3Roots San Diego Project
Environmental Impact Report

SCH No. 2018041065; Project No. 587128

Appendix S

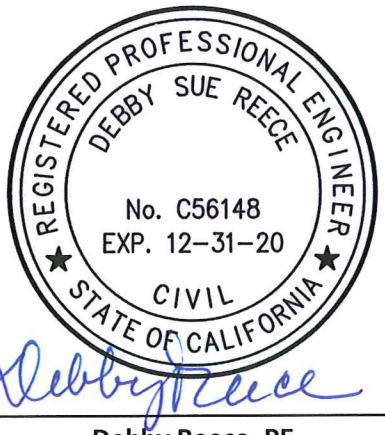
Storm Water Quality Management Plan

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:

Mesa Community Partners
16465 Via Esprillo, Suite 150
San Diego, California 92127

PREPARED BY:

PROJECT DESIGN CONSULTANTS

Planning | Landscape Architecture | Engineering | Survey

701 B Street, Suite 800
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February 4, 2019

Job No. 4182.30

Approved by: City of San Diego Date

TABLE OF CONTENTS

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

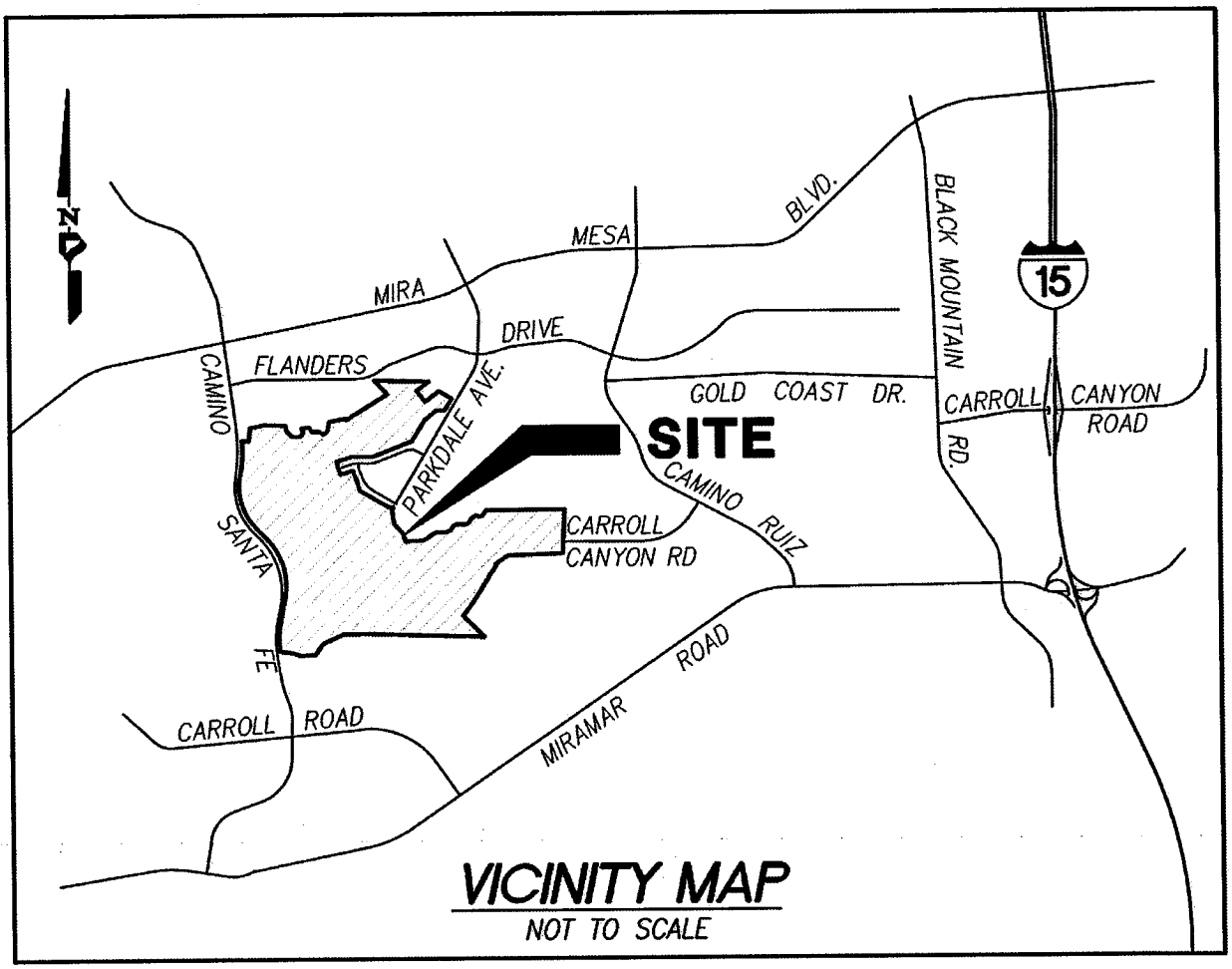
SUBMITTAL RECORD

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)

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'
JOB #: 4182.30
CREATED: 11/8/17

PREPARED BY:

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

CITY OF SAN DIEGO

3 ROOTS

DMA MAP
PROPOSED CONDITIONS
EXHIBIT 1A

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

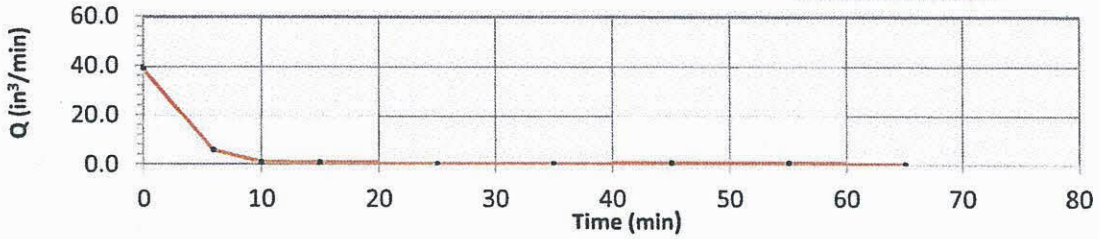
Date: 8/4/2017
By: N. BORJA

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

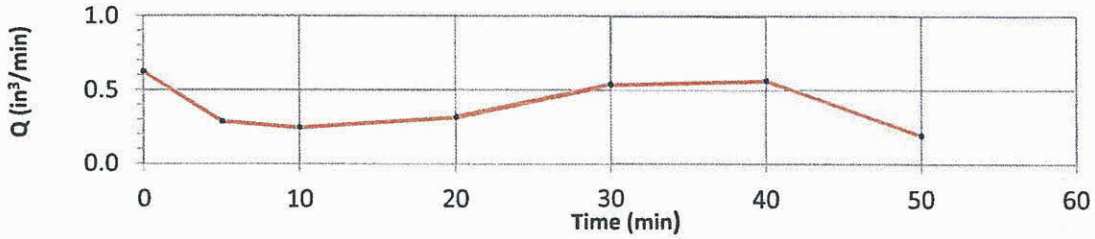
Aardvark Permeameter Data Analysis

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

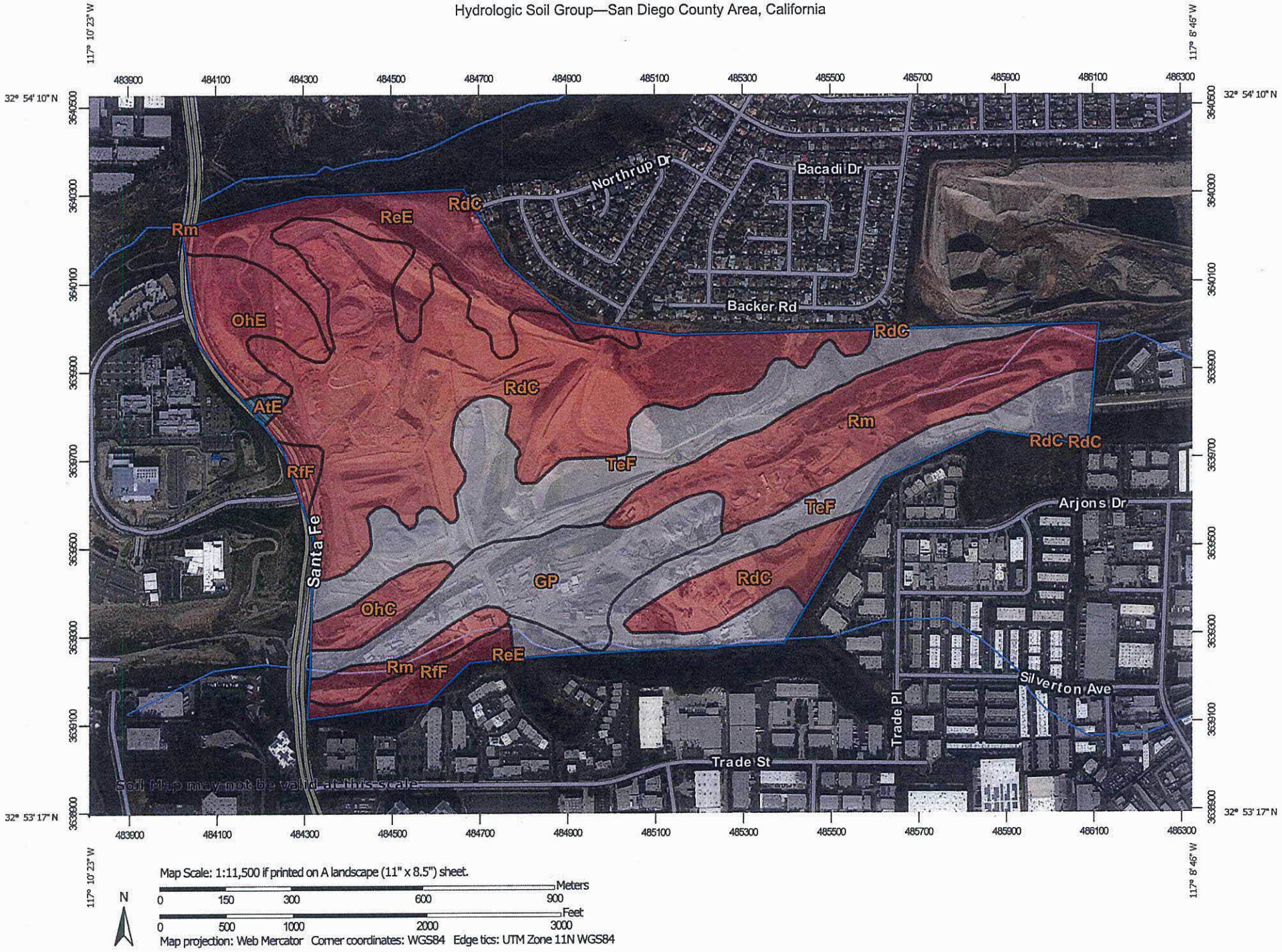
Φ_m= 0.004 in^2/min

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.

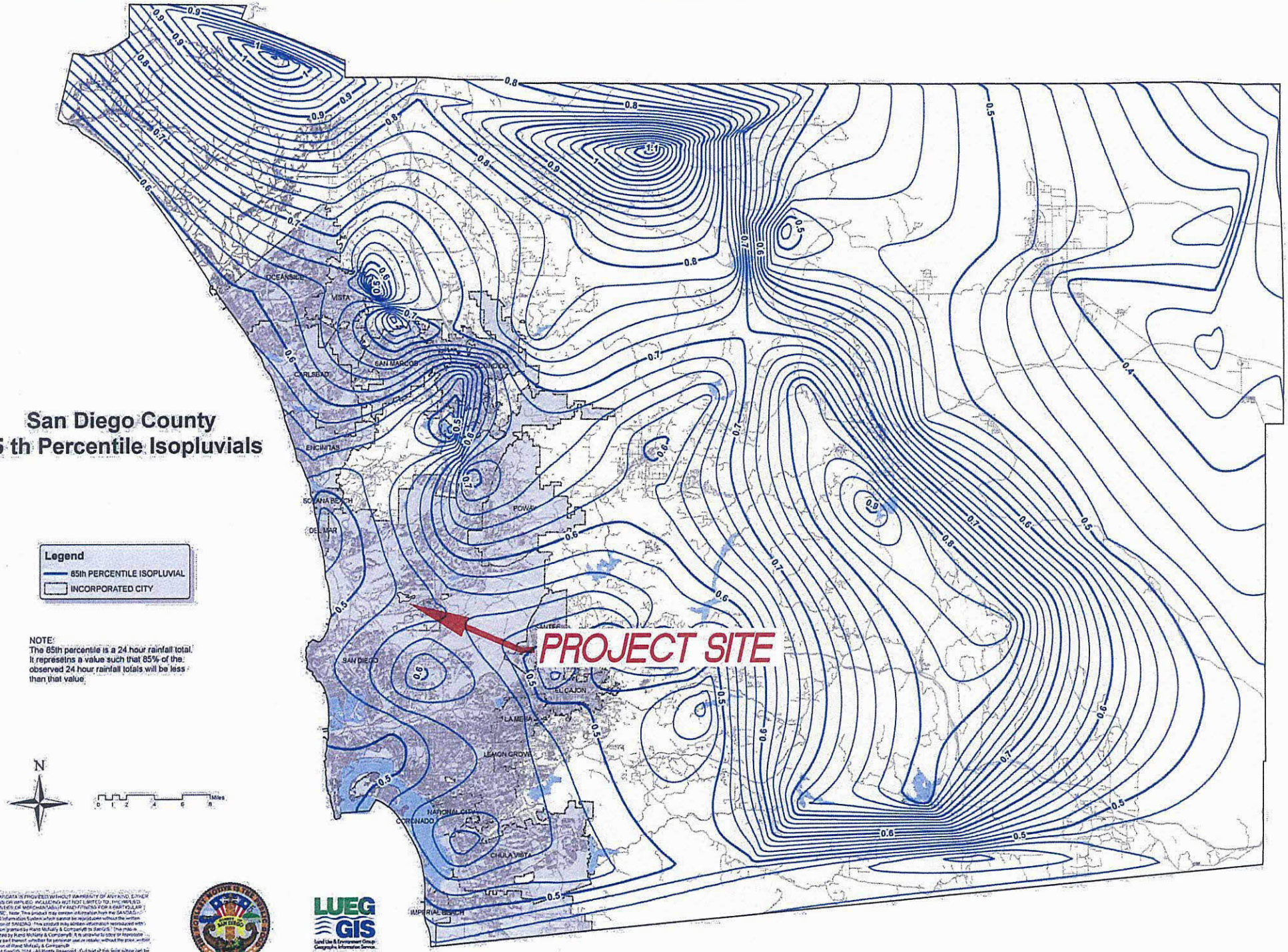
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

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

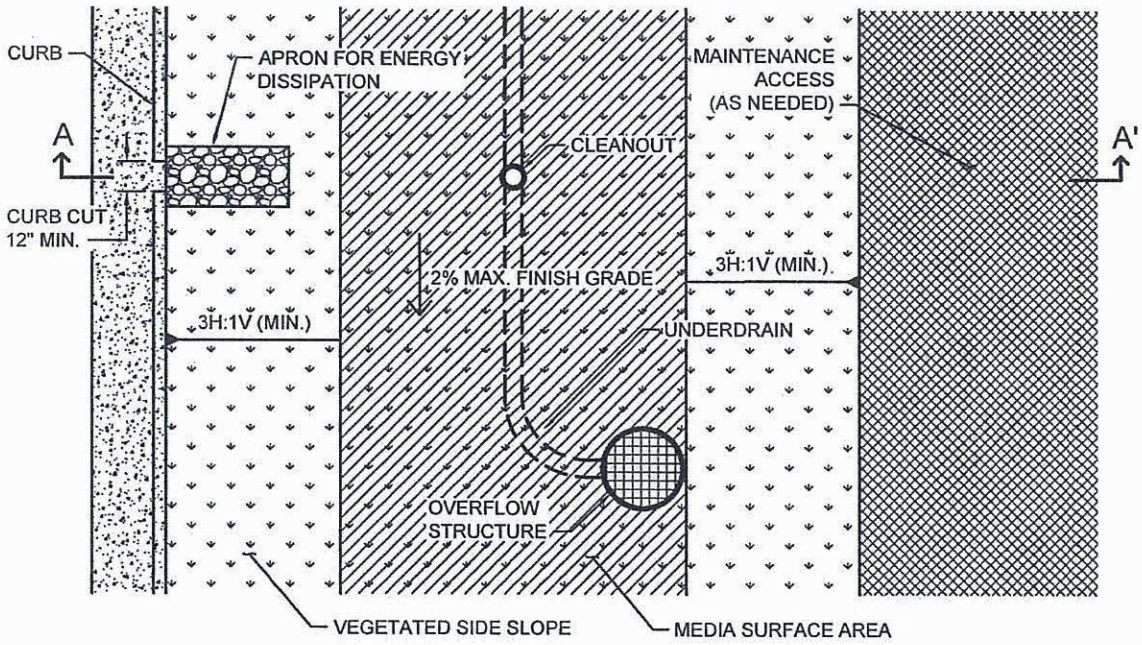
Treatment
Volume Reduction (Incidental)
Peak Flow Attenuation (Optional)

