damp, brown, Sandy GRAVEL; some silt			
4				SC	**COMPACTED FILL (Qcf)** Medium dense, moist, olive brown to brown, Clayey, fine to medium SAND; few gravel			
8				CL	Stiff, moist, olive brown to grayish brown, Sandy CLAY; trace			
10	SB3-1			SM	Medium dense, moist, mottled brown and light gray, Silty, fine to medium SAND; trace gravel	32		
12				CL	Stiff, moist, olive brown, Sandy CLAY; trace gravel; trace boulder at 14 feet			
14				SM	Medium dense, moist, grayish brown, Silty, fine to medium SAND; trace gravel			
18				SC	Medium dense, moist, olive brown to tan brown, Clayey, fine to medium SAND; few gravel			
20	SB3-2			SM	Medium dense, moist, tan brown, Silty, fine to medium SAND; fine gravel	45	119.0	10.5
24					-Becomes olive brown to grayish brown			
28								

Figure A-61,
Log of Boring SB 3, Page 1 of 4

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

BORING SB 3

ELEV. (MSL.) 324' DATE COMPLETED 07-18-2017

EQUIPMENT CME 75 BY: N. BORJA

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	SB3-3			SM	-Becomes brown; few gravel	66	118.4	11.1
32								
34								
36								
38								
40	SB3-4				-Becomes very dense	82	119.0	12.5
42								
44								
46								
48				SC	Dense, moist, brown, Clayey, fine to medium SAND; trace gravel			
50	SB3-5					60	119.1	13.5
52								
54								
56								
58								

Figure A-61,
Log of Boring SB 3, Page 2 of 4

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

BORING SB 3

ELEV. (MSL.) 324' DATE COMPLETED 07-18-2017

EQUIPMENT CME 75 BY: N. BORJA

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
60	SB3-6			SC		55	122.4	10.6
62								
64								
66								
68								
70								
72								
74								
76								
78				SM	Dense, moist, tan brown, Silty, fine to medium SAND; trace gravel			
80	SB3-7					66		
82								
84								
86								
88								

Figure A-61,
Log of Boring SB 3, Page 3 of 4

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

BORING SB 3

ELEV. (MSL.) 324' DATE COMPLETED 07-18-2017

EQUIPMENT CME 75 BY: N. BORJA

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
90								
92								
94								
96								
98								
100	SB3-8					65	117.3	13.0
102								
104								
106	SB3-9					50/2"		
108								
110			▼		-Groundwater encountered at 110 feet			
112				GM	**STADIUM CONGLOMERATE (Tst)** Very dense, saturated, brown, fine to coarse, Sandy CONGLOMERATE			
114								
					BORING TERMINATED AT 115.5 FEET Groundwater encountered at 110 feet			

Figure A-61,
Log of Boring SB 3, Page 4 of 4

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

BORING SB 4

ELEV. (MSL.) 307' DATE COMPLETED 07-19-2017

EQUIPMENT CME 75 BY: N. BORJA

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**UNDOCUMENTED FILL (Qudf)** Medium dense, moist, tan brown, Silty, fine to medium SAND; few gravel			
8				SC	**COMPACTED FILL (Qcf)** Medium dense to dense, moist, brown, Clayey, fine to medium SAND; little gravel			
10	SB4-1					69	121.4	10.4
14				SM	Dense, moist, grayish brown to brown, Silty, fine to medium SAND; few gravel			
16				CL	Hard, moist, brown, Sandy CLAY; trace gravel			
20	SB4-2					50	116.3	11.4
26				SC	Dense, moist, brown to olive brown, Clayey, fine to medium SAND; few gravel			
28								

Figure A-62,
Log of Boring SB 4, Page 1 of 3

G2070-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

BORING SB 4

ELEV. (MSL.) 307' DATE COMPLETED 07-19-2017

EQUIPMENT CME 75 BY: N. BORJA

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	SB4-3			SC	-Excavates with little gravel	57	110.2	10.9
32								
34				CL	Very stiff, moist, brown, Sandy CLAY			
36								
38				SM	Dense to very dense, moist, brown, Silty, fine to medium SAND; little gravel			
40	SB4-4					67/11"	125.6	8.2
42								
44								
46								
48								
50	SB4-5				-Poor recovery	50/5"		
52								
54								
56								
58								

Figure A-62,
Log of Boring SB 4, Page 2 of 3

G2070-42-01.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G2070-42-01

BORING SB 4

ELEV. (MSL.) 307' DATE COMPLETED 07-19-2017

EQUIPMENT CME 75 BY: N. BORJA

DEPTH IN FEET	SAMPLE NO.	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
60		SM				
62						
64						
66						
68		SC	Dense, moist to wet, brown, Clayey, fine to coarse SAND; little gravel			
70	SB4-6			49	111.4	10.8
72						
74						
76						
78						
80	SB4-7		-No recovery at 80 feet due to groundwater	22		
82						
84						
86		GM	**STADIUM CONGLOMERATE (Tst)** Very dense, saturated, brown, fine to coarse, Sandy CONGLOMERATE			
88	SB4-8			50/2"		
			BORING TERMINATED AT 88 FEET Groundwater encountered at 80 feet			

G2070-42-01.GPJ

Figure A-62,
Log of Boring SB 4, Page 3 of 3

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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APPENDIX B

APPENDIX B

LABORATORY TESTING

We performed laboratory tests in accordance with generally accepted test methods of the American Society for Testing and Materials (ASTM) or other suggested procedures. We tested selected samples for their in-place dry density and moisture content, maximum dry density and optimum moisture content, expansion index, shear strength, water-soluble sulfate characteristics, chloride concentration, pH and resistivity, and consolidation characteristics. The results of our laboratory tests are presented in the following tables and graphs. The in-place dry density and moisture content test results are presented on the exploratory boring logs in Appendix A.

TABLE B-I
SUMMARY OF LABORATORY MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT TEST RESULTS
ASTM D 1557

Proctor Curve No.	Source and Description	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
T16-1	Dark brown, Silty SAND with some gravel	135.3	7.6
T19-2	Dark brown, fine to coarse, Sandy GRAVEL with little clay	131.7	8.2
T29-1	Dark brown, Clayey, fine to coarse SAND	128.4	9.5

TABLE B-II
SUMMARY OF LABORATORY EXPANSION INDEX TEST RESULTS
ASTM D 4829

Sample No.	Moisture Content (%)		Dry Density (pcf)	Expansion Index	Expansion Classification
	Before Test	After Test			
T5-1	10.0	22.2	107.8	45	Low
T9-2	9.2	16.7	113.8	3	Very Low
T16-1	8.5	15.0	114.2	4	Very Low
T19-2	9.7	16.4	111.1	1	Very Low
T29-1	10.0	20.8	109.3	47	Low
T34-1	8.8	15.0	113.8	3	Very Low

TABLE B-III
SUMMARY OF LABORATORY DIRECT SHEAR TEST RESULTS
ASTM D 3080

Sample No.	Dry Density (pcf)	Moisture Content (%)		Unit Cohesion (psf)	Angle of Shear Resistance-Ultimate (degrees)
		Initial	Final		
SB1-3	117.0	13.4	14.1	975	34
SB3-3	118.4	11.1	13.1	540	38
T16-1*	122.0	7.2	12.7	650	32
T29-1*	114.5	10.4	17.2	700	26

*Samples remolded to approximately 90 percent relative compaction near optimum moisture content.

TABLE B-IV
SUMMARY OF LABORATORY WATER-SOLUBLE SULFATE CALIFORNIA TEST NO. 417

Sample No.	Water-Soluble Sulfate (%)	Classification
T5-1	0.040	Negligible (S0)
T9-2	0.0003	Negligible (S0)
T16-1	0.025	Negligible (S0)
T19-2	0.015	Negligible (S0)
T29-1	0.022	Negligible (S0)
T34-1	0.001	Negligible (S0)

TABLE B-V
SUMMARY OF LABORATORY CHLORIDE ION CONTENT TEST RESULTS
AASHTO T 291

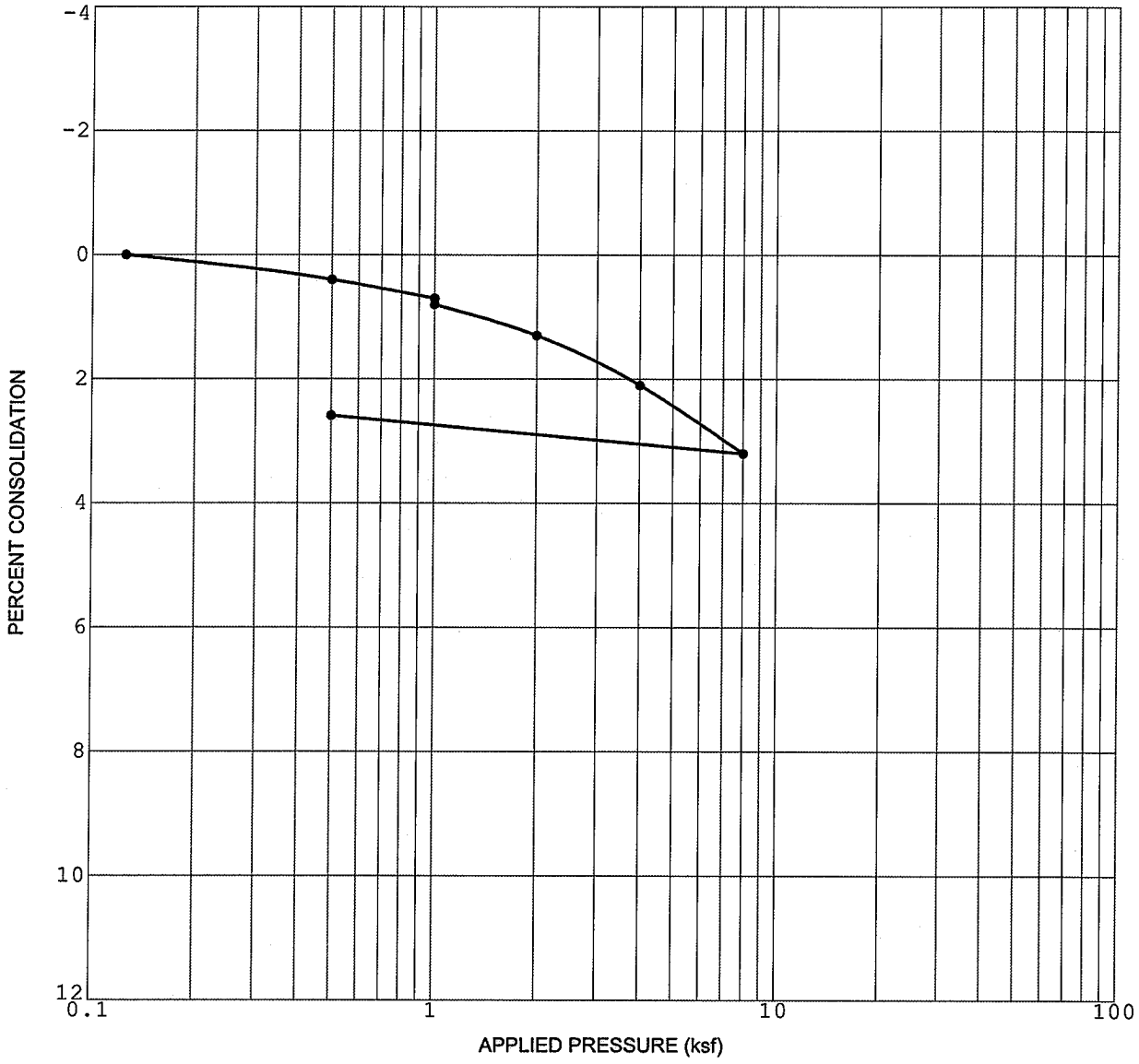
Sample No.	Chloride Ion Content (ppm)	Chloride Ion Content (%)
T5-1	1511	0.151
T29-1	520	0.052
T34-1	395	0.040

TABLE B-VI
SUMMARY OF LABORATORY POTENTIAL OF HYDROGEN (PH) AND RESISTIVITY TEST RESULTS
CALIFORNIA TEST NO. 417

Sample No.	pH	Resistivity (ohm-cm)
T5-1	7.4	300
T29-1	6.7	950

PROJECT NO. G2070-42-01

SAMPLE NO. LB1-4



Initial Dry Density (pcf)	124.9	**Initial Saturation (%)**	76.6
Initial Water Content (%)	9.5	**Sample Saturated at (ksf)**	1.0

