County of San Diego
PRIORITY DEVELOPMENT PROJECT (PDP) SWQMP

GREEHILLS RANCH – PHASE 2
PDS2016-SPA-16-001

9385 ADLAI ROAD
LAKESIDE, CA 92040

ASSESSOR'S PARCEL NUMBER(S):
395-151-16 & 73: 395-160-15, 398-400-08, 09, 10, 20, 54, 55

ENGINEER OF WORK:

Jonathan Raab Rydeen P.E. C64811, Expires 6/30/2023

PREPARED FOR:

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PDP SWQMP PREPARED BY:

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DATE OF SWQMP:
July 31, 2020
Date Revised:
January 27, 2023

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SWQMP APPROVED BY:

APPROVAL DATE:

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Attachments

Attachment 1: Backup for PDP Pollutant Control BMPs
- Attachment 1a: Storm Water Pollutant Control Worksheet Calculations
- Attachment 1b: DMA Exhibit
- Attachment 1c: Individual Structural BMP DMA Mapbook

Attachment 2: Backup for PDP Hydromodification Control Measures
- Attachment 2a: Flow Control Facility Design
- Attachment 2b: Hydromodification Management Exhibit
- Attachment 2c: Management of Critical Coarse Sediment Yield Areas
- Attachment 2d: Geomorphic Assessment of Receiving Channels (optional)
- Attachment 2e: Vector Control Plan (if applicable)

Attachment 3: Structural BMP Maintenance Plan
- Attachment 3a: Structural BMP Maintenance Thresholds and Actions
- Attachment 3b: Draft Maintenance Agreements / Notifications(when applicable)

Attachment 4: County of San Diego PDP Structural BMP Verification for DPW Permitted Land Development Projects

Attachment 5: Copy of Plan Sheets Showing Permanent Storm Water BMPs

Attachment 6: Copy of Project's Drainage Report

Attachment 7: Copy of Project's Geotechnical and Groundwater Investigation Report

Acronyms

ACP	Alternative Compliance Project
APN	Assessor's Parcel Number
BMP	Best Management Practice
BMP DM	Best Management Practice Design Manual
HMP	Hydromodification Management Plan
HSG	Hydrologic Soil Group
MS4	Municipal Separate Storm Sewer System
N/A	Not Applicable
NRCS	Natural Resources Conservation Service
PDCI	Private Development Construction Inspection Section
PDP	Priority Development Project
PDS	Planning and Development Services
PE	Professional Engineer
RPO	Resource Protection Ordinance
SC	Source Control
SD	Site Design
SDRWQCB	San Diego Regional Water Quality Control Board
SIC	Standard Industrial Classification
SWQMP	Storm Water Quality Management Plan
WMAA	Watershed Management Area Analysis
WPO	Watershed Protection Ordinance
WQIP	Water Quality Improvement Plan

PDP SWQMP Preparer's Certification Page

Project Name: Greenhills Ranch Phase - 2
Permit Application Number: PDS-SPA-16-001

PREPARER'S CERTIFICATION

I hereby declare that I am the Engineer in Responsible Charge of design of storm water best management practices (BMPs) for this project, and that I have exercised responsible charge over the design of the BMPs as defined in Section 6703 of the Business and Professions Code, and that the design is consistent with the PDP requirements of the County of San Diego BMP Design Manual, which is a design manual for compliance with local County of San Diego Watershed Protection Ordinance (Sections 67.801 et seq.) and regional MS4 Permit (California Regional Water Quality Control Board San Diego Region Order No. R9-2013-0001 as amended by R9-2015-0001 and R9-2015-0100) requirements for storm water management.

I have read and understand that the County of San Diego has adopted minimum requirements for managing urban runoff, including storm water, from land development activities, as described in the BMP Design Manual. 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 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 County staff 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.

Engineer of Work's Signature, RCE C64811; Expires 06/30/23

Jonathan Raab Rydeen
Print Name

REC Consultants, Inc.
Company

1/27/23
Date

Engineer's Seal:



Template Date: August 28, 2017
LUEG:SW **PDP SWQMP**

Preparation Date: July 2019]

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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 column 4 summarize the changes that have been made or indicate if response to plancheck comments is included. When applicable, insert response to plancheck comments behind this page.

Preliminary Design / Planning / CEQA

Submittal Number	Date	Summary of Changes
1	02/02/2016	Initial Submittal
2	05/11/2018	Response to Comments. Updates to design.
3	07/19/2019	Response to Comments. Updates to design.
4	07/31/2020	Response to comments dated 5/8/20
5	01/27/2023	Replaced HMP Report

Final Design

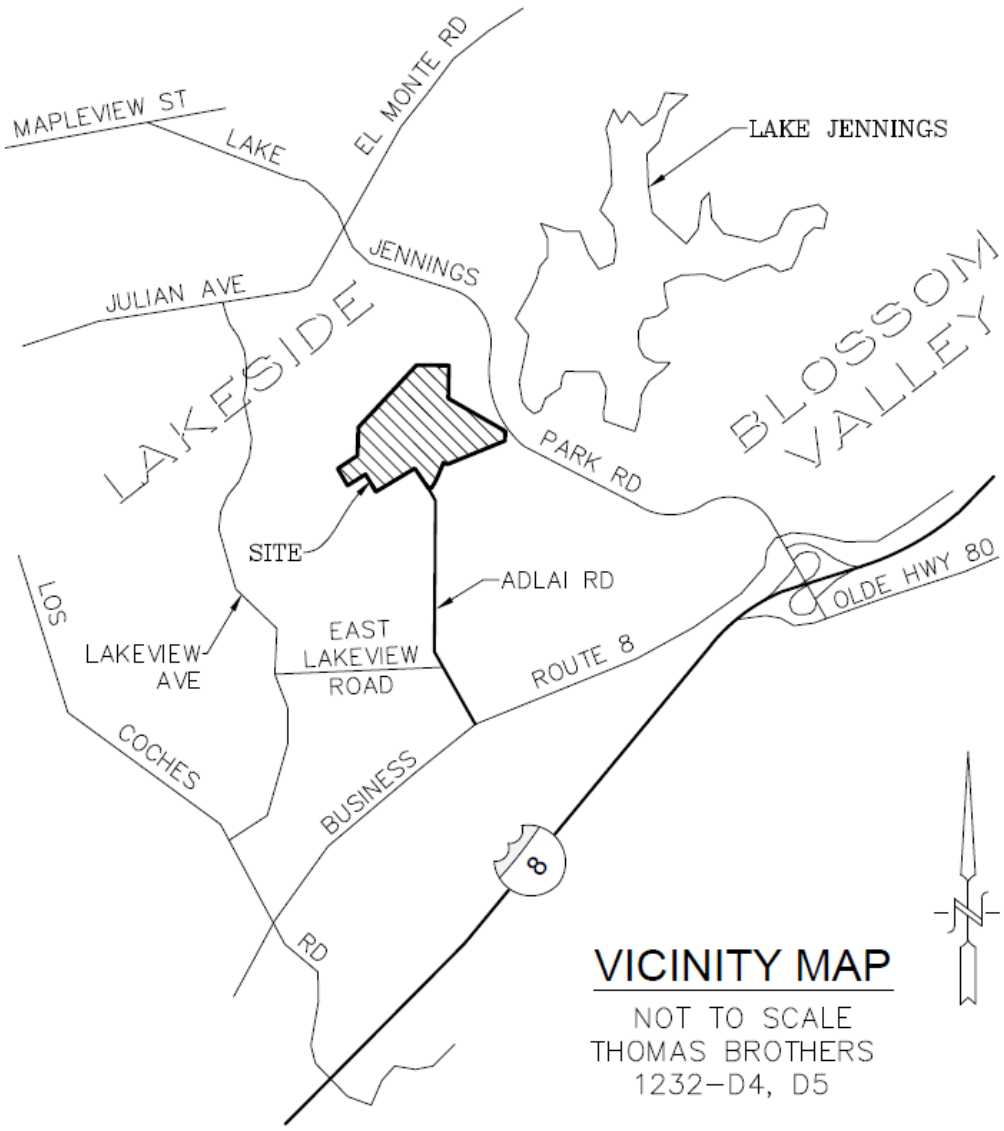
Submittal Number	Date	Summary of Changes
1		Initial Submittal
2		
3		
4		

Plan Changes

Submittal Number	Date	Summary of Changes
1		Initial Submittal
2		
3		
4		

Project Vicinity Map

Project Name: Greenhills Ranch – Phase 2
Record ID: PDS2016-SPA-16-00



Step 1: Project type determination (Standard or Priority Development Project)

Is the project part of another Priority Development Project (PDP)? If so, a PDP SWQMP is required. Go to Step 2.			(☐ Yes ☒ No
The project is (select one): ☐ New Development ☒ Redevelopment[1]			
The total proposed newly created or replaced impervious area is:			250,868 ft^2 + 15944 ft^2 of offsite street
The total existing (pre-project) impervious area is:			11,420 ft^2 + 17871 ft^2 of offsite street
The total area disturbed by the project is:			1552961 ft^2 + 17715 ft^2 of offsite street
If the total area disturbed by the project is 1 acre (43,560 sq. ft.) or more OR the project is part of a larger common plan of development disturbing 1 acre or more, a Waste Discharger Identification (WDID) number must be obtained from the State Water Resources Control Board. WDID: TBD__			
Is the project in any of the following categories, (a) through (f)?[2]			
Yes ☐	No ☒	(a)	New development projects that create 10,000 square feet or more of impervious surfaces [3](collectively over the entire project site). This includes commercial, industrial, residential, mixed-use, and public development projects on public or private land.
Yes ☒	No ☐	(b)	Redevelopment projects that create and/or replace 5,000 square feet or more of impervious surface (collectively over the entire project site 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 ☐	(c)	New and redevelopment projects that create and/or replace 5,000 square feet or more of impervious surface (collectively over the entire project site), and support one or more of the following uses: (i) Restaurants. This category is defined as a facility that sells prepared foods and drinks for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption (Standard Industrial Classification (SIC) code 5812). (ii) Hillside development projects. This category includes development on any natural slope that is twenty-five percent or greater. (iii) Parking lots. This category is defined as a land area or facility for the temporary parking or storage of motor vehicles used personally, for business, or for commerce. (iv) Streets, roads, highways, freeways, and driveways. This category is defined as any paved impervious surface used for the transportation of automobiles, trucks, motorcycles, and other vehicles.

[1] Redevelopment is defined as: The creation and/or replacement of impervious surface on an already developed site. Examples include the expansion of a building footprint, road widening, the addition to or replacement of a structure, and creation or addition of impervious surfaces. Replacement of impervious surfaces includes any activity that is not part of a routine maintenance activity where impervious material(s) are removed, exposing underlying soil during construction. Redevelopment does not include routine maintenance activities, such as trenching and resurfacing associated with utility work; pavement grinding; resurfacing existing roadways; new sidewalks construction; pedestrian ramps; or bike lanes on existing roads; and routine replacement of damaged pavement, such as pothole repair.

[2] Applicants should note that any development project that will create and/or replace 10,000 square feet or more of impervious surface (collectively over the entire project site) is considered a new development.

[3] For solar energy farm projects, the area of the solar panels does not count toward the total impervious area of the site.

Project type determination (continued)

Yes ☐	No ☒	(d)	New or redevelopment projects that create and/or replace 2,500 square feet or more of impervious surface (collectively over the entire project site), and discharging 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). *Note: ESAs are areas that include but are not limited to all Clean Water Act Section 303(d) impaired water bodies; areas designated as Areas of Special Biological Significance by the State Water Board and San Diego Water Board; State Water Quality Protected Areas; water bodies designated with the RARE beneficial use by the State Water Board and San Diego Water Board; and any other equivalent environmentally sensitive areas which have been identified by the Copermittees. See BMP Design Manual Section 1.4.2 for additional guidance.*
Yes ☐	No ☒	(e)	New development projects, or redevelopment projects that create and/or replace 5,000 square feet or more of impervious surface, that support one or more of the following uses: (i) Automotive repair shops. This category is defined as a facility that is categorized in any one of the following SIC codes: 5013, 5014, 5541, 7532-7534, or 7536-7539. (ii) Retail gasoline outlets (RGOs). This category includes RGOs that meet the following criteria: (a) 5,000 square feet or more or (b) a projected Average Daily Traffic (ADT) of 100 or more vehicles per day.
Yes ☒	No ☐	(f)	New or redevelopment projects that result in the disturbance of one or more acres of land and are expected to generate pollutants post construction. *Note: See BMP Design Manual Section 1.4.2 for additional guidance.*

Does the project meet the definition of one or more of the Priority Development Project categories (a) through (f) listed above?

☐ No – the project is not a Priority Development Project (Standard Project).

☒ Yes – the project is a Priority Development Project (PDP).

Further guidance may be found in Chapter 1 and Table 1-2 of the BMP Design Manual.

The following is for **redevelopment PDPs only**:

The area of existing (pre-project) impervious area at the project site is:	11,420	ft^2 (A)
The total proposed newly created or replaced impervious area is :	250,868	ft^2 (B)
Percent impervious surface created or replaced (B/A)*100:	2,217.7	%

The percent impervious surface created or replaced is (select one based on the above calculation):

☐ less than or equal to fifty percent (50%) – **only newly created or replaced impervious areas are considered a PDP and subject to stormwater requirements**

OR

☒ greater than fifty percent (50%) – **the entire project site is considered a PDP and subject to stormwater requirements**

Step 1.1: Storm Water Quality Management Plan requirements

Step	Answer	Progression
Is the project a Standard Project, Priority Development Project (PDP), or exception to PDP definitions? To answer this item, complete Step 1 Project Type Determination Checklist on Pages 1 and 2, and see PDP exemption information below. For further guidance, see Section 1.4 of the BMP Design Manual *in its entirety*.	☐ Standard Project	Standard Project requirements apply, including Standard Project SWQMP. **Complete Standard Project SWQMP.**
	☒ PDP	Standard and PDP requirements apply, including PDP SWQMP. **Complete PDP SWQMP.**
	☐ PDP with ACP	If participating in offsite alternative compliance, **complete Step 6.3 and an ACP SWQMP.**
	☐ PDP Exemption	**Go to Step 1.2 below.**

Step 1.2: Exemption to PDP definitions

Is the project exempt from PDP definitions based on either of the following: ☐ Projects that are only new or retrofit paved sidewalks, bicycle lanes, or trails that meet the following criteria: (i) Designed and constructed to direct storm water runoff to adjacent vegetated areas, or other non-erodible permeable areas; OR (ii) Designed and constructed to be hydraulically disconnected from paved streets or roads [i.e., runoff from the new improvement does not drain directly onto paved streets or roads]; OR (iii) Designed and constructed with permeable pavements or surfaces in accordance with County of San Diego Guidance on Green Infrastructure;	If so: Standard Project requirements apply, AND any additional requirements specific to the type of project. County concurrence with the exemption is required. *Provide discussion and list any additional requirements below in this form.* **Complete Standard Project SWQMP**
☐ Projects that are only retrofitting or redeveloping existing paved alleys, streets or roads that are designed and constructed in accordance with the County of San Diego Guidance on Green Infrastructure.	**Complete Green Streets PDP Exempt SWQMP.**
Discussion / justification, and additional requirements for exceptions to PDP definitions, if applicable:	

Step 2: Construction Storm Water BMP Checklist

Minimum Required Standard Construction Storm Water BMPs		
If you answer "Yes" to any of the questions below, your project is subject to Table 1 on the following page (Minimum Required Standard Construction Stormwater BMPs). As noted in Table 1, please select at least the minimum number of required BMPs, or as many as are feasible for your project. If no BMP is selected, an explanation must be given in the box provided. The following questions are intended to aid in determining construction BMP requirements for your project. **Note: All selected BMPs below must be included on the BMP plan incorporated into the construction plan sets.**		
1. Will there be soil disturbing activities that will result in exposed soil areas? (This includes minor grading and trenching.) **Reference Table 1 Items A, B, D, and E** Note: Soil disturbances NOT considered significant include, but are not limited to, change in use, mechanical/electrical/plumbing activities, signs, temporary trailers, interior remodeling, and minor tenant improvement.	☒ Yes	☐ No
2. Will there be asphalt paving, including patching? **Reference Table 1 Items D and F**	☒ Yes	☐ No
3. Will there be slurries from mortar mixing, coring, or concrete saw cutting? **Reference Table 1 Items D and F**	☒ Yes	☐ No
4. Will there be solid wastes from concrete demolition and removal, wall construction, or form work? **Reference Table 1 Items D and F**	☒ Yes	☐ No
5. Will there be stockpiling (soil, compost, asphalt, concrete, solid waste) for over 24 hours? **Reference Table 1 Items D and F**	☒ Yes	☐ No
6. Will there be dewatering operations? **Reference Table 1 Items C and D**	☒ Yes	☐ No
7. Will there be temporary on-site storage of construction materials, including mortar mix, raw landscaping and soil stabilization materials, treated lumber, rebar, and plated metal fencing materials? **Reference Table 1 Items E and F**	☒ Yes	☐ No
8. Will trash or solid waste product be generated from this project? **Reference Table 1 Item F**	☒ Yes	☐ No
9. Will construction equipment be stored on site (e.g.: fuels, oils, trucks, etc.?) **Reference Table 1 Item F**	☒ Yes	☐ No
10. Will Portable Sanitary Services ("Porta-potty") be used on the site? **Reference Table 1 Item F**	☒ Yes	☐ No

Table 1. Construction Storm Water BMP Checklist

Minimum Required Best Management Practices (BMPs)	CALTRANS SW Handbook[4] Detail or County Std. Detail	✔ BMP Selected	Reference sheet No.'s where each selected BMP is shown on the plans. If no BMP is selected, an explanation must be provided.
A. Select Erosion Control Method for Disturbed Slopes (choose at least one for the appropriate season)			
Vegetation Stabilization Planting[5] (Summer)	SS-2, SS-4	☒	TBD
Hydraulic Stabilization Hydroseeding[2] (Summer)	SS-4	☒	
Bonded Fiber Matrix or Stabilized Fiber Matrix[6] (Winter)	SS-3	☐	
Physical Stabilization Erosion Control Blanket[3] (Winter)	SS-7	☐	
B. Select erosion control method for disturbed flat areas (slope < 5%) (choose at least one)			
County Standard Lot Perimeter Protection Detail	PDS 659[7], SC-2	☐	TBD
Will use erosion control measures from Item A on flat areas also	SS-3, 4, 7	☒	
County Standard Desilting Basin (must treat all site runoff)	PDS 660[8], SC-2	☐	
Mulch, straw, wood chips, soil application	SS-6, SS-8	☒	

4 State of California Department of Transportation (Caltrans). 2003. Storm Water Quality Handbooks, Construction Site Best Management Practices (BMPs) Manual. March. Available online at: http://www.dot.ca.gov/hq/construc/stormwater/manuals.htm.

5 If Vegetation Stabilization (Planting or Hydroseeding) is proposed for erosion control it may be installed between May 1st and August 15th. Slope irrigation is in place and needs to be operable for slopes >3 feet. Vegetation must be watered and established prior to October 1st. The owner must implement a contingency physical BMP by August 15th if vegetation establishment does not occur by that date. If landscaping is proposed, erosion control measures must also be used while landscaping is being established. Established vegetation must have a subsurface mat of intertwined mature roots with a uniform vegetative coverage of 70 percent of the natural vegetative coverage or more on all disturbed areas.

6 All slopes over three feet must have established vegetative cover prior to final permit approval.

7 County of San Diego, Planning & Development Services. 2012. Standard Lot Perimeter Protection Design System. Building Division. PDS 659. Available online at http://www.sandiegocounty.gov/pds/docs/pds659.pdf.

8 County of San Diego, Planning & Development Services. 2012. County Standard Desilting Basin for Disturbed Areas of 1 Acre or Less Building Division. PDS 659. Available online at http://www.sandiegocounty.gov/pds/docs/pds660.pdf.

Table 1. Construction Storm Water BMP Checklist (continued)

Minimum Required Best Management Practices (BMPs)	CALTRANS SW Handbook Detail or County Std. Detail	✔ BMP Selected	Reference sheet No.'s where each selected BMP is shown on the plans. If no BMP is selected, an explanation must be provided.
C. If runoff or dewatering operation is concentrated, velocity must be controlled using an energy dissipater			
Energy Dissipater Outlet Protection[9]	SS-10	☒	TBD
D. Select sediment control method for all disturbed areas (choose at least one)			
Silt Fence	SC-1	☐	TBD
Fiber Rolls (Straw Wattles)	SC-5	☒	
Gravel & Sand Bags	SC-6 & 8	☒	
Dewatering Filtration	NS-2	☐	
Storm Drain Inlet Protection	SC-10	☒	
Engineered Desilting Basin (sized for 10-year flow)	SC-2	☐	
E. Select method for preventing offsite tracking of sediment (choose at least one)			
Stabilized Construction Entrance	TC-1	☒	TBD
Construction Road Stabilization	TC-2	☐	
Entrance/Exit Tire Wash	TC-3	☐	
Entrance/Exit Inspection & Cleaning Facility	TC-1	☐	
Street Sweeping and Vacuuming	SC-7	☒	
F. Select the general site management BMPs			
F.1 Materials Management			
Material Delivery & Storage	WM-1	☒	TBD
Spill Prevention and Control	WM-4	☒	
F.2 Waste Management[10]			
Waste Management Concrete Waste Management	WM-8	☒	TBD
Solid Waste Management	WM-5	☒	
Sanitary Waste Management	WM-9	☒	
Hazardous Waste Management	WM-6	☒	

Note: The Construction General Permit (Order No. 2009-0009-DWQ) also requires all projects not subject to the BMP Design Manual to comply with runoff reduction requirements through the implementation of post-construction BMPs as described in Section XIII of the order.

[9] Regional Standard Drawing D-40 – Rip Rap Energy Dissipater is also acceptable for velocity reduction.

[10] Not all projects will have every waste identified. The applicant is responsible for identifying wastes that will be onsite and applying the appropriate BMP. For example, if concrete will be used, BMP WM-8 must be selected.

Step 3: County of San Diego PDP SWQMP Site Information Checklist

Step 3.1: Description of Existing Site Condition

Project Watershed (Complete Hydrologic Unit, Area, and Subarea Name with Numeric Identifier)	San Diego River Watershed 907 Hydrologic Area: Lower San Diego 907.1 The northwestern section of project site is located in Santee subarea (907.12) The southeastern section of project site is located in Coaches Subarea (907.14

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:
The project site currently contains a single family residence, with undeveloped land surrounding it.

Existing Land Cover Includes (select all that apply and provide each area on site):

- ☒ Vegetative Cover 19.86 Acres (864,948 Square Feet)
- ☐ Non-Vegetated Pervious Areas 0.00 Acres (0.00 Square Feet)
- ☒ Impervious Areas 0.67 Acres (29,291 Square Feet)

Description / Additional Information:
The project site is currently a mostly undeveloped hill with natural vegetative cover and one (1) single family residence with adjacent driveway.

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) (or N/A if no infiltration is used):

- ☐ GW Depth < 5 feet
- ☒ 5 feet < GW Depth < 10 feet
- ☐ 10 feet < GW Depth < 20 feet
- ☐ GW Depth > 20 feet

Existing Natural Hydrologic Features (select all that apply):

- ☐ Watercourses
- ☐ Seeps
- ☐ Springs
- ☐ Wetlands
- ☒ None
- ☐ Other

Description / Additional Information:
The project site is mostly a natural hill; runoff overland flows towards adjacent properties further downhill.

Step 3.2: 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) Is runoff from offsite conveyed through the site? if yes, quantify 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 any existing storm drains, concrete channels, swales, detention facilities, storm water treatment facilities, natural or constructed channels; and
(4) Identify all discharge locations from the existing project site along with a summary of 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.

Describe existing site drainage patterns:

Runoff from the existing site flows to one (1) of four (4) POCs. POC 1 is a catch basin located near the Intersection of Adlai Road and Adlai Terrace. POCs 2 through 4 are low points of natural flow paths. Note that POCs 2 through 4 receive offsite runoff from the hill. The project site ultimately drains to the receiving San Diego River located approximately 2.5 miles west of the project site.

Step 3.3: Description of Proposed Site Development

Project Description / Proposed Land Use and/or Activities:
The Greenhills Ranch – Phase 2 project proposes the construction of 64 single family residences and access roads.

List/describe proposed impervious features of the project (e.g., buildings, roadways, parking lots, courtyards, athletic courts, other impervious features):
Proposed impervious features of the project include buildings, driveways, and walkways.

List/describe proposed pervious features of the project (e.g., landscape areas):
The proposed pervious features of the project include landscaping areas and natural undisturbed areas.

Does the project include grading and changes to site topography?
☒ Yes
☐ No

Description / Additional Information:
The development envelope will be mass graded. All other areas within the project limits will remain undisturbed.

Insert acreage or square feet for the different land cover types in the table below:

Change in Land Cover Type Summary			
Land Cover Type	Existing (acres)	Proposed (acre)	Percent Change
Vegetation	19.86	14.77	-34.46%
Pervious (non-vegetated)	0	0	0%
Impervious	0.67	5.76	+88.37%

Step 3.4: 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 or 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:

Tributary areas draining to POC 1 will be treated by two (2) multiple purpose onsite biofiltration best management practice (BMP) detention facilities. These basins serve to meet water quality, hydromodification and peak flow reduction requirements for the project site. Undeveloped areas that drain to POC 1 will bypass BMP treatment.

Developed site runoff from tributary areas to POC-2 and POC-3 will be intercepted by one (1) multiple purpose onsite BMP detention facility, and will be discharged to both POCs through the use of 2 outlet structures, one per DMA. Undeveloped areas that drain to POC 2 and POC 3 will bypass BMP treatment.

Tributary areas to POC 4 will remain the same as in existing conditions (i.e. undeveloped); therefore runoff will remain the same and will not be treated.

An offsite street to the east of the project site (DMA-Offsite street) will be directed towards 5 proposed tree wells which will serve to meet water quality and hydromodification requirements. All runoff conveyed to the proposed BMPs will be ultimately conveyed towards the proposed discharge locations via a stormdrain network.

The following table shows the peak flows at the Points of Compliance (POCs). Please refer to the project Drainage Study dated 02/2016 and revised 07/2019 for further details.

Discharge Location	Area (ac)			100 Year Peak Flow (cfs)		
	Existing	Developed	Difference	Existing	Developed	Difference
POC-1	11.4	11.4	-	14.9	8.2	-6.7
POC-2	1.0	1.0	-	1.8	1.7	-0.1
POC-3	1.7	1.7	-	2.7	2.4	-0.3
POC-4	7.0	7.0	-	-	-	-
POC-5	1.6	1.6	-	-	-	-
POC-6	2.0	2.0	-	-	-	-
POC-7	1.6	1.6	-	-	-	-
POC-8	2.7	2.7	-	-	-	-
POC-9	1.2	1.2	-	-	-	-
POC-10	1.6	1.6	-	-	-	-
Total	31.8	31.8	0.0	19.4	12.3	-7.1

Step 3.5: Potential Pollutant Source Areas

Identify whether any of the following features, activities, and/or pollutant source areas will be present (select all that apply). Select "Other" if the project is a phased development and provide a description:

☒ 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
☐ Other (provide description)

Description / Additional Information:

<u>On site Storm Drains</u>

Onsite storm drain inlets will be stenciled with prohibitive language in accordance with County Requirements. Inlet markings will be maintained and periodically repainted or replaces when necessary. Storm water pollution prevention information will be provided to new site owners, lessees, or operators. The following will be included in in lease agreements "Tenants shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains."

<u>Interior Parking Garages</u>

Parking garage floor drains must be plumbed to sanitary sewer. Inspect and maintain drains to prevent blockages and overflow.

<u>Need for future indoor and structural pest control</u>

Building design features must discourage entry of pests. Provide Integrated Pest Management Information to owners, lessees, and operators.

Description / Additional Information continuation:

Landscape/Outdoor Pesticide Use

Any pesticides (indoor or outdoor) shall be applied in accordance with the manufacturer instructions and not within 72 hours of an actual or predicted rain event. Landscaping will be maintained using minimum or no pesticides. Provide information to new owners, lessees, and operators.

Miscellaneous Drain or Wash Water

- Boiler drain lines must be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system.
- Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff.

Plazas, sidewalks, and parking lots

Runoff from plazas, sidewalks and parking lots will be collected by the onsite storm drain system and conveyed to the 3 proposed Biofiltration/Bioretention Basins to address water quality and hydromodification prior to offsite discharge. Plazas, sidewalks, and parking lots will be swept regularly to prevent the accumulation of litter and debris.

The following features are not part of the subject development:

Interior floor drains and elevator shaft sump pipes, food service, loading docks, industrial processes and fuel dispensing areas, fire sprinkler test water, pools, spas, ponds, or any other water feature. Additionally the following activities will be discouraged onsite: outdoor material/equipment storage, food service and vehicle/equipment cleaning, repair and/or maintenance.

Step 3.6: Identification and Narrative of Receiving Water and Pollutants of Concern

Describe flow path of storm water from the project site discharge location(s), through urban storm conveyance systems as applicable, to receiving creeks, rivers, and lagoons as applicable, and ultimate discharge to the Pacific Ocean (or bay, lagoon, lake or reservoir, as applicable):
The northwestern section of the project site is conveyed towards the San Diego River (lower), while the southeastern section reaches Los Coches Creek to the south, then onto Forester Creek before flowing onto the lower San Diego River; which ultimately reaches the Pacific Ocean Shoreline at Dog Beach.

List any 303(d) impaired water bodies[11] 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
Los Coches Creek	Selenium	Indicator Bacteria
Forester Creek	Fecal coliform, pH, Selenium, total dissolved solids	
San Diego River, Lower	Enterococcus, fecal coliform, low dissolved oxygen, manganese, nitrogen, phosphorus, total dissolved solids, toxicity	
Pacific Ocean Shoreline, San Diego HU, at the San Diego River outlet, at Dog Beach	Enterococcus, Total Coliform	

Identification of Project Site Pollutants*

*Identification of project site pollutants below 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 expected from the project site based on all proposed use(s) of the site (see BMP Design Manual Appendix B.6):

Pollutant	Not Applicable to the Project Site	Anticipated from the Project Site	Also a Receiving Water Pollutant of Concern
Sediment	☐	☐	☐
Nutrients	☐	☐	☐
Heavy Metals	☐	☐	☐
Organic Compounds	☐	☐	☐
Trash & Debris	☐	☐	☐
Oxygen Demanding Substances	☐	☐	☐

[11] The current list of Section 303(d) impaired water bodies can be found at http://www.waterboards.ca.gov/water_issues/programs/water_quality_assessment/#impaired

Oil & Grease	☐	☐	☐
Bacteria & Viruses	☐	☐	☐
Pesticides	☐	☐	☐

Step 3.7: Hydromodification Management Requirements

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

☒Yes, hydromodification management requirements for flow control and preservation of critical coarse sediment yield areas are applicable.

☐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[12] for the watershed in which the project resides.

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

[12] The Watershed Management Area Analysis (WMAA) is an optional element for inclusion in the Water Quality Improvement Plans (WQIPs) described in the 2013 MS4 Permit [Provision B.3.b.(4)]. It is available online at the Project Clean Water website: http://www.projectcleanwater.org/index.php?option=com_content&view=article&id=248

Step 3.7.1: Critical Coarse Sediment Yield Areas*

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

Projects must satisfy critical coarse sediment yield area (CCSYA) requirements by characterizing the project as one of the scenario-types presented below and satisfying associated criteria. Projects must appropriately satisfy all requirements for identification, avoidance, and bypass, OR may alternatively elect to demonstrate no net impact.

☐ **Scenario 1**: Project is subject to and in compliance with RPO requirements *(without utilization of RPO exemptions 86.604(e)(2)(cc) or 86.604(e)(3) that result in impacts to more than 15% of the project-scale CCSYAs)*.

- ☐ Identify: Project has identified both onsite and upstream CCSYAs as areas that are coarse, ≥25% slope, and ≥50' tall. *(Optional refinement methods may be performed per guidance in Section H.1.2). AND,*
- ☐ Avoid: Project has avoided onsite CCSYAs per existing RPO steep slope encroachment criteria. AND,
- ☐ Bypass: Project has demonstrated that both onsite and upstream CCSYAs are bypassed through or around the project site with a 2 year peak storm velocity of 3 feet per second or greater. OR,
- ☐ No Net Impact: Project does not satisfy all Scenario 1 criteria above and must alternatively demonstrate no net impact to the receiving water.

☒ **Scenario 2**: Project is entirely exempt/not subject to RPO requirements without utilization of RPO exemptions 86.604(e)(2)(cc) or 86.604(e)(3).

- ☒ Identify: Project has identified upstream CCSYAs that are coarse, ≥25% slope, and ≥50' tall. *(Optional refinement methods may be performed per guidance in Section H.1.2). AND,*
- ☒ Avoid: Project is not required to avoid onsite CCSYAs as none were identified in the previous step. AND,
- ☒ Bypass: Project has demonstrated that upstream CCSYAs are bypassed through or around the project site with a 2 year peak storm velocity of 3 feet per second or greater. OR,
- ☐ No Net Impact: Project does not satisfy all Scenario 2 criteria above and must alternatively demonstrate no net impact to the receiving water. *(Skip to next row).*

☐ **Scenario 3**: Project utilizes exemption(s) via RPO Section 86.604(e)(2)(cc) or 86.604(e)(3) and impacts more than 15% of the project-scale CCSYAs.

- ☐ No Net Impact: Project is not eligible for traditional methods of identification, avoidance, and bypass. Project must demonstrate no net impact to the receiving water.

NOTE: CCSYAs have been identified within the project boundary, but are NOT located within the project proposed development area. Thus, these areas will remain undisturbed.

Critical Coarse Sediment Yield Areas Continued

Demonstrate No Net Impact

If the project elects to satisfy CCSYA criteria through demonstration of no net impact to the receiving water. Applicants must identify the methods utilized from the list below and provide supporting documentation in Attachment 2c of the SWQMP. Check all that are applicable.

☒ N/A, the project appropriately identifies, avoids, and bypasses CCSYAs.

☐ Project has performed additional analysis to demonstrate that impacts to CCSYAs satisfy the no net impact standard of Ep/Sp≤1.1.

☐ Project has provided alternate mapping of CCSYAs.

☐ Project has implemented additional onsite hydromodification flow control measures.

☐ Project has implemented an offsite stream rehabilitation project to offset impacts.

☐ Project has implemented other applicant-proposed mitigation measures.

Step 3.7.2: 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.

Runoff from the developed project site is drained to three (3) onsite receiving biofiltration LID BMPs. In regards to the discharge of the BMPs into the POCs, the path is not straightforward, and is as follows:

- BMP-1 and BMP-3 drain to POC-1
- BMP-2 has two (2) outlet structures. There is a French drain system with 2 identical LID orifices (same diameter and same elevation), one located in outlet structure 2-2 and another located in outlet structure 2-3. Outlet structure 2-2 drains to POC-2, while outlet structure 2-3 drains to POC-3. In other words, one BMP drains to 2 POCs.

The reason to distribute the flows of BMP-2 into POC-2 and POC-3 is tied to the nature of the project and the small area associated with those POCs: there is only one possible location for a BMP, adjacent to the NW grading slope of the project, and there is only one pipe system conveying the flow towards BMP-2. The contributing area of BMP-2 is similar to the contributing area of pre-development POC-2 and POC-3 combined. Therefore, the simplest solution was to design two outlet structures in BMP-2.

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:

Discussion / Additional Information: (optional)

Step 3.8: 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.

Step 4: Source Control BMP Checklist

Source Control BMPs

All development projects must implement source control BMPs 4.2.1 through 4.2.6 where applicable and feasible. See Chapter 4.2 and Appendix E of the County 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 4.2 and/or Appendix E of the County 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 must be provided.

Source Control Requirement	Applied?		
4.2.1 Prevention of Illicit Discharges into the MS4	☒Yes	☐No	☐N/A
Discussion / justification if 4.2.1 not implemented:			
4.2.2 Storm Drain Stenciling or Signage	☒Yes	☐No	☐N/A
Discussion / justification if 4.2.2 not implemented:			
4.2.3 Protect Outdoor Materials Storage Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	☐Yes	☐No	☒N/A
Discussion / justification if 4.2.3 not implemented: No outdoor materials storage areas proposed.			
4.2.4 Protect Materials Stored in Outdoor Work Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	☐Yes	☐No	☒N/A
Discussion / justification if 4.2.4 not implemented: No outdoor work areas proposed.			

Source Control Requirement	Applied?		
4.2.5 Protect Trash Storage Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	☒Yes	☐No	☐N/A
Discussion / justification if 4.2.5 not implemented:			
4.2.6 Additional BMPs Based on Potential Sources of Runoff Pollutants (must answer for each source listed below):			
☒ A. On-site storm drain inlets	☒Yes	☐No	☐N/A
☐ B. Interior floor drains and elevator shaft sump pumps	☐Yes	☐No	☒N/A
☒ C. Interior parking garages	☒Yes	☐No	☐N/A
☒ D. Need for future indoor & structural pest control	☒Yes	☐No	☐N/A
☒ E. Landscape/outdoor pesticide use	☒Yes	☐No	☐N/A
☐ F. Pools, spas, ponds, fountains, and other water features	☐Yes	☐No	☒N/A
☐ G. Food service	☐Yes	☐No	☒N/A
☐ H. Refuse areas	☐Yes	☐No	☒N/A
☐ I. Industrial processes	☐Yes	☐No	☒N/A
☐ J. Outdoor storage of equipment or materials	☐Yes	☐No	☒N/A
☐ K. Vehicle and equipment cleaning	☐Yes	☐No	☒N/A
☐ L. Vehicle/equipment repair and maintenance	☐Yes	☐No	☒N/A
☐ M. Fuel dispensing areas	☐Yes	☐No	☒N/A
☐ N. Loading docks	☐Yes	☐No	☒N/A
☐ O. Fire sprinkler test water	☐Yes	☐No	☒N/A
☒ P. Miscellaneous drain or wash water	☒Yes	☐No	☐N/A
☒ Q. Plazas, sidewalks, and parking lots	☒Yes	☐No	☐N/A
Discussion / justification if 4.2.6 not implemented. Clearly identify which sources of runoff pollutants are discussed. Justification must be provided for <u>all</u> "No" answers shown above.			

Note: Show all source control measures described above that are included in design capture volume calculations in the plan sheets of Attachment 5.

Step 5: Site Design BMP Checklist

Site Design BMPs
All development projects must implement site design BMPs SD-A through SD-H where applicable and feasible. See Chapter 4.3 and Appendix E of the County BMP Design Manual 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 4.3 and/or Appendix E of the County 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 must be provided.

Site Design Requirement	Applied?		
4.3.1 Maintain Natural Drainage Pathways and Hydrologic Features	☒Yes	☐No	☐N/A
Discussion / justification if 4.3.1 not implemented: Natural drainage pathways will be maintained in areas of project site that will not be developed.			
4.3.2 Conserve Natural Areas, Soils, and Vegetation	☒Yes	☐No	☐N/A
Discussion / justification if 4.3.2 not implemented: Natural areas, soils, and vegetation will be conserved in areas of project site that will not undergo development.			
4.3.3 Minimize Impervious Area	☒Yes	☐No	☐N/A
Discussion / justification if 4.3.3 not implemented: Impervious areas will be kept to the minimum required to meet project needs.			
4.3.4 Minimize Soil Compaction	☒Yes	☐No	☐N/A
Discussion / justification if 4.3.4 not implemented: Compaction will be limited to areas that will be developed, and to the minimum necessary to meet project needs.			
4.3.5 Impervious Area Dispersion	☒Yes	☐No	☐N/A
Discussion / justification if 4.3.5 not implemented: Impervious areas will be dispersed as much as allowed by project design and needs.			

Site Design Requirement	Applied?		
4.3.6 Runoff Collection	☐Yes	☐No	☒N/A
Discussion / justification if 4.3.6 not implemented: All runoff from proposed development areas will be directed towards proposed biofiltration basins.			
4.3.7 Landscaping with Native or Drought Tolerant Species	☒Yes	☐No	☐N/A
Discussion / justification if 4.3.7 not implemented: Proposed landscaping plants will be kept to natural or drought tolerant species as much as possible.			
4.3.8 Harvesting and Using Precipitation	☐Yes	☐No	☒N/A
Discussion / justification if 4.3.8 not implemented: Per Form I-7 “Harvest and Use Feasibility Checklist”, harvest and reusing precipitation is not feasible.			

Note: Show all site design measures described above that are included in design capture volume calculations in the plan sheets of Attachment 5.

Step 6: PDP Structural BMPs

All PDPs must implement structural BMPs for storm water pollutant control (see Chapter 5 of the BMP Design Manual). 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 County at the completion of construction. This may include requiring the project owner or project owner's representative and engineer of record to certify construction of the structural BMPs (see Section 1.12 of the BMP Design Manual). PDP structural BMPs must be maintained into perpetuity, and the County must confirm the maintenance (see Section 7 of the BMP Design Manual).

Use this section 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 (Step 6.2) for each structural BMP within the project (copy the BMP summary information sheet [Step 6.2] as many times as needed to provide summary information for each individual structural BMP).

Step 6.1: Description of structural BMP strategy

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. At the end of this discussion provide a summary of all the structural BMPs within the project including the type and number.

Per section 5.1 of the BMP manual, and Form I-7 (Harvest and Use Feasibility and Harvest Checklist) it was determined that harvest/reuse is not feasible.

Hydromodification is required for this project; additionally, even though there are Critical Coarse Sediment Yield areas within the property boundary; non lie within the development envelope.

Per percolation tests performed by Geocon Incorporated Geotechnical Engineers, the infiltration rate for the site ranges between 0.01 and 0.03 inches per hour (with an applied safety factor of 2), therefore, full infiltration is not feasible. Per Worksheet B.3-1 found in Attachment 1, neither full nor partial retention is feasible for this project. Additionally, per geotechnical engineer recommendations, no amount of infiltration is recommended as it may pose geotechnical hazards, due to the location of proposed basins. Please refer to Infiltration Feasibility I-8 Form, and to Geotechnical report. Thus, basins have been designed as Category 2 – Biofiltration Basins.

Three biofiltration basins have been proposed to meet water quality, Q100 and hydromodification requirements for DMAs 1 through 3. In developed conditions, the basins will have a surface depth and a riser spillway structure. Flows will then discharge from the basins via the outlet structure to the receiving amended soil and low flow orifice. The riser structure will act as a spillway such that peak flows can be safely discharged to the receiving storm drain system.

Beneath the basins' invert lies the proposed LID biofiltration portion of the drainage facility. This portion of the basin is comprised of a 3-inch layer of mulch, a layer of amended soil (a highly sandy, organic rich composite with an infiltration capacity of at least 5 inches/hr), a layer of gravel and an impermeable liner. All basins will be designed per BMP Design Manual Specifications in Chapter 5.

Runoff from the offsite street to the east and south of the project site will be directed towards five and one proposed tree well(s), respectively. These tree wells will serve to meet hydromodification and water quality purposes. Per County of San Diego Design Standards, a hydromodification multiplier has been applied to the design capture volume in order for these tree wells to meet HMP requirements.

(Continue on following page as necessary.)

Description of structural BMP strategy continued
(Page reserved for continuation of description of general strategy for structural BMP implementation at the site)

(Continued from previous page)

Step 6.2: Structural BMP Checklist

(Copy this page as needed to provide information for each individual proposed structural BMP)	
Structural BMP ID No. BMP-1 (BF-2)	
Construction Plan Sheet No.	
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) ☒ Biofiltration with Nutrient Sensitive Media Design (BF-2) ☐ 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 (See Section 1.12 of the BMP Design Manual)	Rec Consultants, Inc. 2442 Second Avenue San Diego, California 92101
Who will be the final owner of this BMP?	☒ HOA ☐ Property Owner ☐ County ☐ Other (describe)
Who will maintain this BMP into perpetuity?	☒ HOA ☐ Property Owner ☐ County ☐ Other (describe)
What Category (1-4) is the Structural BMP? Refer to the Category definitions in Section 7.3 of the BMP DM. Attach the appropriate maintenance agreement in Attachment 3.	Category 2
Discussion (as needed): *(Continue on subsequent pages as necessary)*	

(Copy this page as needed to provide information for each individual proposed structural BMP)	
Structural BMP ID No. BMP-2 (BF-2)	
Construction Plan Sheet No.	
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) ☒ Biofiltration with Nutrient Sensitive Media Design (BF-2) ☐ 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 (See Section 1.12 of the BMP Design Manual)	Rec Consultants, Inc. 2442 Second Avenue San Diego, California 92101
Who will be the final owner of this BMP?	☒ HOA ☐ Property Owner ☐ County ☐ Other (describe)
Who will maintain this BMP into perpetuity?	☒ HOA ☐ Property Owner ☐ County ☐ Other (describe)
What Category (1-4) is the Structural BMP? Refer to the Category definitions in Section 7.3 of the BMP DM. Attach the appropriate maintenance agreement in Attachment 3.	Category 2
Discussion (as needed): *(Continue on subsequent pages as necessary)*	

(Copy this page as needed to provide information for each individual proposed structural BMP)	
Structural BMP ID No. BMP-3 (BF-2)	
Construction Plan Sheet No.	
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) ☒ Biofiltration with Nutrient Sensitive Media Design (BF-2) ☐ 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 (See Section 1.12 of the BMP Design Manual)	Rec Consultants, Inc. 2442 Second Avenue San Diego, California 92101
Who will be the final owner of this BMP?	☒ HOA ☐ Property Owner ☐ County ☐ Other (describe)
Who will maintain this BMP into perpetuity?	☒ HOA ☐ Property Owner ☐ County ☐ Other (describe)
What Category (1-4) is the Structural BMP? Refer to the Category definitions in Section 7.3 of the BMP DM. Attach the appropriate maintenance agreement in Attachment 3.	Category 2
Discussion (as needed): *(Continue on subsequent pages as necessary)*	

Step 6.3: Offsite Alternative Compliance Participation Form

PDP INFORMATION	
Record ID:	
Assessor's Parcel Number(s) [APN(s)]	
What are your PDP Pollutant Control Debits? *See Attachment 1 of the PDP SWQMP	
What are your PDP HMP Debits? (if applicable) *See Attachment 2 of the PDP SWQMP	
ACP Information	
Record ID:	
Assessor's Parcel Number(s) [APN(s)]	
Project Owner/Address	
What are your ACP Pollutant Control Credits? *See Attachment 1 of the ACP SWQMP	
What are your ACP HMP Debits? (if applicable) *See Attachment 2 of the ACP SWQMP	
Is your ACP in the same watershed as your PDP? ☐ Yes ☐ No	Will your ACP project be completed prior to the completion of the PDP? ☐ Yes ☐ No
Does your ACP account for all Deficits generated by the PDP? ☐ Yes ☐ No (PDP and/or ACP must be redesigned to account for all deficits generated by the PDP.	What is the difference between your PDP debits and ACP Credits? *(ACP Credits -Total PDP Debits = Total Earned Credits)

ATTACHMENT 1

BACKUP FOR PDP POLLUTANT CONTROL BMPS

This is the cover sheet for Attachment 1.

Indicate which Items are Included behind this cover sheet:

Attachment Sequence	Contents	Checklist
Attachment 1a	Storm Water Pollutant Control Worksheet Calculations -Worksheet B.3-1 (Required) -Worksheet B.1-1 (Required) -Worksheet B.4-1 (if applicable) -Worksheet B.4-2 (if applicable) -Worksheet B.5-1 (if applicable) -Worksheet B.5-2 (if applicable) -Worksheet B.5-3 (if applicable) -Worksheet B.6-1 (if applicable) -Summary Worksheet (optional)	☒ Included
Attachment 1b	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 1c	DMA Exhibit (Required) See DMA Exhibit Checklist on the back of this Attachment cover sheet.	☒ Included
Attachment 1d	Individual Structural BMP DMA Mapbook (Required) -Place each map on 8.5”x11” paper. -Show at a minimum the DMA, Structural BMP, and any existing hydrologic features within the DMA.	☒ Included

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 Step 3.5)
☒ Structural BMPs (identify location, structural BMP ID#, type of BMP, and size/detail)

Automated Worksheet B.3-1: Project-Scale BMP Feasibility Analysis (V1.3)

Category	#	Description	Value	Units
Capture & Use Inputs	0	Design Capture Volume for Entire Project Site	12,603	cubic-feet
	1	Proposed Development Type	Residential	unitless
	2	Number of Residents or Employees at Proposed Development	160	#
	3	Total Planted Area within Development	216,615	sq-ft
	4	Water Use Category for Proposed Planted Areas	Low	unitless
Infiltration Inputs	5	Is Average Site Design Infiltration Rate ≤0.500 Inches per Hour?	No	yes/no
	6	Is Average Site Design Infiltration Rate ≤0.010 Inches per Hour?	No	yes/no
	7	Is Infiltration of the Full DCV Anticipated to Produce Negative Impacts?	Yes	yes/no
	8	Is Infiltration of Any Volume Anticipated to Produce Negative Impacts?	Yes	yes/no
Calculations	9	36-Hour Toilet Use Per Resident or Employee	1.86	cubic-feet
	10	Subtotal: Anticipated 36 Hour Toilet Use	298	cubic-feet
	11	Anticipated 1 Acre Landscape Use Over 36 Hours	52.14	cubic-feet
	12	Subtotal: Anticipated Landscape Use Over 36 Hours	259	cubic-feet
	13	Total Anticipated Use Over 36 Hours	558	cubic-feet
	14	Total Anticipated Use / Design Capture Volume	0.04	cubic-feet
	15	Are Full Capture and Use Techniques Feasible for this Project?	No	unitless
	16	Is Full Retention Feasible for this Project?	No	yes/no
	17	Is Partial Retention Feasible for this Project?	No	yes/no
Result	18	Feasibility Category	5	1, 2, 3, 4, 5

Worksheet B.3-1 General Notes:

A. Applicants may use this worksheet to determine the types of structural BMPs that are acceptable for implementation at their project site (as required in Section 5 of the BMPDM). User input should be provided for yellow shaded cells, values for all other cells will be automatically generated. Projects demonstrating feasibility or potential feasibility via this worksheet are encouraged to incorporate capture and use features in their project.

B. Negative impacts associated with retention may include geotechnical, groundwater, water balance, or other issues identified by a geotechnical engineer and substantiated through completion of Form I-8.

C. Feasibility Category 1: Applicant must implement capture & use, retention, and/or infiltration elements for the entire DCV.

D. Feasibility Category 2: Applicant must implement capture & use elements for the entire DCV.

E. Feasibility Category 3: Applicant must implement retention and/or infiltration elements for all DMAs with Design Infiltration Rates greater than 0.50 in/hr.

F. Feasibility Category 4: Applicant must implement standard unlined biofiltration BMPs sized at ≥3% of the effective impervious tributary area for all DMAs with Design Infiltration Rates of 0.011 to 0.50 in/hr. Applicants may be permitted to implement lined BMPs, reduced size BMPs, and/or specialized biofiltration BMPs provided additional criteria identified in "Supplemental Retention Criteria for Non-Standard Biofiltration BMPs" are satisfied.

G. Feasibility Category 5: Applicant must implement standard lined biofiltration BMPs sized at ≥3% of the effective impervious tributary area for all DMAs with Design Infiltration Rates of 0.010 in/hr or less. Applicants may also be permitted to implement reduced size and/or specialized biofiltration BMPs provided additional criteria identified in "Supplemental Retention Criteria for Non-Standard Biofiltration BMPs" are satisfied.

H. PDPs participating in an offsite alternative compliance program are not held to the feasibility categories presented herein.

Automated Worksheet B.1-1: Calculation of Design Capture Volume (V1.3)

Category	#	Description	*i*	*ii*	*iii*	*iv*	*v*	*vi*	*vii*	*viii*	*ix*	Units
Standard Drainage Basin Inputs	0	Drainage Basin ID or Name	DMA-1	DMA-2	DMA-3	DMA-OFFSITE STREET	DMA-4-BYPASS					unitless
	1	Basin Drains to the Following BMP Type	Biofiltration	Biofiltration	Biofiltration	n/a	n/a					unitless
	2	85th Percentile 24-hr Storm Depth	0.48	0.48	0.48	0.48	0.48					inches
	3	Design Infiltration Rate Recommended by Geotechnical Engineer	0.000	0.000	0.000	0.000	0.000					in/hr
	4	Impervious Surfaces Not Directed to Dispersion Area (C=0.90)	193,188	48,192	9,488	15,944	3,141					sq-ft
	5	Semi-Pervious Surfaces Not Serving as Dispersion Area (C=0.30)										sq-ft
	6	Engineered Pervious Surfaces Not Serving as Dispersion Area (C=0.10)										sq-ft
	7	Natural Type A Soil Not Serving as Dispersion Area (C=0.10)										sq-ft
	8	Natural Type B Soil Not Serving as Dispersion Area (C=0.14)										sq-ft
	9	Natural Type C Soil Not Serving as Dispersion Area (C=0.23)	292,461	68,173	12,545	1,772						sq-ft
	10	Natural Type D Soil Not Serving as Dispersion Area (C=0.30)	2,576	301								sq-ft
Dispersion Area, Tree Well & Rain Barrel Inputs (Optional)	11	Does Tributary Incorporate Dispersion, Tree Wells, and/or Rain Barrels?	No	No	No	Yes	Yes	No	No	No	No	yes/no
	12	Impervious Surfaces **Directed to Dispersion Area** per SD-B (Ci=0.90)										sq-ft
	13	Semi-Pervious Surfaces **Serving as Dispersion Area** per SD-B (Ci=0.30)										sq-ft
	14	Engineered Pervious Surfaces **Serving as Dispersion Area** per SD-B (Ci=0.10)										sq-ft
	15	Natural Type A Soil **Serving as Dispersion Area** per SD-B (Ci=0.10)										sq-ft
	16	Natural Type B Soil **Serving as Dispersion Area** per SD-B (Ci=0.14)										sq-ft
	17	Natural Type C Soil **Serving as Dispersion Area** per SD-B (Ci=0.23)										sq-ft
	18	Natural Type D Soil **Serving as Dispersion Area** per SD-B (Ci=0.30)										sq-ft
	19	Number of Tree Wells Proposed per SD-A				5	1					#
	20	Average Mature Tree Canopy Diameter				30	25					ft
	21	Number of Rain Barrels Proposed per SD-E										#
	22	Average Rain Barrel Size										gal
Treatment Train Inputs & Calculations	23	Does BMP Overflow to Stormwater Features in Downstream Drainage?	No	No	No	No	No	No	No	No	No	unitless
	24	Identify Downstream Drainage Basin Providing Treatment in Series										unitless
	25	Percent of Upstream Flows Directed to Downstream Dispersion Areas										percent
	26	Upstream Impervious Surfaces Directed to Dispersion Area (Ci=0.90)	0	0	0	0	0	0	0	0	0	cubic-feet
	27	Upstream Impervious Surfaces Not Directed to Dispersion Area (C=0.90)	0	0	0	0	0	0	0	0	0	cubic-feet
Initial Runoff Factor Calculation	28	Total Tributary Area	488,225	116,666	22,033	17,716	3,141	0	0	0	0	sq-ft
	29	Initial Runoff Factor for Standard Drainage Areas	0.50	0.51	0.52	0.83	0.90	0.00	0.00	0.00	0.00	unitless
	30	Initial Runoff Factor for Dispersed & Dispersion Areas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	unitless
	31	Initial Weighted Runoff Factor	0.50	0.51	0.52	0.83	0.90	0.00	0.00	0.00	0.00	unitless
	32	Initial Design Capture Volume	9,765	2,380	458	588	113	0	0	0	0	cubic-feet
Dispersion Area Adjustments	33	Total Impervious Area Dispersed to Pervious Surface	0	0	0	0	0	0	0	0	0	sq-ft
	34	Total Pervious Dispersion Area	0	0	0	0	0	0	0	0	0	sq-ft
	35	Ratio of Dispersed Impervious Area to Pervious Dispersion Area	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	ratio
	36	Adjustment Factor for Dispersed & Dispersion Areas	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	ratio
	37	Runoff Factor After Dispersion Techniques	0.50	0.51	0.52	0.83	0.90	n/a	n/a	n/a	n/a	unitless
	38	Design Capture Volume After Dispersion Techniques	9,765	2,380	458	588	113	0	0	0	0	cubic-feet
Tree & Barrel Adjustments	39	Total Tree Well Volume Reduction	0	0	0	2,100	290	0	0	0	0	cubic-feet
	40	Total Rain Barrel Volume Reduction	0	0	0	0	0	0	0	0	0	cubic-feet
Results	41	Final Adjusted Runoff Factor	0.50	0.51	0.52	0.00	0.00	0.00	0.00	0.00	0.00	unitless
	42	Final Effective Tributary Area	244,113	59,500	11,457	0	0	0	0	0	0	sq-ft
	43	Initial Design Capture Volume Retained by Site Design Elements	0	0	0	2,100	290	0	0	0	0	cubic-feet
	44	Final Design Capture Volume Tributary to BMP	9,765	2,380	458	0	0	0	0	0	0	cubic-feet

Worksheet B.1-1 General Notes:

A. Applicants may use this worksheet to calculate design capture volumes for up to 10 drainage areas User input must be provided for yellow shaded cells, values for all other cells will be automatically generated, errors/notifications will be highlighted in red and summarized below. Upon completion of this worksheet, proceed to the appropriate BMP Sizing worksheet(s).

Automated Worksheet B.5-1: Sizing Lined or Unlined Biofiltration BMPs (V1.3)

Category	#	Description	*i*	*ii*	*iii*	*iv*	*v*	*vi*	*vii*	*viii*	*ix*	*x*	Units
BMP Inputs	0	Drainage Basin ID or Name	DMA-1	DMA-2	DMA-3	-	-	-	-	-	-	-	sq-ft
	1	Design Infiltration Rate Recommended by Geotechnical Engineer	0.000	0.000	0.000	-	-	-	-	-	-	-	in/hr
	2	Effective Tributary Area	244,113	59,500	11,457	-	-	-	-	-	-	-	sq-ft
	3	Minimum Biofiltration Footprint Sizing Factor	0.030	0.030	0.030	-	-	-	-	-	-	-	ratio
	4	Design Capture Volume Tributary to BMP	9,765	2,380	458	-	-	-	-	-	-	-	cubic-feet
	5	Is Biofiltration Basin Impermeably Lined or Unlined?	Lined	Lined	Lined								unitless
	6	Provided Biofiltration BMP Surface Area	11,887	4,121	459								sq-ft
	7	Provided Surface Ponding Depth	11.48	8.88	8.39								inches
	8	Provided Soil Media Thickness	21	21	21								inches
	9	Provided Depth of Gravel Above Underdrain Invert	15	15	15								inches
	10	Diameter of Underdrain or Hydromod Orifice (Select Smallest)	2.25	1.25	0.50								inches
	11	Provided Depth of Gravel Below the Underdrain	3	3	3								inches
Retention Calculations	12	Volume Infiltrated Over 6 Hour Storm	0	0	0	0	0	0	0	0	0	0	cubic-feet
	13	Soil Media Pore Space Available for Retention	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	unitless
	14	Gravel Pore Space Available for Retention	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	unitless
	15	Effective Retention Depth	1.05	1.05	1.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	inches
	16	Calculated Retention Storage Drawdown (Including 6 Hr Storm)	120	120	120	0	0	0	0	0	0	0	hours
	17	Volume Retained by BMP	1,040	361	40	0	0	0	0	0	0	0	cubic-feet
	18	Fraction of DCV Retained	0.11	0.15	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	ratio
	19	Portion of Retention Performance Standard Satisfied	0.13	0.17	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	ratio
	20	Fraction of DCV Retained (normalized to 36-hr drawdown)	0.06	0.08	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	ratio
	21	Design Capture Volume Remaining for Biofiltration	9,179	2,190	435	0	0	0	0	0	0	0	cubic-feet
Biofiltration Calculations	22	Max Hydromod Flow Rate through Underdrain	0.2613	0.0788	0.0126	n/a	n/a	n/a	n/a	n/a	n/a	n/a	CFS
	23	Max Soil Filtration Rate Allowed by Underdrain Orifice	0.95	0.83	1.19	n/a	n/a	n/a	n/a	n/a	n/a	n/a	in/hr
	24	Soil Media Filtration Rate per Specifications	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	in/hr
	25	Soil Media Filtration Rate to be used for Sizing	0.95	0.83	1.19	5.00	5.00	5.00	5.00	5.00	5.00	5.00	in/hr
	26	Depth Biofiltered Over 6 Hour Storm	5.70	4.96	7.11	30.00	30.00	30.00	30.00	30.00	30.00	30.00	inches
	27	Soil Media Pore Space Available for Biofiltration	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	unitless
	28	Effective Depth of Biofiltration Storage	21.68	19.08	18.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	inches
	29	Drawdown Time for Surface Ponding	12	11	7	0	0	0	0	0	0	0	hours
	30	Drawdown Time for Effective Biofiltration Depth	23	23	16	0	0	0	0	0	0	0	hours
	31	Total Depth Biofiltered	27.38	24.04	25.70	30.00	30.00	30.00	30.00	30.00	30.00	30.00	inches
	32	Option 1 - Biofilter 1.50 DCV: Target Volume	13,769	3,285	653	0	0	0	0	0	0	0	cubic-feet
	33	Option 1 - Provided Biofiltration Volume	13,769	3,285	653	0	0	0	0	0	0	0	cubic-feet
	34	Option 2 - Store 0.75 DCV: Target Volume	6,884	1,643	326	0	0	0	0	0	0	0	cubic-feet
	35	Option 2 - Provided Storage Volume	6,884	1,643	326	0	0	0	0	0	0	0	cubic-feet
	36	Portion of Biofiltration Performance Standard Satisfied	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	ratio
Result	37	Do Site Design Elements and BMPs Satisfy Annual Retention Requirements?	Yes	Yes	Yes	-	-	-	-	-	-	-	yes/no
	38	Overall Portion of Performance Standard Satisfied	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	ratio
	39	This BMP Overflows to the Following Drainage Basin	-	-	-	-	-	-	-	-	-	-	unitless
	40	**Deficit of Effectively Treated Stormwater**	**0**	**0**	**0**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	cubic-feet

Worksheet B.5-1 General Notes:

A. Applicants may use this worksheet to size Lined or Unlined Biofiltration BMPs (BF-1, PR-1) for up to 10 basins. User input must be provided for yellow shaded cells, values for blue cells are automatically populated based on user inputs from previous worksheets, values for all other cells will be automatically generated, errors/notifications will be highlighted in red/orange and summarized below. BMPs fully satisfying the pollutant control performance standards will have a deficit treated volume of zero and be highlighted in green.

Summary of Stormwater Pollutant Control Calculations (V1.3)

Category	#	Description	*i*	*ii*	*iii*	*iv*	*v*	*vi*	*vii*	*viii*	*ix*	Units
General Info	0	Drainage Basin ID or Name	DMA-1	DMA-2	DMA-3	DMA-OFFSITE STREET	DMA-4-BYPASS	-	-	-	-	unitless
	1	85th Percentile Storm Depth	0.48	0.48	0.48	0.48	0.48	-	-	-	-	inches
	2	Design Infiltration Rate Recommended by Geotechnical Engineer	0.000	0.000	0.000	0.000	0.000	-	-	-	-	in/hr
	3	Total Tributary Area	488,225	116,666	22,033	17,716	3,141	-	-	-	-	sq-ft
	4	85th Percentile Storm Volume (Rainfall Volume)	19,529	4,667	881	709	126	-	-	-	-	cubic-feet
Initial DCV	5	Initial Weighted Runoff Factor	0.50	0.51	0.52	0.83	0.90	-	-	-	-	unitless
	6	Initial Design Capture Volume	9,765	2,380	458	588	113	-	-	-	-	cubic-feet
Site Design Volume Reductions	7	Dispersion Area Reductions	0	0	0	0	0	-	-	-	-	cubic-feet
	8	Tree Well and Rain Barrel Reductions	0	0	0	2,100	290	-	-	-	-	cubic-feet
BMP Volume Reductions	9	Effective Area Tributary to BMP	244,113	59,500	11,457	0	0	-	-	-	-	square feet
	10	Final Design Capture Volume Tributary to BMP	9,765	2,380	458	0	0	-	-	-	-	cubic-feet
	11	Basin Drains to the Following BMP Type	Biofiltration	Biofiltration	Biofiltration	n/a	n/a	-	-	-	-	unitless
	12	Volume Retained by BMP (normalized to 36 hour drawdown)	586	190	23	0	0	-	-	-	-	cubic-feet
Total Volume Reductions	13	Total Fraction of Initial DCV Retained within DMA	0.06	0.08	0.05	3.57	2.57	-	-	-	-	fraction
	14	Percent of Average Annual Runoff Retention Provided	9.1%	12.2%	7.6%	#N/A	98.4%	-	-	-	-	%
	15	Percent of Average Annual Runoff Retention Required	4.5%	4.5%	4.5%	4.5%	4.5%	-	-	-	-	%
Performance Standard	16	Percent of Pollution Control Standard Satisfied	100.0%	100.0%	100.0%	100.0%	100.0%	-	-	-	-	%
Treatment Train	17	Discharges to Secondary Treatment in Drainage Basin	-	-	-	-	-	-	-	-	-	unitless
	18	Impervious Surface Area Still Requiring Treatment	0	0	0	0	0	-	-	-	-	square feet
	19	Impervious Surfaces Directed to Downstream Dispersion Area	-	-	-	-	-	-	-	-	-	square feet
	20	Impervious Surfaces Not Directed to Downstream Dispersion Area	-	-	-	-	-	-	-	-	-	square feet
Result	21	Deficit of Effectively Treated Stormwater	0	0	0	0	0	-	-	-	-	cubic-feet

Summary Notes:

All fields in this summary worksheet are populated based on previous user inputs. If applicable, drainage basin elements that require revisions and/or supplemental information outside the scope of these worksheets are highlighted in orange and summairzed in the red text below. If all drainage basins achieve full compliance without a need for supplemental information, a green message will appear below.

-Congratulations, all specified drainage basins and BMPs are in compliance with stormwater pollutant control requirements. Include 11x17 color prints of this summary sheet and supporting worksheet calculations as part of the SWQMP submittal package.

False

Factor of Safety and Design Infiltration Rate Worksheet for BMP-1			**Worksheet D.5-1**		
Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = w x v
A	Suitability Assessment	Soil assessment methods	0.25	3	0.75
		Predominant soil texture	0.25	2	0.5
		Site soil variability	0.25	2	0.5
		Depth to groundwater / impervious layer	0.25	2	0.5
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			2.25
B	Design	Level of pretreatment/ expected sediment loads	0.5	3	1.5
		Redundancy/resiliency	0.25	2	0.5
		Compaction during construction	0.25	3	0.75
		Design Safety Factor, $S_B = \Sigma p$			2.75
Combined Safety Factor, $S_{total} = S_A \times S_B$					6.1875
Observed Infiltration Rate, inch/hr, $K_{observed}$ (corrected for test-specific bias)					0.06
Design Infiltration Rate, in/hr, Kdesign = Kobserved / Stotal Per geotechnical engineer infiltration is not recommended in any amount as it may cause geotechnical hazards. Please refer to Geotechnical Report.					0.010

Supporting Data

Briefly describe infiltration test and provide reference to test forms: Observed infiltration rate was obtained by geotechnical engineer per percolation tests. Buit per geotechnical recommendations there should be no infiltration due to the fact thsat the basins are located next to steep slopes. Thus any amount of infiltration may cause geotechnical hazards. Please refer to Form I-8 and to Geotechnical report.

Factor of Safety and Design Infiltration Rate Worksheet for BMP-2			**Worksheet D.5-1**		
Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = w x v
A	Suitability Assessment	Soil assessment methods	0.25	3	0.75
		Predominant soil texture	0.25	2	0.5
		Site soil variability	0.25	2	0.5
		Depth to groundwater / impervious layer	0.25	2	0.5
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			2.25
B	Design	Level of pretreatment/ expected sediment loads	0.5	3	1.5
		Redundancy/resiliency	0.25	2	0.5
		Compaction during construction	0.25	3	0.75
		Design Safety Factor, $S_B = \Sigma p$			2.75
Combined Safety Factor, $S_{total} = S_A \times S_B$					6.1875
Observed Infiltration Rate, inch/hr, $K_{observed}$ (corrected for test-specific bias)					0.04
Design Infiltration Rate, in/hr, Kdesign = Kobserved / Stotal Per geotechnical engineer infiltration is not recommended in any amount as it may cause geotechnical hazards. Please refer to Geotechnical Report.					0.006

Supporting Data

Briefly describe infiltration test and provide reference to test forms: Observed infiltration rate was obtained by geotechnical engineer per percolation tests. Buit per geotechnical recommendations there should be no infiltration due to the fact thsat the basins are located next to steep slopes. Thus any amount of infiltration may cause geotechnical hazards. Please refer to Form I-8 and to Geotechnical report.

Factor of Safety and Design Infiltration Rate Worksheet for BMP-3			**Worksheet D.5-1**		
Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = w x v
A	Suitability Assessment	Soil assessment methods	0.25	2	0.5
		Predominant soil texture	0.25	2	0.5
		Site soil variability	0.25	2	0.5
		Depth to groundwater / impervious layer	0.25	2	0.5
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			2
B	Design	Level of pretreatment/ expected sediment loads	0.5	3	1.5
		Redundancy/resiliency	0.25	2	0.5
		Compaction during construction	0.25	3	0.75
		Design Safety Factor, $S_B = \Sigma p$			2.75
Combined Safety Factor, $S_{total} = S_A \times S_B$					5.5
Observed Infiltration Rate, inch/hr, $K_{observed}$ (corrected for test-specific bias)					0.02
Design Infiltration Rate, in/hr, Kdesign = Kobserved / Stotal Per geotechnical engineer infiltration is not recommended in any amount as it may cause geotechnical hazards. Please refer to Geotechnical Report.					0.004

Supporting Data

Briefly describe infiltration test and provide reference to test forms: Observed infiltration rate was obtained by geotechnical engineer per percolation tests. Buit per geotechnical recommendations there should be no infiltration due to the fact thsat the basins are located next to steep slopes. Thus any amount of infiltration may cause geotechnical hazards. Please refer to Form I-8 and to Geotechnical report.

OFFSITE STREET: USE OF STREET TREES

The street trees that will be used to treat runoff from the offsite street to the east and DMA 4 of the project site will be used to meet both water quality and hydromodification purposes. The San Diego BMP Sizing Calculator Methodology for Non Structural BMP Sizing Methodology has been used to meet hydromodification requirements for this roadway. A multiplier which depends on the depth of amended soil and hydrologic soil type has been applied to the DCV, therefore Flow Control and Pollutant Control Criteria are met. Please refer to "Sizing Site Design BMPs to meet Flow Control Requirements" by Stuart Kuhn, located in Attachment 2.

In order for the proposed tree wells for DMA-5 will be used to meet both Water Quality and Hydromodification requirements. A safety factor of 3.33 has been applied to the DCV in order to comply with hydromodification. The total DCV treated for hydromodification and the summary of proposed trees are shown in the tables below. Please note that a combination of tree well sizes has been used for efficiency.

DMA	DCV (cu-ft)	Multiplier for HMP	Total DCV (cu-ft)
OFF-STREET-1	588	3.33	1958
OFF-STREET-2	113	3.33	376

DMA	DCV (CU-FT)	S.F. FOR HMP	TOTAL DCV (CU-FT)	5-FT TREES		10-FT TREES		15-FT TREES		20-FT TREES		25-FT TREES		30-FT TREES		TOTAL TCV (CU-FT)	DVC-TCV	ENOUGH CAPACITY	SUMMARY OF TREES
				TCV	# TREES	TCV	# TREES	TCV	# TREES	TCV	# TREES	TCV	# TREES	TCV	# TREES				
OFF-STREET-1	588	3.33	1958	10	0	40	0	100	0	180	0	290	1	420	4	1970	-11.96	YES	1-25' & 4-30' CANOPY TREES
OFF-STREET-2	113	3.33	376	10	0	40	0	100	0	180	0	290	0	420	1	420	-43.71	YES	1-30' CANOPY TREE

The dimension of the proposed structural soil for the trees are shown in the next table:

DMA	TREE NUMBER	TREE CANOPY DIAMETER (FT)	PROPOSED STRUCTURAL SOIL PER TREE WELL								
			REQUIRED VOLUME (CU-FT)	PROPOSED DEPTH (IN)	AREA (SQ-FT)	PROPOSED DIAMETER (FT)	VOLUME PROVIDED (CU-FT)	1.5 X CANOPY RADIUS (FT)	DIAMETER OF SOIL < 1.5 RADIUS OF CANOPY?	2 X CANOPY AREA (SQ-FT)	VOLUME > 2X CANOPY AREA?
OFF-STREET-1	1-1	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-2	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-3	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-4	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-5	25	981.8	45.0	261.8	18.3	986	18.75	YES	982	YES
OFF-STREET-2	2-1	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES

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DCV Multipliers by Tree Well Structural Soil Depth and Underlying Hydrologic Soil Group; Applies to sites subject to Pollutant Control AND Hydromodification Management Performance Requirements (Effective May 17, 2017)

Tree Well Structural Soil Depth[1,2] (inches)	Hydrologic Soil Group			
	A	B	C	D (Default)
	DCV Multiplier			
30"	1.60	2.20	2.50	**2.90**
31"	1.63	2.24	2.56	**2.94**
32"	1.67	2.29	2.61	**2.99**
33"	1.70	2.33	2.67	**3.03**
34"	1.73	2.38	2.72	**3.08**
35"	1.77	2.42	2.78	**3.12**
36"	1.80	2.47	2.83	**3.17**
37"	1.83	2.51	2.89	**3.21**
38"	1.87	2.56	2.94	**3.26**
39"	1.90	2.60	3.00	**3.30**
40"	1.93	2.64	3.06	**3.34**
41"	1.97	2.69	3.11	**3.39**
42"	2.00	2.73	3.17	**3.43**
43"	2.03	2.78	3.22	**3.48**
44"	2.07	2.82	3.28	**3.52**
45"	2.10	2.87	3.33	**3.57**
46"	2.13	2.91	3.39	**3.61**
47"	2.17	2.96	3.44	**3.66**
48"	2.20	3.00	3.50	**3.70**
<30" OR >48"	Determination based on applicant-submitted modeling results			

[1] In cases where the Tree Well design requires a perforated pipe, the tree well credit volume is calculated using the depth of the structural soil below the pipe.

[2] In cases where the Tree Well design requires structural soil over a sand filter, the thickness of the sand filter is not included in the structural soil depth. Sand filters must be at least 6" deep and placed over uncompacted subgrade.

B.2.1.3 Permeable Pavement

When a permeable pavement is implemented in accordance with the SD-6B factsheet and it does not have an impermeable liner and has storage greater than the 85th percentile depth below the underdrain, if an underdrain is present, then the footprint of the permeable pavement shall be assigned a runoff factor of 0.10 for adjusted runoff factor calculations.

Permeable Pavement can also be designed as a structural BMP to treat run on from adjacent areas. Refer to INF-3 factsheet and Appendix B.4 for additional guidance.

B.2.2 Adjustment to DCV

When the following site design BMPs are implemented the anticipated volume reduction from these BMPs shall be deducted from the DCV to estimate the volume for which the downstream structural BMP should be sized for:

- SD-1: Street trees
- SD-8: Rain barrels

B.2.2.1 Street Trees

Street tree credit volume from tree trenches or boxes (tree BMPs) is a sum of three runoff reduction volumes provided by trees that decrease the required DCV for a tributary area. The following reduction in DCV is allowed per tree based on the mature diameter of the tree canopy, when trees are implemented in accordance with SD-1 factsheet:

Mature Tree Canopy Diameter (ft)	Tree Credit Volume (ft^3/tree)
5	10
10	40
15	100
20	180
25	290
30	420

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.

Toilet and urinal flushing demand: $\left(\frac{9.3gal}{person-day}\right)\left(\frac{1ft^3}{7.48gal}\right)(63\ houses)\left(\frac{2.5\ persons}{house}\right)(1.5day) = 294ft^3$

Irrigation demand: $\left(\frac{1470gal}{acre-1.5day}\right)\left(\frac{1ft^3}{7.48gal}\right)(1.5day)(8.28acre) = 2441ft^3$

Total: 2,735 cubic-feet

3. Calculate the DCV using worksheet B-2.1.

12,603 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 ⇨ ⇩	☒ 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. 0.25*(12,603)>2735 3151>2735

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.

Note: All rainwater harvest and use must comply with the California Plumbing Code (Sections 1702.9.3, 1702.9.4, etc.).

Categorization of Infiltration Feasibility Condition — Worksheet C.4-1

Part 1 - Full Infiltration Feasibility Screening Criteria

Would infiltration of the full design volume be feasible from a physical perspective without any undesirable consequences that cannot be reasonably mitigated?

Criteria	Screening Question	Yes	No
1	**Is the estimated reliable infiltration rate below proposed facility locations greater than 0.5 inches per hour?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.		X

Provide basis:

We performed 2 Aardvark Permeameter tests at the site within the weathered portion of the Julian Schist. The following presents the results of our field infiltration tests:

P-1 at 3.5 feet: 0.05 inches/hour (0.03 inches/hour with FOS=2)
P-2 at 4.0 feet: 0.02 inches/hour (0.01 inches/hour with FOS=2)

These tests result in an average of 0.02 inches/hour. The measured rates are less than 0.5 inches per hour and full infiltration is not considered feasible.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.

2	**Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.		X

Provide basis:

We expect compacted fill and Julian Schist will underlie the proposed basins. These materials possess unpredictable vertical and lateral infiltration characteristics. Lateral water migration would cause instability to adjacent slopes, right of ways, and the utilities and fill underlying the right of ways. Water would migrate into the compacted fill associated with the right of way and could cause settlement and distress to roadway pavements and underlying utilities. In addition, if infiltration is allowed, water migration and the resulting seepage forces can negatively affect the stability of the proposed fill slope to the northwest of Biofiltration Basin BF-2 and cause daylight seepage, erosion and surficial slope instability. Therefore, full and partial infiltration should be considered infeasible.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.