Description

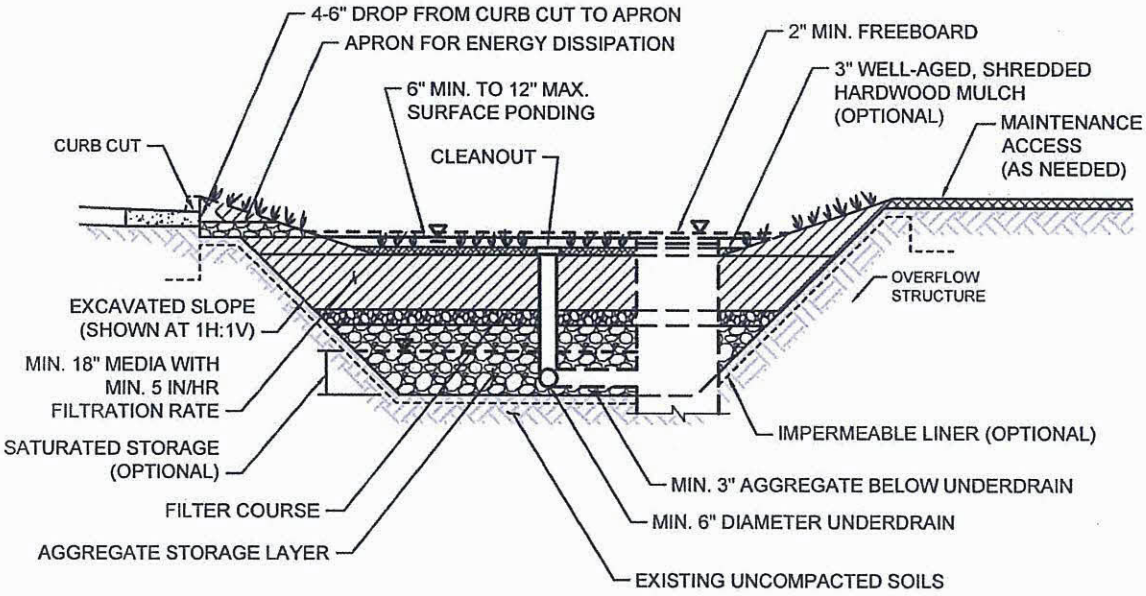
Biofiltration (Bioretention with underdrain) facilities are vegetated surface water systems that filter water through vegetation, and soil or engineered media prior to discharge via underdrain or overflow to the downstream conveyance system. Bioretention with underdrain facilities are commonly incorporated 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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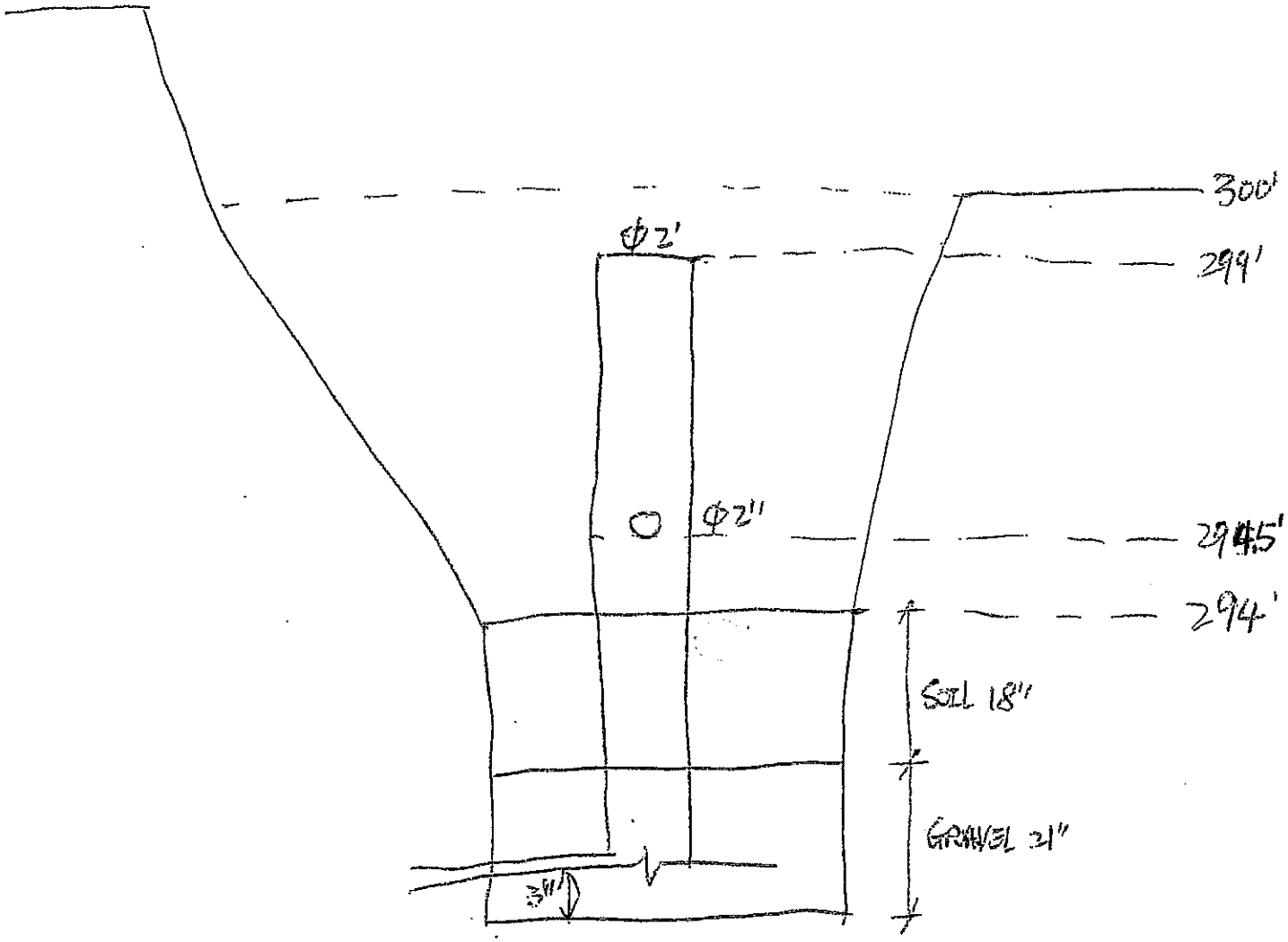

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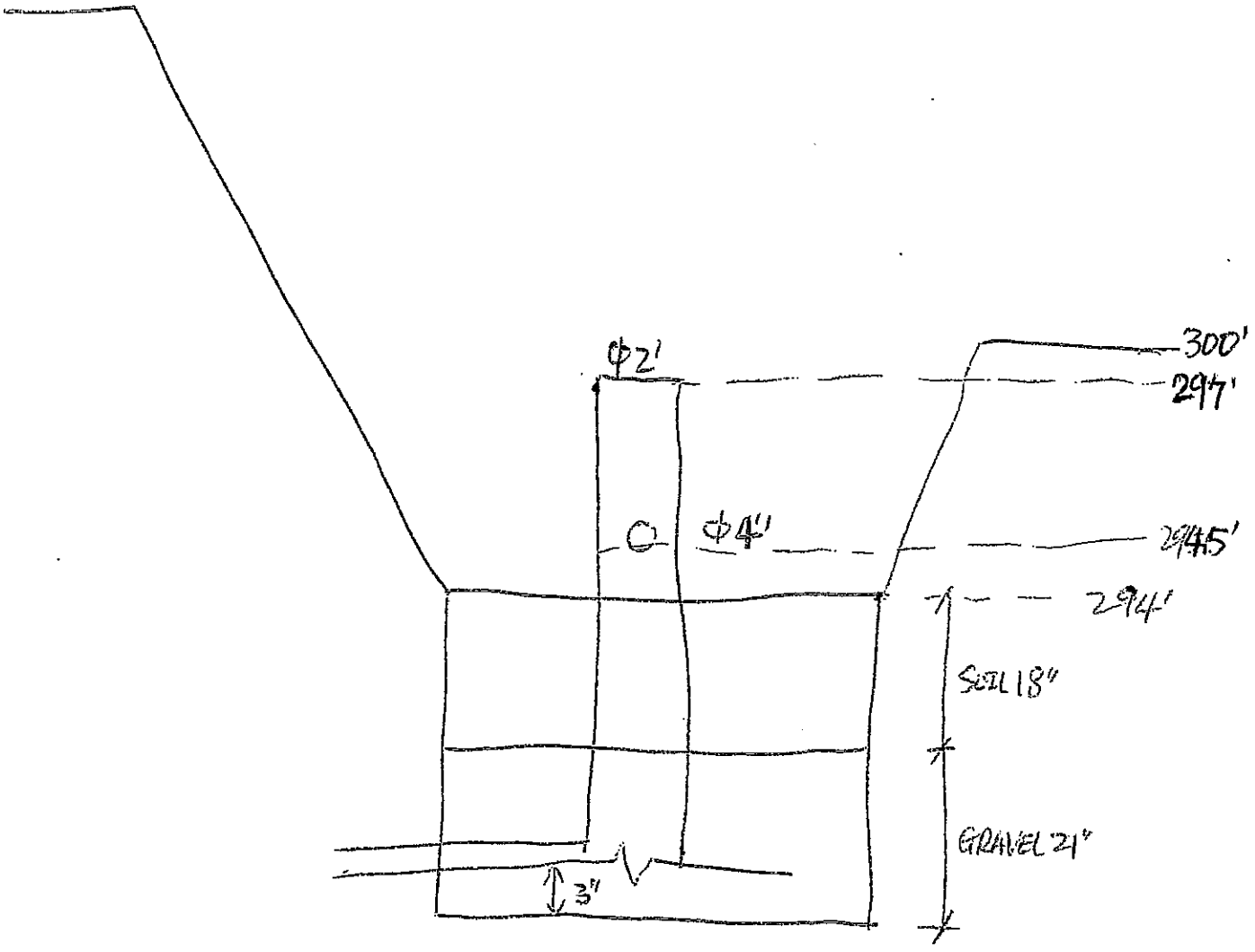

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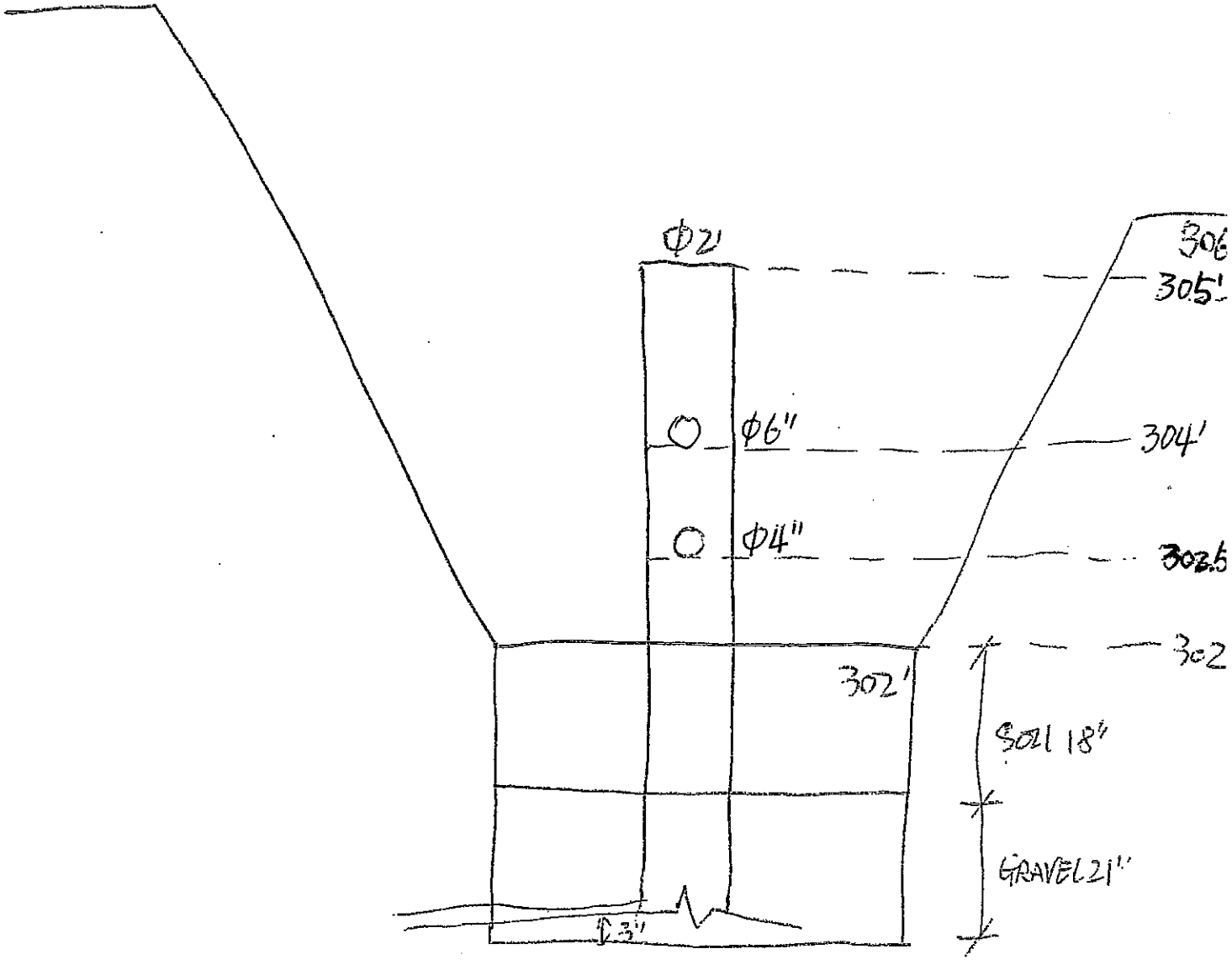

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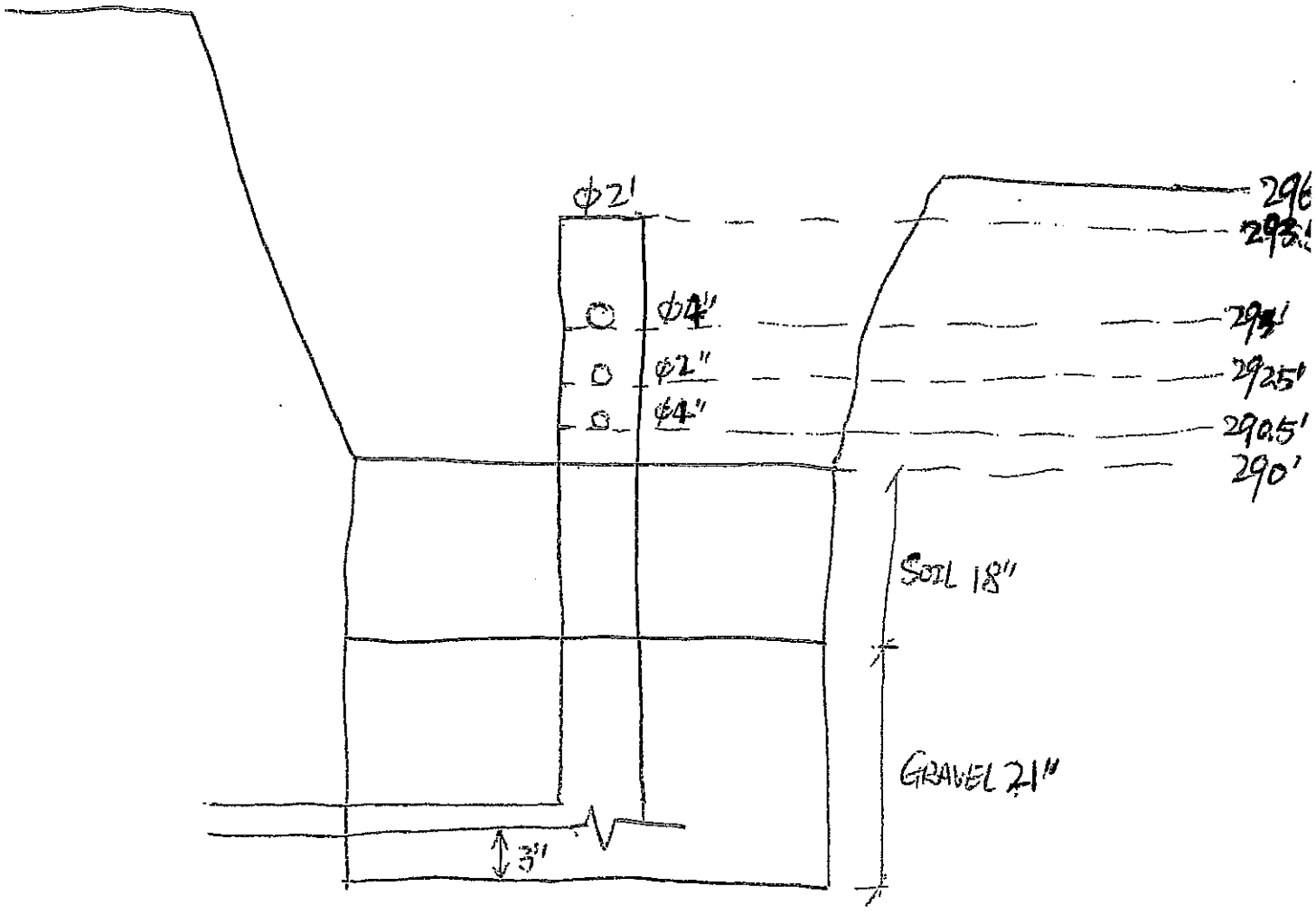

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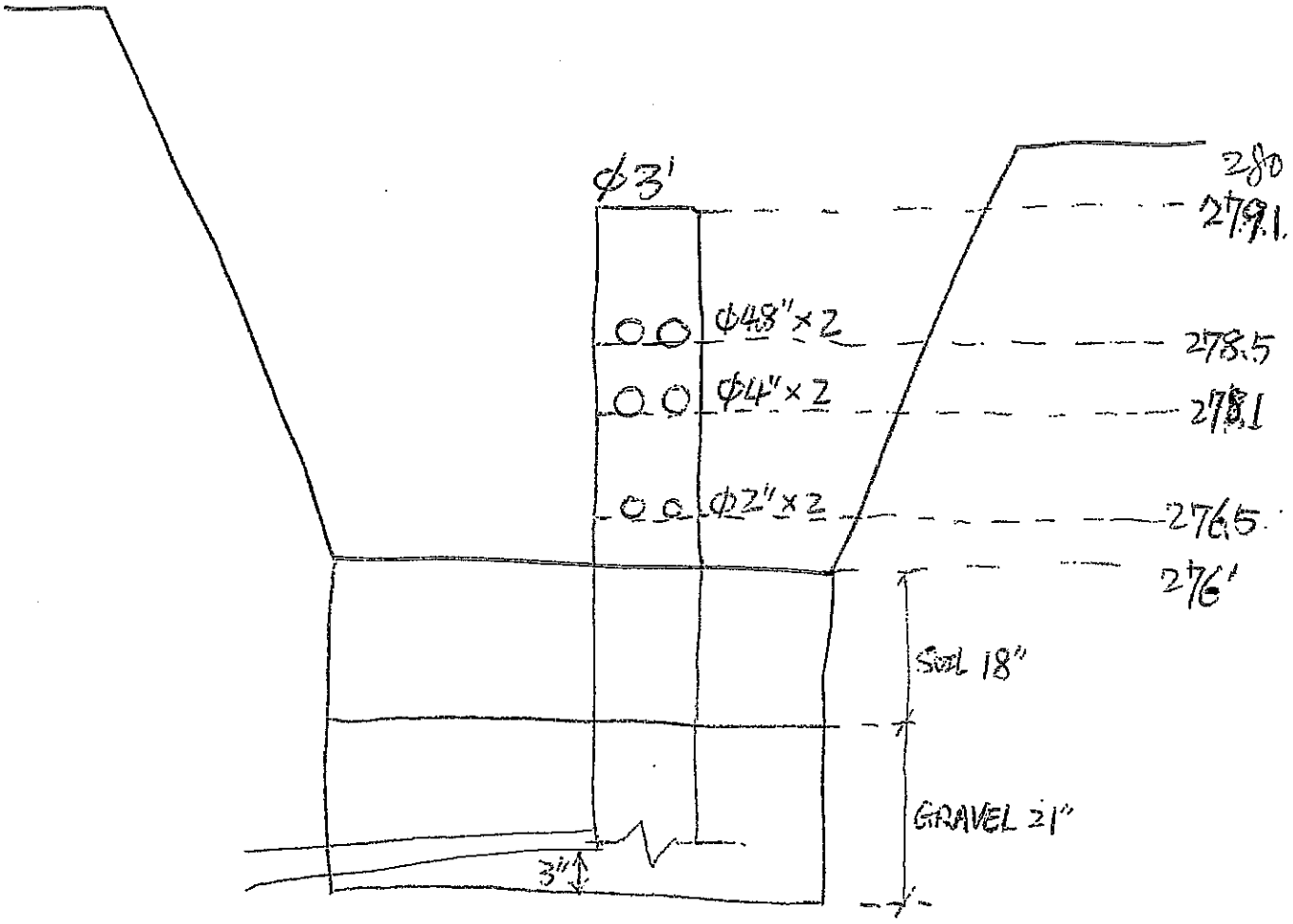