CONSOLIDATION CURVE

HANSON CARROL CANYON

SAN DIEGO, CALIFORNIA

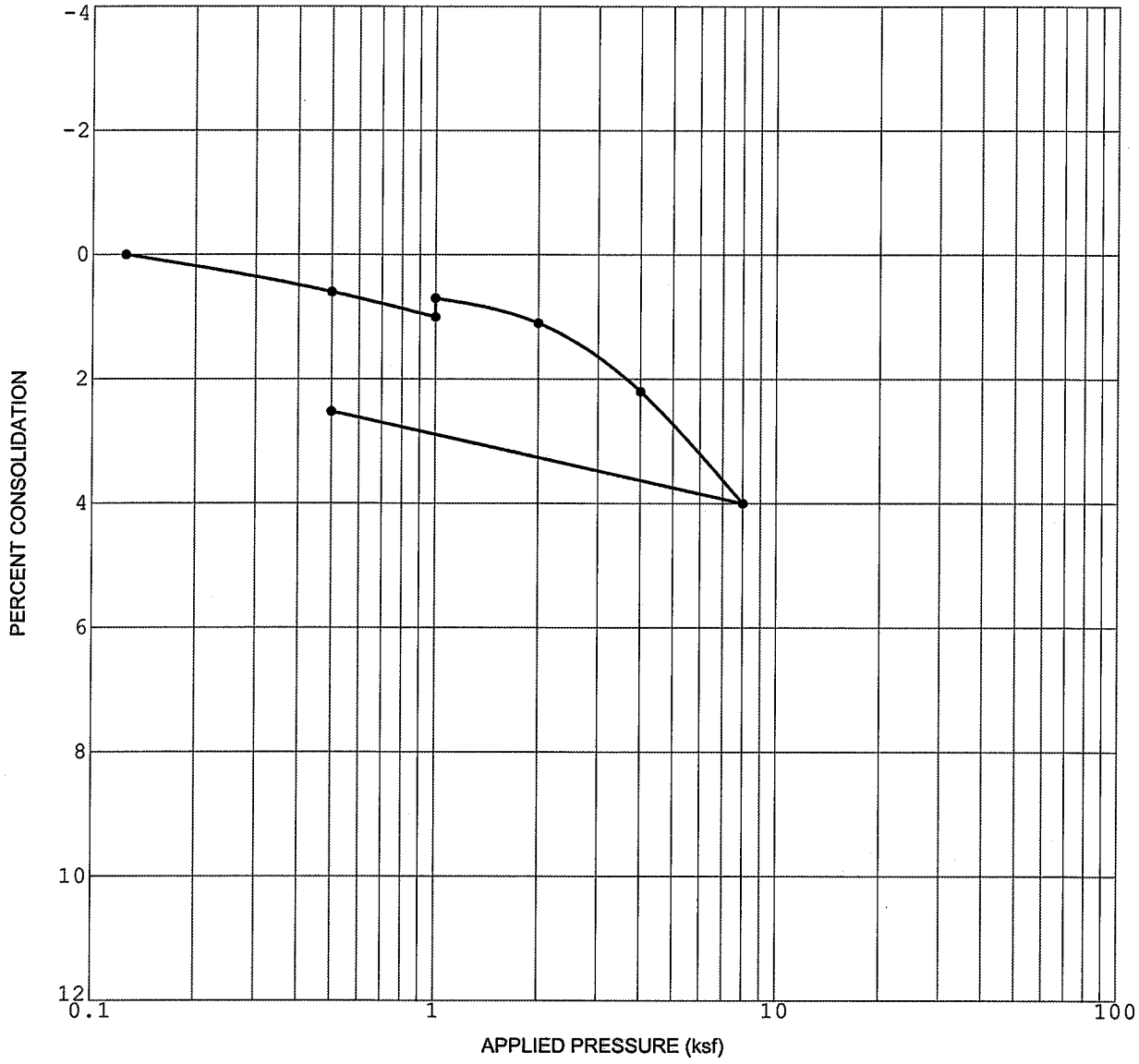
G2070-42-01.GPJ

Figure B-1

GEOCON

PROJECT NO. G2070-42-01

SAMPLE NO. LB2-4



Initial Dry Density (pcf)	108.1
Initial Water Content (%)	14.7

Initial Saturation (%)	72.9
Sample Saturated at (ksf)	1.0

CONSOLIDATION CURVE

HANSON CARROL CANYON

SAN DIEGO, CALIFORNIA

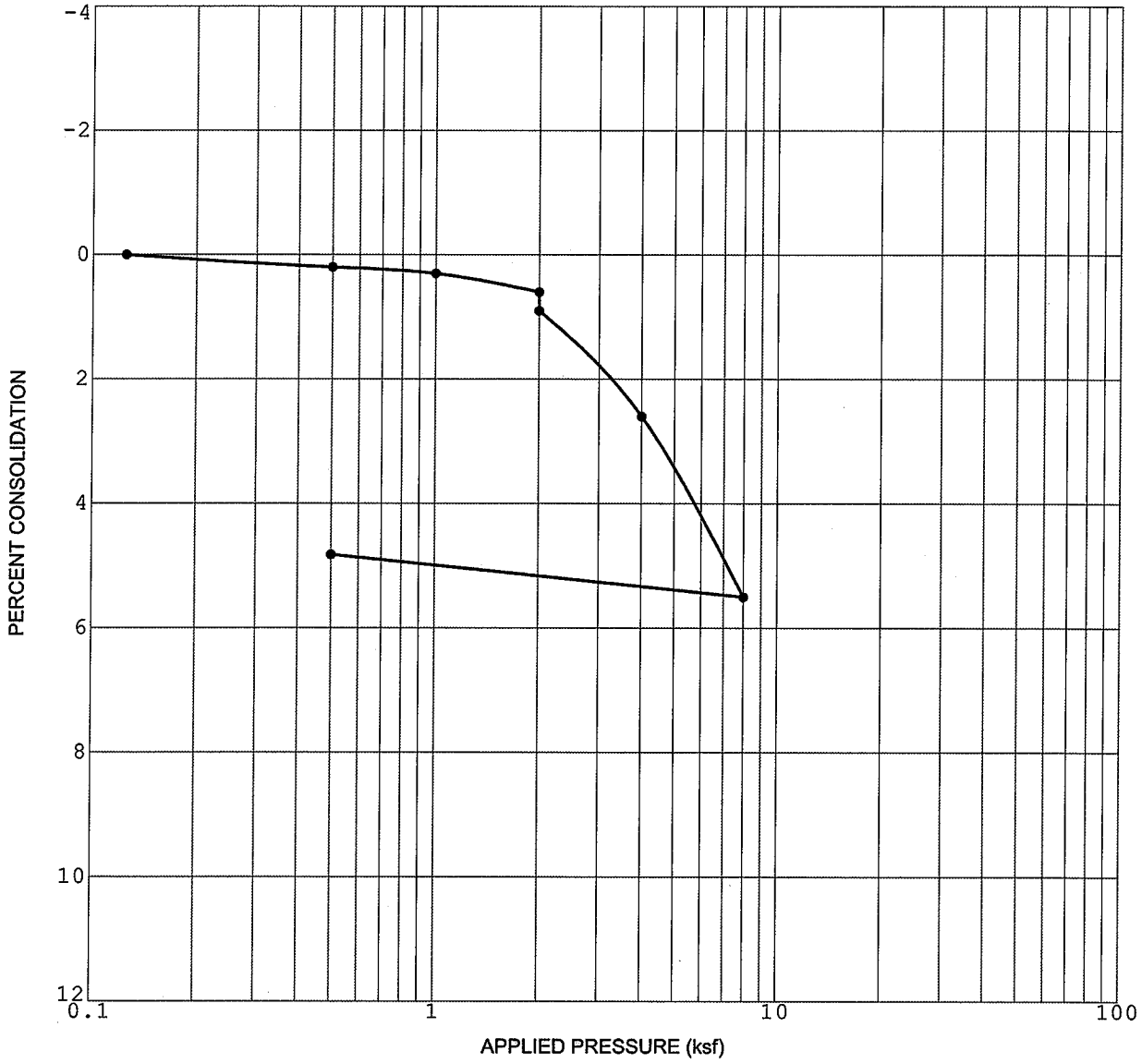
G2070-42-01.GPJ

Figure B-2

GEOCON

PROJECT NO. G2070-42-01

SAMPLE NO. LB2-6



Initial Dry Density (pcf)	112.4	**Initial Saturation (%)**	59.1
Initial Water Content (%)	10.6	**Sample Saturated at (ksf)**	2.0

CONSOLIDATION CURVE

HANSON CARROL CANYON

SAN DIEGO, CALIFORNIA

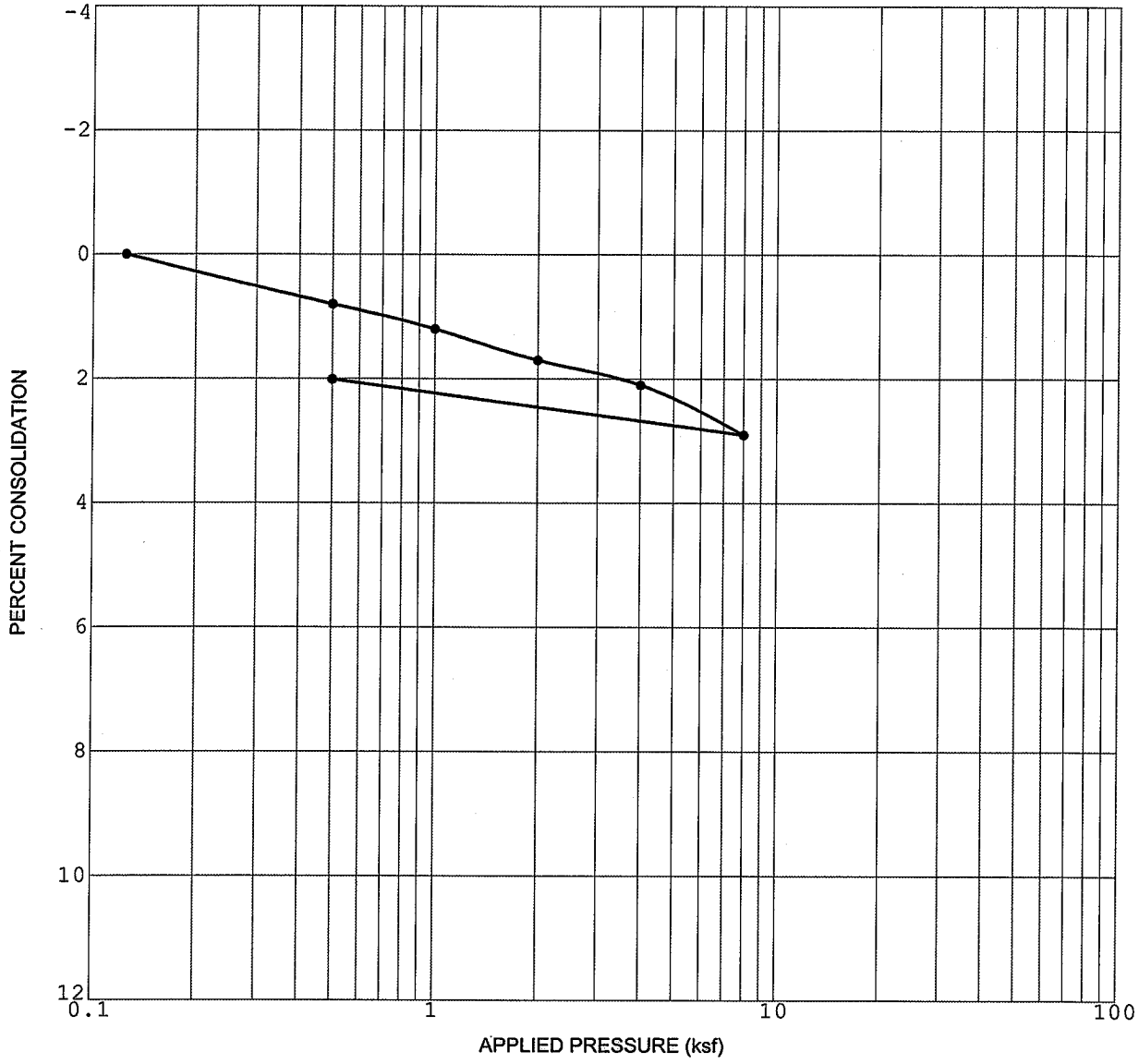
G2070-42-01.GPJ

Figure B-3

GEOCON

PROJECT NO. G2070-42-01

SAMPLE NO. LB10-4



Initial Dry Density (pcf)	125.0
Initial Water Content (%)	13.1

Initial Saturation (%)	100
Sample Saturated at (ksf)	2.0

CONSOLIDATION CURVE

HANSON CARROL CANYON

SAN DIEGO, CALIFORNIA

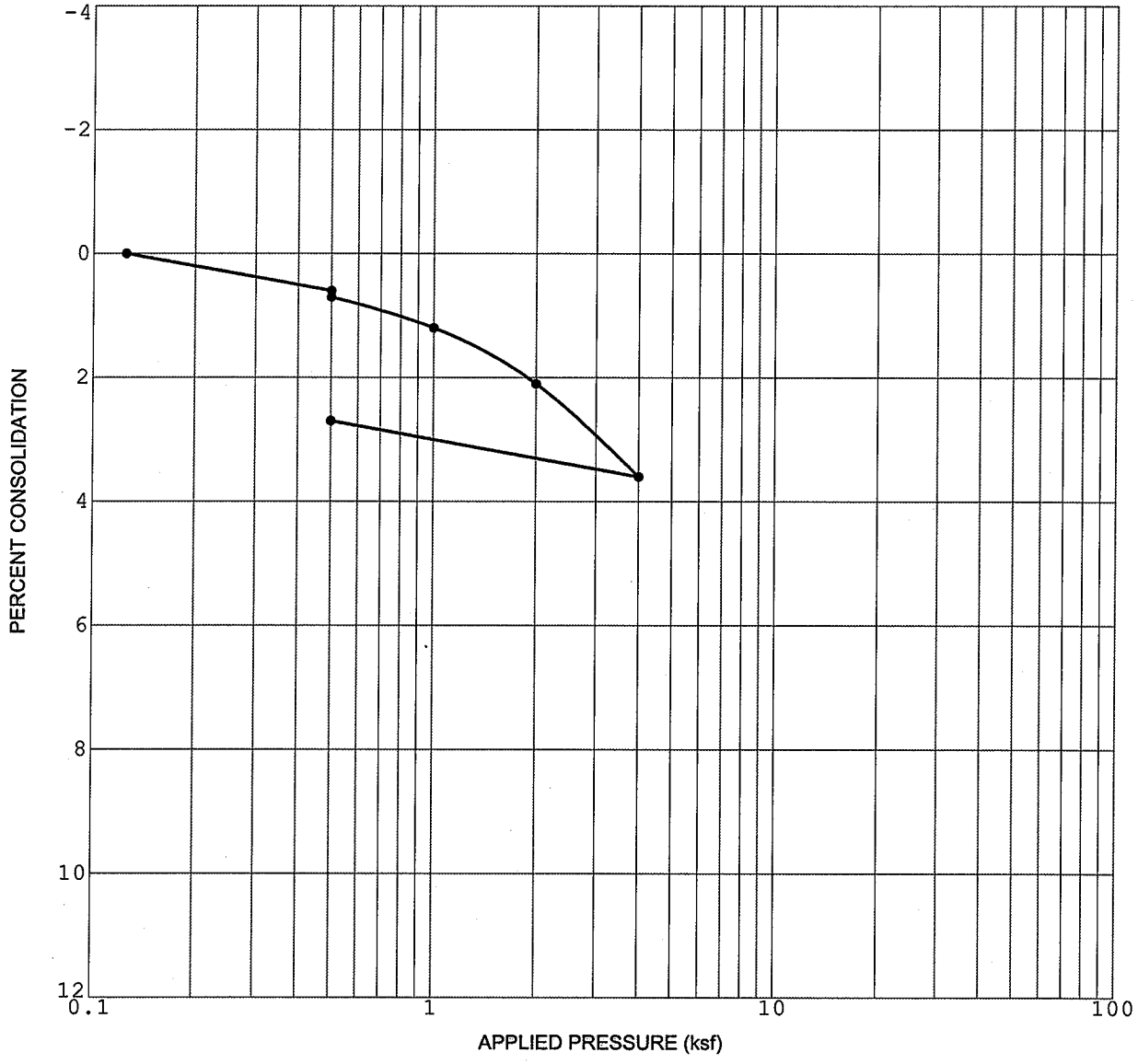
G2070-42-01.GPJ

Figure B-4

GEOCON

PROJECT NO. G2070-42-01

SAMPLE NO. SB1-2



Initial Dry Density (pcf)	109.8	**Initial Saturation (%)**	71.3
Initial Water Content (%)	12.3	**Sample Saturated at (ksf)**	.5