Worksheet C.4-1 Page 2 of 4			
Criteria	Screening Question	**Yes**	**No**
X	**Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of groundwater contamination (shallow water table, storm water pollutants or other factors) that cannot be mitigated to an acceptable level?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	X	
Provide basis: We expect groundwater is at least 50 feet from the existing elevations. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
4	**Can infiltration greater than 0.5 inches per hour be allowed without causing potential water balance issues such as change of seasonality of ephemeral streams or increased discharge of contaminated groundwater to surface waters?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	X	
Provide basis: We do not expect infiltration will cause water balance issues such as seasonality of ephemeral streams or increased discharge of contaminated groundwater to surface waters. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
Part 1 Result*	If all answers to rows 1 - 4 are "**Yes**" a full infiltration design is potentially feasible. The feasibility screening category is **Full Infiltration** If any answer from row 1-4 is "**No**", infiltration may be possible to some extent but would not generally be feasible or desirable to achieve a "full infiltration" design. Proceed to Part 2		No Full Infiltration

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City to substantiate findings.

Worksheet C.4-1 Page 3 of 4

Part 2 – Partial Infiltration vs. No Infiltration Feasibility Screening Criteria
Would infiltration of water in any appreciable amount be physically feasible without any negative consequences that cannot be reasonably mitigated?

Criteria	Screening Question	Yes	No
5	**Do soil and geologic conditions allow for infiltration in any appreciable rate or volume?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.	X	

Provide basis:
We performed 2 Aardvark Permeameter tests at the site within the weathered portion of the Julian Schist. The following presents the results of our field infiltration tests:

P-1 at 3.5 feet: 0.05 inches/hour (0.03 inches/hour with FOS=2)
P-2 at 4.0 feet: 0.02 inches/hour (0.01 inches/hour with FOS=2)

These tests result in an average of 0.02 inches/hour.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.

6	**Can Infiltration in any appreciable quantity be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level**? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.		X

Provide basis:

We expect compacted fill and Julian Schist will underlie the proposed basins. These materials possess unpredictable vertical and lateral infiltration characteristics. Lateral water migration would cause instability to adjacent slopes, right of ways, and the utilities and fill underlying the right of ways. Water would migrate into the compacted fill associated with the right of way and could cause settlement and distress to roadway pavements and underlying utilities. In addition, if infiltration is allowed, water migration and the resulting seepage forces can negatively affect the stability of the proposed fill slope to the northwest of Biofiltration Basin BF-2 and cause daylight seepage, erosion and surficial slope instability. Therefore, full and partial infiltration should be considered infeasible.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.

Worksheet C.4-1 Page 4 of 4			
Criteria	Screening Question	**Yes**	**No**
7	**Can Infiltration in any appreciable quantity be allowed without posing significant risk for groundwater related concerns (shallow water table, storm water pollutants or other factors)?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	X	
Provide basis: We expect groundwater is at least 50 feet from the existing elevations. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.			
8	**Can infiltration be allowed without violating downstream water rights**? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	X	
Provide basis: We did not provide a study regarding water rights. However, these rights are not typical in the San Diego County area. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.			
Part 2 Result*	If all answers from row 1-4 are yes then partial infiltration design is potentially feasible. The feasibility screening category is **Partial Infiltration.** If any answer from row 5-8 is no, then infiltration of any volume is considered to be **infeasible** within the drainage area. The feasibility screening category is **No Infiltration.**		No Infiltration

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City to substantiate findings.

DRAWDOWN TIME

BMP-1

Surface Elevation (Ft)	Surface Discharge (cfs)	LID Discharge (Cfs)	Area (sq-ft)	Vol (cu-ft)	Δt (hr)	Drying time t (hr)
4	37.27	0.121	15940	56060		
3.75	25.28	0.121	15692	52106	0.03	0.0
3.5	15.72	0.121	15445	48214	0.05	0.1
3.25	9.88	0.121	15200	44383	0.08	0.2
3	8.52	0.121	14957	40614	0.11	0.3
2.75	6.72	0.121	14715	36905	0.13	0.4
2.5	4.62	0.121	14474	33256	0.17	0.6
2.25	2.44	0.121	14235	29668	0.27	0.9
2	0.102	0.121	13998	26139	0.70	1.6
1.75	0.087	0.121	13762	22668	4.47	6.0
1.5	0.069	0.121	13528	19257	4.76	10.8
1.25	0.044	0.121	13296	15904	5.25	16.0
1	***0***	0.121	13065	12609	6.41	***22.5***
0.75	0	0.121	12836	9371	7.43	29.9
0.5	0	0.121	12608	6191	7.30	37.2
0.25	0	0.121	12382	3067	7.17	44.4
0	0	0.121	12157	0	7.04	**51.4**

BMP-2

Surface Elevation (Ft)	Surface Discharge (cfs)	LID Discharge (Cfs)	Area (sq-ft)	Vol (cu-ft)	Δt (hr)	Drying time t (hr)
3	40.87	0.029	7985	17216		
2.75	25.37	0.029	7589	15270	0.02	0.0
2.5	13.11	0.029	7198	13421	0.03	0.0
2.25	5.84	0.029	6815	11670	0.05	0.1
2	4.53	0.029	6437	10013	0.09	0.2
1.75	2.36	0.029	6066	8450	0.12	0.3
1.5	0.030	0.029	5701	6979	0.33	0.6
1.25	0.025	0.029	5342	5599	6.78	7.4
1	0.021	0.029	4989	4308	6.89	14.3
0.75	0.014	0.029	4643	3104	7.18	21.5
0.5	***0***	0.029	4303	1985	8.61	***30.1***
0.25	0	0.029	3969	951	9.88	40.0
0	0	0.029	3642	0	9.09	**49.1**

BMP-3

Surface Elevation (Ft)	Surface Discharge (cfs)	LID Discharge (Cfs)	Area (sq-ft)	Vol (cu-ft)	Δt (hr)	Drying time t (hr)
3	16.15	0.007	1421	2990		
2.75	8.80	0.007	1343	2645	0.01	0.0
2.5	3.13	0.007	1266	2319	0.02	0.0
2.25	0.029	0.007	1192	2012	0.05	0.1
2	0.026	0.007	1120	1723	2.36	2.4
1.75	0.022	0.007	1051	1451	2.47	4.9
1.5	0.018	0.007	983	1197	2.66	7.6
1.25	0.012	0.007	918	959	3.07	10.6
1	***0***	0.007	855	738	4.91	***15.5***
0.75	0	0.007	794	532	8.76	24.3
0.5	0	0.007	736	340	8.13	32.4
0.25	0	0.007	680	163	7.52	40.0
0	0	0.007	626	0	6.94	**46.9**

LEGEND

- DMA BOUNDARY
- SOIL BOUNDARY
- POC BOUNDARY
- DMA-1 AREA
- DMA-2 AREA
- DMA-3 AREA
- SELF-MITIGATING-1 (PERVIOUS DG SURFACE)
- IMPERVIOUS AREA
- ONSITE SELF-MITIGATING AREA
- ONSITE BY-PASSING AREA
- OFFSITE BYPASS AREA
- DMA OFF-STREET-1 TO BE TREATED W/ TREE WELLS
- DMA OFF-STREET-2 TO BE TREATED W/ TREE WELL
- BMP BASIN AREA
- STORM DRAIN
- PROHIBITIVE SIGNAGE
- TREE WELLS
- TREE WELL STRUCTURAL SOIL SURFACE AREA

APPROXIMATE GROUNDWATER (GW) DEPTH: 5' < GW < 10'

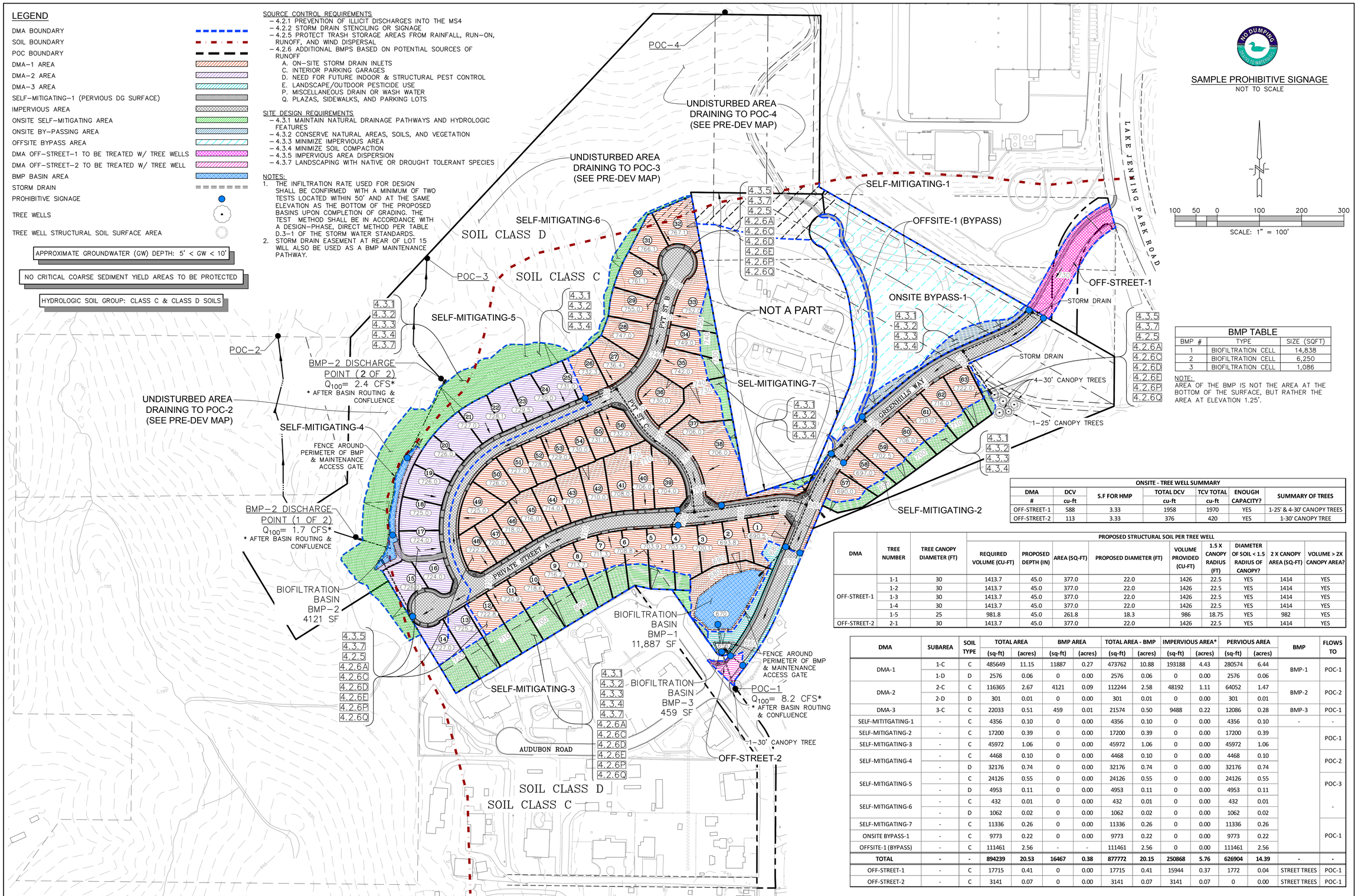
NO CRITICAL COARSE SEDIMENT YIELD AREAS TO BE PROTECTED

HYDROLOGIC SOIL GROUP: CLASS C & CLASS D SOILS

SOURCE CONTROL REQUIREMENTS
- 4.2.1 PREVENTION OF ILLICIT DISCHARGES INTO THE MS4
- 4.2.2 STORM DRAIN STENCILING OR SIGNAGE
- 4.2.5 PROTECT TRASH STORAGE AREAS FROM RAINFALL, RUN-ON, RUNOFF, AND WIND DISPERSAL
- 4.2.6 ADDITIONAL BMPS BASED ON POTENTIAL SOURCES OF RUNOFF
  - A. ON-SITE STORM DRAIN INLETS
  - C. INTERIOR PARKING GARAGES
  - D. NEED FOR FUTURE INDOOR & STRUCTURAL PEST CONTROL
  - E. LANDSCAPE/OUTDOOR PESTICIDE USE
  - P. MISCELLANEOUS DRAIN OR WASH WATER
  - Q. PLAZAS, SIDEWALKS, AND PARKING LOTS

SITE DESIGN REQUIREMENTS
- 4.3.1 MAINTAIN NATURAL DRAINAGE PATHWAYS AND HYDROLOGIC FEATURES
- 4.3.2 CONSERVE NATURAL AREAS, SOILS, AND VEGETATION
- 4.3.3 MINIMIZE IMPERVIOUS AREA
- 4.3.4 MINIMIZE SOIL COMPACTION
- 4.3.5 IMPERVIOUS AREA DISPERSION
- 4.3.7 LANDSCAPING WITH NATIVE OR DROUGHT TOLERANT SPECIES

NOTES:
1. THE INFILTRATION RATE USED FOR DESIGN SHALL BE CONFIRMED WITH A MINIMUM OF TWO TESTS LOCATED WITHIN 50' AND AT THE SAME ELEVATION AS THE BOTTOM OF THE PROPOSED BASINS UPON COMPLETION OF GRADING. THE TEST METHOD SHALL BE IN ACCORDANCE WITH A DESIGN-PHASE, DIRECT METHOD PER TABLE D.3-1 OF THE STORM WATER STANDARDS.
2. STORM DRAIN EASEMENT AT REAR OF LOT 15 WILL ALSO BE USED AS A BMP MAINTENANCE PATHWAY.



SAMPLE PROHIBITIVE SIGNAGE
NOT TO SCALE

100 50 0 100 200 300
SCALE: 1" = 100'

BMP TABLE

BMP #	TYPE	SIZE (SQFT)
1	BIOFILTRATION CELL	14,838
2	BIOFILTRATION CELL	6,250
3	BIOFILTRATION CELL	1,086

NOTE:
AREA OF THE BMP IS NOT THE AREA AT THE BOTTOM OF THE SURFACE, BUT RATHER THE AREA AT ELEVATION 1.25'.

ONSITE - TREE WELL SUMMARY

DMA #	DCV cu-ft	S.F FOR HMP	TOTAL DCV cu-ft	TCV TOTAL cu-ft	ENOUGH CAPACITY?	SUMMARY OF TREES
OFF-STREET-1	588	3.33	1958	1970	YES	1-25' & 4-30' CANOPY TREES
OFF-STREET-2	113	3.33	376	420	YES	1-30' CANOPY TREE

DMA	TREE NUMBER	TREE CANOPY DIAMETER (FT)	PROPOSED STRUCTURAL SOIL PER TREE WELL: REQUIRED VOLUME (CU-FT)	PROPOSED DEPTH (IN)	AREA (SQ-FT)	PROPOSED DIAMETER (FT)	VOLUME PROVIDED (CU-FT)	1.5 X CANOPY RADIUS (FT)	DIAMETER OF SOIL < 1.5 RADIUS OF CANOPY?	2 X CANOPY AREA (SQ-FT)	VOLUME > 2X CANOPY AREA?
OFF-STREET-1	1-1	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-2	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-3	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-4	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-5	25	981.8	45.0	261.8	18.3	986	18.75	YES	982	YES
OFF-STREET-2	2-1	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES

DMA	SUBAREA	SOIL TYPE	TOTAL AREA (sq-ft)	TOTAL AREA (acres)	BMP AREA (sq-ft)	BMP AREA (acres)	TOTAL AREA - BMP (sq-ft)	TOTAL AREA - BMP (acres)	IMPERVIOUS AREA* (sq-ft)	IMPERVIOUS AREA* (acres)	PERVIOUS AREA (sq-ft)	PERVIOUS AREA (acres)	BMP	FLOWS TO
DMA-1	1-C	C	485649	11.15	11887	0.27	473762	10.88	193188	4.43	280574	6.44	BMP-1	POC-1
	1-D	D	2576	0.06	0	0.00	2576	0.06	0	0.00	2576	0.06		
DMA-2	2-C	C	116365	2.67	4121	0.09	112244	2.58	48192	1.11	64052	1.47	BMP-2	POC-2
	2-D	D	301	0.01	0	0.00	301	0.01	0	0.00	301	0.01		
DMA-3	3-C	C	22033	0.51	459	0.01	21574	0.50	9488	0.22	12086	0.28	BMP-3	POC-1
SELF-MITITGATING-1	-	C	4356	0.10	0	0.00	4356	0.10	0	0.00	4356	0.10	-	-
SELF-MITIGATING-2	-	C	17200	0.39	0	0.00	17200	0.39	0	0.00	17200	0.39		POC-1
SELF-MITIGATING-3	-	C	45972	1.06	0	0.00	45972	1.06	0	0.00	45972	1.06		
SELF-MITIGATING-4	-	C	4468	0.10	0	0.00	4468	0.10	0	0.00	4468	0.10		POC-2
	-	D	32176	0.74	0	0.00	32176	0.74	0	0.00	32176	0.74		
SELF-MITIGATING-5	-	C	24126	0.55	0	0.00	24126	0.55	0	0.00	24126	0.55		POC-3
	-	D	4953	0.11	0	0.00	4953	0.11	0	0.00	4953	0.11		
SELF-MITIGATING-6	-	C	432	0.01	0	0.00	432	0.01	0	0.00	432	0.01		-
	-	D	1062	0.02	0	0.00	1062	0.02	0	0.00	1062	0.02		
SELF-MITIGATING-7	-	C	11336	0.26	0	0.00	11336	0.26	0	0.00	11336	0.26		POC-1
ONSITE BYPASS-1	-	C	9773	0.22	0	0.00	9773	0.22	0	0.00	9773	0.22		
OFFSITE-1 (BYPASS)	-	C	111461	2.56	-	-	111461	2.56	0	0.00	111461	2.56		
TOTAL	**-**	**-**	**894239**	**20.53**	**16467**	**0.38**	**877772**	**20.15**	**250868**	**5.76**	**626904**	**14.39**	**-**	**-**
OFF-STREET-1	-	C	17715	0.41	0	0.00	17715	0.41	15944	0.37	1772	0.04	STREET TREES	POC-1
OFF-STREET-2	-	C	3141	0.07	0	0.00	3141	0.07	3141	0.07	0	0.00	STREET TREES	POC-1

IMPERVIOUS AREAS HAVE BEEN CALCULATED BASED ON (A) 90% OF STREET AREA PLUS (B) AVERAGE IMPERVIOUS AREA PER AVERAGE LOT SIZE TIMES THE NUMBER OF LOTS. THE IMPERVIOUS AREA IS ASSUMED LARGER FOR LARGER AVERAGE LOTS. FOR DMA-1 THE AVERAGE LOT SIZE IS 5400 SF AND THE IMPERVIOUS AREA PER LOT IS ESTIMATED AS 2087 SF; FOR DMA-2 THE AVERAGE LOT SIZE IS 5700 SF AND THE IMPERVIOUS AREA PER LOT IS ESTIMATED AS 2146 SF

REVISIONS

NO.	DESCRIPTION	DATE	APP'D

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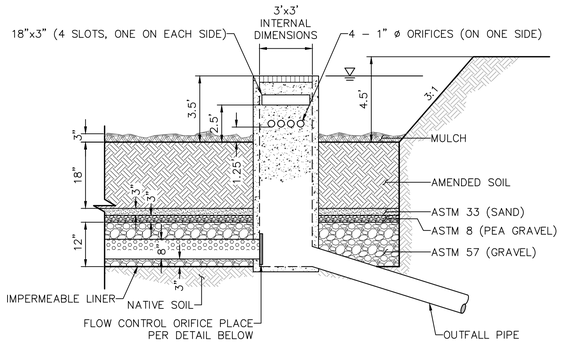
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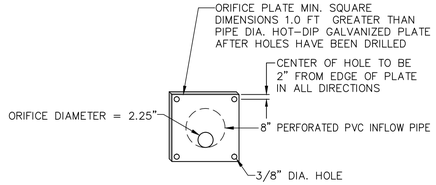
SHEET TITLE: DMA EXHIBIT - PROPOSED

PROJECT: GREENHILLS RANCH
PHASE 2
COUNTY OF SAN DIEGO, CA

SHEET 1 OF 1 SHEETS

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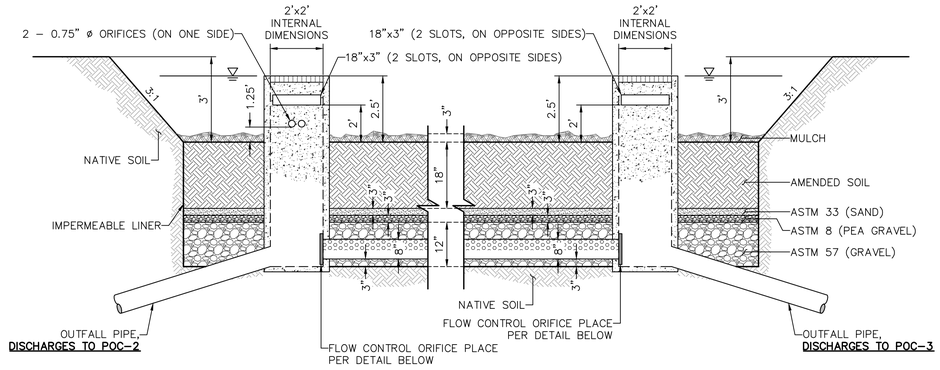


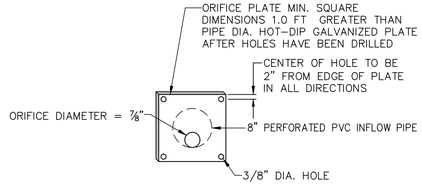
FLOW CONTROL ORIFICE PLATE
NTS

NOTES:

1. SOIL MIX PER COUNTY OF SAN DIEGO LID MANUAL
2. "WELL DRAINED SOIL" SHALL BE "SANDY LOAM" SOIL MIX WITH NO MORE THAN 5% CLAY CONTENT. THE MIX SHALL CONTAIN 50–60% SAND, 20–30% COMPOST OR HARDWOOD MULCH, AND 20–30% TOPSOIL.

1 BMP-1 BASIN DETAIL
NOT TO SCALE



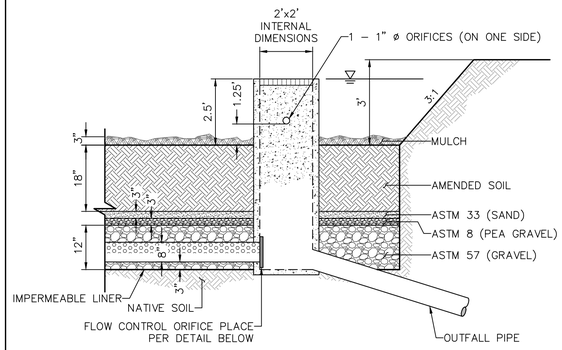


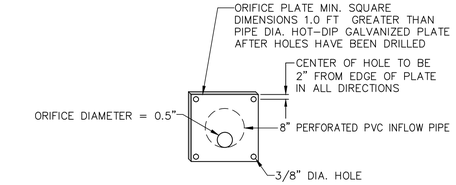
FLOW CONTROL ORIFICE PLATE
NTS

NOTES:

1. SOIL MIX PER COUNTY OF SAN DIEGO LID MANUAL
2. "WELL DRAINED SOIL" SHALL BE "SANDY LOAM" SOIL MIX WITH NO MORE THAN 5% CLAY CONTENT. THE MIX SHALL CONTAIN 50–60% SAND, 20–30% COMPOST OR HARDWOOD MULCH, AND 20–30% TOPSOIL.

2 BMP-2 BASIN DETAIL
NOT TO SCALE





FLOW CONTROL ORIFICE PLATE
NTS

NOTES:

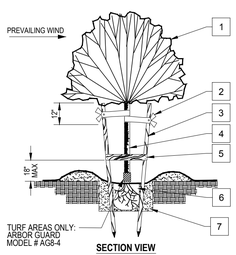
1. SOIL MIX PER COUNTY OF SAN DIEGO LID MANUAL
2. "WELL DRAINED SOIL" SHALL BE "SANDY LOAM" SOIL MIX WITH NO MORE THAN 5% CLAY CONTENT. THE MIX SHALL CONTAIN 50–60% SAND, 20–30% COMPOST OR HARDWOOD MULCH, AND 20–30% TOPSOIL.

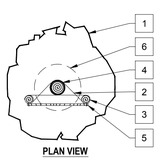
3 BMP-3 BASIN DETAIL
NOT TO SCALE

TREE WELL NOTES

1. TREE CANOPY (SEE TABLE SHOWN HEREON)
2. (2) CINCH TIES, TACK TO STAKE WITH GALVANIZED NAILS TO PREVENT SLIPPING
3. (2) 2" DIA. X 8' LONG UNTREATED LODGEPOLE PINE STAKES FOR 5 GAL. TREES,
   OR
   (2) 2" DIA. X 10' LONG UNTREATED LODGEPOLE PINE TAKES FOR 15 GAL— 36" BOX TREES, SET STAKES OUTSIDE ROOTBALL. ANGLE TOP OF STAKE AWAY FROM BRANCH STRUCTURE.
4. TREE TRUNK
5. 1 X 4 DOUG. FIR BRACE, TACK TO LODGEPOLE STAKES WITH GALV. NAILS
6. ROOT BALL, DO NOT PENETRATE WITH STAKE.
7. USE AMENDED SOIL WITH MINIMUM DEPTH OF 3' + 1' IN ALL DIRECTIONS OF ROOT BALL PER CITY'S BMP MANUAL APPENDIX PG. E–18. MINIMUM SOIL VOLUME 155 CU FT. SEE TABLE SHOWN HEREON FOR DEPTH & DIAMETER.

TREE TIE NOTE:
1. INSTALL TREE TIES AND STAKES ONLY TO PROPER LEVEL TO HOLD TREE UPRIGHT. PROPER HEIGHT IS 6" ABOVE POINT WHERE THE TREE WILL SNAP TO AN UPRIGHT POSITION BY ITSELF IF TOP IS PULLED TO ONE SIDE AS IF WIND LOADED AND THEN RELEASED. DO NOT TOP TREES IN ORDER TO REDUCE SIZE OR WEIGHT OF TREE CROWN, CONTACT LANDSCAPE ARCHITECT PRIOR TO ANY PRUNING OF TREES.





4 TREE WELL DETAILS
NOT TO SCALE

DMA	[1] TREE NUMBER	TREE CANOPY DIAMETER (FT)	PROPOSED STRUCTURAL SOIL PER TREE WELL							
			REQUIRED VOLUME (CU-FT)	[7] PROPOSED DEPTH (IN)	AREA (SQ-FT)	[7] PROPOSED DIAMETER (FT)	VOLUME PROVIDED (CU-FT)	1.5 X CANOPY RADIUS (FT)	DIAMETER OF SOIL < 1.5 RADIUS OF CANOPY?	2 X CANOPY AREA (SQ-FT)	VOLUME > 2X CANOPY AREA?
OFF-STREET-1	1-1	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-2	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-3	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-4	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-5	25	981.8	45.0	261.8	18.3	986	18.75	YES	982	YES
OFF-STREET-2	2-1	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES

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NO.	DESCRIPTION	DATE	APP'D

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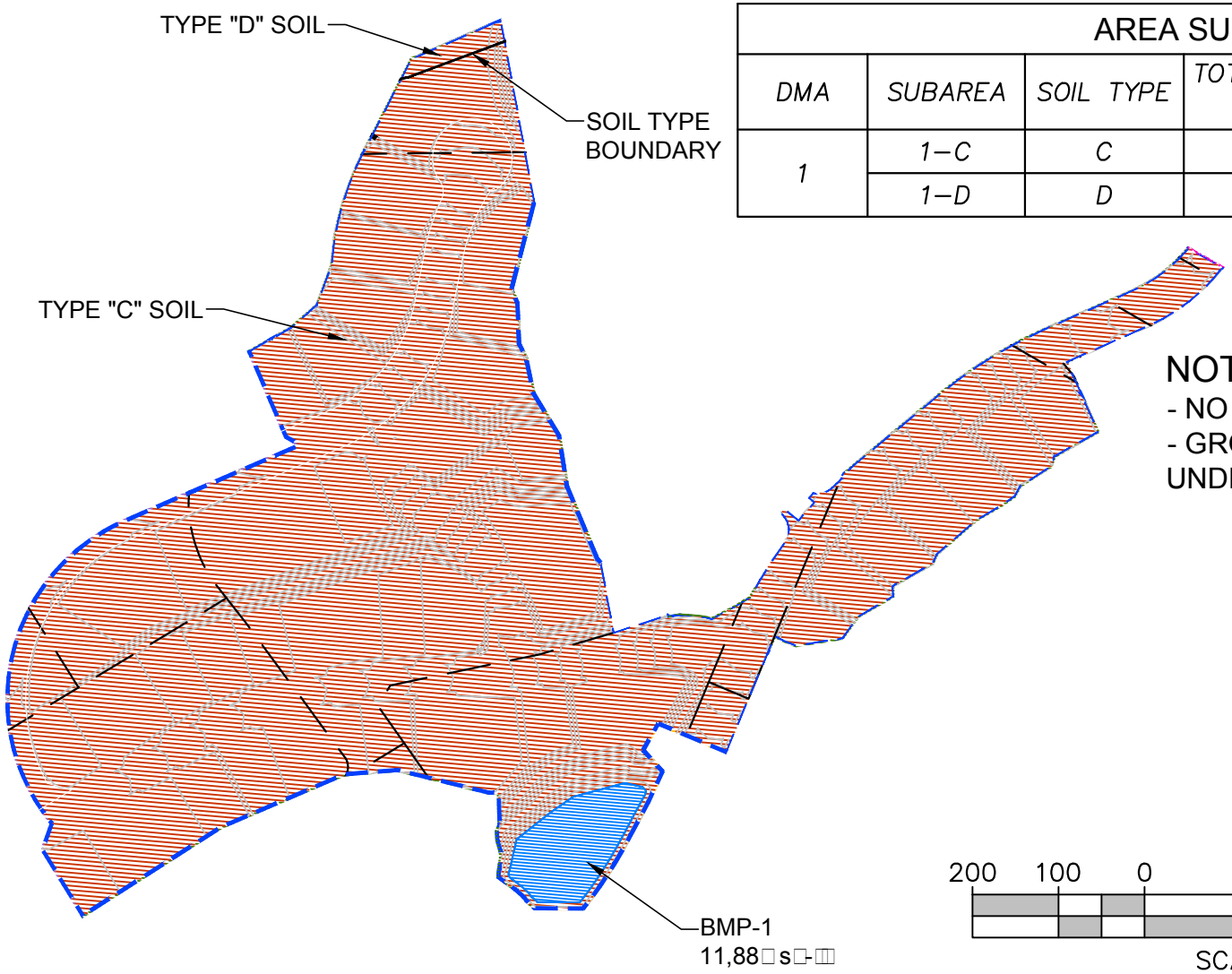
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PROJECT: GREENHILLS RANCH
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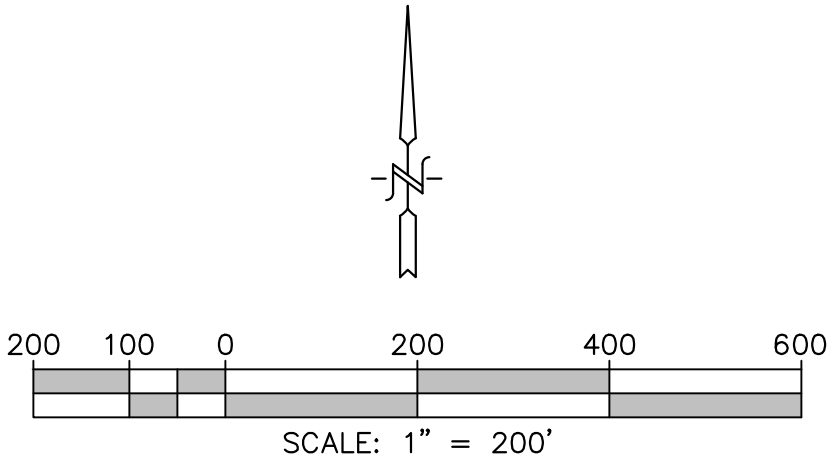
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OF 2 SHEETS

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AREA SUMMARY					
DMA	SUBAREA	SOIL TYPE	TOTAL AREA (AC)	IMPERVIOUS AREA (AC)	PERVIOUS AREA (AC)
1	1–C	C	11.15	4.43	6.72
	1–D	D	0.06	0.00	0.06

NOTE:
- NO CCSYAs TO PROTECT
- GROUNDWATER BETWEEN 5' & 10' UNDERLYING SOIL TYPES "C" AND "D"

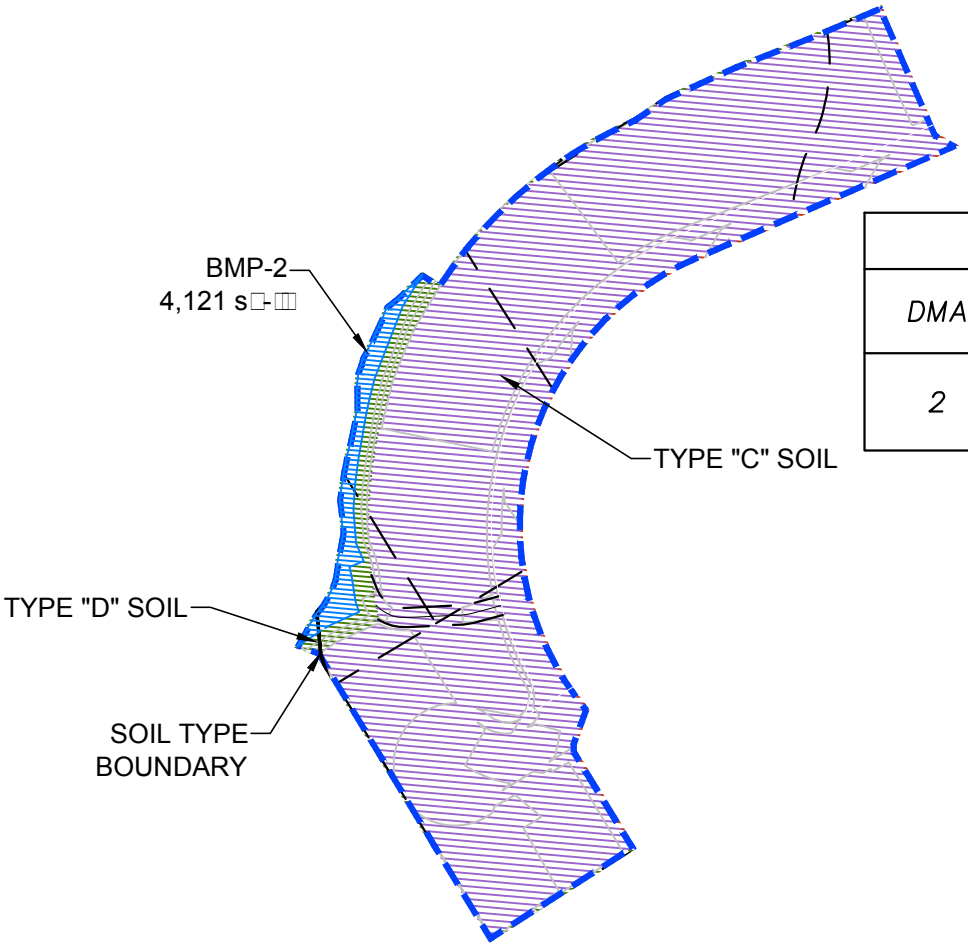


SHEET 1 OF 5 SHEETS

SHEET TITLE: DMA-1

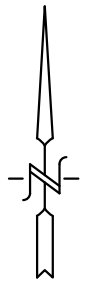
PROJECT: GREENHILLS RANCH - PHASE 2
9385 ADLAI ROAD
LAKESIDE, CA 92040

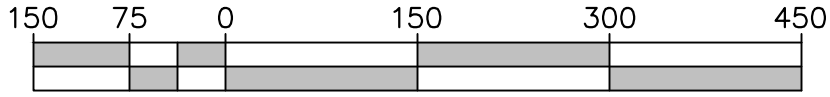
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San Diego, CA 92101
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AREA SUMMARY					
DMA	SUBAREA	SOIL TYPE	TOTAL AREA (AC)	IMPERVIOUS AREA (AC)	PERVIOUS AREA (AC)
2	2–C	C	2.67	1.11	1.56
	2–D	D	0.01	0.00	0.01

NOTE:
- NO CCSYAs TO PROTECT
- GROUNDWATER BETWEEN 5' & 10'
- UNDERLYING SOIL TYPES "C" AND "D"





SCALE: 1" = 150'

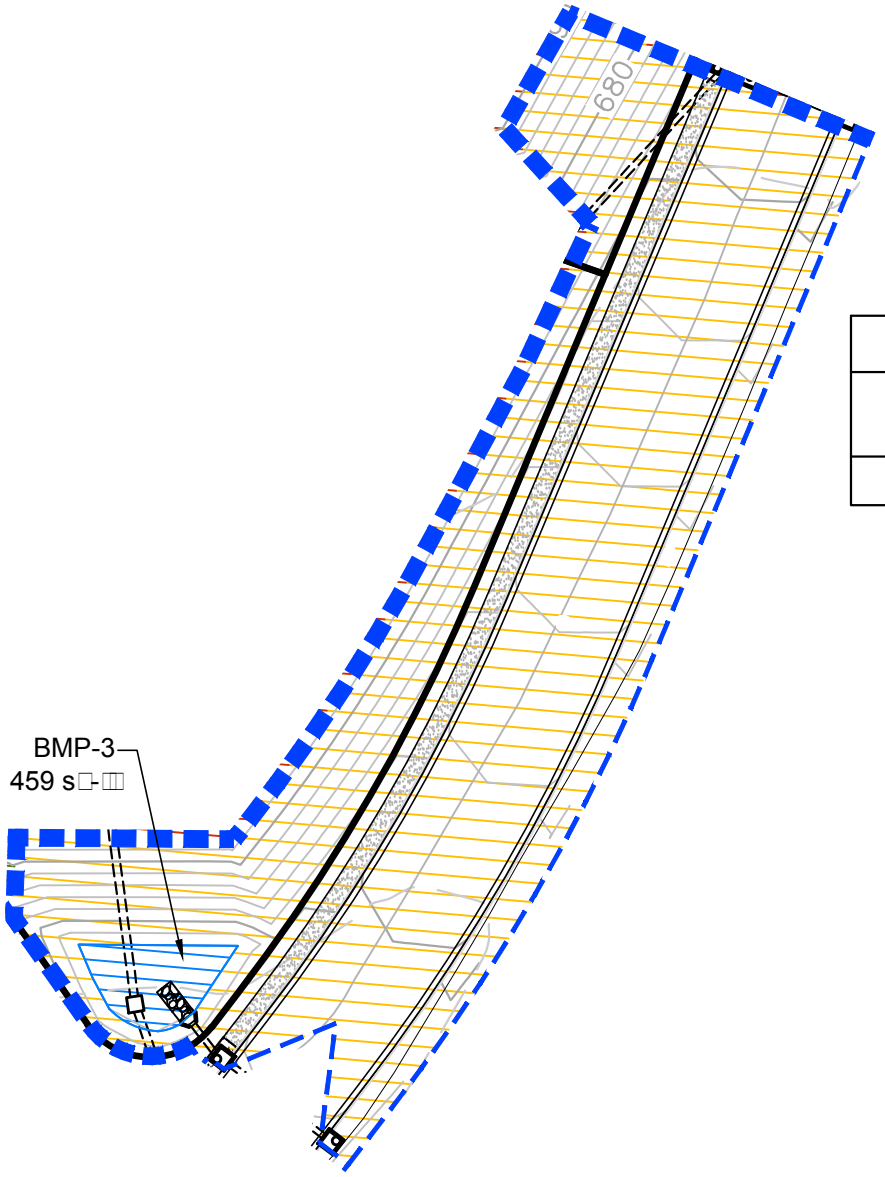
SHEET 2 OF 5 SHEETS

DMA-2

PROJECT

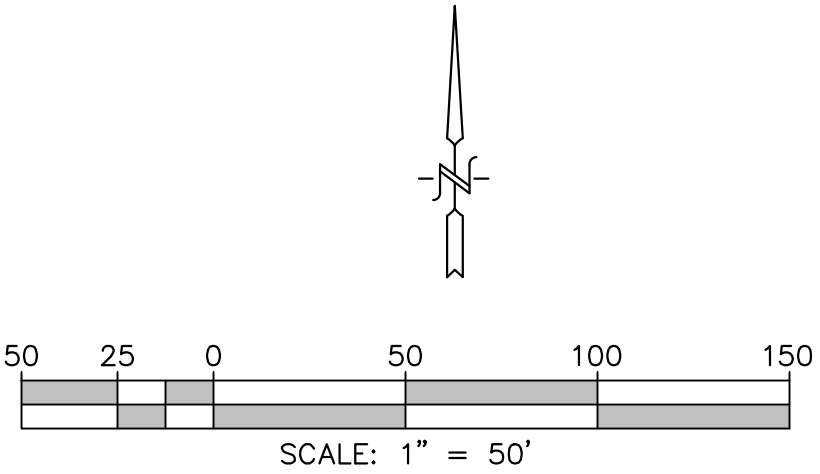
GREENHILLS RANCH - PHASE 2
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LAKESIDE, CA 92040

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AREA SUMMARY					
DMA	SUBAREA	SOIL TYPE	TOTAL AREA (AC)	IMPERVIOUS AREA (AC)	PERVIOUS AREA (AC)
3	3–C	C	0.51	0.22	0.29

NOTE:
- NO CCSYAs TO PROTECT
- GROUNDWATER BETWEEN 5' & 10'
- UNDERLYING SOIL TYPE "C"



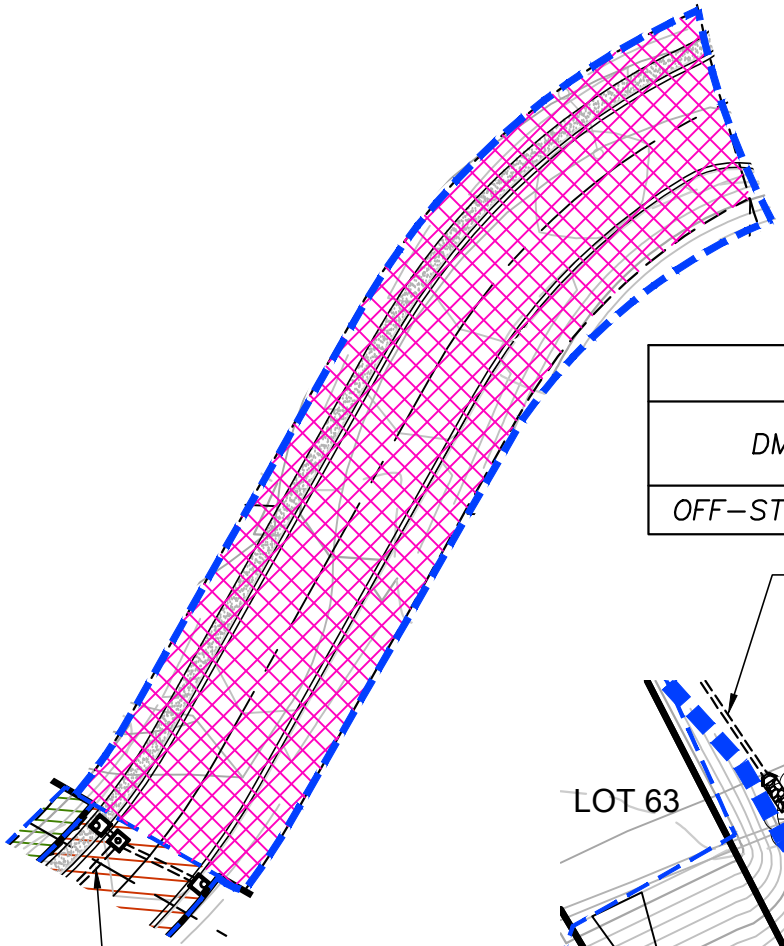
SHEET 3 OF 5 SHEETS

DMA-3

PROJECT

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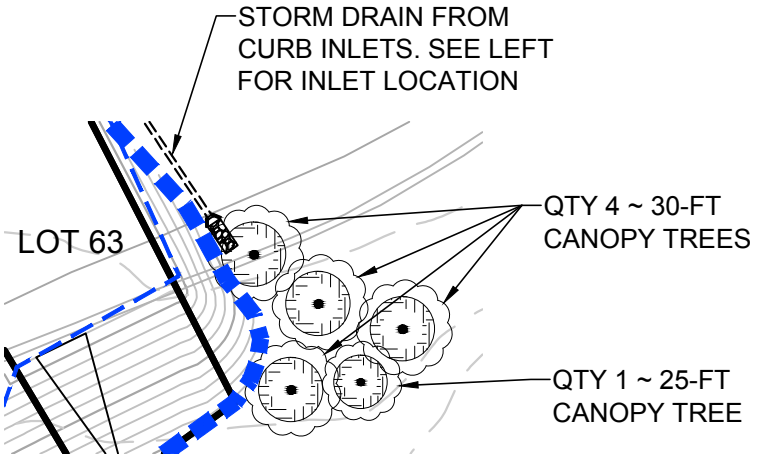


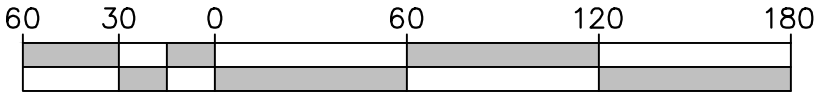
STORM DRAIN TO TREE WELLS. SEE RIGHT FOR OUTLET LOCATION

NOTE:

- NO CCSYAs TO PROTECT
- GROUNDWATER BETWEEN 5' & 10'
- UNDERLYING SOIL TYPE "C"

AREA SUMMARY				
DMA	SOIL TYPE	TOTAL AREA (AC)	IMPERVIOUS AREA (AC)	PERVIOUS AREA (AC)
OFF–STREET–1	C	0.41	0.37	0.04





SCALE: 1" = 60'

SHEET 4 OF 5 SHEETS

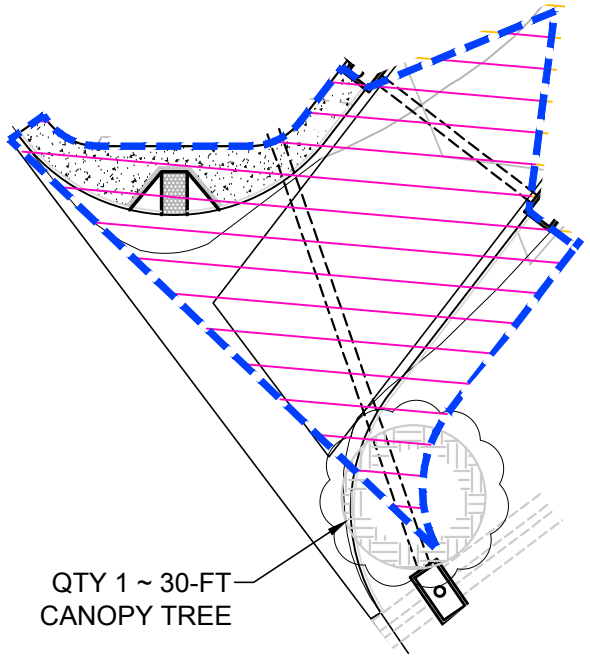
OFF-STREET-1

PROJECT

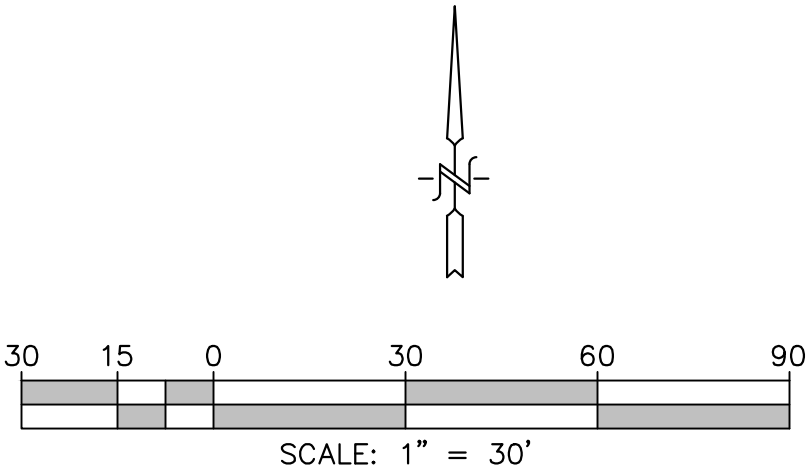
GREENHILLS RANCH - PHASE 2
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NOTE:
- NO CCSYAs TO PROTECT
- GROUNDWATER BETWEEN 5' & 10'
- UNDERLYING SOIL TYPE "C"



AREA SUMMARY				
DMA	SOIL TYPE	TOTAL AREA (AC)	IMPERVIOUS AREA (AC)	PERVIOUS AREA (AC)
OFF-STREET-2	C	0.06	0.06	-



SHEET 5 OF 5 SHEETS

OFF-STREET-2

PROJECT

GREENHILLS RANCH - PHASE 2
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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 behind this cover sheet:

Attachment Sequence	Contents	Checklist
Attachment 2a	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 2b	Hydromodification Management Exhibit (Required)	☒ Included See Hydromodification Management Exhibit Checklist on the back of this Attachment cover sheet.
Attachment 2c	Management of Critical Coarse Sediment Yield Areas See Section 6.2 and Appendix H of the BMP Design Manual.	☒ Exhibit depicting onsite and/or upstream sources of critical coarse sediment as mapped by Regional or Jurisdictional approaches outlined in Appendix H.1 AND, ☐ Demonstration that the project effectively avoids and bypasses sources of mapped critical coarse sediment per approaches outlined in Appendix H.2 and H.3. OR, ☐ Demonstration that project does not generate a net impact on the receiving water per approaches outlined in Appendix H.4.
Attachment 2d	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 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

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)

TECHNICAL MEMORANDUM:

SWMM Modeling for Hydromodification Compliance of:

GREENHILLS RANCH – PHASE 2

Prepared For:

Dan Jill Goodman

January 29, 2016. Revised: January 24, 2018.
Updated April 5, 2018& December 1st, 2022.

Prepared by:

Luis Parra, PhD, CPSWQ, D.WRE., CFM
R.C.E. 66377



REC Consultants
2442 Second Avenue
San Diego, CA 92101
Telephone: (619) 232-9200

TECHNICAL MEMORANDUM

TO: Dan Jill Goodman

FROM: Luis Parra, PhD, PE, CPSWQ, ToR, D.WRE.

DATE: January 29, 2016. Reviewed: 1/24/2018. Updated April 5, 2018 & December 1st, 2022.

RE: Summary of SWMM Modeling for Hydromodification Compliance for Greenhills Ranch – Phase 2, Lakeside, CA.

INTRODUCTION

This memorandum summarizes the approach used to model the proposed residential development project site in Lakeside, County of San Diego, using the Environmental Protection Agency (EPA) Storm Water Management Model 5.0 (SWMM). SWMM models were prepared for the pre and post-developed conditions at the site in order to determine if the proposed LID biofiltration facilities have sufficient volume to meet Order R9-2013-001 requirements of the California Regional Water Quality Control Board San Diego Region (SDRWQCB), as explained in the Final Hydromodification Management Plan (HMP), dated March 2011, prepared for the County of San Diego by Brown and Caldwell.

SWMM Model Development

The Greenhills Ranch project consists of multiple single family residences, including access roads on the property located at 9385 Adlai Road. The entire property drains to 4 Points of Compliance (POC). Of those, only three (3) will include BMPs, but all will include hydromodification modeling. To review, this is the status of the property and the development in relation with the POCs:

- POC-4 is a discharge point in the property whose contributing area will be slightly reduced in post-development condition, with no impervious areas to be included but with new slope areas draining to it; therefore, as the slope of a small portion of the area increases, there is the need for a hydromodification analysis to ensure that the Post-development Flow Duration Curve (FDC) is still in compliance.
- POC-1, POC-2 and POC-3 will include impervious areas and development in post-development conditions; therefore, a hydromodification analysis is needed with the inclusion of the corresponding BMPs.

Important Note: There is both a street modification to the NE of the project area (Audubon Road extension) and SE of the project area (intersection of Adlai Road and Audubon Road) that must be hydromodified. However, these portions of the project are not included in the hydromodification model because they will be treated by tree wells (both in terms of water quality and hydromodification). Therefore, these street areas will not be further discussed in this report.

In summary two SWMM models were prepared for Greenhills Ranch: one for the pre-development condition at each of the four (4) POCs and one for the post-developed conditions at each POC. Four Flow Duration Curves (FDCs) will be prepared, one per POC.

The SWMM model was used since it is a non-proprietary model approved by the HMP document. The FDCs prepared will allow determining if the proposed HMP facilities are sufficient to meet the current HMP requirements. The inputs required to develop SWMM models include rainfall, watershed characteristics, and BMP configurations. The Flinn Gage from the Project Clean Water website was used for this study, since it is the most representative of the project site precipitation due to elevation and proximity to the project site.

Per the California Irrigation Management Information System "Reference Evaporation Zones" (CIMIS ETo Zone Map), the project site is located within the Zone 9 Evapotranspiration Area. Thus evapotranspiration vales for the site were modeled using Zone 9 average monthly values from Table G.1-1 from the 2016 BMP Design Manual. The site was modeled with Type C (mostly) and Type D hydrologic soils as those are the existing soil determined from the NRCS Web Soil Survey. Soils have been assumed to be uncompacted in the existing condition to represent the current land use of the site and fully compacted in the post developed conditions (for areas developed or that include new slopes) and uncompacted in the post-development conditions for areas exempt of development. Other SWMM inputs for the subareas are discussed in the appendices to this document, where the selection of the parameters is explained in detail.

HMP MODELING

PRE-DEVELOPED CONDITIONS

In current existing conditions, runoff from the project development discharges to four (4) POCs located according to the maps shown in Attachment 5. The project site is undeveloped and vegetated with steep natural drainage flowpaths conveying flow to the aforementioned POCs. Per the new permit requirements, the small portion of impervious area will not be accounted in pre-development conditions.

TABLE 1 – SUMMARY OF EXISTING CONDITIONS

POC	Soil Type	Tributary Area, A (ac)	Impervious %, I_p (1)
POC-1	C	18.036	0.00%
POC-2	C	1.058	0.00%
POC-2	D	3.461	0.00%
POC-3	C	3.642	0.00%
POC-3	D	2.524	0.00%
POC-4	C	0.756	0.00%
POC-4	D	6.120	0.00%
TOTAL	**-**	**35.596**	--

Notes: (1) – Per the 2013 RWQCB permit, existing condition impervious surfaces are not to be accounted for in existing conditions analysis. Some impervious areas exists on POC-1, POC-2 and POC-3, but they are not included in the pre-development model.

DEVELOPED CONDITIONS

Runoff from the developed project site is drained to three onsite receiving biofiltration LID BMPs. In regards to the discharge of the BMPs into the POCs, the path is not straightforward, and is as follows:

- BMP-1 and BMP-3 drain to POC-1.
- BMP-2 has two (2) outlet structures. There is a French drain system with 2 identical LID orifices (same diameter and same elevation), one located in outlet structure 2-2 and another located in outlet structure 2-3. Outlet structure 2-2 drains to POC-2, while outlet structure 2-3 drains to POC-3. **In other words, one BMP drains to 2 POCs**.
- POC-4 has no BMPs because its contributing area is not developed and simply reduces in area. A FDC comparison was made to insure the final area satisfies hydromodification requirements.

The reason to distribute the flows of BMP-2 into POC-2 and POC-3 is tied to the nature of the project and the small area associated with those POCs: there is only one possible location for a BMP, adjacent to the NW grading slope of the project, and there is only one pipe system conveying the flow towards BMP-2. The contributing area of BMP-2 is similar to the contributing area of pre-development POC-2 and POC-3 combined. Therefore, the only solution was to design two outlet structures in BMP-2 so that it is possible to satisfy the FDC requirements for both POC-2 and POC-3.

To simplify the model (as SWMM does not allow two different orifices in the LID module) the two identical orifices are included into a single C coefficient in the LID module. Then, the low flow is partitioned in identical parts between each of the POCs (this is represented by the DIV-4 node that breaks the low flow in 2 identical portions, one going to POC-2 and another to POC-3). In regard to the flows exceeding the LID volume, those flows are routed into a single pond in the model (as it occurs in the real system), and the combined discharge of both outlet structures is used for the purpose of routing. The routed flows are then divided according to a discharge table that takes into consideration the proportion of the flow being discharged by outlet structure 2-2 and the proportion of the flow being discharge by outlet structure 2-3.

Although REC tried to make both discharges identical, compliance with POC-3 conditions was more difficult than compliance with POC-2 conditions because the former POC has less runoff than the later (it does not have soils type D among its contributing area). The solution was to incorporate the lower surface orifices only into the outlet structure of POC-2 so that surface flow ponding at an elevation of 0.75 ft or less above the orifices can either leave thru the LIDs to each of the POCs or can leave thru the small surface orifices to POC-2. Consequently, the discharges of those structures are similar but not identical (surface discharges for pond elevation less than 0.75 ft is 0 cfs to POC-3 and up to 0.025 cfs to POC-2). The use of a diversion structure in SWMM (represented by DIV-5 node) allowed the proper partition of the combined flows.

Once flows are routed via the proposed LID BMPs, developed onsite flows are then discharged to the respective POCs. It is assumed all storm water quality requirements for the project will be met by the biofiltration LID BMPs. However, detailed water quality requirements are not discussed within this technical memo. For further information in regard to storm water quality requirements for the project, please refer to the site specific Storm Water Mitigation Plan (SWMP).

TABLE 2 – SUMMARY OF DEVELOPED CONDITIONS

POCs	BMPs	Tributary Area, A (Ac) (1)	Impervious Percentage %, I_P
POC-1	BMP-1	10.876 (to BMP, C soil) 0.059 (to BMP, D soil) 0.273 (BMP itself)	40.78% 0% 0%
	BMP-3	0.495 (to BMP, C soil) 0.011 (BMP itself)	43.96% 0%
	By-Pass areas (pervious)	6 sub-areas in model, C soil, A = 6.520	0%
POC-2	BMP-2 (2 outlet structures)	2.577 (to BMP, C soil) 0.007 (to BMP, D soil) 0.095 (BMP itself)	42.93% 0% 0%
POC-3			
POC-2	By-Pass	0.739 (D soil) 2.776 (C soil)	0% 0%
POC-3	By-Pass	2.524 (D soil, 2 sub-areas) 1.981 (C soil, 2 sub-areas)	0% 0%
POC-4	No BMP for POC-4	6.027 (D soil, 2 sub-areas) 0.637 (C soil, 2 sub-areas)	0% 0%
TOTAL	**TOTAL**	**35.596**	-

Notice that the total contributing area to POC-1, POC-2, POC-3 and POC-4 is identical in post-development conditions than in pre-development conditions, although the partition among different POCs changes. The BMPs designed will have to compensate for the small change in contributing area to POCs 1, 2, 3 and 4 so that the FDC for each POC after development is within the acceptable range when compared with the FDC for each POC in pre-development conditions.

In regards to the BMPs, three (3) LID biofiltration basins are located within the project site and are responsible for handling hydromodification requirements for the project site. In developed conditions, Basin 1 will have a surface depth of 4.5-feet and a riser spillway structure. Basin 2 and Basin 3 will have a surface depth of 3-feet and a riser spillway structure. All dimensions associated with the BMPs and their outlet structures are detailed in Tables 3 and 4.

Beneath the basins' invert lies the proposed LID biofiltration portion of the drainage facility. This portion of the basin is comprised of an 18-inch layer of amended soil (a highly sandy, organic rich composite with an infiltration capacity of at least 5 inches/hr), 6 inches of filter material (3 inches of sand and 3 inches of pea gravel, which are included in SWMM as a part of the storage layer) and a 12-inch layer of gravel (dimensions valid for all BMPs). Due to the location of all BMPs, adjacent to large slopes, all basins will be lined for geotechnical purposes to avoid risks of failure.

The biofiltration basins were modeled using the biofiltration LID module within SWMM. The biofiltration module can model the amended soil layer, and a surface storage pond up to the elevation of the invert of the spillway. It should be noted that detailed outlet structure location and elevations will be shown on the construction plans based on the recommendations of this study.

TABLE 3 – SUMMARY OF DETENTION BASIN DIMENSIONS

BMP	Tributary Area (Ac)[7]	DIMENSIONS					
		BMP Area[1] (ft^2)	Gravel Depth[2] (in)	Lower Orif. D (in)[3]	Elev. Weir (ft)[4]	Weir Perimeter Length[5] (ft)	Total Surface Depth[6] (ft)
1	10.880	11,887	18	1-2.25”	3.50	12	4.5
2	2.584	4,121	18	2 - $^7/_8$” [8]	2.50	16[9]	3.0
3	0.495	459	18	1-0.5”	2.50	8	3.0

Notes: (1): Area of amended soil equal to area of gravel
(2): Gravel depth needed to comply with hydromodification purposes. Includes 6” of filter material.
(3): Diameter of orifice in gravel layer with invert at bottom of layer; tied with hydromod min threshold ($0.1 \cdot Q_2$).
(4): Depth of ponding from bottom of mulch to invert of riser spillway.
(5): Overflow length, the internal perimeter of the riser is 8 ft (2 ft x 2 ft internal dimensions).
(6): Total surface depth of BMP from top of amended soil to crest elevation.
(7): Tributary area to basin not including area of BMP.
(8): BMP 2 has 2 riser structures 2-2 and 2-3 which drain to POC-2 and POC-3 respectively. Each has one LID low orifice, D = 0.875”.
(9): Structure 2-2 and 2-3 each has an 8 foot perimeter weir.

TABLE 4 – SUMMARY OF OUTLET DETAILS (SURFACE LEVEL)

BASIN	Low Surface Orifices		Lower Slot		Emergency Weir	
	# - dia (in)	Elev. (ft) [1]	W (in) x H (in)	Elev. (ft)[1]	L (ft)	Elev. (ft)[1]
1	4 - 1”	1.25	72 x 3 (4 slots 18 x 3)	2.50	12	3.50
2 [2]	2- ¾”	1.25	36 x 3 (2 slots, 18 x 3 each)	2.00	8	2.50
2 [3]	n/a	n/a	36 x 3 (2 slots, 18 x 3 each)	2.00	8	2.50
3	1- 1”	1.25	n/a	n/a	8	2.50

Notes: (1): All elevations measured from the top of the amended soil (amended soil/mulch interphase)
(2): This is the outlet structure of BMP-2 that drains to POC-2
(3): This is the outlet structure of BMP-2 that drains to POC-3 (identical than the other but with no low surface orifices)

Important Note: The elevations in Tables 3 and 4 are different than the elevations in Attachment 4 because the attachment refers to the elevations measured above the lowest invert of the surface outlets, while the tables refer to the elevations measured above the top of the amended soil. It is done this way because the portion of the volume below the invert of the lowest surface outlet is included within SWMM in the LID module, while the portion of the water above the invert of the lowest surface outlet is included within SWMM as a detention facility for modeling purposes. For example, for Basin 1, the low surface orifices are at elevation 1.25, and the lower slot is at elevation 2.50, while the emergency weir is at elevation 3.50. In Attachment 4, those elevations are measured above the lowest invert (1.25 ft) and the three elevations become 0.00, 1.25 and 2.25 ft respectively. It should be also noted that the water volume in those 1.25 ft (3” of mulch plus 12” of open volume) do not correspond to 15” of ponding in the LID but rather to an equivalent depth of 12.38” because SWMM assumes the area of the BMP constant, and 12.38” x A_{BMP} is equal to the calculated void volume contained in those 15” of ponding.

BMP MODELING FOR HMP PURPOSES

Modeling of dual purpose Water Quality/HMP BMP

Three (3) LID BMP biofiltration basins are proposed for water quality treatment and hydromodification conformance for the project site. Table 3 illustrates the dimensions required for HMP compliance according to the SWMM model that was undertaken for the project. Table 4 details the outlet structures for the basin surface.

FLOW DURATION CURVE COMPARISON

The Flow Duration Curve (FDC) for the site was compared at POC-1, POC-2, POC-3 and POC-4 by exporting the hourly runoff time series results from SWMM to a spreadsheet. The FDC was compared between 10% of the existing condition Q_2 up to the existing condition Q_{10} for POC-1. The Q_2 and Q_{10} were determined with a partial duration statistical analysis of the runoff time series in an Excel spreadsheet using the Cunnane plotting position method (which is the preferred plotting methodology in the HMP Permit). As the SWMM Model includes a statistical analysis based on the Weibull Plotting Position Method, the Weibull Method was also used within the spreadsheet to ensure that the results were similar to those obtained by the SWMM Model.

The range between 10% of Q_2 and Q_{10} was divided into 100 equal time intervals; the number of hours that each flow rate was exceeded was counted from the hourly series. Additionally, the intermediate peaks with a return period "i" were obtained (Q_i with i=3 to 9). For the purpose of the plot, the values were presented as percentage of time exceeded for each flow rate. FDC comparison at the POC-1, POC-2 and POC-3 is illustrated in Figures 1, 2, and 3 respectively, in both normal and logarithmic scale. Attachment 5 provides a detailed drainage exhibit for the post-developed condition.

As can be seen in Figures 1 to 4, the FDCs for the proposed conditions with the HMP BMPs are within 110% of the curve for the existing conditions in both peak flows and durations for all POCs. The additional runoff volume generated from developing the site will be released to the existing point of discharge at a flow rate below the 10% Q_2 lower threshold for POC-1, POC-2 and POC-3. Additionally, the project will also not increase peak flow rates between the Q_2 and the Q_{10}, as shown in the graphics and also in the peak flow tables in Attachment 1.

Discussion of the Manning's coefficient (Pervious Areas) for Pre and Post-Development Conditions

Typically the Manning's coefficient is selected as n = 0.15 for pervious areas and n = 0.012 for impervious areas. Due to the complexity of the model carried out in pre and post-development conditions, a more accurate value of the Manning's coefficient for pervious areas has been chosen. Taken into consideration the "Handouts on Supplemental Guidance – Handout #2: Manning's "n" Values for Overland Flow Using EPA SWMM V.5" by the County of San Diego a more accurate value of n = 0.05 has been selected (see Table 1 of this reference included in Attachment 7). An average n value between pasture and shrubs and bushes (which is also the value of dense grass) has been selected per the reference cited, for light rain (<0.8 in/hr) as more than 99% of the rainfall has been measured with this intensity.

DRAWDOWN TIME

The volume accumulated at riser elevation divided by the discharge of the two slots and low flow orifice determines the drawdown time of the surface volume. It takes about 45 hours to drawdown the surface of BMP-1, 40 hours for BMP-2 and 24 hours for BMP-3, from crest elevation to surface elevation (see results in Attachment 4). Next storm considerations are included within the continuous simulation, and drying time is sufficient to accommodate hydromodification requirements.

It should be mentioned that in regard to the water quality portion of the BMPs (below the invert elevation of the lowest surface outlet) it takes about 23 hours for the drawdown of BMP-1 (44.9 – 21.8 hrs), about 22.5 hours for the drawdown of BMP-2 (39.6 – 17.2 hrs) and about 14.5 hours for the drawdown of BMP-3 (23.6 – 9.2 hrs), values compatible with the size of the BMP for water quality considerations (see values in Attachment 4).

SUMMARY

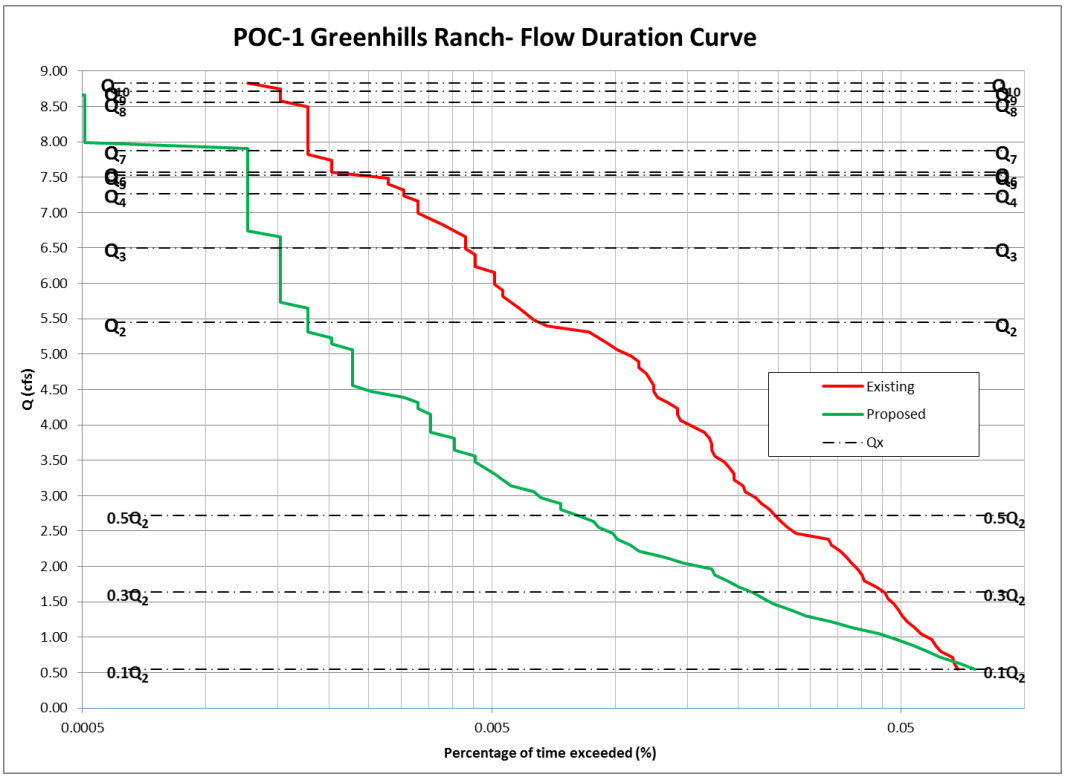
This study has demonstrated that the proposed HMP BMPs provided for the Greenhills Ranch project site are sufficient to meet the current HMP criteria if the cross-section areas and volumes recommended within this technical memorandum and the respective orifice and outlet structure are incorporated as specified within the proposed project site.

KEY ASSUMPTIONS

1. Type C and D Soil are representative of the existing condition site.
2. All Basins are assumed to be lined to prevent infiltration into the ground and/or adjacent to a slope.