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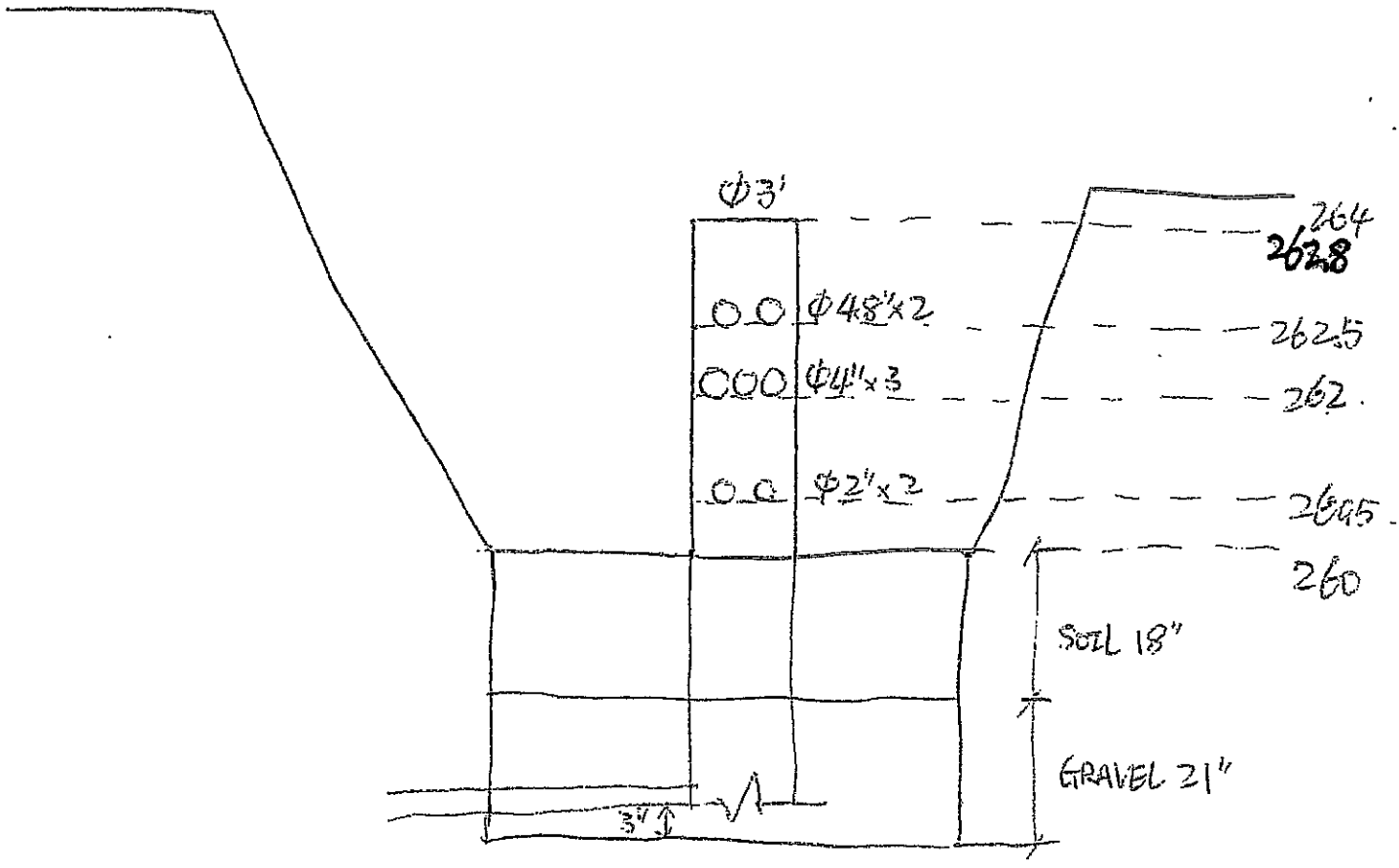

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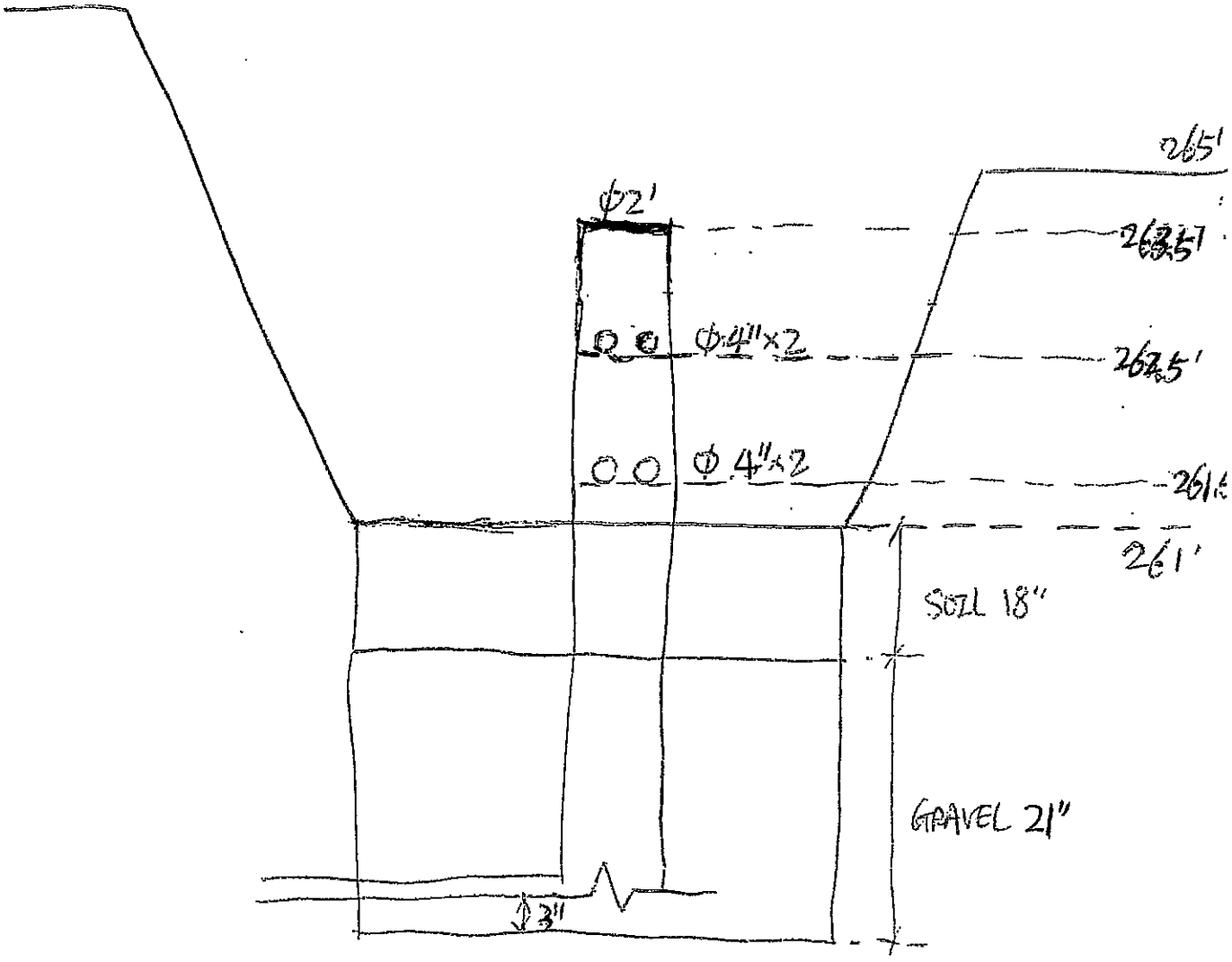

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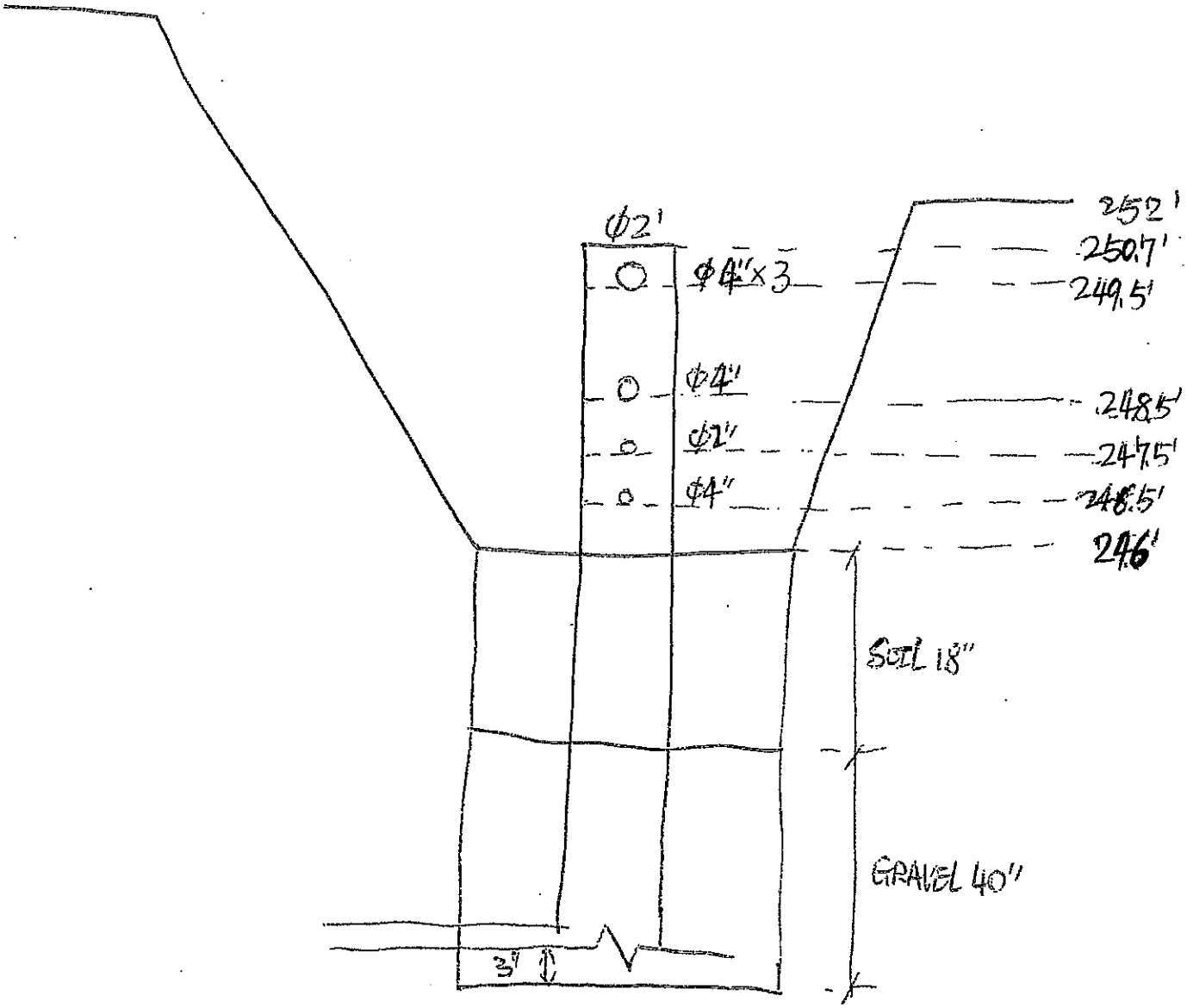


Modular Wetland Sizing Calculations

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.

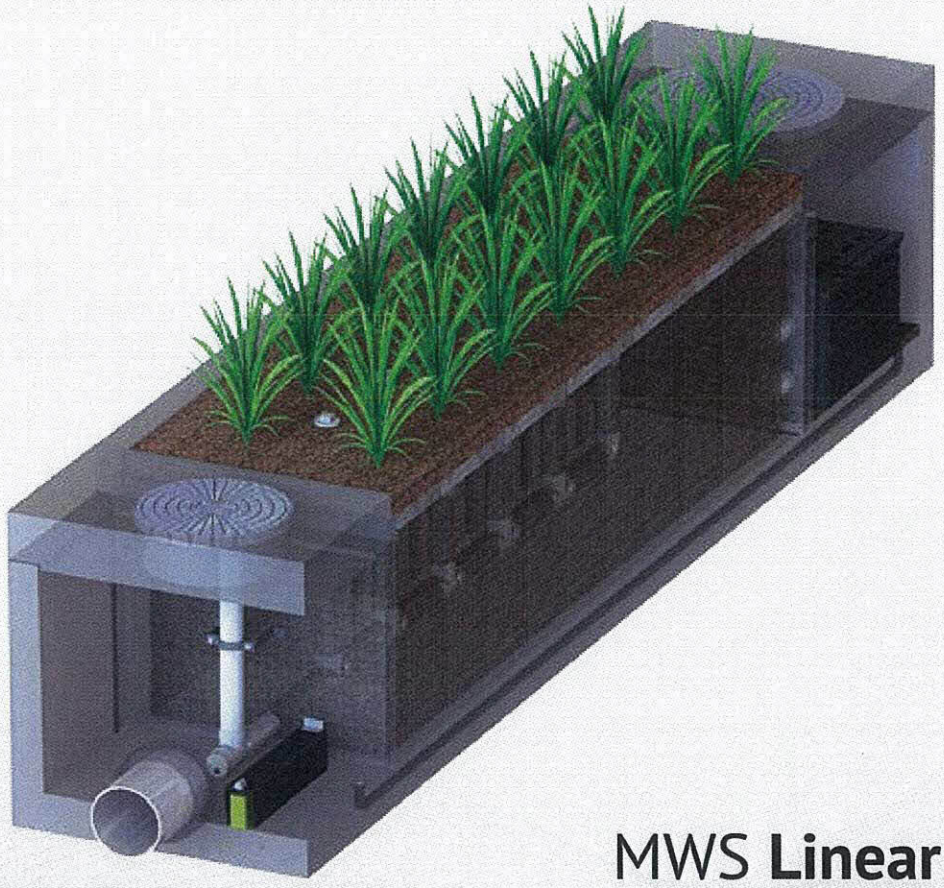
Provide basis for Criteria 7:

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.

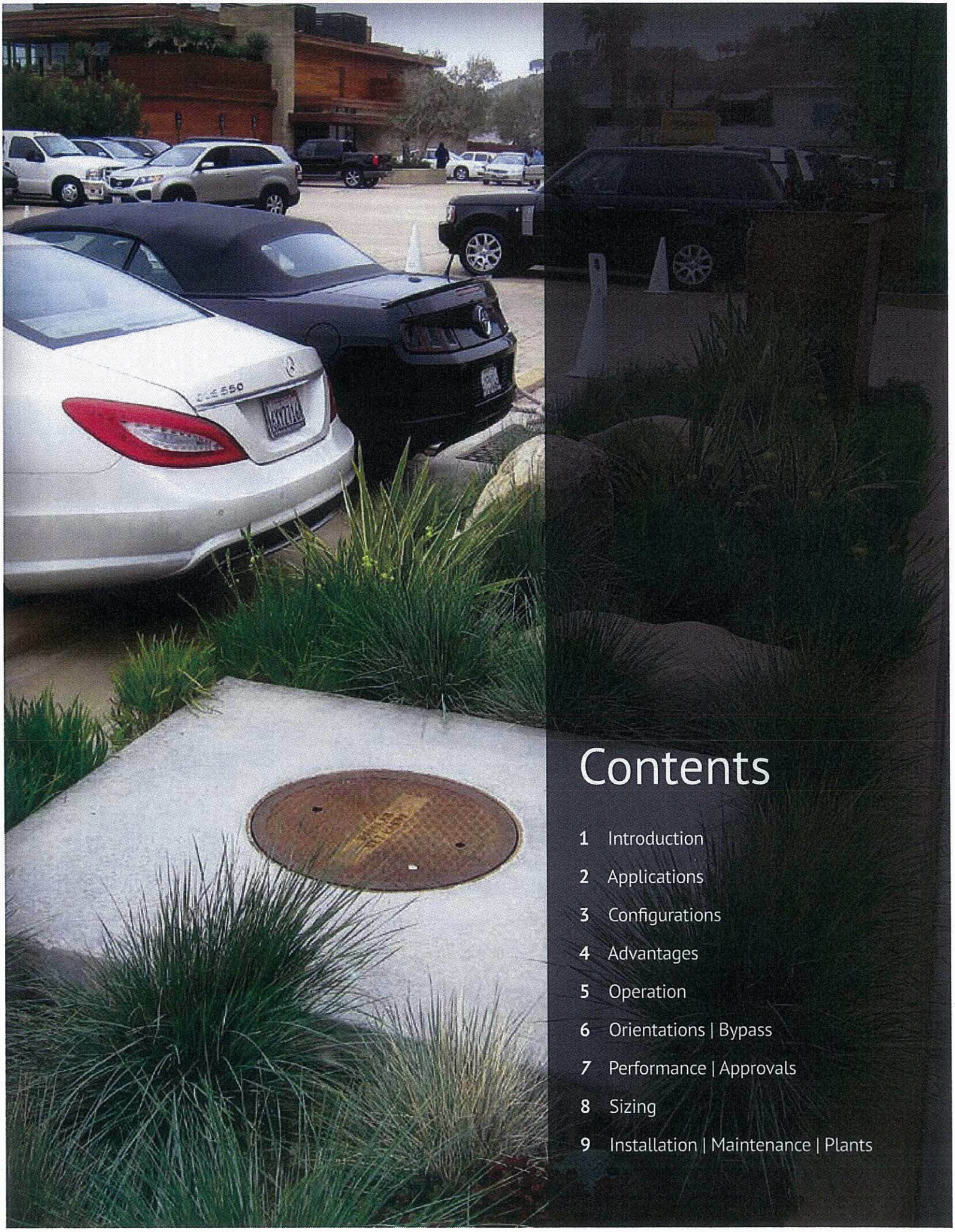
Compact (high rate) Biofiltration BMP Checklist	Form I-10
Section 2: Verification (For City Use Only)	
Is the proposed compact BMP accepted by the City Engineer for onsite pollutant control compliance for the DMA?	○ Yes ○ No, See explanation below
Explanation/reason if the compact BMP is not accepted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

MODULAR WETLANDS™

*Advanced **Stormwater** Biofiltration*



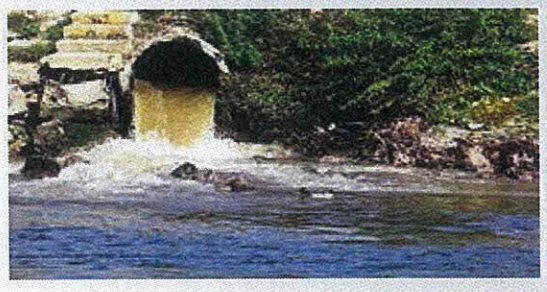
MWS **Linear**



Contents

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

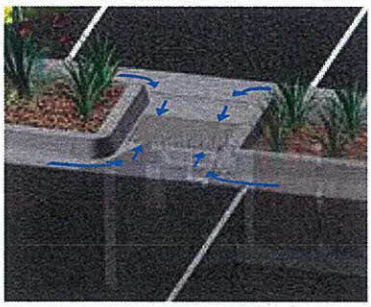
- Agriculture
- Reuse
- Low Impact Development
- Waste Water

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.