CONSOLIDATION CURVE

HANSON CARROL CANYON

SAN DIEGO, CALIFORNIA

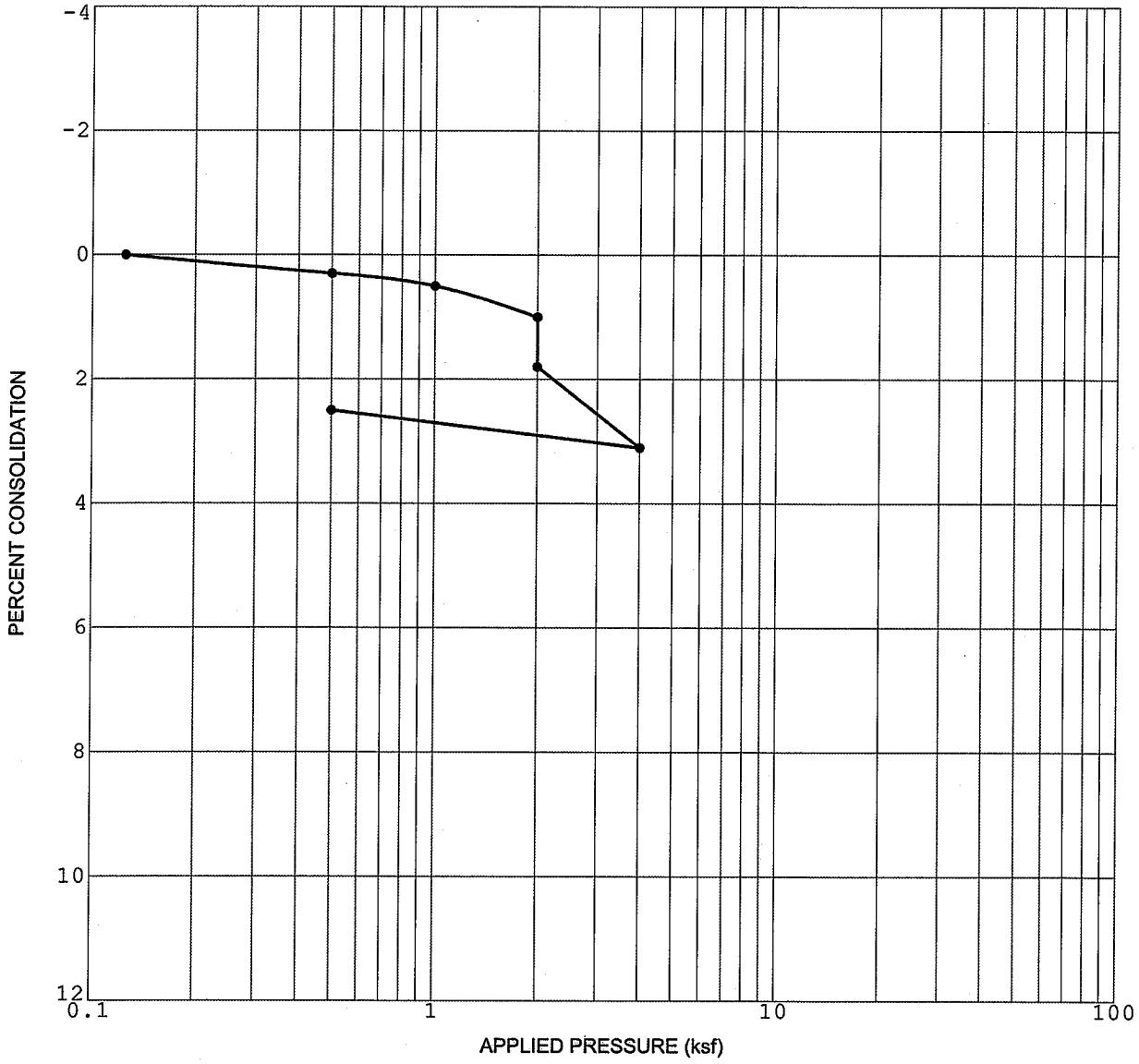
G2070-42-01.GPJ

Figure B-5

GEOCON

PROJECT NO. G2070-42-01

SAMPLE NO. SB1-3



Initial Dry Density (pcf)	114.6
Initial Water Content (%)	10.4

Initial Saturation (%)	61.6
Sample Saturated at (ksf)	2.0

CONSOLIDATION CURVE

HANSON CARROL CANYON

SAN DIEGO, CALIFORNIA

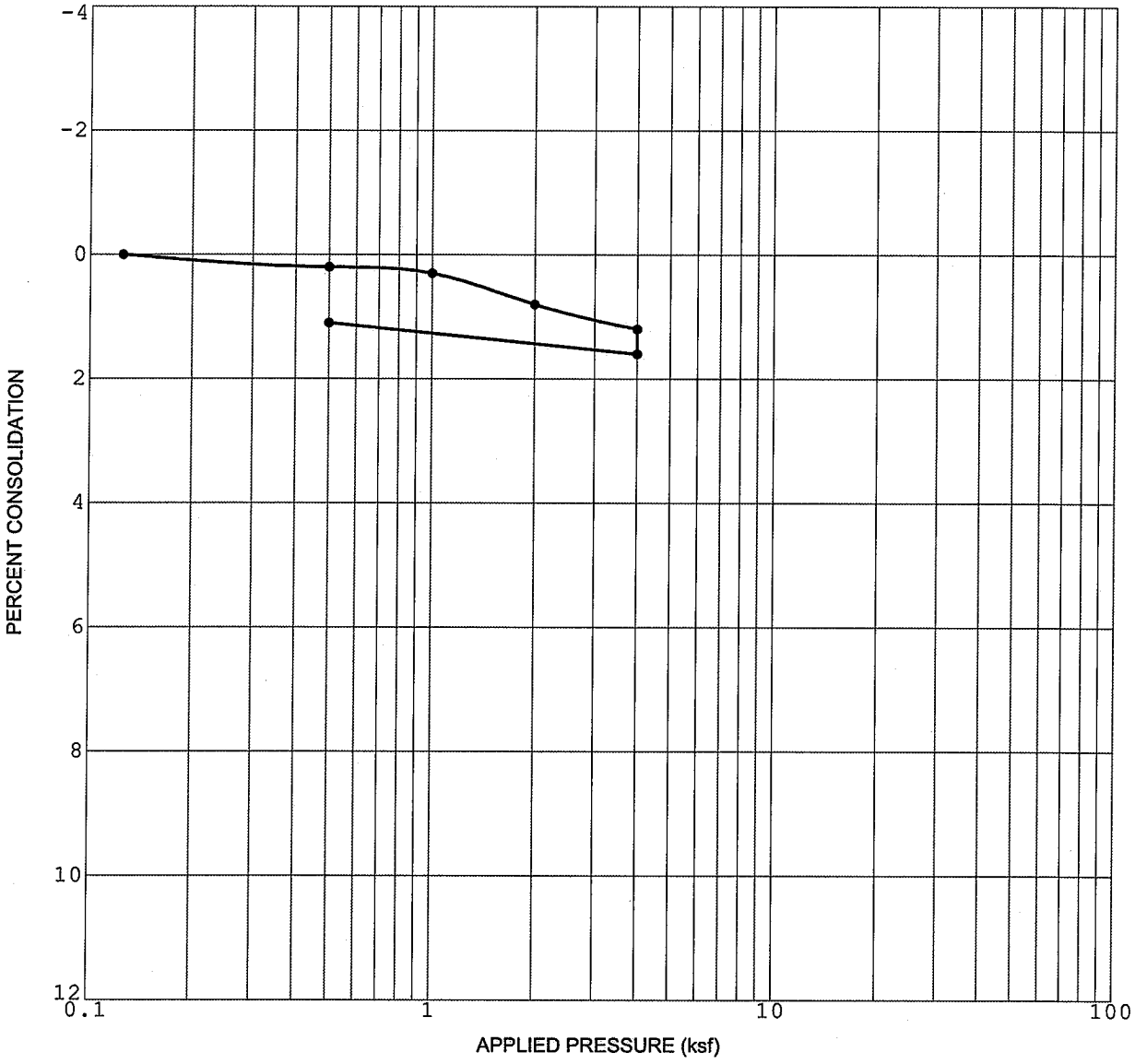
G2070-42-01.GPJ

Figure B-6

GEOCON

PROJECT NO. G2070-42-01

SAMPLE NO. SB1-6



Initial Dry Density (pcf)	115.9	**Initial Saturation (%)**	63.6
Initial Water Content (%)	10.3	**Sample Saturated at (ksf)**	4.0

CONSOLIDATION CURVE

HANSON CARROL CANYON

SAN DIEGO, CALIFORNIA

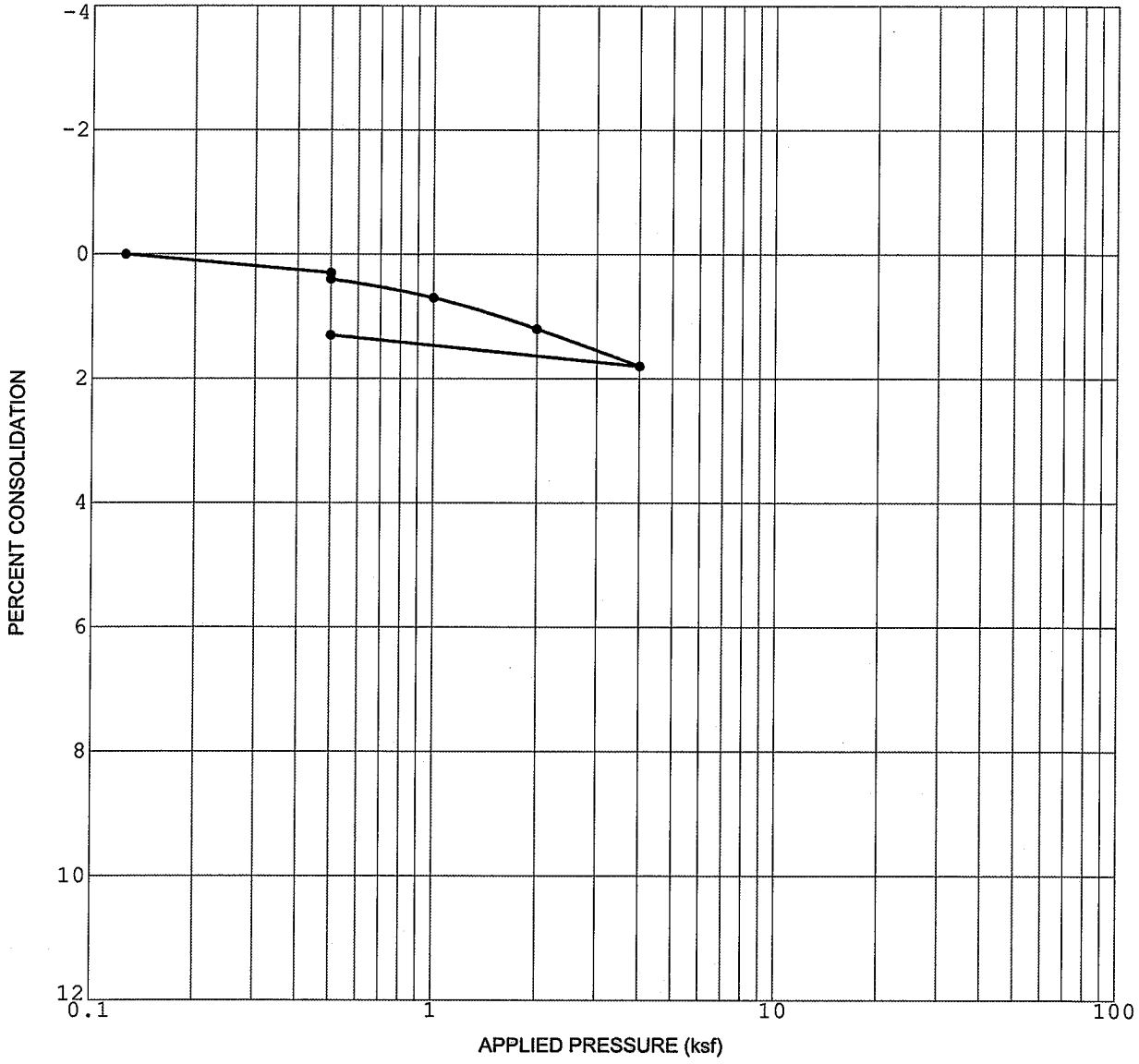
G2070-42-01.GPJ

Figure B-7

GEOCON

PROJECT NO. G2070-42-01

SAMPLE NO. SB2-1



Initial Dry Density (pcf)	119.2	**Initial Saturation (%)**	67.7
Initial Water Content (%)	10.0	**Sample Saturated at (ksf)**	.5