ATTACHMENTS

1. Q_2 to Q_{10} Comparison Tables
2. FDC Plots (log and natural “x” scale) and Flow Duration Table
3. List of the “n” largest Peaks: Pre-Development and Post-Development Conditions
4. Elevations vs. Discharge & Stage- Storage Curves to be used in SWMM. Drawdown Time Calculations
5. Pre & Post Development Maps, Project plan and section sketches
6. SWMM Input Data in Input Format (Existing and Proposed Models)
7. SWMM Screens and Explanation of Significant Variables
8. Soil Maps
9. Summary files from the SWMM Model



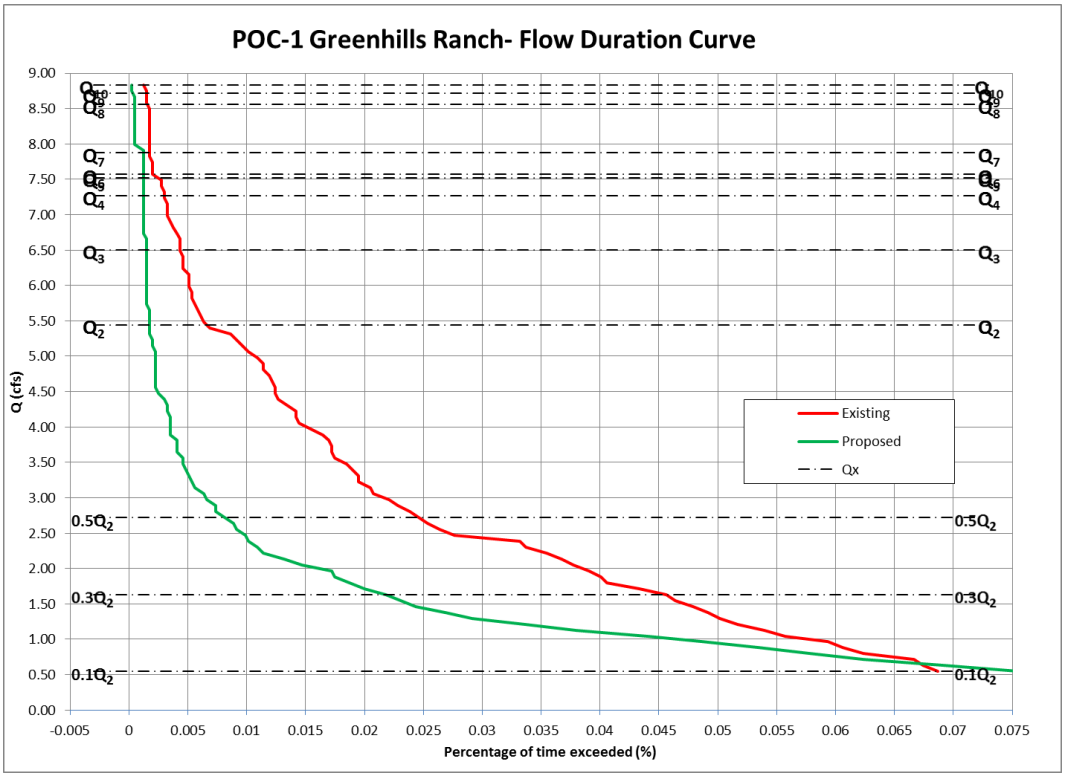


Figure 1a and 1b. Flow Duration Curve Comparison (logarithmic and normal "x" scale)

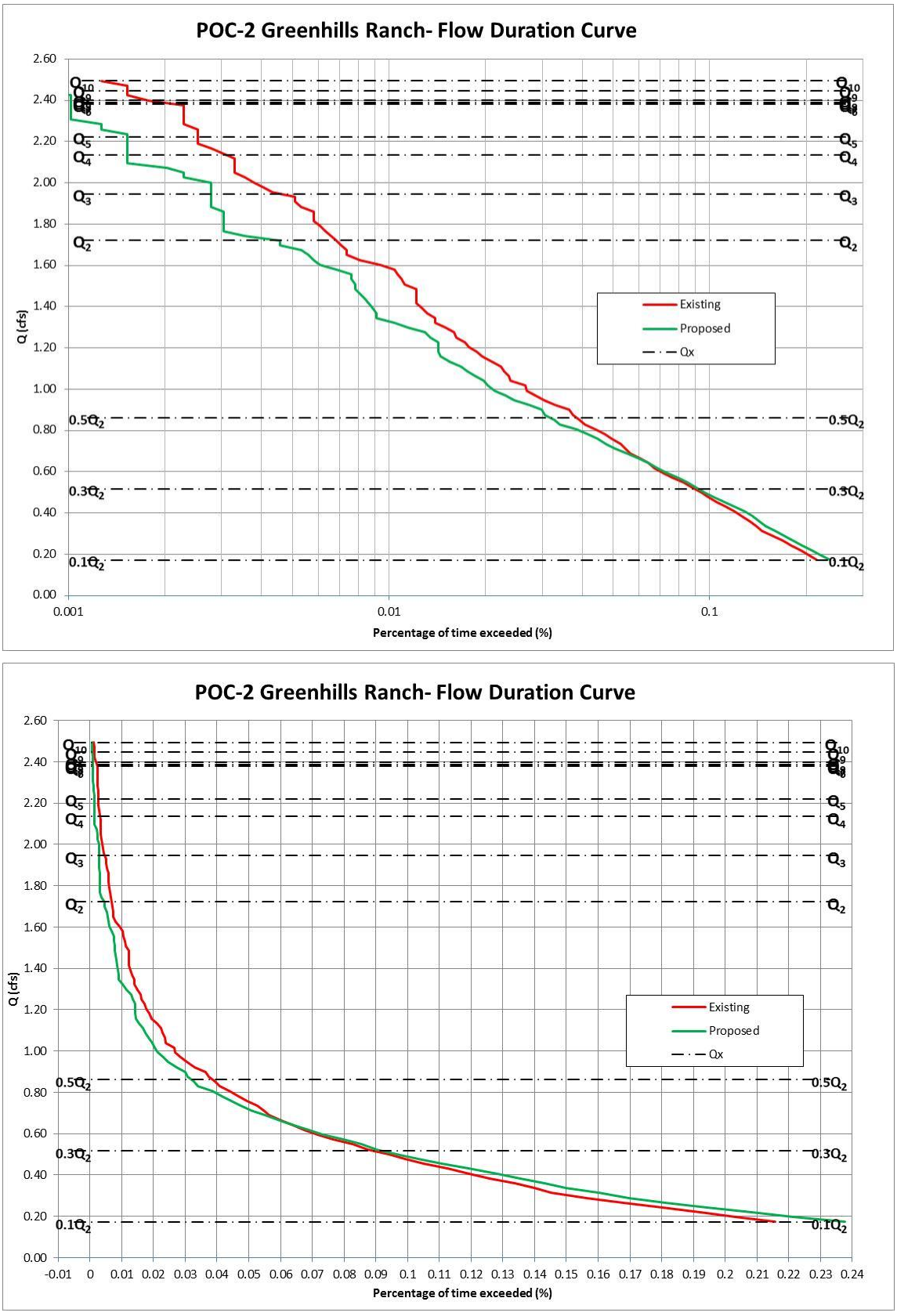
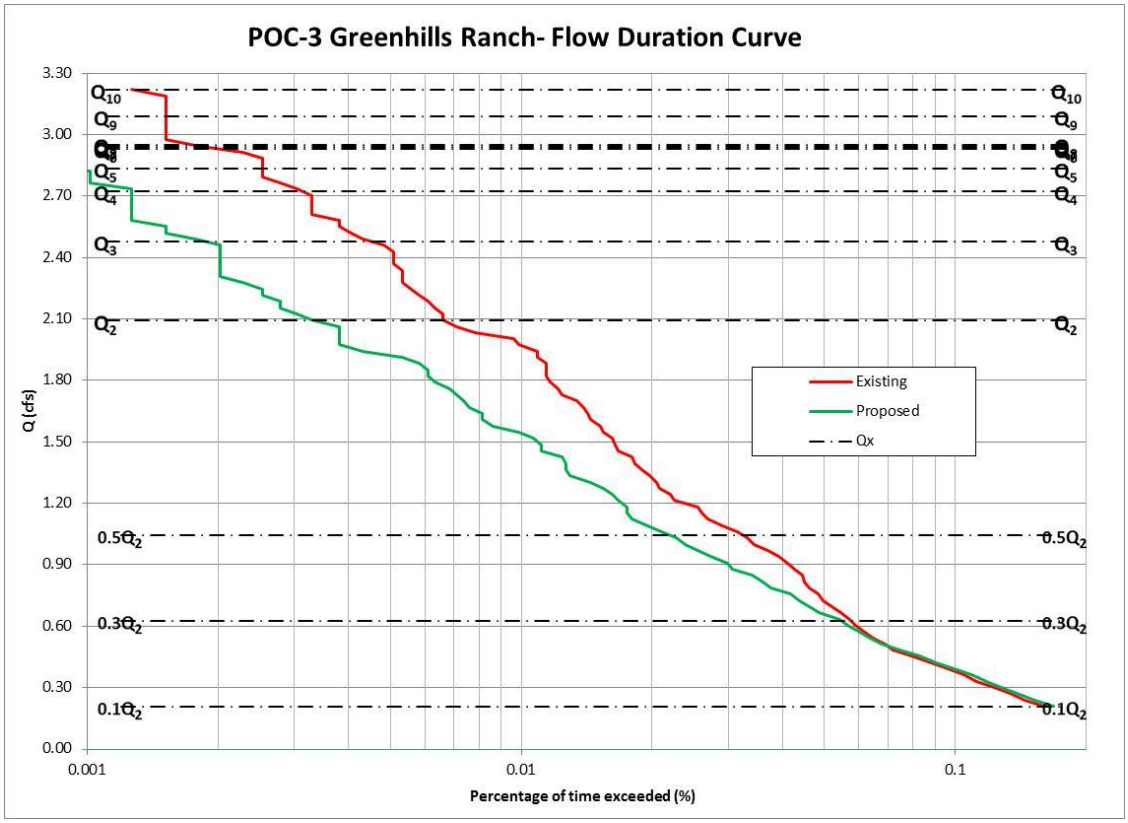


Figure 2a and 2b. Flow Duration Curve Comparison (logarithmic and normal "x" scale)



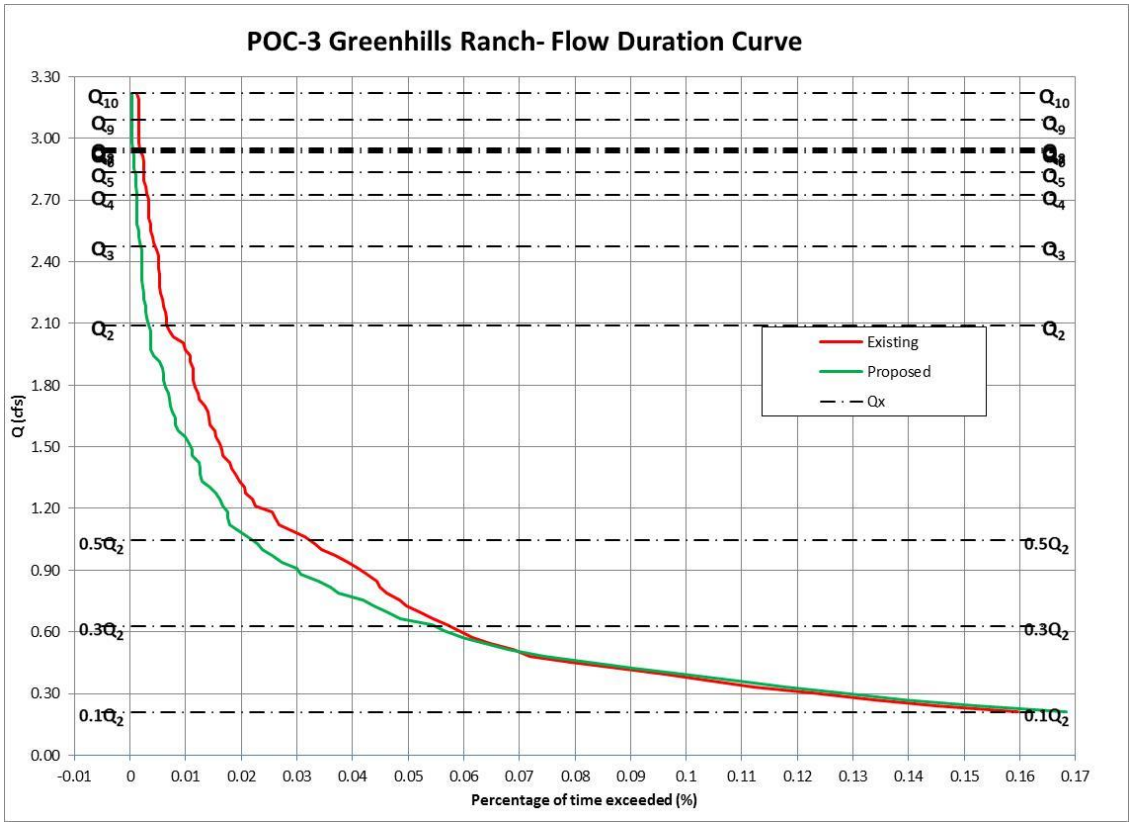
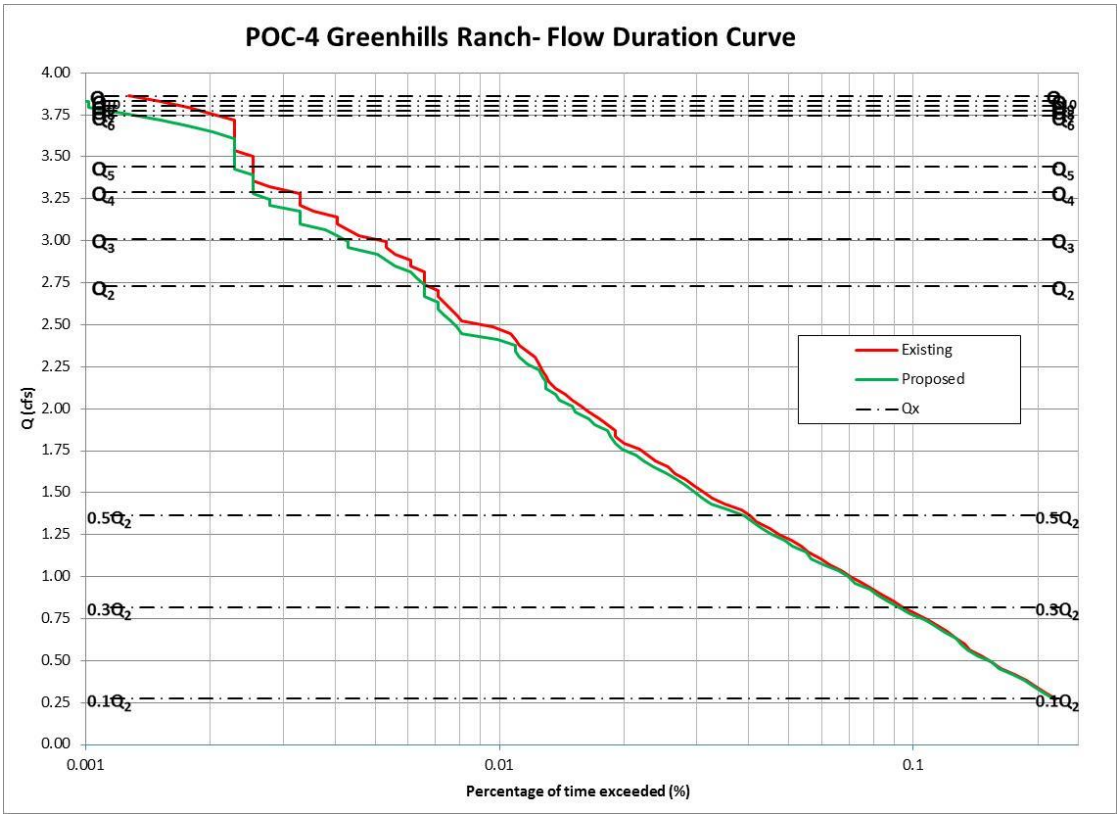


Figure 3a and 3b. Flow Duration Curve Comparison (logarithmic and normal "x" scale)



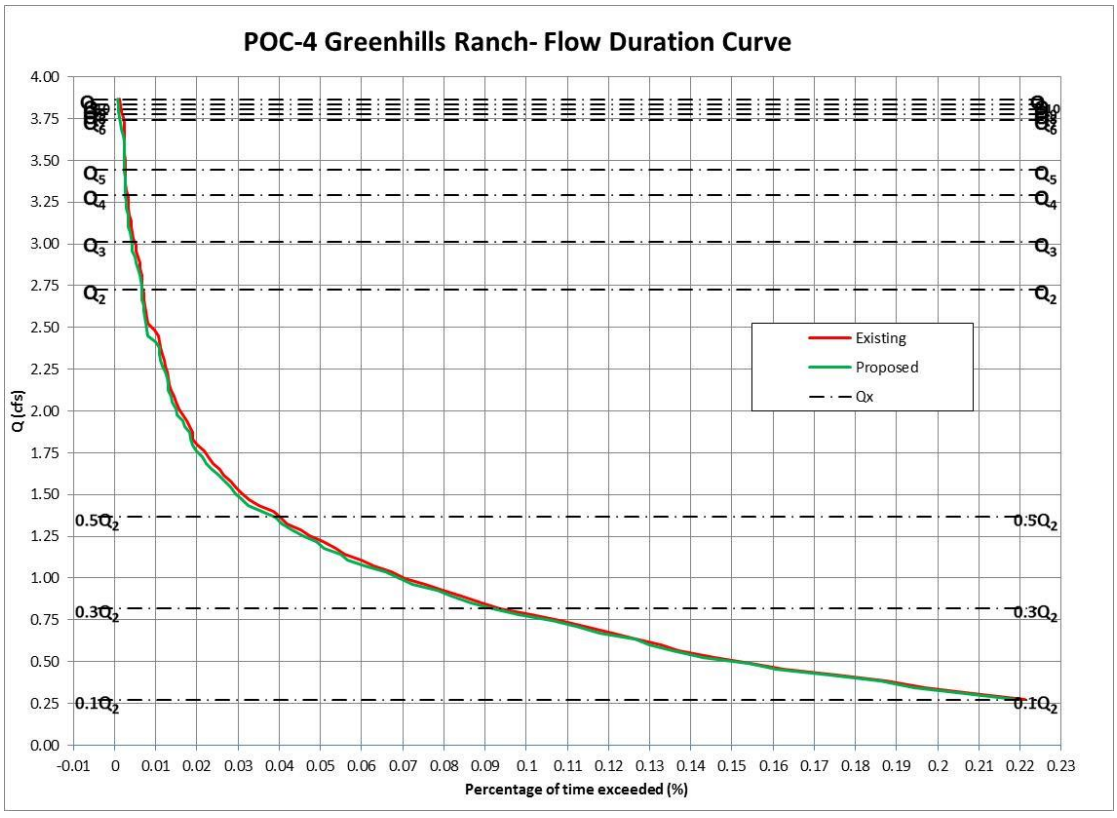


Figure 4a and 4b. Flow Duration Curve Comparison (logarithmic and normal "x" scale)

ATTACHMENT 1.

Q_2 to Q_{10} Comparison Table – POC 1

Return Period	Existing Condition (cfs)	Mitigated Condition (cfs)	Reduction, Exist - Mitigated (cfs)
2-year	5.446	2.423	3.023
3-year	6.504	2.862	3.641
4-year	7.266	3.132	4.134
5-year	7.523	3.860	3.664
6-year	7.569	4.407	3.162
7-year	7.878	4.515	3.363
8-year	8.555	5.081	3.475
9-year	8.713	5.425	3.288
10-year	8.830	5.759	3.070

Q_2 to Q_{10} Comparison Table – POC 2

Return Period	Existing Condition (cfs)	Mitigated Condition (cfs)	Reduction, Exist - Mitigated (cfs)
2-year	1.723	1.557	0.165
3-year	1.945	1.659	0.286
4-year	2.134	1.736	0.398
5-year	2.221	1.890	0.332
6-year	2.379	2.007	0.372
7-year	2.388	2.075	0.312
8-year	2.399	2.085	0.315
9-year	2.447	2.169	0.278
10-year	2.494	2.256	0.238

Q_2 to Q_{10} Comparison Table – POC 3

Return Period	Existing Condition (cfs)	Mitigated Condition (cfs)	Reduction, Exist - Mitigated (cfs)
2-year	2.092	1.690	0.401
3-year	2.477	1.919	0.558
4-year	2.725	2.094	0.631
5-year	2.835	2.163	0.672
6-year	2.931	2.254	0.677
7-year	2.941	2.316	0.626
8-year	2.952	2.485	0.466
9-year	3.091	2.635	0.456
10-year	3.220	2.762	0.458

Q_2 to Q_{10} Comparison Table – POC 4

Return Period	Existing Condition (cfs)	Mitigated Condition (cfs)	Reduction, Exist - Mitigated (cfs)
2-year	2.728	2.652	0.076
3-year	3.011	2.931	0.080
4-year	3.292	3.192	0.100
5-year	3.441	3.344	0.097
6-year	3.742	3.639	0.103
7-year	3.774	3.673	0.101
8-year	3.805	3.713	0.092
9-year	3.834	3.733	0.101
10-year	3.864	3.754	0.110

ATTACHMENT 2

FLOW DURATION CURVE ANALYSIS

1) Flow duration curve shall not exceed the existing conditions by more than 10%, neither in peak flow nor duration.

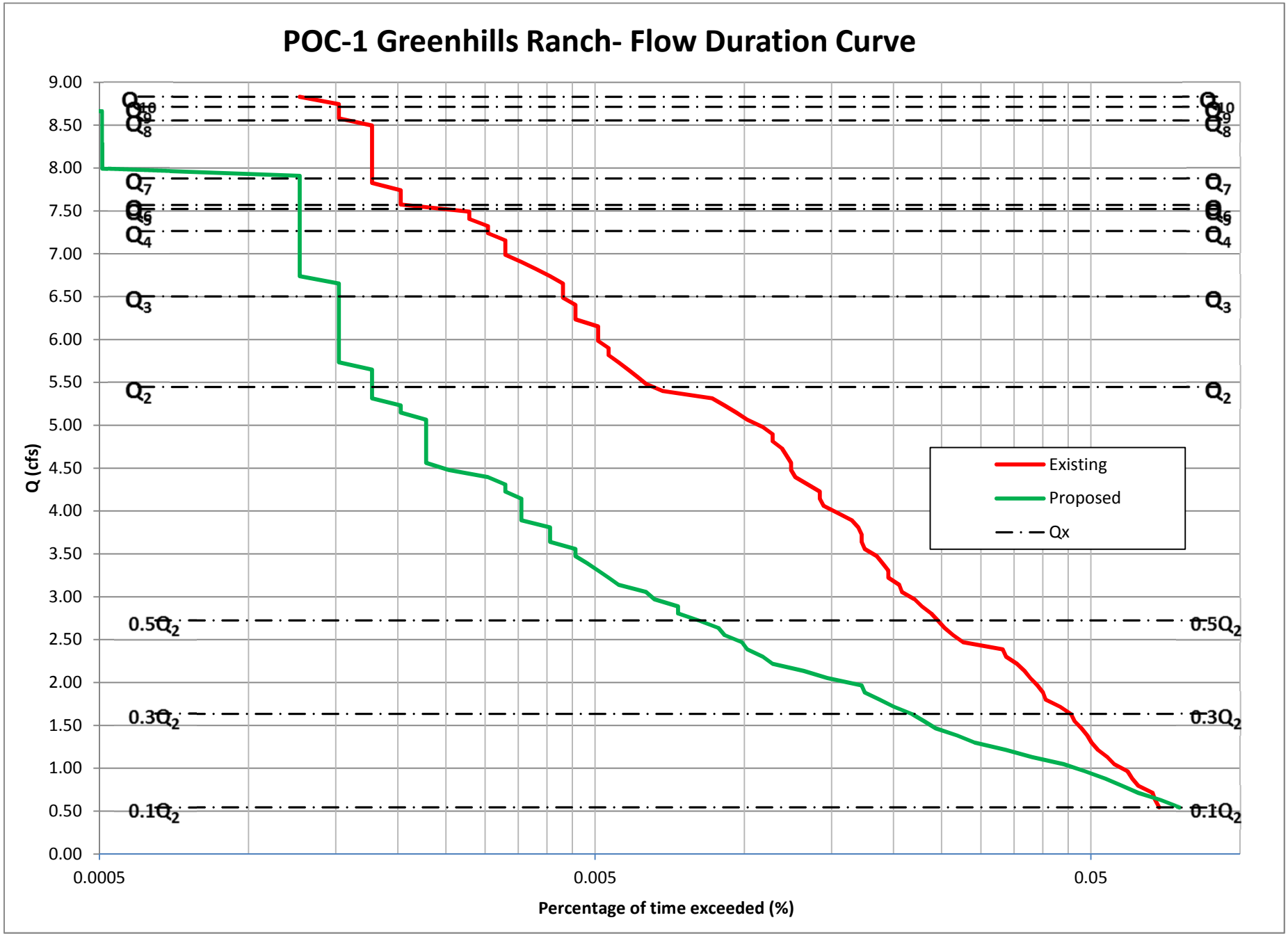
The figures on the following pages illustrate that the flow duration curve in post-development conditions, after the proposed BMP is implemented, is below the existing flow duration curve. The flow duration curve table, following the curve, shows that if the interval $0.10Q_2 - Q_{10}$ is divided in 100 sub-intervals, then a) the post development divided by pre-development durations are never larger than 110% (the permit allows up to 110%); and b) there are no more than 10 intervals in the range 101%-110% which would imply an excess over 10% of the length of the curve (the permit allows less than 10% of excesses measured as 101-110%).

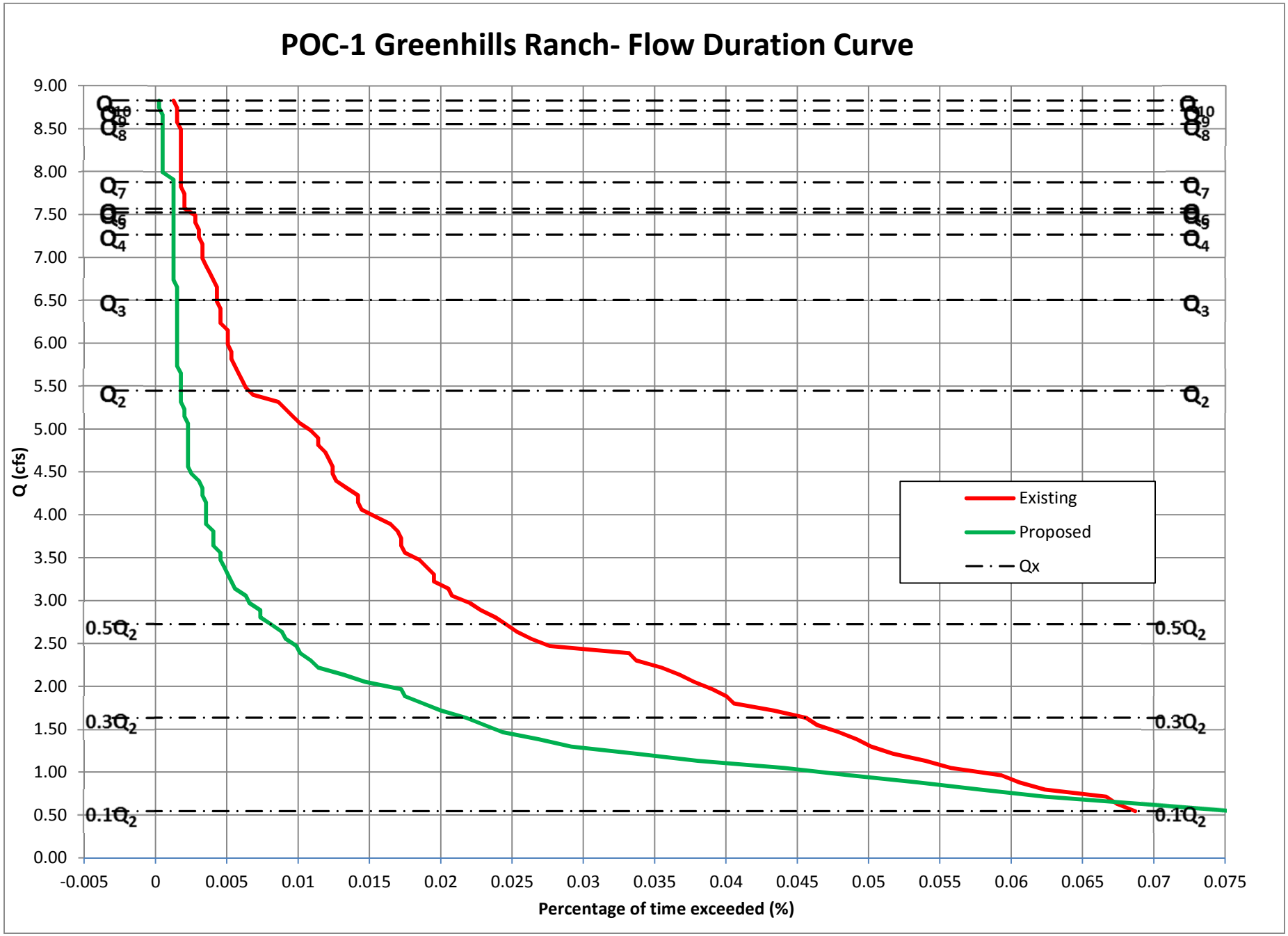
Consequently, the design passes the hydromodification test.

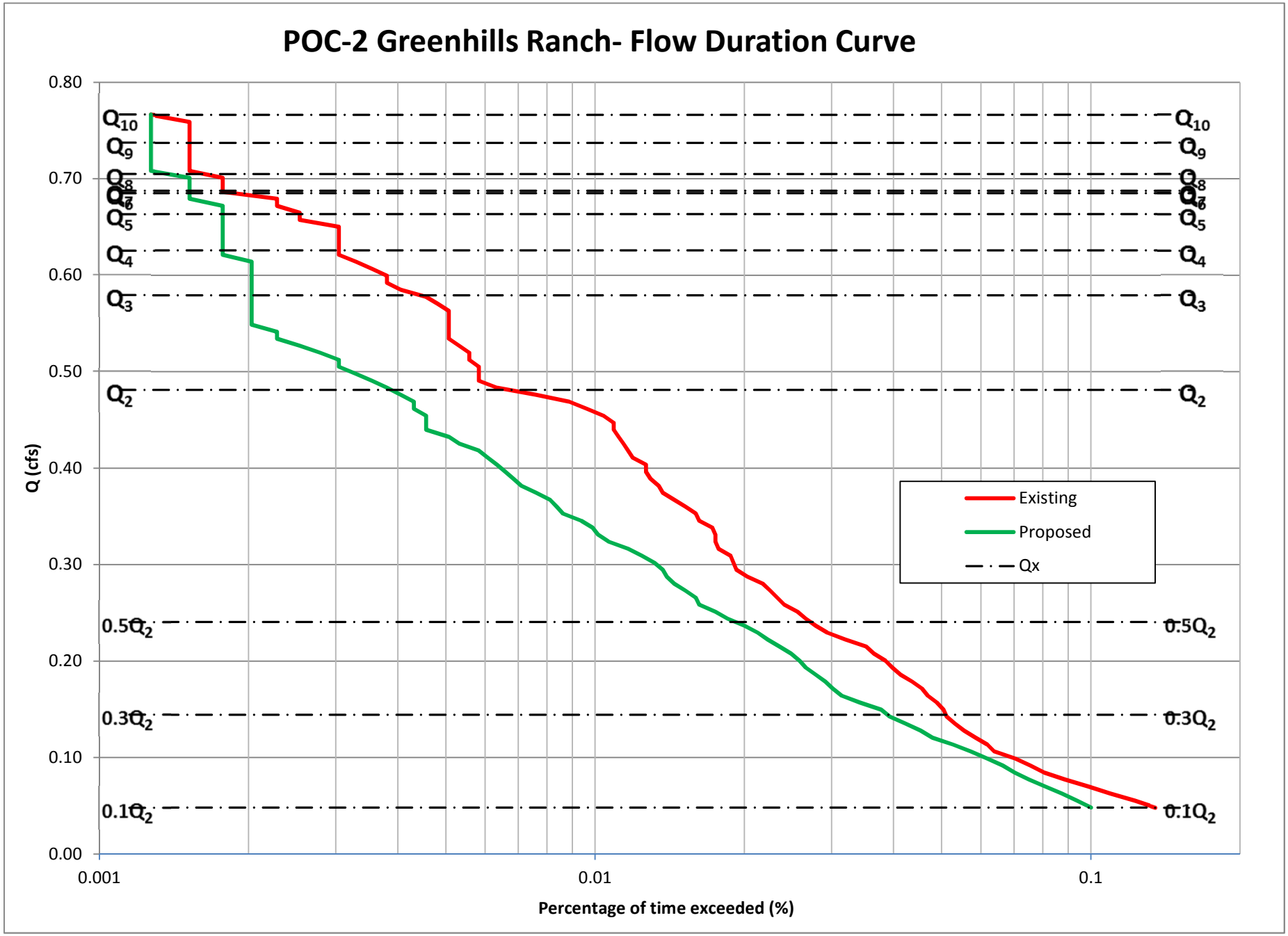
It is important to note that the flow duration curve can be expressed in the "x" axis as percentage of time, hours per year, total number of hours, or any other similar time variable. As those variables only differ by a multiplying constant, their plot in logarithmic scale is going to look exactly the same, and compliance can be observed regardless of the variable selected. However, in order to satisfy the County of San Diego HMP example, % of time exceeded is the variable of choice in the flow duration curve. The selection of a logarithmic scale in lieu of the normal scale is preferred, as differences between the pre-development and post-development curves can be seen more clearly in the entire range of analysis. Both graphics are presented just to prove the difference.

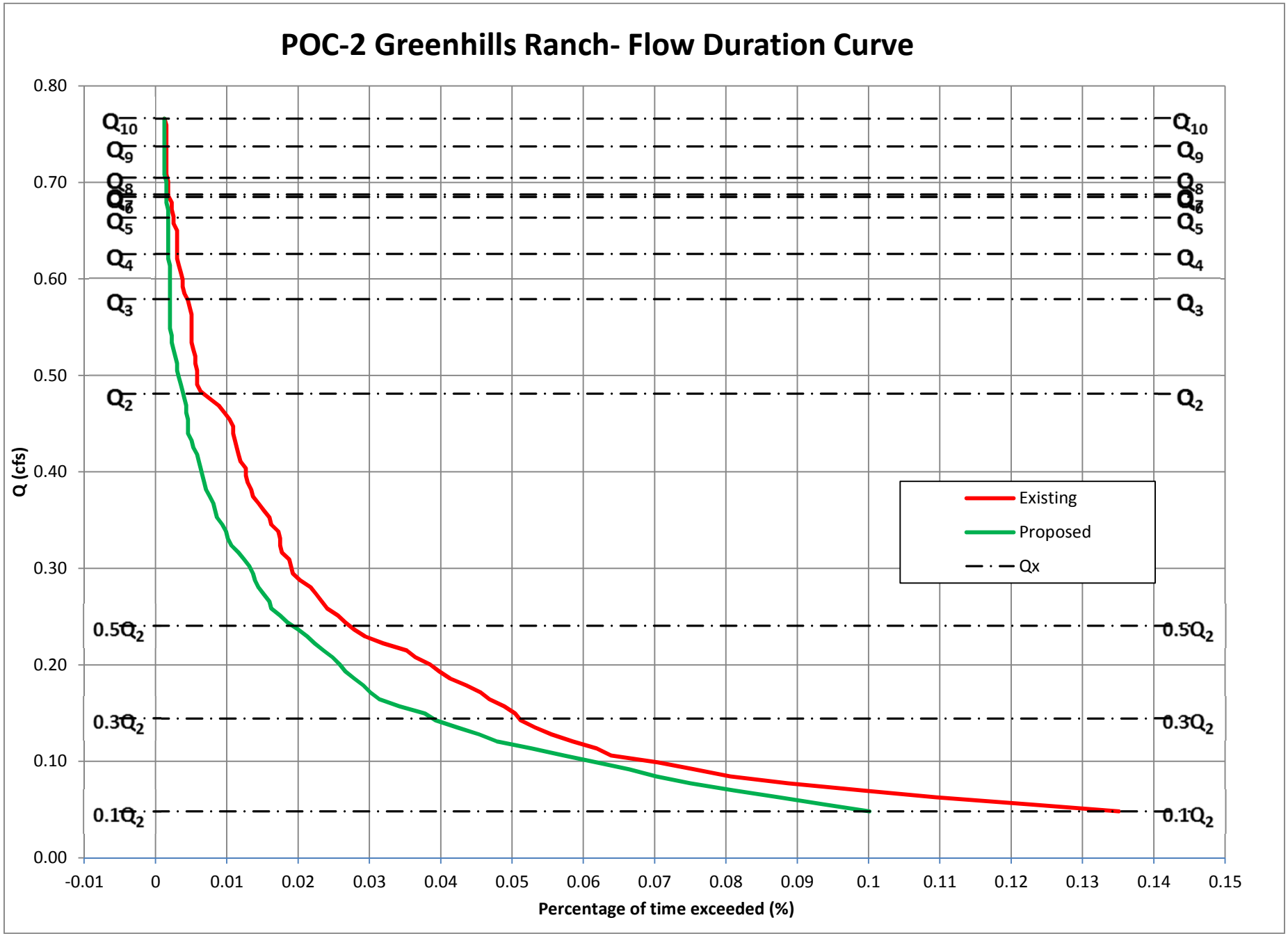
In terms of the "y" axis, the peak flow value is the variable of choice. As an additional analysis performed by REC, not only the range of analysis is clearly depicted (10% of Q_2 to Q_{10}) but also all intermediate flows are shown (Q_2, Q_3, Q_4, Q_5, Q_6, Q_7, Q_8 and Q_9) in order to demonstrate compliance at any range $Q_x - Q_{x+1}$. It must be pointed out that one of the limitations of both the SWMM and SDHM models is that the intermediate analysis is not performed (to obtain Q_i from i = 2 to 10). REC performed the analysis using the Cunnane Plotting position Method (the preferred method in the HMP permit) from the "n" largest independent peak flows obtained from the continuous time series.

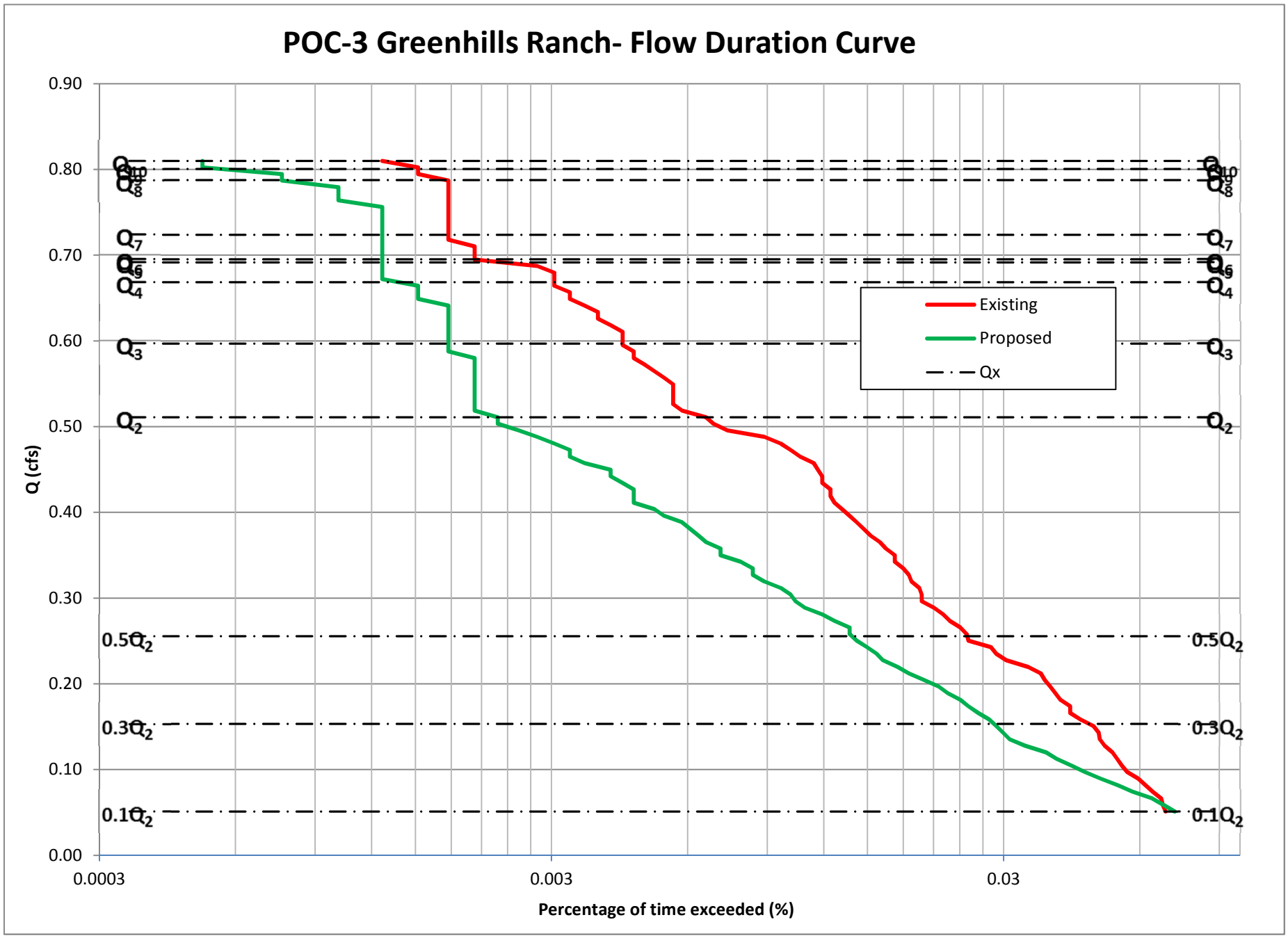
The largest "n" peak flows are attached in this appendix, as well as the values of Q_i with a return period "i", from i=2 to 10. The Q_i values are also added into the flow-duration plot.

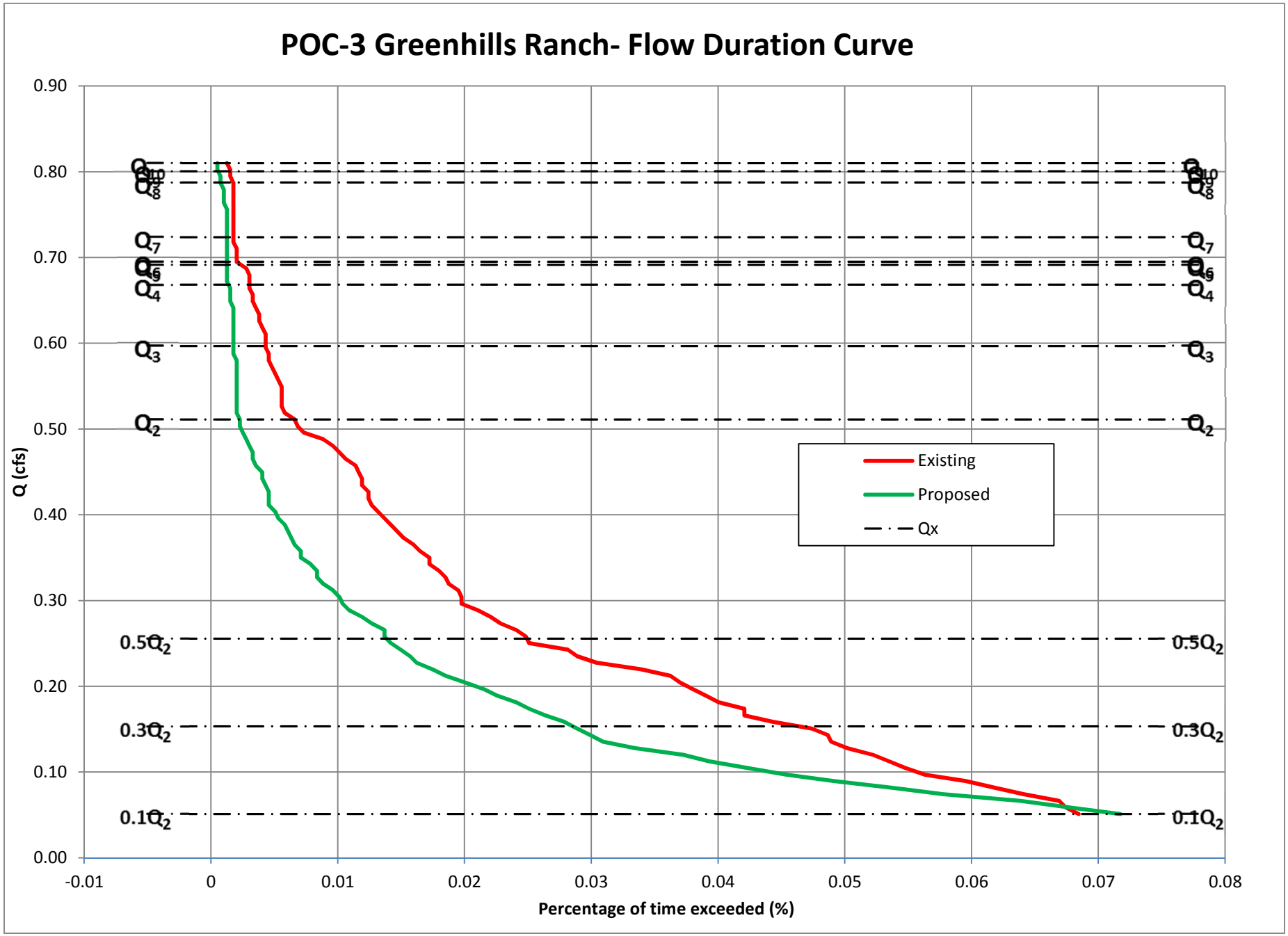

POC-1 Greenhills Ranch- Flow Duration Curve
Q (cfs)
9.00
8.50
8.00
7.50
7.00
6.50
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Q10
Q9
Q8
Q7
Q6
Q4
Q3
Q2
0.5Q2
0.3Q2
0.1Q2
Existing
Proposed
Qx
0.0005
0.005
0.05
Percentage of time exceeded (%)

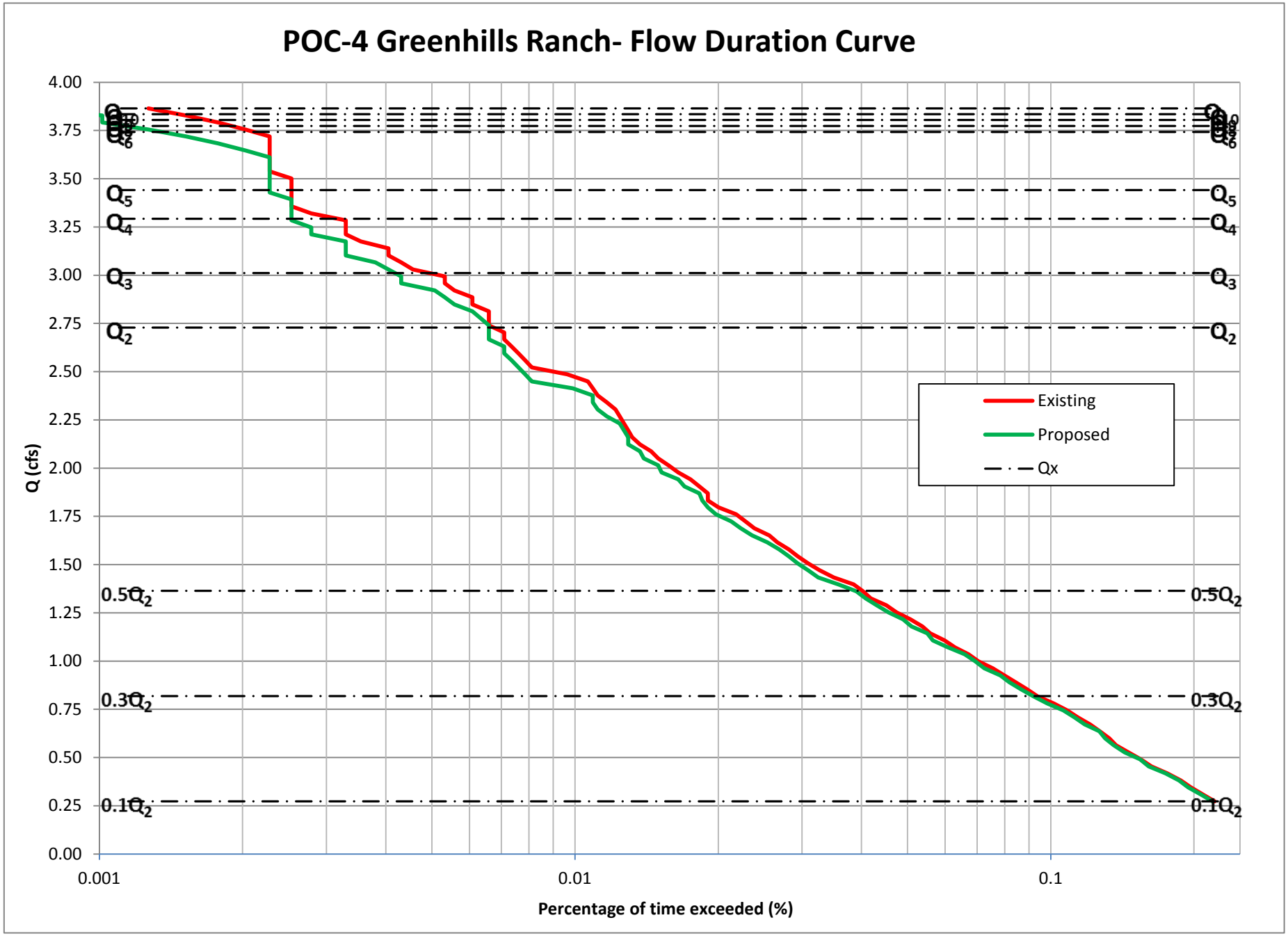

POC-1 Greenhills Ranch- Flow Duration Curve
Q (cfs)
9.00
8.50
8.00
7.50
7.00
6.50
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Q10
Q9
Q8
Q7
Q6
Q4
Q3
Q2
0.5Q2
0.3Q2
0.1Q2
Existing
Proposed
Qx
-0.005
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
0.04
0.045
0.05
0.055
0.06
0.065
0.07
0.075
Percentage of time exceeded (%)

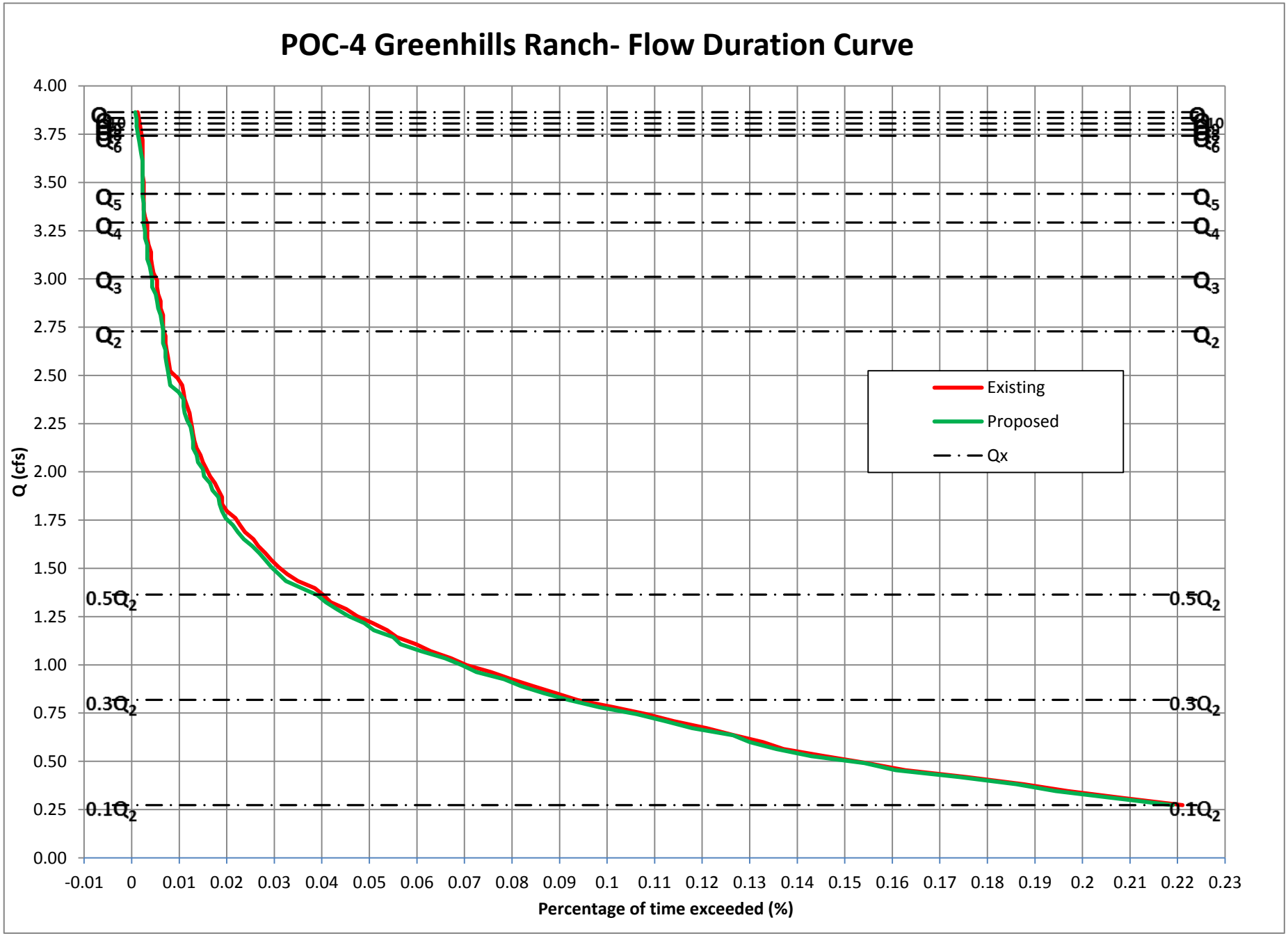

POC-2 Greenhills Ranch- Flow Duration Curve
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Q (cfs)
Q_{10}
Q_9
Q_8
Q_7
Q_6
Q_5
Q_4
Q_3
Q_2
$0.5Q_2$
$0.3Q_2$
$0.1Q_2$
Existing
Proposed
Qx
0.001
0.01
0.1
Percentage of time exceeded (%)


POC-2 Greenhills Ranch- Flow Duration Curve
Q (cfs)
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Q10
Q9
Q8
Q7
Q6
Q5
Q4
Q3
Q2
0.5Q2
0.3Q2
0.1Q2
-0.01
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.1
0.11
0.12
0.13
0.14
0.15
Percentage of time exceeded (%)
Existing
Proposed
Qx


POC-3 Greenhills Ranch- Flow Duration Curve
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Q (cfs)
Existing
Proposed
Qx
0.5Q2
0.3Q2
0.1Q2
0.0003
0.003
0.03
Percentage of time exceeded (%)


POC-3 Greenhills Ranch- Flow Duration Curve
Q (cfs)
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
-0.01
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
Percentage of time exceeded (%)
Existing
Proposed
Qx
Q10
Q8
Q7
Q6
Q4
Q3
Q2
0.5Q2
0.3Q2
0.1Q2


POC-4 Greenhills Ranch- Flow Duration Curve
Q (cfs)
4.00
3.75
3.50
3.25
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
Q6
Q5
Q4
Q3
Q2
0.5Q2
0.3Q2
0.1Q2
Existing
Proposed
Qx
0.001
0.01
0.1
Percentage of time exceeded (%)


POC-4 Greenhills Ranch- Flow Duration Curve
Q (cfs)
4.00
3.75
3.50
3.25
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
Q5
Q4
Q3
Q2
0.5Q2
0.3Q2
0.1Q2
Existing
Proposed
Qx
-0.01 0 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.1 0.11 0.12 0.13 0.14 0.15 0.16 0.17 0.18 0.19 0.2 0.21 0.22 0.23
Percentage of time exceeded (%)

Flow Duration Curve Data for Greenhills Ranch POC-1 , Lakeside, CA

Q2 =	2.745	cfs	Fraction	10 %
Q10 =	4.79	cfs		
Step =	0.0457	cfs		
Count =	394487	hours		
	45.00	years		

	Existing Condition			Detention Optimized			Pass or
Interval	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	Fail?
1	0.275	270	6.84E-02	290	7.35E-02	107%	Pass
2	0.320	256	6.49E-02	275	6.97E-02	107%	Pass
3	0.366	249	6.31E-02	258	6.54E-02	104%	Pass
4	0.411	233	5.91E-02	243	6.16E-02	104%	Pass
5	0.457	223	5.65E-02	224	5.68E-02	100%	Pass
6	0.503	211	5.35E-02	202	5.12E-02	96%	Pass
7	0.548	203	5.15E-02	176	4.46E-02	87%	Pass
8	0.594	189	4.79E-02	162	4.11E-02	86%	Pass
9	0.640	182	4.61E-02	151	3.83E-02	83%	Pass
10	0.685	169	4.28E-02	139	3.52E-02	82%	Pass
11	0.731	162	4.11E-02	129	3.27E-02	80%	Pass
12	0.777	156	3.95E-02	120	3.04E-02	77%	Pass
13	0.822	148	3.75E-02	116	2.94E-02	78%	Pass
14	0.868	141	3.57E-02	107	2.71E-02	76%	Pass
15	0.914	137	3.47E-02	102	2.59E-02	74%	Pass
16	0.959	133	3.37E-02	97	2.46E-02	73%	Pass
17	1.005	126	3.19E-02	91	2.31E-02	72%	Pass
18	1.051	122	3.09E-02	88	2.23E-02	72%	Pass
19	1.096	115	2.92E-02	83	2.10E-02	72%	Pass
20	1.142	111	2.81E-02	76	1.93E-02	68%	Pass
21	1.188	109	2.76E-02	74	1.88E-02	68%	Pass
22	1.233	101	2.56E-02	72	1.83E-02	71%	Pass
23	1.279	98	2.48E-02	69	1.75E-02	70%	Pass
24	1.325	94	2.38E-02	64	1.62E-02	68%	Pass
25	1.370	92	2.33E-02	60	1.52E-02	65%	Pass
26	1.416	88	2.23E-02	58	1.47E-02	66%	Pass
27	1.462	84	2.13E-02	57	1.44E-02	68%	Pass
28	1.507	80	2.03E-02	51	1.29E-02	64%	Pass
29	1.553	77	1.95E-02	48	1.22E-02	62%	Pass
30	1.599	71	1.80E-02	44	1.12E-02	62%	Pass
31	1.644	69	1.75E-02	39	9.89E-03	57%	Pass
32	1.690	68	1.72E-02	37	9.38E-03	54%	Pass
33	1.735	66	1.67E-02	36	9.13E-03	55%	Pass
34	1.781	64	1.62E-02	35	8.87E-03	55%	Pass
35	1.827	63	1.60E-02	33	8.37E-03	52%	Pass
36	1.872	59	1.50E-02	32	8.11E-03	54%	Pass

Interval	Existing Condition			Detention Optimized			Pass or Fail?
	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	
37	1.918	56	1.42E-02	30	7.60E-03	54%	Pass
38	1.964	55	1.39E-02	29	7.35E-03	53%	Pass
39	2.009	51	1.29E-02	27	6.84E-03	53%	Pass
40	2.055	45	1.14E-02	27	6.84E-03	60%	Pass
41	2.101	45	1.14E-02	27	6.84E-03	60%	Pass
42	2.146	44	1.12E-02	25	6.34E-03	57%	Pass
43	2.192	43	1.09E-02	25	6.34E-03	58%	Pass
44	2.238	41	1.04E-02	24	6.08E-03	59%	Pass
45	2.283	41	1.04E-02	24	6.08E-03	59%	Pass
46	2.329	41	1.04E-02	23	5.83E-03	56%	Pass
47	2.375	39	9.89E-03	23	5.83E-03	59%	Pass
48	2.420	38	9.63E-03	21	5.32E-03	55%	Pass
49	2.466	38	9.63E-03	21	5.32E-03	55%	Pass
50	2.512	37	9.38E-03	21	5.32E-03	57%	Pass
51	2.557	37	9.38E-03	20	5.07E-03	54%	Pass
52	2.603	37	9.38E-03	20	5.07E-03	54%	Pass
53	2.649	36	9.13E-03	19	4.82E-03	53%	Pass
54	2.694	35	8.87E-03	19	4.82E-03	54%	Pass
55	2.740	33	8.37E-03	16	4.06E-03	48%	Pass
56	2.786	30	7.60E-03	15	3.80E-03	50%	Pass
57	2.831	28	7.10E-03	14	3.55E-03	50%	Pass
58	2.877	28	7.10E-03	13	3.30E-03	46%	Pass
59	2.923	28	7.10E-03	13	3.30E-03	46%	Pass
60	2.968	26	6.59E-03	12	3.04E-03	46%	Pass
61	3.014	26	6.59E-03	11	2.79E-03	42%	Pass
62	3.059	25	6.34E-03	10	2.53E-03	40%	Pass
63	3.105	24	6.08E-03	10	2.53E-03	42%	Pass
64	3.151	23	5.83E-03	10	2.53E-03	43%	Pass
65	3.196	22	5.58E-03	10	2.53E-03	45%	Pass
66	3.242	22	5.58E-03	9	2.28E-03	41%	Pass
67	3.288	21	5.32E-03	8	2.03E-03	38%	Pass
68	3.333	20	5.07E-03	8	2.03E-03	40%	Pass
69	3.379	18	4.56E-03	8	2.03E-03	44%	Pass
70	3.425	17	4.31E-03	8	2.03E-03	47%	Pass
71	3.470	17	4.31E-03	8	2.03E-03	47%	Pass
72	3.516	17	4.31E-03	8	2.03E-03	47%	Pass
73	3.562	16	4.06E-03	8	2.03E-03	50%	Pass
74	3.607	16	4.06E-03	7	1.77E-03	44%	Pass
75	3.653	15	3.80E-03	7	1.77E-03	47%	Pass
76	3.699	15	3.80E-03	7	1.77E-03	47%	Pass
77	3.744	15	3.80E-03	6	1.52E-03	40%	Pass
78	3.790	15	3.80E-03	6	1.52E-03	40%	Pass
79	3.836	13	3.30E-03	6	1.52E-03	46%	Pass
80	3.881	12	3.04E-03	6	1.52E-03	50%	Pass
81	3.927	11	2.79E-03	6	1.52E-03	55%	Pass

Interval	Existing Condition			Detention Optimized			Pass or Fail?
	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	
82	3.973	11	2.79E-03	6	1.52E-03	55%	Pass
83	4.018	10	2.53E-03	6	1.52E-03	60%	Pass
84	4.064	10	2.53E-03	6	1.52E-03	60%	Pass
85	4.110	10	2.53E-03	6	1.52E-03	60%	Pass
86	4.155	10	2.53E-03	6	1.52E-03	60%	Pass
87	4.201	8	2.03E-03	6	1.52E-03	75%	Pass
88	4.247	8	2.03E-03	6	1.52E-03	75%	Pass
89	4.292	8	2.03E-03	6	1.52E-03	75%	Pass
90	4.338	8	2.03E-03	6	1.52E-03	75%	Pass
91	4.383	8	2.03E-03	6	1.52E-03	75%	Pass
92	4.429	7	1.77E-03	5	1.27E-03	71%	Pass
93	4.475	7	1.77E-03	5	1.27E-03	71%	Pass
94	4.520	5	1.27E-03	5	1.27E-03	100%	Pass
95	4.566	5	1.27E-03	5	1.27E-03	100%	Pass
96	4.612	5	1.27E-03	3	7.60E-04	60%	Pass
97	4.657	5	1.27E-03	3	7.60E-04	60%	Pass
98	4.703	5	1.27E-03	3	7.60E-04	60%	Pass
99	4.749	5	1.27E-03	3	7.60E-04	60%	Pass
100	4.794	4	1.01E-03	3	7.60E-04	75%	Pass

Peak Flows calculated with Cunnane Plotting Position

Return Period (years)	Pre-dev. Q (cfs)	Post-Dev. Q (cfs)	Reduction (cfs)
10	4.794	3.749	1.045
9	4.644	3.358	1.286
8	4.488	2.964	1.524
7	4.214	2.882	1.332
6	4.159	2.807	1.352
5	3.940	2.688	1.252
4	3.810	2.335	1.475
3	3.368	1.785	1.582
2	2.745	1.333	1.412

Flow Duration Curve Data for Greenhills Ranch POC-2 , Lakeside, CA

Q2 =	0.481	cfs	Fraction	10 %
Q10 =	0.77	cfs		
Step =	0.0073	cfs		
Count =	394487	hours		
	45.00	years		

	Existing Condition			Detention Optimized			Pass or
Interval	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	Fail?
1	0.048	533	1.35E-01	395	1.00E-01	74%	Pass
2	0.055	484	1.23E-01	370	9.38E-02	76%	Pass
3	0.063	432	1.10E-01	345	8.75E-02	80%	Pass
4	0.070	391	9.91E-02	320	8.11E-02	82%	Pass
5	0.077	350	8.87E-02	296	7.50E-02	85%	Pass
6	0.084	318	8.06E-02	277	7.02E-02	87%	Pass
7	0.092	298	7.55E-02	262	6.64E-02	88%	Pass
8	0.099	278	7.05E-02	244	6.19E-02	88%	Pass
9	0.106	252	6.39E-02	226	5.73E-02	90%	Pass
10	0.113	244	6.19E-02	208	5.27E-02	85%	Pass
11	0.121	231	5.86E-02	189	4.79E-02	82%	Pass
12	0.128	219	5.55E-02	179	4.54E-02	82%	Pass
13	0.135	210	5.32E-02	167	4.23E-02	80%	Pass
14	0.142	202	5.12E-02	155	3.93E-02	77%	Pass
15	0.150	199	5.04E-02	149	3.78E-02	75%	Pass
16	0.157	193	4.89E-02	135	3.42E-02	70%	Pass
17	0.164	185	4.69E-02	124	3.14E-02	67%	Pass
18	0.171	180	4.56E-02	119	3.02E-02	66%	Pass
19	0.179	172	4.36E-02	115	2.92E-02	67%	Pass
20	0.186	163	4.13E-02	110	2.79E-02	67%	Pass
21	0.193	157	3.98E-02	105	2.66E-02	67%	Pass
22	0.200	152	3.85E-02	102	2.59E-02	67%	Pass
23	0.208	144	3.65E-02	98	2.48E-02	68%	Pass
24	0.215	139	3.52E-02	93	2.36E-02	67%	Pass
25	0.222	126	3.19E-02	88	2.23E-02	70%	Pass
26	0.229	116	2.94E-02	84	2.13E-02	72%	Pass
27	0.237	110	2.79E-02	79	2.00E-02	72%	Pass
28	0.244	105	2.66E-02	73	1.85E-02	70%	Pass
29	0.251	101	2.56E-02	69	1.75E-02	68%	Pass
30	0.258	95	2.41E-02	64	1.62E-02	67%	Pass
31	0.266	92	2.33E-02	63	1.60E-02	68%	Pass
32	0.273	89	2.26E-02	60	1.52E-02	67%	Pass
33	0.280	86	2.18E-02	57	1.44E-02	66%	Pass
34	0.287	80	2.03E-02	55	1.39E-02	69%	Pass
35	0.295	76	1.93E-02	54	1.37E-02	71%	Pass
36	0.302	75	1.90E-02	52	1.32E-02	69%	Pass

Interval	Existing Condition			Detention Optimized			Pass or Fail?
	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	
37	0.309	74	1.88E-02	49	1.24E-02	66%	Pass
38	0.316	70	1.77E-02	46	1.17E-02	66%	Pass
39	0.324	69	1.75E-02	42	1.06E-02	61%	Pass
40	0.331	69	1.75E-02	40	1.01E-02	58%	Pass
41	0.338	68	1.72E-02	39	9.89E-03	57%	Pass
42	0.345	64	1.62E-02	37	9.38E-03	58%	Pass
43	0.353	63	1.60E-02	34	8.62E-03	54%	Pass
44	0.360	60	1.52E-02	33	8.37E-03	55%	Pass
45	0.367	57	1.44E-02	32	8.11E-03	56%	Pass
46	0.375	54	1.37E-02	30	7.60E-03	56%	Pass
47	0.382	53	1.34E-02	28	7.10E-03	53%	Pass
48	0.389	51	1.29E-02	27	6.84E-03	53%	Pass
49	0.396	50	1.27E-02	26	6.59E-03	52%	Pass
50	0.404	50	1.27E-02	25	6.34E-03	50%	Pass
51	0.411	47	1.19E-02	24	6.08E-03	51%	Pass
52	0.418	46	1.17E-02	23	5.83E-03	50%	Pass
53	0.425	45	1.14E-02	21	5.32E-03	47%	Pass
54	0.433	44	1.12E-02	20	5.07E-03	45%	Pass
55	0.440	43	1.09E-02	18	4.56E-03	42%	Pass
56	0.447	43	1.09E-02	18	4.56E-03	42%	Pass
57	0.454	41	1.04E-02	18	4.56E-03	44%	Pass
58	0.462	38	9.63E-03	17	4.31E-03	45%	Pass
59	0.469	35	8.87E-03	17	4.31E-03	49%	Pass
60	0.476	30	7.60E-03	16	4.06E-03	53%	Pass
61	0.483	25	6.34E-03	15	3.80E-03	60%	Pass
62	0.491	23	5.83E-03	14	3.55E-03	61%	Pass
63	0.498	23	5.83E-03	13	3.30E-03	57%	Pass
64	0.505	23	5.83E-03	12	3.04E-03	52%	Pass
65	0.512	22	5.58E-03	12	3.04E-03	55%	Pass
66	0.520	22	5.58E-03	11	2.79E-03	50%	Pass
67	0.527	21	5.32E-03	10	2.53E-03	48%	Pass
68	0.534	20	5.07E-03	9	2.28E-03	45%	Pass
69	0.541	20	5.07E-03	9	2.28E-03	45%	Pass
70	0.549	20	5.07E-03	8	2.03E-03	40%	Pass
71	0.556	20	5.07E-03	8	2.03E-03	40%	Pass
72	0.563	20	5.07E-03	8	2.03E-03	40%	Pass
73	0.570	19	4.82E-03	8	2.03E-03	42%	Pass
74	0.578	18	4.56E-03	8	2.03E-03	44%	Pass
75	0.585	16	4.06E-03	8	2.03E-03	50%	Pass
76	0.592	15	3.80E-03	8	2.03E-03	53%	Pass
77	0.599	15	3.80E-03	8	2.03E-03	53%	Pass
78	0.607	14	3.55E-03	8	2.03E-03	57%	Pass
79	0.614	13	3.30E-03	8	2.03E-03	62%	Pass
80	0.621	12	3.04E-03	7	1.77E-03	58%	Pass
81	0.628	12	3.04E-03	7	1.77E-03	58%	Pass

Interval	Existing Condition			Detention Optimized			Pass or Fail?
	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	
82	0.636	12	3.04E-03	7	1.77E-03	58%	Pass
83	0.643	12	3.04E-03	7	1.77E-03	58%	Pass
84	0.650	12	3.04E-03	7	1.77E-03	58%	Pass
85	0.657	10	2.53E-03	7	1.77E-03	70%	Pass
86	0.665	10	2.53E-03	7	1.77E-03	70%	Pass
87	0.672	9	2.28E-03	7	1.77E-03	78%	Pass
88	0.679	9	2.28E-03	6	1.52E-03	67%	Pass
89	0.686	7	1.77E-03	6	1.52E-03	86%	Pass
90	0.694	7	1.77E-03	6	1.52E-03	86%	Pass
91	0.701	7	1.77E-03	6	1.52E-03	86%	Pass
92	0.708	6	1.52E-03	5	1.27E-03	83%	Pass
93	0.715	6	1.52E-03	5	1.27E-03	83%	Pass
94	0.723	6	1.52E-03	5	1.27E-03	83%	Pass
95	0.730	6	1.52E-03	5	1.27E-03	83%	Pass
96	0.737	6	1.52E-03	5	1.27E-03	83%	Pass
97	0.744	6	1.52E-03	5	1.27E-03	83%	Pass
98	0.752	6	1.52E-03	5	1.27E-03	83%	Pass
99	0.759	6	1.52E-03	5	1.27E-03	83%	Pass
100	0.766	5	1.27E-03	5	1.27E-03	100%	Pass

Peak Flows calculated with Cunnane Plotting Position

Return Period (years)	Pre-dev. Q (cfs)	Post-Dev. Q (cfs)	Reduction (cfs)
10	0.766	0.622	0.144
9	0.737	0.583	0.154
8	0.705	0.544	0.161
7	0.688	0.526	0.162
6	0.685	0.505	0.180
5	0.663	0.483	0.180
4	0.626	0.434	0.191
3	0.579	0.383	0.196
2	0.481	0.313	0.168

Flow Duration Curve Data for Greenhills Ranch POC-3 , Lakeside, CA

Q2 =	0.511	cfs	Fraction	10 %
Q10 =	0.81	cfs		
Step =	0.0077	cfs		
Count =	394487	hours		
	45.00	years		

	Existing Condition			Detention Optimized			Pass or
Interval	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	Fail?
1	0.051	270	6.84E-02	283	7.17E-02	105%	Pass
2	0.059	266	6.74E-02	267	6.77E-02	100%	Pass
3	0.066	264	6.69E-02	252	6.39E-02	95%	Pass
4	0.074	253	6.41E-02	228	5.78E-02	90%	Pass
5	0.082	244	6.19E-02	212	5.37E-02	87%	Pass
6	0.089	235	5.96E-02	194	4.92E-02	83%	Pass
7	0.097	222	5.63E-02	179	4.54E-02	81%	Pass
8	0.105	216	5.48E-02	167	4.23E-02	77%	Pass
9	0.112	211	5.35E-02	155	3.93E-02	73%	Pass
10	0.120	206	5.22E-02	147	3.73E-02	71%	Pass
11	0.128	198	5.02E-02	132	3.35E-02	67%	Pass
12	0.135	193	4.89E-02	122	3.09E-02	63%	Pass
13	0.143	192	4.87E-02	118	2.99E-02	61%	Pass
14	0.151	187	4.74E-02	114	2.89E-02	61%	Pass
15	0.158	175	4.44E-02	110	2.79E-02	63%	Pass
16	0.166	166	4.21E-02	104	2.64E-02	63%	Pass
17	0.174	166	4.21E-02	99	2.51E-02	60%	Pass
18	0.181	158	4.01E-02	95	2.41E-02	60%	Pass
19	0.189	154	3.90E-02	89	2.26E-02	58%	Pass
20	0.197	150	3.80E-02	85	2.15E-02	57%	Pass
21	0.204	146	3.70E-02	79	2.00E-02	54%	Pass
22	0.212	143	3.62E-02	73	1.85E-02	51%	Pass
23	0.220	134	3.40E-02	69	1.75E-02	51%	Pass
24	0.227	120	3.04E-02	64	1.62E-02	53%	Pass
25	0.235	114	2.89E-02	62	1.57E-02	54%	Pass
26	0.243	111	2.81E-02	59	1.50E-02	53%	Pass
27	0.250	99	2.51E-02	56	1.42E-02	57%	Pass
28	0.258	98	2.48E-02	54	1.37E-02	55%	Pass
29	0.266	95	2.41E-02	54	1.37E-02	57%	Pass
30	0.273	90	2.28E-02	50	1.27E-02	56%	Pass
31	0.281	87	2.21E-02	47	1.19E-02	54%	Pass
32	0.289	83	2.10E-02	43	1.09E-02	52%	Pass
33	0.296	78	1.98E-02	41	1.04E-02	53%	Pass
34	0.304	78	1.98E-02	40	1.01E-02	51%	Pass
35	0.312	77	1.95E-02	38	9.63E-03	49%	Pass
36	0.319	74	1.88E-02	35	8.87E-03	47%	Pass

Interval	Existing Condition			Detention Optimized			Pass or Fail?
	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	
37	0.327	73	1.85E-02	33	8.37E-03	45%	Pass
38	0.335	71	1.80E-02	33	8.37E-03	46%	Pass
39	0.342	68	1.72E-02	31	7.86E-03	46%	Pass
40	0.350	68	1.72E-02	28	7.10E-03	41%	Pass
41	0.358	65	1.65E-02	28	7.10E-03	43%	Pass
42	0.365	63	1.60E-02	26	6.59E-03	41%	Pass
43	0.373	60	1.52E-02	25	6.34E-03	42%	Pass
44	0.381	58	1.47E-02	24	6.08E-03	41%	Pass
45	0.388	56	1.42E-02	23	5.83E-03	41%	Pass
46	0.396	54	1.37E-02	21	5.32E-03	39%	Pass
47	0.404	52	1.32E-02	20	5.07E-03	38%	Pass
48	0.411	50	1.27E-02	18	4.56E-03	36%	Pass
49	0.419	49	1.24E-02	18	4.56E-03	37%	Pass
50	0.427	49	1.24E-02	18	4.56E-03	37%	Pass
51	0.434	47	1.19E-02	17	4.31E-03	36%	Pass
52	0.442	47	1.19E-02	16	4.06E-03	34%	Pass
53	0.450	46	1.17E-02	16	4.06E-03	35%	Pass
54	0.457	45	1.14E-02	14	3.55E-03	31%	Pass
55	0.465	42	1.06E-02	13	3.30E-03	31%	Pass
56	0.473	40	1.01E-02	13	3.30E-03	33%	Pass
57	0.480	38	9.63E-03	12	3.04E-03	32%	Pass
58	0.488	35	8.87E-03	11	2.79E-03	31%	Pass
59	0.496	29	7.35E-03	10	2.53E-03	34%	Pass
60	0.503	27	6.84E-03	9	2.28E-03	33%	Pass
61	0.511	26	6.59E-03	9	2.28E-03	35%	Pass
62	0.519	23	5.83E-03	8	2.03E-03	35%	Pass
63	0.526	22	5.58E-03	8	2.03E-03	36%	Pass
64	0.534	22	5.58E-03	8	2.03E-03	36%	Pass
65	0.542	22	5.58E-03	8	2.03E-03	36%	Pass
66	0.549	22	5.58E-03	8	2.03E-03	36%	Pass
67	0.557	21	5.32E-03	8	2.03E-03	38%	Pass
68	0.565	20	5.07E-03	8	2.03E-03	40%	Pass
69	0.572	19	4.82E-03	8	2.03E-03	42%	Pass
70	0.580	18	4.56E-03	8	2.03E-03	44%	Pass
71	0.588	18	4.56E-03	7	1.77E-03	39%	Pass
72	0.595	17	4.31E-03	7	1.77E-03	41%	Pass
73	0.603	17	4.31E-03	7	1.77E-03	41%	Pass
74	0.611	17	4.31E-03	7	1.77E-03	41%	Pass
75	0.618	16	4.06E-03	7	1.77E-03	44%	Pass
76	0.626	15	3.80E-03	7	1.77E-03	47%	Pass
77	0.634	15	3.80E-03	7	1.77E-03	47%	Pass
78	0.641	14	3.55E-03	7	1.77E-03	50%	Pass
79	0.649	13	3.30E-03	6	1.52E-03	46%	Pass
80	0.657	13	3.30E-03	6	1.52E-03	46%	Pass
81	0.664	12	3.04E-03	6	1.52E-03	50%	Pass

Interval	Existing Condition			Detention Optimized			Pass or Fail?
	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	
82	0.672	12	3.04E-03	5	1.27E-03	42%	Pass
83	0.680	12	3.04E-03	5	1.27E-03	42%	Pass
84	0.687	11	2.79E-03	5	1.27E-03	45%	Pass
85	0.695	8	2.03E-03	5	1.27E-03	63%	Pass
86	0.703	8	2.03E-03	5	1.27E-03	63%	Pass
87	0.710	8	2.03E-03	5	1.27E-03	63%	Pass
88	0.718	7	1.77E-03	5	1.27E-03	71%	Pass
89	0.726	7	1.77E-03	5	1.27E-03	71%	Pass
90	0.733	7	1.77E-03	5	1.27E-03	71%	Pass
91	0.741	7	1.77E-03	5	1.27E-03	71%	Pass
92	0.749	7	1.77E-03	5	1.27E-03	71%	Pass
93	0.756	7	1.77E-03	5	1.27E-03	71%	Pass
94	0.764	7	1.77E-03	4	1.01E-03	57%	Pass
95	0.772	7	1.77E-03	4	1.01E-03	57%	Pass
96	0.779	7	1.77E-03	4	1.01E-03	57%	Pass
97	0.787	7	1.77E-03	3	7.60E-04	43%	Pass
98	0.795	6	1.52E-03	3	7.60E-04	50%	Pass
99	0.802	6	1.52E-03	2	5.07E-04	33%	Pass
100	0.810	5	1.27E-03	2	5.07E-04	40%	Pass

Peak Flows calculated with Cunnane Plotting Position

Return Period (years)	Pre-dev. Q (cfs)	Post-Dev. Q (cfs)	Reduction (cfs)
10	0.810	0.591	0.219
9	0.800	0.552	0.248
8	0.787	0.513	0.275
7	0.724	0.495	0.229
6	0.695	0.474	0.221
5	0.692	0.452	0.239
4	0.668	0.403	0.265
3	0.597	0.351	0.245
2	0.511	0.282	0.229

Flow Duration Curve Data for Greenhills Ranch POC-4 , Lakeside, CA

Q2 =	2.728	cfs	Fraction	10 %
Q10 =	3.86	cfs		
Step =	0.0363	cfs		
Count =	394487	hours		
	45.00	years		

	Existing Condition			Detention Optimized			Pass or
Interval	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	Fail?
1	0.273	872	2.21E-01	864	2.19E-01	99%	Pass
2	0.309	824	2.09E-01	816	2.07E-01	99%	Pass
3	0.345	777	1.97E-01	767	1.94E-01	99%	Pass
4	0.382	740	1.88E-01	734	1.86E-01	99%	Pass
5	0.418	693	1.76E-01	687	1.74E-01	99%	Pass
6	0.454	642	1.63E-01	634	1.61E-01	99%	Pass
7	0.491	610	1.55E-01	608	1.54E-01	100%	Pass
8	0.527	575	1.46E-01	564	1.43E-01	98%	Pass
9	0.563	541	1.37E-01	535	1.36E-01	99%	Pass
10	0.599	524	1.33E-01	513	1.30E-01	98%	Pass
11	0.636	500	1.27E-01	499	1.26E-01	100%	Pass
12	0.672	477	1.21E-01	465	1.18E-01	97%	Pass
13	0.708	450	1.14E-01	443	1.12E-01	98%	Pass
14	0.744	427	1.08E-01	419	1.06E-01	98%	Pass
15	0.781	400	1.01E-01	388	9.84E-02	97%	Pass
16	0.817	370	9.38E-02	363	9.20E-02	98%	Pass
17	0.853	352	8.92E-02	342	8.67E-02	97%	Pass
18	0.890	333	8.44E-02	323	8.19E-02	97%	Pass
19	0.926	315	7.99E-02	309	7.83E-02	98%	Pass
20	0.962	298	7.55E-02	286	7.25E-02	96%	Pass
21	0.998	278	7.05E-02	274	6.95E-02	99%	Pass
22	1.035	265	6.72E-02	260	6.59E-02	98%	Pass
23	1.071	248	6.29E-02	240	6.08E-02	97%	Pass
24	1.107	236	5.98E-02	223	5.65E-02	94%	Pass
25	1.144	220	5.58E-02	217	5.50E-02	99%	Pass
26	1.180	212	5.37E-02	201	5.10E-02	95%	Pass
27	1.216	200	5.07E-02	193	4.89E-02	97%	Pass
28	1.252	187	4.74E-02	180	4.56E-02	96%	Pass
29	1.289	178	4.51E-02	170	4.31E-02	96%	Pass
30	1.325	165	4.18E-02	161	4.08E-02	98%	Pass
31	1.361	159	4.03E-02	154	3.90E-02	97%	Pass
32	1.397	152	3.85E-02	141	3.57E-02	93%	Pass
33	1.434	138	3.50E-02	128	3.24E-02	93%	Pass
34	1.470	129	3.27E-02	122	3.09E-02	95%	Pass
35	1.506	122	3.09E-02	116	2.94E-02	95%	Pass

Interval	Existing Condition			Detention Optimized			Pass or Fail?
	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	
36	1.543	116	2.94E-02	111	2.81E-02	96%	Pass
37	1.579	111	2.81E-02	106	2.69E-02	95%	Pass
38	1.615	105	2.66E-02	100	2.53E-02	95%	Pass
39	1.651	101	2.56E-02	93	2.36E-02	92%	Pass
40	1.688	94	2.38E-02	88	2.23E-02	94%	Pass
41	1.724	90	2.28E-02	84	2.13E-02	93%	Pass
42	1.760	86	2.18E-02	78	1.98E-02	91%	Pass
43	1.797	79	2.00E-02	75	1.90E-02	95%	Pass
44	1.833	75	1.90E-02	73	1.85E-02	97%	Pass
45	1.869	75	1.90E-02	72	1.83E-02	96%	Pass
46	1.905	72	1.83E-02	67	1.70E-02	93%	Pass
47	1.942	69	1.75E-02	65	1.65E-02	94%	Pass
48	1.978	65	1.65E-02	60	1.52E-02	92%	Pass
49	2.014	62	1.57E-02	59	1.50E-02	95%	Pass
50	2.051	59	1.50E-02	55	1.39E-02	93%	Pass
51	2.087	57	1.44E-02	54	1.37E-02	95%	Pass
52	2.123	54	1.37E-02	51	1.29E-02	94%	Pass
53	2.159	52	1.32E-02	51	1.29E-02	98%	Pass
54	2.196	51	1.29E-02	50	1.27E-02	98%	Pass
55	2.232	50	1.27E-02	49	1.24E-02	98%	Pass
56	2.268	49	1.24E-02	46	1.17E-02	94%	Pass
57	2.304	48	1.22E-02	44	1.12E-02	92%	Pass
58	2.341	46	1.17E-02	43	1.09E-02	93%	Pass
59	2.377	44	1.12E-02	43	1.09E-02	98%	Pass
60	2.413	43	1.09E-02	39	9.89E-03	91%	Pass
61	2.450	42	1.06E-02	32	8.11E-03	76%	Pass
62	2.486	38	9.63E-03	31	7.86E-03	82%	Pass
63	2.522	32	8.11E-03	30	7.60E-03	94%	Pass
64	2.558	31	7.86E-03	29	7.35E-03	94%	Pass
65	2.595	30	7.60E-03	28	7.10E-03	93%	Pass
66	2.631	29	7.35E-03	28	7.10E-03	97%	Pass
67	2.667	28	7.10E-03	26	6.59E-03	93%	Pass
68	2.704	28	7.10E-03	26	6.59E-03	93%	Pass
69	2.740	26	6.59E-03	26	6.59E-03	100%	Pass
70	2.776	26	6.59E-03	25	6.34E-03	96%	Pass
71	2.812	26	6.59E-03	24	6.08E-03	92%	Pass
72	2.849	24	6.08E-03	22	5.58E-03	92%	Pass
73	2.885	24	6.08E-03	21	5.32E-03	88%	Pass
74	2.921	22	5.58E-03	20	5.07E-03	91%	Pass
75	2.958	21	5.32E-03	17	4.31E-03	81%	Pass
76	2.994	21	5.32E-03	17	4.31E-03	81%	Pass
77	3.030	18	4.56E-03	16	4.06E-03	89%	Pass
78	3.066	17	4.31E-03	15	3.80E-03	88%	Pass

Interval	Existing Condition			Detention Optimized			Pass or Fail?
	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	
79	3.103	16	4.06E-03	13	3.30E-03	81%	Pass
80	3.139	16	4.06E-03	13	3.30E-03	81%	Pass
81	3.175	14	3.55E-03	13	3.30E-03	93%	Pass
82	3.211	13	3.30E-03	11	2.79E-03	85%	Pass
83	3.248	13	3.30E-03	11	2.79E-03	85%	Pass
84	3.284	13	3.30E-03	10	2.53E-03	77%	Pass
85	3.320	11	2.79E-03	10	2.53E-03	91%	Pass
86	3.357	10	2.53E-03	10	2.53E-03	100%	Pass
87	3.393	10	2.53E-03	10	2.53E-03	100%	Pass
88	3.429	10	2.53E-03	9	2.28E-03	90%	Pass
89	3.465	10	2.53E-03	9	2.28E-03	90%	Pass
90	3.502	10	2.53E-03	9	2.28E-03	90%	Pass
91	3.538	9	2.28E-03	9	2.28E-03	100%	Pass
92	3.574	9	2.28E-03	9	2.28E-03	100%	Pass
93	3.611	9	2.28E-03	9	2.28E-03	100%	Pass
94	3.647	9	2.28E-03	8	2.03E-03	89%	Pass
95	3.683	9	2.28E-03	7	1.77E-03	78%	Pass
96	3.719	9	2.28E-03	6	1.52E-03	67%	Pass
97	3.756	8	2.03E-03	5	1.27E-03	63%	Pass
98	3.792	7	1.77E-03	4	1.01E-03	57%	Pass
99	3.828	6	1.52E-03	4	1.01E-03	67%	Pass
100	3.864	5	1.27E-03	3	7.60E-04	60%	Pass

Peak Flows calculated with Cunnane Plotting Position

Return Period (years)	Pre-dev. Q (cfs)	Post-Dev. Q (cfs)	Reduction (cfs)
10	3.864	3.754	0.110
9	3.834	3.733	0.101
8	3.805	3.713	0.092
7	3.774	3.673	0.101
6	3.742	3.639	0.103
5	3.441	3.344	0.097
4	3.292	3.192	0.100
3	3.011	2.931	0.080
2	2.728	2.652	0.076

ATTACHMENT 3

List of the "n" Largest Peaks: Pre & Post-Developed Conditions

Basic Probabilistic Equation:

R = 1/P R: Return period (years).