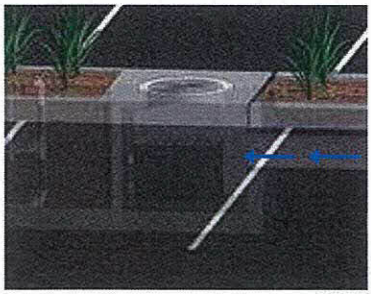
Curb Type

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

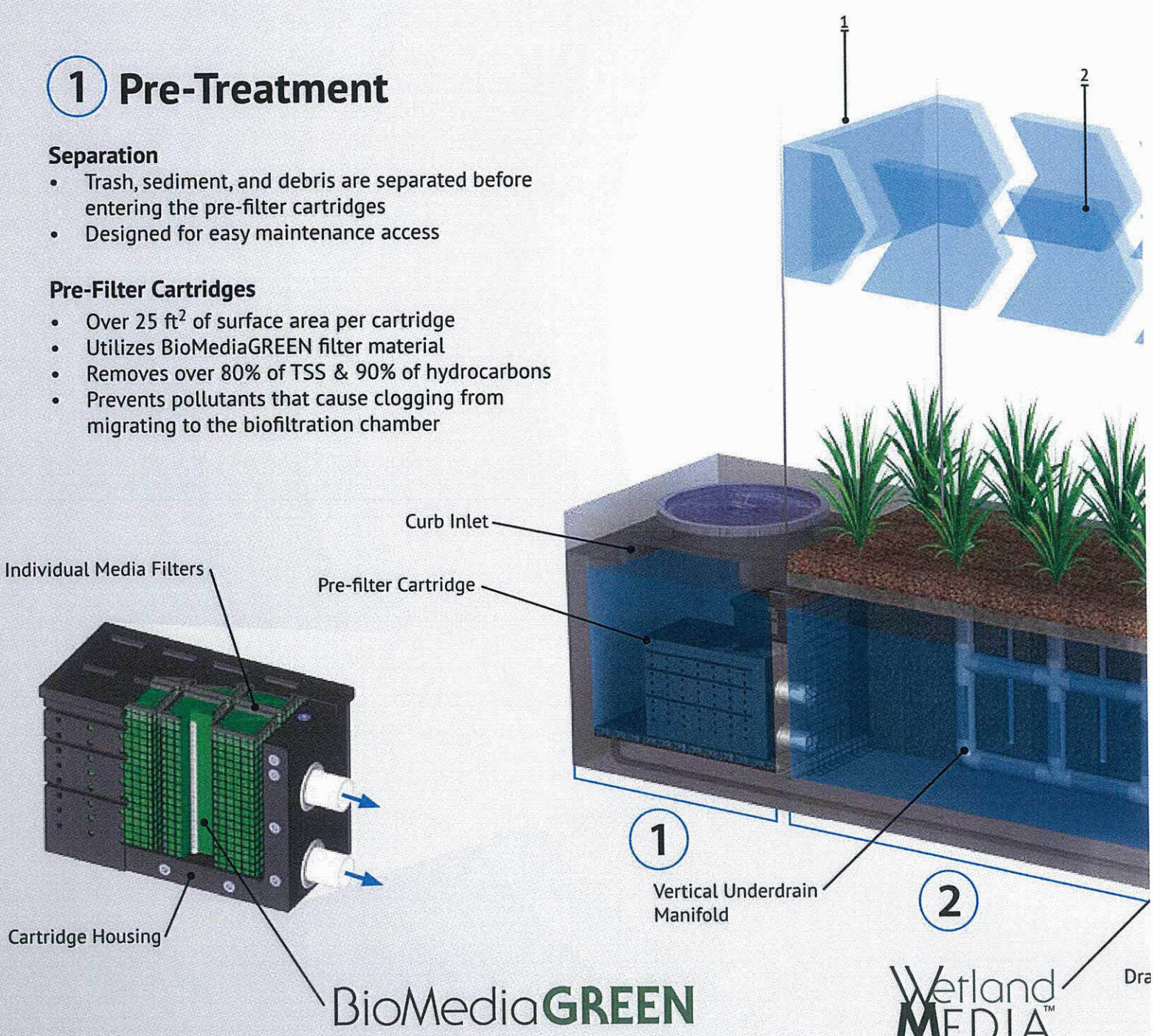
1 Pre-Treatment

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



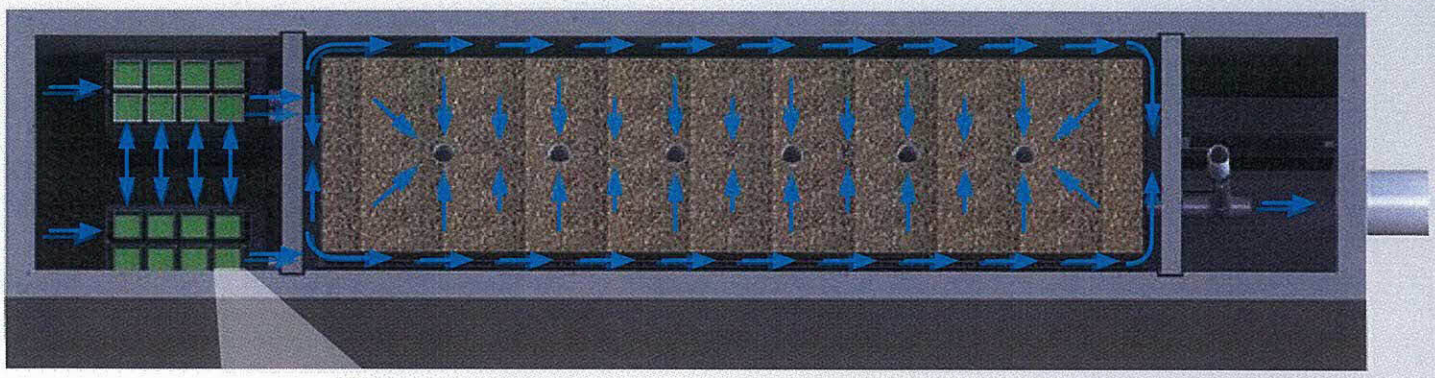


Fig. 2 - Top View

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

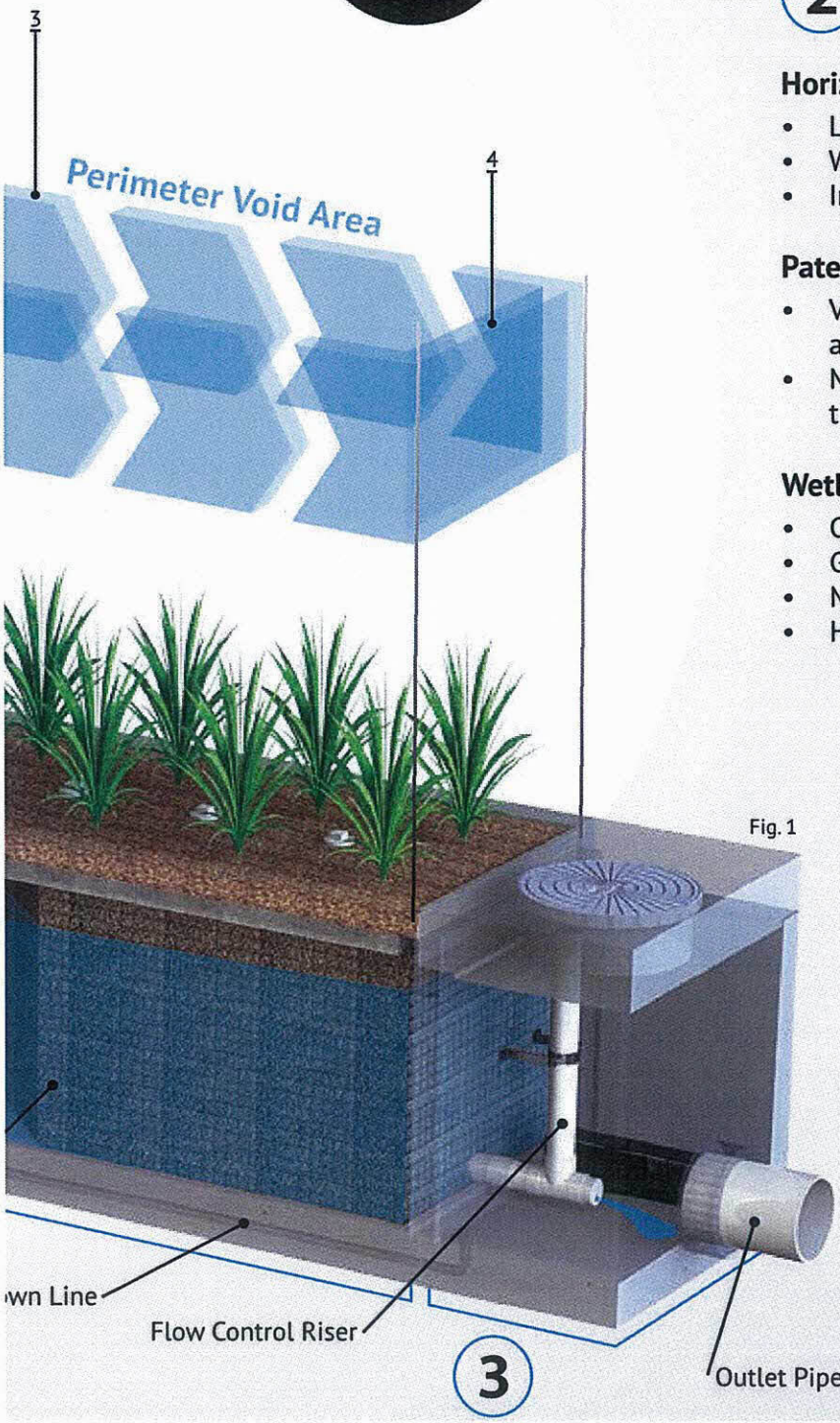


Fig. 1

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

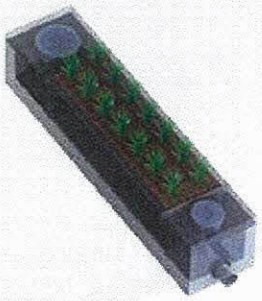
Drain-Down Filter

- 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.

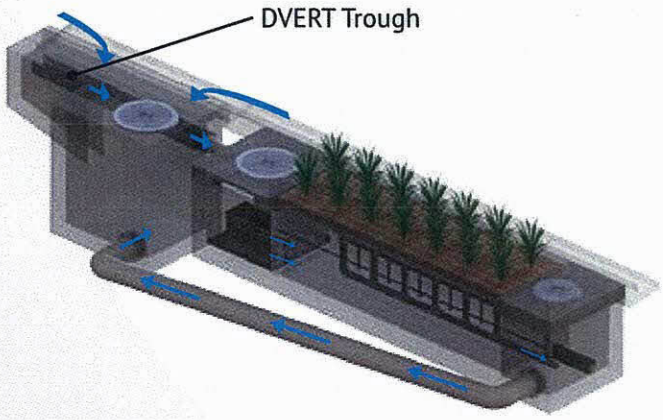
External Diversion Weir Structure

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.

www.ModularWetlands.com | (855) 5MOD-WET | info@ModularWetlands.com

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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Modular Wetland Systems, Inc.
P.O. Box 869
Oceanside, CA 92054
gkent@biocleanenvironmental.net

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

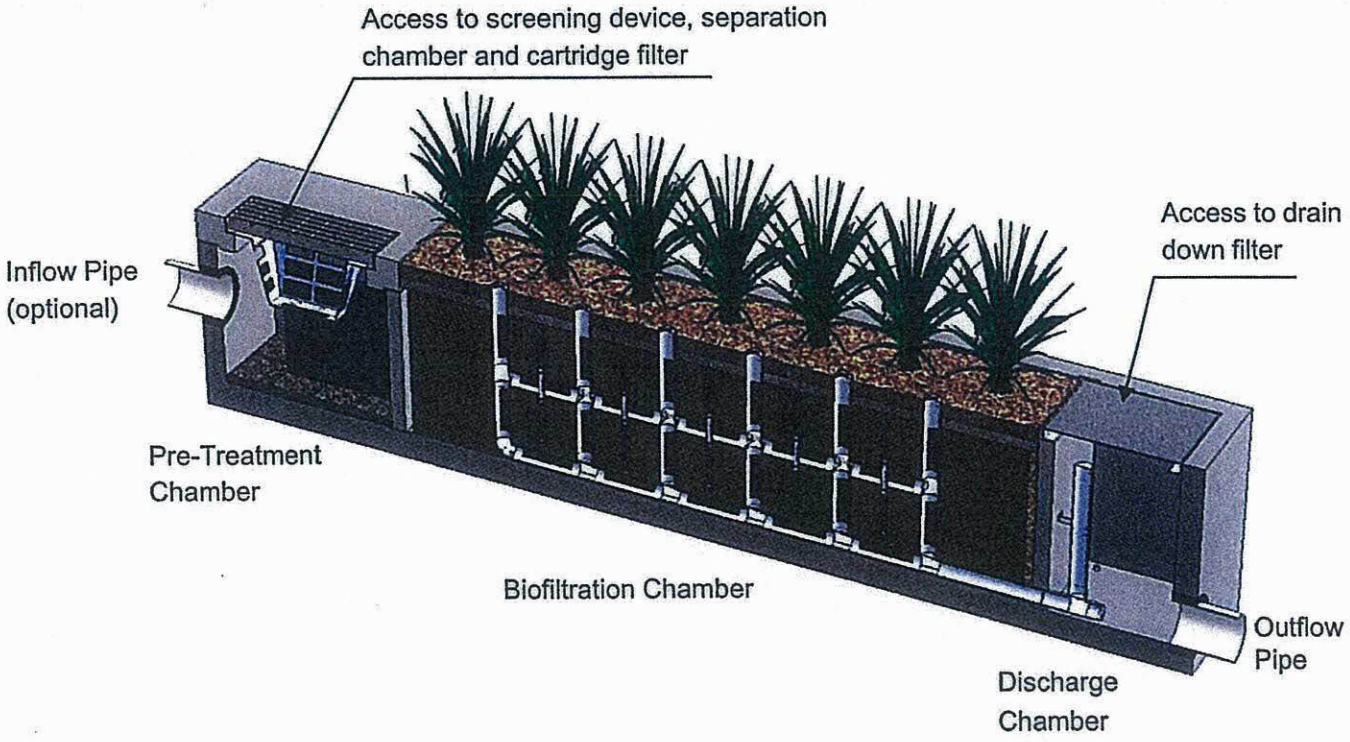
Date	Revision
June 2011	Original use-level-designation document
September 2012	Revised dates for TER and expiration
January 2013	Modified Design Storm Description, added Revision Table, added maintenance discussion, modified format in accordance with Ecology standard
December 2013	Updated name of Applicant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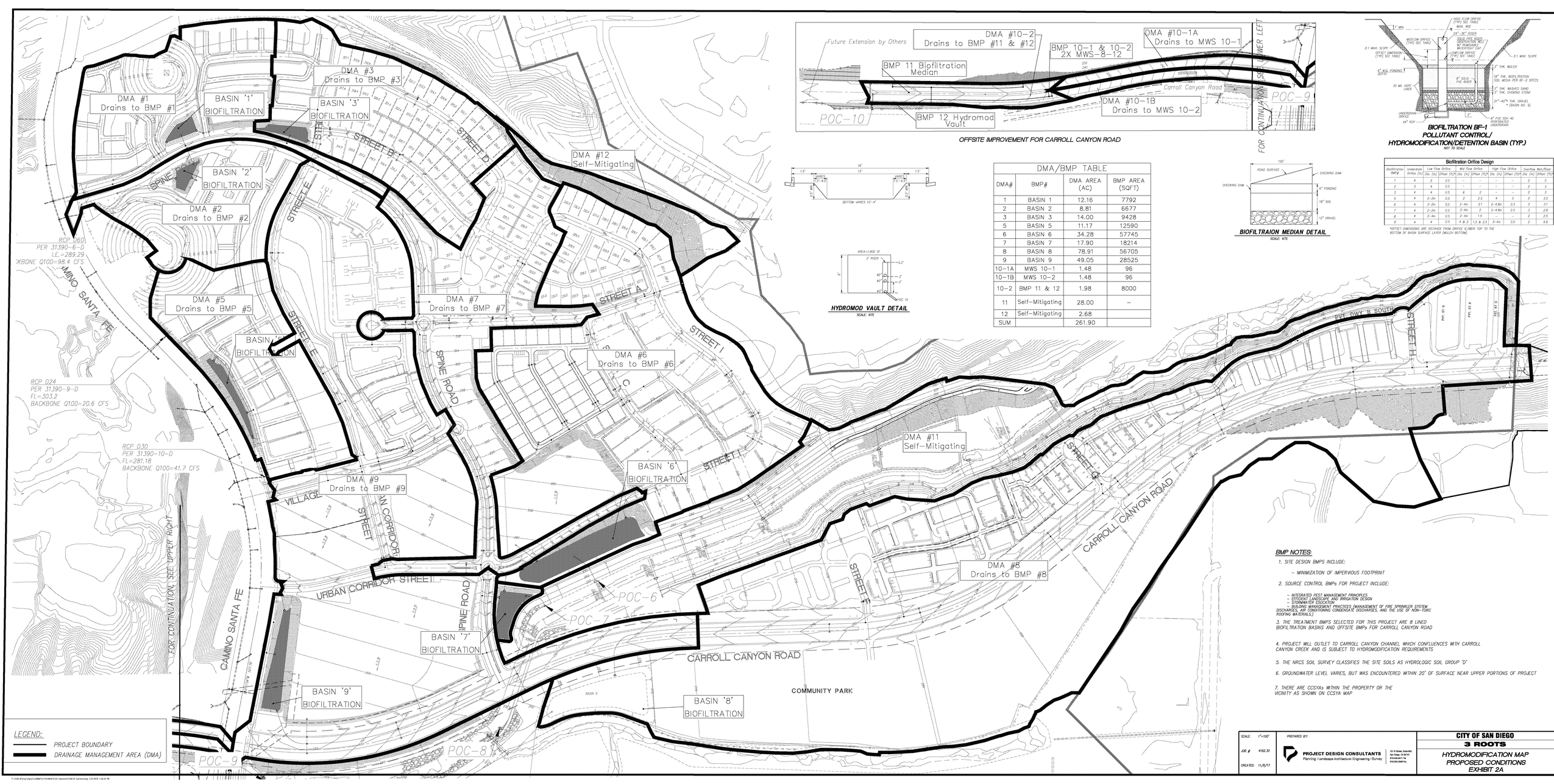