CONSOLIDATION CURVE

HANSON CARROL CANYON

SAN DIEGO, CALIFORNIA

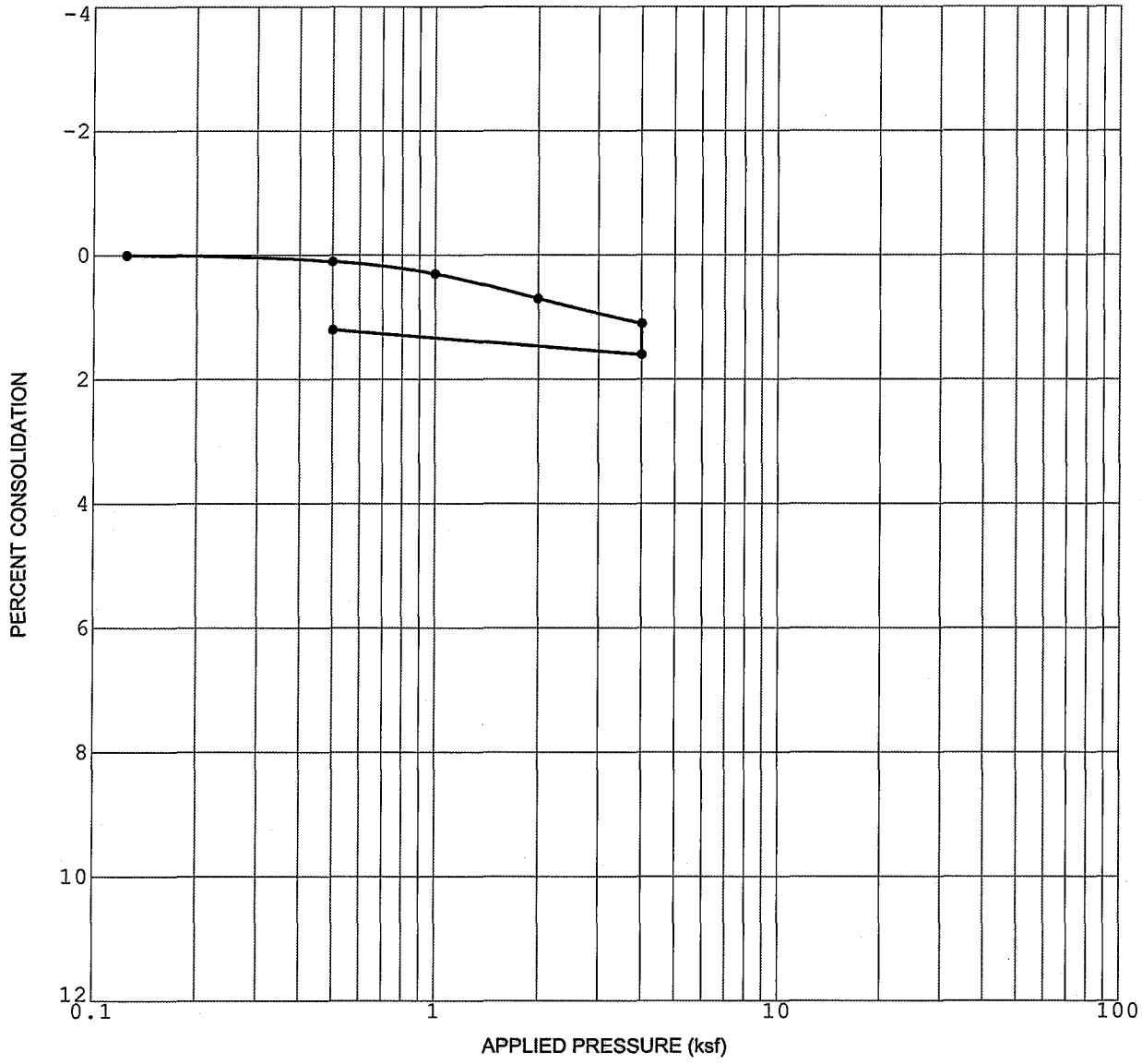
G2070-42-01.GPJ

Figure B-8

GEOCON

PROJECT NO. G2070-42-01

SAMPLE NO. SB2-5



Initial Dry Density (pcf)	112.6	**Initial Saturation (%)**	76.9
Initial Water Content (%)	13.7	**Sample Saturated at (ksf)**	4.0

CONSOLIDATION CURVE

HANSON CARROL CANYON

SAN DIEGO, CALIFORNIA

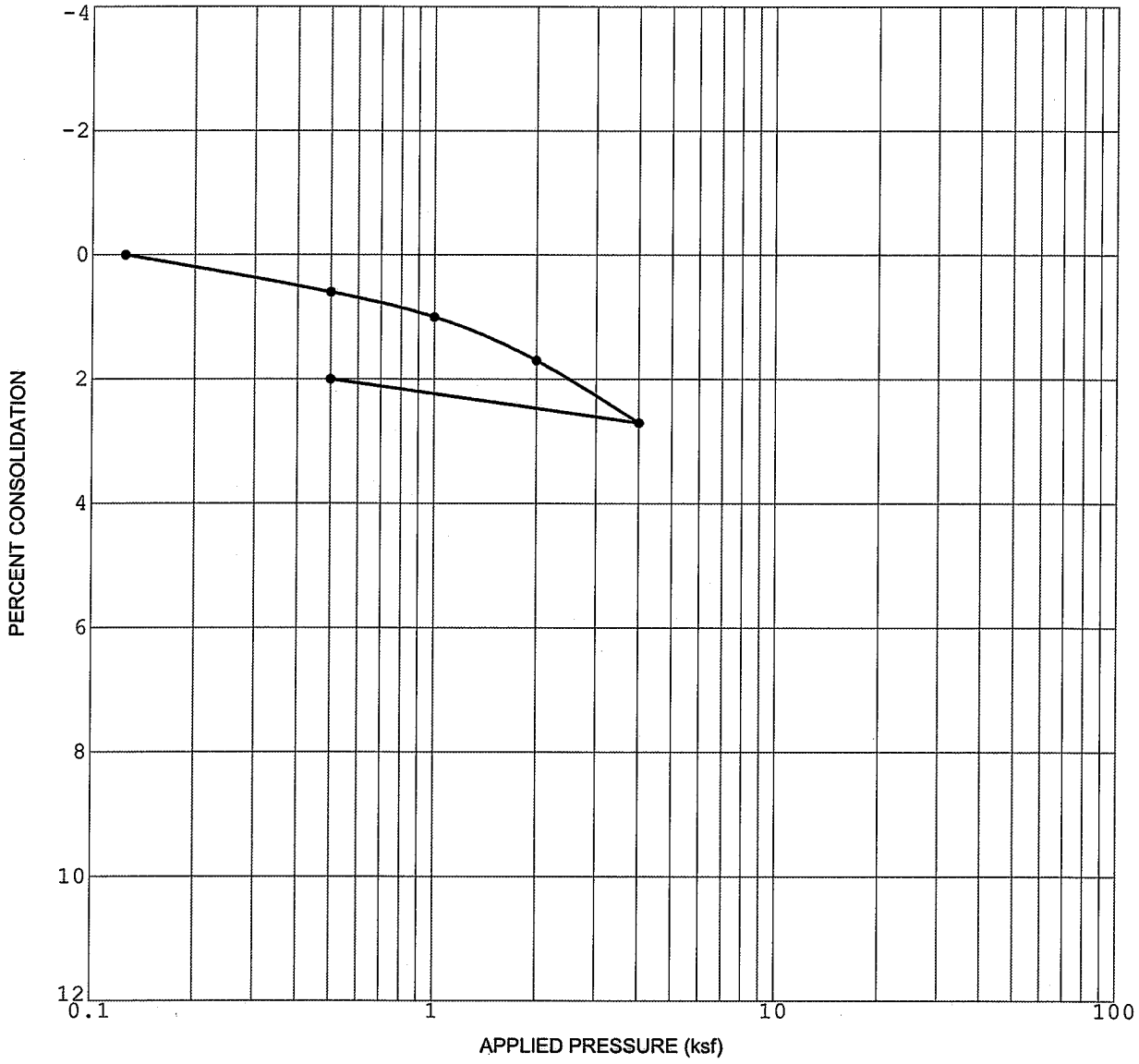
G2070-42-01.GPJ

Figure B-9

GEOCON

PROJECT NO. G2070-42-01

SAMPLE NO. SB3-2



Initial Dry Density (pcf)	119.0
Initial Water Content (%)	10.5

Initial Saturation (%)	70.8
Sample Saturated at (ksf)	.5

CONSOLIDATION CURVE

HANSON CARROL CANYON

SAN DIEGO, CALIFORNIA

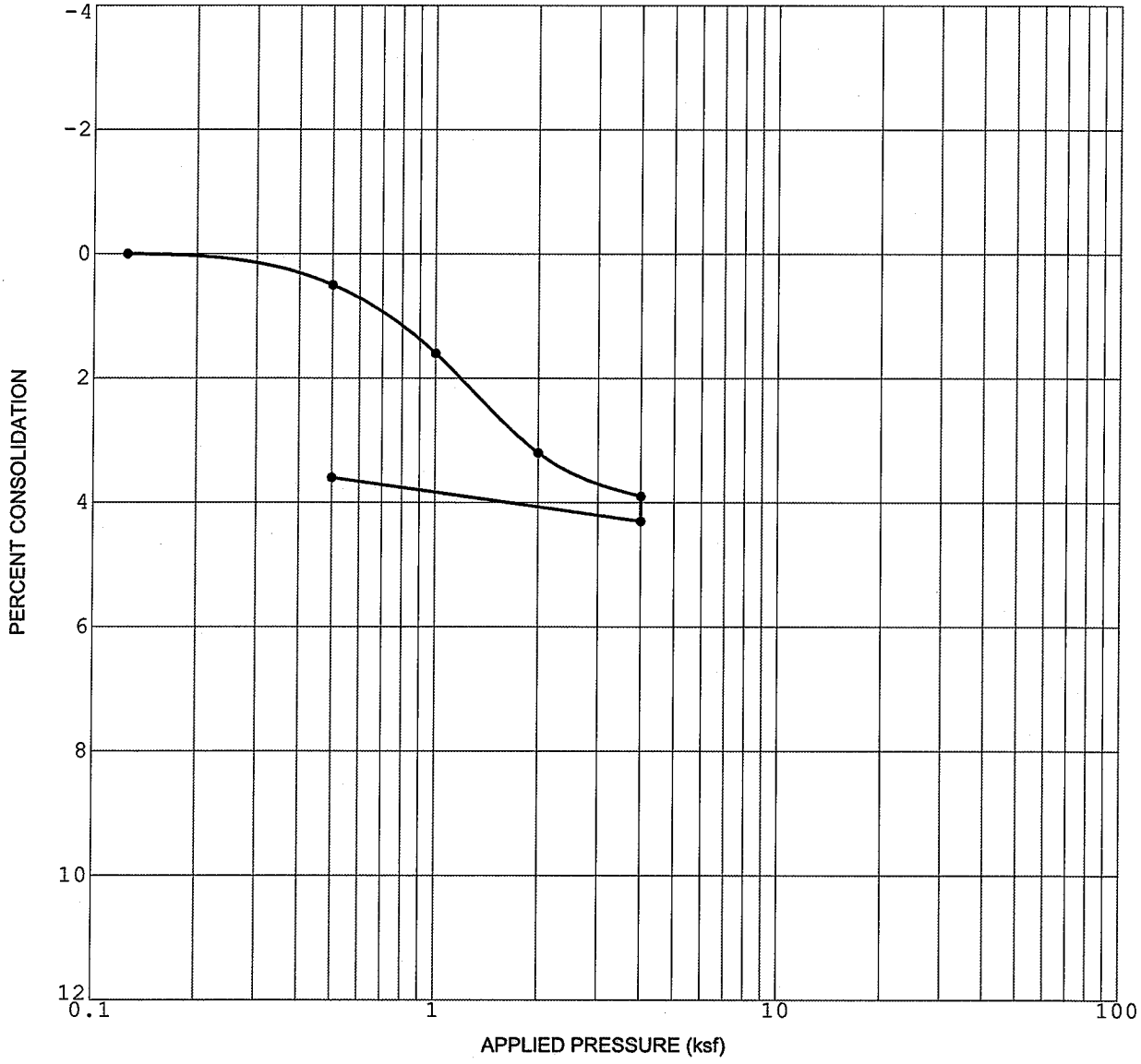
G2070-42-01.GPJ

Figure B-10

GEOCON

PROJECT NO. G2070-42-01

SAMPLE NO. SB3-5



Initial Dry Density (pcf)	119.1	**Initial Saturation (%)**	91.6
Initial Water Content (%)	13.5	**Sample Saturated at (ksf)**	4.0