P: Probability of a flow to be equaled or exceeded any given year (dimensionless).

Cunnane Equation:

$$P = \frac{i-0.4}{n+0.2}$$

Weibull Equation:

$$P = \frac{i}{n+1}$$

i: Position of the peak whose probability is desired (sorted from large to small)

n: number of years analyzed.

Explanation of Variables for the Tables in this Attachment

Peak: Refers to the peak flow at the date given, taken from the continuous simulation hourly results of the n year analyzed.

Posit: If all peaks are sorted from large to small, the position of the peak in a sorting analysis is included under the variable Posit.

Date: Date of the occurrence of the peak at the outlet from the continuous simulation

Note: all peaks are not annual maxima; instead they are defined as event maxima, with a threshold to separate peaks of at least 12 hours. In other words, any peak P in a time series is defined as a value where dP/dt = 0, and the peak is the largest value in 25 hours (12 hours before, the hour of occurrence and 12 hours after the occurrence, so it is in essence a daily peak).

List of Peak events and Determination of P2 and P10 (Pre-Development)
Greenhills Ranch POC-1 - Lakeside

T (Year)	Cunnane (cfs)	Weibull (cfs)	Peaks (cfs)	Date	Posit	Period of Return (Years)	
10	**8.83**	**8.92**				**Weibull**	**Cunnane**
9	**8.71**	**8.78**	3.9895	1/27/2008	45	1.02	1.01
8	**8.56**	**8.65**	4.0589	3/8/1973	44	1.05	1.04
7	**7.88**	**8.10**	4.0697	2/18/1980	43	1.07	1.06
6	**7.57**	**7.62**	4.0863	10/29/1974	42	1.10	1.09
5	**7.52**	**7.52**	4.3086	11/11/1985	41	1.12	1.11
4	**7.27**	**7.30**	4.329	10/31/1987	40	1.15	1.14
3	**6.50**	**6.57**	4.397	2/21/2005	39	1.18	1.17
2	**5.45**	**5.45**	4.4148	3/14/1982	38	1.21	1.20
			4.7566	3/13/1996	37	1.24	1.23
			4.8136	2/19/1980	36	1.28	1.27
			4.919	3/18/1983	35	1.31	1.31
			5.049	12/28/1977	34	1.35	1.35
			5.0578	8/17/1977	33	1.39	1.39
			5.0867	1/3/1977	32	1.44	1.43
			5.2498	12/18/1967	31	1.48	1.48
			5.3024	1/13/1993	30	1.53	1.53
			5.3379	2/16/1980	29	1.59	1.58
			5.3697	3/1/1991	28	1.64	1.64
			5.3791	2/13/1973	27	1.70	1.70
			5.389	2/10/1978	26	1.77	1.77
			5.3966	1/4/1995	25	1.84	1.84
			5.4359	2/14/1998	24	1.92	1.92
			5.4458	1/30/1980	23	2.00	2.00
			5.5661	11/29/1970	22	2.09	2.09
			5.5902	3/4/1978	21	2.19	2.19
			5.6682	1/7/1993	20	2.30	2.31
			5.7838	2/6/1969	19	2.42	2.43
			5.9613	2/28/1978	18	2.56	2.57
			6.2479	4/1/1982	17	2.71	2.72
			6.2531	3/1/1983	16	2.88	2.90
			6.7378	2/22/2004	15	3.07	3.10
			6.766	3/24/1983	14	3.29	3.32
			6.9965	2/3/1998	13	3.54	3.59
			7.2154	11/20/1983	12	3.83	3.90
			7.3967	3/3/1980	11	4.18	4.26
			7.5203	2/14/1995	10	4.60	4.71
			7.526	1/9/2005	9	5.11	5.26
			7.5561	2/8/1998	8	5.75	5.95
			7.7748	1/31/1979	7	6.57	6.85
			8.6039	1/14/1969	6	7.67	8.07
			8.8099	11/23/1965	5	9.20	9.83
			9.1186	11/30/2007	4	11.50	12.56
			10.4581	10/20/2004	3	15.33	17.38
			11.0402	1/25/1995	2	23.00	28.25
			17.253	2/20/1980	1	46.00	75.33

Note:
Cunnane is the preferred method by the HMP permit.

List of Peak events and Determination of P2 and P10 (Post-Development)
Greenhills Ranch POC-1 - Lakeside

T (Year)	Cunnane (cfs)	Weibull (cfs)	Peaks (cfs)	Date	Posit	Period of Return (Years)	
						Weibull	Cunnane
10	**5.76**	**6.04**					
9	**5.43**	**5.62**	1.775	2/21/2005	45	1.02	1.01
8	**5.08**	**5.25**	1.793	11/11/1985	44	1.05	1.04
7	**4.51**	**4.70**	1.797	10/29/1974	43	1.07	1.06
6	**4.41**	**4.41**	1.805	3/14/1982	42	1.10	1.09
5	**3.86**	**4.05**	1.976	12/28/1977	41	1.12	1.11
4	**3.13**	**3.18**	1.995	2/19/1980	40	1.15	1.14
3	**2.86**	**2.88**	2.005	2/21/1980	39	1.18	1.17
2	**2.42**	**2.42**	2.022	3/18/1983	38	1.21	1.20
			2.04	3/13/1996	37	1.24	1.23
			2.076	8/17/1977	36	1.28	1.27
			2.087	12/18/1967	35	1.31	1.31
			2.1	1/3/1977	34	1.35	1.35
			2.122	2/13/1973	33	1.39	1.39
			2.133	1/13/1993	32	1.44	1.43
			2.181	2/14/1998	31	1.48	1.48
			2.194	3/4/1978	30	1.53	1.53
			2.197	11/29/1970	29	1.59	1.58
			2.199	2/16/1980	28	1.64	1.64
			2.231	2/10/1978	27	1.70	1.70
			2.3	1/30/1980	26	1.77	1.77
			2.306	4/1/1982	25	1.84	1.84
			2.349	2/28/1978	24	1.92	1.92
			2.423	12/6/1966	23	2.00	2.00
			2.471	2/6/1969	22	2.09	2.09
			2.53	3/1/1983	21	2.19	2.19
			2.603	3/24/1983	20	2.30	2.31
			2.682	11/20/1983	19	2.42	2.43
			2.741	2/3/1998	18	2.56	2.57
			2.793	3/3/1980	17	2.71	2.72
			2.796	1/7/1993	16	2.88	2.90
			2.924	1/9/2005	15	3.07	3.10
			2.945	2/8/1998	14	3.29	3.32
			2.993	2/23/2004	13	3.54	3.59
			3.067	2/14/1995	12	3.83	3.90
			3.299	1/29/1980	11	4.18	4.26
			3.464	11/30/2007	10	4.60	4.71
			4.207	1/25/1995	9	5.11	5.26
			4.406	1/14/1969	8	5.75	5.95
			4.429	3/5/1995	7	6.57	6.85
			5.121	3/1/1991	6	7.67	8.07
			5.696	1/4/1995	5	9.20	9.83
			6.687	10/20/2004	4	11.50	12.56
			7.922	11/23/1965	3	15.33	17.38
			7.982	1/31/1979	2	23.00	28.25
			14.367	2/20/1980	1	46.00	75.33

Note:
Cunnane is the preferred method by the HMP permit.

List of Peak events and Determination of P2 and P10 (Pre-Development)
Greenhills Ranch POC-2 - Lakeside

T (Year)	Cunnane (cfs)	Weibull (cfs)	Peaks (cfs)	Date	Posit	Period of Return (Years)	
10	**0.77**	**0.77**				Weibull	Cunnane
9	**0.74**	**0.76**	0.365	3/8/1973	45	1.02	1.01
8	**0.70**	**0.72**	0.367	2/18/1980	44	1.05	1.04
7	**0.69**	**0.69**	0.369	10/29/1974	43	1.07	1.06
6	**0.69**	**0.69**	0.369	1/31/1996	42	1.10	1.09
5	**0.66**	**0.67**	0.376	10/31/1987	41	1.12	1.11
4	**0.63**	**0.63**	0.384	2/21/2005	40	1.15	1.14
3	**0.58**	**0.58**	0.395	3/14/1982	39	1.18	1.17
2	**0.48**	**0.48**	0.407	11/11/1985	38	1.21	1.20
			0.408	8/17/1977	37	1.24	1.23
			0.425	2/19/1980	36	1.28	1.27
			0.434	12/28/1977	35	1.31	1.31
			0.451	12/18/1967	34	1.35	1.35
			0.451	3/18/1983	33	1.39	1.39
			0.467	1/3/1977	32	1.44	1.43
			0.467	1/4/1995	31	1.48	1.48
			0.469	3/13/1996	30	1.53	1.53
			0.469	2/14/1998	29	1.59	1.58
			0.472	1/13/1993	28	1.64	1.64
			0.475	2/16/1980	27	1.70	1.70
			0.477	2/13/1973	26	1.77	1.77
			0.478	3/1/1991	25	1.84	1.84
			0.479	2/10/1978	24	1.92	1.92
			0.481	3/4/1978	23	2.00	2.00
			0.484	11/29/1970	22	2.09	2.09
			0.49	1/30/1980	21	2.19	2.19
			0.506	1/7/1993	20	2.30	2.31
			0.524	2/28/1978	19	2.42	2.43
			0.531	4/1/1982	18	2.56	2.57
			0.568	2/6/1969	17	2.71	2.72
			0.574	3/1/1983	16	2.88	2.90
			0.584	3/24/1983	15	3.07	3.10
			0.585	2/22/2004	14	3.29	3.32
			0.6	2/3/1998	13	3.54	3.59
			0.616	11/20/1983	12	3.83	3.90
			0.651	1/9/2005	11	4.18	4.26
			0.656	2/8/1998	10	4.60	4.71
			0.67	3/3/1980	9	5.11	5.26
			0.685	1/31/1979	8	5.75	5.95
			0.685	2/14/1995	7	6.57	6.85
			0.706	1/14/1969	6	7.67	8.07
			0.765	11/23/1965	5	9.20	9.83
			0.784	11/30/2007	4	11.50	12.56
			0.878	10/20/2004	3	15.33	17.38
			0.942	1/25/1995	2	23.00	28.25
			1.456	2/20/1980	1	46.00	75.33

Note:
Cunnane is the preferred method by the HMP permit.

List of Peak events and Determination of P2 and P10 (Post-Development)
Greenhills Ranch POC-2 - Lakeside

T (Year)	Cunnane (cfs)	Weibull (cfs)	Peaks (cfs)	Date	Posit	Period of Return (Years)	
						Weibull	Cunnane
10	**0.62**	**0.65**					
9	**0.58**	**0.61**	0.168	2/10/1978	45	1.02	1.01
8	**0.54**	**0.56**	0.17	1/15/1993	44	1.05	1.04
7	**0.53**	**0.53**	0.192	1/23/1967	43	1.07	1.06
6	**0.51**	**0.51**	0.198	1/8/1993	42	1.10	1.09
5	**0.48**	**0.49**	0.202	2/16/1980	41	1.12	1.11
4	**0.43**	**0.44**	0.204	3/16/1982	40	1.15	1.14
3	**0.38**	**0.39**	0.207	1/15/1978	39	1.18	1.17
2	**0.31**	**0.31**	0.228	12/18/1967	38	1.21	1.20
			0.229	1/25/1995	37	1.24	1.23
			0.23	1/27/2008	36	1.28	1.27
			0.241	2/8/1998	35	1.31	1.31
			0.243	10/19/2004	34	1.35	1.35
			0.245	2/18/1980	33	1.39	1.39
			0.257	3/5/1978	32	1.44	1.43
			0.258	11/25/1985	31	1.48	1.48
			0.264	2/15/1986	30	1.53	1.53
			0.276	1/16/1993	29	1.59	1.58
			0.282	3/13/1996	28	1.64	1.64
			0.285	12/6/1966	27	1.70	1.70
			0.304	1/29/1980	26	1.77	1.77
			0.305	3/2/1983	25	1.84	1.84
			0.311	12/5/1966	24	1.92	1.92
			0.313	2/21/1980	23	2.00	2.00
			0.317	11/11/1985	22	2.09	2.09
			0.322	10/27/2004	21	2.19	2.19
			0.33	2/8/1976	20	2.30	2.31
			0.349	11/30/1982	19	2.42	2.43
			0.351	3/1/1978	18	2.56	2.57
			0.37	2/20/1980	17	2.71	2.72
			0.374	1/29/1980	16	2.88	2.90
			0.391	2/22/2004	15	3.07	3.10
			0.409	10/29/1974	14	3.29	3.32
			0.414	12/1/2007	13	3.54	3.59
			0.424	2/14/1995	12	3.83	3.90
			0.461	3/5/1995	11	4.18	4.26
			0.471	11/29/1970	10	4.60	4.71
			0.494	3/1/1983	9	5.11	5.26
			0.504	1/14/1969	8	5.75	5.95
			0.523	3/1/1991	7	6.57	6.85
			0.545	1/7/1993	6	7.67	8.07
			0.617	1/4/1995	5	9.20	9.83
			0.702	10/20/2004	4	11.50	12.56
			0.835	1/31/1979	3	15.33	17.38
			0.865	11/23/1965	2	23.00	28.25
			1.593	2/20/1980	1	46.00	75.33

Note:
Cunnane is the preferred method by the HMP permit.

List of Peak events and Determination of P2 and P10 (Pre-Development)
Greenhills Ranch POC-3 - Lakeside

T (Year)	Cunnane (cfs)	Weibull (cfs)	Peaks (cfs)	Date	Posit	Period of Return (Years)	
10	**0.81**	**0.82**				Weibull	Cunnane
9	**0.80**	**0.81**	0.374	10/29/1974	45	1.02	1.01
8	**0.79**	**0.80**	0.378	1/18/1979	44	1.05	1.04
7	**0.72**	**0.74**	0.385	3/8/1973	43	1.07	1.06
6	**0.70**	**0.70**	0.385	2/18/1980	42	1.10	1.09
5	**0.69**	**0.69**	0.398	11/11/1985	41	1.12	1.11
4	**0.67**	**0.67**	0.405	3/14/1982	40	1.15	1.14
3	**0.60**	**0.60**	0.405	10/31/1987	39	1.18	1.17
2	**0.51**	**0.51**	0.413	2/21/2005	38	1.21	1.20
			0.446	3/13/1996	37	1.24	1.23
			0.45	2/19/1980	36	1.28	1.27
			0.459	8/17/1977	35	1.31	1.31
			0.459	3/18/1983	34	1.35	1.35
			0.471	12/28/1977	33	1.39	1.39
			0.475	1/3/1977	32	1.44	1.43
			0.487	1/13/1993	31	1.48	1.48
			0.489	12/18/1967	30	1.53	1.53
			0.49	2/16/1980	29	1.59	1.58
			0.495	2/13/1973	28	1.64	1.64
			0.495	2/10/1978	27	1.70	1.70
			0.495	3/1/1991	26	1.77	1.77
			0.496	1/4/1995	25	1.84	1.84
			0.505	2/14/1998	24	1.92	1.92
			0.511	1/30/1980	23	2.00	2.00
			0.512	11/29/1970	22	2.09	2.09
			0.518	3/4/1978	21	2.19	2.19
			0.524	1/7/1993	20	2.30	2.31
			0.556	2/6/1969	19	2.42	2.43
			0.559	2/28/1978	18	2.56	2.57
			0.57	4/1/1982	17	2.71	2.72
			0.574	3/1/1983	16	2.88	2.90
			0.618	2/22/2004	15	3.07	3.10
			0.623	3/24/1983	14	3.29	3.32
			0.644	2/3/1998	13	3.54	3.59
			0.662	11/20/1983	12	3.83	3.90
			0.685	3/3/1980	11	4.18	4.26
			0.691	2/14/1995	10	4.60	4.71
			0.692	1/9/2005	9	5.11	5.26
			0.694	2/8/1998	8	5.75	5.95
			0.714	1/31/1979	7	6.57	6.85
			0.792	1/14/1969	6	7.67	8.07
			0.808	11/23/1965	5	9.20	9.83
			0.838	11/30/2007	4	11.50	12.56
			0.957	10/20/2004	3	15.33	17.38
			1.013	1/25/1995	2	23.00	28.25
			1.58	2/20/1980	1	46.00	75.33

Note:
Cunnane is the preferred method by the HMP permit.

List of Peak events and Determination of P2 and P10 (Post-Development)
Greenhills Ranch POC-3 - Lakeside

T (Year)	Cunnane (cfs)	Weibull (cfs)	Peaks (cfs)	Date	Posit	Period of Return (Years)	
10	**0.59**	**0.62**				Weibull	Cunnane
9	**0.55**	**0.58**	0.138	2/10/1978	45	1.02	1.01
8	**0.51**	**0.53**	0.14	1/15/1993	44	1.05	1.04
7	**0.49**	**0.50**	0.161	1/23/1967	43	1.07	1.06
6	**0.47**	**0.48**	0.167	1/8/1993	42	1.10	1.09
5	**0.45**	**0.46**	0.171	2/16/1980	41	1.12	1.11
4	**0.40**	**0.41**	0.172	3/16/1982	40	1.15	1.14
3	**0.35**	**0.35**	0.176	1/15/1978	39	1.18	1.17
2	**0.28**	**0.28**	0.196	12/18/1967	38	1.21	1.20
			0.197	1/25/1995	37	1.24	1.23
			0.199	1/27/2008	36	1.28	1.27
			0.21	2/8/1998	35	1.31	1.31
			0.212	10/19/2004	34	1.35	1.35
			0.214	2/18/1980	33	1.39	1.39
			0.225	3/5/1978	32	1.44	1.43
			0.226	11/25/1985	31	1.48	1.48
			0.232	2/15/1986	30	1.53	1.53
			0.244	1/16/1993	29	1.59	1.58
			0.25	3/13/1996	28	1.64	1.64
			0.253	12/6/1966	27	1.70	1.70
			0.273	1/29/1980	26	1.77	1.77
			0.273	3/2/1983	25	1.84	1.84
			0.279	12/5/1966	24	1.92	1.92
			0.282	2/21/1980	23	2.00	2.00
			0.286	11/11/1985	22	2.09	2.09
			0.29	10/27/2004	21	2.19	2.19
			0.299	2/8/1976	20	2.30	2.31
			0.318	11/30/1982	19	2.42	2.43
			0.32	3/1/1978	18	2.56	2.57
			0.339	2/20/1980	17	2.71	2.72
			0.343	1/29/1980	16	2.88	2.90
			0.359	2/22/2004	15	3.07	3.10
			0.377	10/29/1974	14	3.29	3.32
			0.382	12/1/2007	13	3.54	3.59
			0.393	2/14/1995	12	3.83	3.90
			0.43	3/5/1995	11	4.18	4.26
			0.44	11/29/1970	10	4.60	4.71
			0.463	3/1/1983	9	5.11	5.26
			0.473	1/14/1969	8	5.75	5.95
			0.492	3/1/1991	7	6.57	6.85
			0.514	1/7/1993	6	7.67	8.07
			0.586	1/4/1995	5	9.20	9.83
			0.67	10/20/2004	4	11.50	12.56
			0.802	1/31/1979	3	15.33	17.38
			0.833	11/23/1965	2	23.00	28.25
			1.559	2/20/1980	1	46.00	75.33

Note:
Cunnane is the preferred method by the HMP permit.

List of Peak events and Determination of P2 and P10 (Pre-Development)
Greenhills Ranch POC-4 - Lakeside

T (Year)	Cunnane (cfs)	Weibull (cfs)	Peaks (cfs)	Date	Posit	Period of Return (Years)	
10	**3.86**	**3.89**				**Weibull**	**Cunnane**
9	**3.83**	**3.85**	2.1196	2/21/2005	45	1.02	1.01
8	**3.80**	**3.82**	2.1443	2/18/1980	44	1.05	1.04
7	**3.77**	**3.78**	2.1675	3/8/1973	43	1.07	1.06
6	**3.74**	**3.75**	2.2194	1/9/1980	42	1.10	1.09
5	**3.44**	**3.49**	2.2357	2/25/1996	41	1.12	1.11
4	**3.29**	**3.29**	2.3003	12/28/1977	40	1.15	1.14
3	**3.01**	**3.01**	2.3328	1/4/1995	39	1.18	1.17
2	**2.73**	**2.73**	2.3549	11/11/1985	38	1.21	1.20
			2.355	2/19/1980	37	1.24	1.23
			2.3789	12/18/1967	36	1.28	1.27
			2.4445	1/29/1983	35	1.31	1.31
			2.4634	2/14/1998	34	1.35	1.35
			2.4685	11/29/1970	33	1.39	1.39
			2.4734	1/13/1993	32	1.44	1.43
			2.5081	2/16/1980	31	1.48	1.48
			2.5124	2/13/1973	30	1.53	1.53
			2.5128	2/10/1978	29	1.59	1.58
			2.525	3/4/1978	28	1.64	1.64
			2.5727	3/1/1991	27	1.70	1.70
			2.615	4/1/1982	26	1.77	1.77
			2.6332	3/18/1983	25	1.84	1.84
			2.7167	1/3/1977	24	1.92	1.92
			2.7283	1/7/1993	23	2.00	2.00
			2.8179	1/30/1980	22	2.09	2.09
			2.8215	12/23/1995	21	2.19	2.19
			2.8873	2/8/1993	20	2.30	2.31
			2.9199	2/28/1978	19	2.42	2.43
			2.9554	2/22/2004	18	2.56	2.57
			3.0026	3/24/1983	17	2.71	2.72
			3.0085	3/13/1996	16	2.88	2.90
			3.0138	2/3/1998	15	3.07	3.10
			3.0385	11/20/1983	14	3.29	3.32
			3.1594	3/1/1983	13	3.54	3.59
			3.2924	1/9/2005	12	3.83	3.90
			3.2926	1/14/1969	11	4.18	4.26
			3.3443	2/8/1998	10	4.60	4.71
			3.5265	1/31/1979	9	5.11	5.26
			3.7404	2/14/1995	8	5.75	5.95
			3.7689	3/3/1980	7	6.57	6.85
			3.8071	2/6/1969	6	7.67	8.07
			3.8586	11/23/1965	5	9.20	9.83
			3.951	11/30/2007	4	11.50	12.56
			4.255	10/20/2004	3	15.33	17.38
			4.6491	1/25/1995	2	23.00	28.25
			7.0186	2/20/1980	1	46.00	75.33

Note:
Cunnane is the preferred method by the HMP permit.

List of Peak events and Determination of P2 and P10 (Post-Development)
Greenhills Ranch POC-4 - Lakeside

T (Year)	Cunnane (cfs)	Weibull (cfs)	Peaks (cfs)	Date	Posit	Period of Return (Years)	
10	**3.75**	**3.78**				**Weibull**	**Cunnane**
9	**3.73**	**3.74**	2.0585	2/21/2005	45	1.02	1.01
8	**3.71**	**3.72**	2.0874	2/18/1980	44	1.05	1.04
7	**3.67**	**3.69**	2.1105	3/8/1973	43	1.07	1.06
6	**3.64**	**3.65**	2.1833	1/9/1980	42	1.10	1.09
5	**3.34**	**3.39**	2.2031	2/25/1996	41	1.12	1.11
4	**3.19**	**3.19**	2.2361	12/28/1977	40	1.15	1.14
3	**2.93**	**2.93**	2.2656	1/4/1995	39	1.18	1.17
2	**2.65**	**2.65**	2.2906	2/19/1980	38	1.21	1.20
			2.2945	11/11/1985	37	1.24	1.23
			2.3121	12/18/1967	36	1.28	1.27
			2.3941	2/14/1998	35	1.31	1.31
			2.3981	11/29/1970	34	1.35	1.35
			2.4008	1/13/1993	33	1.39	1.39
			2.4087	1/29/1983	32	1.44	1.43
			2.4398	2/16/1980	31	1.48	1.48
			2.4426	2/13/1973	30	1.53	1.53
			2.443	2/10/1978	29	1.59	1.58
			2.4538	3/4/1978	28	1.64	1.64
			2.5016	3/1/1991	27	1.70	1.70
			2.5382	4/1/1982	26	1.77	1.77
			2.5632	3/18/1983	25	1.84	1.84
			2.6458	1/3/1977	24	1.92	1.92
			2.6518	1/7/1993	23	2.00	2.00
			2.7427	1/30/1980	22	2.09	2.09
			2.7833	12/23/1995	21	2.19	2.19
			2.8271	2/8/1993	20	2.30	2.31
			2.8396	2/28/1978	19	2.42	2.43
			2.8711	2/22/2004	18	2.56	2.57
			2.9147	3/24/1983	17	2.71	2.72
			2.9271	2/3/1998	16	2.88	2.90
			2.9352	3/13/1996	15	3.07	3.10
			2.9405	11/20/1983	14	3.29	3.32
			3.0749	3/1/1983	13	3.54	3.59
			3.1915	1/14/1969	12	3.83	3.90
			3.1932	1/9/2005	11	4.18	4.26
			3.2491	2/8/1998	10	4.60	4.71
			3.4271	1/31/1979	9	5.11	5.26
			3.6375	2/14/1995	8	5.75	5.95
			3.6669	3/3/1980	7	6.57	6.85
			3.716	2/6/1969	6	7.67	8.07
			3.7484	11/23/1965	5	9.20	9.83
			3.8375	11/30/2007	4	11.50	12.56
			4.1278	10/20/2004	3	15.33	17.38
			4.5135	1/25/1995	2	23.00	28.25
			6.81	2/20/1980	1	46.00	75.33

Note:
Cunnane is the preferred method by the HMP permit.

ATTACHMENT 4

AREA VS ELEVATION

The area vs. elevation curves in the model are calculated in Excel and imported into the model. It should be noted that the up to the first surface orifice the storage is allocated to the LID Module of the SWMM model. Please refer to Attachment 7 for further information. The Excel stage-storage calculation is provided on the following pages.

DISCHARGE VS ELEVATION

The orifice has been selected to maximize its size while still restricting flows to conform with the required 10% of the Q2 event flow as mandated in the Final Hydromodification Management Plan by Brown & Caldwell, dated March 2011. While REC acknowledges that the orifice is small, to increase the size of the outlet would impact the basin's ability to restrict flows beneath the HMP thresholds, thus preventing the BMP from conformance with HMP requirements.

In order to further reduce the risk of blockage of the orifices, regular maintenance of the riser and orifice must be performed to ensure potential blockages are minimized. A detail of the orifice and riser structure is provided in Attachment 5 of this memorandum.

A stage-discharge relationship was developed to represent the outlet structure for the detention basin and is provided on the following pages.

DISCHARGE EQUATIONS

1) Weir:

$$Q_W = C_W \cdot L \cdot H^{3/2} \quad (1)$$

2) Slot:

As an orifice: $$Q_s = B_s \cdot h_s \cdot c_g \cdot \sqrt{2g\left(H - \frac{h_s}{2}\right)} \quad (2.a)$$

As a weir: $$Q_s = C_W \cdot B_s \cdot H^{3/2} \quad (2.b)$$

For H > h_s slot works as weir until orifice equation provides a smaller discharge. The elevation such that equation (2.a) = equation (2.b) is the elevation at which the behavior changes from weir to orifice.

3) Vertical Orifices

As an orifice: $$Q_o = 0.25 \cdot \pi D^2 \cdot c_g \cdot \sqrt{2g\left(H - \frac{D}{2}\right)} \quad (3.a)$$

As a weir: Critical depth and geometric family of circular sector must be solved to determined Q as a function of H:

$$\frac{Q_O^2}{g} = \frac{A_{cr}^3}{T_{cr}}; \quad H = y_{cr} + \frac{A_{cr}}{2 \cdot T_{cr}}; \; T_{cr} = 2\sqrt{y_{cr}(D - y_{cr})}\,; \quad A_{cr} = \frac{D^2}{8}[\alpha_{cr} - sin(\alpha_{cr})]\,;$$

$$y_{cr} = \frac{D}{2}[1 - sin(0.5 \cdot \alpha_{cr})] \quad \text{(3.b.1, 3.b.2, 3.b.3, 3.b.4 and 3.b.5)}$$

There is a value of H (approximately H = 110% D) from which orifices no longer work as weirs as critical depth is not possible at the entrance of the orifice. This value of H is obtained equaling the discharge using critical equations and equations (3.b).

A mathematical model is prepared with the previous equations depending on the type o discharge.

The following are the variables used above:

Q_W, Q_s, Q_O = Discharge of weir, slot or orifice (cfs)

C_W, c_g : Coefficients of discharge of weir (typically 3.1) and orifice (0.61 to 0.62)

L, B_s, D, h_s : Length of weir, width of slot, diameter of orifice and height of slot, respectively; (ft)

H: Level of water in the pond over the invert of slot, weir or orifice (ft)

A_{cr}, T_{cr}, y_{cr}, α_{cr}: Critical variables for circular sector: area (sq-ft), top width (ft), critical depth (ft), and angle to the center, respectively.

Stage-Area for BMP 1

Elevation (ft)	Area (ft^2)	Volume (ft^3)	
0.00	10257	**0**	
0.25	10575	1042	**TOP OF MULCH[(2)]**
0.50	10898	3726	
0.75	11224	6491	
1.00	11553	9338	
1.25	11887	12268	**BIOFILTRATION[(1)], SURFACE DISCHARGE[(3)]**
1.50	12223	15281	
1.75	12565	18380	
2.00	12909	21564	
2.25	13257	24834	
2.50	13609	28193	
2.75	13964	31639	
3.00	14324	35175	
3.10	14467	36615	
3.25	14685	38801	
3.50	15051	42518	**EMERGENCY WEIR[(4)]**
4.00	15798	50230	
4.50	16550	58316	

SUB SURFACE STORAGE BMP 1

Elevation (ft)	Area (ft^2)	Volume (ft^3)	
-1.50	11887	5349	**Amended Soil Base (0.3 voids)**
-3.50	11887	9510	**Gravel Base (0.4 voids)[(5)]**
Gravel & Amended Soil	**TOTAL =**	14859	(ft^3)
Surface Total	**TOTAL =**	12268	(ft^3)
IMP	**TOTAL =**	**27126**	**(ft^3)**

(1): The area at this surface elevation corresponds to the area of gravel and amended soil (Bio-filtration layer)
(2): The volume for the first 3 inches of surface depth accounts for the voids of mulch
(3): Volume at this elevation coresponds with surface volume for WQ purposes (invert of lowest surface outlet)
(4): This elevation corresponds to the top of the riser elevation.
(5): Gravel Depth includes three (3) inches of storage below the LID orifice.

Effective Depth:	12.38 in	(hydromodification purposes)
Effective Depth:	11.48 in	(water quality purposes)

Stage-Area for BMP 2

Elevation (ft)	Area (ft^2)	Volume (ft^3)	
0.00	1810	**0**	
0.25	2239	202	**TOP OF MULCH[2]**
0.50	2694	818	
0.75	3147	1547	
1.00	3623	2393	
1.25	4121	3360	**BIOFILTRATION[1], SURFACE DISCHARGE[3]**
1.50	4607	4450	
1.75	5163	5671	
2.00	5722	7031	
2.25	6271	8530	
2.50	6871	10172	**EMERGENCY WEIR[4]**
2.75	7447	11961	
3.00	8047	13897	

SUB SURFACE STORAGE BMP 2

Elevation (ft)	Area (ft^2)	Volume (ft^3)	
-1.50	4121	1854	**Amended Soil Base (0.3 voids)**
-3.50	4121	3297	**Gravel Base (0.4 voids)[5]**
Gravel & Amended Soil	**TOTAL =**	5151	(ft^3)
Surface Total	**TOTAL =**	3360	(ft^3)
IMP	**TOTAL =**	**8511**	**(ft^3)**

(1): The area at this surface elevation corresponds to the area of gravel and amended soil (Bio-filtration layer)
(2): The volume for the first 3 inches of surface depth accounts for the voids of mulch
(3): Volume at this elevation coresponds with surface volume for WQ purposes (invert of lowest surface outlet)
(4): This elevation corresponds to the top of the riser elevation.
(5): Gravel Depth includes three (3) inches of storage below the LID orifice.

Effective Depth:	9.78 in	(hydromodification purposes)
Effective Depth:	8.88 in	(water quality purposes)

Stage-Area for BMP 3

Elevation (ft)	Area (ft^2)	Volume (ft^3)	
0.00	179	**0**	
0.25	225	20	**TOP OF MULCH(2)**
0.50	276	83	
0.75	333	159	
1.00	393	249	
1.25	459.3	356	**BIOFILTRATION(1), SURFACE DISCHARGE(3)**
1.50	530	479	
1.75	605	621	
2.00	687	782	
2.25	771	965	
2.50	861	1168	**EMERGENCY WEIR(4)**
2.75	956	1395	
3.00	1055	1647	

SUB SURFACE STORAGE BMP 3

Elevation (ft)	Area (ft^2)	Volume (ft^3)	
-1.50	459	207	**Amended Soil Base (0.3 voids)**
-3.50	459	367	**Gravel Base (0.4 voids)(5)**
Gravel & Amended Soil	**TOTAL =**	574	(ft^3)
Surface Total	**TOTAL =**	356	(ft^3)
IMP	**TOTAL =**	**929**	**(ft^3)**

(1): The area at this surface elevation corresponds to the area of gravel and amended soil (Bio-filtration layer)
(2): The volume for the first 3 inches of surface depth accounts for the voids of mulch
(3): Volume at this elevation coresponds with surface volume for WQ purposes (invert of lowest surface outlet)
(4): This elevation corresponds to the top of the riser elevation.
(5): Gravel Depth includes three (3) inches of storage below the LID orifice.

Effective Depth:	9.29 in	(hydromodification purposes)
Effective Depth:	8.39 in	(water quality purposes)

Outlet structure for Discharge of Detention Basin 1

(note: 0.0 elev corresponds to elev 1.25 ft from above top of ammended soil)

Discharge vs Elevation Table

Low orifice:	1	"	Lower slot			Emergency Weir	
Number:	4		Invert:	1.25	ft	Invert:	2.250 ft
Cg-low:	0.61	ft	B	6.00	ft	B:	12 ft
			h	0.250	ft		
Middle orifice:	1.5	"	Upper slot				
number of orif:	0		Invert:	0.000	ft		
Cg-middle:	0.61		B:	0.00	ft		
invert elev:	0.00	ft	h	0.000	ft		

h (ft)	H/D-low -	H/D-mid -	Qlow-orif (cfs)	Qlow-weir (cfs)	Qtot-low (cfs)	Qmid-orif (cfs)	Qmid-weir (cfs)	Qtot-med (cfs)	Qslot-low (cfs)	Qslot-upp (cfs)	Qemer (cfs)	Qtot (cfs)
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.083	1.000	0.667	0.022	0.021	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.021
0.167	2.000	1.333	0.038	0.050	0.038	0.000	0.000	0.000	0.000	0.000	0.000	0.038
0.250	3.000	2.000	0.049	0.057	0.049	0.000	0.000	0.000	0.000	0.000	0.000	0.049
0.333	4.000	2.667	0.058	0.095	0.058	0.000	0.000	0.000	0.000	0.000	0.000	0.058
0.417	5.000	3.333	0.065	0.382	0.065	0.000	0.000	0.000	0.000	0.000	0.000	0.065
0.500	6.000	4.000	0.072	0.723	0.072	0.000	0.000	0.000	0.000	0.000	0.000	0.072
0.583	7.000	4.667	0.079	0.786	0.079	0.000	0.000	0.000	0.000	0.000	0.000	0.079
0.667	8.000	5.333	0.084	0.844	0.084	0.000	0.000	0.000	0.000	0.000	0.000	0.084
0.750	9.000	6.000	0.090	0.899	0.090	0.000	0.000	0.000	0.000	0.000	0.000	0.090
0.833	10.000	6.667	0.095	0.950	0.095	0.000	0.000	0.000	0.000	0.000	0.000	0.095
0.917	11.000	7.333	0.100	0.999	0.100	0.000	0.000	0.000	0.000	0.000	0.000	0.100
1.000	12.000	8.000	0.105	1.045	0.105	0.000	0.000	0.000	0.000	0.000	0.000	0.105
1.083	13.000	8.667	0.109	1.090	0.109	0.000	0.000	0.000	0.000	0.000	0.000	0.109
1.167	14.000	9.333	0.113	1.133	0.113	0.000	0.000	0.000	0.000	0.000	0.000	0.113
1.250	15.000	10.000	0.117	1.174	0.117	0.000	0.000	0.000	0.000	0.000	0.000	0.117
1.333	16.000	10.667	0.121	1.214	0.121	0.000	0.000	0.000	0.447	0.000	0.000	0.569
1.417	17.000	11.333	0.125	1.252	0.125	0.000	0.000	0.000	1.266	0.000	0.000	1.391
1.500	18.000	12.000	0.129	1.290	0.129	0.000	0.000	0.000	2.325	0.000	0.000	2.454
1.583	19.000	12.667	0.133	1.326	0.133	0.000	0.000	0.000	3.352	0.000	0.000	3.484
1.667	20.000	13.333	0.136	1.361	0.136	0.000	0.000	0.000	3.966	0.000	0.000	4.102
1.750	21.000	14.000	0.140	1.396	0.140	0.000	0.000	0.000	4.497	0.000	0.000	4.636
1.833	22.000	14.667	0.143	1.430	0.143	0.000	0.000	0.000	4.971	0.000	0.000	5.114
1.917	23.000	15.333	0.146	1.462	0.146	0.000	0.000	0.000	5.404	0.000	0.000	5.550
2.000	24.000	16.000	0.149	1.495	0.149	0.000	0.000	0.000	5.805	0.000	0.000	5.954
2.083	25.000	16.667	0.153	1.526	0.153	0.000	0.000	0.000	6.180	0.000	0.000	6.333
2.167	26.000	17.333	0.156	1.557	0.156	0.000	0.000	0.000	6.533	0.000	0.000	6.689
2.250	27.000	18.000	0.159	1.587	0.159	0.000	0.000	0.000	6.869	0.000	0.000	7.027
2.333	28.000	18.667	0.162	1.617	0.162	0.000	0.000	0.000	7.188	0.000	0.895	8.245
2.417	29.000	19.333	0.165	1.646	0.165	0.000	0.000	0.000	7.494	0.000	2.531	10.190
2.500	30.000	20.000	0.167	1.674	0.167	0.000	0.000	0.000	7.788	0.000	4.650	12.606
2.583	31.000	20.667	0.170	1.703	0.170	0.000	0.000	0.000	8.072	0.000	7.159	15.401
2.667	32.000	21.333	0.173	1.730	0.173	0.000	0.000	0.000	8.345	0.000	10.005	18.523
2.750	33.000	22.000	0.176	1.758	0.176	0.000	0.000	0.000	8.610	0.000	13.152	21.938
2.833	34.000	22.667	0.178	1.784	0.178	0.000	0.000	0.000	8.867	0.000	16.574	25.619
2.917	35.000	23.333	0.181	1.811	0.181	0.000	0.000	0.000	9.117	0.000	20.249	29.547
3.000	36.000	24.000	0.184	1.837	0.184	0.000	0.000	0.000	9.360	0.000	24.162	33.706
3.083	37.000	24.667	0.186	1.863	0.186	0.000	0.000	0.000	9.597	0.000	28.299	38.083
3.167	38.000	25.333	0.189	1.888	0.189	0.000	0.000	0.000	9.829	0.000	32.648	42.666
3.250	39.000	26.000	0.191	1.913	0.191	0.000	0.000	0.000	10.055	0.000	37.200	47.446

Outlet structure for Discharge of Detention Basin 2

(note: 0.0 elev corresponds to elev 1.25 ft from above top of ammended soil)

Discharge vs Elevation Table

Low orifice:	0.75	"	Lower slot			Emergency Weir	
Number:	2		Invert:	0.75	ft	Invert:	1.250 ft
Cg-low:	0.61	ft	B	6.00	ft	B:	16 ft
			h	0.250	ft		
Middle orifice:	1	"	Upper slot				
number of orif:	0		Invert:	0.000	ft		
Cg-middle:	0.61		B:	0.00	ft		
invert elev:	0.25	ft	h	0.000	ft		

h (ft)	H/D-low -	H/D-mid -	Qlow-orif (cfs)	Qlow-weir (cfs)	Qtot-low (cfs)	Qmid-orif (cfs)	Qmid-weir (cfs)	Qtot-med (cfs)	Qslot-low (cfs)	Qslot-upp (cfs)	Qemer (cfs)	Qtot (cfs)
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.042	0.667	0.000	0.003	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.003
0.083	1.333	0.000	0.007	0.008	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.007
0.125	2.000	0.000	0.009	0.012	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.009
0.167	2.667	0.000	0.011	0.014	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.011
0.208	3.333	0.000	0.013	0.014	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.013
0.250	4.000	0.000	0.014	0.023	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.014
0.292	4.667	0.500	0.015	0.057	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.015
0.333	5.333	1.000	0.017	0.147	0.017	0.000	0.000	0.000	0.000	0.000	0.000	0.017
0.375	6.000	1.500	0.018	0.176	0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.018
0.417	6.667	2.000	0.019	0.186	0.019	0.000	0.000	0.000	0.000	0.000	0.000	0.019
0.458	7.333	2.500	0.020	0.196	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.020
0.500	8.000	3.000	0.021	0.206	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.021
0.542	8.667	3.500	0.021	0.215	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.021
0.583	9.333	4.000	0.022	0.223	0.022	0.000	0.000	0.000	0.000	0.000	0.000	0.022
0.625	10.000	4.500	0.023	0.231	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.023
0.667	10.667	5.000	0.024	0.239	0.024	0.000	0.000	0.000	0.000	0.000	0.000	0.024
0.708	11.333	5.500	0.025	0.247	0.025	0.000	0.000	0.000	0.000	0.000	0.000	0.025
0.750	12.000	6.000	0.025	0.255	0.025	0.000	0.000	0.000	0.000	0.000	0.000	0.025
0.792	12.667	6.500	0.026	0.262	0.026	0.000	0.000	0.000	0.158	0.000	0.000	0.184
0.833	13.333	7.000	0.027	0.269	0.027	0.000	0.000	0.000	0.447	0.000	0.000	0.474
0.875	14.000	7.500	0.028	0.276	0.028	0.000	0.000	0.000	0.822	0.000	0.000	0.850
0.917	14.667	8.000	0.028	0.283	0.028	0.000	0.000	0.000	1.266	0.000	0.000	1.294
0.958	15.333	8.500	0.029	0.289	0.029	0.000	0.000	0.000	1.769	0.000	0.000	1.798
1.000	16.000	9.000	0.030	0.296	0.030	0.000	0.000	0.000	2.325	0.000	0.000	2.355
1.042	16.667	9.500	0.030	0.302	0.030	0.000	0.000	0.000	2.930	0.000	0.000	2.960
1.083	17.333	10.000	0.031	0.308	0.031	0.000	0.000	0.000	3.352	0.000	0.000	3.382
1.125	18.000	10.500	0.031	0.314	0.031	0.000	0.000	0.000	3.671	0.000	0.000	3.703
1.167	18.667	11.000	0.032	0.320	0.032	0.000	0.000	0.000	3.966	0.000	0.000	3.998
1.208	19.333	11.500	0.033	0.326	0.033	0.000	0.000	0.000	4.239	0.000	0.000	4.272
1.250	20.000	12.000	0.033	0.332	0.033	0.000	0.000	0.000	4.497	0.000	0.000	4.530
1.292	20.667	12.500	0.034	0.337	0.034	0.000	0.000	0.000	4.740	0.000	0.422	5.195
1.333	21.333	13.000	0.034	0.343	0.034	0.000	0.000	0.000	4.971	0.000	1.193	6.199
1.375	22.000	13.500	0.035	0.348	0.035	0.000	0.000	0.000	5.192	0.000	2.192	7.419
1.417	22.667	14.000	0.035	0.354	0.035	0.000	0.000	0.000	5.404	0.000	3.375	8.814
1.458	23.333	14.500	0.036	0.359	0.036	0.000	0.000	0.000	5.608	0.000	4.716	10.361
1.500	24.000	15.000	0.036	0.364	0.036	0.000	0.000	0.000	5.805	0.000	6.200	12.041
1.542	24.667	15.500	0.037	0.369	0.037	0.000	0.000	0.000	5.995	0.000	7.813	13.845
1.583	25.333	16.000	0.037	0.374	0.037	0.000	0.000	0.000	6.180	0.000	9.545	15.763
1.625	26.000	16.500	0.038	0.379	0.038	0.000	0.000	0.000	6.359	0.000	11.390	17.787
1.667	26.667	17.000	0.038	0.384	0.038	0.000	0.000	0.000	6.533	0.000	13.340	19.912
1.708	27.333	17.500	0.039	0.389	0.039	0.000	0.000	0.000	6.703	0.000	15.390	22.132
1.750	28.000	18.000	0.039	0.394	0.039	0.000	0.000	0.000	6.869	0.000	17.536	24.444

Outlet structure for Discharge of Detention Basin 2 (Riser 2-2)

(note: 0.0 elev corresponds to elev 1.25 ft from above top of ammended so

Discharge vs Elevation Table

Low orifice:	0.75 "	Lower slot		Emergency Weir	
Number:	2	Invert:	0.75 ft	Invert:	1.250 ft
Cg-low:	0.61 ft	B	3.00 ft	B:	8 ft
		h	0.250 ft		
Middle orifice:	1 "	Upper slot			
number of orif:	0	Invert:	0.000 ft		
Cg-middle:	0.61	B:	0.00 ft		
invert elev:	0.25 ft	h	0.000 ft		

h (ft)	H/D-low -	H/D-mid -	Qlow-orif (cfs)	Qlow-weir (cfs)	Qtot-low (cfs)	Qmid-orif (cfs)	Qmid-weir (cfs)	Qtot-med (cfs)	Qslot-low (cfs)	Qslot-upp (cfs)	Qemer (cfs)	Qtot (cfs)
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.042	0.667	0.000	0.003	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.003
0.083	1.333	0.000	0.007	0.008	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.007
0.125	2.000	0.000	0.009	0.012	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.009
0.167	2.667	0.000	0.011	0.014	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.011
0.208	3.333	0.000	0.013	0.014	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.013
0.250	4.000	0.000	0.014	0.023	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.014
0.292	4.667	0.500	0.015	0.057	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.015
0.333	5.333	1.000	0.017	0.147	0.017	0.000	0.000	0.000	0.000	0.000	0.000	0.017
0.375	6.000	1.500	0.018	0.176	0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.018
0.417	6.667	2.000	0.019	0.186	0.019	0.000	0.000	0.000	0.000	0.000	0.000	0.019
0.458	7.333	2.500	0.020	0.196	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.020
0.500	8.000	3.000	0.021	0.206	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.021
0.542	8.667	3.500	0.021	0.215	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.021
0.583	9.333	4.000	0.022	0.223	0.022	0.000	0.000	0.000	0.000	0.000	0.000	0.022
0.625	10.000	4.500	0.023	0.231	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.023
0.667	10.667	5.000	0.024	0.239	0.024	0.000	0.000	0.000	0.000	0.000	0.000	0.024
0.708	11.333	5.500	0.025	0.247	0.025	0.000	0.000	0.000	0.000	0.000	0.000	0.025
0.750	12.000	6.000	0.025	0.255	0.025	0.000	0.000	0.000	0.000	0.000	0.000	0.025
0.792	12.667	6.500	0.026	0.262	0.026	0.000	0.000	0.000	0.079	0.000	0.000	0.105
0.833	13.333	7.000	0.027	0.269	0.027	0.000	0.000	0.000	0.224	0.000	0.000	0.251
0.875	14.000	7.500	0.028	0.276	0.028	0.000	0.000	0.000	0.411	0.000	0.000	0.439
0.917	14.667	8.000	0.028	0.283	0.028	0.000	0.000	0.000	0.633	0.000	0.000	0.661
0.958	15.333	8.500	0.029	0.289	0.029	0.000	0.000	0.000	0.884	0.000	0.000	0.913
1.000	16.000	9.000	0.030	0.296	0.030	0.000	0.000	0.000	1.162	0.000	0.000	1.192
1.042	16.667	9.500	0.030	0.302	0.030	0.000	0.000	0.000	1.465	0.000	0.000	1.495
1.083	17.333	10.000	0.031	0.308	0.031	0.000	0.000	0.000	1.676	0.000	0.000	1.707
1.125	18.000	10.500	0.031	0.314	0.031	0.000	0.000	0.000	1.836	0.000	0.000	1.867
1.167	18.667	11.000	0.032	0.320	0.032	0.000	0.000	0.000	1.983	0.000	0.000	2.015
1.208	19.333	11.500	0.033	0.326	0.033	0.000	0.000	0.000	2.120	0.000	0.000	2.152
1.250	20.000	12.000	0.033	0.332	0.033	0.000	0.000	0.000	2.248	0.000	0.000	2.281
1.292	20.667	12.500	0.034	0.337	0.034	0.000	0.000	0.000	2.370	0.000	0.211	2.615
1.333	21.333	13.000	0.034	0.343	0.034	0.000	0.000	0.000	2.486	0.000	0.597	3.116
1.375	22.000	13.500	0.035	0.348	0.035	0.000	0.000	0.000	2.596	0.000	1.096	3.727
1.417	22.667	14.000	0.035	0.354	0.035	0.000	0.000	0.000	2.702	0.000	1.687	4.425
1.458	23.333	14.500	0.036	0.359	0.036	0.000	0.000	0.000	2.804	0.000	2.358	5.198
1.500	24.000	15.000	0.036	0.364	0.036	0.000	0.000	0.000	2.903	0.000	3.100	6.039
1.542	24.667	15.500	0.037	0.369	0.037	0.000	0.000	0.000	2.998	0.000	3.906	6.941
1.583	25.333	16.000	0.037	0.374	0.037	0.000	0.000	0.000	3.090	0.000	4.773	7.900
1.625	26.000	16.500	0.038	0.379	0.038	0.000	0.000	0.000	3.180	0.000	5.695	8.913
1.667	26.667	17.000	0.038	0.384	0.038	0.000	0.000	0.000	3.267	0.000	6.670	9.975
1.708	27.333	17.500	0.039	0.389	0.039	0.000	0.000	0.000	3.352	0.000	7.695	11.086
1.750	28.000	18.000	0.039	0.394	0.039	0.000	0.000	0.000	3.434	0.000	8.768	12.242

Outlet structure for Discharge of Detention Basin 2 (Riser 2-3)

(note: 0.0 elev corresponds to elev 1.25 ft from above top of ammended soi

Discharge vs Elevation Table

Low orifice:	0.75 "	Lower slot		Emergency Weir	
Number:	0	Invert:	0.75 ft	Invert:	1.250 ft
Cg-low:	0.61 ft	B	3.00 ft	B:	8 ft
		h	0.250 ft		
Middle orifice:	1 "	Upper slot			
number of orif:	0	Invert:	0.000 ft		
Cg-middle:	0.61	B:	0.00 ft		
invert elev:	0.25 ft	h	0.000 ft		

h (ft)	H/D-low -	H/D-mid -	Qlow-orif (cfs)	Qlow-weir (cfs)	Qtot-low (cfs)	Qmid-orif (cfs)	Qmid-weir (cfs)	Qtot-med (cfs)	Qslot-low (cfs)	Qslot-upp (cfs)	Qemer (cfs)	Qtot (cfs)
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.042	0.667	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.083	1.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.125	2.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.167	2.667	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.208	3.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.250	4.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.292	4.667	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.333	5.333	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.375	6.000	1.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.417	6.667	2.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.458	7.333	2.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.500	8.000	3.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.542	8.667	3.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.583	9.333	4.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.625	10.000	4.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.667	10.667	5.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.708	11.333	5.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.750	12.000	6.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.792	12.667	6.500	0.000	0.000	0.000	0.000	0.000	0.000	0.079	0.000	0.000	0.079
0.833	13.333	7.000	0.000	0.000	0.000	0.000	0.000	0.000	0.224	0.000	0.000	0.224
0.875	14.000	7.500	0.000	0.000	0.000	0.000	0.000	0.000	0.411	0.000	0.000	0.411
0.917	14.667	8.000	0.000	0.000	0.000	0.000	0.000	0.000	0.633	0.000	0.000	0.633
0.958	15.333	8.500	0.000	0.000	0.000	0.000	0.000	0.000	0.884	0.000	0.000	0.884
1.000	16.000	9.000	0.000	0.000	0.000	0.000	0.000	0.000	1.162	0.000	0.000	1.162
1.042	16.667	9.500	0.000	0.000	0.000	0.000	0.000	0.000	1.465	0.000	0.000	1.465
1.083	17.333	10.000	0.000	0.000	0.000	0.000	0.000	0.000	1.676	0.000	0.000	1.676
1.125	18.000	10.500	0.000	0.000	0.000	0.000	0.000	0.000	1.836	0.000	0.000	1.836
1.167	18.667	11.000	0.000	0.000	0.000	0.000	0.000	0.000	1.983	0.000	0.000	1.983
1.208	19.333	11.500	0.000	0.000	0.000	0.000	0.000	0.000	2.120	0.000	0.000	2.120
1.250	20.000	12.000	0.000	0.000	0.000	0.000	0.000	0.000	2.248	0.000	0.000	2.248
1.292	20.667	12.500	0.000	0.000	0.000	0.000	0.000	0.000	2.370	0.000	0.211	2.581
1.333	21.333	13.000	0.000	0.000	0.000	0.000	0.000	0.000	2.486	0.000	0.597	3.082
1.375	22.000	13.500	0.000	0.000	0.000	0.000	0.000	0.000	2.596	0.000	1.096	3.692
1.417	22.667	14.000	0.000	0.000	0.000	0.000	0.000	0.000	2.702	0.000	1.687	4.390
1.458	23.333	14.500	0.000	0.000	0.000	0.000	0.000	0.000	2.804	0.000	2.358	5.162
1.500	24.000	15.000	0.000	0.000	0.000	0.000	0.000	0.000	2.903	0.000	3.100	6.002
1.542	24.667	15.500	0.000	0.000	0.000	0.000	0.000	0.000	2.998	0.000	3.906	6.904
1.583	25.333	16.000	0.000	0.000	0.000	0.000	0.000	0.000	3.090	0.000	4.773	7.863
1.625	26.000	16.500	0.000	0.000	0.000	0.000	0.000	0.000	3.180	0.000	5.695	8.875
1.667	26.667	17.000	0.000	0.000	0.000	0.000	0.000	0.000	3.267	0.000	6.670	9.937
1.708	27.333	17.500	0.000	0.000	0.000	0.000	0.000	0.000	3.352	0.000	7.695	11.047
1.750	28.000	18.000	0.000	0.000	0.000	0.000	0.000	0.000	3.434	0.000	8.768	12.202

Outlet structure for Discharge of Detention Basin 3

(note: 0.0 elev corresponds to elev 1.25 ft from above top of ammended soil)

Discharge vs Elevation Table

Low orifice:	1	"	Lower slot			Emergency Weir	
Number:	1		Invert:	0.00	ft	Invert:	1.250 ft
Cg-low:	0.61	ft	B	0.00	ft	B:	8 ft
			h	0.167	ft		
Middle orifice:	1	"	Upper slot				
number of orif:	0		Invert:	0.000	ft		
Cg-middle:	0.61		B:	0.00	ft		
invert elev:	0.25	ft	h	0.083	ft		

h (ft)	H/D-low -	H/D-mid -	Qlow-orif (cfs)	Qlow-weir (cfs)	Qtot-low (cfs)	Qmid-orif (cfs)	Qmid-weir (cfs)	Qtot-med (cfs)	Qslot-low (cfs)	Qslot-upp (cfs)	Qemer (cfs)	Qtot (cfs)
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.042	0.500	0.000	0.000	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.002
0.083	1.000	0.000	0.005	0.005	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.005
0.125	1.500	0.000	0.008	0.009	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.008
0.167	2.000	0.000	0.009	0.013	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.009
0.208	2.500	0.000	0.011	0.014	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.011
0.250	3.000	0.000	0.012	0.014	0.012	0.000	0.000	0.000	0.000	0.000	0.000	0.012
0.292	3.500	0.500	0.013	0.016	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.013
0.333	4.000	1.000	0.014	0.024	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.014
0.375	4.500	1.500	0.015	0.046	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.015
0.417	5.000	2.000	0.016	0.095	0.016	0.000	0.000	0.000	0.000	0.000	0.000	0.016
0.458	5.500	2.500	0.017	0.172	0.017	0.000	0.000	0.000	0.000	0.000	0.000	0.017
0.500	6.000	3.000	0.018	0.181	0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.018
0.542	6.500	3.500	0.019	0.189	0.019	0.000	0.000	0.000	0.000	0.000	0.000	0.019
0.583	7.000	4.000	0.020	0.197	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.020
0.625	7.500	4.500	0.020	0.204	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.020
0.667	8.000	5.000	0.021	0.211	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.021
0.708	8.500	5.500	0.022	0.218	0.022	0.000	0.000	0.000	0.000	0.000	0.000	0.022
0.750	9.000	6.000	0.022	0.225	0.022	0.000	0.000	0.000	0.000	0.000	0.000	0.022
0.792	9.500	6.500	0.023	0.231	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.023
0.833	10.000	7.000	0.024	0.238	0.024	0.000	0.000	0.000	0.000	0.000	0.000	0.024
0.875	10.500	7.500	0.024	0.244	0.024	0.000	0.000	0.000	0.000	0.000	0.000	0.024
0.917	11.000	8.000	0.025	0.250	0.025	0.000	0.000	0.000	0.000	0.000	0.000	0.025
0.958	11.500	8.500	0.026	0.256	0.026	0.000	0.000	0.000	0.000	0.000	0.000	0.026
1.000	12.000	9.000	0.026	0.261	0.026	0.000	0.000	0.000	0.000	0.000	0.000	0.026
1.042	12.500	9.500	0.027	0.267	0.027	0.000	0.000	0.000	0.000	0.000	0.000	0.027
1.083	13.000	10.000	0.027	0.272	0.027	0.000	0.000	0.000	0.000	0.000	0.000	0.027
1.125	13.500	10.500	0.028	0.278	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.028
1.167	14.000	11.000	0.028	0.283	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.028
1.208	14.500	11.500	0.029	0.288	0.029	0.000	0.000	0.000	0.000	0.000	0.000	0.029
1.250	15.000	12.000	0.029	0.293	0.029	0.000	0.000	0.000	0.000	0.000	0.000	0.029
1.292	15.500	12.500	0.030	0.299	0.030	0.000	0.000	0.000	0.000	0.000	0.211	0.241
1.333	16.000	13.000	0.030	0.303	0.030	0.000	0.000	0.000	0.000	0.000	0.597	0.627
1.375	16.500	13.500	0.031	0.308	0.031	0.000	0.000	0.000	0.000	0.000	1.096	1.127
1.417	17.000	14.000	0.031	0.313	0.031	0.000	0.000	0.000	0.000	0.000	1.687	1.719
1.458	17.500	14.500	0.032	0.318	0.032	0.000	0.000	0.000	0.000	0.000	2.358	2.390
1.500	18.000	15.000	0.032	0.322	0.032	0.000	0.000	0.000	0.000	0.000	3.100	3.132
1.542	18.500	15.500	0.033	0.327	0.033	0.000	0.000	0.000	0.000	0.000	3.906	3.939
1.583	19.000	16.000	0.033	0.332	0.033	0.000	0.000	0.000	0.000	0.000	4.773	4.806
1.625	19.500	16.500	0.034	0.336	0.034	0.000	0.000	0.000	0.000	0.000	5.695	5.729
1.667	20.000	17.000	0.034	0.340	0.034	0.000	0.000	0.000	0.000	0.000	6.670	6.704
1.708	20.500	17.500	0.034	0.345	0.034	0.000	0.000	0.000	0.000	0.000	7.695	7.730
1.750	21.000	18.000	0.035	0.349	0.035	0.000	0.000	0.000	0.000	0.000	8.768	8.803

DRAWDOWN TIME

BMP-1

Surface Elevation (Ft)	Surface Discharge (cfs)	LID Discharge (cfs)	Area (sq-ft)	Vol (cu-ft)	Δt (hr)	Drying time t (hr)
4.5	47.45	0.147	16550	58319		
4.25	33.71	0.147	16174	54229	0.03	0.0
4	21.94	0.147	15798	50232	0.04	0.1
3.75	12.61	0.147	15425	46329	0.06	0.1
3.5	7.03	0.147	15051	42520	0.11	0.2
3.25	5.95	0.147	14688	38803	0.16	0.4
3	4.64	0.147	14324	35176	0.19	0.6
2.75	2.45	0.147	13964	31640	0.27	0.8
2.5	0.117	0.147	13609	28194	0.67	1.5
2.25	0.105	0.147	13257	24835	3.62	5.1
2	0.090	0.147	12909	21565	3.72	8.8
1.75	0.072	0.147	12565	18380	3.88	12.7
1.5	0.049	0.147	12223	15282	4.15	16.9
1.25	***0.000***	0.147	11887	12268	4.88	***21.8***
1	0	0.147	11553	9338	5.54	27.3
0.75	0	0.147	11224	6491	5.38	32.7
0.5	0	0.147	10898	3726	5.23	37.9
0.25	0	0.147	10575	1042	5.07	43.0
0	0	0.147	10257	0	1.97	**44.9**

BMP-2

Surface Elevation (Ft)	Surface Discharge (cfs)	LID Discharge (cfs)	Area (sq-ft)	Vol (cu-ft)	Δt (hr)	Drying time t (hr)
3	24.44	0.046	8047	14208		
2.75	12.04	0.046	7447	12272	0.03	0.0
2.5	4.53	0.046	6871	10482	0.06	0.1
2.25	2.36	0.046	6271	8839	0.13	0.2
2	0.025	0.046	5722	7340	0.34	0.6
1.75	0.021	0.046	5163	5979	5.52	6.1
1.5	0.014	0.046	4607	4758	5.38	11.5
1.25	***0.000***	0.046	4121	3667	5.77	***17.2***
1	0	0.046	3623	2699	5.91	23.1
0.75	0	0.046	3147	1853	5.17	28.3
0.5	0	0.046	2694	1123	4.46	32.8
0.25	0	0.046	2239	506	3.76	36.5
0	0	0.046	1810	0	3.09	**39.6**

BMP-3

Surface Elevation (Ft)	Surface Discharge (cfs)	LID Discharge (cfs)	Area (sq-ft)	Vol (cu-ft)	Δt (hr)	Drying time t (hr)
3	8.80	0.0075	1055	1678		
2.75	3.13	0.0075	956	1427	0.01	0.0
2.5	0.029	0.0075	861	1200	0.04	0.1
2.25	0.026	0.0075	771	996	1.62	1.7
2	0.022	0.0075	687	814	1.61	3.3
1.75	0.018	0.0075	605	652	1.63	4.9
1.5	0.012	0.0075	530	510	1.75	6.7
1.25	***0.000***	0.0075	459	387	2.55	***9.2***
1	0	0.0075	393	280	3.96	13.2
0.75	0	0.0075	333	189	3.37	16.6
0.5	0	0.0075	276	113	2.83	19.4
0.25	0	0.0075	225	51	2.33	21.7
0	0	0.0075	179	0	1.88	**23.6**

ATTACHMENT 5

Pre & Post-Developed Maps, Project Plan and Detention

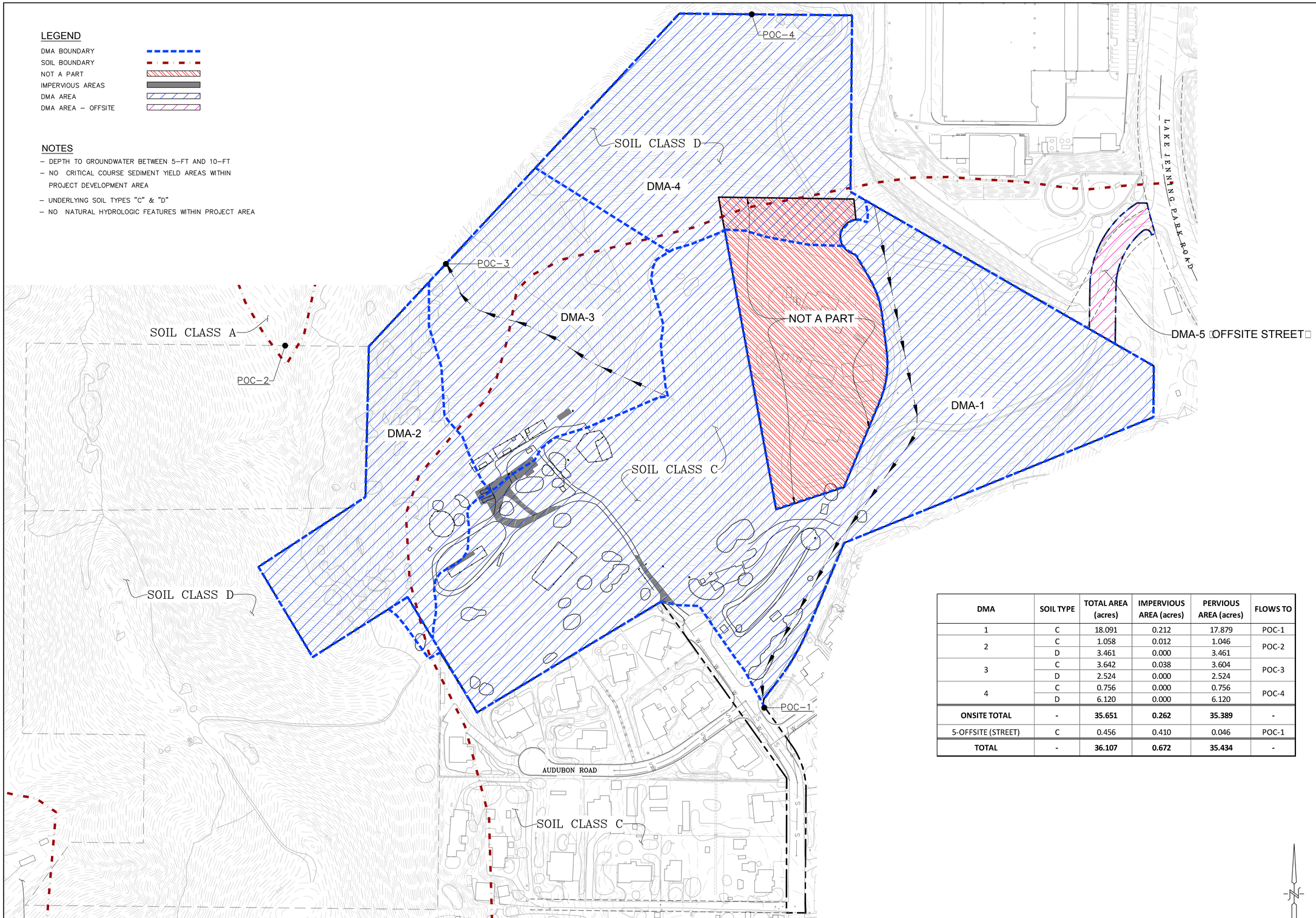
Section Sketches

LEGEND

- DMA BOUNDARY
- SOIL BOUNDARY
- NOT A PART
- IMPERVIOUS AREAS
- DMA AREA
- DMA AREA – OFFSITE

NOTES

- DEPTH TO GROUNDWATER BETWEEN 5–FT AND 10–FT
- NO CRITICAL COURSE SEDIMENT YIELD AREAS WITHIN PROJECT DEVELOPMENT AREA
- UNDERLYING SOIL TYPES "C" & "D"
- NO NATURAL HYDROLOGIC FEATURES WITHIN PROJECT AREA



DMA	SOIL TYPE	TOTAL AREA (acres)	IMPERVIOUS AREA (acres)	PERVIOUS AREA (acres)	FLOWS TO
1	C	18.091	0.212	17.879	POC-1
2	C	1.058	0.012	1.046	POC-2
	D	3.461	0.000	3.461	
3	C	3.642	0.038	3.604	POC-3
	D	2.524	0.000	2.524	
4	C	0.756	0.000	0.756	POC-4
	D	6.120	0.000	6.120	
ONSITE TOTAL	**-**	**35.651**	**0.262**	**35.389**	**-**
5-OFFSITE (STREET)	C	0.456	0.410	0.046	POC-1
TOTAL	**-**	**36.107**	**0.672**	**35.434**	**-**

100 50 0 100 200 300

SCALE: 1" = 100'

REVISIONS

NO.	DESCRIPTION	DATE	APP'D

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2442 Second Avenue
San Diego, CA 92101
(619)232–9200 (619)232–9210 Fax
R·E·C Consultants, Inc.

DATE: 01–24–18
SCALE: AS SHOWN
DRAWN: WZV
CHECKED: LP

SHEET TITLE: HYDROMOD EXHIBIT - EXISTING

PROJECT: GREENHILLS RANCH
PHASE 2
COUNTY OF SAN DIEGO, CA

SHEET 1 OF 1 SHEETS

SAVE DATE: 1/24/2018 ~ PLOT DATE: 1/24/2018 ~ FILE NAME: C:\Users\Wil\Desktop\Files to Transfer\1083 – Greenhills Ranch\SW – Hydromod Exhibit – Existing.dwg

LEGEND

- DMA BOUNDARY
- SOIL BOUNDARY
- POC BOUNDARY
- DMA–1 AREA
- DMA–2 AREA
- DMA–3 AREA
- SELF–MITIGATING–1 (PERVIOUS DG SURFACE)
- IMPERVIOUS AREA
- ONSITE SELF–MITIGATING AREA
- ONSITE BY–PASSING AREA
- OFFSITE BYPASS AREA
- DMA OFF–STREET–1 TO BE TREATED W/ TREE WELLS
- DMA OFF–STREET–2 TO BE TREATED W/ TREE WELL
- BMP BASIN AREA
- STORM DRAIN
- PROHIBITIVE SIGNAGE
- TREE WELLS
- TREE WELL STRUCTURAL SOIL SURFACE AREA

APPROXIMATE GROUNDWATER (GW) DEPTH: 5' < GW < 10'

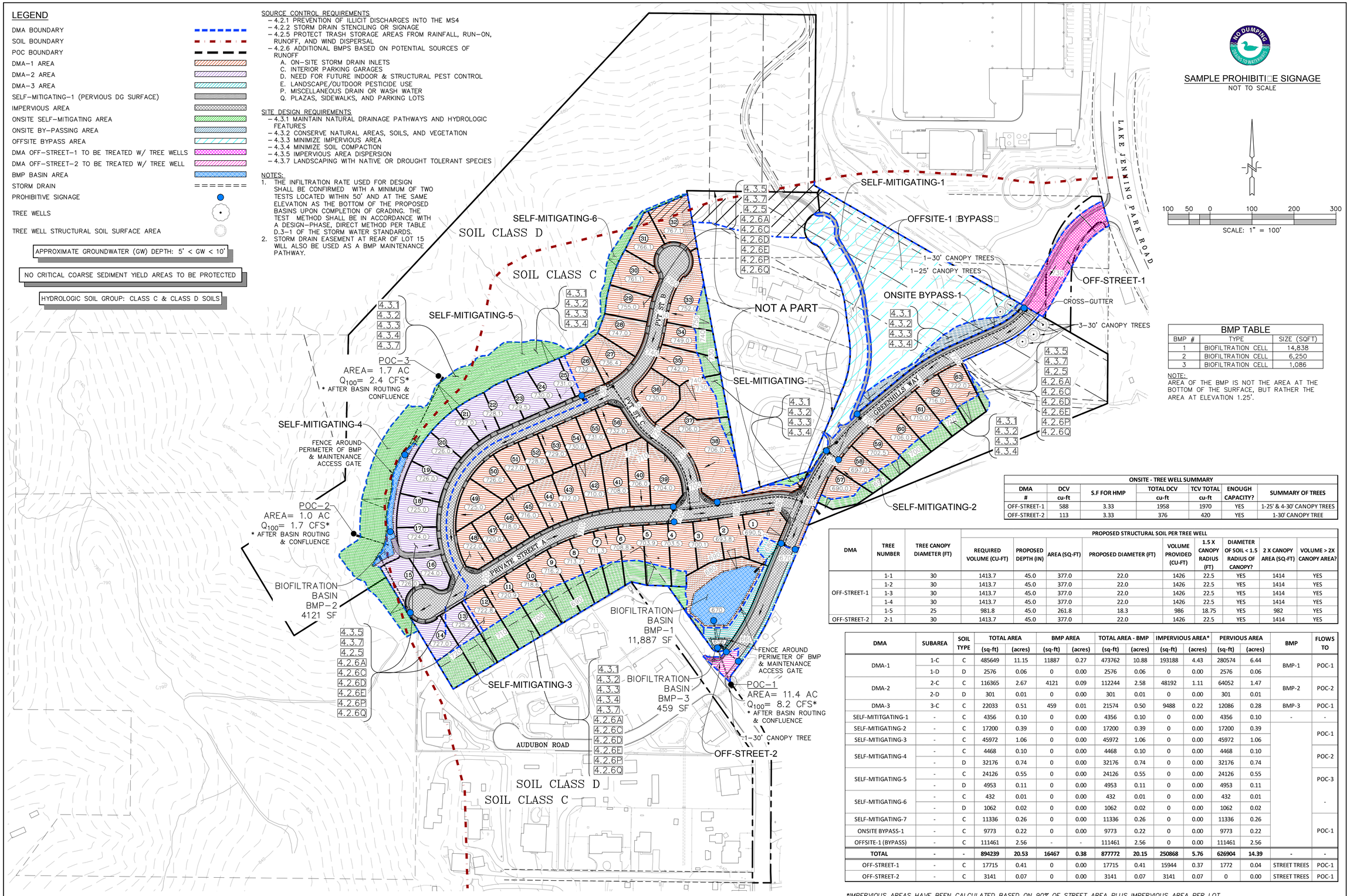
NO CRITICAL COARSE SEDIMENT YIELD AREAS TO BE PROTECTED

HYDROLOGIC SOIL GROUP: CLASS C & CLASS D SOILS

SOURCE CONTROL REQUIREMENTS
- 4.2.1 PREVENTION OF ILLICIT DISCHARGES INTO THE MS4
- 4.2.2 STORM DRAIN STENCILING OR SIGNAGE
- 4.2.5 PROTECT TRASH STORAGE AREAS FROM RAINFALL, RUN–ON, RUNOFF, AND WIND DISPERSAL
- 4.2.6 ADDITIONAL BMPS BASED ON POTENTIAL SOURCES OF RUNOFF
  - A. ON–SITE STORM DRAIN INLETS
  - C. INTERIOR PARKING GARAGES
  - D. NEED FOR FUTURE INDOOR & STRUCTURAL PEST CONTROL
  - E. LANDSCAPE/OUTDOOR PESTICIDE USE
  - P. MISCELLANEOUS DRAIN OR WASH WATER
  - Q. PLAZAS, SIDEWALKS, AND PARKING LOTS

SITE DESIGN REQUIREMENTS
- 4.3.1 MAINTAIN NATURAL DRAINAGE PATHWAYS AND HYDROLOGIC FEATURES
- 4.3.2 CONSERVE NATURAL AREAS, SOILS, AND VEGETATION
- 4.3.3 MINIMIZE IMPERVIOUS AREA
- 4.3.4 MINIMIZE SOIL COMPACTION
- 4.3.5 IMPERVIOUS AREA DISPERSION
- 4.3.7 LANDSCAPING WITH NATIVE OR DROUGHT TOLERANT SPECIES

NOTES:
1. THE INFILTRATION RATE USED FOR DESIGN SHALL BE CONFIRMED WITH A MINIMUM OF TWO TESTS LOCATED WITHIN 50' AND AT THE SAME ELEVATION AS THE BOTTOM OF THE PROPOSED BASINS UPON COMPLETION OF GRADING. THE TEST METHOD SHALL BE IN ACCORDANCE WITH A DESIGN–PHASE, DIRECT METHOD PER TABLE D.3–1 OF THE STORM WATER STANDARDS.
2. STORM DRAIN EASEMENT AT REAR OF LOT 15 WILL ALSO BE USED AS A BMP MAINTENANCE PATHWAY.