OFFSITE IMPROVEMENT FOR CARROLL CANYON ROAD

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
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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

ChangConsultants

Civil Engineering ◦ Hydrology ◦ Hydraulics ◦ Sedimentation

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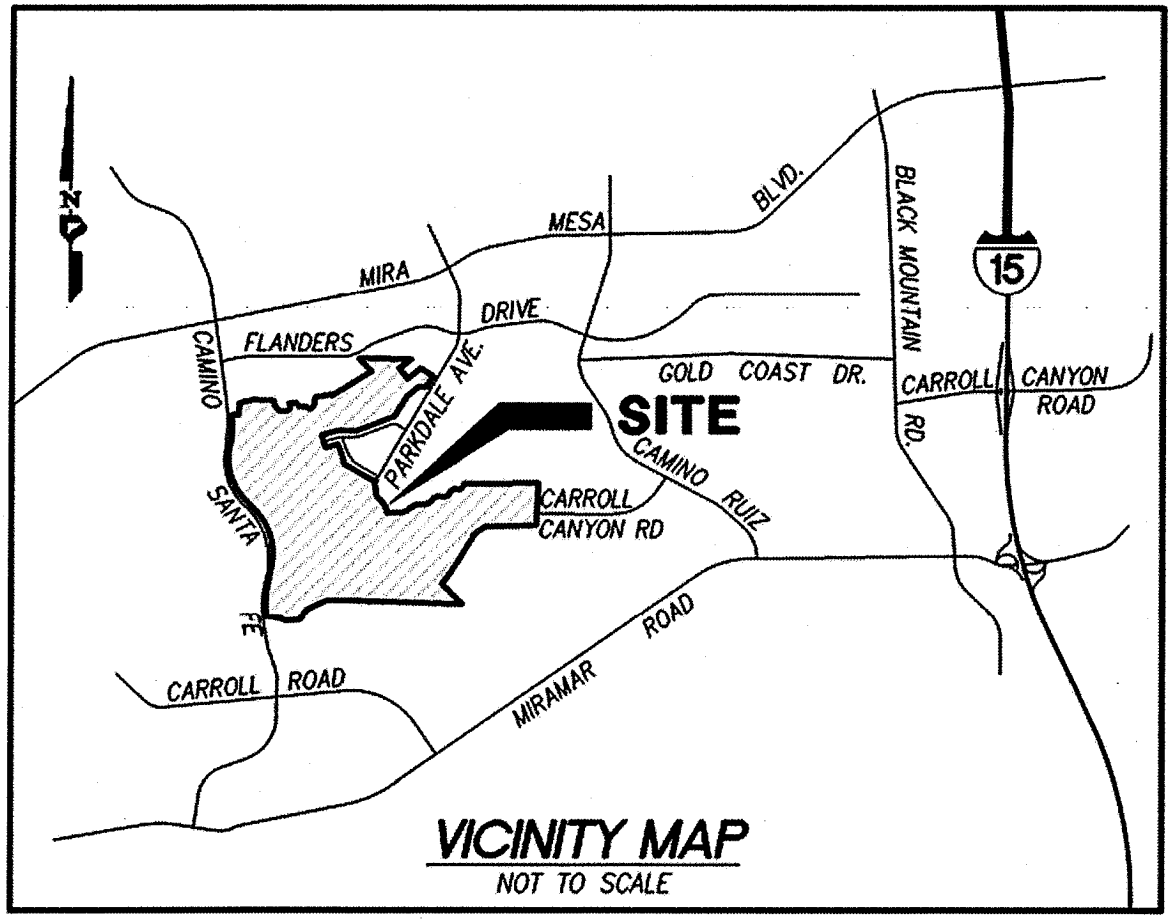
APPENDICES

MAP POCKET

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)

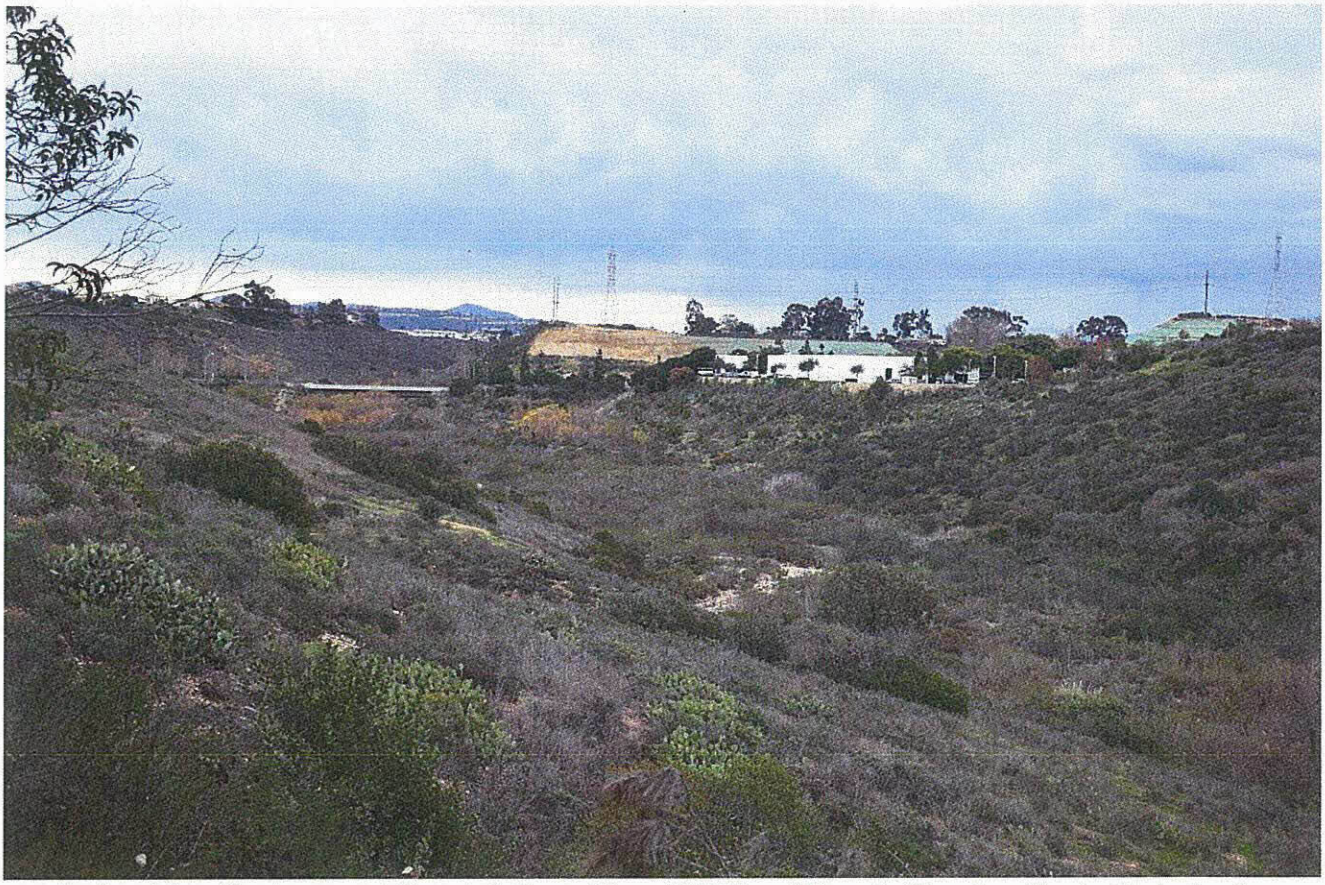


Figure 7. Looking Upstream at Reach 1 from Near Middle of Reach (Camino Santa Fe in background)

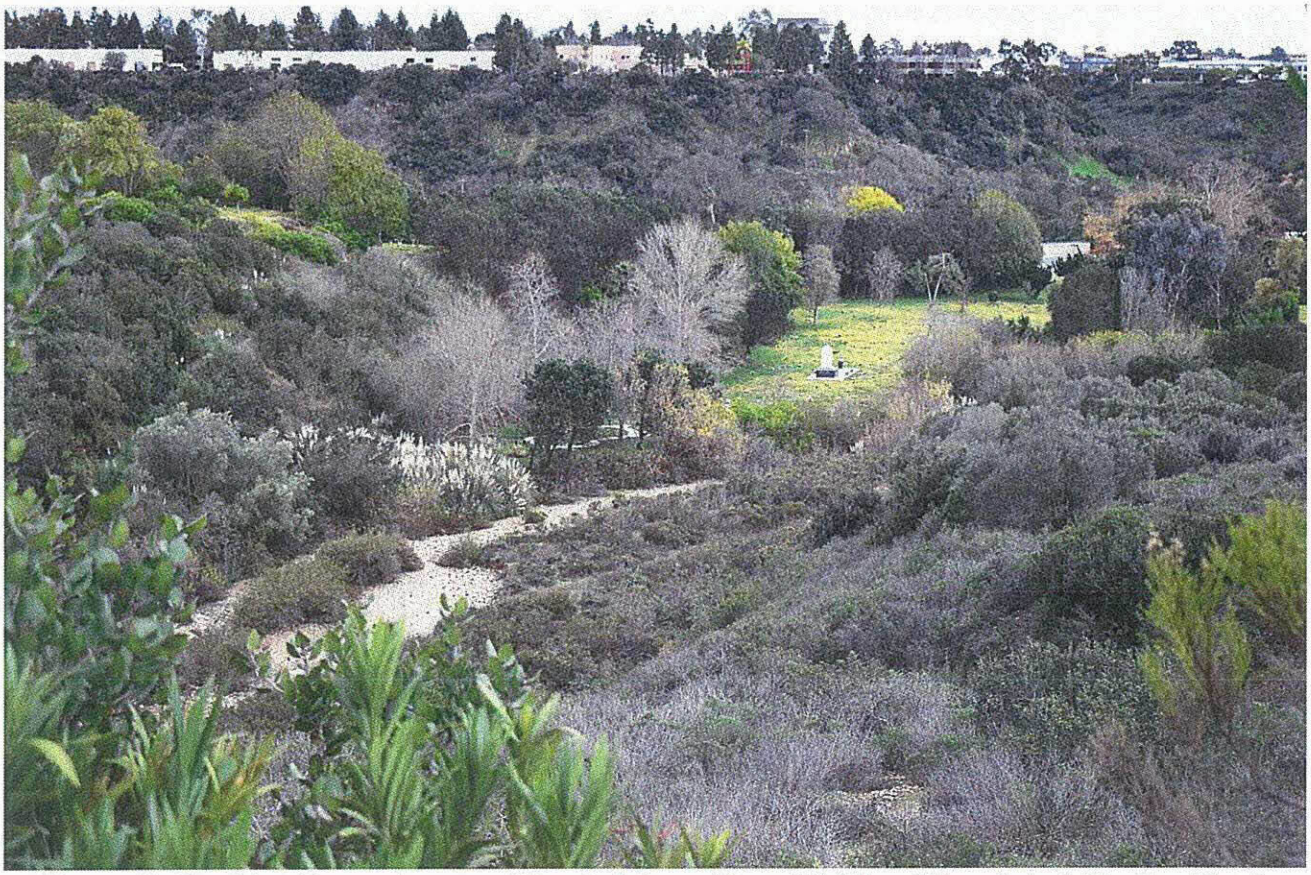


Figure 8. Looking Downstream at Reach 1 from Near Middle of Reach (cobble-lined bed)

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

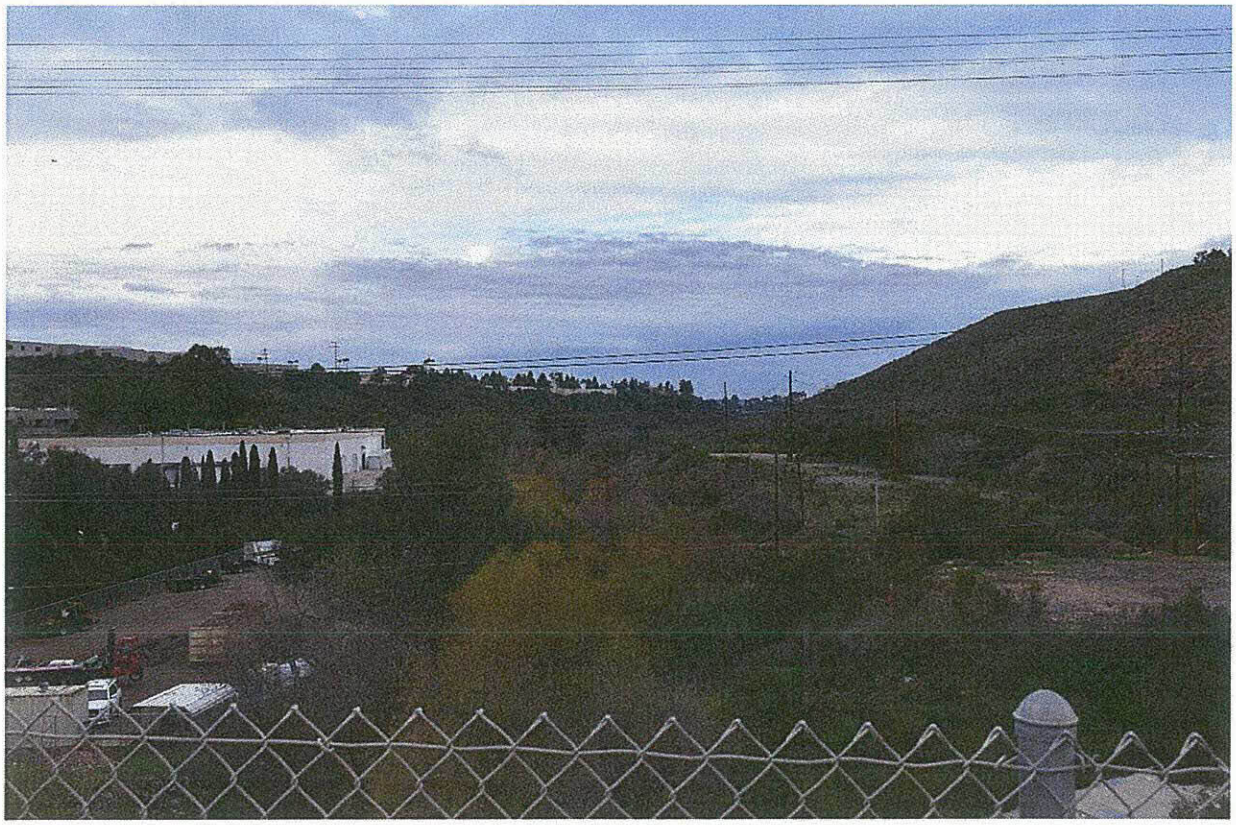


Figure 16. Looking Downstream at Reach 3 from Camino Santa Fe at Upper End

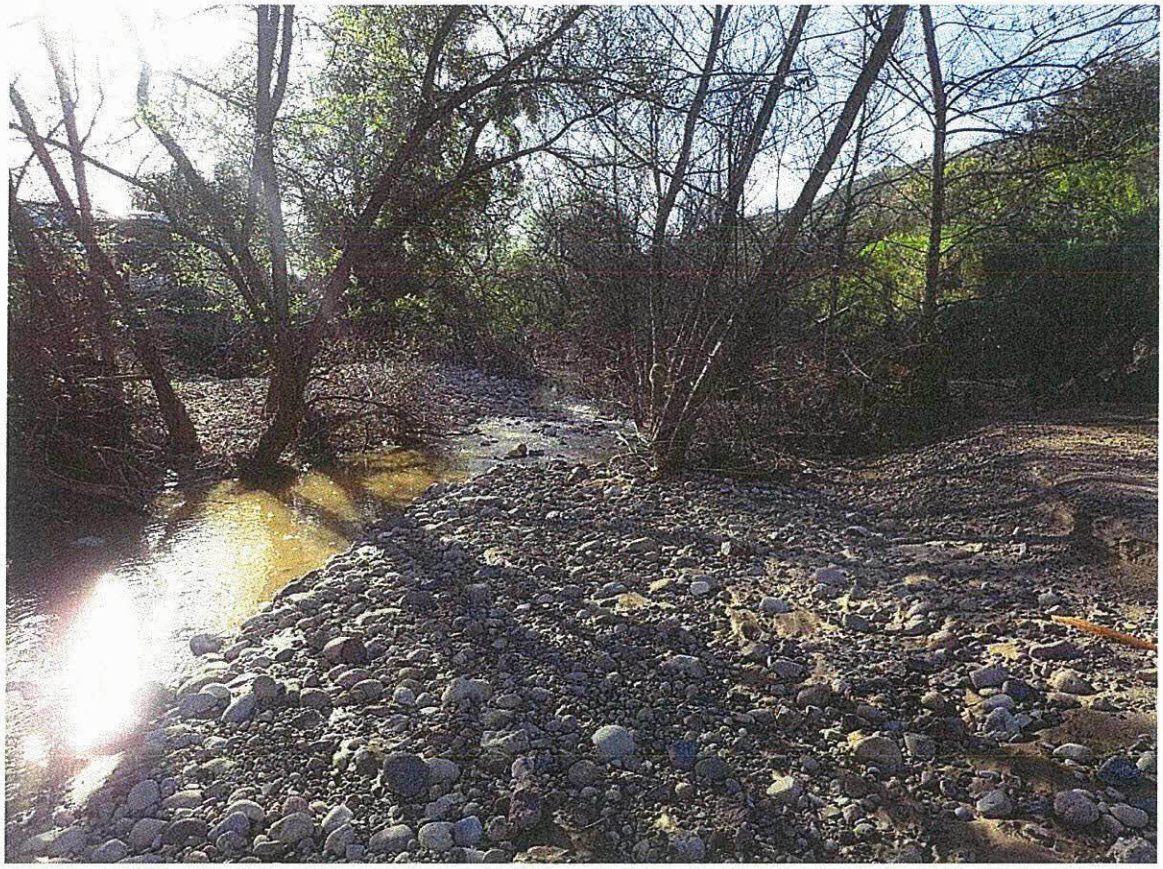


Figure 17. Looking Downstream at Reach 3 from Upper End (cobble-lined bed)