CONSOLIDATION CURVE

HANSON CARROL CANYON

SAN DIEGO, CALIFORNIA

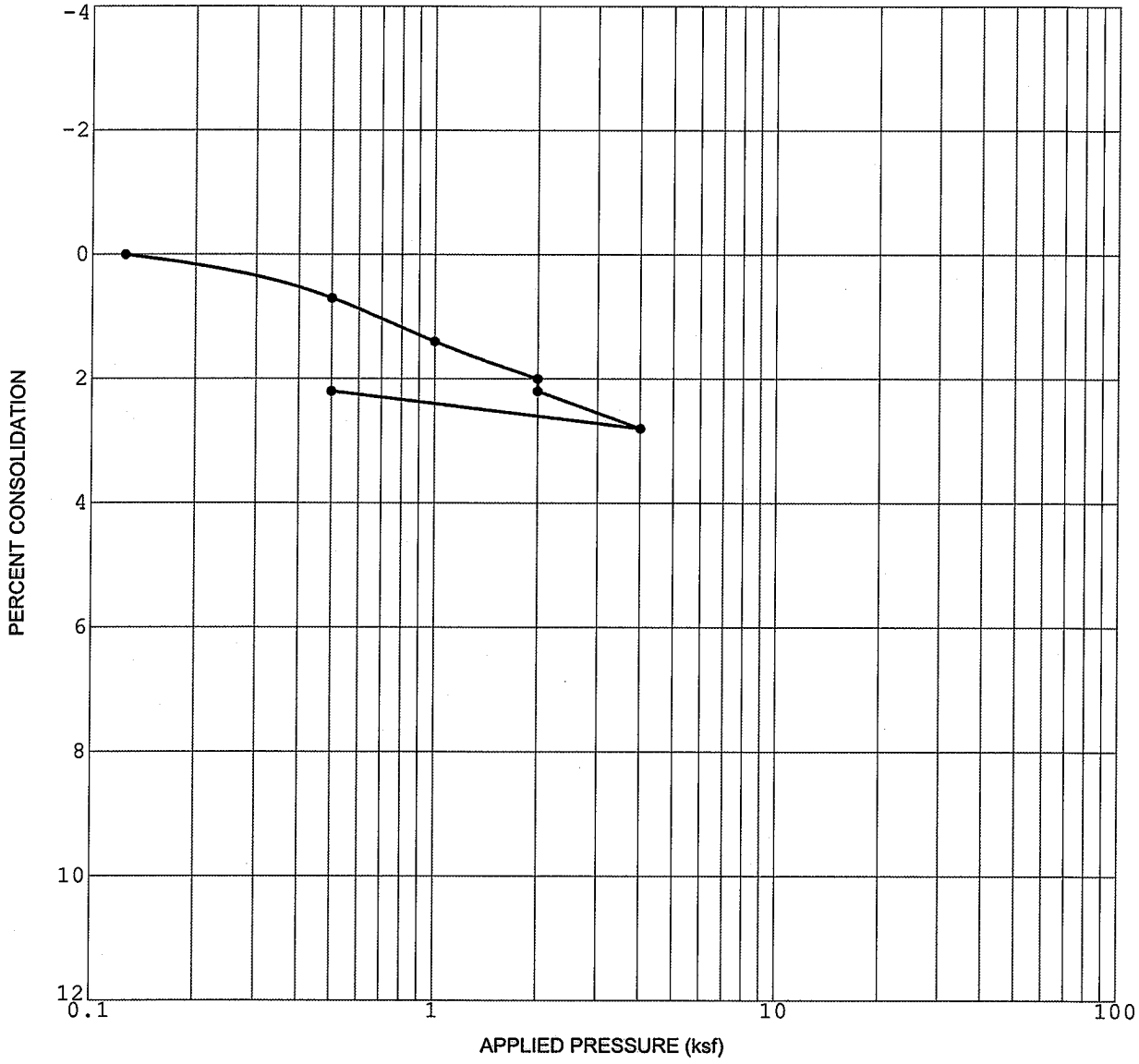
G2070-42-01.GPJ

Figure B-11

GEOCON

PROJECT NO. G2070-42-01

SAMPLE NO. SB4-1



Initial Dry Density (pcf)	121.4
Initial Water Content (%)	10.4

Initial Saturation (%)	75.1
Sample Saturated at (ksf)	2.0

CONSOLIDATION CURVE

HANSON CARROL CANYON

SAN DIEGO, CALIFORNIA

G2070-42-01.GPJ

Figure B-12

GEOCON

APPENDIX C

STORM WATER MANAGEMENT

We understand storm water management devices are being proposed in accordance with the current Storm Water Standards (SWS). If not properly constructed, there is a potential for distress to improvements and properties located hydrologically down gradient or adjacent to these devices. Factors such as the amount of water to be detained, its residence time, and soil permeability have an important effect on seepage transmission and the potential adverse impacts that may occur if the storm water management features are not properly designed and constructed. We have not performed a hydrogeological study at the site. If infiltration of storm water runoff occurs, downstream properties and improvements may be subjected to seeps, springs, slope instability, raised groundwater, movement of foundations and slabs, or other undesirable impacts as a result of water infiltration.

Hydrologic Soil Group

The United States Department of Agriculture (USDA), Natural Resources Conservation Services, possesses general information regarding the existing soil conditions for areas within the United States. The USDA website also provides the Hydrologic Soil Group. Table C-1 presents the descriptions of the hydrologic soil groups.

TABLE C-1
HYDROLOGIC SOIL GROUP DEFINITIONS

Soil Group	Soil Group Definition
A	Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
B	Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
C	Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.
D	Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high-water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

The property is underlain by undocumented fill, compacted fill, alluvium, colluvium, and the Stadium Conglomerate. Table C-2 presents the information from the USDA website for the subject property.

APPENDIX C

TABLE C-2
USDA WEB SOIL SURVEY – HYDROLOGIC SOIL GROUP

Map Unit Name	Map Unit Symbol	Approximate Percentage of Property	Hydrologic Soil Group
Altamont Clay, 15 to 30 percent slopes	AtE	0.2	C
Gravel Pits	GP	11.8	NA
Olivenhain cobbly loam, 2 to 9 percent slopes	OhC	3	D
Olivenhain cobbly loam, 9 to 30 percent slopes	OhE	5	D
Redding gravelly loam, 2 to 9 percent slopes	RdC	34	D
Redding cobbly loam, 9 to 30 percent slopes	RdE	10	D
Redding cobbly loam, dissected, 15 to 50 percent slopes	RfF	1	D
Riverwash	Rm	15	D
Terrace Escarpments	TeF	20	NA

Infiltration Testing

We performed in-place hydraulic conductivity tests to evaluate the infiltration characteristics of the bedrock geologic unit on the property (Stadium Conglomerate) using a Soilmoisture Corp Aardvark Permeameter. The tests were performed in 8-inch-diameter auger borings. The Geologic Map, Figure 2 shows the approximate locations of the infiltration tests. Table C-3 presents the results of the testing. The calculation sheets are also provided herein.

We used the guidelines presented in the Riverside County Low Impact Development BMP Design Handbook, which references the United States Bureau of Reclamation Well Permeameter Test Method (USBR 7300-89). Based on this widely-accepted guideline, the saturated hydraulic conductivity (Ksat) is equal to the infiltration rate.

The Ksat value determined from the Aardvark Permeameter test is the unfactored infiltration rate. The Ksat (infiltration rate) equation provided in the Riverside County Handbook was used to compute the unfactored infiltration rate.

TABLE C-3
UNFACTORED HYDRAULIC CONDUCTIVITY TEST RESULTS

Test No.	Geologic Unit	Infiltration Rate, I (inches/hour)	Factored* Field Infiltration Rate, I (inches/hour)
A-1	Tst	0.015	0.0075
A-2	Tst	0.006	0.003

*Factor of Safety of 2.0 for feasibility determination

STORM WATER MANAGEMENT CONCLUSIONS

Soil Types

Undocumented Fill (Qudf) – We encountered undocumented fill through the site. Recommendations are provided to remove the undocumented fill within structural improvement areas. In non-structural areas, the undocumented fill may be left in place. Infiltration should not occur within the undocumented fill due to the potential for adverse settlement. Undocumented fill is considered infeasible for full or partial infiltration.

Alluvium/Colluvium (Qal/Qc) – Alluvium is present within the creek drainages. Colluvium is present at the base and on the native slopes at the east end of the project. Recommendations are provided to remove replace alluvium and colluvium with compacted fill, therefore, alluvium and colluvium will not be present below proposed basins.

Compacted Fill (Qcf) – Compacted fill exists within several areas on the property. At the completion of grading, compacted fill will exist throughout the majority of the property. Compacted fill thickness up to 100 feet deep are expected. Infiltration should not occur within the compacted fill due to the potential for adverse settlement. Undocumented fill is considered infeasible for full or partial infiltration.

Stadium Conglomerate (Tst) – The Stadium Conglomerate is the underlying bedrock unit and exposed on the cut slopes along the perimeter of the property. The Stadium Conglomerate is very dense and cemented in many locations. The Stadium Conglomerate has very slow infiltration characteristics.

Groundwater Elevation

Groundwater was encountered in several borings within the southern portion of the property, which appears to be perched on the underlying Stadium Conglomerate.

Utilities and Structures

Existing utilities are present on the property. Many of the utilities will be abandoned to enable grading to be performed. Some utilities, including a trunk sewer main and electrical conduit will likely remain in place. Structures on the property will be removed during grading.

Soil or Groundwater Contamination

We are unaware of contaminated soil on the property. Therefore, full and partial infiltration associated with this risk is considered feasible.

Slopes

There are both ascending and descending slopes on the property. We recommend a 50-foot setback from the top of slopes. Basins within 50 feet of the top of slopes should be lined to prevent lateral water migration to the face of the slope.

Infiltration Rates

The results of the infiltration rates in the underlying bedrock of 0.006 to 0.015 inches per hour. The infiltration rates are not high enough to support full or partial infiltration.

Storm Water Management Devices

Because of the presence of undocumented fill, compacted fill, and the very low infiltration rates of the underlying Stadium Conglomerate bedrock, full and partial infiltration in considered infeasible and we recommend the basins be fully lined. The liner should be impermeable (e.g. High-density polyethylene, HDPE, with a thickness of about 30 mil or equivalent Polyvinyl Chloride, PVC). Penetration of the liner should be properly sealed. Drains should be incorporated in the basin to collect storm water runoff and transmit it to a suitable outlet structure. Overflow protection devices should also be incorporated into the design and construction of the basin.

Storm Water Standard Worksheets

The SWS requests the geotechnical engineer complete the *Categorization of Infiltration Feasibility Condition* (Worksheet C.4-1) worksheet information to help evaluate the potential for infiltration on the property. The attached Worksheet C.4-1 presents the completed information for the submittal process.

The regional storm water standards also have a worksheet (Worksheet Form D.5-1) that helps the project civil engineer estimate the factor of safety based on several factors. Table C-4 describes the suitability assessment input parameters related to the geotechnical engineering aspects for the factor of safety determination.

TABLE C-4
SUITABILITY ASSESSMENT RELATED CONSIDERATIONS FOR INFILTRATION FACILITY SAFETY FACTORS

Consideration	High Concern – 3 Points	Medium Concern – 2 Points	Low Concern – 1 Point
Assessment Methods	Use of soil survey maps or simple texture analysis to estimate short-term infiltration rates. Use of well permeameter or borehole methods without accompanying continuous boring log. Relatively sparse testing with direct infiltration methods	Use of well permeameter or borehole methods with accompanying continuous boring log. Direct measurement of infiltration area with localized infiltration measurement methods (e.g., Infiltrometer). Moderate spatial resolution	Direct measurement with localized (i.e. small-scale) infiltration testing methods at relatively high resolution or use of extensive test pit infiltration measurement methods.
Predominant Soil Texture	Silty and clayey soils with significant fines	Loamy soils	Granular to slightly loamy soils
Site Soil Variability	Highly variable soils indicated from site assessment or unknown variability	Soil boring/test pits indicate moderately homogenous soils	Soil boring/test pits indicate relatively homogenous soils
Depth to Groundwater/ Impervious Layer	<5 feet below facility bottom	5-15 feet below facility bottom	>15 feet below facility bottom

Based on our geotechnical investigation and the previous table, Table C-5 presents the estimated factor values for the evaluation of the factor of safety. This table only presents the suitability assessment safety factor (Part A) of the worksheet. The project civil engineer should evaluate the safety factor for design (Part B) and use the combined safety factor for the design infiltration rate.

TABLE C-5
FACTOR OF SAFETY WORKSHEET D.5-1 DESIGN VALUES[1]

Suitability Assessment Factor Category	Assigned Weight (w)	Factor Value (v)	Product (p = w x v)
Assessment Methods	0.25	2	0.50
Predominant Soil Texture	0.25	2	0.50
Site Soil Variability	0.25	2	0.50
Depth to Groundwater/Impervious Layer	0.25	2	0.55
Suitability Assessment Safety Factor, $S_A = \Sigma p$			2.0

[1] The project civil engineer should complete Worksheet D.5-1 using the data on this table. Additional information is required to evaluate the design factor of safety.

CONCLUSIONS

Our results indicate the underlying bedrock has very slow infiltration characteristics. Considering the presence of undocumented fill and relatively thick compacted fills, and the slow infiltration characteristics of the bedrock on the property, we recommend the basins utilize an impermeable liner.

GEOCON

Aardvark Permeameter Data Analysis

Project Name: THREE ROOTS
Project Number: G2070-42-01
Test Number: A-1

Date: 8/4/2017
By: N. BORJA

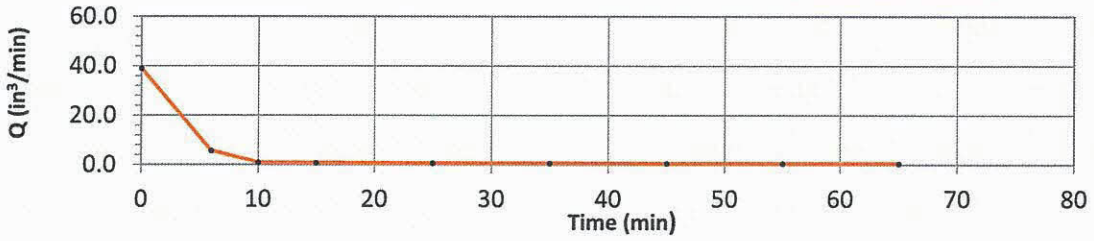
Borehole Diameter, d (in.):	8.00
Borehole Depth, **H** (in):	18.00
Distance Between Reservoir & Top of Borehole (in.):	30.50
Estimated Depth to Water Table, **S** (feet):	45.00
Height APM Raised from Bottom (in.):	2.00
Pressure Reducer Used:	No

Ref. EL (feet, MSL): 0.0
Bottom EL (feet, MSL): -1.5

Distance Between Resevoir and APM Float, **D** (in.):	39.25
Head Height Calculated, **h** (in.):	5.63
Head Height Measured, **h** (in.):	5.50
Distance Between Constant Head and Water Table, **L** (in.):	527.50

Reading	Time Elapsed (min)	Water Weight Consummed (lbs)	Water Volume Consummed (in^3)	Q (in^3/min)
1	0.00	0.000	0.00	0.00
2	6.00	8.445	233.86	38.977
3	4.00	0.825	22.85	5.712
4	5.00	0.170	4.71	0.942
5	10.00	0.270	7.48	0.748
6	10.00	0.235	6.51	0.651
7	10.00	0.225	6.23	0.623
8	10.00	0.205	5.68	0.568
9	10.00	0.205	5.68	0.568
10	10.00	0.200	5.54	0.554