SAMPLE PROHIBITI□E SIGNAGE
NOT TO SCALE

100 50 0 100 200 300
SCALE: 1" = 100'

BMP TABLE		
BMP #	TYPE	SIZE (SQFT)
1	BIOFILTRATION CELL	14,838
2	BIOFILTRATION CELL	6,250
3	BIOFILTRATION CELL	1,086

NOTE:
AREA OF THE BMP IS NOT THE AREA AT THE BOTTOM OF THE SURFACE, BUT RATHER THE AREA AT ELEVATION 1.25'.

ONSITE - TREE WELL SUMMARY						
DMA #	DCV cu-ft	S.F FOR HMP	TOTAL DCV cu-ft	TCV TOTAL cu-ft	ENOUGH CAPACITY?	SUMMARY OF TREES
OFF-STREET-1	588	3.33	1958	1970	YES	1-25' & 4-30' CANOPY TREES
OFF-STREET-2	113	3.33	376	420	YES	1-30' CANOPY TREE

DMA	TREE NUMBER	TREE CANOPY DIAMETER (FT)	PROPOSED STRUCTURAL SOIL PER TREE WELL							
			REQUIRED VOLUME (CU-FT)	PROPOSED DEPTH (IN)	AREA (SQ-FT)	PROPOSED DIAMETER (FT)	VOLUME PROVIDED (CU-FT)	1.5 X CANOPY RADIUS (FT)	DIAMETER OF SOIL < 1.5 RADIUS OF CANOPY?	2 X CANOPY AREA (SQ-FT)	VOLUME > 2X CANOPY AREA?
OFF-STREET-1	1-1	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-2	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-3	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-4	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-5	25	981.8	45.0	261.8	18.3	986	18.75	YES	982	YES
OFF-STREET-2	2-1	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES

DMA	SUBAREA	SOIL TYPE	TOTAL AREA		BMP AREA		TOTAL AREA - BMP		IMPERVIOUS AREA*		PERVIOUS AREA		BMP	FLOWS TO
			(sq-ft)	(acres)	(sq-ft)	(acres)	(sq-ft)	(acres)	(sq-ft)	(acres)	(sq-ft)	(acres)		
DMA-1	1-C	C	485649	11.15	11887	0.27	473762	10.88	193188	4.43	280574	6.44	BMP-1	POC-1
	1-D	D	2576	0.06	0	0.00	2576	0.06	0	0.00	2576	0.06		
DMA-2	2-C	C	116365	2.67	4121	0.09	112244	2.58	48192	1.11	64052	1.47	BMP-2	POC-2
	2-D	D	301	0.01	0	0.00	301	0.01	0	0.00	301	0.01		
DMA-3	3-C	C	22033	0.51	459	0.01	21574	0.50	9488	0.22	12086	0.28	BMP-3	POC-1
SELF-MITITGATING-1	-	C	4356	0.10	0	0.00	4356	0.10	0	0.00	4356	0.10	-	-
SELF-MITIGATING-2	-	C	17200	0.39	0	0.00	17200	0.39	0	0.00	17200	0.39		POC-1
SELF-MITIGATING-3	-	C	45972	1.06	0	0.00	45972	1.06	0	0.00	45972	1.06		
SELF-MITIGATING-4	-	C	4468	0.10	0	0.00	4468	0.10	0	0.00	4468	0.10		POC-2
	-	D	32176	0.74	0	0.00	32176	0.74	0	0.00	32176	0.74		
SELF-MITIGATING-5	-	C	24126	0.55	0	0.00	24126	0.55	0	0.00	24126	0.55		POC-3
	-	D	4953	0.11	0	0.00	4953	0.11	0	0.00	4953	0.11		
SELF-MITIGATING-6	-	C	432	0.01	0	0.00	432	0.01	0	0.00	432	0.01		-
	-	D	1062	0.02	0	0.00	1062	0.02	0	0.00	1062	0.02		
SELF-MITIGATING-7	-	C	11336	0.26	0	0.00	11336	0.26	0	0.00	11336	0.26		POC-1
ONSITE BYPASS-1	-	C	9773	0.22	0	0.00	9773	0.22	0	0.00	9773	0.22		
OFFSITE-1 (BYPASS)	-	C	111461	2.56	-	-	111461	2.56	0	0.00	111461	2.56		
TOTAL	**-**	**-**	**894239**	**20.53**	**16467**	**0.38**	**877772**	**20.15**	**250868**	**5.76**	**626904**	**14.39**	**-**	**-**
OFF-STREET-1	-	C	17715	0.41	0	0.00	17715	0.41	15944	0.37	1772	0.04	STREET TREES	POC-1
OFF-STREET-2	-	C	3141	0.07	0	0.00	3141	0.07	3141	0.07	0	0.00	STREET TREES	POC-1

IMPERVIOUS AREAS HAVE BEEN CALCULATED BASED ON 90% OF STREET AREA PLUS IMPERVIOUS AREA PER LOT IMPERVIOUS AREA PER LOT HAS BEEN CALCULATED PER THE FOLLOWING FORMULA:

$A_{IMP,HOUSE} = MIN(4500, -0.0000049*ALOT2+0.25*ALOT+880)$

AVERAGE LOT SIZE IS 5400 SF FOR DMA–1 AND 5700 SF FOR DMA–2. THERE ARE NOT PROPOSED LOTS FOR DMA–3.

NO.	DESCRIPTION	DATE	APP'D
	REVISIONS		

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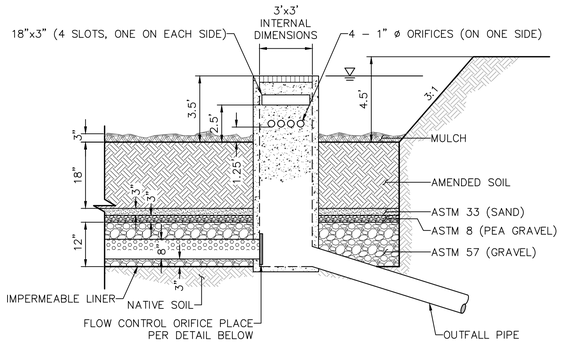
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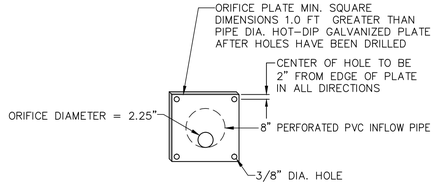
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PROJECT: GREENHILLS RANCH
PHASE 2
COUNTY OF SAN DIEGO, CA

SHEET 1 OF 2 SHEETS

SAVE DATE: 7/18/2019 ~ PLOT DATE: 7/18/2019 ~ FILE NAME: P:\Acad\1083 Greenhills Ranch\Reports\WQTR\SWQMP\CAD\DMA Exhibit.dwg



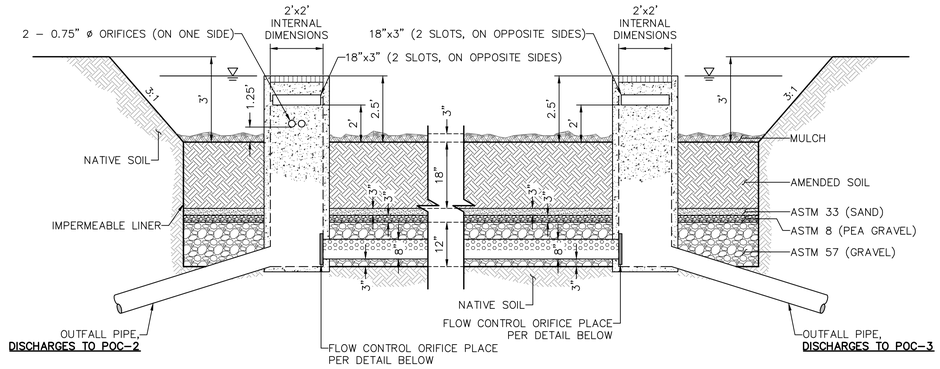


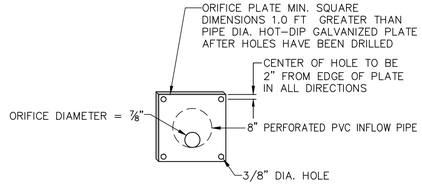
FLOW CONTROL ORIFICE PLATE
NTS

NOTES:

1. SOIL MIX PER COUNTY OF SAN DIEGO LID MANUAL
2. "WELL DRAINED SOIL" SHALL BE "SANDY LOAM" SOIL MIX WITH NO MORE THAN 5% CLAY CONTENT. THE MIX SHALL CONTAIN 50–60% SAND, 20–30% COMPOST OR HARDWOOD MULCH, AND 20–30% TOPSOIL.

1 BMP-1 BASIN DETAIL
NOT TO SCALE



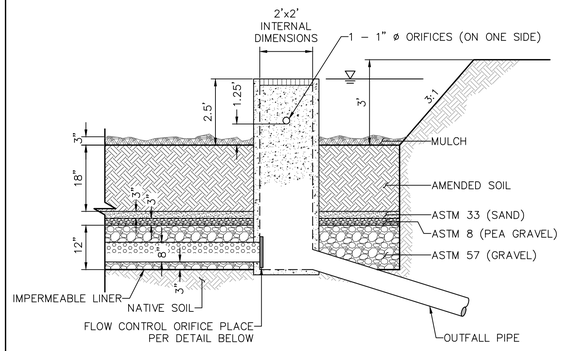


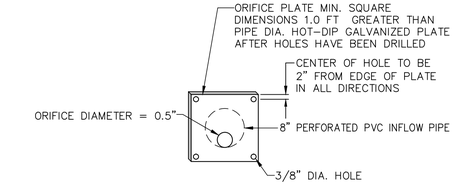
FLOW CONTROL ORIFICE PLATE
NTS

NOTES:

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2 BMP-2 BASIN DETAIL
NOT TO SCALE





FLOW CONTROL ORIFICE PLATE
NTS

NOTES:

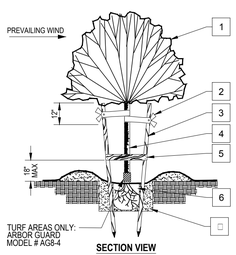
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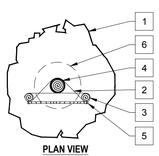
3 BMP-3 BASIN DETAIL
NOT TO SCALE

TREE WELL NOTES

1. TREE CANOPY (SEE TABLE SHOWN HEREON)
2. (2) CINCH TIES, TACK TO STAKE WITH GALVANIZED NAILS TO PREVENT SLIPPING
3. (2) 2" DIA. X 8' LONG UNTREATED LODGEPOLE PINE STAKES FOR 5 GAL. TREES,
   OR
   (2) 2" DIA. X 10' LONG UNTREATED LODGEPOLE PINE TAKES FOR 15 GAL— 36" BOX TREES, SET STAKES OUTSIDE ROOTBALL. ANGLE TOP OF STAKE AWAY FROM BRANCH STRUCTURE.
4. TREE TRUNK
5. 1 X 4 DOUG. FIR BRACE, TACK TO LODGEPOLE STAKES WITH GALV. NAILS
6. ROOT BALL, DO NOT PENETRATE WITH STAKE.
7. USE AMENDED SOIL WITH MINIMUM DEPTH OF 3' + 1' IN ALL DIRECTIONS OF ROOT BALL PER CITY'S BMP MANUAL APPENDIX P.G, E–18. MINIMUM SOIL VOLUME 155 CU FT. SEE TABLE SHOWN HEREON FOR DEPTH & DIAMETER.

TREE TIE NOTE:
1. INSTALL TREE TIES AND STAKES ONLY TO PROPER LEVEL TO HOLD TREE UPRIGHT. PROPER HEIGHT IS 6" ABOVE POINT WHERE THE TREE WILL SNAP TO AN UPRIGHT POSITION BY ITSELF IF TOP IS PULLED TO ONE SIDE AS IF WIND LOADED AND THEN RELEASED. DO NOT TOP TREES IN ORDER TO REDUCE SIZE OR WEIGHT OF TREE CROWN, CONTACT LANDSCAPE ARCHITECT PRIOR TO ANY PRUNING OF TREES.





4 TREE WELL DETAILS
NOT TO SCALE

DMA	1 TREE NUMBER	TREE CANOPY DIAMETER (FT)	PROPOSED STRUCTURAL SOIL PER TREE WELL								
			REQUIRED VOLUME (CU-FT)	□ PROPOSED DEPTH (IN)	AREA (SQ-FT)	□ PROPOSED DIAMETER (FT)	VOLUME PROVIDED (CU-FT)	1.5 X CANOPY RADIUS (FT)	DIAMETER OF SOIL < 1.5 RADIUS OF CANOPY?	2 X CANOPY AREA (SQ-FT)	VOLUME > 2X CANOPY AREA?
OFF-STREET-1	1-1	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-2	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-3	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-4	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-5	25	981.8	45.0	261.8	18.3	986	18.75	YES	982	YES
OFF-STREET-2	2-1	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES

REVISIONS

NO.	DESCRIPTION	DATE	APP'D

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Civil Engineering · Environmental
Land Surveying
2442 Second Avenue
San Diego, CA 92101
(619)232-9200 (619)232-9210 Fax

DATE: 07.18.19
SCALE: NO SCALE
DRAWN: GMB
CHECKED: LP

SHEET TITLE: HYDROMOD EXHIBIT - PROPOSED

PROJECT: GREENHILLS RANCH
PHASE 2
COUNTY OF SAN DIEGO, CA

SHEET 2 OF 2 SHEETS

SAVE DATE: 7/18/2019 ~ PLOT DATE: 7/18/2019 ~ FILE NAME: P:\Acad\1083 Greenhills Ranch\Reports\WQTR\SWQMP\CAD\DMA Exhibit.dwg

ATTACHMENT 6

SWMM Input Data in Input Format (Existing & Proposed Models)

```
[TITLE]

[OPTIONS]
FLOW_UNITS           CFS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         KINWAVE
START_DATE           08/09/1963
START_TIME           00:00:00
REPORT_START_DATE    08/08/1963
REPORT_START_TIME    00:00:00
END_DATE             08/08/2008
END_TIME             23:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          01:00:00
WET_STEP             00:15:00
DRY_STEP             04:00:00
ROUTING_STEP         0:01:00
ALLOW_PONDING        NO
INERTIAL_DAMPING     PARTIAL
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         0
NORMAL_FLOW_LIMITED  BOTH
SKIP_STEADY_STATE    NO
FORCE_MAIN_EQUATION  H-W
LINK_OFFSETS         DEPTH
MIN_SLOPE            0

[EVAPORATION]
;;Type       Parameters
;;---------- ----------
MONTHLY      0.070  0.100  0.130  0.170  0.190  0.220  0.240  0.220  0.190  0.130  0.090  0.060
DRY_ONLY     NO

[RAINGAGES]
;;               Rain      Time   Snow   Data
;;Name           Type      Intrvl Catch  Source
;;-------------- --------- ------ ------ ----------
FLINN            INTENSITY 1:00   1.0    TIMESERIES FLINN

[SUBCATCHMENTS]
;;                                                 Total    Pcnt.             Pcnt.    Curb
Snow
;;Name           Raingage         Outlet           Area     Imperv   Width    Slope    Length
Pack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- -
-------
DMA-1-C          FLINN            POC-1            18.036   0        1970     18.57    0
DMA-2-C          FLINN            POC-2            1.058    0        175      19.25    0
DMA-2-D          FLINN            POC-2            3.461    0        580      19.20    0
DMA-3-C          FLINN            POC-3            3.642    0        530      19.64    0
DMA-3-D          FLINN            POC-3            2.524    0        370      19.64    0
DMA-4-C          FLINN            POC-4            0.756    0        80       24.7     0
DMA-4-D          FLINN            POC-4            6.12     0        620      24.7     0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
DMA-1-C          0.012      0.05       0.05       0.10       25         OUTLET
DMA-2-C          0.012      0.05       0.05       0.10       25         OUTLET
DMA-2-D          0.012      0.05       0.05       0.10       25         OUTLET
DMA-3-C          0.012      0.05       0.05       0.10       25         OUTLET
DMA-3-D          0.012      0.05       0.05       0.10       25         OUTLET
DMA-4-C          0.012      0.05       0.05       0.10       25         OUTLET
DMA-4-D          0.012      0.05       0.05       0.10       25         OUTLET

[INFILTRATION]
;;Subcatchment   Suction    HydCon     IMDmax
;;-------------- ---------- ---------- ----------
```

```
DMA-1-C          6          0.10       0.32
DMA-2-C          6          0.1        0.32
DMA-2-D          9          0.025      0.33
DMA-3-C          6          0.1        0.32
DMA-3-D          9          0.025      0.33
DMA-4-C          6          0.1        0.32
DMA-4-D          9          0.025      0.33

[OUTFALLS]
;;               Invert     Outfall    Stage/Table      Tide
;;Name           Elev.      Type       Time Series      Gate
;;-------------- ---------- ---------- ---------------- ----
POC-1            0          FREE                        NO
POC-2            0          FREE                        NO
POC-3            0          FREE                        NO
POC-4            0          FREE                        NO

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
FLINN            FILE "Flinn.txt"

[REPORT]
INPUT      NO
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS -1733.569 2428.509 5838.559 7075.640
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
POC-1            -500.000           2650.000
POC-2            1500.000           2650.000
POC-3            2500.000           2650.000
POC-4            4500.000           2650.000

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------

[Polygons]
;;Subcatchment   X-Coord            Y-Coord
;;-------------- ------------------ ------------------
DMA-1-C          -500.000           6000.000
DMA-2-C          500.000            6000.000
DMA-2-C          500.000            6000.000
DMA-2-D          1500.000           6000.000
DMA-3-C          2500.000           6000.000
DMA-3-D          3500.000           6000.000
DMA-4-C          4500.000           6000.000
DMA-4-D          5500.000           6000.000

[SYMBOLS]
;;Gage           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
FLINN            1500.000           6500.000
```

POST_DEV

```
[TITLE]

[OPTIONS]
FLOW_UNITS           CFS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         KINWAVE
START_DATE           08/09/1963
START_TIME           00:00:00
REPORT_START_DATE    08/08/1963
REPORT_START_TIME    00:00:00
END_DATE             08/08/2008
END_TIME             23:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          01:00:00
WET_STEP             00:15:00
DRY_STEP             00:30:00
ROUTING_STEP         0:01:00
ALLOW_PONDING        NO
INERTIAL_DAMPING     PARTIAL
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         0
NORMAL_FLOW_LIMITED  BOTH
SKIP_STEADY_STATE    NO
FORCE_MAIN_EQUATION  H-W
LINK_OFFSETS         DEPTH
MIN_SLOPE            0

[EVAPORATION]
;;Type       Parameters
;;---------- ----------
MONTHLY      0.070  0.100  0.130  0.170  0.190  0.220  0.240  0.220  0.190  0.130  0.090  0.060
DRY_ONLY     NO

[RAINGAGES]
;;               Rain      Time   Snow   Data
;;Name           Type      Intrvl Catch  Source
;;-------------- --------- ------ ------ ----------
FLINN            INTENSITY 1:00   1.0    TIMESERIES FLINN

[SUBCATCHMENTS]
;;                                                 Total    Pcnt.            Pcnt.    Curb     Snow
;;Name           Raingage         Outlet           Area     Imperv   Width   Slope    Length   Pack
;;-------------- ---------------- ---------------- -------- -------- ------- -------- -------- --------
DMA-1-C          FLINN            BR-1             10.876   40.78    1214    6.7      0
DMA-1-D          FLINN            BR-1             0.059    0        27      6.49     0
DMA-2-C          FLINN            BR-2             2.577    42.93    291     1.64     0
DMA-2-D          FLINN            BR-2             0.007    0        22      1.15     0
DMA-3-C          FLINN            BR-3             0.495    43.96    73      5.64     0
DMA-4-C          FLINN            POC-4            0.627    0        66      24.7     0
DMA-4-D          FLINN            POC-4            6.003    0        608     24.7     0
BR-1             FLINN            DIV-1            0.27289  0        10      0        0
BR-2             FLINN            DIV-2            0.09460  0        10      0        0
BR-3             FLINN            DIV-3            0.01055  0        10      0        0
ON-BY-1-C        FLINN            POC-1            0.224    0        490     50       0
ON-BY-2-C        FLINN            POC-1            0.395    0        520     50       0
ON-BY-3-C        FLINN            POC-1            1.055    0        600     50       0
ON-BY-4-C        FLINN            POC-2            0.103    0        100     50       0
ON-BY-4-D        FLINN            POC-2            0.739    0        520     50       0
ON-BY-5-C        FLINN            POC-3            0.554    0        540     50       0
ON-BY-5-D        FLINN            POC-3            0.114    0        100     50       0
ON-BY-6-C        FLINN            POC-4            0.010    0        10      50       0
ON-BY-6-D        FLINN            POC-4            0.0244   0        10      50       0
ON-BY-7-C        FLINN            POC-1            0.260    0        370     50       0
7-C-SELF-TR      FLINN            OFF-1-C          0.100    0        435     12       0
OFF-1-C          FLINN            POC-1            4.486    0        488     18.57    0
OFF-2-C          FLINN            POC-2            2.673    0        413     19.20    0
OFF-3-C          FLINN            POC-3            1.427    0        150     19.64    0
OFF-3-D          FLINN            POC-3            2.410    0        253     19.64    0

[SUBAREAS]
```

POST_DEV

```
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
DMA-1-C          0.012      0.05       0.05       0.10       25         OUTLET
DMA-1-D          0.012      0.05       0.05       0.10       25         OUTLET
DMA-2-C          0.012      0.05       0.05       0.10       25         OUTLET
DMA-2-D          0.012      0.05       0.05       0.10       25         OUTLET
DMA-3-C          0.012      0.05       0.05       0.10       25         OUTLET
DMA-4-C          0.012      0.05       0.05       0.10       25         OUTLET
DMA-4-D          0.012      0.05       0.05       0.10       25         OUTLET
BR-1             0.012      0.05       0.05       0.10       25         OUTLET
BR-2             0.012      0.05       0.05       0.10       25         OUTLET
BR-3             0.012      0.05       0.05       0.10       25         OUTLET
ON-BY-1-C        0.012      0.05       0.05       0.10       25         OUTLET
ON-BY-2-C        0.012      0.05       0.05       0.10       25         OUTLET
ON-BY-3-C        0.012      0.05       0.05       0.10       25         OUTLET
ON-BY-4-C        0.012      0.05       0.05       0.10       25         OUTLET
ON-BY-4-D        0.012      0.05       0.05       0.10       25         OUTLET
ON-BY-5-C        0.012      0.05       0.05       0.10       25         OUTLET
ON-BY-5-D        0.012      0.05       0.05       0.10       25         OUTLET
ON-BY-6-C        0.012      0.05       0.05       0.10       25         OUTLET
ON-BY-6-D        0.012      0.05       0.05       0.10       25         OUTLET
ON-BY-7-C        0.012      0.05       0.05       0.10       25         OUTLET
7-C-SELF-TR      0.012      0.05       0.05       0.10       25         OUTLET
OFF-1-C          0.012      0.05       0.05       0.10       25         OUTLET
OFF-2-C          0.012      0.05       0.05       0.10       25         OUTLET
OFF-3-C          0.012      0.05       0.05       0.10       25         OUTLET
OFF-3-D          0.012      0.05       0.05       0.10       25         OUTLET

[INFILTRATION]
;;Subcatchment   Suction    HydCon     IMDmax
;;-------------- ---------- ---------- ----------
DMA-1-C          6          0.075      0.32
DMA-1-D          9          0.01875    0.33
DMA-2-C          6          0.075      0.32
DMA-2-D          9          0.01875    0.33
DMA-3-C          6          0.075      0.32
DMA-4-C          6          0.1        0.32
DMA-4-D          9          0.025      0.33
BR-1             6          0.075      0.32
BR-2             6          0.075      0.32
BR-3             6          0.075      0.32
ON-BY-1-C        6          0.075      0.32
ON-BY-2-C        6          0.075      0.32
ON-BY-3-C        6          0.075      0.32
ON-BY-4-C        6          0.075      0.32
ON-BY-4-D        9          0.01875    0.33
ON-BY-5-C        6          0.075      0.32
ON-BY-5-D        9          0.01875    0.33
ON-BY-6-C        6          0.075      0.32
ON-BY-6-D        9          0.01875    0.33
ON-BY-7-C        6          0.075      0.32
7-C-SELF-TR      6          0.075      0.32
OFF-1-C          6          0.1        0.32
OFF-2-C          9          0.025      0.33
OFF-3-C          6          0.1        0.32
OFF-3-D          9          0.025      0.33

[LID_CONTROLS]
;;               Type/Layer Parameters
;;-------------- ---------- ----------
BR-1             BC
BR-1             SURFACE    12.38      0.05       0          0          5
BR-1             SOIL       18         0.4        0.2        0.1        5          5          1.5
BR-1             STORAGE    18         0.67       0          0
BR-1             DRAIN      0.1418     0.5        3          6

BR-2             BC
BR-2             SURFACE    9.78       0.05       0          0          5
BR-2             SOIL       18         0.4        0.2        0.1        5          5          1.5
BR-2             STORAGE    18         0.67       0          0
BR-2             DRAIN      0.1237     0.5        3          6

BR-3             BC
```

```
BR-3            SURFACE    9.29       0.05       0          0          5
BR-3            SOIL       18         0.4        0.2        0.1        5          5          1.5
BR-3            STORAGE    18         0.67       0          0
BR-3            DRAIN      0.1814     0.5        3          6

[LID_USAGE]
;;Subcatchment   LID Process      Number  Area       Width      InitSatur  FromImprv  ToPerv     Report File
;;-------------- ---------------- ------- ---------- ---------- ---------- ---------- ---------- -----------
BR-1            BR-1             1       11887      0          0          100        0
BR-2            BR-2             1       4121       0          0          100        0
BR-3            BR-3             1       459.4      0          0          100        0

[OUTFALLS]
;;               Invert     Outfall    Stage/Table      Tide
;;Name           Elev.      Type       Time Series      Gate
;;-------------- ---------- ---------- ---------------- ----
POC-2           0          FREE                        NO
POC-1           0          FREE                        NO
POC-3           0          FREE                        NO
POC-4           0          FREE                        NO

[DIVIDERS]
;;               Invert     Diverted         Divider
;;Name           Elev.      Link             Type       Parameters
;;-------------- ---------- ---------------- ---------- ----------
DIV-1           0          BYPASS-1         CUTOFF     0.1468     0          0          0          0
DIV-2           0          BYPASS-2         CUTOFF     0.04549    0          0          0          0
DIV-3           0          BYPASS-3         CUTOFF     0.00747    0          0          0          0
DIV-4           0          BYPASS-4         TABULAR    SPLIT-1          0          0          0          0
DIV-5           0          BYPASS-5         TABULAR    SPLIT2           0          0          0          0

[STORAGE]
;;               Invert   Max.     Init.    Storage    Curve                    Ponded   Evap.
;;Name           Elev.    Depth    Depth    Curve      Params                   Area     Frac.
Infiltration Parameters
;;-------------- -------- -------- -------- ---------- -------- -------- -------- -------- -------- ---------
--------------
BASIN-1         0        3.25     0        TABULAR    Basin-1                  16550    1
BASIN-2         0        1.75     0        TABULAR    Basin-2                  8047     1
BASIN-3         0        1.75     0        TABULAR    BASIN-3                  1055     1

[CONDUITS]
;;               Inlet            Outlet                      Manning    Inlet      Outlet     Init.
Max.
;;Name           Node             Node             Length     N          Offset     Offset     Flow
Flow
;;-------------- ---------------- ---------------- ---------- ---------- ---------- ---------- ---------- ---
-------
BYPASS-2        DIV-2            BASIN-2          10         0.01       0          0          0          0
U-DRAIN-2       DIV-2            DIV-4            10         0.01       0          0          0          0
BYPASS-3        DIV-3            BASIN-3          10         0.01       0          0          0          0
BYPASS-1        DIV-1            BASIN-1          10         0.01       0          0          0          0
U-DRAIN-1       DIV-1            POC-1            10         0.01       0          0          0          0
U-DRAIN-3       DIV-3            POC-1            10         0.01       0          0          0          0
BYPASS-4        DIV-4            POC-2            10         0.01       0          0          0          0
DRAIN-1         DIV-4            POC-3            10         0.01       0          0          0          0
BYPASS-5        DIV-5            POC-2            10         0.01       0          0          0          0
DRAIN-5         DIV-5            POC-3            10         0.01       0          0          0          0

[OUTLETS]
;;               Inlet            Outlet           Outflow    Outlet           Qcoeff/
Flap
;;Name           Node             Node             Height     Type             QTable           Qexpon
Gate
;;-------------- ---------------- ---------------- ---------- ---------------- ---------------- ---------- ---
-
OUTLET-1        BASIN-1          POC-1            0          TABULAR/HEAD     OUT-1                       NO
OUTLET-2        BASIN-2          DIV-5            0          TABULAR/HEAD     OUT-2                       NO
OUTLET-3        BASIN-3          POC-1            0          TABULAR/HEAD     OUT-3                       NO

[XSECTIONS]
;;Link           Shape        Geom1            Geom2      Geom3      Geom4      Barrels
;;-------------- ------------ ---------------- ---------- ---------- ---------- ----------
```

```
BYPASS-2         DUMMY        0               0          0          0          1
U-DRAIN-2        DUMMY        0               0          0          0          1
BYPASS-3         DUMMY        0               0          0          0          1
BYPASS-1         DUMMY        0               0          0          0          1
U-DRAIN-1        DUMMY        0               0          0          0          1
U-DRAIN-3        DUMMY        0               0          0          0          1
BYPASS-4         DUMMY        0               0          0          0          1
DRAIN-1          DUMMY        0               0          0          0          1
BYPASS-5         DUMMY        0               0          0          0          1
DRAIN-5          DUMMY        0               0          0          0          1

[LOSSES]
;;Link           Inlet      Outlet     Average    Flap Gate
;;-------------- ---------- ---------- ---------- ----------

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
SPLIT-1          Diversion  0          0
SPLIT-1                     0.1        0.05
SPLIT-1                     0.5        0.25

SPLIT2           Diversion  0.000      0.000
SPLIT2                      0.030      0.030
SPLIT2                      0.188      0.109
SPLIT2                      0.478      0.255
SPLIT2                      0.853      0.442
SPLIT2                      1.298      0.665
SPLIT2                      1.801      0.917
SPLIT2                      2.358      1.196
SPLIT2                      2.964      1.499
SPLIT2                      3.386      1.710
SPLIT2                      3.706      1.871
SPLIT2                      4.001      2.018
SPLIT2                      4.275      2.156
SPLIT2                      4.533      2.285
SPLIT2                      4.777      2.407
SPLIT2                      5.009      2.523
SPLIT2                      5.230      2.634
SPLIT2                      5.443      2.741
SPLIT2                      5.647      2.843
SPLIT2                      5.844      2.942
SPLIT2                      6.457      3.248
SPLIT2                      7.413      3.727
SPLIT2                      8.592      4.316
SPLIT2                      9.949      4.995
SPLIT2                      11.461     5.751
SPLIT2                      13.111     6.576
SPLIT2                      14.886     7.464
SPLIT2                      16.777     8.410
SPLIT2                      18.776     9.410
SPLIT2                      20.878     10.461
SPLIT2                      23.078     11.561
SPLIT2                      25.369     12.707
SPLIT2                      27.750     13.897
SPLIT2                      30.215     15.130
SPLIT2                      32.763     16.405
SPLIT2                      35.390     17.718
SPLIT2                      38.095     19.071
SPLIT2                      40.874     20.460

OUT-1            Rating     0.000      0.000
OUT-1                       0.083      0.021
OUT-1                       0.167      0.038
OUT-1                       0.250      0.049
OUT-1                       0.333      0.058
OUT-1                       0.417      0.065
OUT-1                       0.500      0.072
OUT-1                       0.583      0.079
OUT-1                       0.667      0.084
OUT-1                       0.750      0.090
OUT-1                       0.833      0.095
OUT-1                       0.917      0.100
```

POST_DEV

OUT-1		1.000	0.105
OUT-1		1.083	0.109
OUT-1		1.167	0.113
OUT-1		1.250	0.117
OUT-1		1.333	0.569
OUT-1		1.417	1.391
OUT-1		1.500	2.454
OUT-1		1.583	3.484
OUT-1		1.667	4.102
OUT-1		1.750	4.636
OUT-1		1.833	5.114
OUT-1		1.917	5.550
OUT-1		2.000	5.954
OUT-1		2.083	6.333
OUT-1		2.167	6.689
OUT-1		2.250	7.027
OUT-1		2.333	8.245
OUT-1		2.417	10.190
OUT-1		2.500	12.606
OUT-1		2.583	15.401
OUT-1		2.667	18.523
OUT-1		2.750	21.938
OUT-1		2.833	25.619
OUT-1		2.917	29.547
OUT-1		3.000	33.706
OUT-1		3.083	38.083
OUT-1		3.167	42.666
OUT-1		3.250	47.446
OUT-3	Rating	0.000	0.000
OUT-3		0.042	0.002
OUT-3		0.083	0.005
OUT-3		0.125	0.008
OUT-3		0.167	0.009
OUT-3		0.208	0.011
OUT-3		0.250	0.012
OUT-3		0.292	0.013
OUT-3		0.333	0.014
OUT-3		0.375	0.015
OUT-3		0.417	0.016
OUT-3		0.458	0.017
OUT-3		0.500	0.018
OUT-3		0.542	0.019
OUT-3		0.583	0.020
OUT-3		0.625	0.020
OUT-3		0.667	0.021
OUT-3		0.708	0.022
OUT-3		0.750	0.022
OUT-3		0.792	0.023
OUT-3		0.833	0.024
OUT-3		0.875	0.024
OUT-3		0.917	0.025
OUT-3		0.958	0.026
OUT-3		1.000	0.026
OUT-3		1.042	0.027
OUT-3		1.083	0.027
OUT-3		1.125	0.028
OUT-3		1.167	0.028
OUT-3		1.208	0.029
OUT-3		1.250	0.029
OUT-3		1.292	0.241
OUT-3		1.333	0.627
OUT-3		1.375	1.127
OUT-3		1.417	1.719
OUT-3		1.458	2.390
OUT-3		1.500	3.132
OUT-3		1.542	3.939
OUT-3		1.583	4.806
OUT-3		1.625	5.729
OUT-3		1.667	6.704
OUT-3		1.708	7.730
OUT-3		1.750	8.803

OUT-2	Rating	0.000	0.000
OUT-2		0.042	0.003
OUT-2		0.083	0.007
OUT-2		0.125	0.009
OUT-2		0.167	0.011
OUT-2		0.208	0.013
OUT-2		0.250	0.014
OUT-2		0.292	0.015
OUT-2		0.333	0.017
OUT-2		0.375	0.018
OUT-2		0.417	0.019
OUT-2		0.458	0.020
OUT-2		0.500	0.021
OUT-2		0.542	0.021
OUT-2		0.583	0.022
OUT-2		0.625	0.023
OUT-2		0.667	0.024
OUT-2		0.708	0.025
OUT-2		0.750	0.025
OUT-2		0.792	0.184
OUT-2		0.833	0.474
OUT-2		0.875	0.850
OUT-2		0.917	1.294
OUT-2		0.958	1.798
OUT-2		1.000	2.355
OUT-2		1.042	2.960
OUT-2		1.083	3.382
OUT-2		1.125	3.703
OUT-2		1.167	3.998
OUT-2		1.208	4.272
OUT-2		1.250	4.530
OUT-2		1.292	5.195
OUT-2		1.333	6.199
OUT-2		1.375	7.419
OUT-2		1.417	8.814
OUT-2		1.458	10.361
OUT-2		1.500	12.041
OUT-2		1.542	13.845
OUT-2		1.583	15.763
OUT-2		1.625	17.787
OUT-2		1.667	19.912
OUT-2		1.708	22.132
OUT-2		1.750	24.444
Basin-1	Storage	0.00	11887
Basin-1		0.25	12223
Basin-1		0.50	12565
Basin-1		0.75	12909
Basin-1		1.00	13257
Basin-1		1.25	13609
Basin-1		1.50	13964
Basin-1		1.75	14324
Basin-1		2.00	14685
Basin-1		2.25	15051
Basin-1		2.75	15798
Basin-1		3.25	16550
Basin-2	Storage	0.00	4121
Basin-2		0.25	4607
Basin-2		0.50	5163
Basin-2		0.75	5722
Basin-2		1.00	6271
Basin-2		1.25	6871
Basin-2		1.50	7447
Basin-2		1.75	8047
BASIN-3	Storage	0.00	459
BASIN-3		0.25	530
BASIN-3		0.50	605
BASIN-3		0.75	687
BASIN-3		1.00	771
BASIN-3		1.25	861
BASIN-3		1.50	956

```
BASIN-3                   1.75       1055

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
FLINN            FILE "Flinn.txt"

[REPORT]
INPUT      NO
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS -1555.000 110.000 8455.000 6490.000
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
POC-2            4800.000           3400.000
POC-1            500.000            2000.000
POC-3            6500.000           2500.000
POC-4            8000.000           2500.000
DIV-1            0.000              4650.000
DIV-2            4750.000           4900.000
DIV-3            1000.000           4650.000
DIV-4            6500.000           3400.000
DIV-5            4800.000           2500.000
BASIN-1          -1100.000          3950.000
BASIN-2          3000.000           2500.000
BASIN-3          2100.000           3950.000

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
BYPASS-2         2996.076           4900.746

[Polygons]
;;Subcatchment   X-Coord            Y-Coord
;;-------------- ------------------ ------------------
DMA-1-C          -800.000           6200.000
DMA-1-D          800.000            6200.000
DMA-2-C          4000.000           6200.000
DMA-2-C          4000.000           6200.000
DMA-2-D          5500.000           6200.000
DMA-3-C          2100.000           6200.000
DMA-4-C          7000.000           4600.000
DMA-4-D          8000.000           4600.000
BR-1             0.000              5350.000
BR-2             4750.000           5500.000
BR-3             2100.000           5350.000
ON-BY-1-C        2100.000           2000.000
ON-BY-2-C        1885.000           1200.000
ON-BY-3-C        1300.000           615.000
ON-BY-4-C        3400.000           3400.000
ON-BY-4-D        3636.000           4028.000
ON-BY-5-C        3000.000           1600.000
ON-BY-5-D        3900.000           1200.000
ON-BY-6-C        7000.000           400.000
ON-BY-6-D        8000.000           400.000
ON-BY-7-C        500.000            400.000
7-C-SELF-TR      -885.000           1200.000
OFF-1-C          -300.000           615.000
OFF-2-C          4500.000           4400.000
OFF-3-C          5700.000           400.000
OFF-3-D          4800.000           800.000

[SYMBOLS]
;;Gage           X-Coord            Y-Coord
```

```
;;-------------- ------------------ ------------------
FLINN            6520.315           4908.829
```

ATTACHMENT 7

EPA SWMM FIGURES AND EXPLANATIONS

Per the attached, the reader can see the screens associated with the EPA-SWMM Model in both pre-development and post-development conditions. Each portion, i.e., sub-catchments, outfalls, storage units, weir as a discharge, and outfalls (point of compliance), are also shown.

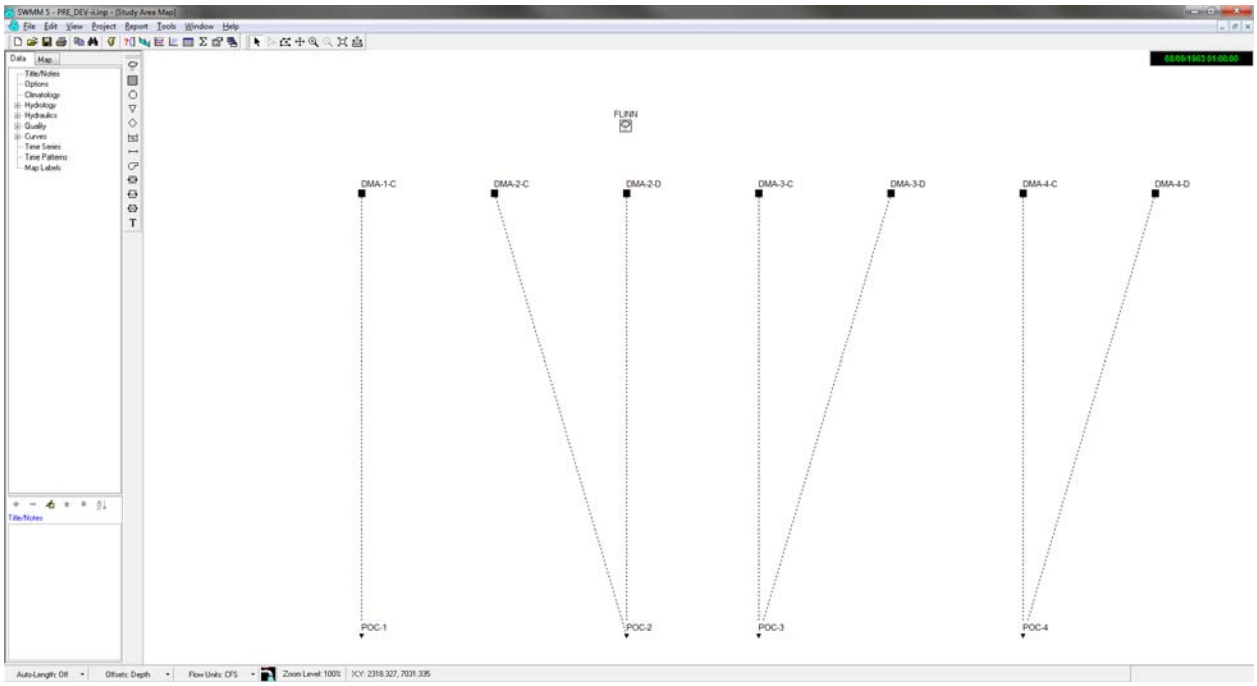
Variables for modeling are associated with typical recommended values by the EPA-SWMM model, typical values found in technical literature (such as Maidment's Handbook of Hydrology). Recommended values for the SWMM model have been attained from the interim Orange County criteria established for their SWMM calibration. Currently, no recommended values have been established by the San Diego County HMP Permit for the SWMM Model.

Soil characteristics of the existing soils were determined from the NRCS Web Soil Survey Exhibit (located in Attachment 8 of this report).

Some values incorporated within the SWMM model have been determined from the professional experience of REC using conservative assumptions that have a tendency to increase the size of the needed BMP and also generate a long-term runoff as a percentage of rainfall similar to those measured in gage stations in Southern California by the USGS.

A Technical document prepared by Tory R Walker Engineering for the Cities of San Marcos, Oceanside and Vista (Reference [1]) can also be consulted for additional information regarding typical values for SWMM parameters.

PRE-DEVELOPED CONDITION



Rain Gage FLINN

Property	Value
Name	FLINN
X-Coordinate	1500.000
Y-Coordinate	6500.000
Description	
Tag	
Rain Format	INTENSITY
Time Interval	1:00
Snow Catch Factor	1.0
Data Source	TIMESERIES
TIME SERIES:	
- Series Name	FLINN
DATA FILE:	
- File Name	*
- Station ID	*
- Rain Units	IN

User-assigned name of rain gage

Outfall POC-1

Property	Value
Name	POC-1
X-Coordinate	-500.000
Y-Coordinate	2650.000
Description	
Tag	
Inflows	NO
Treatment	NO
Invert El.	0
Tide Gate	NO
Type	FREE
Fixed Outfall	
Fixed Stage	0
Tidal Outfall	
Curve Name	*
Time Series Outfall	
Series Name	*

User-assigned name of outfall

Outfall POC-2

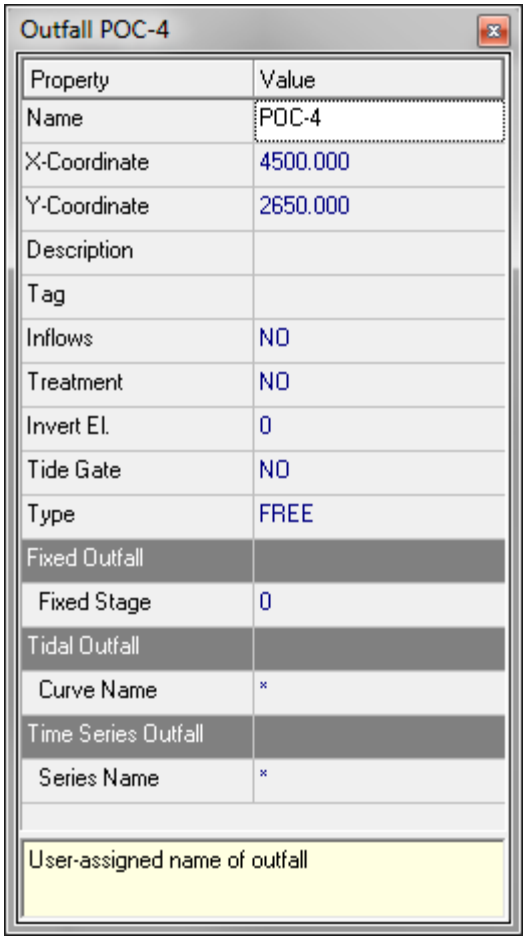
Property	Value
Name	POC-2
X-Coordinate	1500.000
Y-Coordinate	2650.000
Description	
Tag	
Inflows	NO
Treatment	NO
Invert El.	0
Tide Gate	NO
Type	FREE
Fixed Outfall	
Fixed Stage	0
Tidal Outfall	
Curve Name	*
Time Series Outfall	
Series Name	*

User-assigned name of outfall

Outfall POC-3

Property	Value
Name	POC-3
X-Coordinate	2500.000
Y-Coordinate	2650.000
Description	
Tag	
Inflows	NO
Treatment	NO
Invert El.	0
Tide Gate	NO
Type	FREE
Fixed Outfall	
Fixed Stage	0
Tidal Outfall	
Curve Name	*
Time Series Outfall	
Series Name	*

User-assigned name of outfall


Outfall POC-4
Property
Value
Name
POC-4
X-Coordinate
4500.000
Y-Coordinate
2650.000
Description
Tag
Inflows
NO
Treatment
NO
Invert El.
0
Tide Gate
NO
Type
FREE
Fixed Outfall
Fixed Stage
0
Tidal Outfall
Curve Name
*
Time Series Outfall
Series Name
*
User-assigned name of outfall

Subcatchment DMA-1-C

Property	Value
Name	DMA-1-C
X-Coordinate	-500.000
Y-Coordinate	6000.000
Description	
Tag	
Rain Gage	FLINN
Outlet	POC-1
Area	18.036
Width	1970
% Slope	18.57
% Imperv	0
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.10
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

User-assigned name of subcatchment

Subcatchment DMA-2-C

Property	Value
Name	DMA-2-C
X-Coordinate	500.000
Y-Coordinate	6000.000
Description	
Tag	
Rain Gage	FLINN
Outlet	POC-2
Area	1.058
Width	175
% Slope	19.25
% Imperv	0
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.10
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT ...
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Infiltration parameters (click to edit)

Infiltration Editor

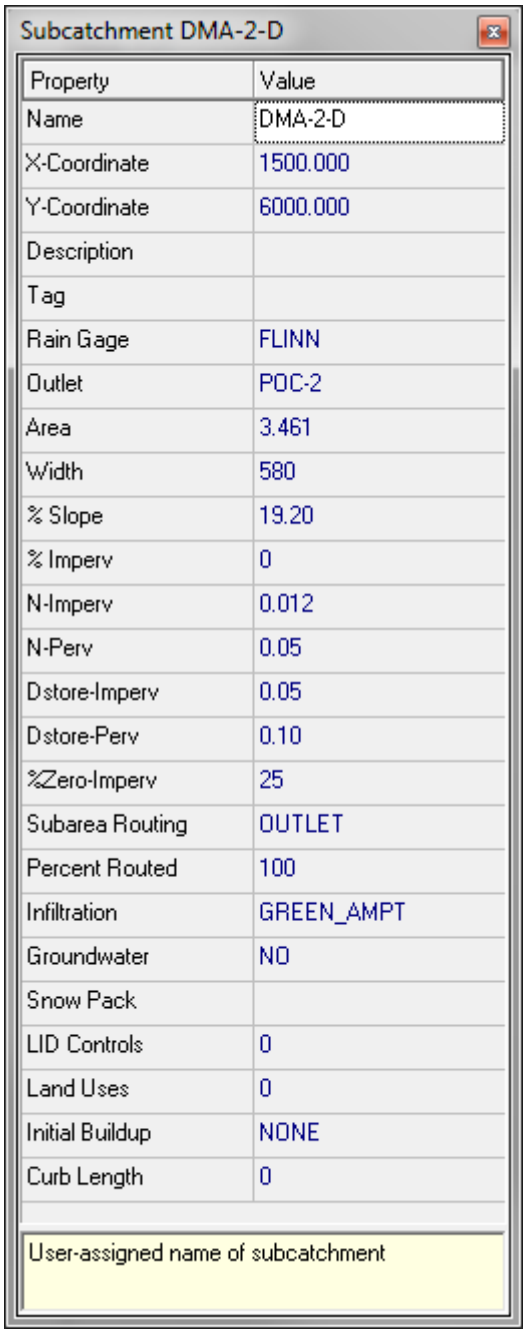
Infiltration Method: GREEN_AMPT

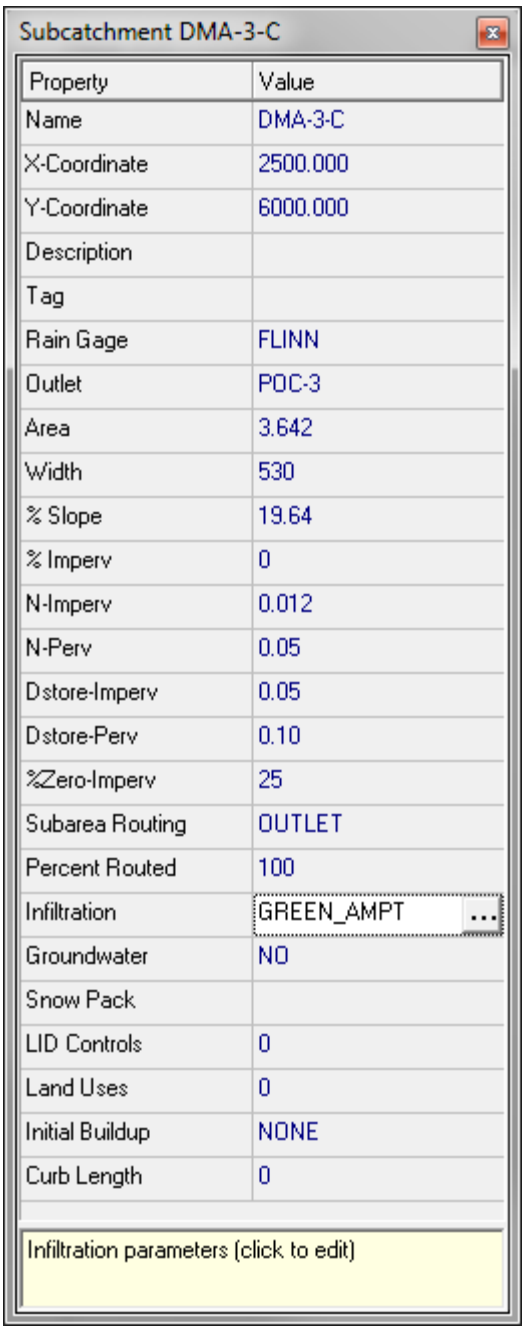
Property	Value
Suction Head	6
Conductivity	0.10
Initial Deficit	0.32

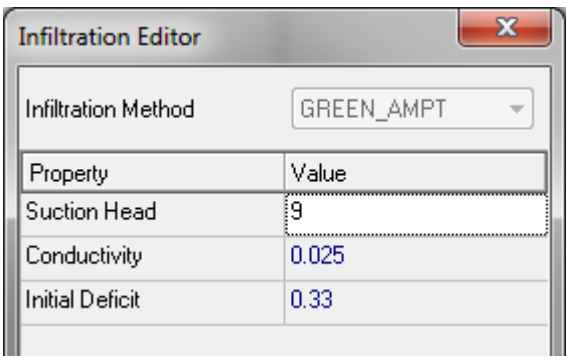
Infiltration Editor

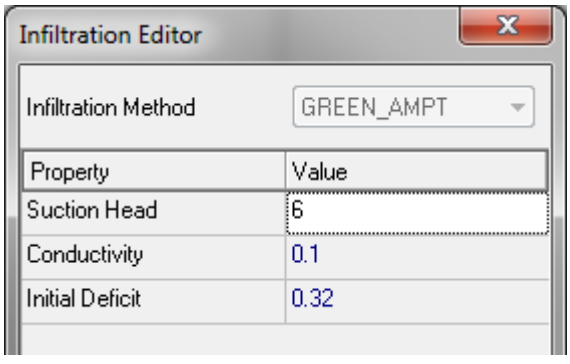
Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	6
Conductivity	0.1
Initial Deficit	0.32


Subcatchment DMA-2-D
Property
Value
Name
DMA-2-D
X-Coordinate
1500.000
Y-Coordinate
6000.000
Description
Tag
Rain Gage
FLINN
Outlet
POC-2
Area
3.461
Width
580
% Slope
19.20
% Imperv
0
N-Imperv
0.012
N-Perv
0.05
Dstore-Imperv
0.05
Dstore-Perv
0.10
%Zero-Imperv
25
Subarea Routing
OUTLET
Percent Routed
100
Infiltration
GREEN_AMPT
Groundwater
NO
Snow Pack
LID Controls
0
Land Uses
0
Initial Buildup
NONE
Curb Length
0
User-assigned name of subcatchment


Subcatchment DMA-3-C
Property
Value
Name
DMA-3-C
X-Coordinate
2500.000
Y-Coordinate
6000.000
Description
Tag
Rain Gage
FLINN
Outlet
POC-3
Area
3.642
Width
530
% Slope
19.64
% Imperv
0
N-Imperv
0.012
N-Perv
0.05
Dstore-Imperv
0.05
Dstore-Perv
0.10
%Zero-Imperv
25
Subarea Routing
OUTLET
Percent Routed
100
Infiltration
GREEN_AMPT
...
Groundwater
NO
Snow Pack
LID Controls
0
Land Uses
0
Initial Buildup
NONE
Curb Length
0
Infiltration parameters (click to edit)


Infiltration Editor
Infiltration Method
GREEN_AMPT
Property
Value
Suction Head
9
Conductivity
0.025
Initial Deficit
0.33


Infiltration Editor
Infiltration Method
GREEN_AMPT
Property
Value
Suction Head
6
Conductivity
0.1
Initial Deficit
0.32

Subcatchment DMA-3-D

Property	Value
Name	DMA-3-D
X-Coordinate	3500.000
Y-Coordinate	6000.000
Description	
Tag	
Rain Gage	FLINN
Outlet	POC-3
Area	2.524
Width	370
% Slope	19.64
% Imperv	0
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.10
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT ...
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Infiltration parameters (click to edit)

Subcatchment DMA-4-C

Property	Value
Name	DMA-4-C
X-Coordinate	4500.000
Y-Coordinate	6000.000
Description	
Tag	
Rain Gage	FLINN
Outlet	POC-4
Area	0.756
Width	80
% Slope	24.7
% Imperv	0
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.10
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT ...
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Infiltration parameters (click to edit)

Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	9
Conductivity	0.025
Initial Deficit	0.33

Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	6
Conductivity	0.1
Initial Deficit	0.32

Subcatchment DMA-4-D

Property	Value
Name	DMA-4-D
X-Coordinate	5500.000
Y-Coordinate	6000.000
Description	
Tag	
Rain Gage	FLINN
Outlet	POC-4
Area	6.12
Width	620
% Slope	24.7
% Imperv	0
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.10
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT ...
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

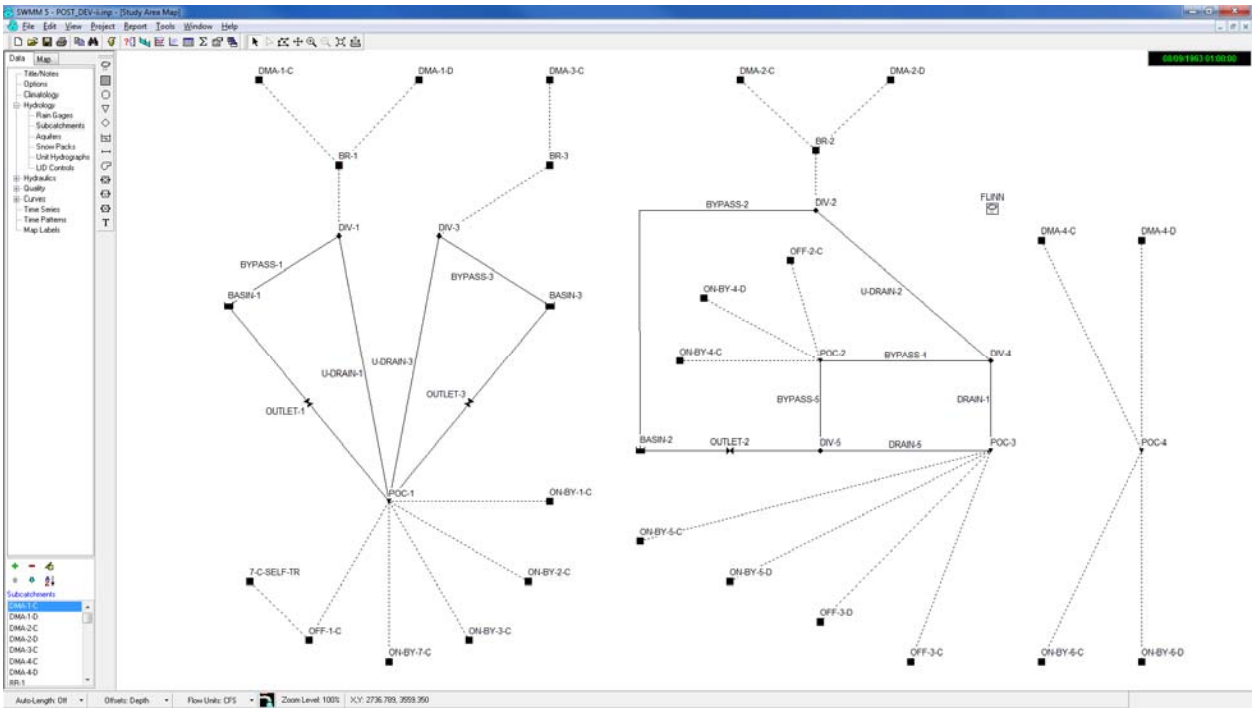
Infiltration parameters (click to edit)

Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	9
Conductivity	0.025
Initial Deficit	0.33

POST-DEVELOPED CONDITION



Rain Gage FLINN

Property	Value
Name	FLINN
X-Coordinate	6520.315
Y-Coordinate	4908.829
Description	
Tag	
Rain Format	INTENSITY
Time Interval	1:00
Snow Catch Factor	1.0
Data Source	TIMESERIES
TIME SERIES:	
- Series Name	FLINN
DATA FILE:	
- File Name	*
- Station ID	*
- Rain Units	IN

User-assigned name of rain gage

Outfall POC-1

Property	Value
Name	POC-1
X-Coordinate	500.000
Y-Coordinate	2000.000
Description	
Tag	
Inflows	NO
Treatment	NO
Invert El.	0
Tide Gate	NO
Type	FREE
Fixed Outfall	
Fixed Stage	0
Tidal Outfall	
Curve Name	*
Time Series Outfall	
Series Name	*

User-assigned name of outfall

Outfall POC-2

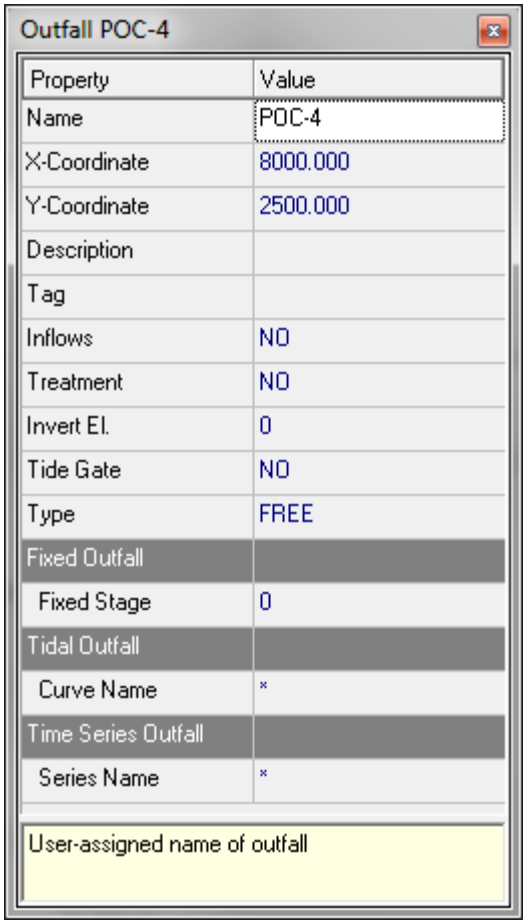
Property	Value
Name	POC-2
X-Coordinate	4800.000
Y-Coordinate	3400.000
Description	
Tag	
Inflows	NO
Treatment	NO
Invert El.	0
Tide Gate	NO
Type	FREE
Fixed Outfall	
Fixed Stage	0
Tidal Outfall	
Curve Name	*
Time Series Outfall	
Series Name	*

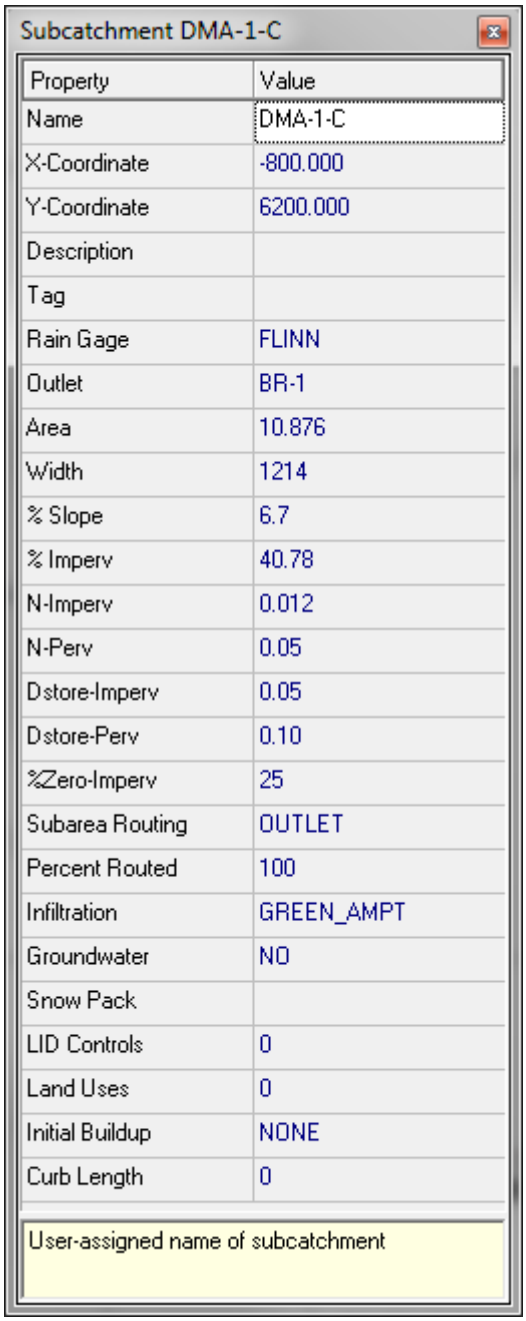
User-assigned name of outfall

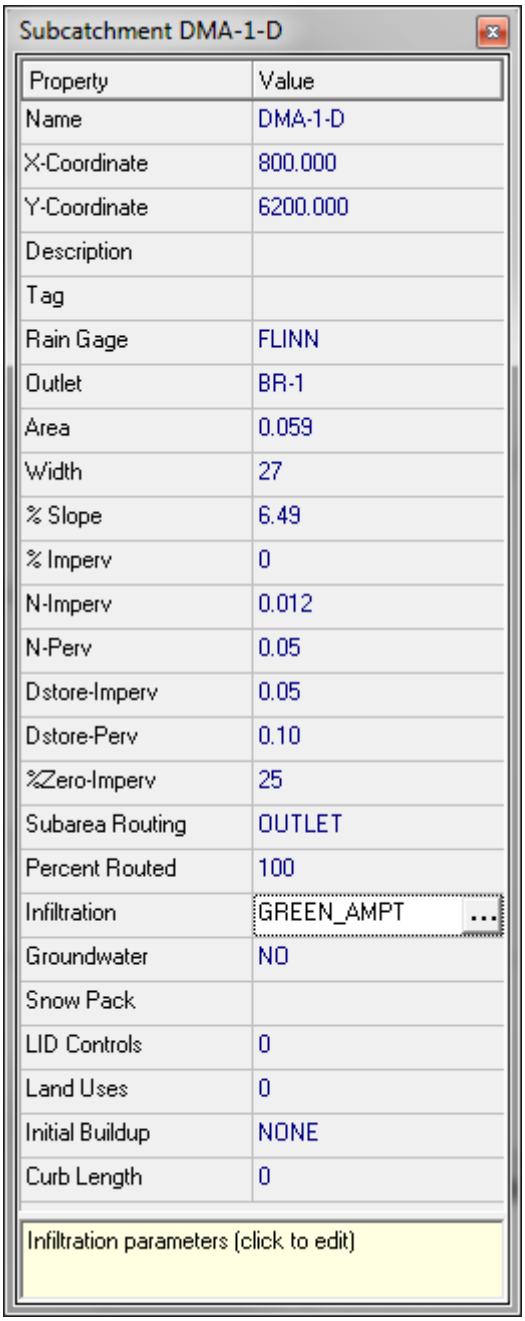
Outfall POC-3

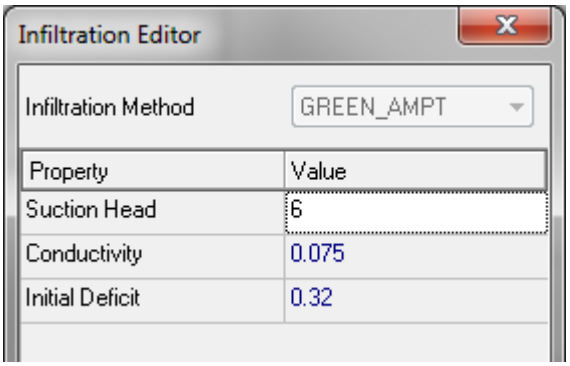
Property	Value
Name	POC-3
X-Coordinate	6500.000
Y-Coordinate	2500.000
Description	
Tag	
Inflows	NO
Treatment	NO
Invert El.	0
Tide Gate	NO
Type	FREE
Fixed Outfall	
Fixed Stage	0
Tidal Outfall	
Curve Name	*
Time Series Outfall	
Series Name	*

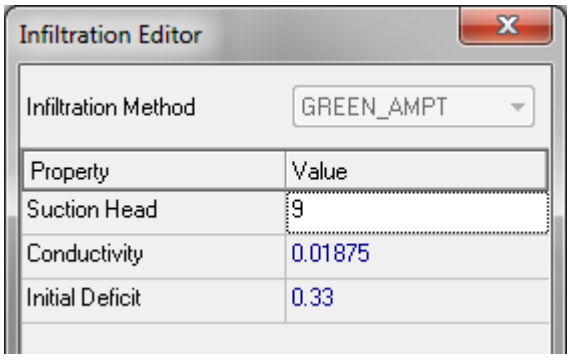
User-assigned name of outfall

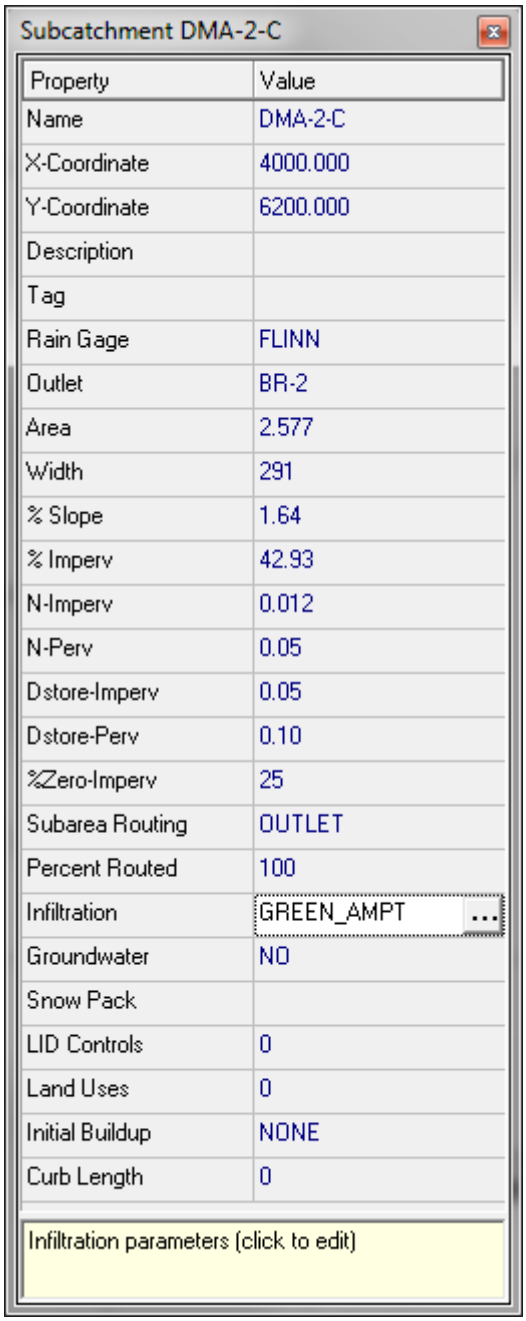

Outfall POC-4
Property
Value
Name
POC-4
X-Coordinate
8000.000
Y-Coordinate
2500.000
Description
Tag
Inflows
NO
Treatment
NO
Invert El.
0
Tide Gate
NO
Type
FREE
Fixed Outfall
Fixed Stage
0
Tidal Outfall
Curve Name
*
Time Series Outfall
Series Name
*
User-assigned name of outfall

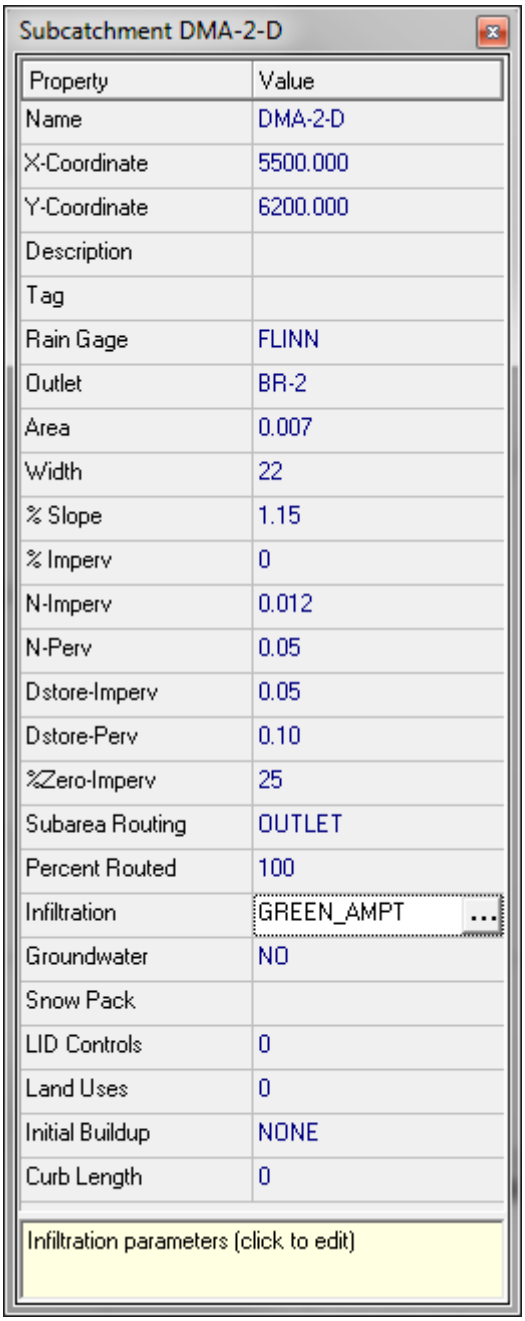

Subcatchment DMA-1-C
Property
Value
Name
DMA-1-C
X-Coordinate
-800.000
Y-Coordinate
6200.000
Description
Tag
Rain Gage
FLINN
Outlet
BR-1
Area
10.876
Width
1214
% Slope
6.7
% Imperv
40.78
N-Imperv
0.012
N-Perv
0.05
Dstore-Imperv
0.05
Dstore-Perv
0.10
%Zero-Imperv
25
Subarea Routing
OUTLET
Percent Routed
100
Infiltration
GREEN_AMPT
Groundwater
NO
Snow Pack
LID Controls
0
Land Uses
0
Initial Buildup
NONE
Curb Length
0
User-assigned name of subcatchment

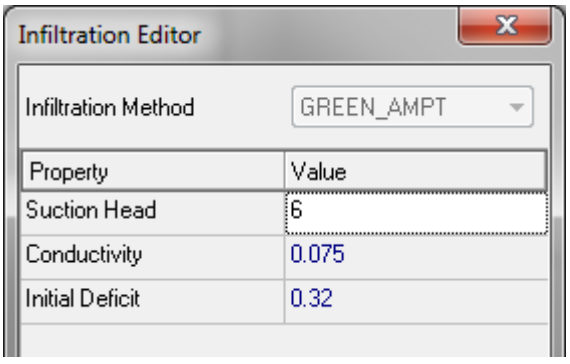

Subcatchment DMA-1-D
Property
Value
Name
DMA-1-D
X-Coordinate
800.000
Y-Coordinate
6200.000
Description
Tag
Rain Gage
FLINN
Outlet
BR-1
Area
0.059
Width
27
% Slope
6.49
% Imperv
0
N-Imperv
0.012
N-Perv
0.05
Dstore-Imperv
0.05
Dstore-Perv
0.10
%Zero-Imperv
25
Subarea Routing
OUTLET
Percent Routed
100
Infiltration
GREEN_AMPT
...
Groundwater
NO
Snow Pack
LID Controls
0
Land Uses
0
Initial Buildup
NONE
Curb Length
0
Infiltration parameters (click to edit)

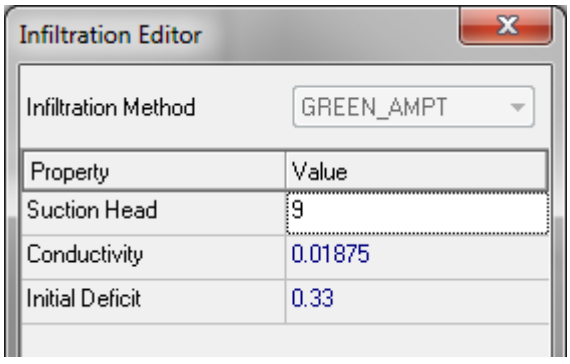

Infiltration Editor
Infiltration Method
GREEN_AMPT
Property
Value
Suction Head
6
Conductivity
0.075
Initial Deficit
0.32