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)

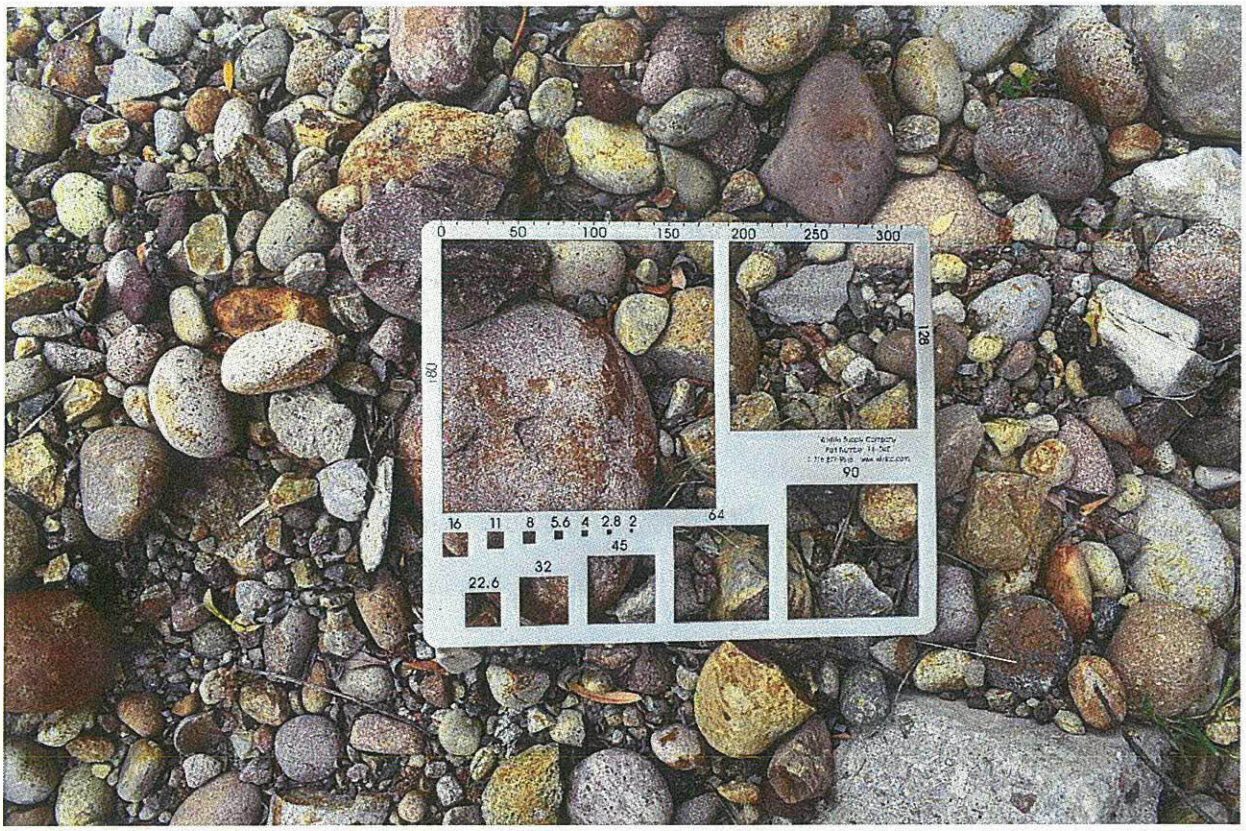


Figure 25. Gravelometer on Reach 1 Channel Bed

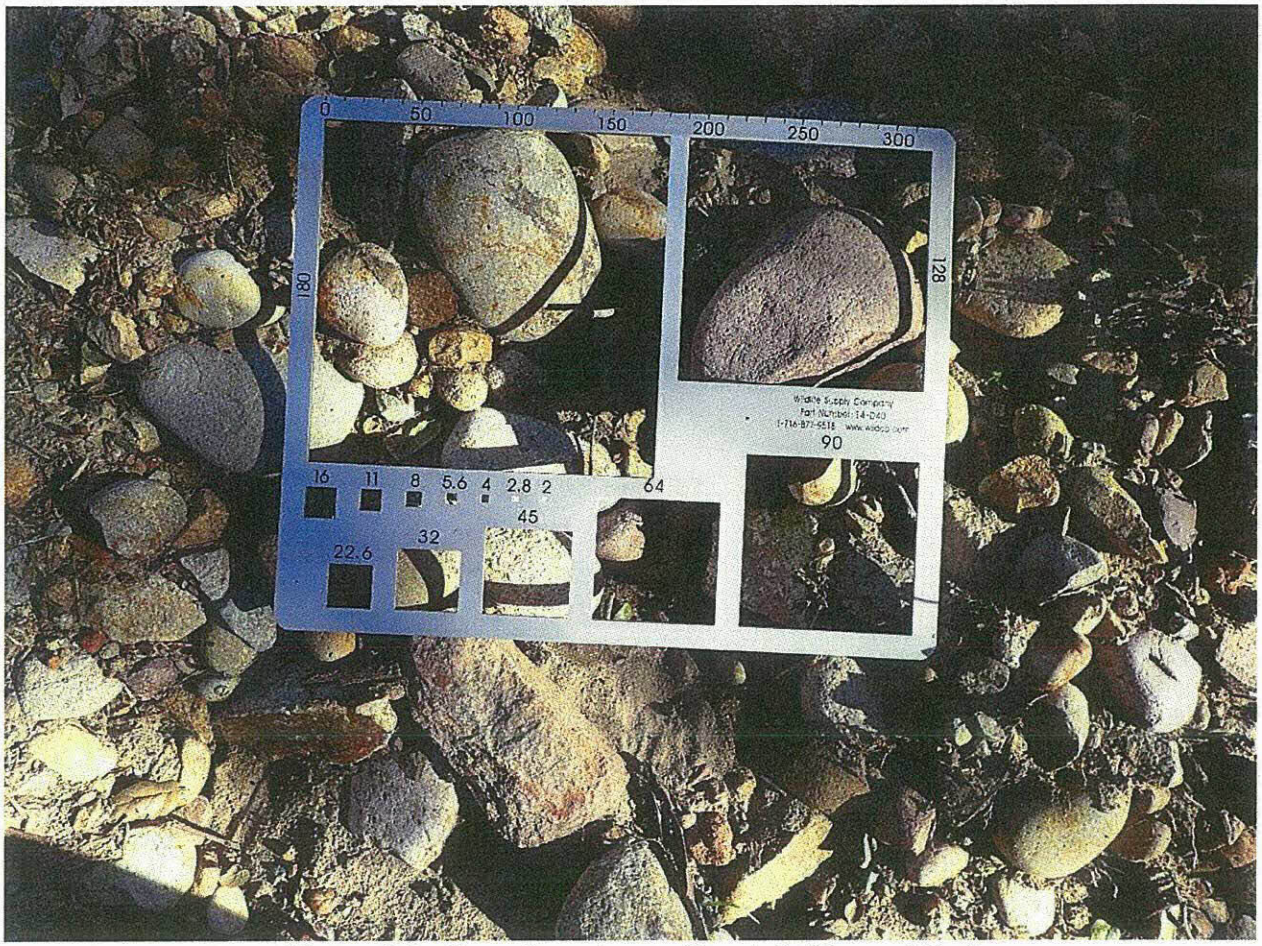


Figure 26. Gravelometer on Reach 2 Channel Bed

Figure 27. Gravelometer on Reach 3 Channel Bed

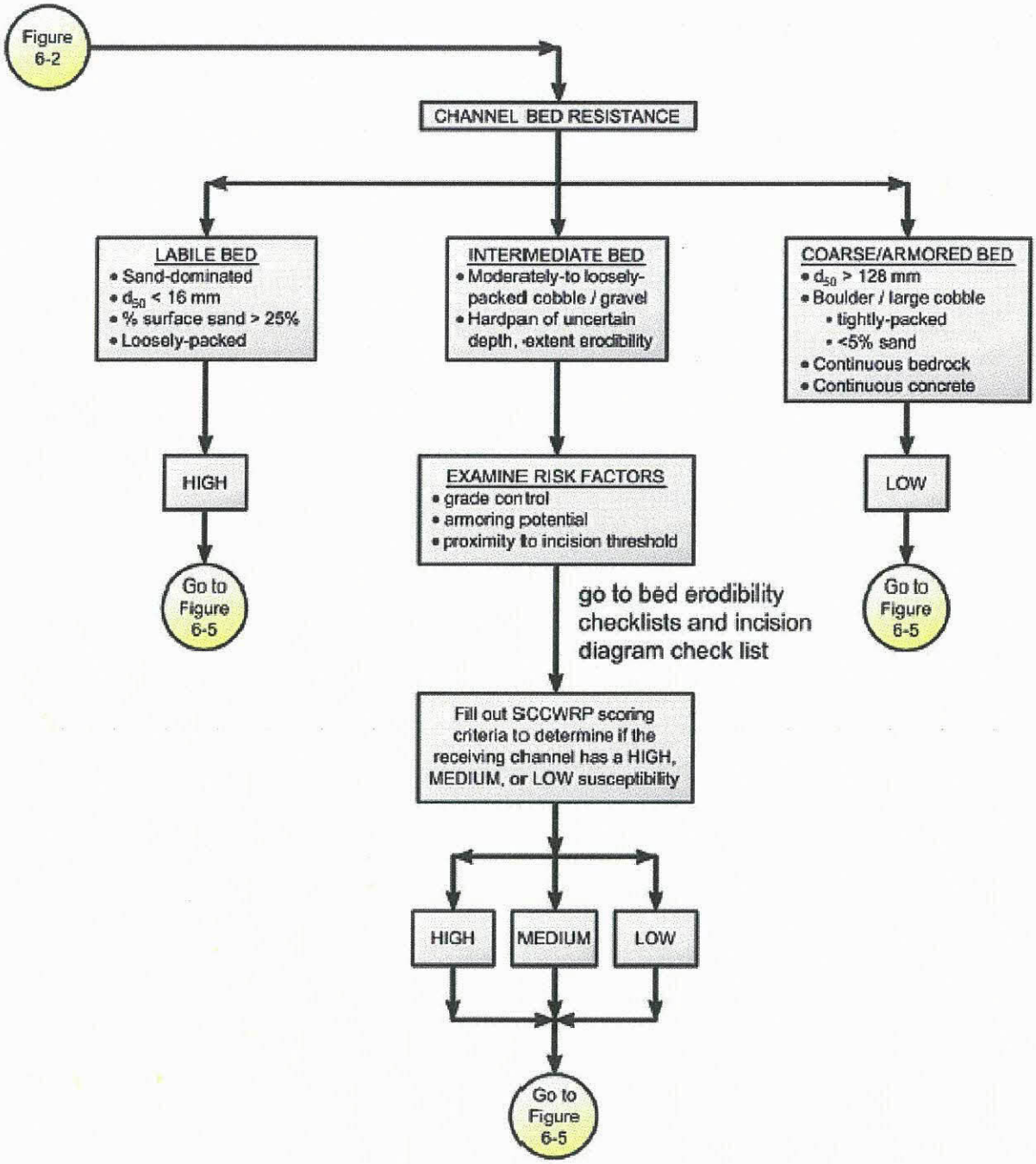


Figure 6-4. SCCWRP Vertical Susceptibility

Figure 28. SCCWRP Vertical Channel Susceptibility Matrix

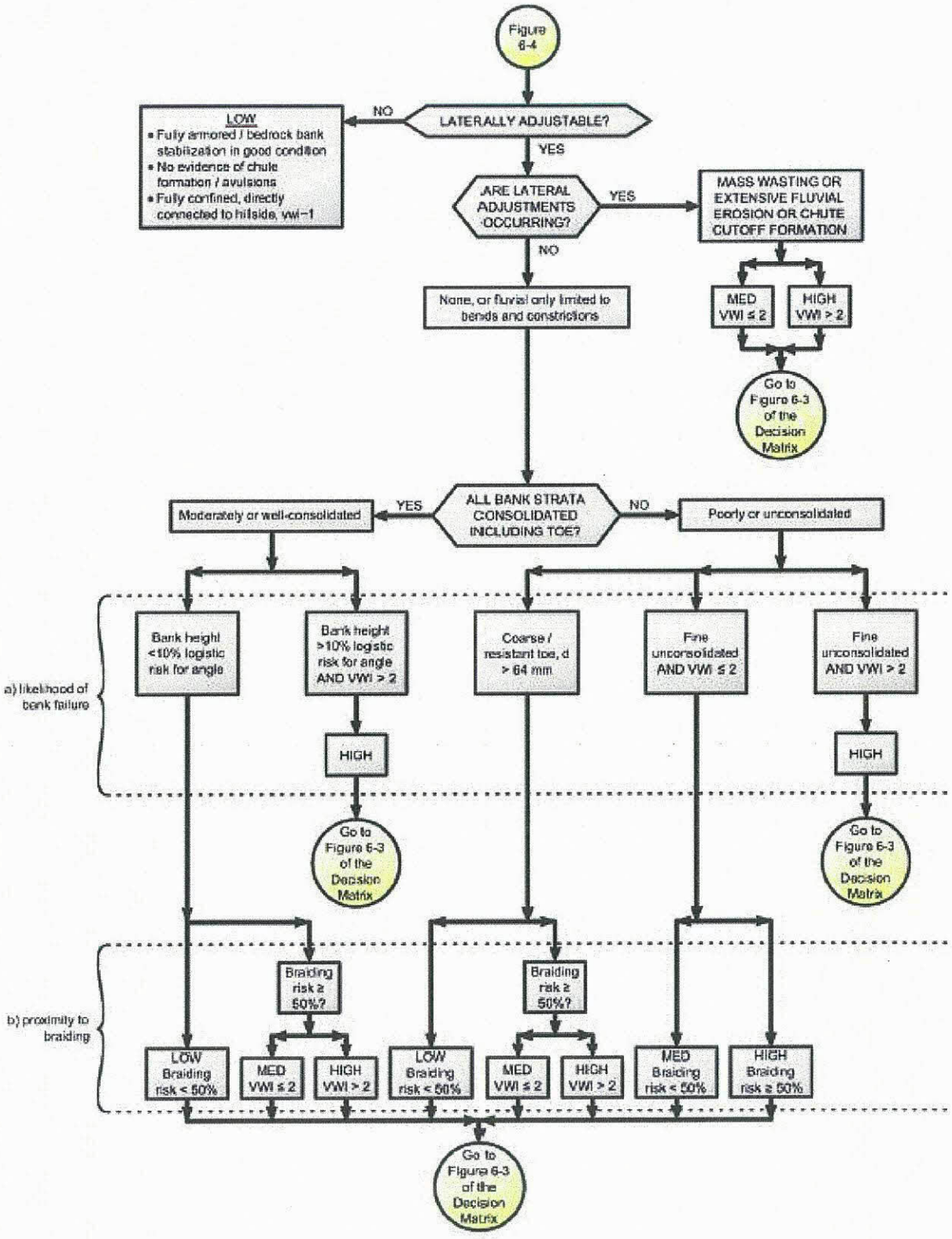


Figure 6-5. Lateral Channel Susceptibility

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

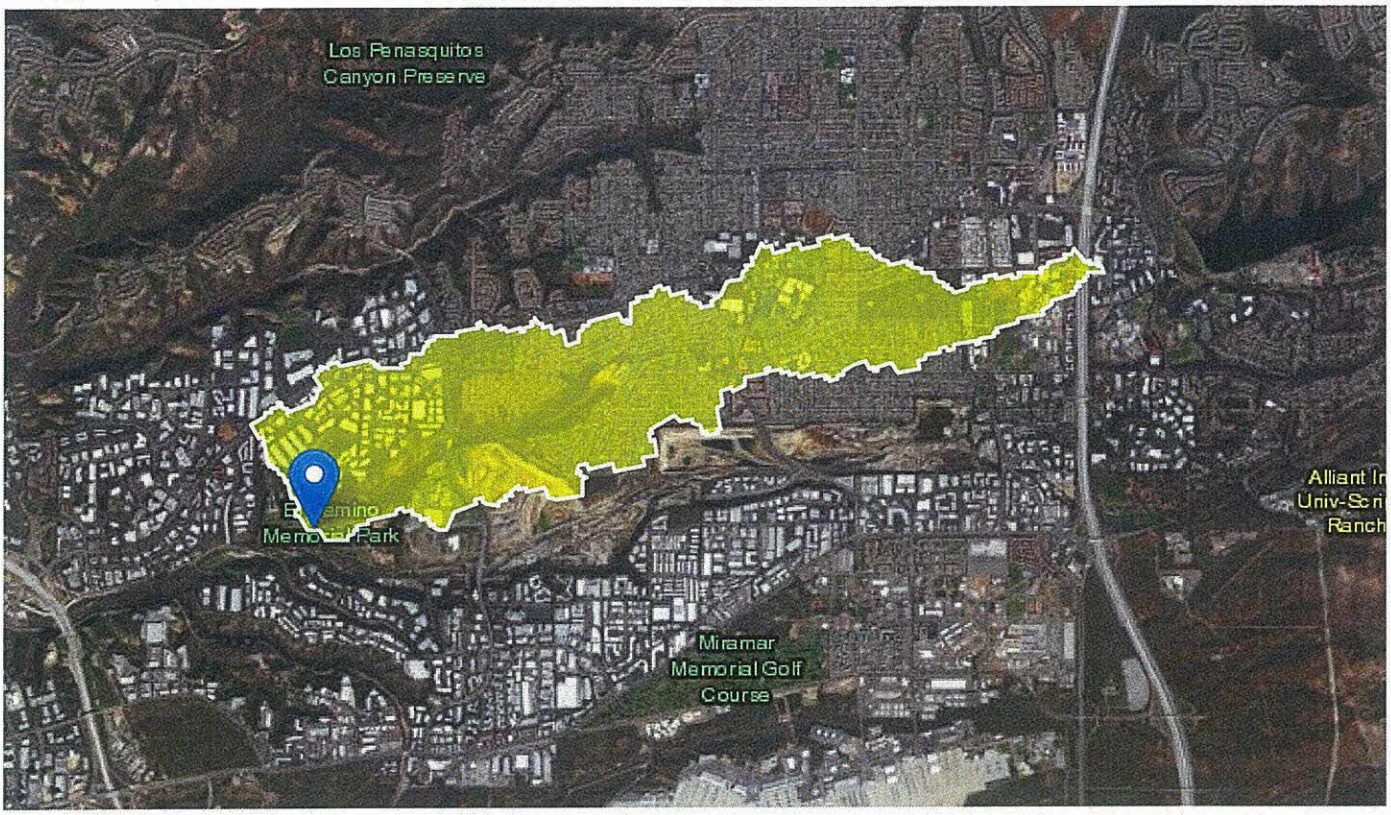
Reach	Area A, sq. mi.	Mean Annual Precip. P, inches	Valley Slope Sv, m/m	Valley Width Wv, m	10-Year Flow Q10cfs, cfs	10-Year Flow Q10, cms
1	2.5057	9.66	0.0163	12.19	232	6.6
2	8.7464	9.66	0.0138	15.24	688	19.5
3	11.9765	9.66	0.0109	9.14	905	25.6