Steady Flow Rate, Q (in^3/min): 0.563



Soil Matric Flux Potential, Φ_m

Φ_m= 0.010 in^2/min

Field-Saturated Hydraulic Conductivity (Infiltration Rate)

K_{sat} = 2.55E-04 in/min 0.015 in/hr

GEOCON

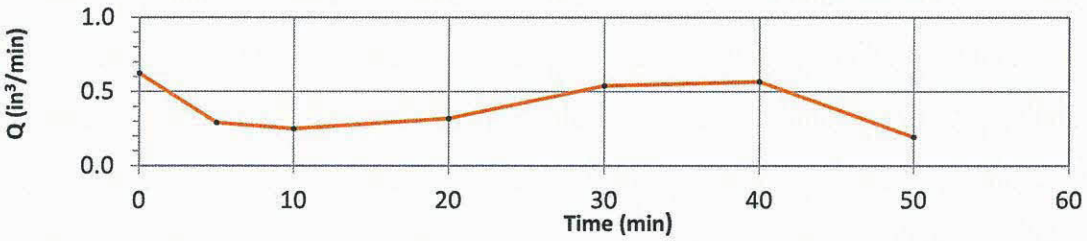
Aardvark Permeameter Data Analysis

Project Name:	THREE ROOTS	Date:	8/4/2017
Project Number:	G2070-42-01	By:	N. BORJA
Test Number:	A-2	Ref. EL (feet, MSL):	0.0
		Bottom EL (feet, MSL):	-4.0

Borehole Diameter, d (in.):	8.00
Borehole Depth, **H** (in):	47.75
Distance Between Reservoir & Top of Borehole (in.):	28.00
Estimated Depth to Water Table, **S** (feet):	45.00
Height APM Raised from Bottom (in.):	2.00
Pressure Reducer Used:	No

Distance Between Resevoir and APM Float, **D** (in.):	66.50
Head Height Calculated, **h** (in.):	5.72
Head Height Measured, **h** (in.):	4.88
Distance Between Constant Head and Water Table, **L** (in.):	497.13

Reading	Time Elapsed (min)	Water Weight Consummed (lbs)	Water Volume Consummed (in^3)	Q (in^3/min)
1	0.00	0.000	0.00	0.00
2	5.00	10.045	278.17	55.634
3	5.00	0.600	16.62	3.323
4	10.00	0.225	6.23	0.623
5	10.00	0.105	2.91	0.291
6	10.00	0.090	2.49	0.249
7	10.00	0.115	3.18	0.318
8	10.00	0.195	5.40	0.540
9	10.00	0.205	5.68	0.568
10	10.00	0.070	1.94	0.194
11	10.00	0.075	2.08	0.208
12	10.00	0.070	1.94	0.194
			Steady Flow Rate, Q (in^3/min):	0.198



Soil Matric Flux Potential, Φ_m

Φ_m= 0.004 in^2/min

Field-Saturated Hydraulic Conductivity (Infiltration Rate)

K_{sat} = 9.53E-05 in/min 0.006 in/hr

Categorization of Infiltration Feasibility Condition	Worksheet C.4-1

Part 1 - Full Infiltration Feasibility Screening Criteria

Would infiltration of the full design volume be feasible from a physical perspective without any undesirable consequences that cannot be reasonably mitigated?

Criteria	Screening Question	Yes	No
1	**Is the estimated reliable infiltration rate below proposed facility locations greater than 0.5 inches per hour?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.		X

Provide basis:

The results of the field infiltration tests are as follows:

A-1: 0.015 inches/hour (0.0075 with a FOS of 2.0)

A-2: 0.006 inches/hour (0.003 with a FOS of 2.0)

The rates are less than 0.5 inches/hour. Therefore, full infiltration is not feasible.

2	**Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.		X

Provide basis:

Based on the comprehensive study presented in the geotechnical documents, infiltration could not be incorporated without increasing the risk of geotechnical hazards including settlement within undocumented and compacted fill and uncontrolled water lateral migration.

The very slow infiltration rates in the Stadium Conglomerate suggest lateral migration of infiltration water will likely occur. The uncontrolled lateral migration could impact existing and proposed adjacent improvements and utilities.

Worksheet C.4-1 Page 2 of 4			
Criteria	Screening Question	**Yes**	**No**
3	**Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of groundwater contamination (shallow water table, storm water pollutants or other factors) that cannot be mitigated to an acceptable level?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	X	
Provide basis: The groundwater elevation was found to be in excess of 15 feet below existing grades. It is our opinion that there is no significant increase in risk of groundwater contamination due to infiltration.			
4	**Can infiltration greater than 0.5 inches per hour be allowed without causing potential water balance issues such as change of seasonality of ephemeral streams or increased discharge of contaminated groundwater to surface waters?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	X	
Provide basis: We do not expect infiltration will cause water balance issues such as seasonality of ephemeral streams or increased discharge of contaminated groundwater to surface waters.			
Part 1 Result*	If all answers to rows 1 - 4 are "**Yes**" a full infiltration design is potentially feasible. The feasibility screening category is **Full Infiltration** If any answer from row 1-4 is "**No**", infiltration may be possible to some extent but would not generally be feasible or desirable to achieve a "full infiltration" design. Proceed to Part 2	No	

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City to substantiate findings.

Worksheet C.4-1 Page 3 of 4

Part 2 – Partial Infiltration vs. No Infiltration Feasibility Screening Criteria

Would infiltration of water in any appreciable amount be physically feasible without any negative consequences that cannot be reasonably mitigated?

Criteria	Screening Question	Yes	No
5	**Do soil and geologic conditions allow for infiltration in any appreciable rate or volume?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.		X

Provide basis:

The results of the field infiltration tests are as follows:

A-1: 0.015 inches/hour (0.0075 with a FOS of 2.0)
A-2: 0.006 inches/hour (0.003 with a FOS of 2.0)

The rates are less than 0.1 inches/hour. The test results indicate that the geologic conditions do not allow for appreciable infiltration rate. Partial infiltration is not feasible.

6	**Can Infiltration in any appreciable quantity be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.		X

Provide basis:

Based on the comprehensive study presented in the geotechnical documents, infiltration could not be incorporated without increasing the risk of geotechnical hazards including settlement within undocumented and compacted fill and uncontrolled water lateral migration.

The very slow infiltration rates in the Stadium Conglomerate suggest lateral migration of infiltration water will likely occur. The uncontrolled lateral migration could impact existing and proposed adjacent improvements and utilities.

Worksheet C.4-1 Page 4 of 4			
Criteria	Screening Question	Yes	No
7	**Can Infiltration in any appreciable quantity be allowed without posing significant risk for groundwater related concerns (shallow water table, storm water pollutants or other factors)?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	X	
Provide basis: The groundwater elevation is assumed to be in excess of 15 feet below existing grades. It is our opinion that there is no significant increase in risk of groundwater contamination due to infiltration. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.			
8	**Can infiltration be allowed without violating downstream water rights?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	X	
Provide basis: We did not provide a study regarding water rights. However, these rights are not typical in the San Diego area. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.			
Part 2 Result*	If all answers from row 1-4 are yes then partial infiltration design is potentially feasible. The feasibility screening category is **Partial Infiltration.** If any answer from row 5-8 is no, then infiltration of any volume is considered to be **infeasible** within the drainage area. The feasibility screening category is **No Infiltration.**		No

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City to substantiate findings.

APPENDIX D

APPENDIX D

RECOMMENDED GRADING SPECIFICATIONS

FOR

3ROOTS
SAN DIEGO, CALIFORNIA

PROJECT NO. G2070-42-01

RECOMMENDED GRADING SPECIFICATIONS

1. GENERAL

1.1 These Recommended Grading Specifications shall be used in conjunction with the Geotechnical Report for the project prepared by Geocon. The recommendations contained in the text of the Geotechnical Report are a part of the earthwork and grading specifications and shall supersede the provisions contained hereinafter in the case of conflict.

1.2 Prior to the commencement of grading, a geotechnical consultant (Consultant) shall be employed for the purpose of observing earthwork procedures and testing the fills for substantial conformance with the recommendations of the Geotechnical Report and these specifications. The Consultant should provide adequate testing and observation services so that they may assess whether, in their opinion, the work was performed in substantial conformance with these specifications. It shall be the responsibility of the Contractor to assist the Consultant and keep them apprised of work schedules and changes so that personnel may be scheduled accordingly.

1.3 It shall be the sole responsibility of the Contractor to provide adequate equipment and methods to accomplish the work in accordance with applicable grading codes or agency ordinances, these specifications and the approved grading plans. If, in the opinion of the Consultant, unsatisfactory conditions such as questionable soil materials, poor moisture condition, inadequate compaction, and/or adverse weather result in a quality of work not in conformance with these specifications, the Consultant will be empowered to reject the work and recommend to the Owner that grading be stopped until the unacceptable conditions are corrected.

2. DEFINITIONS

2.1 **Owner** shall refer to the owner of the property or the entity on whose behalf the grading work is being performed and who has contracted with the Contractor to have grading performed.

2.2 **Contractor** shall refer to the Contractor performing the site grading work.

2.3 **Civil Engineer** or **Engineer of Work** shall refer to the California licensed Civil Engineer or consulting firm responsible for preparation of the grading plans, surveying and verifying as-graded topography.

2.4 **Consultant** shall refer to the soil engineering and engineering geology consulting firm retained to provide geotechnical services for the project.

2.5 **Soil Engineer** shall refer to a California licensed Civil Engineer retained by the Owner, who is experienced in the practice of geotechnical engineering. The Soil Engineer shall be responsible for having qualified representatives on-site to observe and test the Contractor's work for conformance with these specifications.

2.6 **Engineering Geologist** shall refer to a California licensed Engineering Geologist retained by the Owner to provide geologic observations and recommendations during the site grading.

2.7 **Geotechnical Report** shall refer to a soil report (including all addenda) which may include a geologic reconnaissance or geologic investigation that was prepared specifically for the development of the project for which these Recommended Grading Specifications are intended to apply.

3. MATERIALS

3.1 Materials for compacted fill shall consist of any soil excavated from the cut areas or imported to the site that, in the opinion of the Consultant, is suitable for use in construction of fills. In general, fill materials can be classified as *soil* fills, *soil-rock* fills or *rock* fills, as defined below.

3.1.1 **Soil fills** are defined as fills containing no rocks or hard lumps greater than 12 inches in maximum dimension and containing at least 40 percent by weight of material smaller than ¾ inch in size.

3.1.2 **Soil-rock fills** are defined as fills containing no rocks or hard lumps larger than 4 feet in maximum dimension and containing a sufficient matrix of soil fill to allow for proper compaction of soil fill around the rock fragments or hard lumps as specified in Paragraph 6.2. **Oversize rock** is defined as material greater than 12 inches.

3.1.3 **Rock fills** are defined as fills containing no rocks or hard lumps larger than 3 feet in maximum dimension and containing little or no fines. Fines are defined as material smaller than ¾ inch in maximum dimension. The quantity of fines shall be less than approximately 20 percent of the rock fill quantity.

3.2 Material of a perishable, spongy, or otherwise unsuitable nature as determined by the Consultant shall not be used in fills.

3.3 Materials used for fill, either imported or on-site, shall not contain hazardous materials as defined by the California Code of Regulations, Title 22, Division 4, Chapter 30, Articles 9

and 10; 40CFR; and any other applicable local, state or federal laws. The Consultant shall not be responsible for the identification or analysis of the potential presence of hazardous materials. However, if observations, odors or soil discoloration cause Consultant to suspect the presence of hazardous materials, the Consultant may request from the Owner the termination of grading operations within the affected area. Prior to resuming grading operations, the Owner shall provide a written report to the Consultant indicating that the suspected materials are not hazardous as defined by applicable laws and regulations.

3.4 The outer 15 feet of *soil-rock* fill slopes, measured horizontally, should be composed of properly compacted *soil* fill materials approved by the Consultant. *Rock* fill may extend to the slope face, provided that the slope is not steeper than 2:1 (horizontal:vertical) and a soil layer no thicker than 12 inches is track-walked onto the face for landscaping purposes. This procedure may be utilized provided it is acceptable to the governing agency, Owner and Consultant.

3.5 Samples of soil materials to be used for fill should be tested in the laboratory by the Consultant to determine the maximum density, optimum moisture content, and, where appropriate, shear strength, expansion, and gradation characteristics of the soil.

3.6 During grading, soil or groundwater conditions other than those identified in the Geotechnical Report may be encountered by the Contractor. The Consultant shall be notified immediately to evaluate the significance of the unanticipated condition

4. CLEARING AND PREPARING AREAS TO BE FILLED

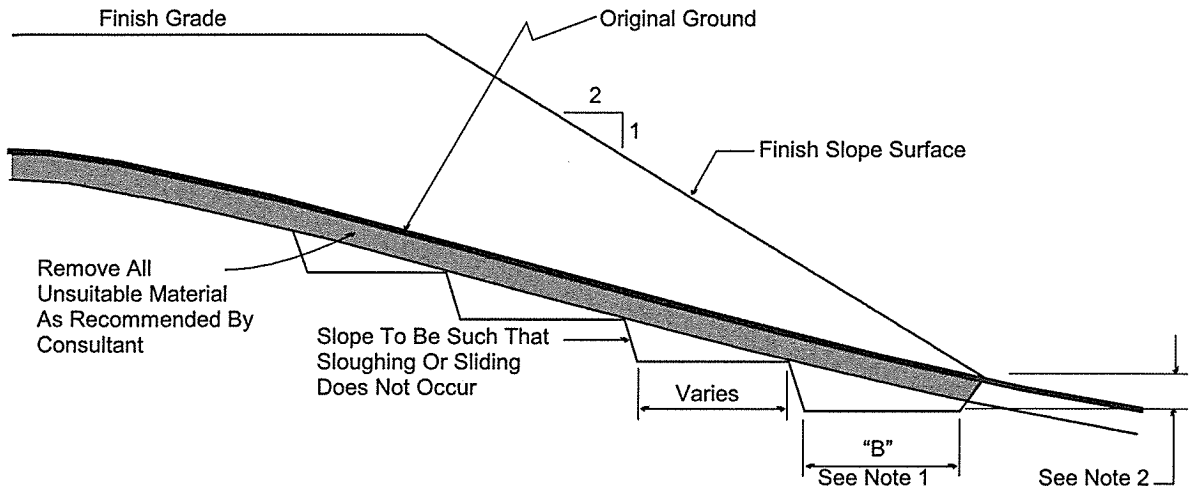
4.1 Areas to be excavated and filled shall be cleared and grubbed. Clearing shall consist of complete removal above the ground surface of trees, stumps, brush, vegetation, man-made structures, and similar debris. Grubbing shall consist of removal of stumps, roots, buried logs and other unsuitable material and shall be performed in areas to be graded. Roots and other projections exceeding 1½ inches in diameter shall be removed to a depth of 3 feet below the surface of the ground. Borrow areas shall be grubbed to the extent necessary to provide suitable fill materials.