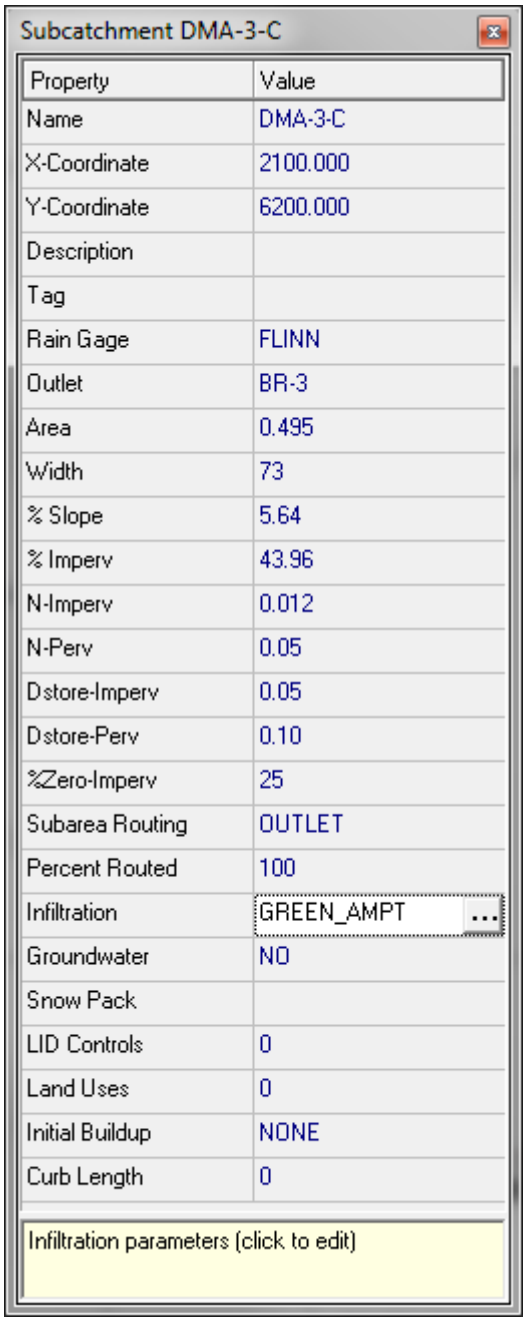

Infiltration Editor
Infiltration Method
GREEN_AMPT
Property
Value
Suction Head
9
Conductivity
0.01875
Initial Deficit
0.33

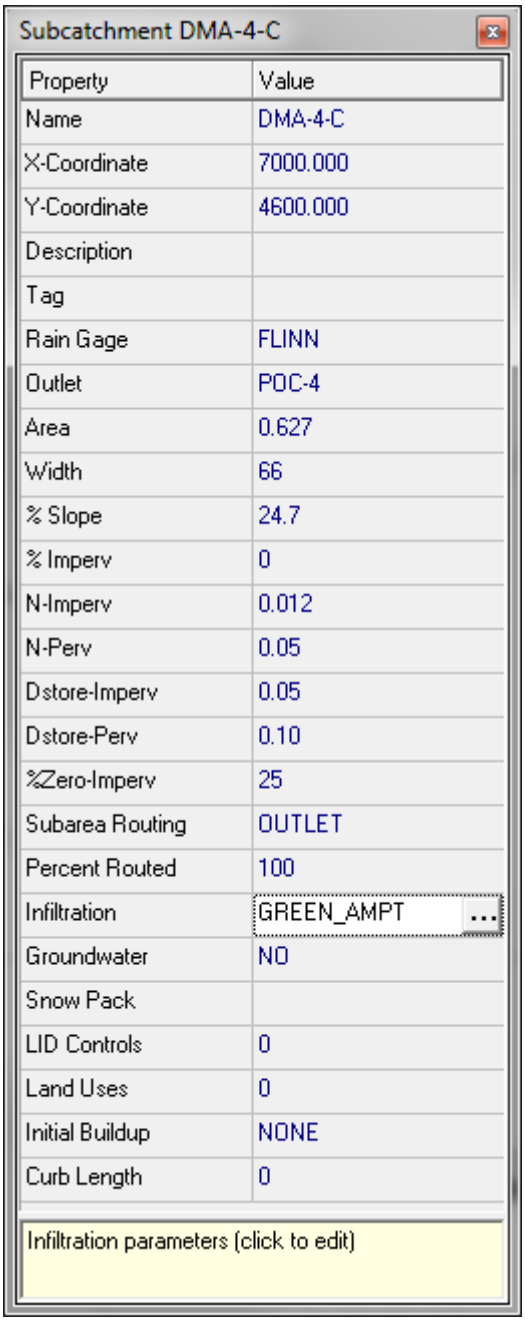

Subcatchment DMA-2-C
Property
Value
Name
DMA-2-C
X-Coordinate
4000.000
Y-Coordinate
6200.000
Description
Tag
Rain Gage
FLINN
Outlet
BR-2
Area
2.577
Width
291
% Slope
1.64
% Imperv
42.93
N-Imperv
0.012
N-Perv
0.05
Dstore-Imperv
0.05
Dstore-Perv
0.10
%Zero-Imperv
25
Subarea Routing
OUTLET
Percent Routed
100
Infiltration
GREEN_AMPT
Groundwater
NO
Snow Pack
LID Controls
0
Land Uses
0
Initial Buildup
NONE
Curb Length
0
Infiltration parameters (click to edit)

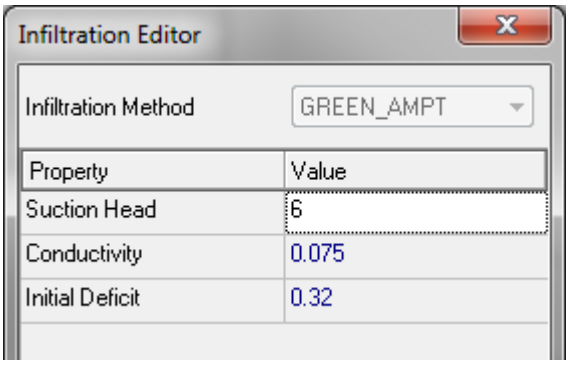

Subcatchment DMA-2-D
Property
Value
Name
DMA-2-D
X-Coordinate
5500.000
Y-Coordinate
6200.000
Description
Tag
Rain Gage
FLINN
Outlet
BR-2
Area
0.007
Width
22
% Slope
1.15
% Imperv
0
N-Imperv
0.012
N-Perv
0.05
Dstore-Imperv
0.05
Dstore-Perv
0.10
%Zero-Imperv
25
Subarea Routing
OUTLET
Percent Routed
100
Infiltration
GREEN_AMPT
Groundwater
NO
Snow Pack
LID Controls
0
Land Uses
0
Initial Buildup
NONE
Curb Length
0
Infiltration parameters (click to edit)

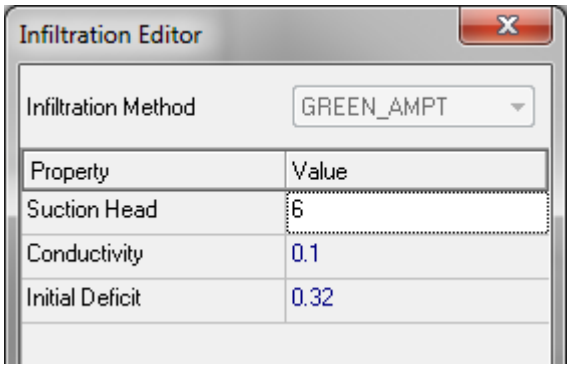

Infiltration Editor
Infiltration Method
GREEN_AMPT
Property
Value
Suction Head
6
Conductivity
0.075
Initial Deficit
0.32


Infiltration Editor
Infiltration Method
GREEN_AMPT
Property
Value
Suction Head
9
Conductivity
0.01875
Initial Deficit
0.33


Subcatchment DMA-3-C
Property
Value
Name
DMA-3-C
X-Coordinate
2100.000
Y-Coordinate
6200.000
Description
Tag
Rain Gage
FLINN
Outlet
BR-3
Area
0.495
Width
73
% Slope
5.64
% Imperv
43.96
N-Imperv
0.012
N-Perv
0.05
Dstore-Imperv
0.05
Dstore-Perv
0.10
%Zero-Imperv
25
Subarea Routing
OUTLET
Percent Routed
100
Infiltration
GREEN_AMPT
Groundwater
NO
Snow Pack
LID Controls
0
Land Uses
0
Initial Buildup
NONE
Curb Length
0
Infiltration parameters (click to edit)


Subcatchment DMA-4-C
Property
Value
Name
DMA-4-C
X-Coordinate
7000.000
Y-Coordinate
4600.000
Description
Tag
Rain Gage
FLINN
Outlet
POC-4
Area
0.627
Width
66
% Slope
24.7
% Imperv
0
N-Imperv
0.012
N-Perv
0.05
Dstore-Imperv
0.05
Dstore-Perv
0.10
%Zero-Imperv
25
Subarea Routing
OUTLET
Percent Routed
100
Infiltration
GREEN_AMPT
Groundwater
NO
Snow Pack
LID Controls
0
Land Uses
0
Initial Buildup
NONE
Curb Length
0
Infiltration parameters (click to edit)


Infiltration Editor
Infiltration Method
GREEN_AMPT
Property
Value
Suction Head
6
Conductivity
0.075
Initial Deficit
0.32


Infiltration Editor
Infiltration Method
GREEN_AMPT
Property
Value
Suction Head
6
Conductivity
0.1
Initial Deficit
0.32

Subcatchment BR-1

Property	Value
Name	BR-1
X-Coordinate	0.000
Y-Coordinate	5350.000
Description	
Tag	
Rain Gage	FLINN
Outlet	DIV-1
Area	0.27289
Width	10
% Slope	0
% Imperv	0
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.10
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT ...
Groundwater	NO
Snow Pack	
LID Controls	1
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Infiltration parameters (click to edit)

Subcatchment DMA-4-D

Property	Value
Name	DMA-4-D
X-Coordinate	8000.000
Y-Coordinate	4600.000
Description	
Tag	
Rain Gage	FLINN
Outlet	POC-4
Area	6.003
Width	608
% Slope	24.7
% Imperv	0
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.10
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT ...
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Infiltration parameters (click to edit)

Infiltration Editor

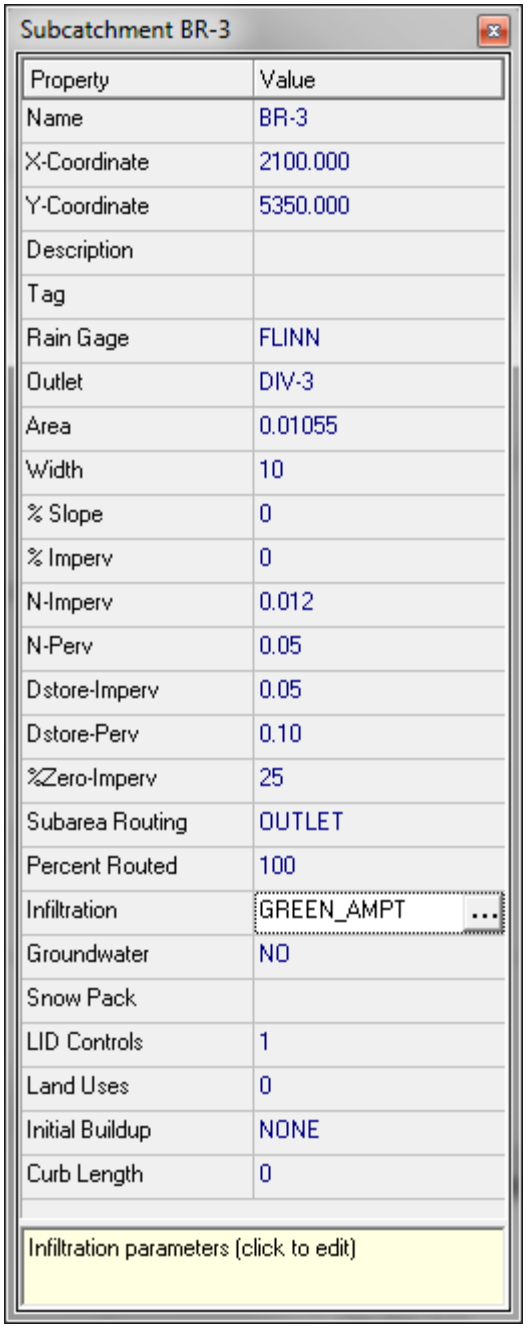
Infiltration Method: GREEN_AMPT

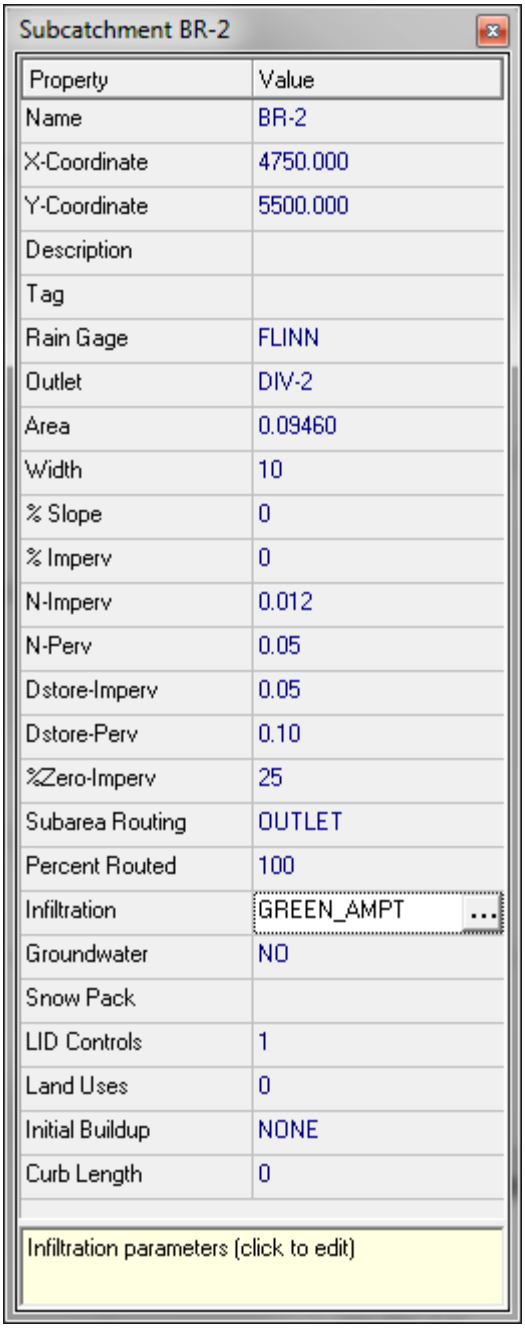
Property	Value
Suction Head	6
Conductivity	0.075
Initial Deficit	0.32

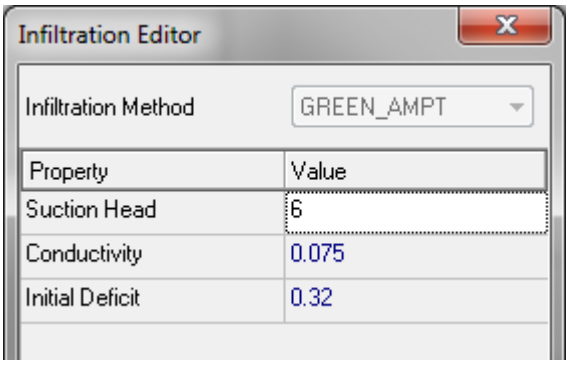
Infiltration Editor

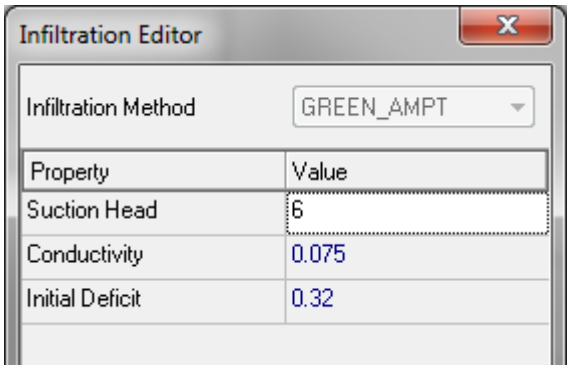
Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	9
Conductivity	0.025
Initial Deficit	0.33


Subcatchment BR-3
Property
Value
Name
BR-3
X-Coordinate
2100.000
Y-Coordinate
5350.000
Description
Tag
Rain Gage
FLINN
Outlet
DIV-3
Area
0.01055
Width
10
% Slope
0
% Imperv
0
N-Imperv
0.012
N-Perv
0.05
Dstore-Imperv
0.05
Dstore-Perv
0.10
%Zero-Imperv
25
Subarea Routing
OUTLET
Percent Routed
100
Infiltration
GREEN_AMPT
Groundwater
NO
Snow Pack
LID Controls
1
Land Uses
0
Initial Buildup
NONE
Curb Length
0
Infiltration parameters (click to edit)


Subcatchment BR-2
Property
Value
Name
BR-2
X-Coordinate
4750.000
Y-Coordinate
5500.000
Description
Tag
Rain Gage
FLINN
Outlet
DIV-2
Area
0.09460
Width
10
% Slope
0
% Imperv
0
N-Imperv
0.012
N-Perv
0.05
Dstore-Imperv
0.05
Dstore-Perv
0.10
%Zero-Imperv
25
Subarea Routing
OUTLET
Percent Routed
100
Infiltration
GREEN_AMPT
Groundwater
NO
Snow Pack
LID Controls
1
Land Uses
0
Initial Buildup
NONE
Curb Length
0
Infiltration parameters (click to edit)


Infiltration Editor
Infiltration Method
GREEN_AMPT
Property
Value
Suction Head
6
Conductivity
0.075
Initial Deficit
0.32


Infiltration Editor
Infiltration Method
GREEN_AMPT
Property
Value
Suction Head
6
Conductivity
0.075
Initial Deficit
0.32

Subcatchment ON-BY-2-C

Property	Value
Name	ON-BY-2-C
X-Coordinate	1885.000
Y-Coordinate	1200.000
Description	
Tag	
Rain Gage	FLINN
Outlet	POC-1
Area	0.395
Width	520
% Slope	50
% Imperv	0
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.10
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT ...
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Infiltration parameters (click to edit)

Subcatchment ON-BY-1-C

Property	Value
Name	ON-BY-1-C
X-Coordinate	2100.000
Y-Coordinate	2000.000
Description	
Tag	
Rain Gage	FLINN
Outlet	POC-1
Area	0.224
Width	490
% Slope	50
% Imperv	0
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.10
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT ...
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Infiltration parameters (click to edit)

Infiltration Editor

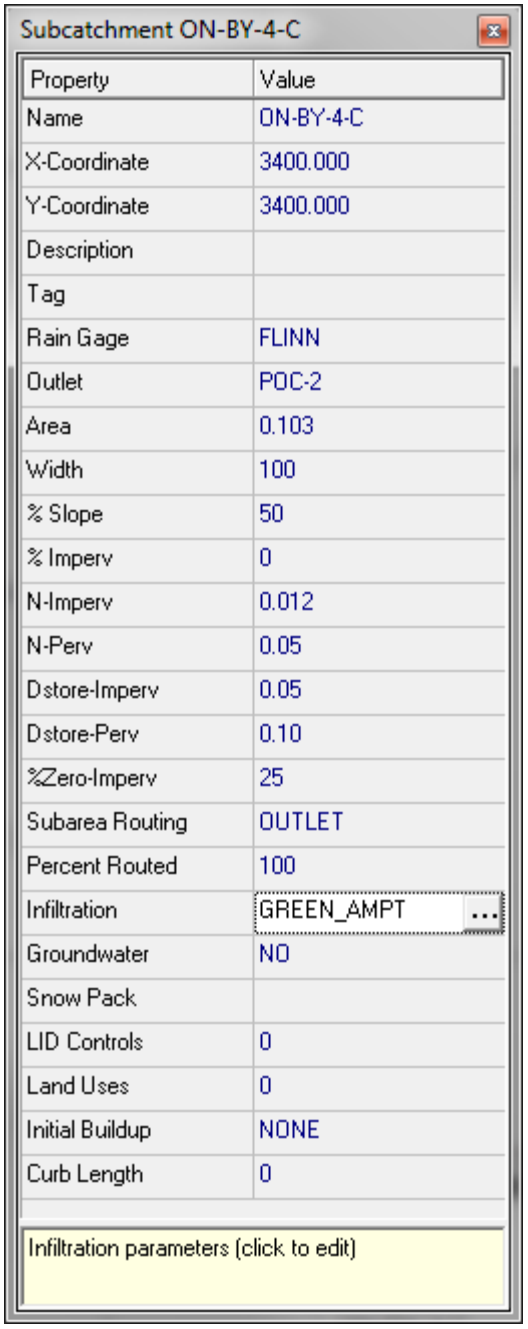
Infiltration Method: GREEN_AMPT

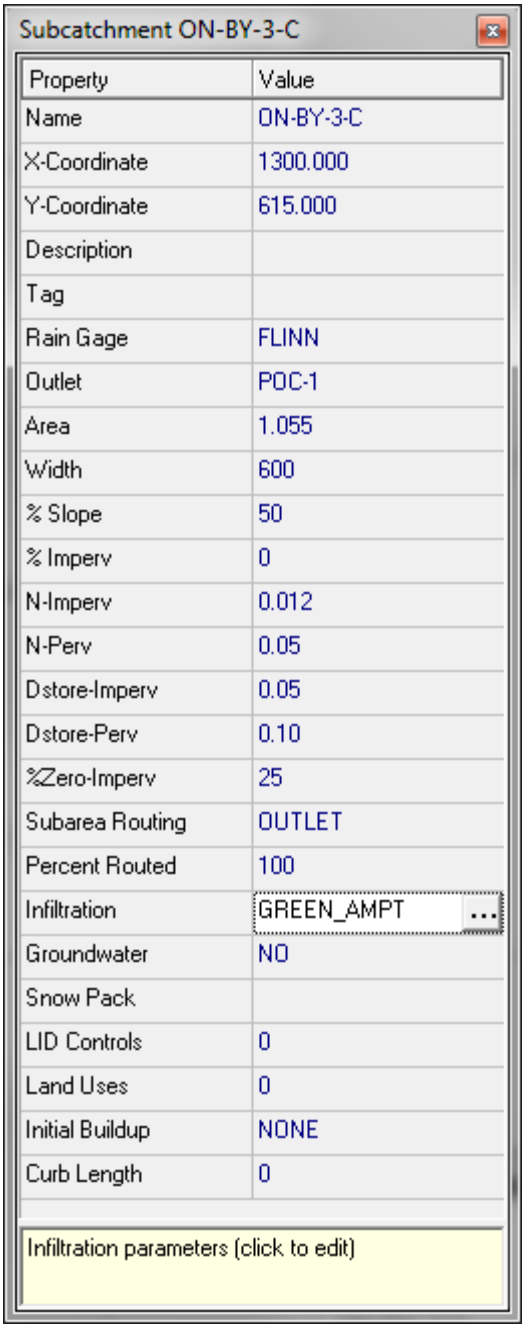
Property	Value
Suction Head	6
Conductivity	0.075
Initial Deficit	0.32

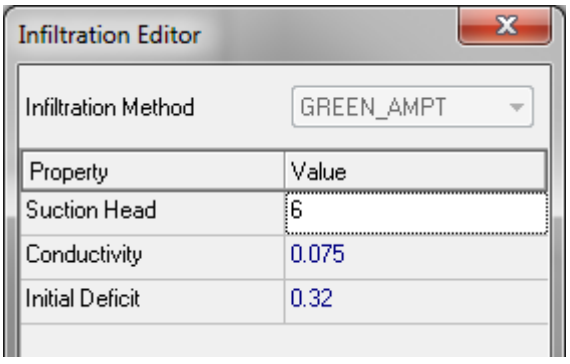
Infiltration Editor

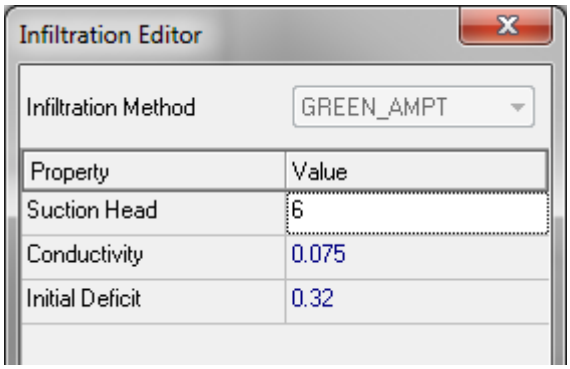
Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	6
Conductivity	0.075
Initial Deficit	0.32


Subcatchment ON-BY-4-C
Property
Value
Name
ON-BY-4-C
X-Coordinate
3400.000
Y-Coordinate
3400.000
Description
Tag
Rain Gage
FLINN
Outlet
POC-2
Area
0.103
Width
100
% Slope
50
% Imperv
0
N-Imperv
0.012
N-Perv
0.05
Dstore-Imperv
0.05
Dstore-Perv
0.10
%Zero-Imperv
25
Subarea Routing
OUTLET
Percent Routed
100
Infiltration
GREEN_AMPT
Groundwater
NO
Snow Pack
LID Controls
0
Land Uses
0
Initial Buildup
NONE
Curb Length
0
Infiltration parameters (click to edit)


Subcatchment ON-BY-3-C
Property
Value
Name
ON-BY-3-C
X-Coordinate
1300.000
Y-Coordinate
615.000
Description
Tag
Rain Gage
FLINN
Outlet
POC-1
Area
1.055
Width
600
% Slope
50
% Imperv
0
N-Imperv
0.012
N-Perv
0.05
Dstore-Imperv
0.05
Dstore-Perv
0.10
%Zero-Imperv
25
Subarea Routing
OUTLET
Percent Routed
100
Infiltration
GREEN_AMPT
Groundwater
NO
Snow Pack
LID Controls
0
Land Uses
0
Initial Buildup
NONE
Curb Length
0
Infiltration parameters (click to edit)


Infiltration Editor
Infiltration Method
GREEN_AMPT
Property
Value
Suction Head
6
Conductivity
0.075
Initial Deficit
0.32


Infiltration Editor
Infiltration Method
GREEN_AMPT
Property
Value
Suction Head
6
Conductivity
0.075
Initial Deficit
0.32

Subcatchment ON-BY-5-C

Property	Value
Name	ON-BY-5-C
X-Coordinate	3000.000
Y-Coordinate	1600.000
Description	
Tag	
Rain Gage	FLINN
Outlet	POC-3
Area	0.554
Width	540
% Slope	50
% Imperv	0
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.10
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT ...
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Infiltration parameters (click to edit)

Subcatchment ON-BY-4-D

Property	Value
Name	ON-BY-4-D
X-Coordinate	3636.000
Y-Coordinate	4028.000
Description	
Tag	
Rain Gage	FLINN
Outlet	POC-2
Area	0.739
Width	520
% Slope	50
% Imperv	0
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.10
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT ...
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Infiltration parameters (click to edit)

Infiltration Editor

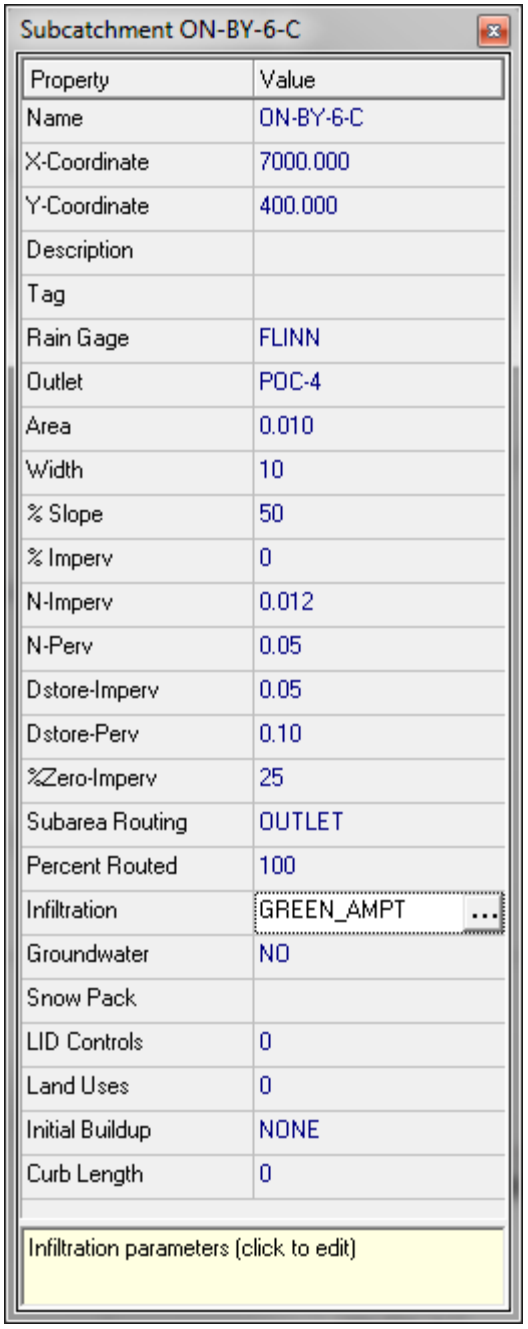
Infiltration Method: GREEN_AMPT

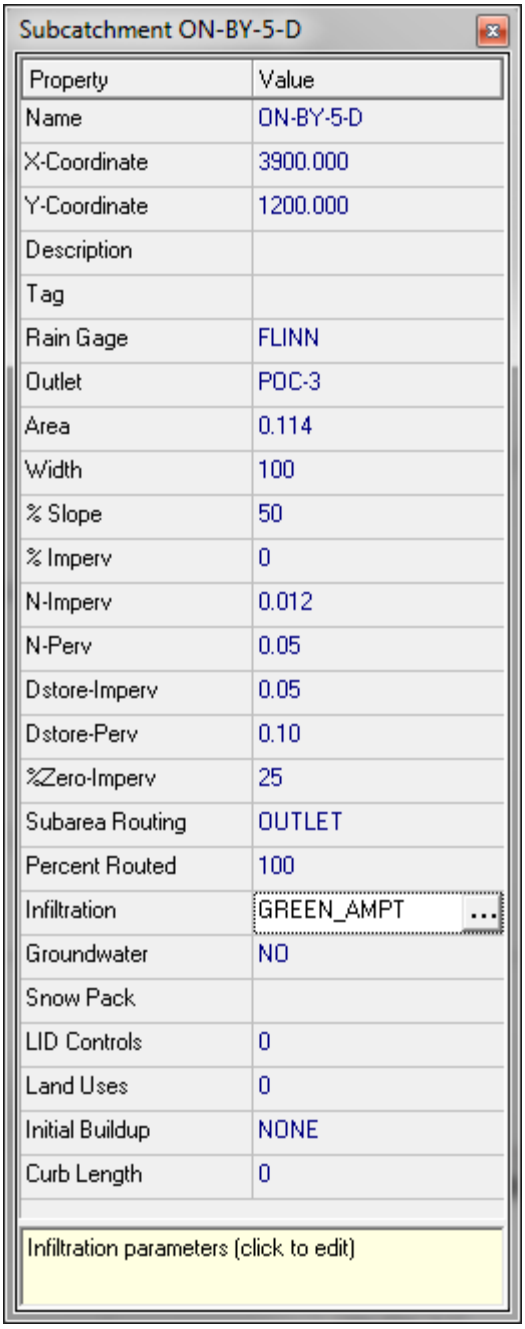
Property	Value
Suction Head	6
Conductivity	0.075
Initial Deficit	0.32

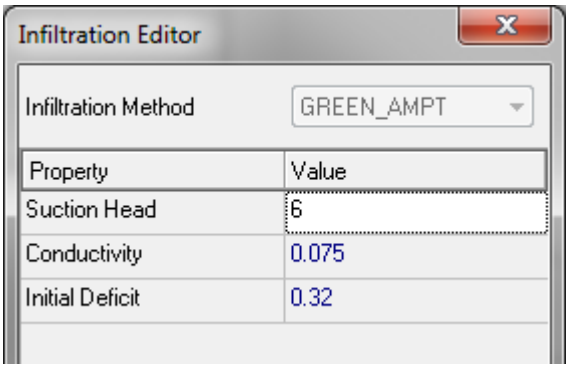
Infiltration Editor

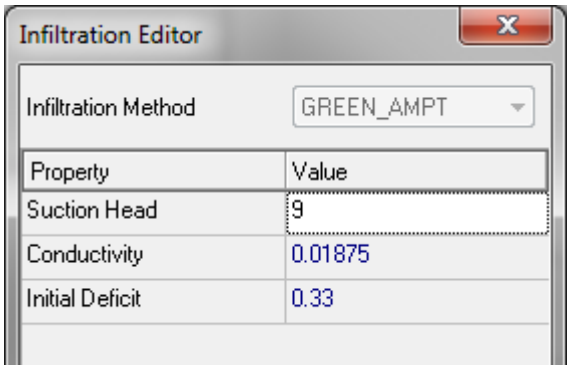
Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	9
Conductivity	0.01875
Initial Deficit	0.33


Subcatchment ON-BY-6-C
Property
Value
Name
ON-BY-6-C
X-Coordinate
7000.000
Y-Coordinate
400.000
Description
Tag
Rain Gage
FLINN
Outlet
POC-4
Area
0.010
Width
10
% Slope
50
% Imperv
0
N-Imperv
0.012
N-Perv
0.05
Dstore-Imperv
0.05
Dstore-Perv
0.10
%Zero-Imperv
25
Subarea Routing
OUTLET
Percent Routed
100
Infiltration
GREEN_AMPT
Groundwater
NO
Snow Pack
LID Controls
0
Land Uses
0
Initial Buildup
NONE
Curb Length
0
Infiltration parameters (click to edit)


Subcatchment ON-BY-5-D
Property
Value
Name
ON-BY-5-D
X-Coordinate
3900.000
Y-Coordinate
1200.000
Description
Tag
Rain Gage
FLINN
Outlet
POC-3
Area
0.114
Width
100
% Slope
50
% Imperv
0
N-Imperv
0.012
N-Perv
0.05
Dstore-Imperv
0.05
Dstore-Perv
0.10
%Zero-Imperv
25
Subarea Routing
OUTLET
Percent Routed
100
Infiltration
GREEN_AMPT
Groundwater
NO
Snow Pack
LID Controls
0
Land Uses
0
Initial Buildup
NONE
Curb Length
0
Infiltration parameters (click to edit)


Infiltration Editor
Infiltration Method
GREEN_AMPT
Property
Value
Suction Head
6
Conductivity
0.075
Initial Deficit
0.32


Infiltration Editor
Infiltration Method
GREEN_AMPT
Property
Value
Suction Head
9
Conductivity
0.01875
Initial Deficit
0.33

Subcatchment ON-BY-7-C

Property	Value
Name	ON-BY-7-C
X-Coordinate	500.000
Y-Coordinate	400.000
Description	
Tag	
Rain Gage	FLINN
Outlet	POC-1
Area	0.260
Width	370
% Slope	50
% Imperv	0
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.10
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT ...
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Infiltration parameters (click to edit)

Subcatchment ON-BY-6-D

Property	Value
Name	ON-BY-6-D
X-Coordinate	8000.000
Y-Coordinate	400.000
Description	
Tag	
Rain Gage	FLINN
Outlet	POC-4
Area	0.0244
Width	10
% Slope	50
% Imperv	0
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.10
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT ...
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Infiltration parameters (click to edit)

Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	6
Conductivity	0.075
Initial Deficit	0.32

Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	9
Conductivity	0.01875
Initial Deficit	0.33

Subcatchment OFF-1-C

Property	Value
Name	OFF-1-C
X-Coordinate	-300.000
Y-Coordinate	615.000
Description	
Tag	
Rain Gage	FLINN
Outlet	POC-1
Area	4.486
Width	488
% Slope	18.57
% Imperv	0
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.10
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT ...
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Infiltration parameters (click to edit)

Subcatchment 7-C-SELF-TR

Property	Value
Name	7-C-SELF-TR
X-Coordinate	-885.000
Y-Coordinate	1200.000
Description	
Tag	
Rain Gage	FLINN
Outlet	OFF-1-C
Area	0.100
Width	435
% Slope	12
% Imperv	0
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.10
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT ...
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Infiltration parameters (click to edit)

Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	6
Conductivity	0.1
Initial Deficit	0.32

Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	6
Conductivity	0.075
Initial Deficit	0.32

Subcatchment OFF-3-C

Property	Value
Name	OFF-3-C
X-Coordinate	5700.000
Y-Coordinate	400.000
Description	
Tag	
Rain Gage	FLINN
Outlet	POC-3
Area	1.427
Width	150
% Slope	19.64
% Imperv	0
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.10
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT ...
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Infiltration parameters (click to edit)

Subcatchment OFF-2-C

Property	Value
Name	OFF-2-C
X-Coordinate	4500.000
Y-Coordinate	4400.000
Description	
Tag	
Rain Gage	FLINN
Outlet	POC-2
Area	2.673
Width	413
% Slope	19.20
% Imperv	0
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.10
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT ...
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Infiltration parameters (click to edit)

Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	6
Conductivity	0.1
Initial Deficit	0.32

Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	9
Conductivity	0.025
Initial Deficit	0.33

Subcatchment OFF-3-D

Property	Value
Name	OFF-3-D
X-Coordinate	4800.000
Y-Coordinate	800.000
Description	
Tag	
Rain Gage	FLINN
Outlet	POC-3
Area	2.410
Width	253
% Slope	19.64
% Imperv	0
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.10
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT ...
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Infiltration parameters (click to edit)

Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	9
Conductivity	0.025
Initial Deficit	0.33

EXPLANATION OF SELECTED VARIABLES

Sub Catchment Areas:

Please refer to the attached diagrams that indicate the DMA and Bio-Retention BMP (BMP) sub areas modeled within the project site at both the pre and post developed conditions draining to the POC.

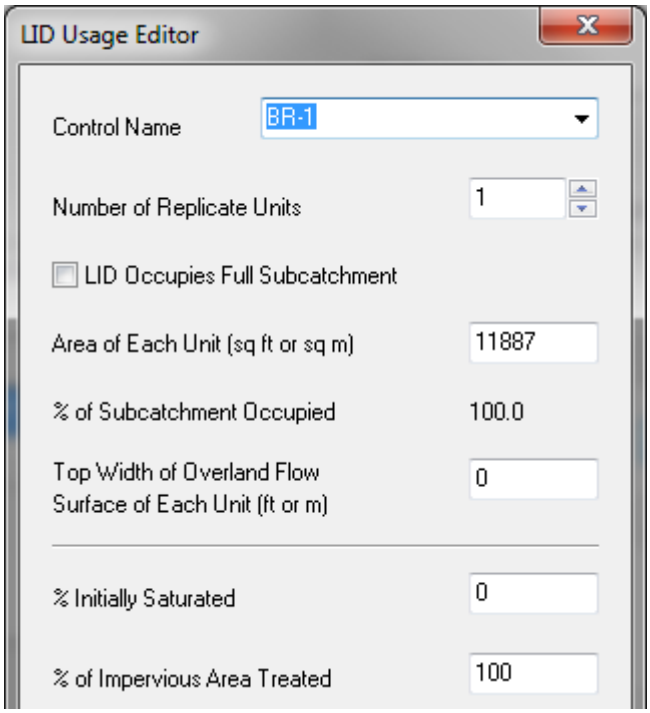
Parameters for the pre- and post-developed models include soil types C & D as determined from the site specific Natural Resources Conservation Service (NRCS) We Soil Survey (attached at the end of this appendix). Suction head, conductivity and initial deficit corresponds to average values expected for these soils types, according to sources consulted, professional experience, and approximate values obtained by the interim Orange County modeling approach.

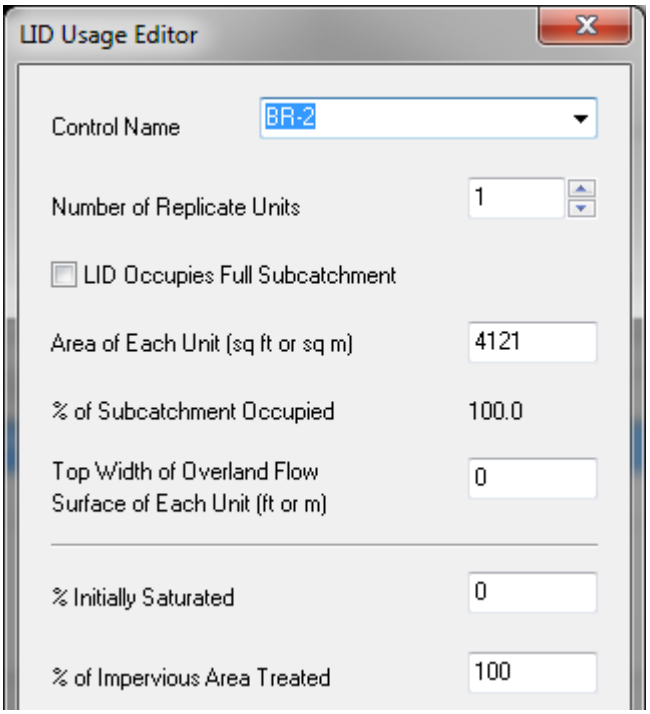
REC selected infiltration values, such that the percentage of total precipitation that becomes runoff, is realistic for the soil types and slightly smaller than measured values for Southern California watersheds.

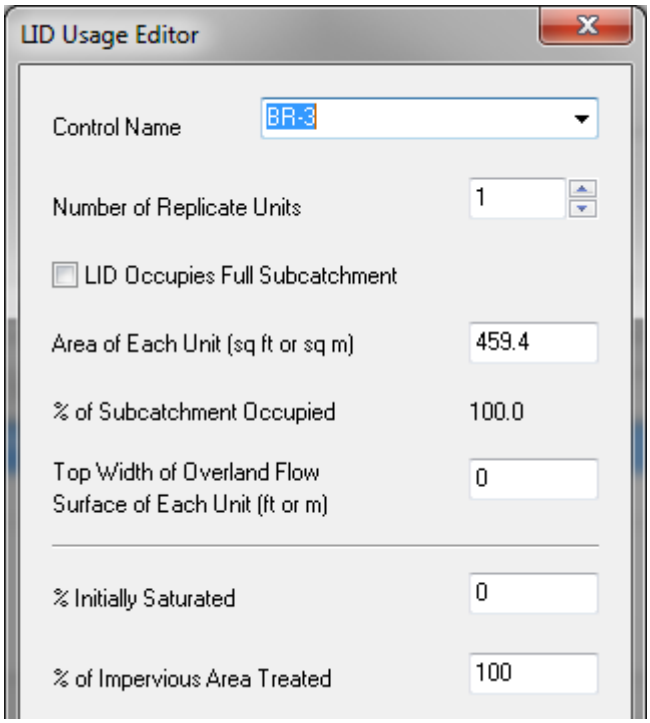
Selection of a Kinematic Approach: As the continuous model is based on hourly rainfall, and the time of concentration for the pre-development and post-development conditions is significantly smaller than 60 minutes, precise routing of the flows through the impervious surfaces, the underdrain pipe system, and the discharge pipe was considered unnecessary. The truncation error of the precipitation into hourly steps is much more significant than the precise routing in a system where the time of concentration is much smaller than 1 hour.

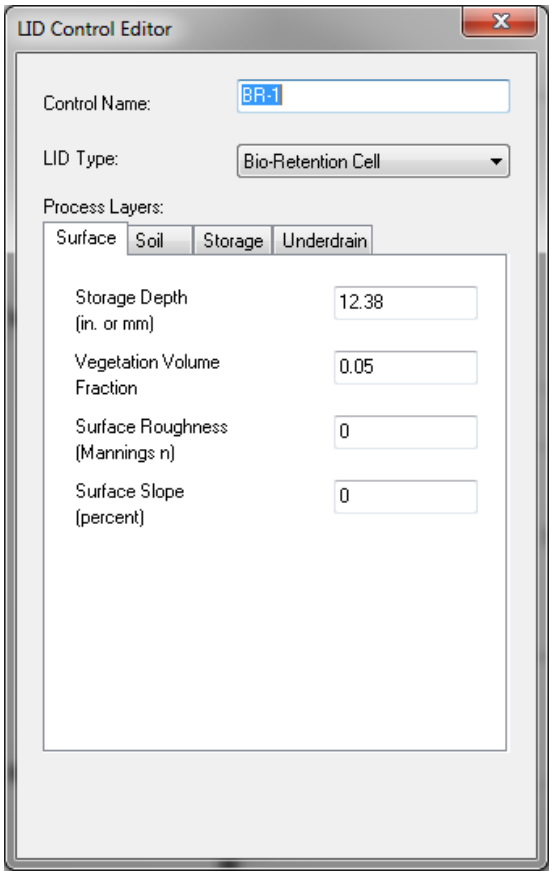
Sub-catchment BMP:

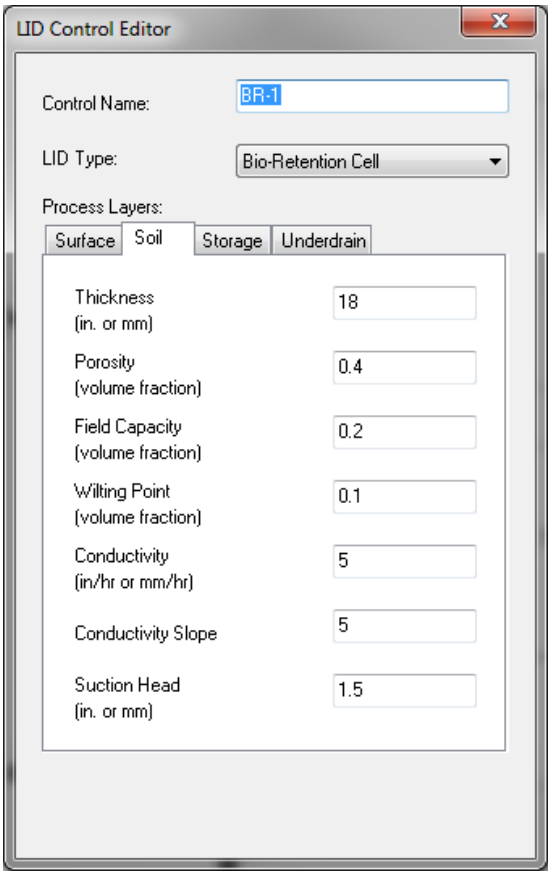
The area of bio-filtration must be equal to the area of the development tributary to the bioretention facility (area that drains into the biofiltration, equal external area plus bio-filtration itself). Five (5) decimal places were given regarding the areas of the bio-filtration to insure that the area used by the program for the LID subroutine corresponds exactly with this tributary.

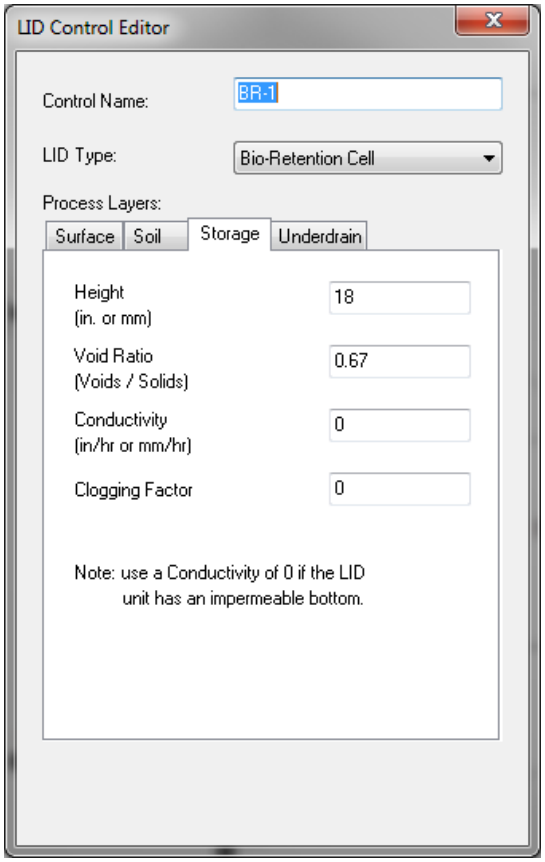


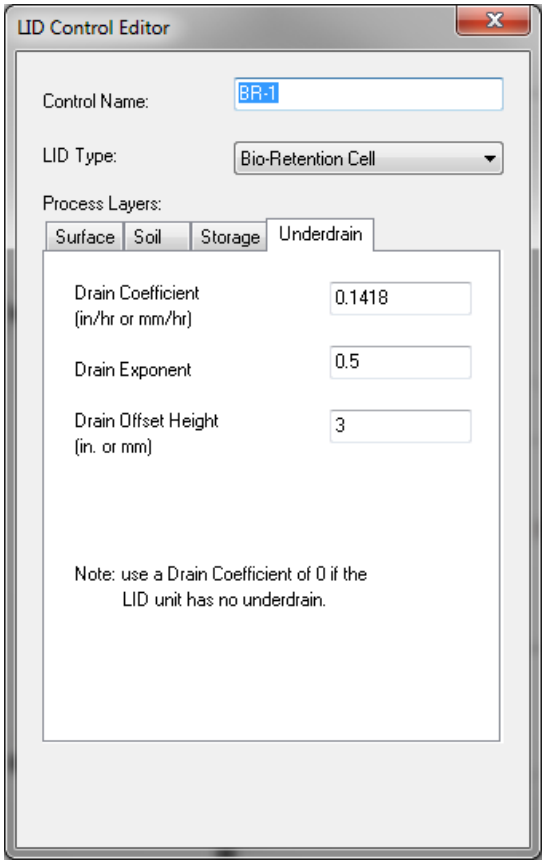


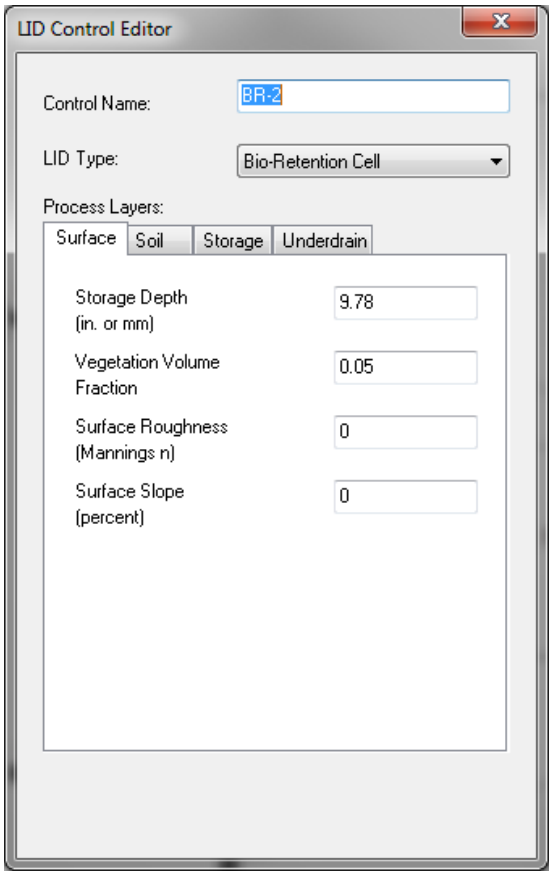

LID Usage Editor
Control Name
BR-3
Number of Replicate Units
1
LID Occupies Full Subcatchment
Area of Each Unit (sq ft or sq m)
459.4
% of Subcatchment Occupied
100.0
Top Width of Overland Flow Surface of Each Unit (ft or m)
0
% Initially Saturated
0
% of Impervious Area Treated
100

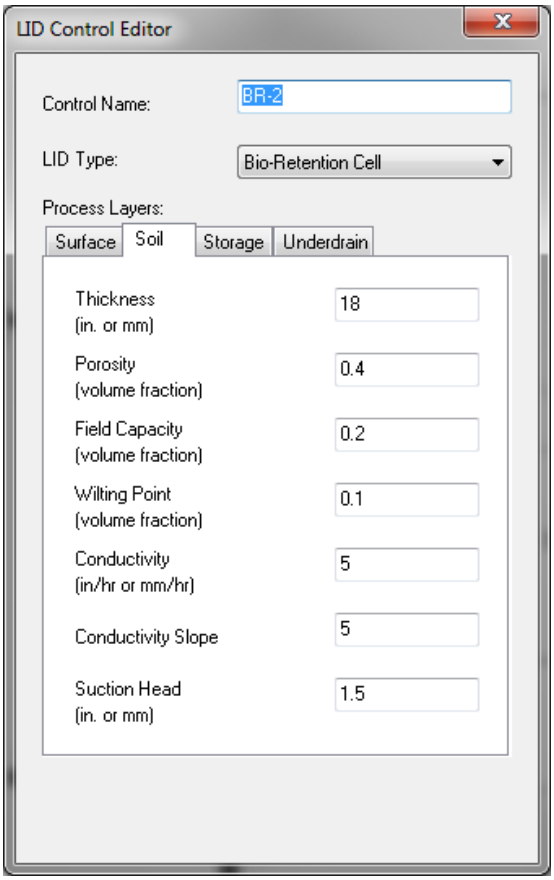

LID Control Editor
Control Name:
BR-1
LID Type:
Bio-Retention Cell
Process Layers:
Surface
Soil
Storage
Underdrain
Storage Depth
(in. or mm)
12.38
Vegetation Volume
Fraction
0.05
Surface Roughness
(Mannings n)
0
Surface Slope
(percent)
0

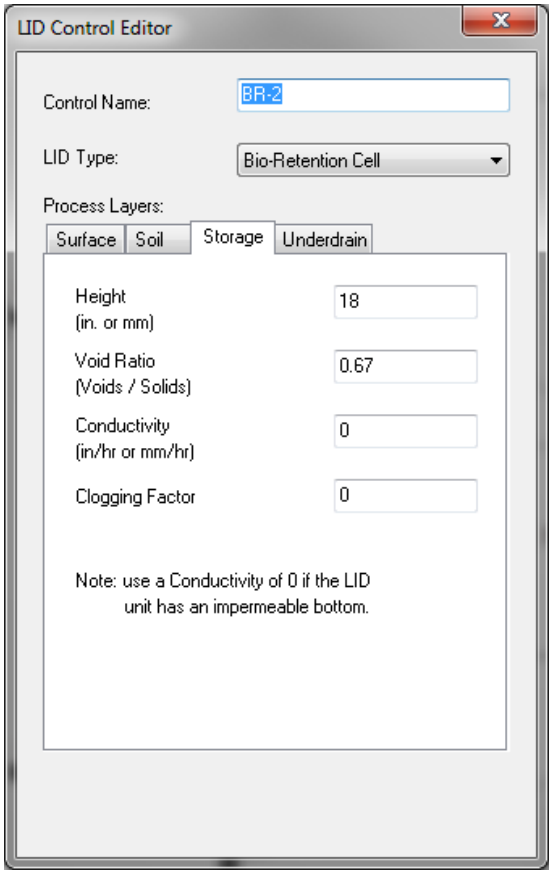

LID Control Editor
Control Name:
BR-1
LID Type:
Bio-Retention Cell
Process Layers:
Surface
Soil
Storage
Underdrain
Thickness
(in. or mm)
18
Porosity
(volume fraction)
0.4
Field Capacity
(volume fraction)
0.2
Wilting Point
(volume fraction)
0.1
Conductivity
(in/hr or mm/hr)
5
Conductivity Slope
5
Suction Head
(in. or mm)
1.5

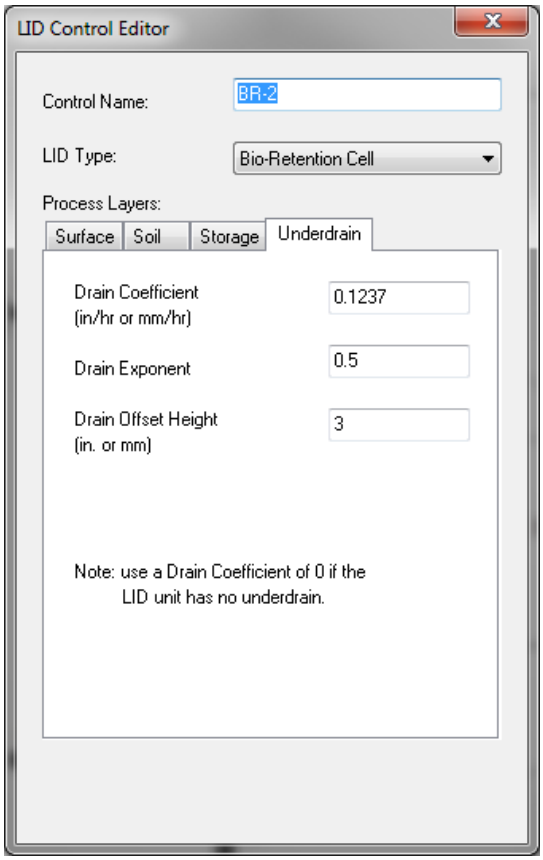

LID Control Editor
Control Name:
BR-1
LID Type:
Bio-Retention Cell
Process Layers:
Surface
Soil
Storage
Underdrain
Height
(in. or mm)
18
Void Ratio
(Voids / Solids)
0.67
Conductivity
(in/hr or mm/hr)
0
Clogging Factor
0
Note: use a Conductivity of 0 if the LID
unit has an impermeable bottom.

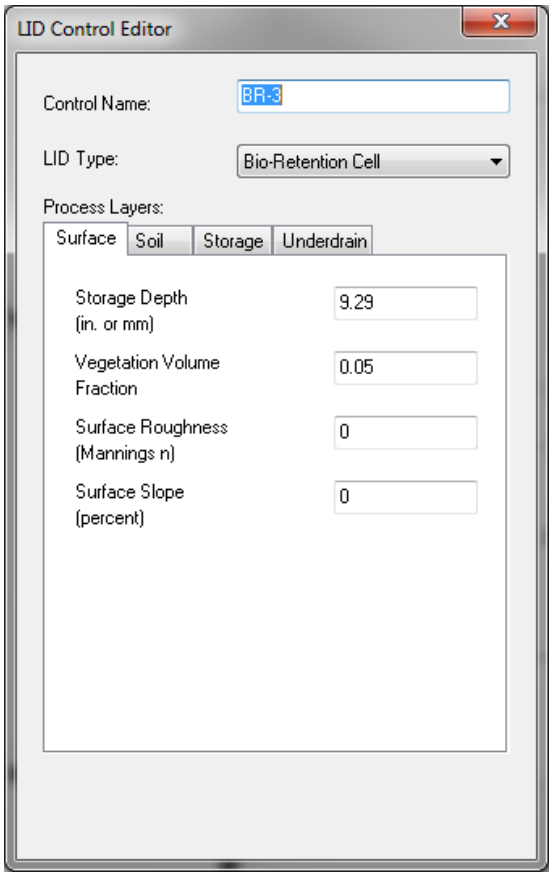

LID Control Editor
Control Name:
BR-1
LID Type:
Bio-Retention Cell
Process Layers:
Surface
Soil
Storage
Underdrain
Drain Coefficient
(in/hr or mm/hr)
0.1418
Drain Exponent
0.5
Drain Offset Height
(in. or mm)
3
Note: use a Drain Coefficient of 0 if the
LID unit has no underdrain.

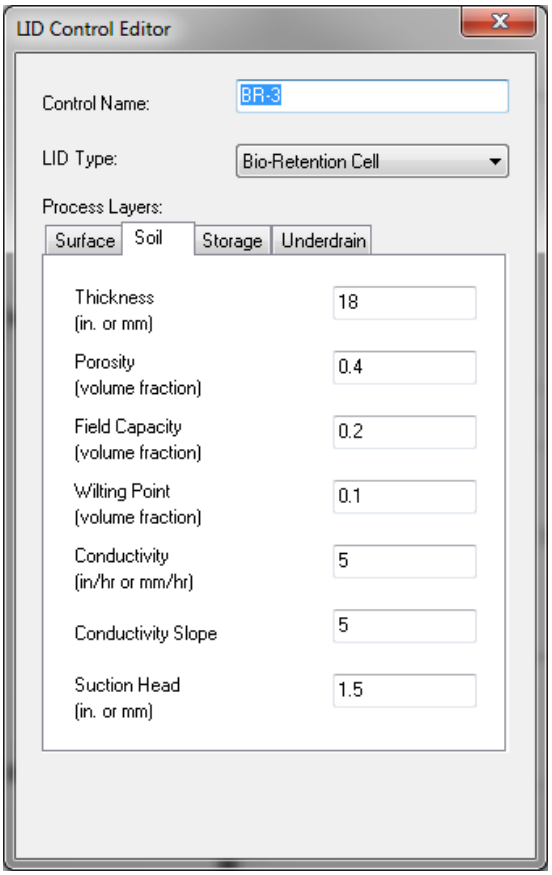

LID Control Editor
Control Name:
BR-2
LID Type:
Bio-Retention Cell
Process Layers:
Surface
Soil
Storage
Underdrain
Storage Depth
(in. or mm)
9.78
Vegetation Volume
Fraction
0.05
Surface Roughness
(Mannings n)
0
Surface Slope
(percent)
0

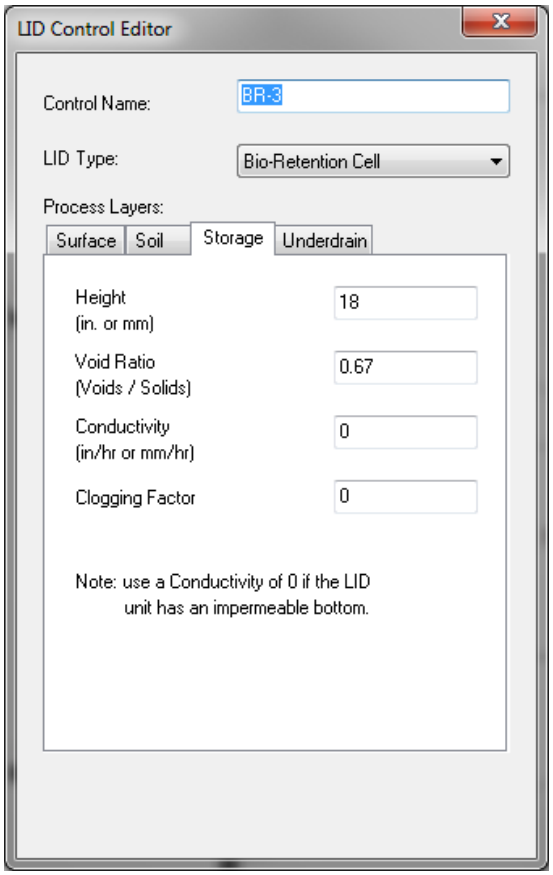

LID Control Editor
Control Name:
BR-2
LID Type:
Bio-Retention Cell
Process Layers:
Surface
Soil
Storage
Underdrain
Thickness
(in. or mm)
18
Porosity
(volume fraction)
0.4
Field Capacity
(volume fraction)
0.2
Wilting Point
(volume fraction)
0.1
Conductivity
(in/hr or mm/hr)
5
Conductivity Slope
5
Suction Head
(in. or mm)
1.5

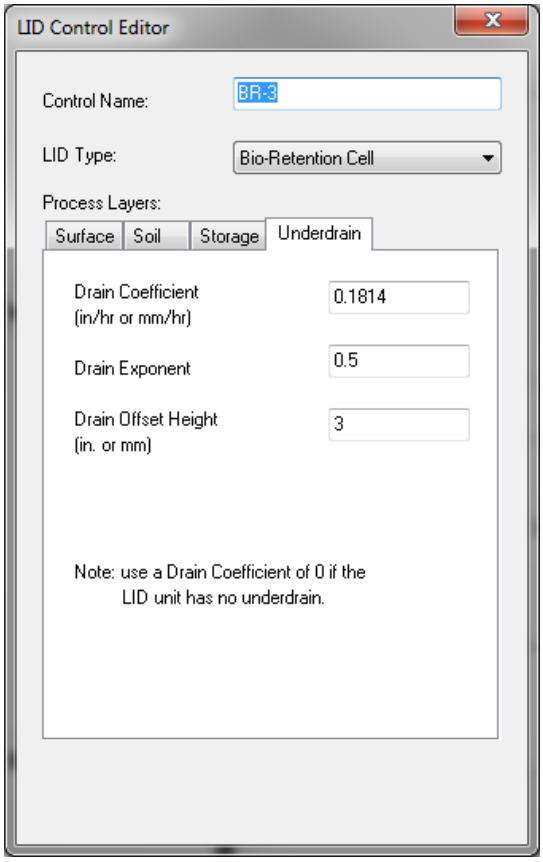

LID Control Editor
Control Name:
BR-2
LID Type:
Bio-Retention Cell
Process Layers:
Surface
Soil
Storage
Underdrain
Height
(in. or mm)
18
Void Ratio
(Voids / Solids)
0.67
Conductivity
(in/hr or mm/hr)
0
Clogging Factor
0
Note: use a Conductivity of 0 if the LID
unit has an impermeable bottom.


LID Control Editor
Control Name:
BR-2
LID Type:
Bio-Retention Cell
Process Layers:
Surface
Soil
Storage
Underdrain
Drain Coefficient
(in/hr or mm/hr)
0.1237
Drain Exponent
0.5
Drain Offset Height
(in. or mm)
3
Note: use a Drain Coefficient of 0 if the
LID unit has no underdrain.


LID Control Editor
Control Name:
BR-3
LID Type:
Bio-Retention Cell
Process Layers:
Surface
Soil
Storage
Underdrain
Storage Depth
(in. or mm)
9.29
Vegetation Volume
Fraction
0.05
Surface Roughness
(Mannings n)
0
Surface Slope
(percent)
0


LID Control Editor
Control Name:
BR-3
LID Type:
Bio-Retention Cell
Process Layers:
Surface
Soil
Storage
Underdrain
Thickness
(in. or mm)
18
Porosity
(volume fraction)
0.4
Field Capacity
(volume fraction)
0.2
Wilting Point
(volume fraction)
0.1
Conductivity
(in/hr or mm/hr)
5
Conductivity Slope
5
Suction Head
(in. or mm)
1.5


LID Control Editor
Control Name:
BR-3
LID Type:
Bio-Retention Cell
Process Layers:
Surface
Soil
Storage
Underdrain
Height
(in. or mm)
18
Void Ratio
(Voids / Solids)
0.67
Conductivity
(in/hr or mm/hr)
0
Clogging Factor
0
Note: use a Conductivity of 0 if the LID
unit has an impermeable bottom.


LID Control Editor
Control Name:
BR-3
LID Type:
Bio-Retention Cell
Process Layers:
Surface
Soil
Storage
Underdrain
Drain Coefficient
(in/hr or mm/hr)
0.1814
Drain Exponent
0.5
Drain Offset Height
(in. or mm)
3
Note: use a Drain Coefficient of 0 if the
LID unit has no underdrain.

LID Control Editor: Explanation of Significant Variables

Storage Depth:

The storage depth variable within the SWMM model is representative of the storage volume provided beneath the surface riser outlet and the engineered soil and mulch components of the bioretention facility.

In those cases where the surface storage has a variable area that is also different to the area of the gravel and amended soil, the SWMM model needs to be calibrated as the LID module will use the storage depth multiplied by the BMP area as the amount of volume stored at the surface.

Let A_{BMP} be the area of the BMP (area of amended soil and area of gravel). The proper value of the storage depth S_D to be included in the LID module can be calculated by using geometric properties of the surface volume. Let A_0 be the surface area at the bottom of the surface pond, and let A_i be the surface area at the elevation of the invert of the first row of orifices (or at the invert of the riser if not surface orifices are included). Finally, let h_i be the difference in elevation between A_0 and A_i. By volumetric definition:

$$A_{BMP} \cdot S_D = \frac{(A_0 + A_i)}{2} h_i \qquad (1)$$

Equation (1) allows the determination of S_D to be included as Storage Depth in the LID module.

Porosity: A porosity value of 0.4 has been selected for the model. The amended soil is to be highly sandy in content in order to have a saturated hydraulic conductivity of approximately 5 in/hr.

REC considers such a value to be slightly high; however, in order to comply with the HMP Permit, the value recommended by the Copermittees for the porosity of amended soil is 0.4, per Appendix A of the Final Hydromodification Management Plan by Brown & Caldwell, dated March 2011. Such porosity is equal to the porosity of the gravel per the same document.

Void Ratio: The ratio of the void volume divided by the soil volume is directly related to porosity as n/(1-n). As the underdrain layer is composed of gravel, a porosity value of 0.4 has been selected (also per Appendix A of the Final HMP document), which results in a void ratio of 0.4/(1-0.4) = 0.67 for the gravel detention layer.

Conductivity: Due to the existing type C soils located on the project site, BMPs 1 & 3 will not be lined to allow for infiltration into the ground. However, BMP 2 will be lined due to its location on a hillside.

Clogging factor: A clogging factor was not used (0 indicates that there is no clogging assumed within the model). The reason for this is related to the fairness of a comparison with the SDHM

model and the HMP sizing tables: a clogging factor was not considered, and instead, a conservative value of infiltration was recommended.

Drain (Flow) coefficient: The flow coefficient C in the SWMM Model is the coefficient needed to transform the orifice equation into a general power law equation of the form:

$$q = C(H - H_D)^n \quad (2)$$

where q is the peak flow in in/hr, n is the exponent (typically 0.5 for orifice equation), H_D is the elevation of the centroid of the orifice in inches (assumed equal to the invert of the orifice for small orifices and in our design equal to 0) and H is the depth of the water in inches.

The general orifice equation can be expressed as:

$$Q = \frac{\pi}{4} c_g \frac{D^2}{144} \sqrt{2g \frac{(H - H_D)}{12}} \quad (3)$$

where Q is the peak flow in cfs, D is the diameter in inches, c_g is the typical discharge coefficient for orifices (0.61-0.63 for thin walls and around 0.75-0.8 for thick walls), g is the acceleration of gravity in ft/s^2, and H and H_D are defined above and are also used in inches in Equation (3).

It is clear that:

$$q \left(\frac{in}{hr}\right) X \frac{A_{BMP}}{12\ X\ 3600} = Q\ (cfs) \quad (4)$$

Cut-Off Flow: Q (cfs) and q (in/hr) are also the cutoff flow. For numerical reasons to insure the LID is full, the model uses cut-off = 1.01 Q.