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



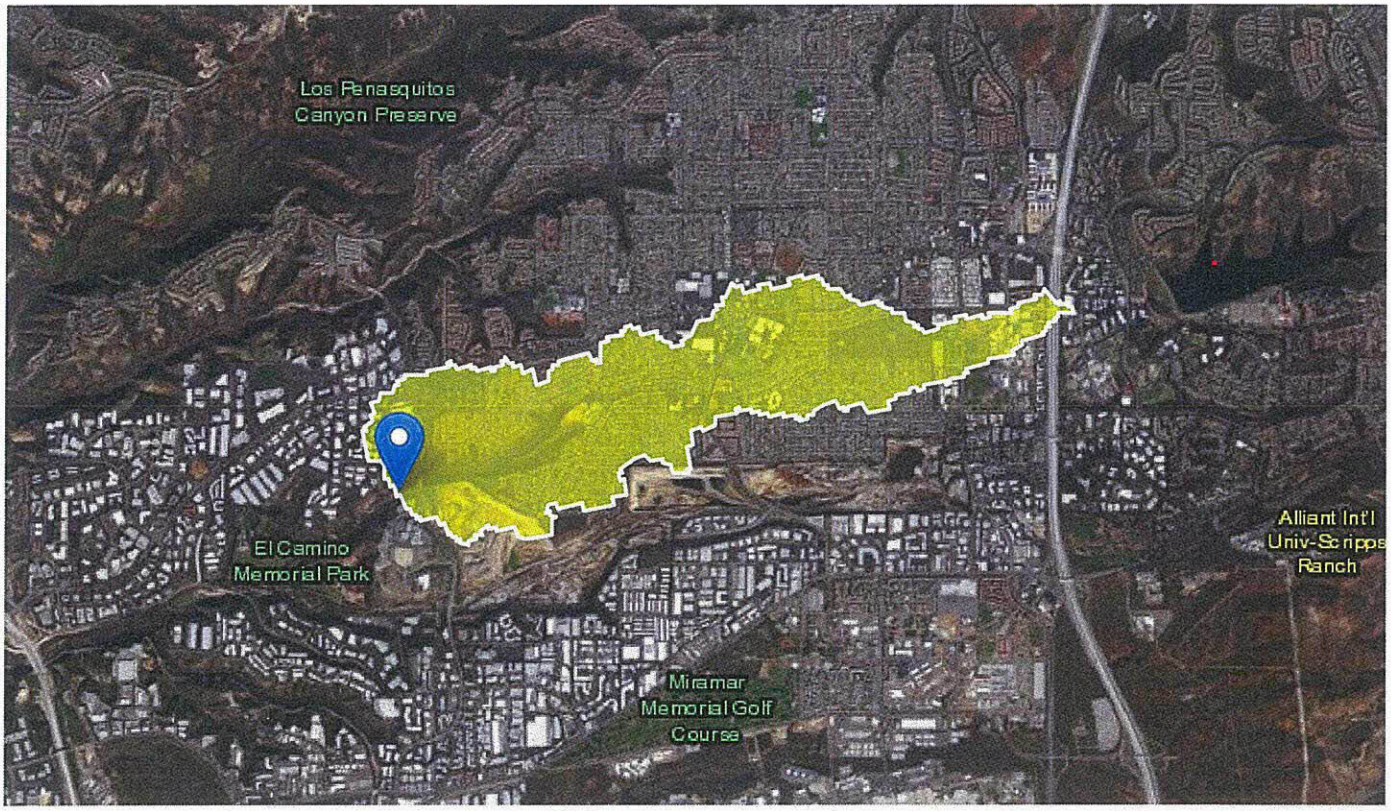
Basin Characteristics

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

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



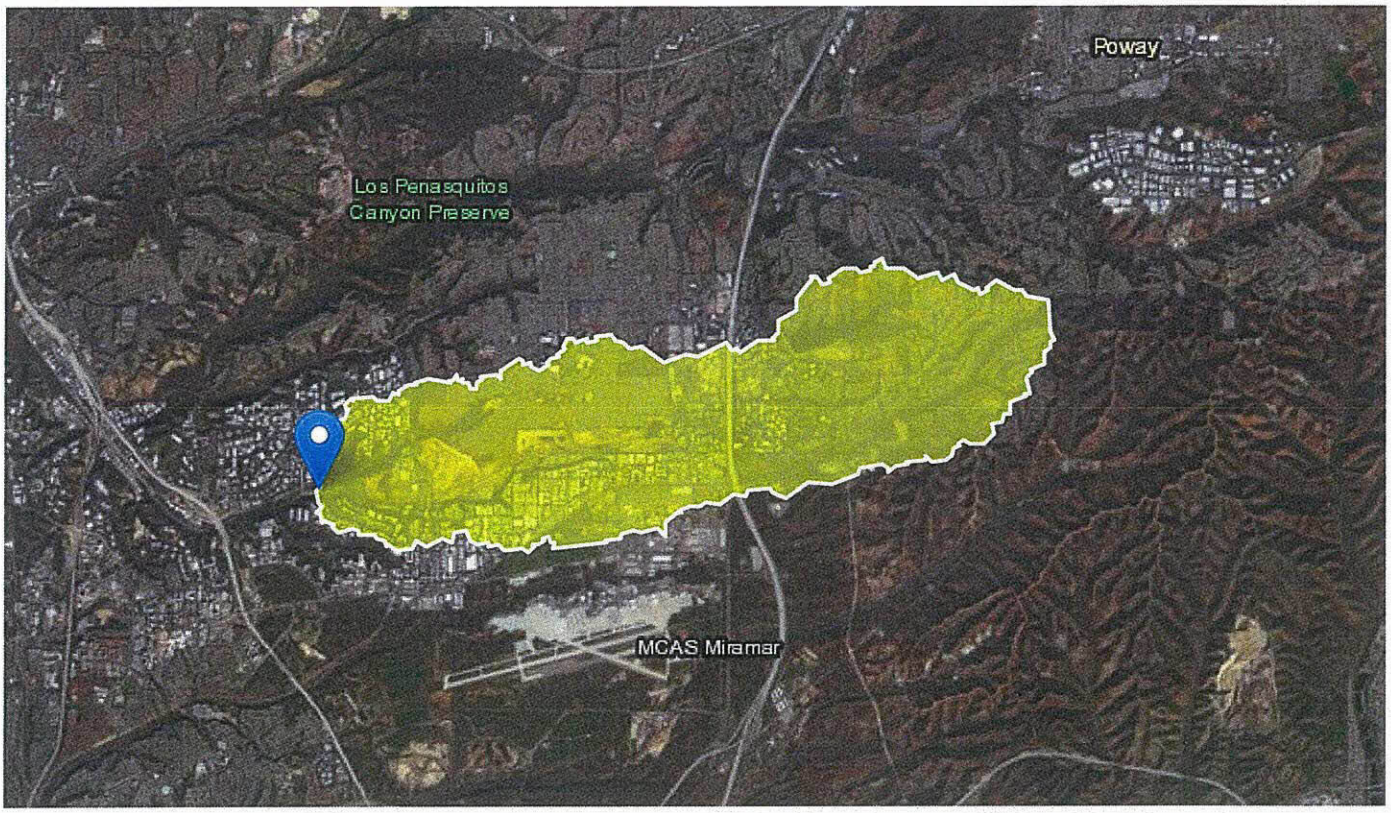
Basin Characteristics

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

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



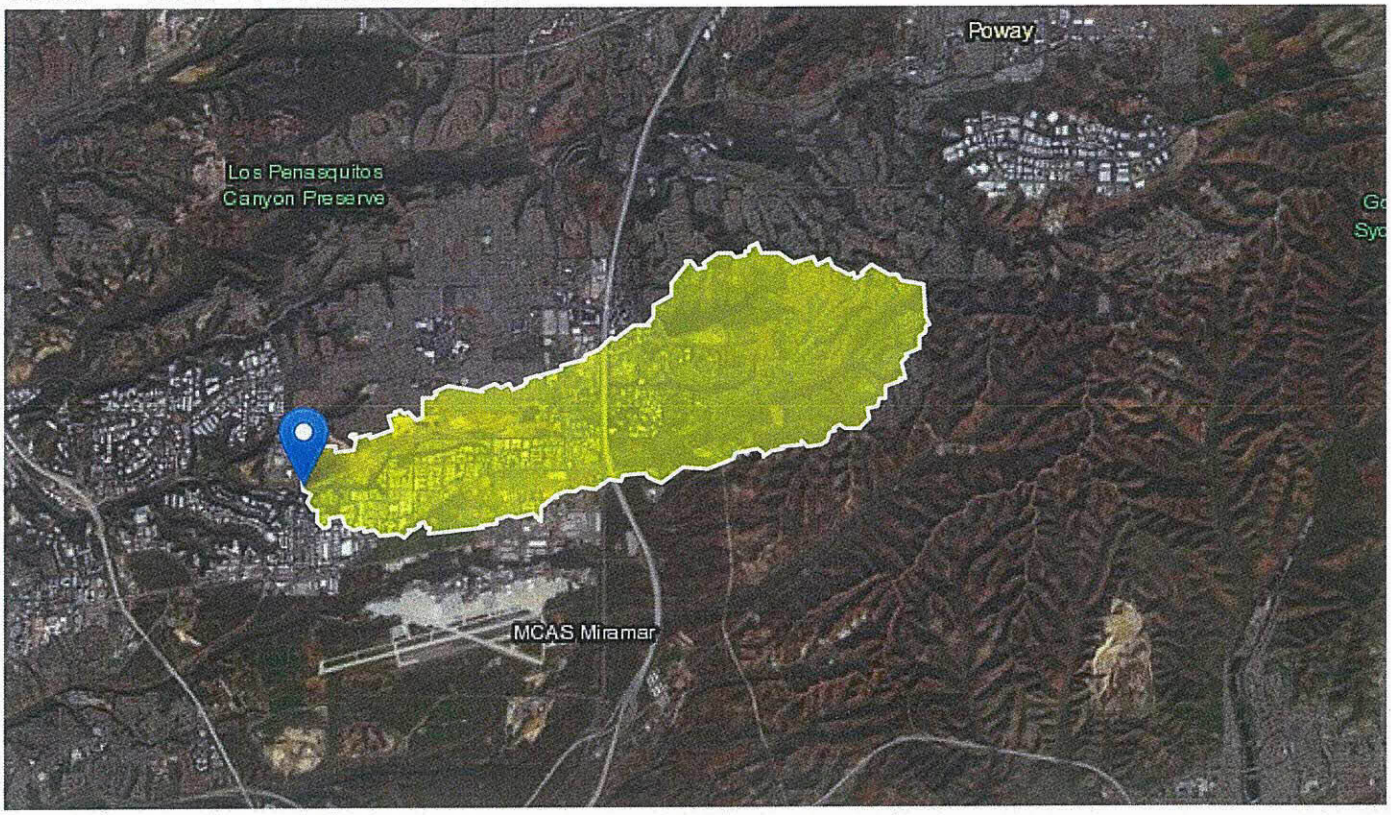
Basin Characteristics

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

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



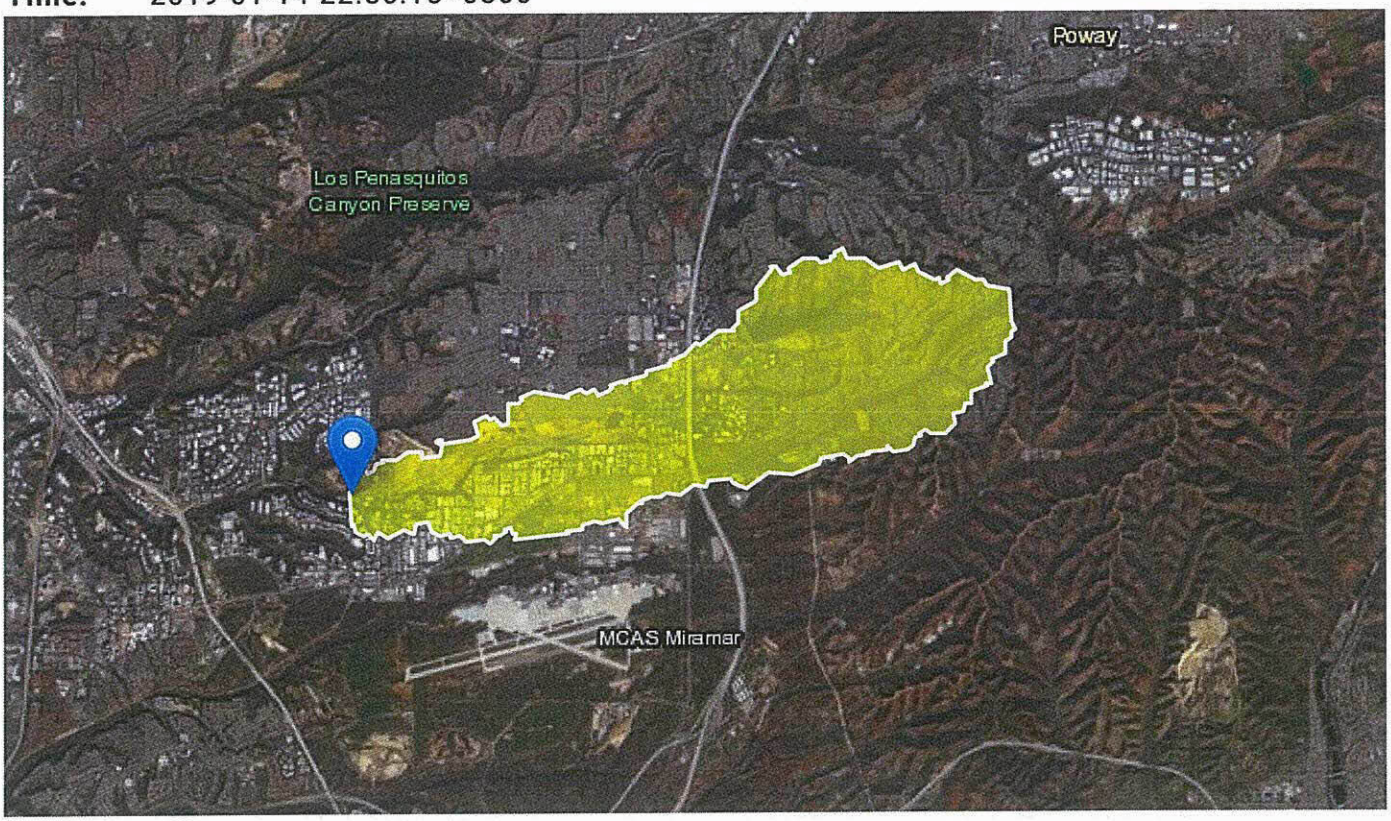
Basin Characteristics

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

Watershed Tributary to Reach 10

StreamStats Report

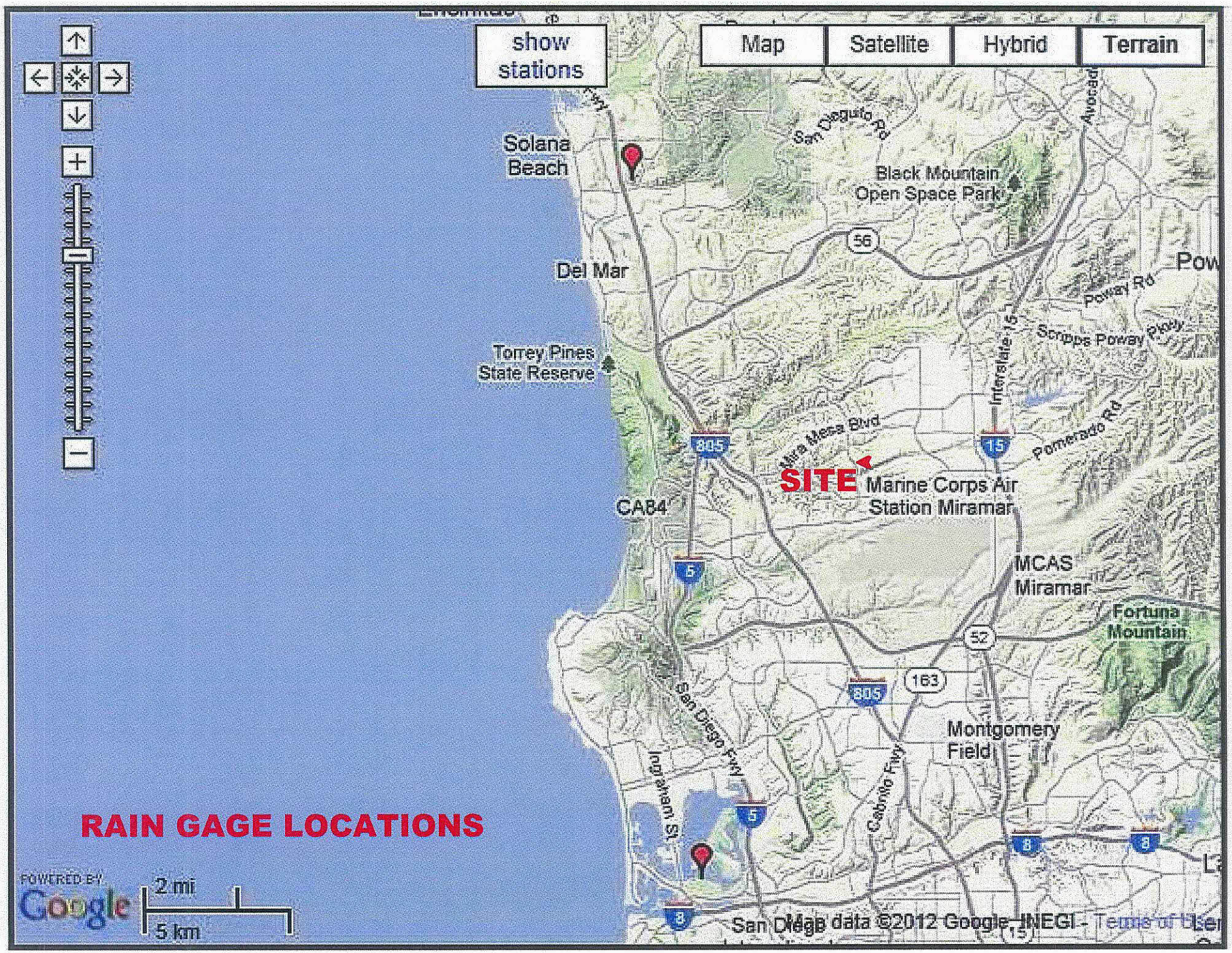
Region ID: CA
Workspace ID: CA20190115065600891000
Clicked Point (Latitude, Longitude): 32.89087, -117.17455
Time: 2019-01-14 22:56:15 -0800