4.2 Asphalt pavement material removed during clearing operations should be properly disposed at an approved off-site facility or in an acceptable area of the project evaluated by Geocon and the property owner. Concrete fragments that are free of reinforcing steel may be placed in fills, provided they are placed in accordance with Section 6.2 or 6.3 of this document.

4.3 After clearing and grubbing of organic matter and other unsuitable material, loose or porous soils shall be removed to the depth recommended in the Geotechnical Report. The depth of removal and compaction should be observed and approved by a representative of the Consultant. The exposed surface shall then be plowed or scarified to a minimum depth of 6 inches and until the surface is free from uneven features that would tend to prevent uniform compaction by the equipment to be used.

4.4 Where the slope ratio of the original ground is steeper than 5:1 (horizontal:vertical), or where recommended by the Consultant, the original ground should be benched in accordance with the following illustration.

TYPICAL BENCHING DETAIL



No Scale

DETAIL NOTES:

(1) Key width "B" should be a minimum of 10 feet, or sufficiently wide to permit complete coverage with the compaction equipment used. The base of the key should be graded horizontal, or inclined slightly into the natural slope.

(2) The outside of the key should be below the topsoil or unsuitable surficial material and at least 2 feet into dense formational material. Where hard rock is exposed in the bottom of the key, the depth and configuration of the key may be modified as approved by the Consultant.

4.5 After areas to receive fill have been cleared and scarified, the surface should be moisture conditioned to achieve the proper moisture content, and compacted as recommended in Section 6 of these specifications.

5. COMPACTION EQUIPMENT

5.1 Compaction of *soil* or *soil-rock* fill shall be accomplished by sheepsfoot or segmented-steel wheeled rollers, vibratory rollers, multiple-wheel pneumatic-tired rollers, or other types of acceptable compaction equipment. Equipment shall be of such a design that it will be capable of compacting the *soil* or *soil-rock* fill to the specified relative compaction at the specified moisture content.

5.2 Compaction of *rock* fills shall be performed in accordance with Section 6.3.

6. PLACING, SPREADING AND COMPACTION OF FILL MATERIAL

6.1 *Soil* fill, as defined in Paragraph 3.1.1, shall be placed by the Contractor in accordance with the following recommendations:

6.1.1 *Soil* fill shall be placed by the Contractor in layers that, when compacted, should generally not exceed 8 inches. Each layer shall be spread evenly and shall be thoroughly mixed during spreading to obtain uniformity of material and moisture in each layer. The entire fill shall be constructed as a unit in nearly level lifts. Rock materials greater than 12 inches in maximum dimension shall be placed in accordance with Section 6.2 or 6.3 of these specifications.

6.1.2 In general, the *soil* fill shall be compacted at a moisture content at or above the optimum moisture content as determined by ASTM D 1557.

6.1.3 When the moisture content of *soil* fill is below that specified by the Consultant, water shall be added by the Contractor until the moisture content is in the range specified.

6.1.4 When the moisture content of the *soil* fill is above the range specified by the Consultant or too wet to achieve proper compaction, the *soil* fill shall be aerated by the Contractor by blading/mixing, or other satisfactory methods until the moisture content is within the range specified.

6.1.5 After each layer has been placed, mixed, and spread evenly, it shall be thoroughly compacted by the Contractor to a relative compaction of at least 90 percent. Relative compaction is defined as the ratio (expressed in percent) of the in-place dry density of the compacted fill to the maximum laboratory dry density as determined in accordance with ASTM D 1557. Compaction shall be continuous over the entire area, and compaction equipment shall make sufficient passes so that the specified minimum relative compaction has been achieved throughout the entire fill.

6.1.6 Where practical, soils having an Expansion Index greater than 50 should be placed at least 3 feet below finish pad grade and should be compacted at a moisture content generally 2 to 4 percent greater than the optimum moisture content for the material.

6.1.7 Properly compacted *soil* fill shall extend to the design surface of fill slopes. To achieve proper compaction, it is recommended that fill slopes be over-built by at least 3 feet and then cut to the design grade. This procedure is considered preferable to track-walking of slopes, as described in the following paragraph.

6.1.8 As an alternative to over-building of slopes, slope faces may be back-rolled with a heavy-duty loaded sheepsfoot or vibratory roller at maximum 4-foot fill height intervals. Upon completion, slopes should then be track-walked with a D-8 dozer or similar equipment, such that a dozer track covers all slope surfaces at least twice.

6.2 *Soil-rock* fill, as defined in Paragraph 3.1.2, shall be placed by the Contractor in accordance with the following recommendations:

6.2.1 Rocks larger than 12 inches but less than 4 feet in maximum dimension may be incorporated into the compacted *soil* fill, but shall be limited to the area measured 15 feet minimum horizontally from the slope face and 5 feet below finish grade or 3 feet below the deepest utility, whichever is deeper.

6.2.2 Rocks or rock fragments up to 4 feet in maximum dimension may either be individually placed or placed in windrows. Under certain conditions, rocks or rock fragments up to 10 feet in maximum dimension may be placed using similar methods. The acceptability of placing rock materials greater than 4 feet in maximum dimension shall be evaluated during grading as specific cases arise and shall be approved by the Consultant prior to placement.

6.2.3 For individual placement, sufficient space shall be provided between rocks to allow for passage of compaction equipment.

6.2.4 For windrow placement, the rocks should be placed in trenches excavated in properly compacted *soil* fill. Trenches should be approximately 5 feet wide and 4 feet deep in maximum dimension. The voids around and beneath rocks should be filled with approved granular soil having a Sand Equivalent of 30 or greater and should be compacted by flooding. Windrows may also be placed utilizing an "open-face" method in lieu of the trench procedure, however, this method should first be approved by the Consultant.

6.2.5 Windrows should generally be parallel to each other and may be placed either parallel to or perpendicular to the face of the slope depending on the site geometry. The minimum horizontal spacing for windrows shall be 12 feet center-to-center with a 5-foot stagger or offset from lower courses to next overlying course. The minimum vertical spacing between windrow courses shall be 2 feet from the top of a lower windrow to the bottom of the next higher windrow.

6.2.6 Rock placement, fill placement and flooding of approved granular soil in the windrows should be continuously observed by the Consultant.

6.3 *Rock* fills, as defined in Section 3.1.3, shall be placed by the Contractor in accordance with the following recommendations:

6.3.1 The base of the *rock* fill shall be placed on a sloping surface (minimum slope of 2 percent). The surface shall slope toward suitable subdrainage outlet facilities. The *rock* fills shall be provided with subdrains during construction so that a hydrostatic pressure buildup does not develop. The subdrains shall be permanently connected to controlled drainage facilities to control post-construction infiltration of water.

6.3.2 *Rock* fills shall be placed in lifts not exceeding 3 feet. Placement shall be by rock trucks traversing previously placed lifts and dumping at the edge of the currently placed lift. Spreading of the *rock* fill shall be by dozer to facilitate *seating* of the rock. The *rock* fill shall be watered heavily during placement. Watering shall consist of water trucks traversing in front of the current rock lift face and spraying water continuously during rock placement. Compaction equipment with compactive energy comparable to or greater than that of a 20-ton steel vibratory roller or other compaction equipment providing suitable energy to achieve the required compaction or deflection as recommended in Paragraph 6.3.3 shall be utilized. The number of passes to be made should be determined as described in Paragraph 6.3.3. Once a *rock* fill lift has been covered with *soil* fill, no additional *rock* fill lifts will be permitted over the *soil* fill.

6.3.3 Plate bearing tests, in accordance with ASTM D 1196, may be performed in both the compacted *soil* fill and in the *rock* fill to aid in determining the required minimum number of passes of the compaction equipment. If performed, a minimum of three plate bearing tests should be performed in the properly compacted *soil* fill (minimum relative compaction of 90 percent). Plate bearing tests shall then be performed on areas of *rock* fill having two passes, four passes and six passes of the compaction equipment, respectively. The number of passes required for the *rock* fill shall be determined by comparing the results of the plate bearing tests for the *soil* fill and the *rock* fill and by evaluating the deflection

variation with number of passes. The required number of passes of the compaction equipment will be performed as necessary until the plate bearing deflections are equal to or less than that determined for the properly compacted *soil* fill. In no case will the required number of passes be less than two.

6.3.4 A representative of the Consultant should be present during *rock* fill operations to observe that the minimum number of "passes" have been obtained, that water is being properly applied and that specified procedures are being followed. The actual number of plate bearing tests will be determined by the Consultant during grading.

6.3.5 Test pits shall be excavated by the Contractor so that the Consultant can state that, in their opinion, sufficient water is present and that voids between large rocks are properly filled with smaller rock material. In-place density testing will not be required in the *rock* fills.

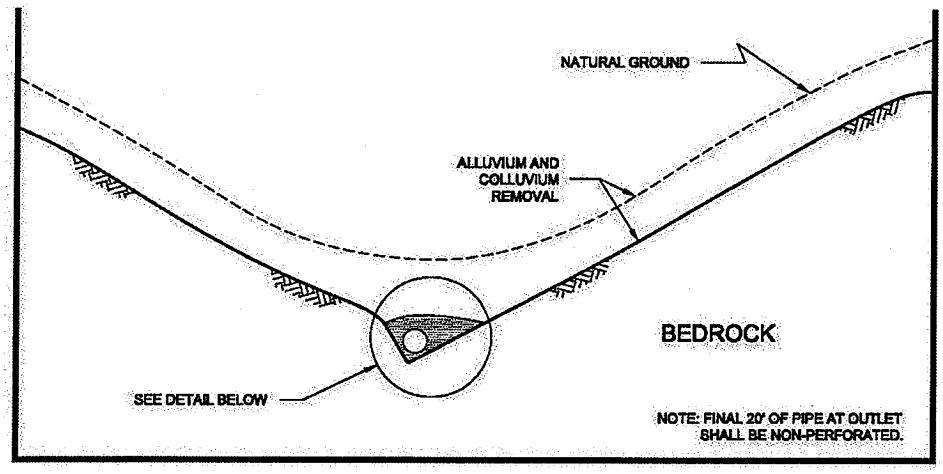
6.3.6 To reduce the potential for "piping" of fines into the *rock* fill from overlying *soil* fill material, a 2-foot layer of graded filter material shall be placed above the uppermost lift of *rock* fill. The need to place graded filter material below the *rock* should be determined by the Consultant prior to commencing grading. The gradation of the graded filter material will be determined at the time the *rock* fill is being excavated. Materials typical of the *rock* fill should be submitted to the Consultant in a timely manner, to allow design of the graded filter prior to the commencement of *rock* fill placement.

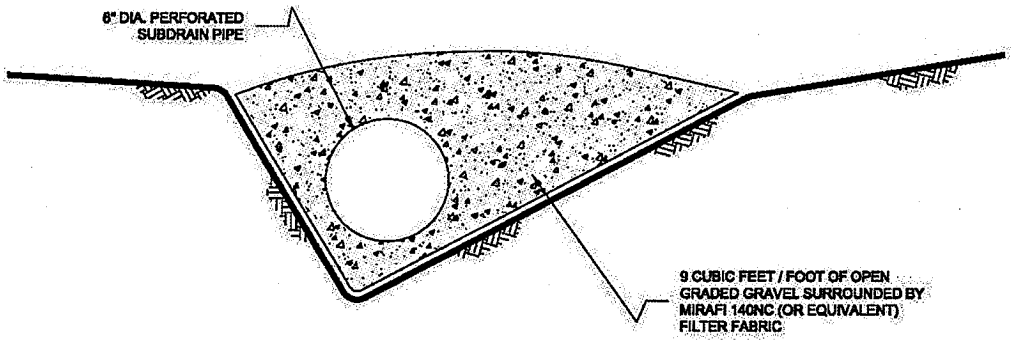
6.3.7 *Rock* fill placement should be continuously observed during placement by the Consultant.

7. SUBDRAINS

7.1 The geologic units on the site may have permeability characteristics and/or fracture systems that could be susceptible under certain conditions to seepage. The use of canyon subdrains may be necessary to mitigate the potential for adverse impacts associated with seepage conditions. Canyon subdrains with lengths in excess of 500 feet or extensions of existing offsite subdrains should use 8-inch-diameter pipes. Canyon subdrains less than 500 feet in length should use 6-inch-diameter pipes.