Detention Basin

Storage Unit BASIN-1

Property	Value
Name	BASIN-1
X-Coordinate	-1100.000
Y-Coordinate	3950.000
Description	
Tag	
Inflows	NO
Treatment	NO
Invert El.	0
Max. Depth	3.25
Initial Depth	0
Ponded Area	16550
Evap. Factor	1
Infiltration	NO ...
Storage Curve	TABULAR
Functional Curve	
Coefficient	1000
Exponent	0
Constant	0
Tabular Curve	
Curve Name	Basin-1

Click to specify infiltration through the bottom of the storage unit

Outlet OUTLET-1

Property	Value
Name	OUTLET-1
Inlet Node	BASIN-1
Outlet Node	POC-1
Description	
Tag	
Inlet Offset	0
Flap Gate	NO
Rating Curve	TABULAR/HEAD
Functional Curve	
Coefficient	10.0
Exponent	0.5
Tabular Curve	
Curve Name	OUT-1

User-assigned name of outlet

Storage Curve Editor

Curve Name: Basin-1

Description:

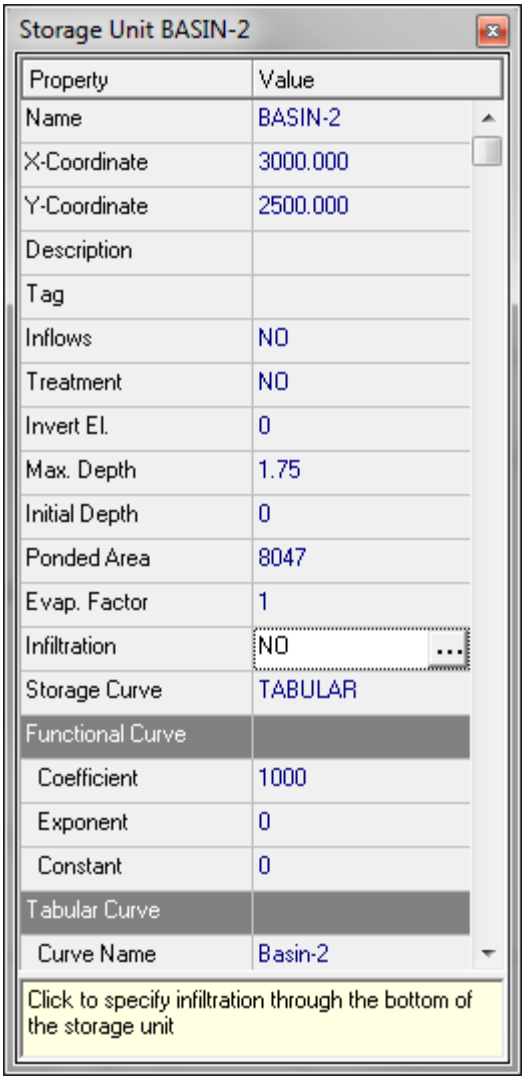
	Depth (ft)	Area (ft2)
1	0.00	11887
2	0.25	12223
3	0.50	12565
4	0.75	12909
5	1.00	13257
6	1.25	13609
7	1.50	13964
8	1.75	14324
9	2.00	14685

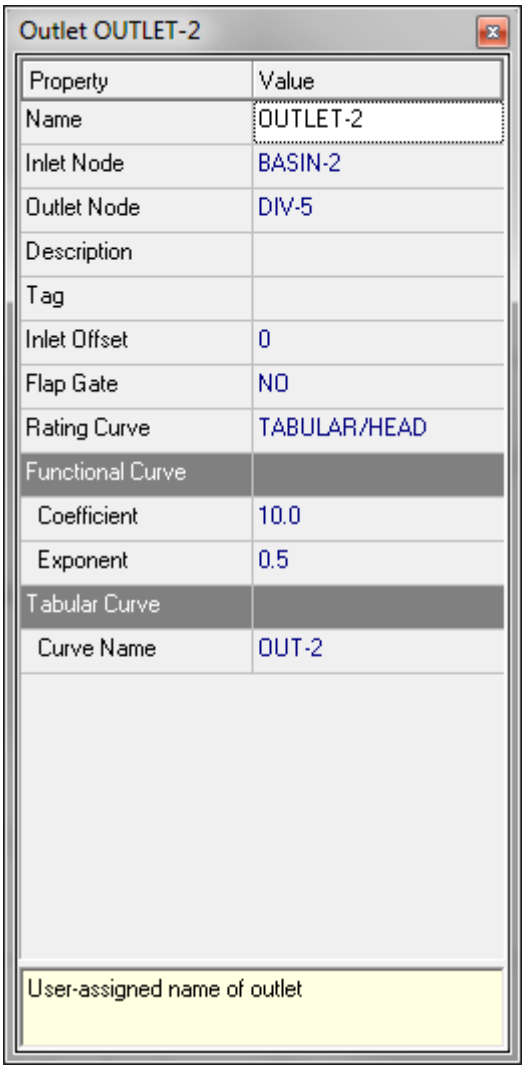
Rating Curve Editor

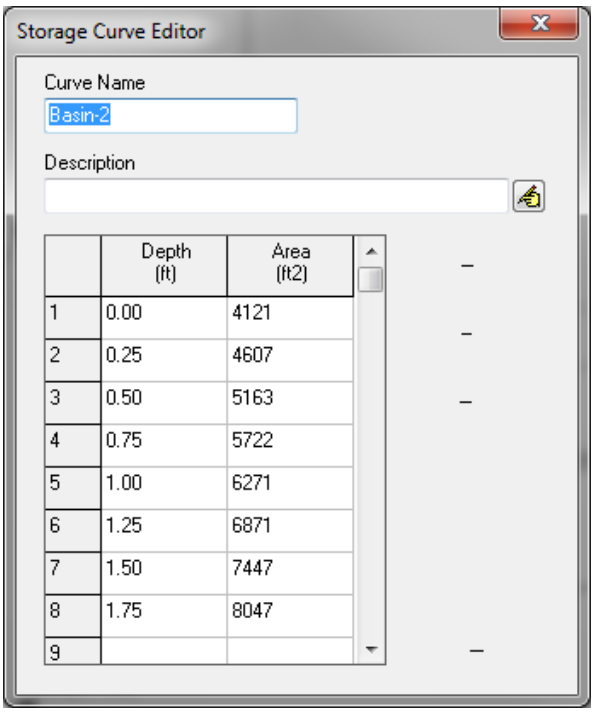
Curve Name: OUT-1

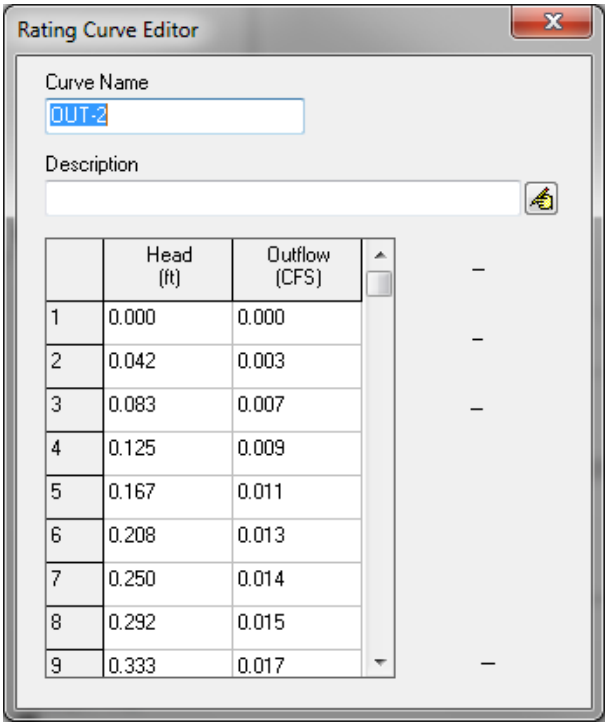
Description:

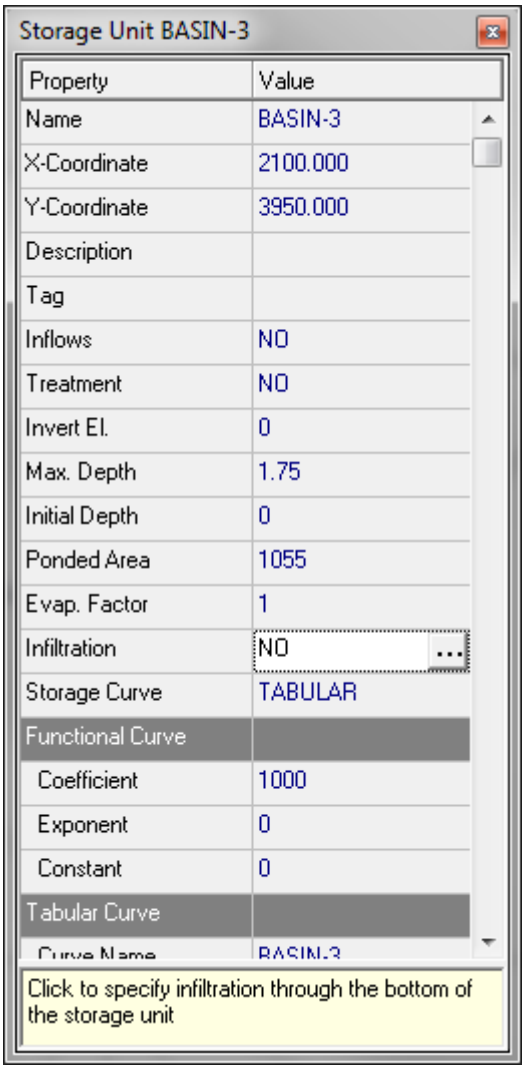
	Head (ft)	Outflow (CFS)
1	0.000	0.000
2	0.083	0.021
3	0.167	0.038
4	0.250	0.049
5	0.333	0.058
6	0.417	0.065
7	0.500	0.072
8	0.583	0.079
9	0.667	0.084

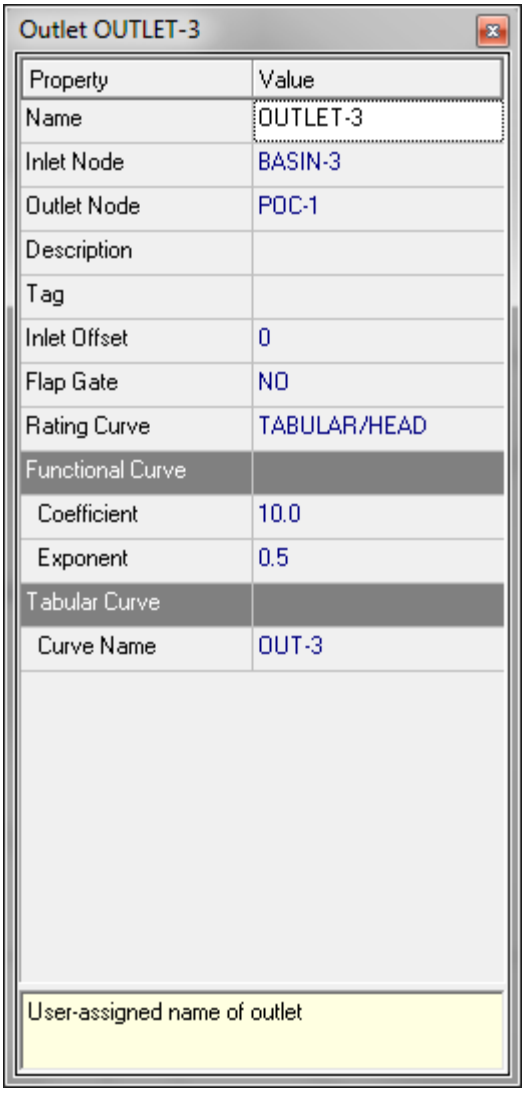

Storage Unit BASIN-2
Property
Value
Name
BASIN-2
X-Coordinate
3000.000
Y-Coordinate
2500.000
Description
Tag
Inflows
NO
Treatment
NO
Invert El.
0
Max. Depth
1.75
Initial Depth
0
Ponded Area
8047
Evap. Factor
1
Infiltration
NO
Storage Curve
TABULAR
Functional Curve
Coefficient
1000
Exponent
0
Constant
0
Tabular Curve
Curve Name
Basin-2
Click to specify infiltration through the bottom of the storage unit

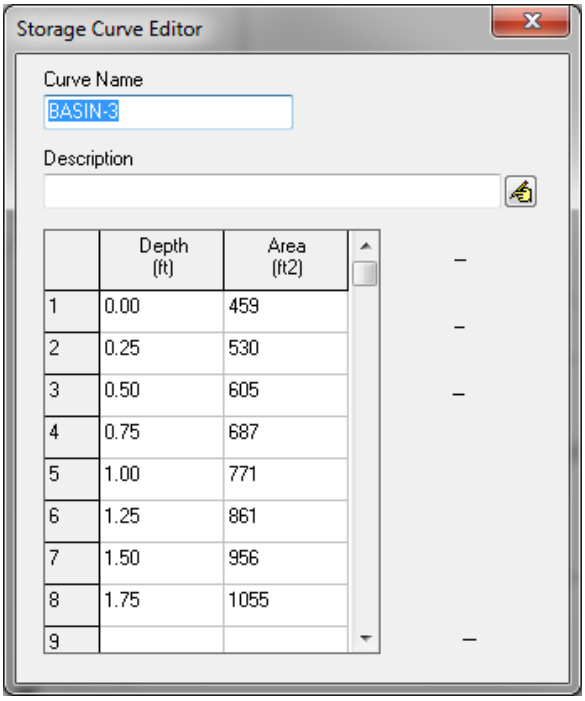

Outlet OUTLET-2
Property
Value
Name
OUTLET-2
Inlet Node
BASIN-2
Outlet Node
DIV-5
Description
Tag
Inlet Offset
0
Flap Gate
NO
Rating Curve
TABULAR/HEAD
Functional Curve
Coefficient
10.0
Exponent
0.5
Tabular Curve
Curve Name
OUT-2
User-assigned name of outlet

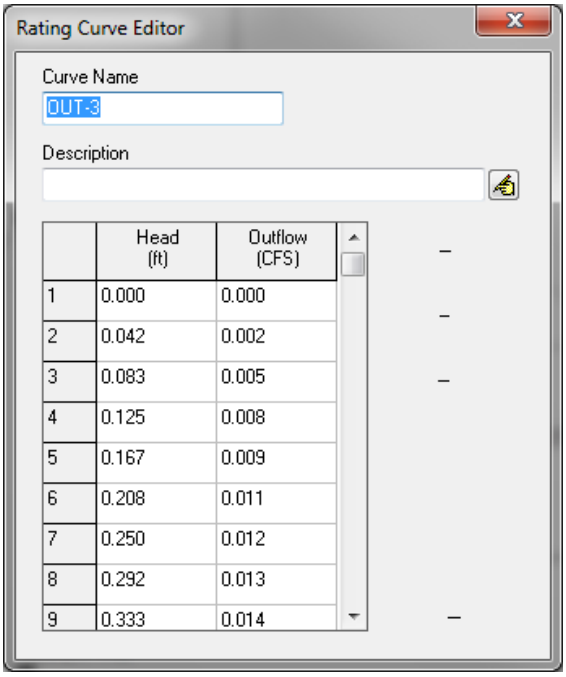

Storage Curve Editor
Curve Name
Basin-2
Description
Depth (ft)
Area (ft2)
1 0.00 4121
2 0.25 4607
3 0.50 5163
4 0.75 5722
5 1.00 6271
6 1.25 6871
7 1.50 7447
8 1.75 8047
9


Rating Curve Editor
Curve Name
OUT-2
Description
Head (ft)
Outflow (CFS)
1 0.000 0.000
2 0.042 0.003
3 0.083 0.007
4 0.125 0.009
5 0.167 0.011
6 0.208 0.013
7 0.250 0.014
8 0.292 0.015
9 0.333 0.017


Storage Unit BASIN-3
Property
Value
Name
BASIN-3
X-Coordinate
2100.000
Y-Coordinate
3950.000
Description
Tag
Inflows
NO
Treatment
NO
Invert El.
0
Max. Depth
1.75
Initial Depth
0
Ponded Area
1055
Evap. Factor
1
Infiltration
NO
Storage Curve
TABULAR
Functional Curve
Coefficient
1000
Exponent
0
Constant
0
Tabular Curve
Curve Name
BASIN-3
Click to specify infiltration through the bottom of the storage unit


Outlet OUTLET-3
Property
Value
Name
OUTLET-3
Inlet Node
BASIN-3
Outlet Node
POC-1
Description
Tag
Inlet Offset
0
Flap Gate
NO
Rating Curve
TABULAR/HEAD
Functional Curve
Coefficient
10.0
Exponent
0.5
Tabular Curve
Curve Name
OUT-3
User-assigned name of outlet


Storage Curve Editor
Curve Name
BASIN-3
Description
Depth (ft)
Area (ft2)
1 0.00 459
2 0.25 530
3 0.50 605
4 0.75 687
5 1.00 771
6 1.25 861
7 1.50 956
8 1.75 1055
9


Rating Curve Editor
Curve Name
OUT-3
Description
Head (ft)
Outflow (CFS)
1 0.000 0.000
2 0.042 0.002
3 0.083 0.005
4 0.125 0.008
5 0.167 0.009
6 0.208 0.011
7 0.250 0.012
8 0.292 0.013
9 0.333 0.014

Overland Flow Manning's Coefficient per TRWE (Reference [6])

Improving Accuracy in Continuous Hydrologic Modeling:

Guidance for Selecting Pervious Overland Flow Manning's *n* Values in the San Diego Region

Alex J. Smith, MS, EIT

Tory R. Walker, PE, CFM, LEED GA

TORY R. WALKER ENGINEERING
RELIABLE SOLUTIONS IN WATER RESOURCES

Tory R. Walker Engineering
122 Civic Center Drive, Suite 206
Vista, CA 92084

listed surface descriptions, SWMM 5 User's Manual Table A.6 is notably limited for local application. Due to these limited options, the absence of additional references suitable for local use, and the streamlining appeal of a de facto value, we anticipate that jurisdictions will not be inclined to approve land surfaces other than short prairie grass. Therefore, in order to provide SWMM users with a wider range of land surfaces suitable for local application and to provide Copermittees with confidence in the design parameters, we recommend using the values published by Yen and Chow in Table 3-5 of the EPA SWMM Reference Manual Volume I – Hydrology.

SWMM-Endorsed Values Will Improve Model Quality

In January 2016, the EPA released the SWMM Reference Manual Volume I – Hydrology (SWMM Hydrology Reference Manual). The SWMM Hydrology Reference Manual complements the SWMM 5 User's Manual and SWMM 5 Applications Manual by providing an in-depth description of the program's hydrologic components (EPA 2016). Table 3-5 of the SWMM Hydrology Reference Manual expounds upon SWMM 5 User's Manual Table A.6 by providing Manning's *n* values for additional overland flow surfaces[3]. The values are provided in Table 1:

Table 1: Manning's *n* Values for Overland Flow (EPA, 2016; Yen 2001; Yen and Chow, 1983).

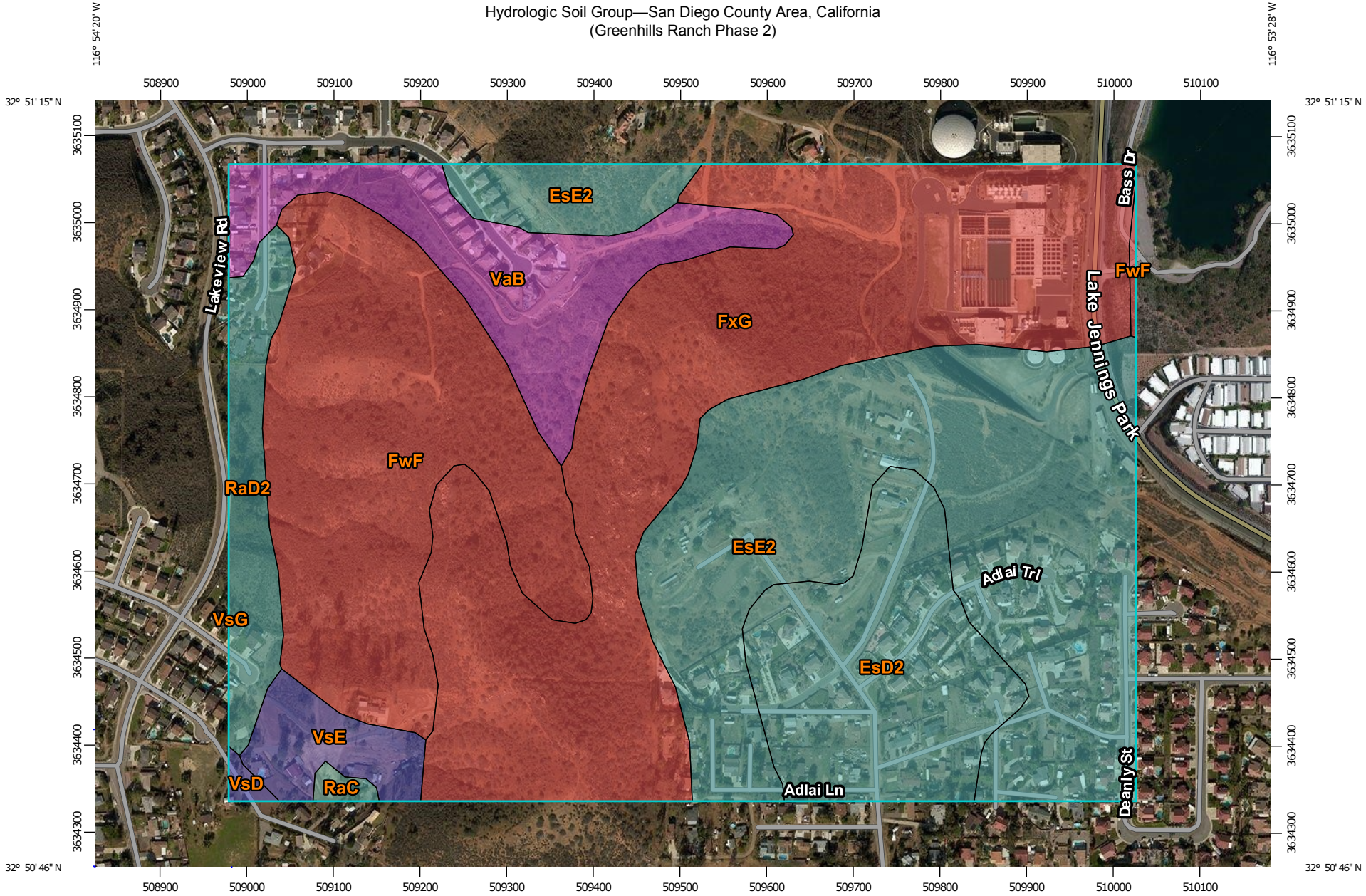
Overland Surface	**Light Rain (< 0.8 in/hr)**	**Moderate Rain (0.8-1.2 in/hr)**	**Heavy Rain (> 1.2 in/hr)**
Smooth asphalt pavement	0.010	0.012	0.015
Smooth impervious surface	0.011	0.013	0.015
Tar and sand pavement	0.012	0.014	0.016
Concrete pavement	0.014	0.017	0.020
Rough impervious surface	0.015	0.019	0.023
Smooth bare packed soil	0.017	0.021	0.025
Moderate bare packed soil	0.025	0.030	0.035
Rough bare packed soil	0.032	0.038	0.045
Gravel soil	0.025	0.032	0.045
Mowed poor grass	0.030	0.038	0.045
Average grass, closely clipped sod	0.040	0.050	0.060
Pasture	0.040	0.055	0.070
Timberland	0.060	0.090	0.120
Dense grass	0.060	0.090	0.120
Shrubs and bushes	0.080	0.120	0.180
Land Use			
Business	0.014	0.022	0.035
Semibusiness	0.022	0.035	0.050
Industrial	0.020	0.035	0.050
Dense residential	0.025	0.040	0.060
Suburban residential	0.030	0.055	0.080
Parks and lawns	0.040	0.075	0.120

[3] Further discussion is provided on page 6 under "Discussion of Differences Between Manning's *n* Values"

ATTACHMENT 8

Soils Maps

Hydrologic Soil Group—San Diego County Area, California
(Greenhills Ranch Phase 2)



Map Scale: 1:6,210 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 300 600 1200 1800

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: http://websoilsurvey.nrcs.usda.gov
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 9, Sep 17, 2015

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

Date(s) aerial images were photographed: May 3, 2010—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**
EsD2	Escondido very fine sandy loam, 9 to 15 percent slopes, eroded	C	19.4	10.2%
EsE2	Escondido very fine sandy loam, 15 to 30 percent slopes , eroded	C	52.2	27.5%
FwF	Friant fine sandy loam, 30 to 50 percent slopes	D	34.3	18.1%
FxG	Friant rocky fine sandy loam, 30 to 70 percent slopes	D	56.2	29.6%
RaC	Ramona sandy loam, 5 to 9 percent slopes	C	0.6	0.3%
RaD2	Ramona sandy loam, 9 to 15 percent slopes, eroded	C	7.2	3.8%
VaB	Visalia sandy loam, 2 to 5 percent slopes	A	15.1	8.0%
VsD	Vista coarse sandy loam, 9 to 15 percent slopes	B	0.4	0.2%
VsE	Vista coarse sandy loam, 15 to 30 percent slopes	B	4.6	2.4%
VsG	Vista coarse sandy loam, 30 to 65 percent slopes	B	0.0	0.0%
Totals for Area of Interest			**190.1**	**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

Categorization of Infiltration Feasibility Condition — Worksheet C.4-1

Part 1 - Full Infiltration Feasibility Screening Criteria

Would infiltration of the full design volume be feasible from a physical perspective without any undesirable consequences that cannot be reasonably mitigated?

Criteria	Screening Question	Yes	No
1	**Is the estimated reliable infiltration rate below proposed facility locations greater than 0.5 inches per hour?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.		X

Provide basis:

We performed 2 Aardvark Permeameter tests at the site within the weathered portion of the Julian Schist. The following presents the results of our field infiltration tests:

P-1 at 3.5 feet: 0.05 inches/hour (0.03 inches/hour with FOS=2)
P-2 at 4.0 feet: 0.02 inches/hour (0.01 inches/hour with FOS=2)

These tests result in an average of 0.02 inches/hour. The measured rates are less than 0.5 inches per hour and full infiltration is not considered feasible.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.

2	**Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.		X

Provide basis:

We expect compacted fill and Julian Schist will underlie the proposed basins. These materials possess unpredictable vertical and lateral infiltration characteristics. Lateral water migration would cause instability to adjacent slopes, right of ways, and the utilities and fill underlying the right of ways. Water would migrate into the compacted fill associated with the right of way and could cause settlement and distress to roadway pavements and underlying utilities. In addition, if infiltration is allowed, water migration and the resulting seepage forces can negatively affect the stability of the proposed fill slope to the northwest of Biofiltration Basin BF-2 and cause daylight seepage, erosion and surficial slope instability. Therefore, full and partial infiltration should be considered infeasible.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.

Worksheet C.4-1 Page 2 of 4			
Criteria	Screening Question	**Yes**	**No**
X	**Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of groundwater contamination (shallow water table, storm water pollutants or other factors) that cannot be mitigated to an acceptable level?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	X	
Provide basis: We expect groundwater is at least 50 feet from the existing elevations. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
4	**Can infiltration greater than 0.5 inches per hour be allowed without causing potential water balance issues such as change of seasonality of ephemeral streams or increased discharge of contaminated groundwater to surface waters?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	X	
Provide basis: We do not expect infiltration will cause water balance issues such as seasonality of ephemeral streams or increased discharge of contaminated groundwater to surface waters. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
Part 1 Result*	If all answers to rows 1 - 4 are "**Yes**" a full infiltration design is potentially feasible. The feasibility screening category is **Full Infiltration** If any answer from row 1-4 is "**No**", infiltration may be possible to some extent but would not generally be feasible or desirable to achieve a "full infiltration" design. Proceed to Part 2		No Full Infiltration

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City to substantiate findings.

Worksheet C.4-1 Page 3 of 4

Part 2 – Partial Infiltration vs. No Infiltration Feasibility Screening Criteria
Would infiltration of water in any appreciable amount be physically feasible without any negative consequences that cannot be reasonably mitigated?

Criteria	Screening Question	Yes	No
5	**Do soil and geologic conditions allow for infiltration in any appreciable rate or volume?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.	X	

Provide basis:
We performed 2 Aardvark Permeameter tests at the site within the weathered portion of the Julian Schist. The following presents the results of our field infiltration tests:

P-1 at 3.5 feet: 0.05 inches/hour (0.03 inches/hour with FOS=2)
P-2 at 4.0 feet: 0.02 inches/hour (0.01 inches/hour with FOS=2)

These tests result in an average of 0.02 inches/hour.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.

6	**Can Infiltration in any appreciable quantity be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level**? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.		X

Provide basis:

We expect compacted fill and Julian Schist will underlie the proposed basins. These materials possess unpredictable vertical and lateral infiltration characteristics. Lateral water migration would cause instability to adjacent slopes, right of ways, and the utilities and fill underlying the right of ways. Water would migrate into the compacted fill associated with the right of way and could cause settlement and distress to roadway pavements and underlying utilities. In addition, if infiltration is allowed, water migration and the resulting seepage forces can negatively affect the stability of the proposed fill slope to the northwest of Biofiltration Basin BF-2 and cause daylight seepage, erosion and surficial slope instability. Therefore, full and partial infiltration should be considered infeasible.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.

Worksheet C.4-1 Page 4 of 4			
Criteria	Screening Question	**Yes**	**No**
7	**Can Infiltration in any appreciable quantity be allowed without posing significant risk for groundwater related concerns (shallow water table, storm water pollutants or other factors)?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	X	
Provide basis: We expect groundwater is at least 50 feet from the existing elevations. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.			
8	**Can infiltration be allowed without violating downstream water rights**? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	X	
Provide basis: We did not provide a study regarding water rights. However, these rights are not typical in the San Diego County area. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.			
Part 2 Result*	If all answers from row 1-4 are yes then partial infiltration design is potentially feasible. The feasibility screening category is **Partial Infiltration.** If any answer from row 5-8 is no, then infiltration of any volume is considered to be **infeasible** within the drainage area. The feasibility screening category is **No Infiltration.**		No Infiltration

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City to substantiate findings.

ATTACHMENT 9

Summary Files from the SWMM Model

PRE_DEV

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.022)

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
****

****
Analysis Options
****
Flow Units ..... CFS
Process Models:
  Rainfall/Runoff ..... YES
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... NO
  Water Quality ..... NO
Infiltration Method ..... GREEN_AMPT
Starting Date AUG-09-1963 00:00:00
Ending Date AUG-08-2008 23:00:00
Antecedent Dry Days 0.0
Report Time Step 01:00:00
Wet Time Step 00:15:00
Dry Time Step 04:00:00

Runoff Quantity Continuity	Volume acre-feet	Depth inches
Total Precipitation	1766.916	595.640
Evaporation Loss	36.290	12.234
Infiltration Loss	1569.076	528.947
Surface Runoff	177.978	59.998
Final Surface Storage	0.000	0.000
Continuity Error (%)	-0.930	

Flow Routing Continuity	Volume acre-feet	Volume 10^6 gal
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	177.978	57.997
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	177.978	57.997
Internal Outflow	0.000	0.000
Storage Losses	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	0.000	

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip in	Total Runon in	Total Evap in	Total Infil in	Total Runoff in	Total Runoff 10^6 gal	Peak Runoff CFS	Runoff Coeff
DMA-1-C	595.64	0.00	5.74	559.83	32.61	15.97	17.20	0.055
DMA-2-C	595.64	0.00	5.67	559.12	33.66	0.97	1.01	0.057
DMA-2-D	595.64	0.00	24.80	468.58	113.85	10.70	3.56	0.191
DMA-3-C	595.64	0.00	5.70	559.31	33.38	3.30	3.47	0.056
DMA-3-D	595.64	0.00	24.83	468.92	113.28	7.76	2.60	0.190

DMA-4-C	595.64	0.00	5.72	559.64	32.89	0.68	0.72	0.055
DMA-4-D	595.64	0.00	24.90	469.74	112.03	18.62	6.30	0.188

Analysis begun on: Tue Apr 10 13:21:01 2018
Analysis ended on: Tue Apr 10 13:21:14 2018
Total elapsed time: 00:00:13

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.022)
--------------------------------------------------------------


***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Infiltration Method ...... GREEN_AMPT
Flow Routing Method ...... KINWAVE
Starting Date ............ AUG-09-1963 00:00:00
Ending Date .............. AUG-08-2008 23:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Wet Time Step ............ 00:15:00
Dry Time Step ............ 00:30:00
Routing Time Step ........ 60.00 sec


WARNING 04: minimum elevation drop used for Conduit BYPASS-2

WARNING 04: minimum elevation drop used for Conduit U-DRAIN-2

WARNING 04: minimum elevation drop used for Conduit BYPASS-3

WARNING 04: minimum elevation drop used for Conduit BYPASS-1

WARNING 04: minimum elevation drop used for Conduit U-DRAIN-1

WARNING 04: minimum elevation drop used for Conduit U-DRAIN-3

WARNING 04: minimum elevation drop used for Conduit BYPASS-4

WARNING 04: minimum elevation drop used for Conduit DRAIN-1

WARNING 04: minimum elevation drop used for Conduit BYPASS-5

WARNING 04: minimum elevation drop used for Conduit DRAIN-5

*************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
*************************     ---------       -------
Total Precipitation ......      1766.889       595.640
Evaporation Loss .........       111.915        37.728
Infiltration Loss ........      1265.022       426.454
Surface Runoff ...........       402.164       135.575
Final Surface Storage ....         0.000         0.000
Continuity Error (%) .....        -0.691


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......       402.164       131.051
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
```

```
  External Inflow .........         0.000         0.000
  External Outflow .........      401.058       130.691
  Internal Outflow .........         0.000         0.000
  Storage Losses ...........         1.094         0.356
  Initial Stored Volume ....         0.000         0.000
  Final Stored Volume ......         0.000         0.000
  Continuity Error (%) .....         0.003


  ******************************
  Highest Flow Instability Indexes
  ******************************
  All links are stable.


  ************************
  Routing Time Step Summary
  ************************
  Minimum Time Step           :    60.00 sec
  Average Time Step           :    60.00 sec
  Maximum Time Step           :    60.00 sec
  Percent in Steady State     :     0.00
  Average Iterations per Step :     1.00


  ***************************
  Subcatchment Runoff Summary
  ***************************

  ---------------------------------------------------------------------------------------------------
--
                          Total      Total      Total      Total      Total       Total     Peak
Runoff
                         Precip      Runon       Evap      Infil     Runoff      Runoff   Runoff
Coeff
  Subcatchment               in         in         in         in         in    10^6 gal      CFS
  ---------------------------------------------------------------------------------------------------
--
  DMA-1-C                595.64       0.00      48.63     322.49     229.38       67.74    10.98
0.385
  DMA-1-D                595.64       0.00      24.12     439.22     137.84        0.22     0.06
0.231
  DMA-2-C                595.64       0.00      51.82     311.73     236.08       16.52     2.61
0.396
  DMA-2-D                595.64       0.00      23.86     437.64     142.06        0.03     0.01
0.238
  DMA-3-C                595.64       0.00      51.73     304.88     244.32        3.28     0.50
0.410
  DMA-4-C                595.64       0.00       4.86     559.65      32.80        0.56     0.60
0.055
  DMA-4-D                595.64       0.00      20.05     467.51     111.62       18.19     6.18
0.187
  BR-1                   595.64    9171.67     961.96       0.00    8830.53       65.43    11.32
0.904
  BR-2                   595.64    6441.53     920.33       0.00    6131.93       15.75     2.70
0.871
  BR-3                   595.64   11463.29     988.96       0.00   11107.31        3.18     0.51
0.921
  ON-BY-1-C              595.64       0.00       6.80     540.99      53.19        0.32     0.22
0.089
  ON-BY-2-C              595.64       0.00       6.82     541.26      52.68        0.57     0.39
0.088
  ON-BY-3-C              595.64       0.00       6.85     541.80      51.50        1.48     1.03
0.086
  ON-BY-4-C              595.64       0.00       6.83     541.42      52.31        0.15     0.10
0.088
  ON-BY-4-D              595.64       0.00      23.80     437.27     143.38        2.88     0.76
0.241
  ON-BY-5-C              595.64       0.00       6.83     541.43      52.33        0.79     0.54
0.088
```

```
  ON-BY-5-D                595.64       0.00      23.78     437.12     144.05        0.45     0.12
0.242
  ON-BY-6-C                595.64       0.00       6.82     541.41      52.38        0.01     0.01
0.088
  ON-BY-6-D                595.64       0.00      23.89     437.79     141.50        0.09     0.03
0.238
  ON-BY-7-C                595.64       0.00       6.81     541.22      52.76        0.37     0.25
0.089
  7-C-SELF-TR              595.64       0.00       6.80     541.00      53.18        0.14     0.10
0.089
  OFF-1-C                  595.64       1.19       4.90     560.06      33.50        4.08     4.38
0.056
  OFF-2-C                  595.64       0.00      19.93     466.67     113.02        8.20     2.75
0.190
  OFF-3-C                  595.64       0.00       4.88     559.85      32.51        1.26     1.36
0.055
  OFF-3-D                  595.64       0.00      20.09     467.79     111.22        7.28     2.48
0.187


  **********************
  LID Performance Summary
  **********************

  ------------------------------------------------------------------------------------------------------
------------
                                        Total      Evap     Infil   Surface    Drain      Init.
Final     Pcnt.
                                      Inflow      Loss      Loss   Outflow   Outflow   Storage
Storage     Error
  Subcatchment      LID Control            in        in        in        in        in        in
in
  ------------------------------------------------------------------------------------------------------
------------
  BR-1              BR-1             9767.31    962.00      0.00   1215.69   7615.24      0.00
0.00     -0.26
  BR-2              BR-2             7037.17    920.31      0.00    587.03   5544.80      0.00
0.00     -0.21
  BR-3              BR-3            12058.93    989.34      0.00   1958.01   9153.53      0.00
0.00     -0.35

  ******************
  Node Depth Summary
  ******************

  ---------------------------------------------------------------------
                               Average  Maximum  Maximum  Time of Max
                                 Depth    Depth      HGL   Occurrence
  Node                 Type       Feet     Feet     Feet  days hr:min
  ---------------------------------------------------------------------
  POC-2                OUTFALL    0.00     0.00     0.00     0  00:00
  POC-1                OUTFALL    0.00     0.00     0.00     0  00:00
  POC-3                OUTFALL    0.00     0.00     0.00     0  00:00
  POC-4                OUTFALL    0.00     0.00     0.00     0  00:00
  DIV-1                DIVIDER    0.00     0.00     0.00     0  00:00
  DIV-2                DIVIDER    0.00     0.00     0.00     0  00:00
  DIV-3                DIVIDER    0.00     0.00     0.00     0  00:00
  DIV-4                DIVIDER    0.00     0.00     0.00     0  00:00
  DIV-5                DIVIDER    0.00     0.00     0.00     0  00:00
  BASIN-1              STORAGE    0.00     2.42     2.42  6039  20:19
  BASIN-2              STORAGE    0.00     1.02     1.02  6039  20:13
  BASIN-3              STORAGE    0.00     1.32     1.32  6039  20:01