Basin Characteristics

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

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

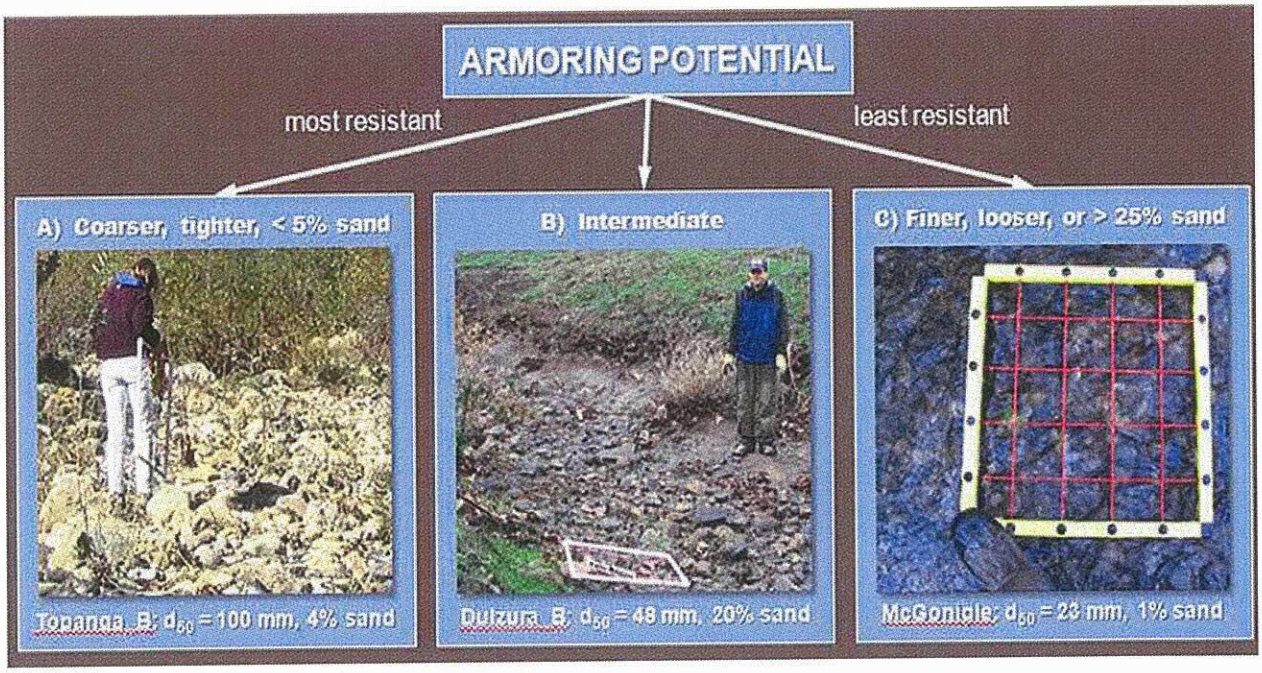
SCCWRP FIELD SCREENING DATA

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

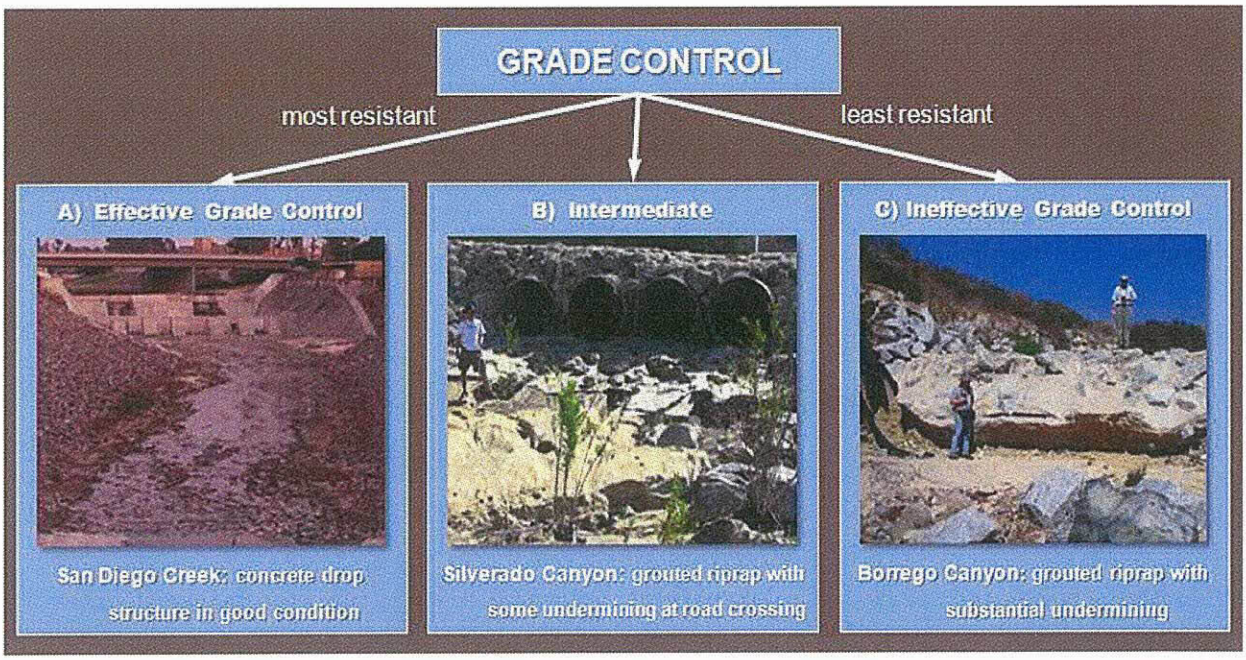
☒	A	A mix of coarse gravels and cobbles that are tightly packed with <5% surface material of diameter <2 mm
☐	B	Intermediate to A and C or hardpan of unknown resistance, spatial extent (longitudinal and depth), or unknown armoring potential due to surface veneer covering gravel or coarser layer encountered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

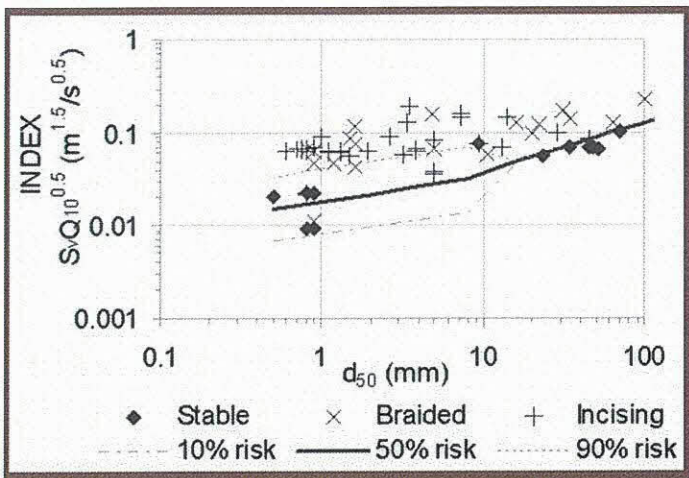
☐	A	Grade control is present with spacing <50 m or $2/S_v$ m • No evidence of failure/ineffectiveness, e.g., no headcutting (>30 cm), no active mass wasting (analyst cannot say grade control sufficient if mass-wasting checklist indicates presence of bank failure), no exposed bridge pilings, no culverts/structures 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

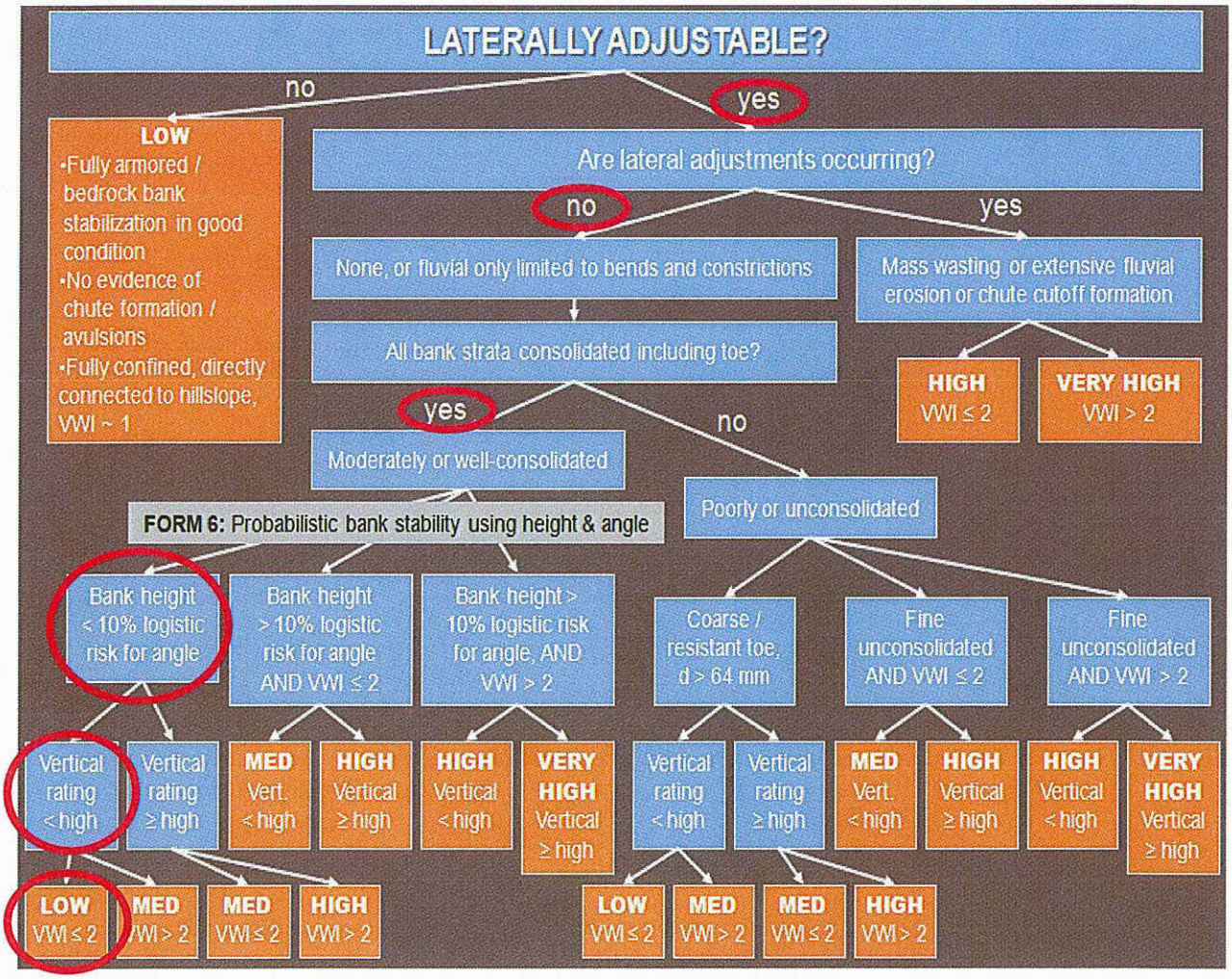
Calculate the overall Vertical Rating for Transitional Bed channels using the formula below. Numeric values for responses to Form 3 Checklists and Table 1 as follows: A = 3, B = 6, C = 9.

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

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.



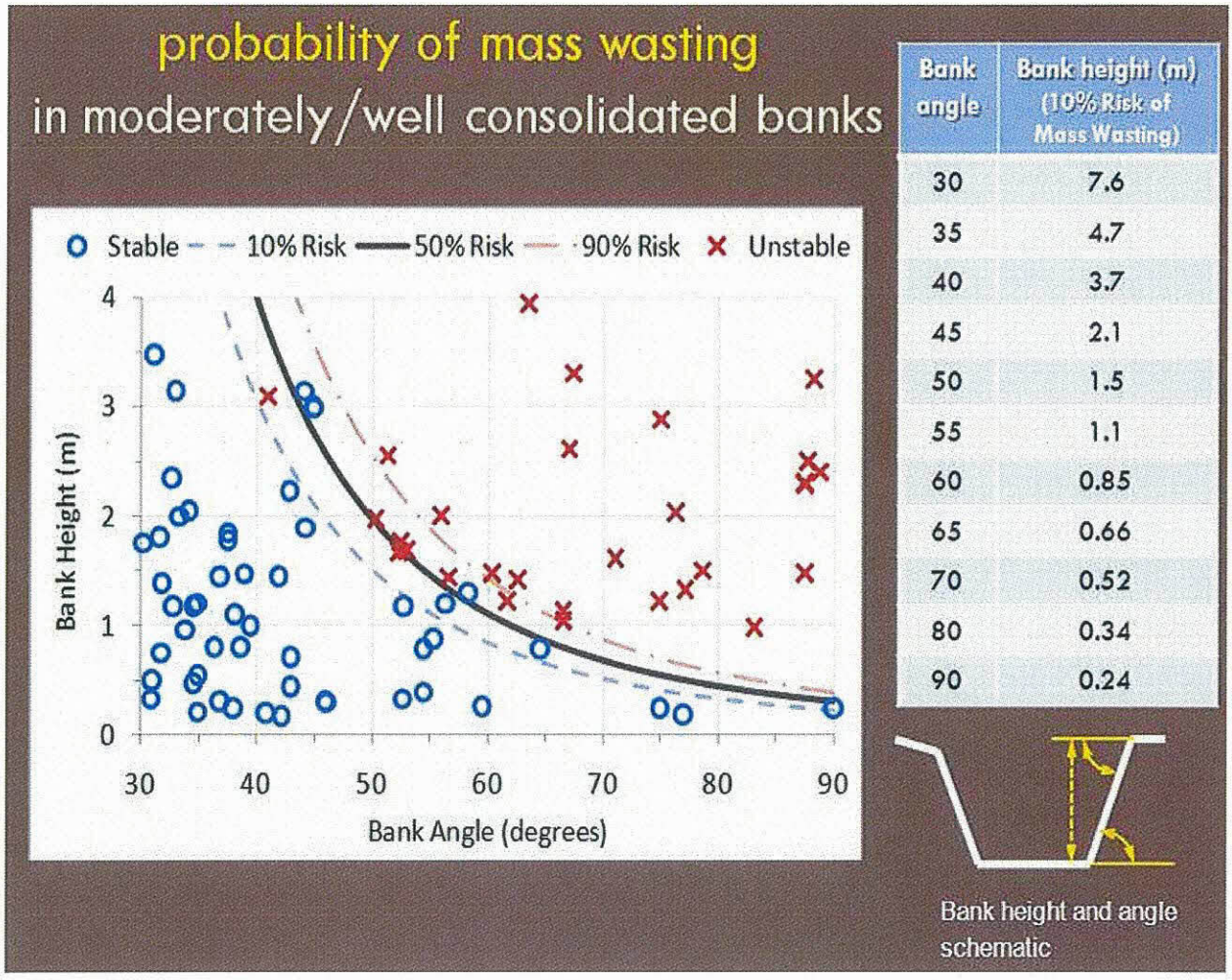
(Sheet 1 of 1)

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.

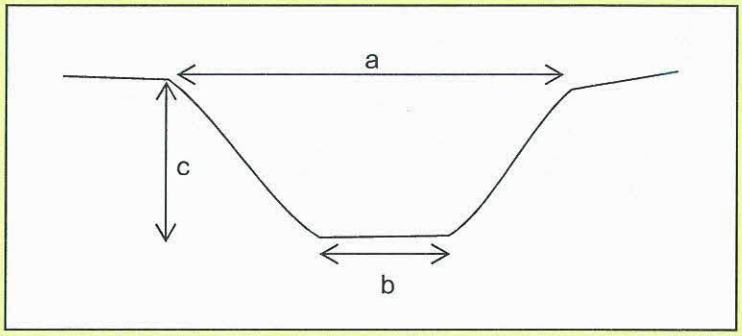
(Sheet 1 of 1)

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

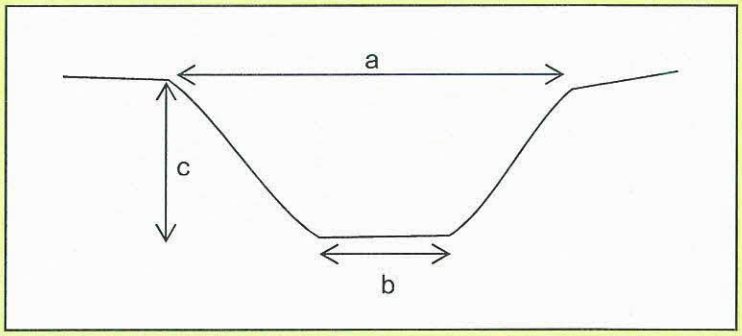
Outputs - Flow control range

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

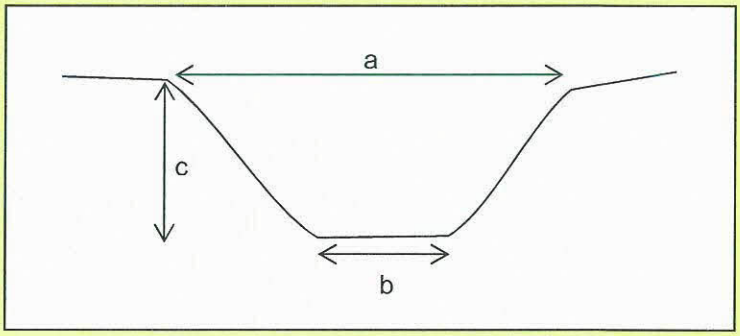
Outputs - Flow control range

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