TYPICAL CANYON DRAIN DETAIL





NOTES:

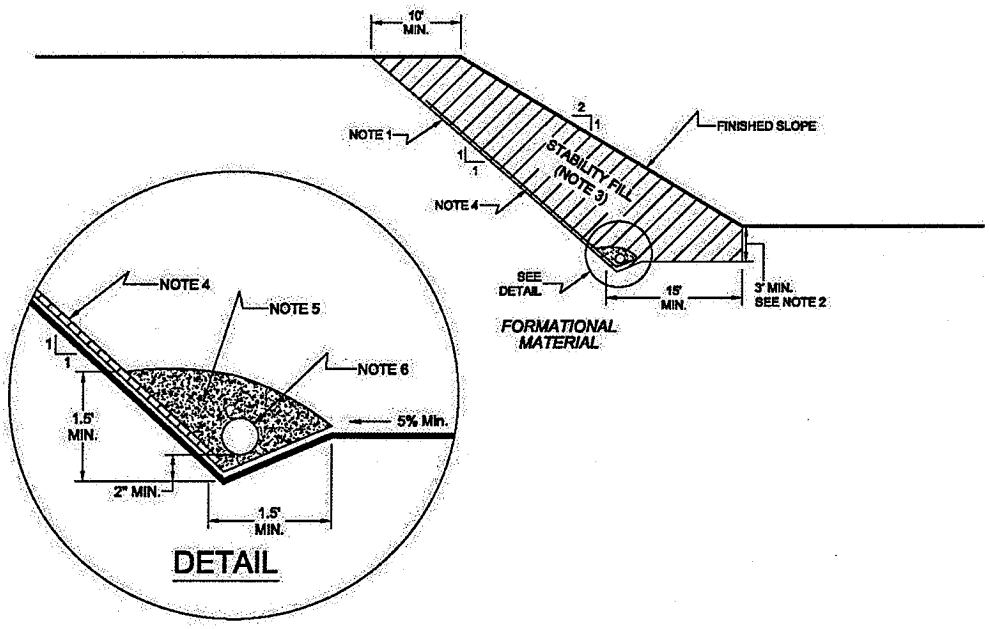
1.....6-INCH DIAMETER, SCHEDULE 80 PVC PERFORATED PIPE FOR FILLS IN EXCESS OF 100-FEET IN DEPTH OR A PIPE LENGTH OF LONGER THAN 500 FEET.

2.....6-INCH DIAMETER, SCHEDULE 40 PVC PERFORATED PIPE FOR FILLS LESS THAN 100-FEET IN DEPTH OR A PIPE LENGTH SHORTER THAN 500 FEET.

NO SCALE

7.2 Slope drains within stability fill keyways should use 4-inch-diameter (or lager) pipes.

TYPICAL STABILITY FILL DETAIL



NOTES:

1.....EXCAVATE BACKCUT AT 1:1 INCLINATION (UNLESS OTHERWISE NOTED).

2.....BASE OF STABILITY FILL TO BE 3 FEET INTO FORMATIONAL MATERIAL, SLOPING A MINIMUM 5% INTO SLOPE.

3.....STABILITY FILL TO BE COMPOSED OF PROPERLY COMPACTED GRANULAR SOIL.

4.....CHIMNEY DRAINS TO BE APPROVED PREFABRICATED CHIMNEY DRAIN PANELS (MIRADRAIN G200N OR EQUIVALENT) SPACED APPROXIMATELY 20 FEET CENTER TO CENTER AND 4 FEET WIDE. CLOSER SPACING MAY BE REQUIRED IF SEEPAGE IS ENCOUNTERED.

5.....FILTER MATERIAL TO BE 3/4-INCH, OPEN-GRADED CRUSHED ROCK ENCLOSED IN APPROVED FILTER FABRIC (MIRAFI 140NC).

6.....COLLECTOR PIPE TO BE 4-INCH MINIMUM DIAMETER, PERFORATED, THICK-WALLED PVC SCHEDULE 40 OR EQUIVALENT, AND SLOPED TO DRAIN AT 1 PERCENT MINIMUM TO APPROVED OUTLET.

NO SCALE

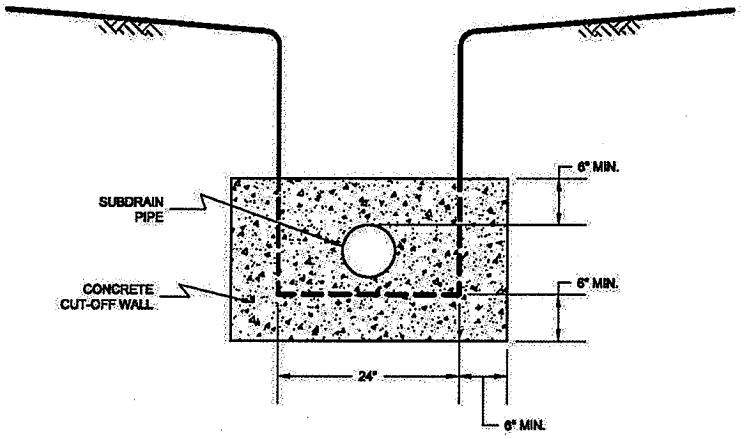
7.3 The actual subdrain locations will be evaluated in the field during the remedial grading operations. Additional drains may be necessary depending on the conditions observed and the requirements of the local regulatory agencies. Appropriate subdrain outlets should be evaluated prior to finalizing 40-scale grading plans.

7.4 *Rock* fill or *soil-rock* fill areas may require subdrains along their down-slope perimeters to mitigate the potential for buildup of water from construction or landscape irrigation. The subdrains should be at least 6-inch-diameter pipes encapsulated in gravel and filter fabric. *Rock* fill drains should be constructed using the same requirements as canyon subdrains.

7.5 Prior to outletting, the final 20-foot segment of a subdrain that will not be extended during future development should consist of non-perforated drainpipe. At the non-perforated/ perforated interface, a seepage cutoff wall should be constructed on the downslope side of the pipe.

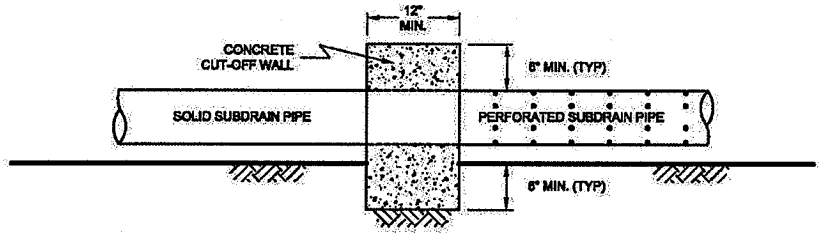
TYPICAL CUT OFF WALL DETAIL

FRONT VIEW



NO SCALE

SIDE VIEW

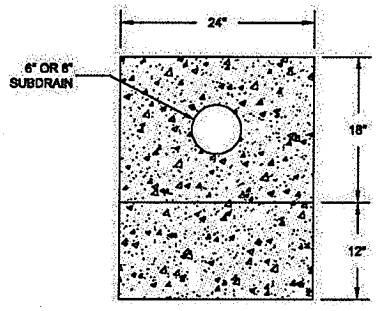


NO SCALE

7.6 Subdrains that discharge into a natural drainage course or open space area should be provided with a permanent headwall structure.

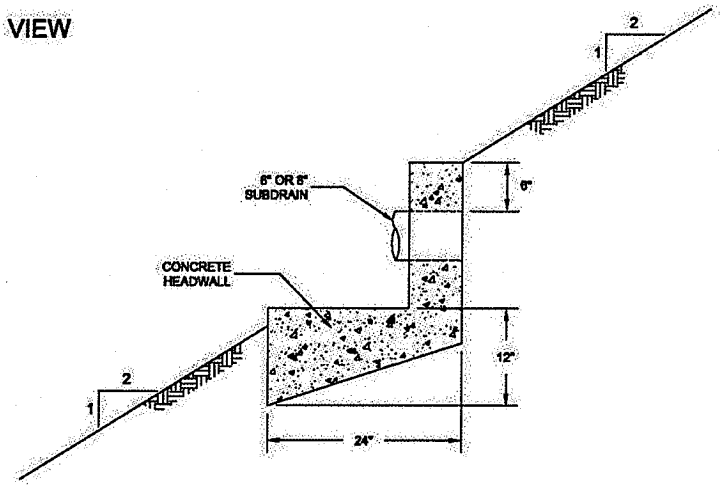
TYPICAL HEADWALL DETAIL

FRONT VIEW



NO SCALE

SIDE VIEW



NOTE: HEADWALL SHOULD OUTLET AT TOE OF FILL SLOPE OR INTO CONTROLLED SURFACE DRAINAGE

NO SCALE

7.7 The final grading plans should show the location of the proposed subdrains. After completion of remedial excavations and subdrain installation, the project civil engineer should survey the drain locations and prepare an "as-built" map showing the drain locations. The final outlet and connection locations should be determined during grading operations. Subdrains that will be extended on adjacent projects after grading can be placed on formational material and a vertical riser should be placed at the end of the subdrain. The grading contractor should consider videoing the subdrains shortly after burial to check proper installation and functionality. The contractor is responsible for the performance of the drains.

8. OBSERVATION AND TESTING

8.1 The Consultant shall be the Owner's representative to observe and perform tests during clearing, grubbing, filling, and compaction operations. In general, no more than 2 feet in vertical elevation of *soil* or *soil-rock* fill should be placed without at least one field density test being performed within that interval. In addition, a minimum of one field density test should be performed for every 2,000 cubic yards of *soil* or *soil-rock* fill placed and compacted.

8.2 The Consultant should perform a sufficient distribution of field density tests of the compacted *soil* or *soil-rock* fill to provide a basis for expressing an opinion whether the fill material is compacted as specified. Density tests shall be performed in the compacted materials below any disturbed surface. When these tests indicate that the density of any layer of fill or portion thereof is below that specified, the particular layer or areas represented by the test shall be reworked until the specified density has been achieved.

8.3 During placement of *rock* fill, the Consultant should observe that the minimum number of passes have been obtained per the criteria discussed in Section 6.3.3. The Consultant should request the excavation of observation pits and may perform plate bearing tests on the placed *rock* fills. The observation pits will be excavated to provide a basis for expressing an opinion as to whether the *rock* fill is properly seated and sufficient moisture has been applied to the material. When observations indicate that a layer of *rock* fill or any portion thereof is below that specified, the affected layer or area shall be reworked until the *rock* fill has been adequately seated and sufficient moisture applied.

8.4 A settlement monitoring program designed by the Consultant may be conducted in areas of *rock* fill placement. The specific design of the monitoring program shall be as recommended in the Conclusions and Recommendations section of the project Geotechnical Report or in the final report of testing and observation services performed during grading.

8.5 We should observe the placement of subdrains, to check that the drainage devices have been placed and constructed in substantial conformance with project specifications.

8.6 Testing procedures shall conform to the following Standards as appropriate:

8.6.1 Soil and Soil-Rock Fills:

8.6.1.1 Field Density Test, ASTM D 1556, *Density of Soil In-Place By the Sand-Cone Method.*

8.6.1.2 Field Density Test, Nuclear Method, ASTM D 6938, *Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth).*

8.6.1.3 Laboratory Compaction Test, ASTM D 1557, *Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-Pound Hammer and 18-Inch Drop.*

8.6.1.4. Expansion Index Test, ASTM D 4829, *Expansion Index Test.*

9. PROTECTION OF WORK

9.1 During construction, the Contractor shall properly grade all excavated surfaces to provide positive drainage and prevent ponding of water. Drainage of surface water shall be controlled to avoid damage to adjoining properties or to finished work on the site. The Contractor shall take remedial measures to prevent erosion of freshly graded areas until such time as permanent drainage and erosion control features have been installed. Areas subjected to erosion or sedimentation shall be properly prepared in accordance with the Specifications prior to placing additional fill or structures.

9.2 After completion of grading as observed and tested by the Consultant, no further excavation or filling shall be conducted except in conjunction with the services of the Consultant.

10. CERTIFICATIONS AND FINAL REPORTS

10.1 Upon completion of the work, Contractor shall furnish Owner a certification by the Civil Engineer stating that the lots and/or building pads are graded to within 0.1 foot vertically of elevations shown on the grading plan and that all tops and toes of slopes are within 0.5 foot horizontally of the positions shown on the grading plans. After installation of a section of subdrain, the project Civil Engineer should survey its location and prepare an *as-built* plan of the subdrain location. The project Civil Engineer should verify the proper outlet for the subdrains and the Contractor should ensure that the drain system is free of obstructions.

10.2 The Owner is responsible for furnishing a final as-graded soil and geologic report satisfactory to the appropriate governing or accepting agencies. The as-graded report should be prepared and signed by a California licensed Civil Engineer experienced in geotechnical engineering and by a California Certified Engineering Geologist, indicating that the geotechnical aspects of the grading were performed in substantial conformance with the Specifications or approved changes to the Specifications.

LIST OF REFERENCES

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2. Chiou, Brian S. J., and Robert R. Youngs, *A NGA Model for the Average Horizontal Component of Peak Ground Motion and Response Spectra,* preprint for article to be published in NGA Special Edition for Earthquake Spectra, Spring 2008.

3. California Department of Conservation, Division of Mines and Geology, *Probabilistic Seismic Hazard Assessment for the State of California,* Open File Report 96-08, 1996.

4. California Geological Survey, *Seismic Shaking Hazards in California,* Based on the USGS/ CGS Probabilistic Seismic Hazards Assessment (PSHA) Model, 2002 (revised April 2003). 0% probability of being exceeded in 50 years. http://redirect.conservation.ca.gov/cgs/rghm/pshamap/pshamain.html

5. Campbell, K. W., Y. Bozorgnia, *NGA Ground Motion Model for the Geometric Mean Horizontal Component of PGA, PGV, PGD and 5% Damped Linear Elastic Response Spectra for Periods Ranging from 0.01 to 10 s,* Preprint of version submitted for publication in the NGA Special Volume of Earthquake Spectra, Volume 24, Issue 1, pages 139-171, February 2008.

6. *Characterization of San Diego's Stadium Conglomerate For Tunnel Design,* 2001 Proceedings Rapid Excavation and Tunneling Conference, pgs. 33-45.

7. Geocon Incorporated, *Compaction Test Summary Report, Hanson Carroll Canyon Materials Plant, San Diego, California,* dated April 14, 2017 (Project No. G2070-42-01).

8. Jennings, C. W., 1994, California Division of Mines and Geology, *Fault Activity Map of California and Adjacent Areas,* California Geologic Data Map Series Map No. 6.

9. Kennedy, M. P., and S. S. Tan, 2005, *Geologic Map of the San Diego 30'x60' Quadrangle, California,* USGS Regional Map Series Map No. 3, Scale 1:100,000.

10. Risk Engineering, *EZ-FRISK,* Version 7.65.

11. Unpublished reports and maps on file with Geocon Incorporated.

12. USGS computer program, *Seismic Hazard Curves and Uniform Hazard Response Spectra.*