  ********************
  Node Inflow Summary
  ********************

  -------------------------------------------------------------------------------
                                Maximum  Maximum                  Lateral       Total
                                Lateral    Total  Time of Max      Inflow      Inflow
```

Node	Type	Inflow CFS	Inflow CFS	Occurrence days hr:min	Volume 10^6 gal	Volume 10^6 gal
POC-2	OUTFALL	3.61	4.94	6039 20:00	11.227	19.516
POC-1	OUTFALL	6.27	14.37	6039 20:00	6.817	75.112
POC-3	OUTFALL	4.50	5.80	6039 20:00	9.771	17.193
POC-4	OUTFALL	6.81	6.81	6039 20:00	18.861	18.861
DIV-1	DIVIDER	11.32	11.32	6039 20:00	65.433	65.433
DIV-2	DIVIDER	2.70	2.70	6039 20:00	15.751	15.751
DIV-3	DIVIDER	0.51	0.51	6039 20:00	3.182	3.182
DIV-4	DIVIDER	0.00	0.05	836 22:14	0.000	14.245
DIV-5	DIVIDER	0.00	2.64	6039 20:13	0.000	1.466
BASIN-1	STORAGE	0.00	11.17	6039 20:00	0.000	9.444
BASIN-2	STORAGE	0.00	2.65	6039 20:00	0.000	1.506
BASIN-3	STORAGE	0.00	0.50	6039 20:00	0.000	0.559

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
DIV-1	DIVIDER	394487.02	0.000	0.000
DIV-2	DIVIDER	394487.02	0.000	0.000
DIV-3	DIVIDER	394487.02	0.000	0.000
DIV-4	DIVIDER	394487.02	0.000	0.000
DIV-5	DIVIDER	394487.02	0.000	0.000
BASIN-1	STORAGE	394487.02	2.422	0.828
BASIN-2	STORAGE	394487.02	1.020	0.730
BASIN-3	STORAGE	394487.02	1.320	0.430

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	E&I Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
BASIN-1	0.051	0	3	32.867	71	6039 20:18	10.32
BASIN-2	0.008	0	3	5.296	50	6039 20:12	2.64
BASIN-3	0.001	0	1	0.874	68	6039 20:01	0.50

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
POC-2	5.43	0.03	4.94	19.516
POC-1	6.21	0.11	14.37	75.112
POC-3	5.34	0.03	5.80	17.193
POC-4	0.40	0.45	6.81	18.861

System	4.34	0.62	31.92	130.681

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
BYPASS-2	DUMMY	2.65	6039	20:00			
U-DRAIN-2	DUMMY	0.05	836	22:14			
BYPASS-3	DUMMY	0.50	6039	20:00			
BYPASS-1	DUMMY	11.17	6039	20:00			
U-DRAIN-1	DUMMY	0.15	6039	19:27			
U-DRAIN-3	DUMMY	0.01	836	22:18			
BYPASS-4	DUMMY	0.02	836	22:14			
DRAIN-1	DUMMY	0.02	836	22:14			
BYPASS-5	DUMMY	1.34	6039	20:13			
DRAIN-5	DUMMY	1.30	6039	20:13			
OUTLET-1	DUMMY	10.32	6039	20:19			
OUTLET-2	DUMMY	2.64	6039	20:13			
OUTLET-3	DUMMY	0.50	6039	20:01			

****
Conduit Surcharge Summary
****

Conduit	Hours Full --- Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
BYPASS-2	0.01	0.01	0.01	394487.02	0.01
U-DRAIN-2	0.01	0.01	0.01	394487.02	0.01
BYPASS-3	0.01	0.01	0.01	394487.02	0.01
BYPASS-1	0.01	0.01	0.01	394487.02	0.01
U-DRAIN-1	0.01	0.01	0.01	394487.02	0.01
U-DRAIN-3	0.01	0.01	0.01	394487.02	0.01
BYPASS-4	0.01	0.01	0.01	394487.02	0.01
DRAIN-1	0.01	0.01	0.01	394487.02	0.01
BYPASS-5	0.01	0.01	0.01	394487.02	0.01
DRAIN-5	0.01	0.01	0.01	394487.02	0.01

Analysis begun on: Tue Apr 10 13:25:13 2018
Analysis ended on: Tue Apr 10 13:26:12 2018
Total elapsed time: 00:00:59

OFFSITE STREET: USE OF STREET TREES

The street trees that will be used to treat runoff from the offsite street to the east and DMA 4 of the project site will be used to meet both water quality and hydromodification purposes. The San Diego BMP Sizing Calculator Methodology for Non Structural BMP Sizing Methodology has been used to meet hydromodification requirements for this roadway. A multiplier which depends on the depth of amended soil and hydrologic soil type has been applied to the DCV, therefore Flow Control and Pollutant Control Criteria are met. Please refer to "Sizing Site Design BMPs to meet Flow Control Requirements" by Stuart Kuhn, located in Attachment 2.

In order for the proposed tree wells for DMA-5 will be used to meet both Water Quality and Hydromodification requirements. A safety factor of 3.33 has been applied to the DCV in order to comply with hydromodification. The total DCV treated for hydromodification and the summary of proposed trees are shown in the tables below. Please note that a combination of tree well sizes has been used for efficiency.

DMA	DCV (cu-ft)	Multiplier for HMP	Total DCV (cu-ft)
OFF-STREET-1	588	3.33	1958
OFF-STREET-2	113	3.33	376

DMA	DCV (CU-FT)	S.F. FOR HMP	TOTAL DCV (CU-FT)	5-FT TREES		10-FT TREES		15-FT TREES		20-FT TREES		25-FT TREES		30-FT TREES		TOTAL TCV (CU-FT)	DVC-TCV	ENOUGH CAPACITY	SUMMARY OF TREES
				TCV	# TREES	TCV	# TREES	TCV	# TREES	TCV	# TREES	TCV	# TREES	TCV	# TREES				
OFF-STREET-1	588	3.33	1958	10	0	40	0	100	0	180	0	290	1	420	4	1970	-11.96	YES	1-25' & 4-30' CANOPY TREES
OFF-STREET-2	113	3.33	376	10	0	40	0	100	0	180	0	290	0	420	1	420	-43.71	YES	1-30' CANOPY TREE

The dimension of the proposed structural soil for the trees are shown in the next table:

DMA	TREE NUMBER	TREE CANOPY DIAMETER (FT)	PROPOSED STRUCTURAL SOIL PER TREE WELL								
			REQUIRED VOLUME (CU-FT)	PROPOSED DEPTH (IN)	AREA (SQ-FT)	PROPOSED DIAMETER (FT)	VOLUME PROVIDED (CU-FT)	1.5 X CANOPY RADIUS (FT)	DIAMETER OF SOIL < 1.5 RADIUS OF CANOPY?	2 X CANOPY AREA (SQ-FT)	VOLUME > 2X CANOPY AREA?
OFF-STREET-1	1-1	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-2	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-3	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-4	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-5	25	981.8	45.0	261.8	18.3	986	18.75	YES	982	YES
OFF-STREET-2	2-1	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES

DRAFT

DCV Multipliers by Tree Well Structural Soil Depth and Underlying Hydrologic Soil Group; Applies to sites subject to Pollutant Control AND Hydromodification Management Performance Requirements (Effective May 17, 2017)

Tree Well Structural Soil Depth[1,2] (inches)	Hydrologic Soil Group			
	A	B	C	D (Default)
	DCV Multiplier			
30"	1.60	2.20	2.50	**2.90**
31"	1.63	2.24	2.56	**2.94**
32"	1.67	2.29	2.61	**2.99**
33"	1.70	2.33	2.67	**3.03**
34"	1.73	2.38	2.72	**3.08**
35"	1.77	2.42	2.78	**3.12**
36"	1.80	2.47	2.83	**3.17**
37"	1.83	2.51	2.89	**3.21**
38"	1.87	2.56	2.94	**3.26**
39"	1.90	2.60	3.00	**3.30**
40"	1.93	2.64	3.06	**3.34**
41"	1.97	2.69	3.11	**3.39**
42"	2.00	2.73	3.17	**3.43**
43"	2.03	2.78	3.22	**3.48**
44"	2.07	2.82	3.28	**3.52**
45"	2.10	2.87	3.33	**3.57**
46"	2.13	2.91	3.39	**3.61**
47"	2.17	2.96	3.44	**3.66**
48"	2.20	3.00	3.50	**3.70**
<30" OR >48"	Determination based on applicant-submitted modeling results			

[1] In cases where the Tree Well design requires a perforated pipe, the tree well credit volume is calculated using the depth of the structural soil below the pipe.

[2] In cases where the Tree Well design requires structural soil over a sand filter, the thickness of the sand filter is not included in the structural soil depth. Sand filters must be at least 6" deep and placed over uncompacted subgrade.

B.2.1.3 Permeable Pavement

When a permeable pavement is implemented in accordance with the SD-6B factsheet and it does not have an impermeable liner and has storage greater than the 85th percentile depth below the underdrain, if an underdrain is present, then the footprint of the permeable pavement shall be assigned a runoff factor of 0.10 for adjusted runoff factor calculations.

Permeable Pavement can also be designed as a structural BMP to treat run on from adjacent areas. Refer to INF-3 factsheet and Appendix B.4 for additional guidance.

B.2.2 Adjustment to DCV

When the following site design BMPs are implemented the anticipated volume reduction from these BMPs shall be deducted from the DCV to estimate the volume for which the downstream structural BMP should be sized for:

- SD-1: Street trees
- SD-8: Rain barrels

B.2.2.1 Street Trees

Street tree credit volume from tree trenches or boxes (tree BMPs) is a sum of three runoff reduction volumes provided by trees that decrease the required DCV for a tributary area. The following reduction in DCV is allowed per tree based on the mature diameter of the tree canopy, when trees are implemented in accordance with SD-1 factsheet:

Mature Tree Canopy Diameter (ft)	Tree Credit Volume (ft^3/tree)
5	10
10	40
15	100
20	180
25	290
30	420

Sizing Site Design BMPs to meet Flow Control Requirements

A Guidance for Meeting Flow Control Requirements on PDP Projects without implementing Structural BMPs

September 22, 2016

Stuart Kuhn, P.E.

2016 BMP Design Manual
5.3 DCV Reduction through Site Design BMP's

- Methods presented in Appendix B.2
- Based on meeting **pollutant control** obligation (85th Percentile Event, DCV)

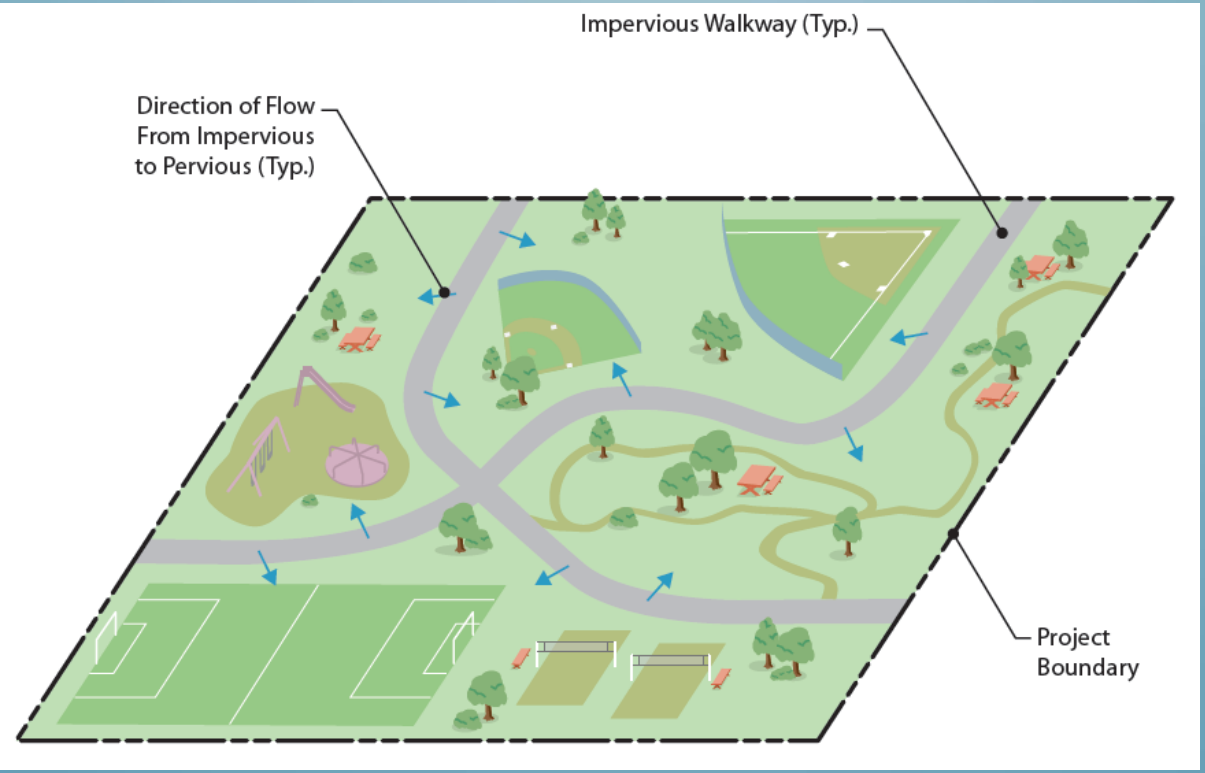
- Site Design BMPs in Appendix E
  - SD-A Tree Wells
  - SD-B Impervious Area Dispersion
  - SD-C Green Roof
  - SD-D Permeable Pavement
  - SD-F Rain Barrels



(Source: http://mtlebanon.org/2037/Rain-Garden)

2016 BMP Design Manual
5.2.3 Self-retaining DMA

- If you reduce DCV to Zero the DMA is Self-Retaining and is compliant with pollutant control BMP Sizing Requirements.
- Site design BMPs are applicable to treatment control only and do not apply to HMP requirements.
- Must do a hydromodification (**flow control**) analysis for the DMA.



Its Been Done Before!

- San Diego BMP Sizing Calculator Methodology: **Non-Structural BMP Sizing Methodology**
  - Modeling analysis confirmed Self Retaining areas meet flow duration requirements for Group D soils at 1:1 ratio of impervious to pervious area with 3" ponding depth.(Retains 1.5" direct rainfall)
  - In many cases in San Diego the Flow Control Devices are about *Twice* as big as the Pollutant Control Devices.
- Thus, if we capture twice the volume of the DCV we meet **Flow Control** Requirements.
  - Self-retaining areas meeting **flow control** also satisfy the **pollutant control** criteria.

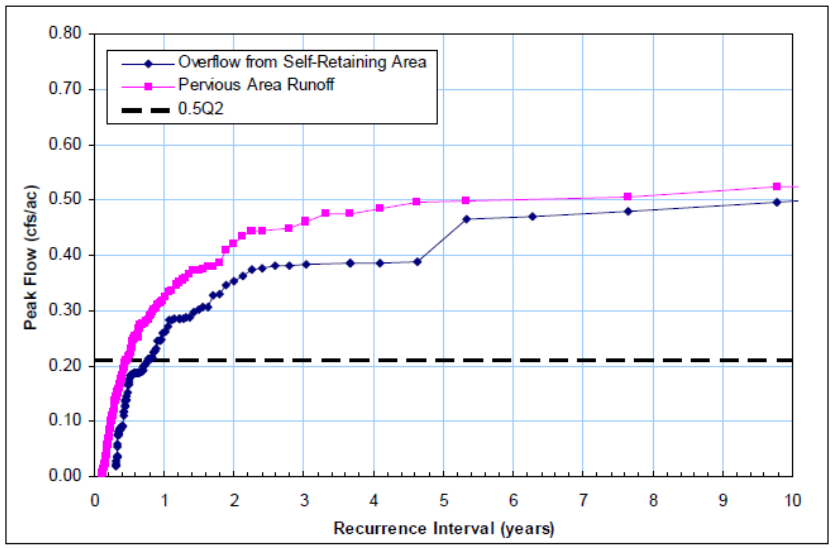


Figure 3-1. GROUP D SOILS: Peak Flows Frequency Statistics for Pre-Project and Self-Retaining Area Simulations with 1:1 Ratio of Upstream Connected Impervious Area

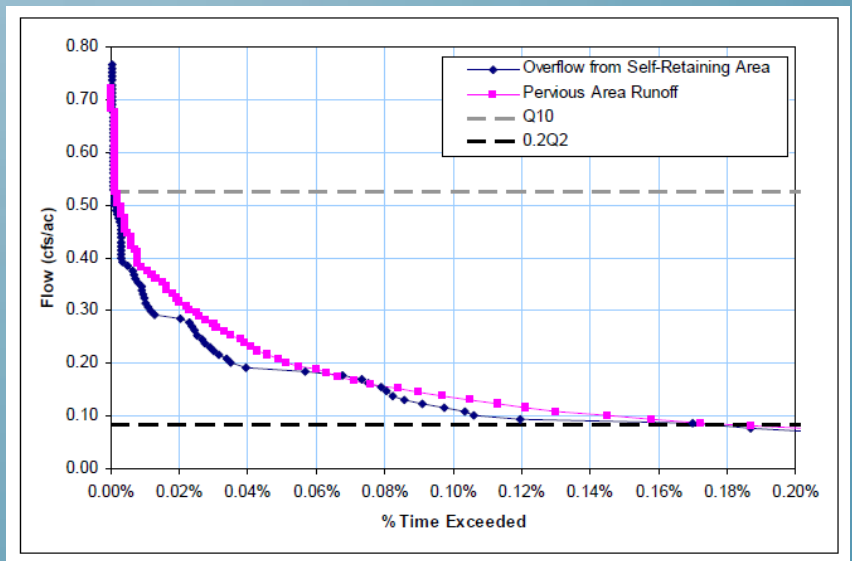


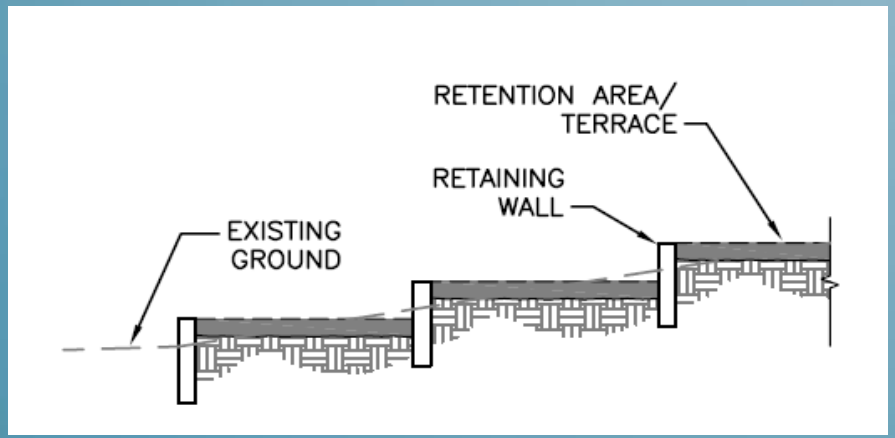
Figure 3-2. GROUP D SOILS: Comparison of Flow Duration Statistics for Pre-Project and Self-Retaining Area Simulations with 1:1 Ratio of Upstream Connected Impervious Area

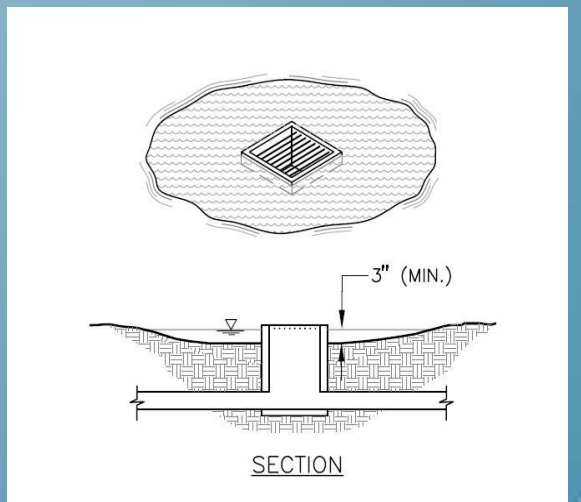
Step by Step Implementation

1. Minimize impervious surfaces
2. Utilize self-mitigating area
3. Drain Impervious areas to self-retaining areas
4. Design self-retaining areas to retain **2** x DCV(1.0 to 2.0 inches) to meet **Flow Control** requirements.
5. Limitations to this methodology:
   - Diversion of flow is not allowed.
   - Maximum 96-hour drawdown time.

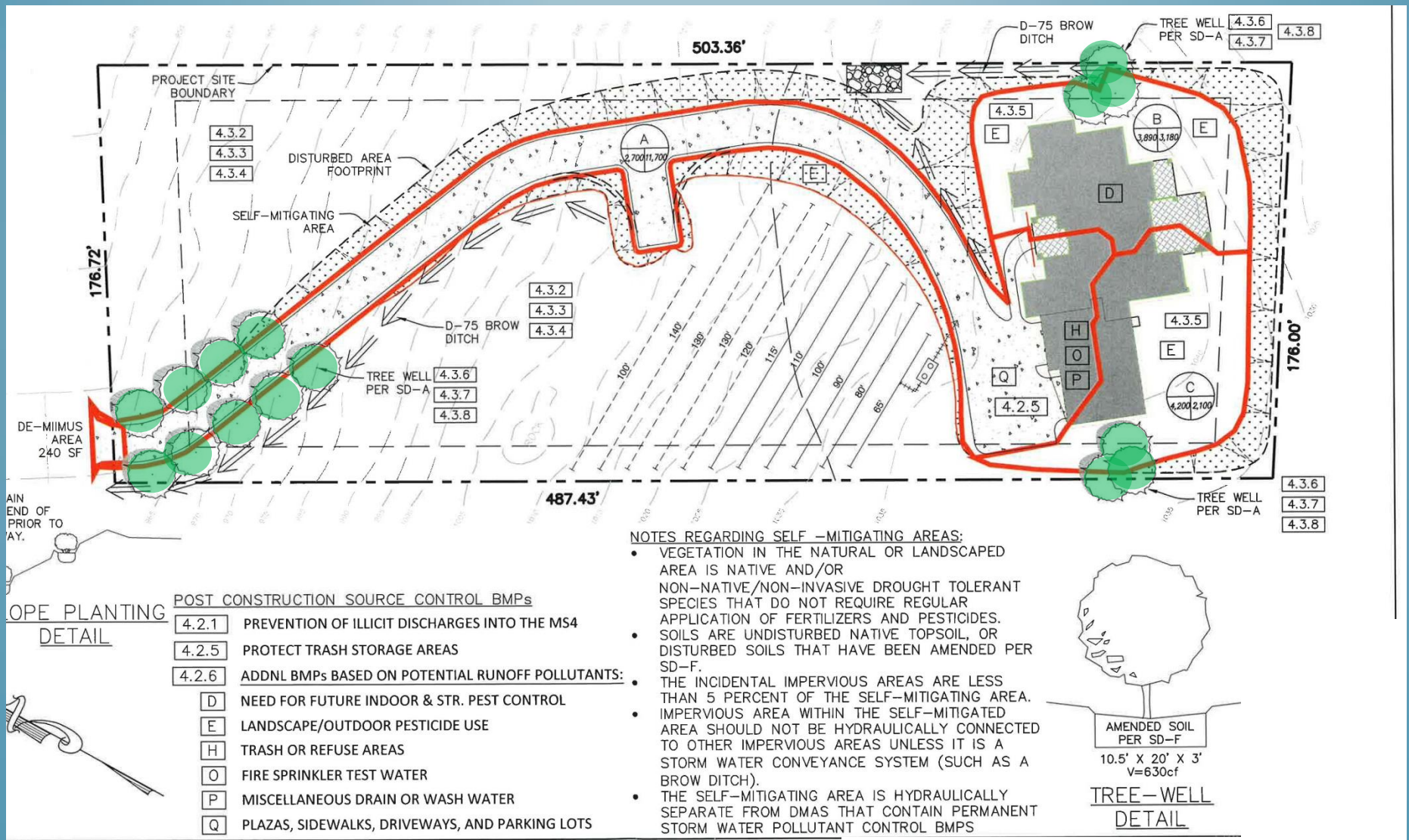
Projects designed with all proposed areas meeting the above criteria have been determined to meet storm water obligations and do not require Structural BMPs.

- Include a narrative in your PDP SWQMP explaining how your project follows this guidance.

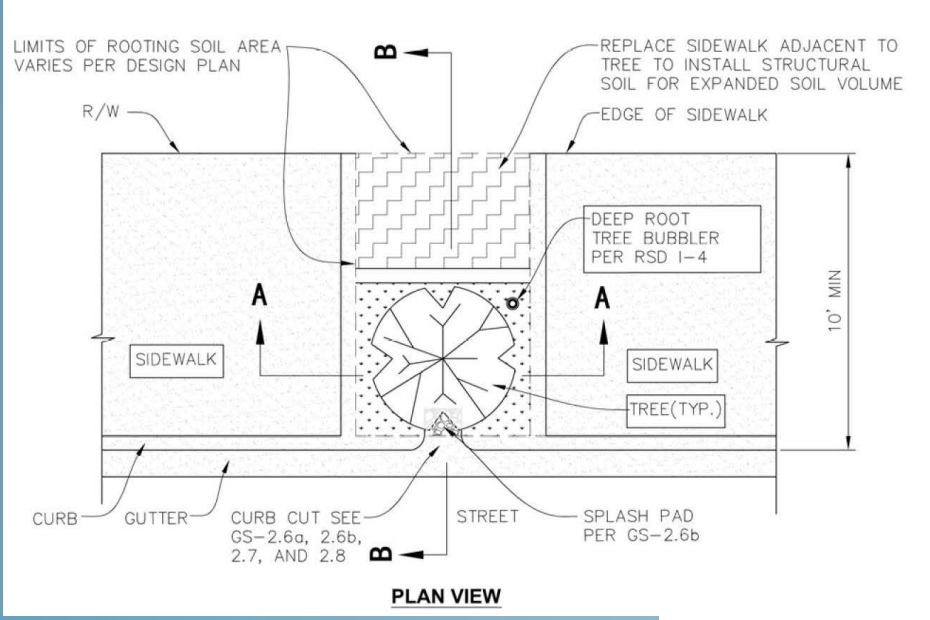


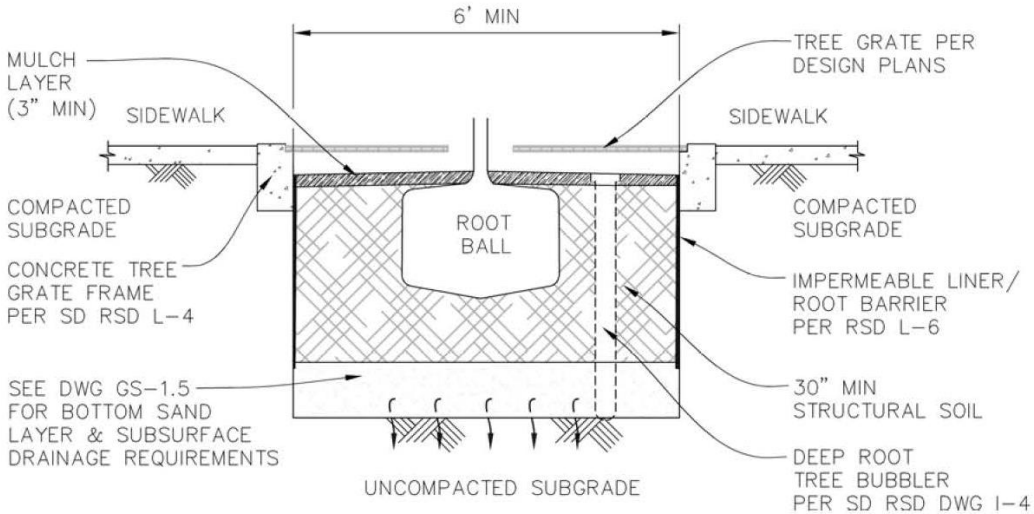


Example Project:
Residential DMA Exhibit



Example Project:
Residential Tree Well (Site Design SD-A)





DCV Calculations for Pollutant Control and Flow Control (w/ tree wells)

85th percentile 24-hr storm depth = 0.75"
2x.75=1.5"

Automated Worksheet B.1-1: Calculation of Design Capture Volume (V1.2)

Category	#	Description	*i*	*ii*	*iii*	Units
Standard Drainage Basin Inputs	0	Drainage Basin ID or Name	A	B	C	unitless
	1	Basin Drains to the Following BMP Type	n/a	n/a	n/a	unitless
	2	85th Percentile 24-hr Storm Depth	1.50	1.50	1.50	inches
	3	Design Infiltration Rate Recommended by Geotechnical Engineer	0.024	0.024	0.024	in/hr
	4	Impervious Surfaces Not Directed to Dispersion Area (C=0.90)	11,700	3,180	2,100	sq-ft
	5	Semi-Pervious Surfaces Not Serving as Dispersion Area (C=0.30)				sq-ft
	6	Engineered Pervious Surfaces Not Serving as Dispersion Area (C=0.10)	2,700	3,890	4,200	sq-ft
	7	Natural Type A Soil Not Serving as Dispersion Area (C=0.10)				sq-ft
	8	Natural Type B Soil Not Serving as Dispersion Area (C=0.14)				sq-ft
	9	Natural Type C Soil Not Serving as Dispersion Area (C=0.23)				sq-ft
	10	Natural Type D Soil Not Serving as Dispersion Area (C=0.30)				sq-ft
Dispersion Area, Tree Well & Rain Barrel Inputs (Optional)	11	Does Tributary Incorporate Dispersion, Tree Wells, and/or Rain Barrels?	Yes	Yes	Yes	yes/no
	12	Impervious Surfaces **Directed to Dispersion Area** per SD-B (Ci=0.90)				sq-ft
	13	Semi-Pervious Surfaces **Serving as Dispersion Area** per SD-B (Ci=0.30)				sq-ft
	14	Engineered Pervious Surfaces **Serving as Dispersion Area** per SD-B (Ci=0.10)				sq-ft
	15	Natural Type A Soil **Serving as Dispersion Area** per SD-B (Ci=0.10)				sq-ft
	16	Natural Type B Soil **Serving as Dispersion Area** per SD-B (Ci=0.14)				sq-ft
	17	Natural Type C Soil **Serving as Dispersion Area** per SD-B (Ci=0.23)				sq-ft
	18	Natural Type D Soil **Serving as Dispersion Area** per SD-B (Ci=0.30)				sq-ft
	19	Number of Tree Wells Proposed per SD-A	8	3	2	#
	20	Average Mature Tree Canopy Diameter	20	20	20	ft
	21	Number of Rain Barrels Proposed per SD-E				#
	22	Average Rain Barrel Size				gal
Treatment Train Inputs & Calculations	23	Does BMP Overflow to Stormwater Features in Downstream Drainage?	No	No	No	unitless
	24	Identify Downstream Drainage Basin Providing Treatment in Series				unitless
	25	Percent of Upstream Flows Directed to Downstream Dispersion Areas				percent
	26	Upstream Impervious Surfaces Directed to Dispersion Area (Ci=0.90)	0	0	0	cubic-feet
	27	Upstream Impervious Surfaces Not Directed to Dispersion Area (C=0.90)	0	0	0	cubic-feet
Initial Runoff Factor Calculation	28	Total Tributary Area	14,400	7,070	6,300	sq-ft
	29	Initial Runoff Factor for Standard Drainage Areas	0.75	0.46	0.37	unitless
	30	Initial Runoff Factor for Dispersed & Dispersion Areas	0.00	0.00	0.00	unitless
	31	Initial Weighted Runoff Factor	0.75	0.46	0.37	unitless
	32	Initial Design Capture Volume	1,350	407	291	cubic-feet
Dispersion Area Adjustments	33	Total Impervious Area Dispersed to Pervious Surface	0	0	0	sq-ft
	34	Total Pervious Dispersion Area	0	0	0	sq-ft
	35	Ratio of Dispersed Impervious Area to Pervious Dispersion Area	n/a	n/a	n/a	ratio
	36	Adjustment Factor for Dispersed & Dispersion Areas	1.00	1.00	1.00	ratio
	37	Runoff Factor After Dispersion Techniques	0.75	0.46	0.37	unitless
	38	Design Capture Volume After Dispersion Techniques	1,350	407	291	cubic-feet
Tree & Barrel Adjustments	39	Total Tree Well Volume Reduction	1,440	540	360	cubic-feet
	40	Total Rain Barrel Volume Reduction	0	0	0	cubic-feet
Results	41	Final Adjusted Runoff Factor	0.00	0.00	0.00	unitless
	42	Final Effective Tributary Area	0	0	0	sq-ft
	43	Initial Design Capture Volume Retained by Site Design Elements	1,440	540	360	cubic-feet
	44	Final Design Capture Volume Tributary to BMP	0	0	0	cubic-feet

Biofiltration BMP Size for Flow Control

BMP Sizing Spreadsheet V2.0			
Project Name:	test	Hydrologic Unit:	sdf
Project Applicant:	sdf	Rain Gauge:	Oceanside
Jurisdiction:	sdf	Total Project Area:	27,700
Parcel (APN):	sdf	Low Flow Threshold:	0.1Q2
BMP Name:	Test	BMP Type:	Biofiltration w/ Impermeable Liner
BMP Native Soil Type:	D	BMP Infiltration Rate (in/hr):	0.024

Areas Draining to BMP						HMP Sizing Factors			Minimum BMP Size		
DMA Name	Area (sf)	Soil Type	Pre-project Slope	Post Project Surface Type	Runoff Factor (Table G.2-1)[1]	Surface Area	Surface Volume	Subsurface Volume	Surface Area (sf)	Surface Volume (cf)	Subsurface Volume (cf)
A	11,700	D	Moderate	perv	0.9	0.16	0.1333	0.096	1685	1404	1011
A	2,700	D	Moderate	imperv	0.3	0.16	0.1333	0.096	130	108	78
B	3,180	D	Flat	perv	0.9	0.16	0.1333	0.096	458	382	275
B	3,890	D	Flat	imperv	0.3	0.16	0.1333	0.096	187	156	112
C	2,100	D	Flat	perv	0.9	0.16	0.1333	0.096	302	252	181
C	4,200	D	Flat	imperv	0.3	0.16	0.1333	0.096	202	168	121
Total BMP Area	27,770										

Minimum BMP Size	[illegible]	2469	1778
Proposed BMP Size*	3000	2500	1800
[illegible]		18.00	in
Minimum Ponding Depth		9.87	in
Maximum Ponding Depth		11.12	in
Selected Ponding Depth		10.00	in

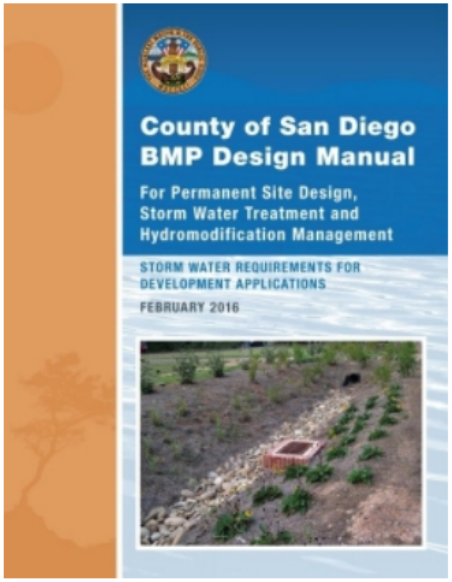
Probable Cost for a Typical SFR Development Biofiltration BMP vs. Self-Retaining Area

BMP Type	Design Cost	Plancheck Review Cost	Construction Cost	Inspection / Verification	Total Cost
Biofiltration BMP	**$25,000**	**$10,000**	**$45,000** ($15/sf.)	**$4,000**	**$84,000**
Self-retaining area	**$5,000**	**$3,000**	**$8,000** ($15/c.y. for soil & $200/tree)	**n/a**	**$16,000**

Note: costs are only inclusive of design and construction . Operation, maintenance, and replacement costs were not considered. Similar savings are anticipated for these costs.

Resources

Best Management Practice Design Manual



The County of San Diego BMP Design Manual (BMP DM) provides guidance for land development and public improvement projects to comply with the 2013 Municipal Separate Storm Sewer System (MS4) Permit (Order No. R9-2013-0001 as amended by R9-2015-0001 and R9-2015-0100). This Manual replaces County of San Diego Standard Urban Stormwater Mitigation Plan (SUSMP). It is focused on project design requirements and related post-construction requirements, not on the construction process itself.

The County's regulatory programs for stormwater are established in County ordinances, principally the **County of San Diego Watershed Protection, Stormwater Management, and Discharge Control Ordinance** (WPO), at County Code sections 67.801 *et seq*. The WPO defines the requirements that are legally enforceable by the County in the unincorporated parts of San Diego County.

BMP Design Manual Chapters Effective February 26 2016

Handouts on Supplemental Guidance (To be included in next Manual update)

BMP Design Manual Appendices (Complete)

- Appendix A: Submittal Templates
  - **A.1 Intake Form**
  - **A.2 Standard SWQMP**
  - **A.3 Priority Development Project (PDP)**

Handouts on Supplemental Guidance

To be included in the next County BMP Design Manual update:

- **Handout #1: Options for Hydromodification Management Plan (HMP) Flow Control Analysis**
- **Handout #2: Manning's "n" Values for Overland Flow Using EPA SWMM V.5**
- **Handout #3: Supplemental Retention Guidance for Non-Standard Biofiltration BMPs**

Documenting Project Compliance in PDP SWQMP:

Discuss Self-Retaining DMA for Flow Control in the following steps:

- Step 3.4 – Description of Proposed Site Drainage
- Step 3.7 – Hydromodification Management Requirement
- Step 6.1 – Description of Structural BMP Strategy

Leave Blank:

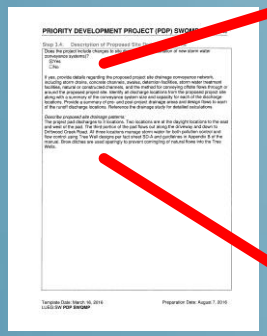
- Step 6.2 – Structural BMP Checklist
- Step 6.3 – Alternative Compliance Participation Form

Attachments:

- Attachment 1 – Applicable: Worksheets B.1-1 and DMA Exhibit (minimum)
- Attachment 2 – **Not** Applicable
- Attachment 3 – **Not** Applicable
- Attachment 4 – **Not** Applicable
- Attachment 5 – Applicable
- Attachment 6 – Applicable
- Attachment 7 – **Not** Applicable

Documenting Project Compliance in PDP SWQMP Example:

- Step 3.4 – Description of Proposed Site Drainage



Step 3.4: Description of Proposed Site Drainage Patterns

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

☒Yes

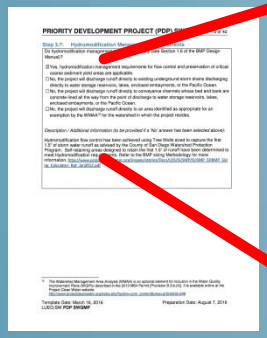
☐No

Describe proposed site drainage patterns:

The project pad discharges to 3 locations. Two locations are at the daylight locations to the east and west of the pad. The third portion of the pad flows out along the driveway and down to Driftwood Creek Road. All three locations manage storm water for both pollution control and flow control using Tree Well designs per fact sheet SD-A and guidleines in Appendix B of the manual. Brow ditches are used sparingly to prevent comingling of natural flows into the Tree Wells.

Documenting Project Compliance in PDP SWQMP Example:

- Step 3.7 – Hydromodification Management Requirement



Step 3.7: Hydromodification Management Requirements

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

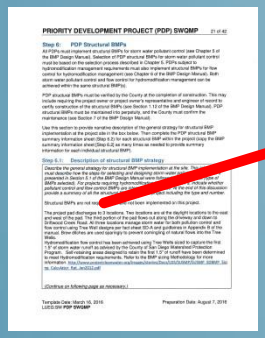
☒Yes, hydromodification management requirements for flow control and preservation of critical coarse sediment yield areas are applicable.

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

Hydromodification flow control has been achieved using Tree Wells sized to capture the first 1.5" of storm water runoff as advised by the County of San Diego Watershed Protection Program. Self-retaining areas designed to retain the first 1.5" of runoff have been determined to meet Hydromodification requirements. Refer to the BMP sizing Methodology for more information. http://www.projectcleanwater.org/images/stories/Docs/LDS/SUSMP/SUSMP_SDBMP_Sizing_Calculator_Rpt_Jan2012.pdf

Documenting Project Compliance in PDP SWQMP Example:

- Step 6.1 – Description of Structural BMP Strategy.



Structural BMPs are not required and have not been implemented on this project.

The project pad discharges to 3 locations. Two locations are at the daylight locations to the east and west of the pad. The third portion of the pad flows out along the driveway and down to Driftwood Creek Road. All three locations manage storm water for both pollution control and flow control using Tree Well designs per fact sheet SD-A and guidleines in Appendix B of the manual. Brow ditches are used sparingly to prevent comingling of natural flows into the Tree Wells.
Hydromodification flow control has been achieved using Tree Wells sized to capture the first 1.5" of storm water runoff as advised by the County of San Diego Watershed Protection Program. Self-retaining areas designed to retain the first 1.5" of runoff have been determined to meet Hydromodification requirements. Refer to the BMP sizing Methodology for more information. http://www.projectcleanwater.org/images/stories/Docs/LDS/SUSMP/SUSMP_SDBMP_Sizing_Calculator_Rpt_Jan2012.pdf

LEGEND

CRITICAL COARSE SEDIMENT YIELD AREAS

PROJECT BOUNDARY



NOT TO SCALE

SHEET 1 OF 1 SHEETS	SHEET TITLE: CRITICAL COASE SEDIMENT YIELD AREAS	DATE: 07.17.19	R·E·C Consultants, Inc.
	PROJECT: GREENHILLS RANCH PHASE 2 COUNTY OF SAN DIEGO, CA	SCALE: NTS DRAWN: GMB CHECKED: JRR	Civil Engineering · Environmental Land Surveying 2442 Second Avenue San Diego, CA 92101 (619)232-9200 (619)232-9210 Fax

ATTACHMENT 3

Structural BMP Maintenance Information

This is the cover sheet for Attachment 3.

Indicate which Items are Included behind this cover sheet:

Attachment Sequence	**Contents**	**Checklist**
Attachment 3a	Structural BMP Maintenance Plan (Required)	☒ Included See Structural BMP Maintenance Information Checklist on the back of this Attachment cover sheet.
Attachment 3b	Draft Stormwater Maintenance Notification / Agreement (when applicable)	☒ Included ☐ Not Applicable

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

Attachment 3a must identify:

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

Attachment 3b: For all Structural BMPs, Attachment 3b must include a draft maintenance agreement in the County's standard format depending on the Category (PDP applicant to contact County staff to obtain the current maintenance agreement forms). Refer to Section 7.3 in the BMP Design Manual for a description of the different categories.

BMPs 1 THROUGH 3: BIOFILTRATION BASIN MAINTENCANCE ACTIVITIES					
ROUTINE ACTION	**MAINTENANCE INDICATOR**	**FIELD MEASUREMENT**	**MEASUREMENT FREQUENCY**	**MAINTENANCE ACTIVITY**	**Frequency (times/yr)**
Vegetation Management	Average vegetation height greater than 12-inches, emergence of trees or woody vegetation	Visual observation and random measurements throughout the side slope area	Monthly and prior to start of wet season, and after wet season	Cut vegetation to an average height of 12 inches, but not less than 6 inches and remove trimmings. Remove any trees, or woody vegetation. (California gray rush is recommended by landscape plans)	12
Poor vegetation establishment	Presence of barren spots	Visual observation of bare spots or areas.	Monthly, especially prior to start of wet season, and after wet season	Re-seed, replant or re-establish vegetation per original plans without the use of chemical applications.	12
Soil Repair	Evidence of erosion in slopes and especially in barren spots	Visual observation	Monthly, especially prior to start of wet season, and after wet season or as needed	Reseed/revegetate barren spots prior to wet season. Fill In holes and/or rills; revegetate as well. Amend soil media. Add mulch to bare soils. Adjust irrigation system.	12
Standing Water	Standing water for more than 96 hours	Visual observation	Quarterly, and 96 hours after each target storm (0.60 in) event	Drain facility. Corrective action prior to wet season, such as adjust irrigation system, remove obstructions of debris and invasive vegetation, loosen top soil. Clear underdrain. Consult engineers if immediate solution is not evident.	4
Trash and Debris	Trash and Debris present	Visual observation	Weekly, especially prior to start of wet season	Remove and dispose of trash and debris	52
Sediment Management	Silt level post. Visual observation of an accumulation of sediment at or near vegetation height,	Measure depth at apparent max. and min. accumulation of sediment with any type measuring device. Calculate avg. depth. Use silt level post as reference to bottom of and sediment height.	Quarterly, especially prior to start of wet season, and at the end of wet season	Remove and properly dispose of accumulated material, without damage to vegetation. Regrade if necessary. (expected every 2 years)	4
Underdrains	Evidence of clogging by ponding water	Visual observation	Twice a year, prior to start of wet season, and after end of wet season	Corrective action prior to wet season. Consult engineers if immediate solution not evident	2
General Maintenance Inspection	Debris in inlet structures, outlet structures, side slopes or other features damaged, significant erosion, burrows, emergence of trees or woody vegetation, graffiti or vandalism, fence damage, structural component damage. etc.	Visual observation	Monthly, especially prior to start of wet season	Clear, clean storm inlets regularly. Repair damaged components. Corrective action prior to wet season. Consult engineers if immediate solution is not evident.	12
Storm Drain Signage	Evidence of deterioration	Visual observation	Twice a year, prior and post wet season	Re-apply stencil if required. Recondition signage if needed	2
Irrigation	N/A	N/A	Approximately every 10 days. Cease activity during storm events and up to 96 hours after each event	I Irrigate vegetation on a regular basis with automated irrigation (sprinkler system).Ponding of water shall be avoided.	Continuous
Reporting	N/A	N/A	Due to City by September 15th of each year	Property owner is required to complete and return annual certification form, verifying performance of all routine maintenance activities of treatment control BMPs on their property. See page 15 of Operation and Maintenance Plan.	1

Maintenance Schedule

Tree Wells			
When	Maintenance Task	Frequency	Time of Year
Initial Maintenance during establishement period (first three years)	Inspect tree for health and establishment and report any changes to County	Three times during establishment; every five years for life of tree	Spring 1st season Fall 1sr season Fall 2nd season
	Remove stakes and wires	One time	One year after planting
	Water tree – first year	25 gallons weekly via slow revise device	April – October
	Water tree – second and third year	25 gallons bi-monthly via slow revise device	April – October
Routine Maintenance	Remove sediment and trash	Quarterly inspection at minimum and maintenance as needed	March – November
	Remove sediment and trash from inlets and slot drains	Annually or as needed	
As – Needed Maintenance	Mulch with 3 inches double ground shredded hardwood mulch. Place mulch in a ring to capture rain water. Mulch shall not be mounded around tree.	Annually or as needed	Feb – April
	Inspect tree for damage, disease, or interference with utilities. Contact County if pruning is required.	Annually or as needed	Broken branches should be pruned at any time. Most trees should be pruned in winter or fall

REQUEST AND INSTRUCTIONS FOR PREPARATION OF STORM WATER FACILITIES MAINTENANCE AGREEMENT

Provide the following information, to enable PDS to prepare the "STORMWATER FACILITIES MAINTENANCE AGREEMENT, WITH EASEMENT AND COVENANTS":

#	Done	Information to be Inserted

[1] ☐ County staff document custodian to receive document after recording will be:

_____ _____

Name of Custodian Mail Stop

[2] ☐ Provide applicable Project **Reference Number(s)**:

Tentative Map:	TM_____
Tentative Parcel Map:	TPM_____
Grading Plan / Grading Permit:	L-_____
Major Use Permit:	MUP_____
Site Plan:	STP_____

[3] ☐ Provide EXACT **name of Owner** [This must be word-for-word, letter-for-letter identical to vesting title information]:

_____

Name of Owner

[4] ☐ Indicate the status of the Owner:

☐ a natural person; or

☐ a business entity.

If the Owner is a business entity, then please indicate what type ("a California Corporation", "a [other state] Corporation", "a California General Partnership", "a California Limited Partnership" or "a California Limited Liability Company"):

_____

Type of Owner's Business Entity

[5] ☐ Create and attach an "Exhibit A", which is an accurate Legal Description of the property involved in the entire project

[6] ☐ Provide brief Description of Type of Project [E.g. "a 100-unit residential subdivision"]:

_____

Project Description

[7] ☐ Provide official name, number and date of plan or drawing which shows the BMPs in detail ["Improvement Plans", "Site Plan", "Grading Plans" etc.]:

_____ _____ _____

Type of Plan Plan Number Plan Date

[8] ☐ Create and attach an "Exhibit B", using the format of Attachment 2 ("BMP MAINTENANCE PROGRAM") as an example.

[9] ☐ Create and attach an "Exhibit C", which shows the locations of the installed BMPs.

[10] Advise us whether the on-site easement to be granted to the County to access and maintain the BMPs, covers:

☐ the entire project property; or

☐ a smaller area

☐ If "a smaller area" is checked, then create and provide an Exhibit C, being a legal description of the access and maintenance area

[11] ☐ If a private off-site easement or right of way is used to access the PROPERTY, please provide the following information about the off-site easement:

_____

Date of Easement

_____

Grantor of Easement

_____

Grantee of Easement

_____
Date Easement Was Recorded

_____
Recording File/Page No. or Document No.

☐ ALSO, please attach a copy of the Easement and a copy of a "plan view" drawing showing the Easement, if available.

[12] Advise us whether the owner will provide as security:

~~☐ a Letter of Credit; or~~ ☐ a Cash Deposit

[13] ☐ Specify the amount of the security:

$_____

[14] ☐ Provide Name and Address of the person who the Owner designates as his/her/its Agent for administration of the Agreement and receipt of notices:

Name: _____

Address: _____

[15] Advise us whether or not the project is a **Common Interest Development**:

☐ No ☐ Yes

[16] ☐ Provide the Name(s) and title(s) of **persons who will sign** agreement for the Owner:

_____
Name

_____
Title

If the Owner (see #3 above) is a natural person, County Counsel will assume that person will sign the agreement, and will so provide in the signature block. If the Owner is a business entity, please indicate the names and titles of all persons who will sign on behalf of the business entity.

A sample signature block for a corporation would look like:

"Clean Water, Inc., a California Corporation

By: _____ _____
John Q. Adams, President Date

By: _____ _____
Adam Q. Johns, Secretary Date"

Include Exhibits that illustrate:

- the Project Site Vicinity;
- the Project Site Map; and
- a map for each BMP and it's Drainage Management Area .

Samples of each of these map types are shown in Figure I.11-1 through Figure I.11-4.

BF-1
Biofiltration

BMP MAINTENANCE FACT SHEET
FOR
STRUCTURAL BMP BF-1 BIOFILTRATION

Biofiltration 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. Biofiltration 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. Typical biofiltration 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 climate and ponding depth
- Non-floating mulch layer
- Media layer (planting mix or engineered media) capable of supporting vegetation growth
- Filter course 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

Normal Expected Maintenance

Biofiltration requires routine maintenance to: remove accumulated materials such as sediment, trash or debris; maintain vegetation health; maintain infiltration capacity of the media layer; replenish mulch; and maintain integrity of side slopes, inlets, energy dissipators, and outlets. A summary table of standard inspection and maintenance indicators is provided within this Fact Sheet.

Non-Standard Maintenance or BMP Failure

If any of the following scenarios are observed, the BMP is not performing as intended to protect downstream waterways from pollution and/or erosion. Corrective maintenance, increased inspection and maintenance, BMP replacement, or a different BMP type will be required.

- The BMP is not drained between storm events. Surface ponding longer than approximately 24 hours following a storm event may be detrimental to vegetation health, and surface ponding longer than approximately 96 hours following a storm event poses a risk of vector (mosquito) breeding. Poor drainage can result from clogging of the media layer, filter course, aggregate storage layer, underdrain, or outlet structure. The specific cause of the drainage issue must be determined and corrected.
- Sediment, trash, or debris accumulation greater than 25% of the surface ponding volume within one month. This means the load from the tributary drainage area is too high, reducing BMP function or clogging the BMP. This would require pretreatment measures within the tributary area draining to the BMP to intercept the materials. Pretreatment components, especially for sediment, will extend the life of components that are more expensive to replace such as media, filter course, and aggregate layers.
- Erosion due to concentrated storm water runoff flow that is not readily corrected by adding erosion control blankets, adding stone at flow entry points, or minor re-grading to restore proper drainage according to the original plan. If the issue is not corrected by restoring the BMP to the original plan and grade, the [City Engineer] shall be contacted prior to any additional repairs or reconstruction.

Other Special Considerations

Biofiltration is a vegetated structural BMP. Vegetated structural BMPs that are constructed in the vicinity of, or connected to, an existing jurisdictional water or wetland could inadvertently result in creation of expanded waters or wetlands. As such, vegetated structural BMPs have the potential to come under the jurisdiction of the United States Army Corps of Engineers, SDRWQCB, California Department of Fish and Wildlife, or the United States Fish and Wildlife Service. This could result in the need for specific resource agency permits and costly mitigation to perform maintenance of the structural BMP. Along with proper placement of a structural BMP, **routine maintenance is key to preventing this scenario**.

BF-1
Biofiltration

SUMMARY OF STANDARD INSPECTION AND MAINTENANCE FOR BF-1 BIOFILTRATION		
The property owner is responsible to ensure inspection, operation and maintenance of permanent BMPs on their property unless responsibility has been formally transferred to an agency, community facilities district, homeowners association, property owners association, or other special district. Maintenance frequencies listed in this table are average/typical frequencies. Actual maintenance needs are site-specific, and maintenance may be required more frequently. Maintenance must be performed whenever needed, based on maintenance indicators presented in this table. The BMP owner is responsible for conducting regular inspections to see when maintenance is needed based on the maintenance indicators. During the first year of operation of a structural BMP, inspection is recommended at least once prior to August 31 and then monthly from September through May. Inspection during a storm event is also recommended. After the initial period of frequent inspections, the minimum inspection and maintenance frequency can be determined based on the results of the first year inspections.		
Threshold/Indicator	**Maintenance Action**	**Typical Maintenance Frequency**
Accumulation of sediment, litter, or debris	Remove and properly dispose of accumulated materials, without damage to the vegetation or compaction of the media layer.	• Inspect monthly. If the BMP is 25% full* or more in one month, increase inspection frequency to monthly plus after every 0.1-inch or larger storm event. • Remove any accumulated materials found at each inspection.
Obstructed inlet or outlet structure	Clear blockage.	• Inspect monthly and after every 0.5-inch or larger storm event. • Remove any accumulated materials found at each inspection.
Damage to structural components such as weirs, inlet or outlet structures	Repair or replace as applicable	• Inspect annually. • Maintenance when needed.
Poor vegetation establishment	Re-seed, re-plant, or re-establish vegetation per original plans.	• Inspect monthly. • Maintenance when needed.
Dead or diseased vegetation	Remove dead or diseased vegetation, re-seed, re-plant, or re-establish vegetation per original plans.	• Inspect monthly. • Maintenance when needed.
Overgrown vegetation	Mow or trim as appropriate.	• Inspect monthly. • Maintenance when needed.
2/3 of mulch has decomposed, or mulch has been removed	Remove decomposed fraction and top off with fresh mulch to a total depth of 3 inches.	• Inspect monthly. • Replenish mulch annually, or more frequently when needed based on inspection.

*"25% full" is defined as ¼ of the depth from the design bottom elevation to the crest of the outflow structure (e.g., if the height to the outflow opening is 12 inches from the bottom elevation, then the materials must be removed when there is 3 inches of accumulation – this should be marked on the outflow structure).

SUMMARY OF STANDARD INSPECTION AND MAINTENANCE FOR BF-1 BIOFILTRATION (Continued from previous page)		
Threshold/Indicator	**Maintenance Action**	**Typical Maintenance Frequency**
Erosion due to concentrated irrigation flow	Repair/re-seed/re-plant eroded areas and adjust the irrigation system.	• Inspect monthly. • Maintenance when needed.
Erosion due to concentrated storm water runoff flow	Repair/re-seed/re-plant eroded areas, and make appropriate corrective measures such as adding erosion control blankets, adding stone at flow entry points, or minor re-grading to restore proper drainage according to the original plan. If the issue is not corrected by restoring the BMP to the original plan and grade, the [City Engineer] shall be contacted prior to any additional repairs or reconstruction.	• Inspect after every 0.5-inch or larger storm event. If erosion due to storm water flow has been observed, increase inspection frequency to after every 0.1-inch or larger storm event. • Maintenance when needed. If the issue is not corrected by restoring the BMP to the original plan and grade, the [City Engineer] shall be contacted prior to any additional repairs or reconstruction.
Standing water in BMP for longer than 24 hours following a storm event Surface ponding longer than approximately 24 hours following a storm event may be detrimental to vegetation health	Make appropriate corrective measures such as adjusting irrigation system, removing obstructions of debris or invasive vegetation, clearing underdrains, or repairing/replacing clogged or compacted soils.	• Inspect monthly and after every 0.5-inch or larger storm event. If standing water is observed, increase inspection frequency to after every 0.1-inch or larger storm event. • Maintenance when needed.
Presence of mosquitos/larvae For images of egg rafts, larva, pupa, and adult mosquitos, see http://www.mosquito.org/biology	If mosquitos/larvae are observed: first, immediately remove any standing water by dispersing to nearby landscaping; second, make corrective measures as applicable to restore BMP drainage to prevent standing water. If mosquitos persist following corrective measures to remove standing water, or if the BMP design does not meet the 96-hour drawdown criteria due to release rates controlled by an orifice installed on the underdrain, the [City Engineer] shall be contacted to determine a solution. A different BMP type, or a Vector Management Plan prepared with concurrence from the County of San Diego Department of Environmental Health, may be required.	• Inspect monthly and after every 0.5-inch or larger storm event. If mosquitos are observed, increase inspection frequency to after every 0.1-inch or larger storm event. • Maintenance when needed.
Underdrain clogged	Clear blockage.	• Inspect if standing water is observed for longer than 24-96 hours following a storm event. • Maintenance when needed.

References

American Mosquito Control Association.
http://www.mosquito.org/
California Storm Water Quality Association (CASQA). 2003. Municipal BMP Handbook.
https://www.casqa.org/resources/bmp-handbooks/municipal-bmp-handbook
County of San Diego. 2014. Low Impact Development Handbook.
http://www.sandiegocounty.gov/content/sdc/dpw/watersheds/susmp/lid.html
San Diego County Copermittees. 2016. Model BMP Design Manual, Appendix E, Fact Sheet BF-1.
http://www.projectcleanwater.org/index.php?option=com_content&view=article&id=250&Itemid=220

ATTACHMENT 4

County of San Diego PDP Structural BMP Verification for Permitted Land Development Projects

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County of San Diego PDP-IVF:

Installation Verification Form for Priority Development Projects (PDPs)

This form must be accepted by the County prior to the release of construction permits or granting of occupancy for applicable portions of a Priority Development Project (PDP). Applicants are responsible for providing all requested information. Do not leave any fields blank; indicate *N/A* for any requested item that is not applicable.

PART 1 General Project and Applicant Information

Table 1: Project and Applicant Information

A. Project Summary Information	ID No. IVF-20__-____ To be assigned by DPW-WPP
Project Name	Green Hills Ranch – Phase 2
Record ID (e.g., grading/improvement plan number, building permit)	PDS2016-SPA-16-001
Project Address	9385 Adlai Road, Lakeside, California 92040
Assessor's Parcel Number(s) APN(s))	395-151-16 & 73: 395-160-15, 398-400-08, 09, 10, 20, 54, 55:
Project Watershed (complete Hydrologic Unit, Area, and Subarea Name with Numeric Identifier)	San Diego River Watershed Hydrologic Unit (907.00), within the Lower San Diego Hydrologic Area (907.10) Sub areas: Los Coches (907.14) and Santee (907.12)
B. Owner Information	
Name	Dan Jill Goodman, Trustee of the Goodman Irrevocable Trust
Address	11661 San Vicente Blvd., Suite 701, Los Angeles, CA
Email Address	N/A
Phone Number	N/A

PART 2 DMA and BMP Inventory Information

Use this table to document Structural BMPs (S-BMPs) and Significant Site Design BMPs (SSD-BMPs) for the PDP. All DMAs are required to have at least one Structural BMP or Significant Site Design BMP.

- In **Part A**, list all Structural BMPs (including both Pollutant Control and/or Hydromodification as applicable) by DMA.
- Complete **Part B** for all DMAs that contain only Significant Site Design BMPs. SSD-BMPs are Site Design BMPs credited in **Worksheet B-1.1** of the BMP Design Manual for Design Capture Volume (DCV) reductions. Only Tree Wells and Dispersion Areas should be included in this inventory.
- For any DMA that contains both S-BMPs and SD-BMPs, document only the S-BMPs; you do not need to include the SD-BMPs.
- The information provided for each BMP in the table must match that provided in the Stormwater Quality Management Plan (SWQMP), construction plans, maintenance agreements, and other relevant project documentation.

Table 3: Required Information for Structural BMPs and Significant Site Design BMPs

DMA #	BMP Information			Maintenance Category	Maintenance Agreement or Maintenance Notification Recorded Doc. #	Construction Plan Sheet #	Landscape Plan # & Sheet # (For Vegetated BMPs Only)	FOR DPW-WPP USE ONLY *Reviewer concurs that the BMP(s) may be accepted into inventory (date and initial)*
	Quantity	Description/Type of Structural BMP	BMP ID #(s)					
Part A Structural BMPs								
1	1	Biofiltration Basin	BMP-1	2				
2	1	Biofiltration Basin	BMP-2	2				
3	1	Biofiltration Basin	BMP-3	2				
Add rows as needed								
Part B Significant Site Design BMPs								
OFFSITE STREET	5	Tree Wells	BMP-6					
OFFSITE STREET	1	Tree Wells	BMP-7					
Add rows as needed								

PART 3 Required Attachments for All BMPs Listed in Table 3

For ALL projects, submit the following to the County inspector (check all that are attached):

☐ Photographs: A photograph of each fully constructed S-BMP or SSD-BMP (or group of BMPs).

☐ Maintenance Agreements: Copies of all approved and recorded Storm Water Maintenance Agreements (SWMAs) or Maintenance Notifications (MNs) for all S-BMPs.

Note: All BMPs proposed for County ownership will remain the responsibility of the owner listed on **Page 1** until a signed Letter of Acceptance of Completion is received by the DPW Watershed Protection Program.

For Grading and Improvement projects only, ALSO submit:

☐ Landscape Plans: An 11" X 17" copy of the most current applicable Landscape Plan sheets where the BMPs are required to be vegetated, including:

- ☐ The Certification of Completion (Form 407), AND
- ☐ The Certificate of Approval from PDS Landscape Architect

Note: For each Landscape Plan, the sheets submitted must show the location of each verified as-built BMP.

☐ Construction Plans: An 11" X 17" copy of the most current applicable approved Construction Plan sheets:

- ☐ Grading Plans, AND/OR
- ☐ Improvement Plans, AND/OR
- ☐ Precise Grading Plan(s) (only for residential subdivisions with tract homes), AND/OR
- ☐ Other (Please specify) Click here to enter text.

Note: For each Construction Plan, the sheets submitted must incorporate all of the following:

- ☐ A BMP Table, AND
- ☐ A plan/cross-section of each verified as-built BMP, AND
- ☐ The location of each verified as-built BMP

Required only for Verifications for Partial Record Plans

☐ If this is a partial record plan verification, please include the following:

- ☐ A list of previously submitted Verification Forms (**Table 2, part A**)
- ☐ A map of DMAs and BMPs (**Table 2, part B**)

PART 4 Engineer of Work Certification

By signing below, I certify that the BMP(s) listed in Table 3 of this Verification Form have been constructed and all are in substantial conformance with the approved plans and applicable regulations. I understand the County reserves the right to inspect the above BMPs to verify compliance with the approved plans and Watershed Protection Ordinance (WPO). Should it be determined that the BMPs were not constructed to plan or code, corrective actions may be necessary before permits can be closed.

Please sign and provide your seal below.

[SEAL]

Professional Engineer's Printed Name:

Jason M. Evans

Email: jason@rec-consultants.com

Phone Number: (619) 232-9200

Professional Engineer's Signed Name:

_____

Date: May 11, 2018

COUNTY - OFFICIAL USE ONLY:

For County Inspectors

County Department: _____

Date verification received from EOW: _____

By signing below, County Inspector concurs that every noted BMP has been installed per plan.

Inspector Name: _____

Inspector's Signature: _____ Date: _____

For Building Division Only

Inspection Supervisor Name: _____

Inspector Supervisor's Signature: _____ Date: _____

PDCI & Building, along with the rest of this package, please provide to DPW WPP:

☐ A copy of the final accepted SWQMP and any accepted addendum

For Watershed Protection Program Only

Date Received: _____

WPP Submittal Reviewer: _____

WPP Reviewer concurs that the BMPs accepted in **Part 2** above may be entered into inventory.

WPP Reviewer's Signature: _____ Date: _____

ATTACHMENT 5

Copy of Plan Sheets Showing Permanent Storm Water BMPs, Source Control, and Site Design

This is the cover sheet for Attachment 5.

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

The plans must identify:

☒ Structural BMP(s) with ID numbers matching Step 6 Summary of PDP Structural BMPs
☒ The grading and drainage design shown on the plans must be consistent with the delineation of DMAs shown on the DMA exhibit
☒ Details and specifications for construction of structural BMP(s)
☒ Signage indicating the location and boundary of structural BMP(s) as required by County staff
☒ How to access the structural BMP(s) to inspect and perform maintenance
☒ Features that are provided to facilitate inspection (e.g., observation ports, cleanouts, silt posts, or other features that allow the inspector to view necessary components of the structural BMP and compare to maintenance thresholds)
☒ Manufacturer and part number for proprietary parts of structural BMP(s) when applicable
☒ Maintenance thresholds specific to the structural BMP(s), with a location-specific frame of reference (e.g., level of accumulated materials that triggers removal of the materials, to be identified based on viewing marks on silt posts or measured with a survey rod with respect to a fixed benchmark within the BMP)
☒ Recommended equipment to perform maintenance
☒ When applicable, necessary special training or certification requirements for inspection and maintenance personnel such as confined space entry or hazardous waste management
☒ Include landscaping plan sheets showing vegetation requirements for vegetated structural BMP(s)
☒ All BMPs must be fully dimensioned on the plans
☒ When proprietary BMPs are used, site-specific cross section with outflow, inflow, and model number must be provided. Photocopies of general brochures are not acceptable.
☒ Include all source control and site design measures described in Steps 4 and 5 of the SWQMP. Can be included as a separate exhibit as necessary.

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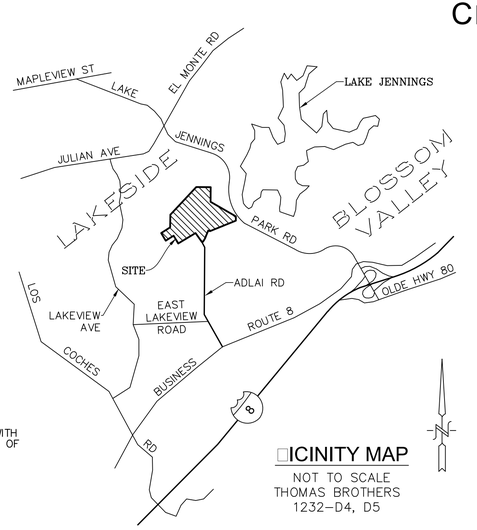
PRELIMINARY GRADING PLAN

"GREENHILLS RANCH - PHASE 2"

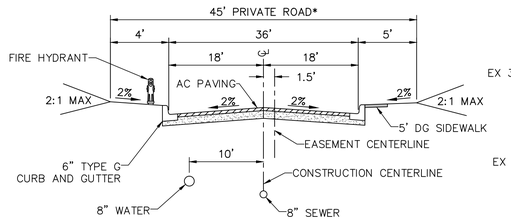
C□□□□ □□S□□ D□□□□, C□□□r□□

GENERAL NOTES:

1. ASSESSORS PARCEL NUMBERS WITHIN SPECIFIC PLAN AREA (SPA): 395-151-16 & 73, 395-160-15, 398-400-08, 09, 10, 20, 54 & 55
2. TAX RATE AREA: 82051
3. GROSS AREA = 36.33 ACRES, NET AREA = 30.32 ± ACRES
4. NUMBER OF PROPOSED LOT:
   63 RESIDENTIAL (LOTS 1-63, INCLUSIVE)
   7 PRIVATE STREET (LOTS 70-76, INCLUSIVE)
   2 HOA LOTS (LOTS A AND B)
   3 OPEN SPACE LOT (LOT C-E, INCLUSIVE)
   75 TOTAL LOTS
5. MINIMUM LOT SIZE: 5,000 SF
6. TOPOGRAPHY OBTAINED FROM: JESS L. McMARTIN PHOTOGRAMMETRIC CONSULTANTS, DATED: 7-17-2015
7. SEWER SERVICE: LAKESIDE SANITATION DISTRICT
8. WATER SERVICE: HELIX WATER DISTRICT
9. FIRE PROTECTION SERVICE: LAKESIDE FIRE PROTECTION DISTRICT
10. SCHOOLS: ELEMENTARY: LAKESIDE UNION ELEMENTARY SCHOOL DISTRICT
    HIGH SCHOOL: GROSSMONT UNION HIGH SCHOOL DISTRICT
11. STREET LIGHTING: PRIVATE SERVICE
12. ALL STREETS TO BE PRIVATE.
13. THE PROJECT AREA IS NOT SUBJECT TO 100 YEAR FLOOD INUNDATION PER FEMA FIRM PANEL: 06073C1660G (DATED 5-16-2012)
14. ALL CUT AND FILL SLOPES ARE 2:1 UNLESS OTHERWISE NOTED.
15. ALL EXISTING STRUCTURES TO BE DEMOLISHED
16. EXISTING WELL TO BE DESTROYED IN ACCORDANCE WITH DEPARTMENT OF ENVIRONMENTAL HEALTH REGULATIONS.
17. APN 395-160-15 TO BE DETACHED FROM LAKESIDE WATER DISTRICT AND ANNEXED TO HELIX WATER DISTRICT
18. STORM DRAIN DETENTION FACILITIES SHALL BE PROVIDED IN ACCORDANCE WITH THE REQUIREMENT OF THE COUNTY OF SAN DIEGO, DEPARTMENT OF PUBLIC WORKS.

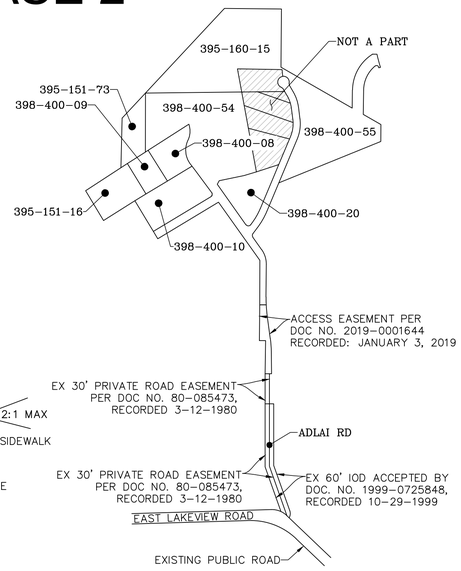


□ICINITY MAP
NOT TO SCALE
THOMAS BROTHERS
1232-D4, D5



(* 60' IOD GREENHILLS WAY, AUDOBON ROAD)

PRI□ATE STREETS
NTS



LEGEND

PROPOSED:

SYMBOL:	DESCRIPTION:
P	BOUNDARY
	EASEMENTS
	PROPOSED STORM DRAIN INLET
	PROPOSED STORM DRAIN CLEANOUT
S S S	PROPOSED 8" PVC SEWER MAIN
W	PROPOSED 12" PVC WATER MAIN
	PROPOSED STORM DRAIN
	PROPOSED 6" CURB AND GUTTER
	ACCESS TO BE RELINQUISHED
	OPEN SPACE FENCING
	OPEN SPACE SIGNAGE

E□ISTING:

SYMBOL:	DESCRIPTION:
FH	EXIST FH
420	EXIST CONTOUR
	EX POWER POLE
	EX STREET LIGHT
S S S	EX PVC SEWER MAIN (SIZE AS SHOWN)
W	EX PVC WATER MAIN (SIZE AS SHOWN)
	EX STORM DRAIN (SIZE AS SHOWN)

SEE TYPICAL PAD DRAINAGE DETAIL – SHEET 5

EASEMENTS NOTES (SEE SHEET 2 FOR LOCATION)

ITEM NUMBERS ARE PER PRELIMINARY TITLE REPORT BY CHICAGO TITLE INSURANCE COMPANY, ORDER NO. 12205743-996-SD1 DATED 8-11-2015

(1) RIGHTS OF THE PUBLIC TO ANY PORTION OF THE LAND LYING WITHIN THE AREA COMMONLY KNOWN AS AUDUBON ROAD AND ADLAI ROAD.

(2) EASEMENT TO ARTHUR LOUIS MALLORY, ET UX, FOR ROAD PURPOSES PER DOC. REC. JULY 21, 1954 AS DOC. NO. 95380 IN BOOK 5307, PG. 18 O.R.

(3) EASEMENT TO SAN DIEGO GAS & ELECTRIC COMPANY PER DOC. REC. APR. 21, 1955 AS DOC. NO. 52744 IN BOOK 5614, PG. 199 O.R., (PORTIONS TO BE QUITCLAIMED).

4 EASEMENT TO RAYMOND R. BRULE, ET UX, FOR ROAD PURPOSES PER DOC. REC. JULY 1, 1955 AS DOC. NO. 85168 IN BOOK 5701, PG. 4 O.R. (SAID EASEMENT HAS NO SPECIFIC LOCATION SET FORTH AND CANNOT BE PLOTTED).

(5) EASEMENT TO SAN DIEGO GAS & ELECTRIC COMPANY PER DOC. REC. JAN. 24, 1956 AS DOC. NO. 10307 IN BOOK 5951, PG. 104 O.R., (TO BE QUITCLAIMED).

(6) EASEMENT TO SAN DIEGO GAS & ELECTRIC COMPANY PER DOC. REC. JAN. 24, 1956 AS DOC. NO. 10312 IN BOOK 5951, PG. 479 O.R., (TO BE QUITCLAIMED).

(7) EASEMENT TO SAN DIEGO GAS & ELECTRIC COMPANY PER DOC. REC. FEB. 6, 1956 AS DOC. NO. 15970 IN BOOK 5965, PG. 479 O.R., (TO BE QUITCLAIMED).

(8) EASEMENT TO SAN DIEGO GAS & ELECTRIC COMPANY PER DOC. REC. FEB. 6, 1956 IN BOOK 5965, PG. 497 O.R., (TO BE QUITCLAIMED).

(9) EASEMENT TO SAN DIEGO GAS & ELECTRIC COMPANY PER DOC. REC. MAR. 6, 1956 IN BOOK 5965, PG. 497 O.R., (TO BE QUITCLAIMED).

10 EASEMENT TO JOHN BERSCH FOR ROAD PURPOSES PER DOC. REC. APR. 23, 1956 AS DOC. NO. 55529 IN BOOK 6069, PG. 398 O.R., (SAID EASEMENT HAS NO SPECIFIC LOCATION SET FORTH AND CANNOT BE PLOTTED).

(11) EASEMENT TO SAN DIEGO GAS & ELECTRIC COMPANY PER DOC. REC. JUN. 7, 1956 AS DOC. NO. 78487 IN BOOK 6131, PG. 290 OF O.R., (TO BE QUITCLAIMED).

(12) EASEMENT TO SAN DIEGO GAS & ELECTRIC COMPANY PER DOC. REC. SEP. 4, 1957 AS DOC. NO. 135034 IN BOOK 6734, PG. 276 O.R., (TO BE QUITCLAIMED).

(13) EASEMENT TO SAN DIEGO GAS & ELECTRIC COMPANY PER DOC. REC. SEP. 4, 1957 AS DOC. NO. 135042 IN BOOK 6734, PG. 292 O.R., (TO BE QUITCLAIMED).

(14) EASEMENT TO JOSEPH C. DI CRISTINA FOR ROAD PURPOSES PER DOC. REC. NOV. 12, 1958 AS DOC. NO. 188628 IN BOOK 7345, PG. 413 O.R.

(15) EASEMENT TO HELIX IRRIGATION DISTRICT FOR WATER PIPELINE PER DOC. REC. JAN. 25, 1962 AS FILE NO. 14707 O.R. (PORTIONS TO BE QUITCLAIMED).

16 EASEMENT TO M. GOLDMAN FOR ROAD PURPOSES PER DOC. REC. SEP. 5, 1963 AS FILE NO. 159069 O.R. (SAID EASEMENT HAS NO SPECIFIC LOCATION SET FORTH AND CANNOT BE PLOTTED).

(17) RIGHT OF WAY AND EASEMENT TO THE COUNTY OF SAN DIEGO PER DOC. REC. JUN. 21, 1965 AS INSTR. NO. 110415 O.R. (PAR. A: FEE SIMPLE, PAR B: SLOPE RIGHTS).

(18) EASEMENT TO LAKESIDE SANITATION DISTRICT FOR SEWER PIPELINE PER DOC. REC. DEC. 27, 1966 AS FILE NO. 200101 OF O.R., (TO BE VACATED).

(19) EASEMENT TO LAKESIDE SANITATION DISTRICT FOR SEWER PIPELINE PER DOC. REC. DEC. 27, 1966 AS FILE NO. 200102 O.R., (TO BE VACATED).

(20) EASEMENT TO LAKESIDE SANITATION DISTRICT FOR SEWER PIPELINE PER DOC. REC. DEC. 27, 1966 AS FILE NO. 200103 O.R., (TO BE VACATED).

(21) EASEMENT TO LAKESIDE SANITATION DISTRICT FOR SEWER PIPELINE PER DOC. REC. DEC. 27, 1966 AS FILE NO. 200104 OF O.R., (TO BE VACATED).

(22) EASEMENT TO LAKESIDE SANITATION DISTRICT FOR SEWER PIPELINE PER DOC. REC. DEC. 27, 1966 AS FILE NO. 200107 OF O.R., (TO BE VACATED).

(23) EASEMENT TO CLARA BERSCH FOR ROAD PURPOSES PER DOC. REC. MAR. 15, 1967 AS FILE NO. 35419 OF O.R., (SAID EASEMENT HAS NO SPECIFIC LOCATION SET FORTH AND CANNOT BE PLOTTED).

(24) EASEMENT TO THE SAN DIEGO MUNICIPAL WATER DISTRICT FOR WATER PIPELINE PER DOC. REC. NOV. 15, 1976 AS INSTR. NO. 76-381612 OF O.R.

(36) EASEMENT TO KENNEDY DEVELOPMENT FOR PRIVATE ROAD AND PUBLIC ACCESS PER DOC. REC. JULY 23, 2003 AS FILE NO. 2003-0874601, O.R., (PORTIONS TO BE QUITCLAIMED AND REGRANTED IN PROPOSED GREENHILLS WAY).

(37) EASEMENT TO SAN DIEGO COUNTY FLOOD CONTROL DISTRICT FOR INGRESS AND EGRESS PER DOC. REC. SEP. 4, 2003 AS FILE NO. 2003-01078267 OF O.R., (PORTIONS TO BE QUITCLAIMED AND REGRANTED IN PROPOSED GREENHILLS WAY).

(38) EASEMENT TO KENNEDY DEVELOPMENT FOR PRIVATE ROAD AND SLOPE MANAGEMENT PER DOC. REC. OCT. 9, 2003 AS FILE NO. 2003-01244556, O.R.

(40) EASEMENT TO KENNEDY DEVELOPMENT FOR PRIVATE ROAD AND SLOPE MANAGEMENT PER DOC. REC. APR. 19, 2004 AS FILE NO. 2004-0337691, O.R.

(41) EASEMENT TO SAN DIEGO COUNTY FLOOD CONTROL DISTRICT FOR INGRESS AND EGRESS PER DOC. REC. MAY 20, 2004 AS FILE NO. 2004-0461735, O.R.

(42) EASEMENT TO SAN DIEGO GAS & ELECTRIC COMPANY FOR PUBLIC UTILITIES, INGRESS AND EGRESS PER DOC. REC. OCT. 15, 2004 AS FILE NO. 2004-0980698, O.R.

(44) EASEMENT TO ARTHUR LOUIS MALLORY, ET UX, FOR INGRESS AND EGRESS PER DOC. REC. MAY 28, 1954 AS DOC. NO. 70147 IN BOOK 5151, PG. 462 O.R. RE-RECORDING PER DOC. REC. JULY 21, 1954 AS DOC. NO. 95380 IN BOOK 5307, PG. 18 OF O.R., (PORTIONS TO BE QUITCLAIMED).

(45) EASEMENT TO SAN DIEGO GAS & ELECTRIC COMPANY FOR PUBLIC UTILITIES, INGRESS AND EGRESS PER DOC. REC. APR 21, 1955 AS DOC. NO. 52744 IN BOOK 5614, PG. 199 OF O.R., (PORTIONS TO BE QUITCLAIMED).

46 EASEMENT TO RAYMOND R. BRULE AND ADELINE K. BRULE FOR ROAD PURPOSES PER DOC. REC. JULY 1, 1955 AS DOC. NO. 85168 IN BOOK 5701, PG. 4 OF O.R., (SAID EASEMENT HAS NO SPECIFIC LOCATION SET FORTH AND CANNOT BE PLOTTED).

(47) EASEMENT TO SAN DIEGO GAS & ELECTRIC COMPANY FOR PUBLIC UTILITIES, INGRESS AND EGRESS PER DOC. REC. SEP. 2, 1955 AS DOC. NO. 116458 IN BOOK 5781, PG. 174 OF O.R., (PORTIONS TO BE QUITCLAIMED).

(48) EASEMENT TO SAN DIEGO GAS & ELECTRIC COMPANY FOR PUBLIC UTILITIES, INGRESS AND EGRESS PER DOC. REC. JAN. 24, 1956 AS DOC. NO. 10307 IN BOOK 5951, PG. 104 O.R., (PORTIONS TO BE QUITCLAIMED).

(49) EASEMENT TO SAN DIEGO GAS & ELECTRIC COMPANY FOR PUBLIC UTILITIES, INGRESS AND EGRESS PER DOC. REC. FEB. 6, 1956 AS DOC. NO. 15970 IN BOOK 5965, PG. 479 OF O.R., (PORTIONS TO BE QUITCLAIMED).

50 EASEMENT TO JULIENE NICELI CLINGINGSMITH AND HENRY MONROE CLINGINGSMITH FOR ROAD PURPOSES PER DOC. REC. APR. 23, 1956 AS DOC. NO. 55529 IN BOOK 6069, PG. 398 OF O.R., (SAID EASEMENT HAS NO SPECIFIC LOCATION SET FORTH AND CANNOT BE PLOTTED).

51 EASEMENT TO SAN DIEGO GAS & ELECTRIC COMPANY FOR PUBLIC UTILITIES, INGRESS AND EGRESS PER DOC. REC. JUN. 7, 1956 AS DOC. NO. 78487 IN BOOK 6130, PG. 290 OF O.R., (SAID EASEMENT HAS NO SPECIFIC LOCATION SET FORTH AND CANNOT BE PLOTTED).

52 EASEMENT TO CLARA BERSCH FOR ROAD PURPOSES PER DOC. REC. MAR. 15, 1967 AS FILE NO. 35419 OF O.R., (SAID EASEMENT HAS NO SPECIFIC LOCATION SET FORTH AND CANNOT BE PLOTTED).

53 EASEMENT TO THE COUNTY OF SAN DIEGO FOR OPEN SPACE PER DOC. REC. FEB. 8, 1995 AS FILE NO. 95-058206 OF O.R., (SAID EASEMENT HAS NO SPECIFIC LOCATION SET FORTH AND CANNOT BE PLOTTED).

LEGAL DESCRIPTION

PORTIONS OF LOTS 5, 6, 7, 8 AND 10 IN BLOCK 47 OF THE SUBDIVISION OF THE "S" TRACT OF RANCHO EL CAJON, IN THE COUNTY OF SAN DIEGO, STATE OF CALIFORNIA, ACCORDING TO MAP THEREOF RECORDED IN BOOK 170, PAGE 71 OF DEEDS, RECORDS OF SAN DIEGO COUNTY.

SOLAR ACCESS STATEMENT:

ALL UNITS WITHIN THIS SUBDIVISION HAVE A MINIMUM OF 100 SQ. FT. OF SOLAR ACCESS FOR EACH FUTURE DWELLING UNIT ALLOWED BY THIS SUBDIVISION.

STREET LIGHT STATEMENT:

THE SUBDIVIDER INTENDS TO COMPLY WITH, THE STREET LIGHT REQUIREMENTS AS SPECIFIED IN THE COUNTY STANDARDS. THIS SUBDIVISION IS PROPOSING ONLY PRIVATE STREETS.

GRADING QUANTITIES:

CUT	180,000 CY
FILL	180,000 CY
EXPORT	NONE CY

PLAN NOTE:

THIS PLAN IS PROVIDED TO ALLOW FOR FULL AND ADEQUATE DISCRETIONARY REVIEW OF A PROPOSED DEVELOPMENT PROJECT. THE PROPERTY OWNER ACKNOWLEDGES THAT ACCEPTANCE OR APPROVAL OF THIS PLAN DOES NOT CONSTITUTE AN APPROVAL TO PERFORM ANY GRADING SHOWN HEREON, AND AGREES TO OBTAIN VALID GRADING PERMISSIONS BEFORE COMMENCING SUCH ACTIVITY

SITE ADDRESS:

9385 ADLAI ROAD
LAKESIDE, CA 92040

APPLICANT/OWNER:

DANA JILL GOODMAN, TRUSTEE OF THE GOODMAN IRREVOCABLE TRUST DATED DECEMBER 11, 1992

11661 SAN VICENTE BLVD., STE 701
LOS ANGELES, CA 90049

DANA JILL GOODMAN — DATE 7/11/2019

STEPHEN RICHARD GOODMAN — DATE 7/11/19

ENGINEER OF WORK:

REGISTERED PROFESSIONAL ENGINEER — JONATHAN RAAB RYDEEN — RCE - 64811 EXP 6/30/21 — CIVIL — STATE OF CALIFORNIA

REC CONSULTANTS, INC.
2442 SECOND AVENUE
SAN DIEGO, CA 92101
PH. (619) 232-9200

JONATHAN RAAB RYDEEN R.C.E. 64811
EXPIRES ON 6/30/21

7-11-2019 DATE

NO.	DESCRIPTION	DATE	APP'D
	REVISIONS		

Civil Engineering · Environmental
Land Surveying
2442 Second Avenue
San Diego, CA 92101
(619)232-9200 (619)232-9210 Fax
R·E·C Consultants, Inc.

DATE: 5-17-2017
SCALE: 1" = 100'
DRAWN: J.M.W.
CHECKED: J.R.R.

SHEET TITLE: PRELIMINARY GRADING PLAN
PROJECT: GREENHILLS RANCH PHASE 2 COUNTY OF SAN DIEGO, CA

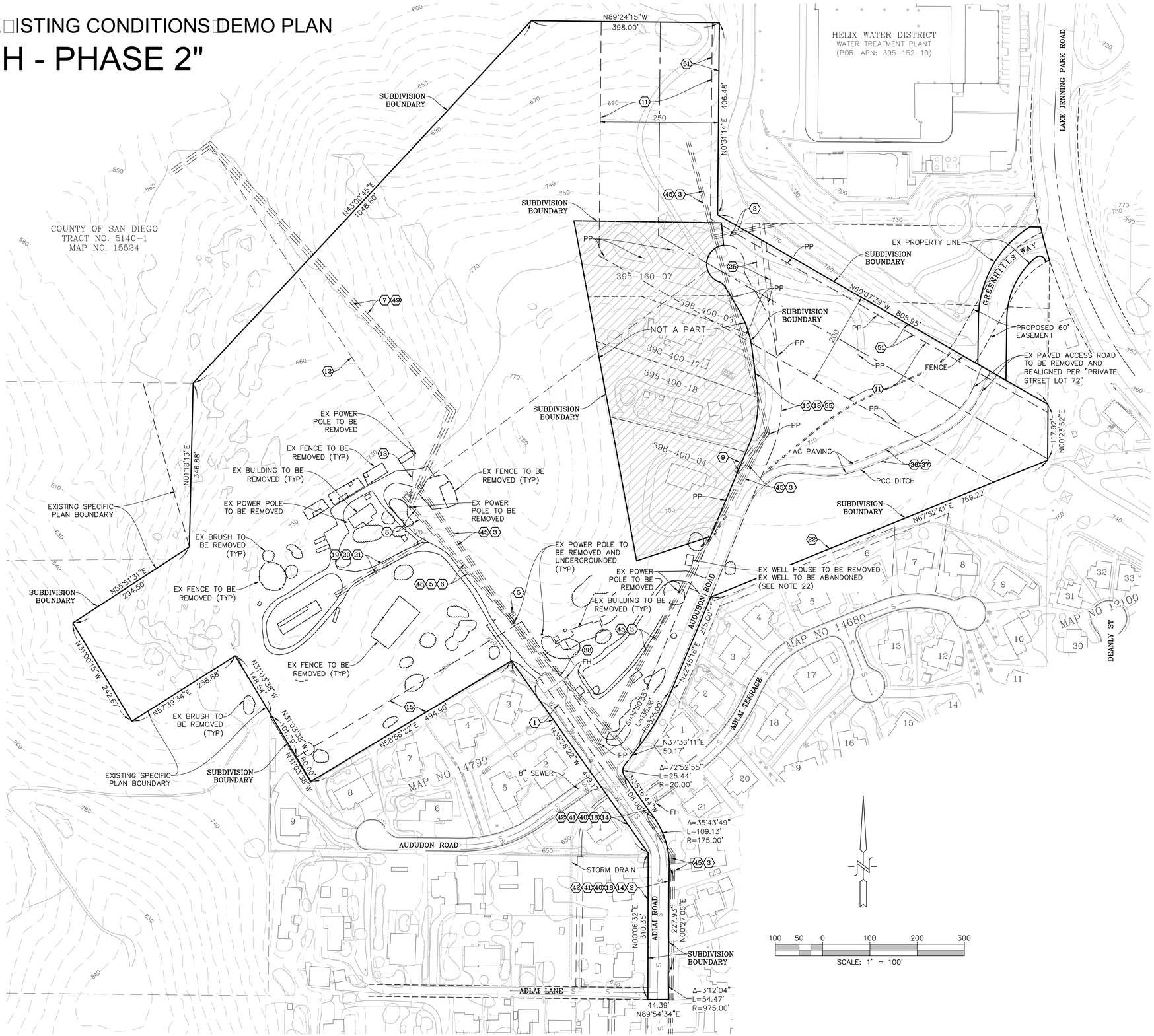
SHEET 1 OF 6 SHEETS

SAVE DATE: 7/17/2019 ~ PLOT DATE: 7/17/2019 ~ FILE NAME: P:\Acad\1083 Greenhills Ranch\Civil\Preliminary Grading Plan\Greenhills Ranch – Preliminary Grading Plan.dwg

PRELIMINARY GRADING PLAN - E□ISTING CONDITIONS□DEMO PLAN

"GREENHILLS RANCH - PHASE 2"

C□□□□□ □□S□□ D□□□□, C□□□r□□



NO.	DESCRIPTION	DATE	APP'D

REVISIONS

R·E·C Consultants, Inc.

Civil Engineering · Environmental
Land Surveying

2442 Second Avenue
San Diego, CA 92101
(619)232-9200 (619)232-9210 Fax

DATE: 7-17-2017
SCALE: 1" = 100'
DRAWN: J.M.W.
CHECKED: J.R.R.

SHEET TITLE: E□ISTING CONDITIONS - DEMO PLAN

PROJECT: GREENHILLS RANCH
PHASE 2
COUNTY OF SAN DIEGO, CA

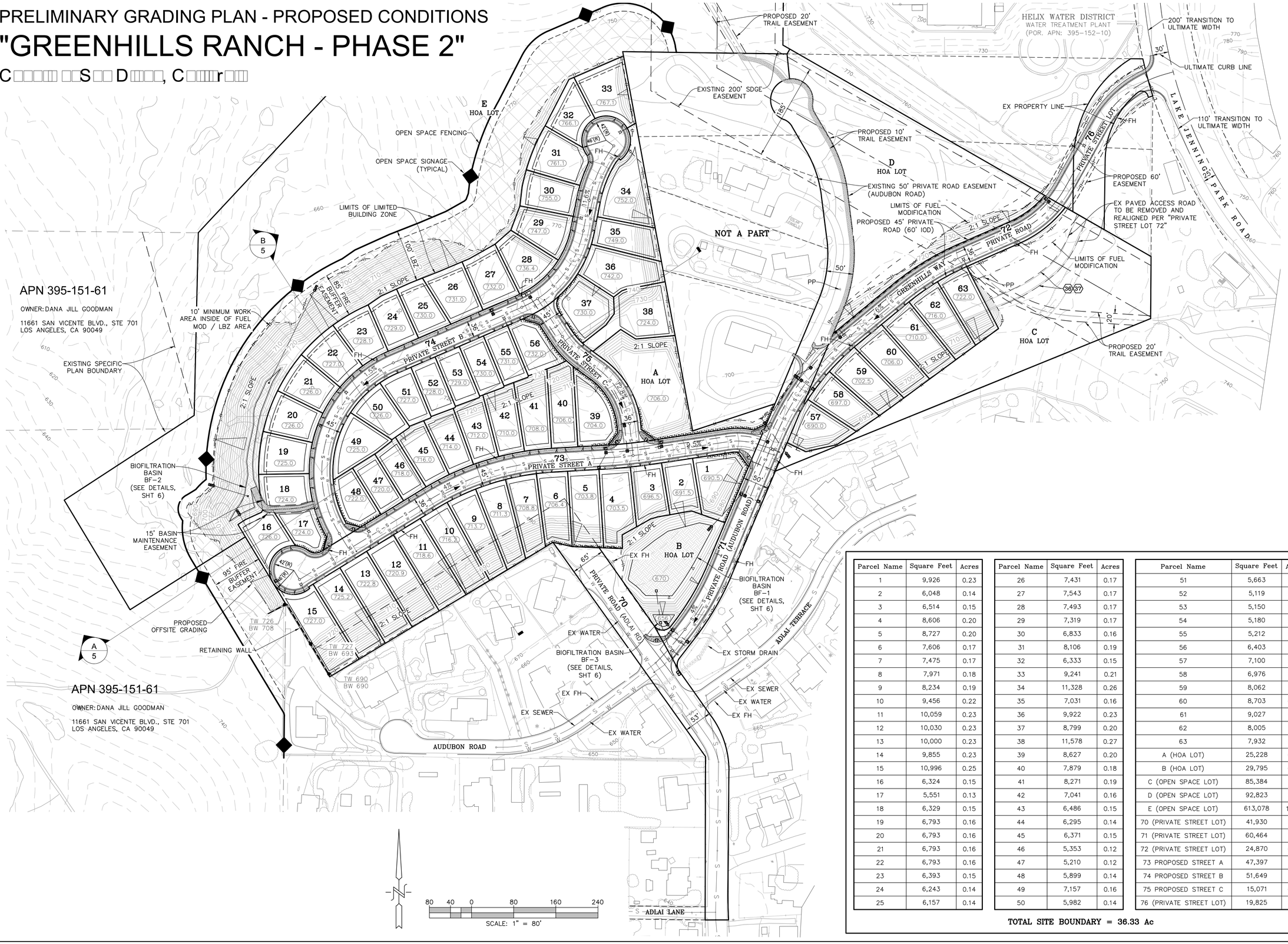
SHEET 2 OF 6 SHEETS

SAVE DATE: 7/17/2019 ~ PLOT DATE: 7/17/2019 ~ FILE NAME: P:\Acad\1083 Greenhills Ranch\Civil\Preliminary Grading Plan\Greenhills Ranch – Preliminary Grading Plan.dwg

PRELIMINARY GRADING PLAN - PROPOSED CONDITIONS

"GREENHILLS RANCH - PHASE 2"

C□□□□□ □□S□□ D□□□□, C□□□r□□



Parcel Name	Square Feet	Acres
1	9,926	0.23
2	6,048	0.14
3	6,514	0.15
4	8,606	0.20
5	8,727	0.20
6	7,606	0.17
7	7,475	0.17
8	7,971	0.18
9	8,234	0.19
10	9,456	0.22
11	10,059	0.23
12	10,030	0.23
13	10,000	0.23
14	9,855	0.23
15	10,996	0.25
16	6,324	0.15
17	5,551	0.13
18	6,329	0.15
19	6,793	0.16
20	6,793	0.16
21	6,793	0.16
22	6,793	0.16
23	6,393	0.15
24	6,243	0.14
25	6,157	0.14

Parcel Name	Square Feet	Acres
26	7,431	0.17
27	7,543	0.17
28	7,493	0.17
29	7,319	0.17
30	6,833	0.16
31	8,106	0.19
32	6,333	0.15
33	9,241	0.21
34	11,328	0.26
35	7,031	0.16
36	9,922	0.23
37	8,799	0.20
38	11,578	0.27
39	8,627	0.20
40	7,879	0.18
41	8,271	0.19
42	7,041	0.16
43	6,486	0.15
44	6,295	0.14
45	6,371	0.15
46	5,353	0.12
47	5,210	0.12
48	5,899	0.14
49	7,157	0.16
50	5,982	0.14

Parcel Name	Square Feet	Acres
51	5,663	0.13
52	5,119	0.12
53	5,150	0.12
54	5,180	0.12
55	5,212	0.12
56	6,403	0.15
57	7,100	0.16
58	6,976	0.16
59	8,062	0.19
60	8,703	0.20
61	9,027	0.21
62	8,005	0.18
63	7,932	0.18
A (HOA LOT)	25,228	0.58
B (HOA LOT)	29,795	0.68
C (OPEN SPACE LOT)	85,384	1.96
D (OPEN SPACE LOT)	92,823	2.13
E (OPEN SPACE LOT)	613,078	14.07
70 (PRIVATE STREET LOT)	41,930	0.96
71 (PRIVATE STREET LOT)	60,464	1.39
72 (PRIVATE STREET LOT)	24,870	0.57
73 PROPOSED STREET A	47,397	1.09
74 PROPOSED STREET B	51,649	1.19
75 PROPOSED STREET C	15,071	0.35
76 (PRIVATE STREET LOT)	19,825	0.46

TOTAL SITE BOUNDARY = 36.33 Ac

NO.	DESCRIPTION	DATE	APP'D
	REVISIONS		

Civil Engineering · Environmental
Land Surveying
2442 Second Avenue
San Diego, CA 92101
(619)232-9200 (619)232-9210 Fax
R·E·C
Consultants, Inc.

DATE: 5-17-2017
SCALE: 1" = 80'
DRAWN: J.M.W.
CHECKED: J.R.R.

SHEET TITLE: PROPOSED CONDITIONS

PROJECT: GREENHILLS RANCH
PHASE 2
COUNTY OF SAN DIEGO, CA

SHEET 3 OF 6 SHEETS

SAVE DATE: 7/17/2019 ~ PLOT DATE: 7/17/2019 ~ FILE NAME: P:\Acad\1083 Greenhills Ranch\Civil\Preliminary Grading Plan\Greenhills Ranch – Preliminary Grading Plan.dwg

PRELIMINARY GRADING PLAN - BMP PLAN

"GREENHILLS RANCH - PHASE 2"

C□□□□□ □□S□□ D□□□□, C□□□r□□



LEGEND

ITEM	CALTRANS □	SYMBOL
RIPRAP ENERGY DISSIPATOR	SS-10	
SILT FENCE	SE-1	
STORM DRAIN INLET PROTECTION	SE-10	
GRAVEL BAGS	SE-6, SE-8	
DRAINAGE SWALE		
STABILIZED CONSTRUCTION ENTRANCE	TC-1	
FIBER ROLL:	SE-5	—FR—FR—
MATERIAL DELIVERY & STORAGE:	WM-1	WM-1
STOCKPILE MANAGEMENT:	WM-3	WM-3
SPILL PREVENTION AND CONTROL:	WM-4	WM-4
SOLID WASTE MANAGEMENT:	WM-5	WM-5
HAZARDOUS WASTE MANAGEMENT:	WM-6	WM-6
CONCRETE WASTE MANAGEMENT:	WM-8	WM-8
SANITARY WASTE MANAGEMENT:	WM-9	WM-9
WATER CONSERVATION PRACTICES:	NS-1	NS-1
PAVING AND GRINDING OPERATIONS:	NS-3	NS-3
VEHICLE AND EQUIPMENT MAINT.	NS-10	NS-10
STREET SWEEPING AND VACUUMING:	SE-7	SE-7
HYDRAULIC MULCH:	SS-3	SS-3
HYDROSEEDING:	SS-4	SS-4
PAD STABILIZATION:	SS-5	SS-5

NO.	DESCRIPTION	DATE	APP'D

REVISIONS

Civil Engineering · Environmental
Land Surveying
2442 Second Avenue
San Diego, CA 92101
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R·E·C Consultants, Inc.

DATE: 5-17-2017
SCALE: 1" = 80'
DRAWN: J.M.W.
CHECKED: J.R.R.

SHEET TITLE: BMP PLAN

PROJECT: GREENHILLS RANCH
PHASE 2
COUNTY OF SAN DIEGO, CA

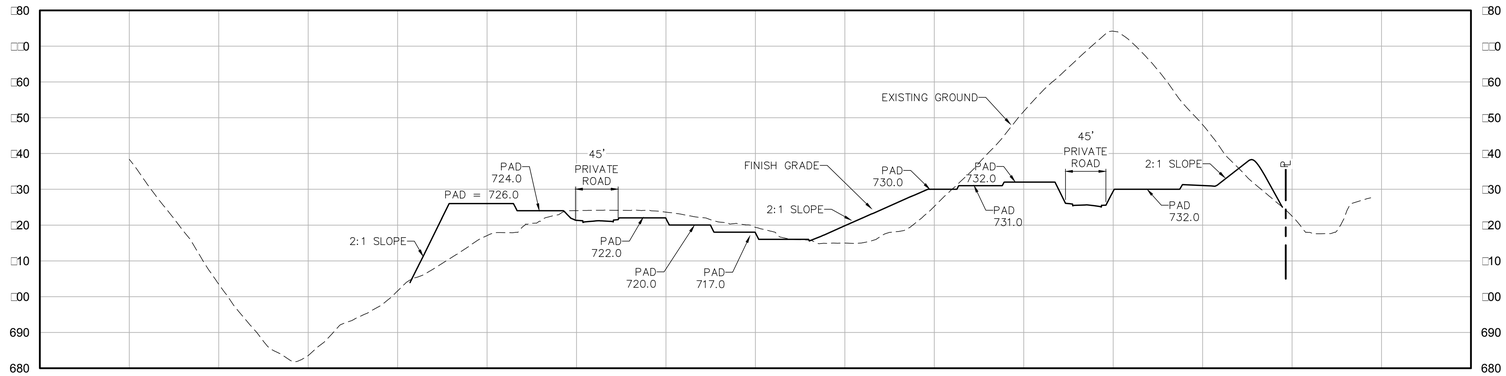
SHEET 4 OF 6 SHEETS

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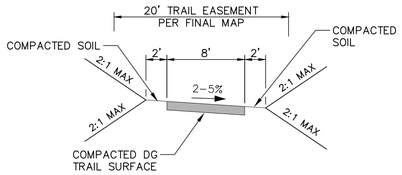
PRELIMINARY GRADING PLAN - SITE CROSS SECTIONS

"GREENHILLS RANCH - PHASE 2"

C□□□□□ □□S□□ D□□□□, C□□□r□□

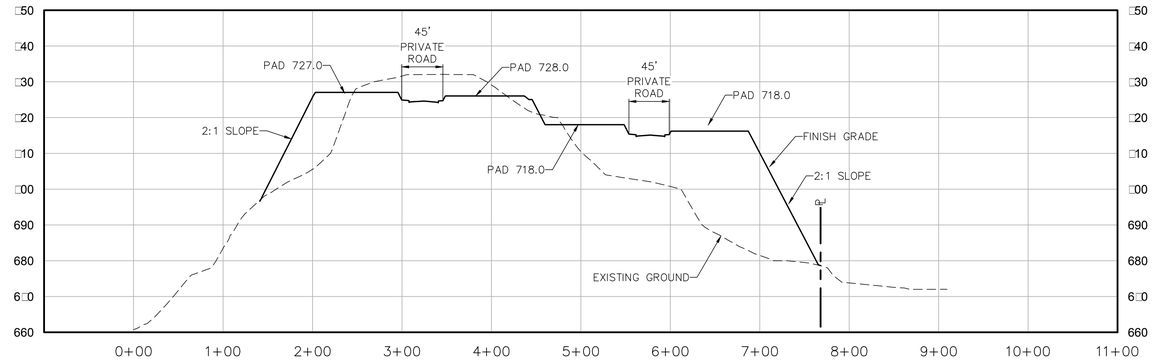


SECTION A
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VERT: 1" = 20'

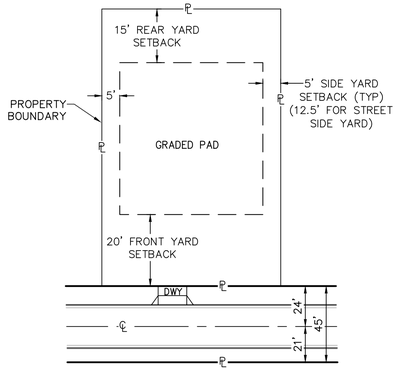


TYPICAL TYPE "A" URBAN TRAIL SECTION

NOT TO SCALE
TRAILS TO BE CONSTRUCTED PER THE
"COUNTY TRAILS PROGRAM – COMMUNITY TRAILS MASTER PLAN"
SECTION 7
6" PVC UNDER DRAINS TO BE INSTALLED AS REQUIRED

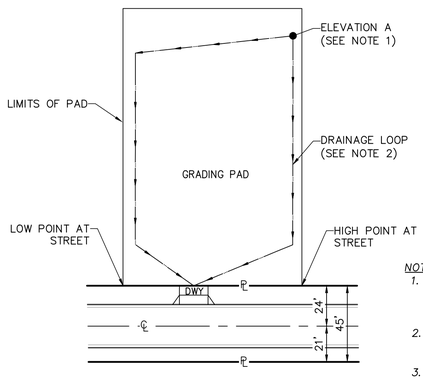


SECTION B
SCALE: HORZ: 1" = 80'
VERT: 1" = 20'



TYPICAL RESIDENTIAL LOT SETBACKS

NO SCALE



TYPICAL RESIDENTIAL PAD DRAINAGE

NO SCALE

NOTES:

1. *ELEVATION "A" IS LOCATED AT THE MOST REMOTE CORNER OF THE PAD FROM THE DRIVEWAY.*
2. *MINIMUM 1% SWALE TO STREET OR OTHER DISCHARGE POINT.*
3. *ALL SLOPE SURFACES SHALL BE PROTECTED BY APPROVED EROSION CONTROL MATERIAL.*
4. *ALL PADS TO BE BERMED TO PREVENT RUN-OFF TO ADJACENT PADS.*

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DATE: 5-17-2017
SCALE: 1" = 100'
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CHECKED: J.R.R.

SHEET TITLE: SITE CROSS SECTION

PROJECT: GREENHILLS RANCH
PHASE 2
COUNTY OF SAN DIEGO, CA

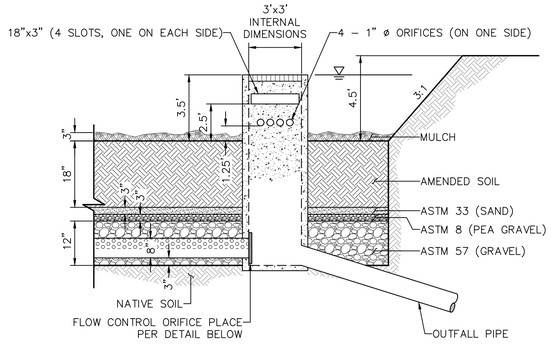
SHEET 5 OF 6 SHEETS

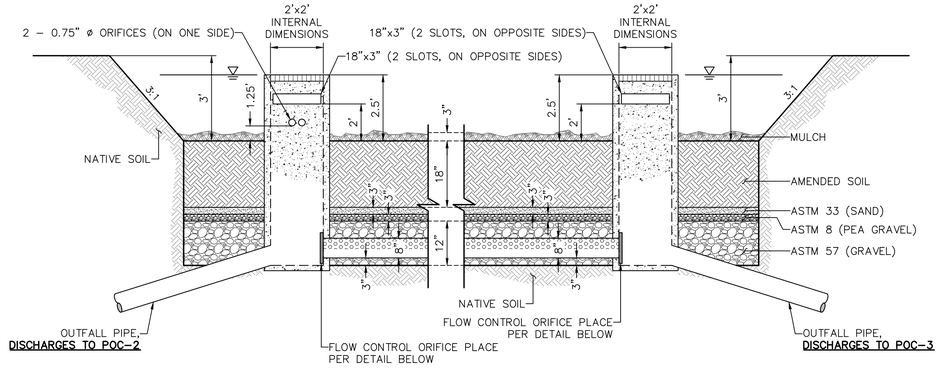
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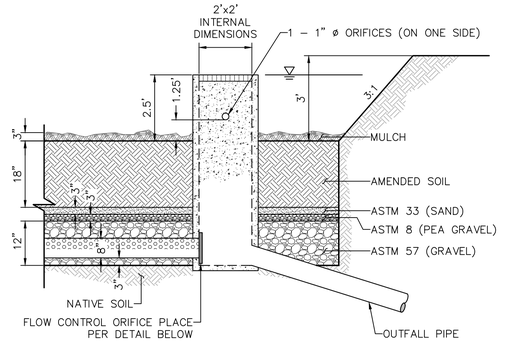
PRELIMINARY GRADING PLAN - SITE CROSS SECTIONS

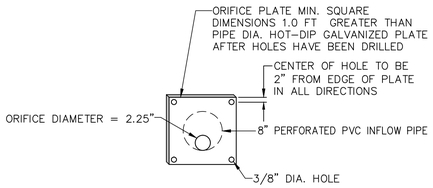
"GREENHILLS RANCH - PHASE 2"

C□□□□□ □□S□□ D□□□□, C□□□r□□







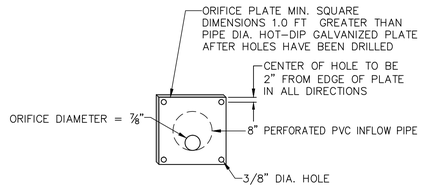


FLOW CONTROL ORIFICE PLATE
NTS

NOTES:

1. SOIL MIX PER COUNTY OF SAN DIEGO LID MANUAL
2. "WELL DRAINED SOIL" SHALL BE "SANDY LOAM" SOIL MIX WITH NO MORE THAN 5% CLAY CONTENT. THE MIX SHALL CONTAIN 50–60% SAND, 20–30% COMPOST OR HARDWOOD MULCH, AND 20–30% TOPSOIL.

1 BMP-1 BASIN DETAIL
NOT TO SCALE

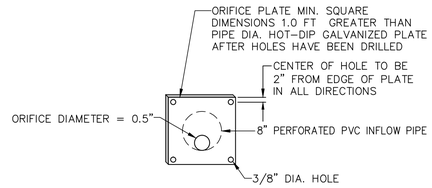


FLOW CONTROL ORIFICE PLATE
NTS

NOTES:

1. SOIL MIX PER COUNTY OF SAN DIEGO LID MANUAL
2. "WELL DRAINED SOIL" SHALL BE "SANDY LOAM" SOIL MIX WITH NO MORE THAN 5% CLAY CONTENT. THE MIX SHALL CONTAIN 50–60% SAND, 20–30% COMPOST OR HARDWOOD MULCH, AND 20–30% TOPSOIL.

2 BMP-2 BASIN DETAIL
NOT TO SCALE



FLOW CONTROL ORIFICE PLATE
NTS

NOTES:

1. SOIL MIX PER COUNTY OF SAN DIEGO LID MANUAL
2. "WELL DRAINED SOIL" SHALL BE "SANDY LOAM" SOIL MIX WITH NO MORE THAN 5% CLAY CONTENT. THE MIX SHALL CONTAIN 50–60% SAND, 20–30% COMPOST OR HARDWOOD MULCH, AND 20–30% TOPSOIL.

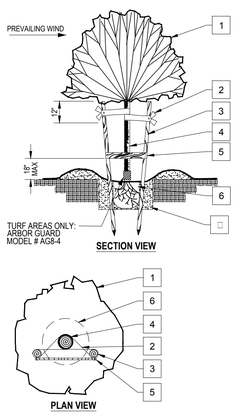
3 BMP-3 BASIN DETAIL
NOT TO SCALE

TREE WELL NOTES

1. TREE CANOPY (SEE TABLE SHOWN HEREON)
2. (2) CINCH TIES, TACK TO STAKE WITH GALVANIZED NAILS TO PREVENT SLIPPING
3. (2) 2" DIA. X 8' LONG UNTREATED LODGEPOLE PINE STAKES FOR 5 GAL. TREES, OR (2) 2" DIA. X 10' LONG UNTREATED LODGEPOLE PINE TAKES FOR 15 GAL.– 36" BOX TREES, SET STAKES OUTSIDE ROOTBALL. ANGLE TOP OF STAKE AWAY FROM BRANCH STRUCTURE.
4. TREE TRUNK
5. 1 X 4 DOUG. FIR BRACE, TACK TO LODGEPOLE STAKES WITH GALV. NAILS
6. ROOT BALL, DO NOT PENETRATE WITH STAKE.
□. USE AMENDED SOIL WITH MINIMUM DEPTH OF 3' + 1' IN ALL DIRECTIONS OF ROOT BALL PER CITY'S BMP MANUAL APPENDIX PG. E–18. MINIMUM SOIL VOLUME 155 CU FT. SEE TABLE SHOWN HEREON FOR DEPTH & DIAMETER.

TREE TIE NOTE:

1. INSTALL TREE TIES AND STAKES ONLY TO PROPER LEVEL TO HOLD TREE UPRIGHT. PROPER HEIGHT IS 6" ABOVE POINT WHERE THE TREE WILL SNAP TO AN UPRIGHT POSITION BY ITSELF IF TOP IS PULLED TO ONE SIDE AS IF WIND LOADED AND THEN RELEASED. DO NOT TOP TREES IN ORDER TO REDUCE SIZE OR WEIGHT OF TREE CROWN, CONTACT LANDSCAPE ARCHITECT PRIOR TO ANY PRUNING OF TREES.



4 TREE WELL DETAILS
NOT TO SCALE

DMA	TREE NUMBER	[1] TREE CANOPY DIAMETER (FT)	PROPOSED STRUCTURAL SOIL PER TREE WELL								
			REQUIRED VOLUME (CU-FT)	□ PROPOSED DEPTH (IN)	AREA (SQ-FT)	□ PROPOSED DIAMETER (FT)	VOLUME PROVIDED (CU-FT)	1.5 X CANOPY RADIUS (FT)	DIAMETER OF SOIL < 1.5 RADIUS OF CANOPY?	2 X CANOPY AREA (SQ-FT)	VOLUME > 2X CANOPY AREA?
1	1-1	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-2	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-3	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-4	30	1413.7	45.0	377.0	22.0	1426	22.5	YES	1414	YES
	1-5	25	981.8	45.0	261.8	18.3	986	18.75	YES	982	YES

REVISIONS

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R·E·C Consultants, Inc.

DATE: 5–17–2017
SCALE: 1" = 100'
DRAWN: J.M.W.
CHECKED: J.R.R.

SHEET TITLE: STRUCTURAL BMPS DETAILS

PROJECT: GREENHILLS RANCH
PHASE 2
COUNTY OF SAN DIEGO, CA

SHEET 6 OF 6 SHEETS

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ATTACHMENT 6

Copy of Project's Drainage Report

This is the cover sheet for Attachment 6.

If hardcopy or CD is not attached, the following information should be provided:

Title: Drainage Study for Greenhills Ranch – Phase 2
Prepared By: REC Consultants, Inc
Date: February 2016, Revised January 2017, Updated April 2018

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DRAINAGE STUDY

For

GREENHILLS RANCH – PHASE 2

9385 ADLAI ROAD
LAKESDIE, CA 92040

Prepared for**:**

Dan Jill Goodman
Trustees of the Goodman Irrevocable Trust
Dated December 11,1992

Prepared by:

REC Consultants, Inc.
2442 Second Avenue
San Diego, CA 92101
Telephone: 619-232-9200

Report Prepared:

February 2, 2016
Revised January 2017
Revised April 2018
Revised July 2019
Revised July 2020

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1.2 Summary of Existing Conditions
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CHAPTER 1 - EXECUTIVE SUMMARY

1.1 - Introduction

The Greenhills Ranch project site is located east of Lake Jennings Park Road and south of Julian Avenue within the County of San Diego, California.

The project site drains to four (4) Points of Compliance (POC): POC-1 is located to the south near the intersection of Audubon Rd and Adlai Road; POC-2 is located to the northwestern portion of the project site; and POC-3 is located to the north of the project site slightly east of POC-2. POC-4 is located at the north property line, however, since there will be a slight reduction in drainage area (runoff from the development will instead flow to a biofiltration basin) and no proposed impervious area, this POC was not analyzed since there will be a lower post-developed 100-year peak flow rate. Please see attached exhibits.

This study analyzes existing and developed condition 100-year peak flowrates from the development to the individual POCs from the project site.

The project site lies outside any FEMA 100-year floodplain zones. Therefore, no Letters of Map Revision will be required.

Treatment of storm water runoff from the site has been addressed in a separate report - the “Storm Water Quality Management Plan for Green Hills Ranch – Phase 2” prepared by REC Consultants, Inc. and dated July 2019. Hydromodification (HMP) analysis has been presented within the “Technical Memorandum: SWMM Modeling for Green Hills Ranch – Phase 2”, prepared by REC Consultants, Inc. and dated July 2019.

Per County of San Diego drainage criteria, the Modified Rational Method should be used to determine peak design flowrates when the contributing drainage area is less than 1.0 square mile. Since the total watershed area discharging from the site is less than 1.0 square mile, the AES computer software was used to model the pre & post developed condition runoff response per the Modified Rational Method.

Methodology used for the computation of design rainfall events, runoff coefficients, and rainfall intensity values are consistent with criteria set forth in the “County of San Diego Drainage Design Manual” dated 2003. A more detailed explanation of methodology used for this analysis is listed in Chapter 2 of this report.

Hydraulic Modified-Puls detention basin routing of the aforementioned AES rational method hydrology was performed using the Army Corps of Engineers HEC-HMS 4.0 software.

1.2 – Summary of Existing Conditions

In existing conditions, the Green Hills Ranch – Phase 2 project site is a vegetated hilltop-site containing four (4) residences. Type C and D hydrologic soil groups were located on the project site via the USGS web soil survey data for the project site (see Chapter 2).

Runoff from the existing site flows to one (1) of ten (10) POCs. POC 1 is a catch basin located near the intersection of Adlai Road and Adlai Terrace. POCs 2 through 10 are natural flow paths. Note that POCs 2 through 10 receive offsite runoff from the adjacent hill. The project site ultimately drains to the receiving San Diego River located approximately 2.5 miles west of the project site.

Per County of San Diego criteria: 0.36 and 0.41 were the assumed runoff coefficients used for the weighted coefficient, 0.37, for the tributary area to POC 1. Tributary areas to POC 2 and 3 also contain C and D-type soils, therefore, a weighted runoff coefficient of 0.34 was assumed. A coefficient value of 0.35 was used for the tributary areas to POC 4-10. Per County of San Diego rainfall isopluvial maps, the design 100-year rainfall depth for the project site is 2.86 inches.

Table 1 below summarizes the existing condition design 100-year peak flow from the project site. The complete analysis can be found in Chapter 3 of this report.

TABLE 1 – Summary of Existing Condition Flows

Discharge Location	Drainage Area (Ac)	Imp %	C coeff	Tc (min)	Intensity (in/hr)	100-Year Peak Flow (cfs)	Peak Velocity (fps)
POC-1	11.45	10%	0.37	16.25	3.52	14.9	2.22
POC-2	1.03	0%	0.34	8.51	5.35	1.8	1.93
POC-3	1.68	0%	0.34	8.52	5.34	2.7	1.45
POC-4	7.02	0%	0.35	-	-	-	-
POC-5	1.6	0%	0.35	-	-	-	-
POC-6	2.0	0%	0.34	-	-	-	-
POC-7	1.6	0%	0.34	-	-	-	-
POC-8	2.7	0%	0.34	-	-	-	-
POC-9	1.2	0%	0.34	-	-	-	-
POC-10	1.6	0%	0.34	-	-	-	-
TOTAL	31.88	-	-	-	-	19.4	-

1.3 – Summary of Developed Conditions

The Greenhills Ranch – Phase 2 project proposes the construction of 64 single family residences and access roads. Three (3) out of the four (4) existing residences will remain undisturbed.

Tributary areas draining to POC 1 will be treated by two (2) multiple purpose onsite biofiltration best management practice (BMP) detention facilities. These basins serve to meet water quality, hydromodification and peak flow reduction requirements for the project site. Undeveloped areas that drain to POC 1 will bypass BMP treatment.

Developed site runoff from tributary areas to POC 2 and POC 3 will be intercepted by one (1) multiple purpose onsite BMP detention facility, and will be discharged to both POCs through the use of two (2) outlet structures, one per BMP. Undeveloped areas that drain to POC 2 and POC 3 will bypass BMP treatment.

Tributary areas to POCs 4 through 10 will remain the same as in existing conditions (i.e. undeveloped) therefore; runoff will remain the same and will not be treated.

Forty eight (48) residential homes are located within the developed portion (11.4 ac) of the tributary area to POC 1. Per County of San Diego criteria, runoff coefficients of 0.48 and 0.52 were used in the determination of weighted coefficient value, 0.48. Sixteen (16) residential homes are located within the developed portion (3.2 ac) of the tributary areas to POC 2 and 3. Runoff coefficients of 0.54 and 0.57 were used in the determination of weighted coefficient value, 0.54. Values of 0.30 and 0.35 were used for the tributary areas to POC 4-10. Per County of San Diego rainfall isopluvial maps, the design 100-year rainfall depth for the project site is 2.86 inches.

Table 2 summarizes the developed, unmitigated condition design 100-year peak flow from the project site. The complete analysis can be found in Chapter 4 of this report. Table 3 summaries the developed, mitigated condition design 100-year peak flow from the project site. The complete analysis can be found in Chapter 5 of this report.

TABLE 2 – Summary of Developed Condition Flows – Unmitigated

Discharge Location	Drainage Area (Ac)	Imp %	C coeff	Tc (min)	Intensity (in/hr)	100-Year Peak Flow (cfs)	Peak Velocity (fps)
POC-1	11.49	54%	0.48	11.58	4.38	25.43	8.51
POC-2	1.08	53%	0.54	13.89	3.93	6.01	8.50
POC-3	1.75	28%	0.54	14.12	3.86	6.01	21.39
POC-4	6.86	0%	0.35	-	-	-	-
POC-5	1.6	0%	0.35	-	-	-	-
POC-6	2.0	0%	0.34	-	-	-	-
POC-7	1.6	0%	0.34	-	-	-	-
POC-8	2.7	0%	0.34	-	-	-	-
POC-9	1.2	0%	0.34	-	-	-	-
POC-10	1.6	0%	0.34	-	-	-	-
TOTAL	31.88	-	-	-	-	37.45	-

TABLE 3 – Summary of Developed Condition Flows - Mitigated

Discharge Location	Drainage Area (Ac)	Imp %	C coeff	Tc (min)	Intensity (in/hr)	100-Year Peak Flow (cfs)	Peak Velocity (fps)
POC-1	11.49	54%	0.48	23.48	2.78	8.2	6.42
POC-2	1.08	53%	0.54	13.89	3.42	1.7	8.50
POC-3	1.75	28%	0.54	17.0	3.42	2.4	15.65
POC-4	6.86	0%	0.35	-	-	-	-
POC-5	1.6	0%	0.35	-	-	-	-
POC-6	2.0	0%	0.34	-	-	-	-
POC-7	1.6	0%	0.34	-	-	-	-
POC-8	2.7	0%	0.34	-	-	-	-
POC-9	1.2	0%	0.34	-	-	-	-
POC-10	1.6	0%	0.34	-	-	-	-
TOTAL	31.88	-	-	-	-	12.3	-

Please note flows outletting to the POCs shall pass over an energy dissipator (rip rap) in order to prevent scouring and erosion.

Prior to discharging from the site, first flush runoff will be treated via the biofiltration based BMP in accordance with standards set forth by the Regional Water Quality Control Board and the County of San Diego's BMP Design Manual (see "Storm Water Quality Management Plan for Green Hills Ranch – Phase 2").

Three (3) LID biofiltration basins are located within the project site and are responsible for handling hydromodification requirements for the project. In developed conditions, the basins will have surface ponding and riser spillway structures (see dimensions in Tables 4 and 5). Flows will then discharge from the basin via the outlet structures or infiltrate through the bio-filtration layer of the facilities to the low flow orifices. The riser structure will act as a spillway such that peak flows can be safely discharged to the receiving storm drain systems.

Beneath the basins' invert lies the proposed LID biofiltration portion of the drainage facility. This portion of the basin is comprised of a 3-inch layer of mulch, an 18-inch layer of amended soil (a highly sandy, organic rich composite with an infiltration capacity of at least 5 inches/hr) and a layer of gravel.

TABLE 4 – SUMMARY OF BMP BASIN DIMENSIONS

BMP	Tributary Area (Ac)[7]	DIMENSIONS					
		BMP Area[1] (ft^2)	Gravel Depth[2] (in)	Lower Orif. D (in)[3]	Elev. Weir (ft)[4]	Weir Perimeter Length[5] (ft)	Total Surface Depth[6] (ft)
1	10.880	13,066	18	1-2.25"	3.50	12	4.5
2	2.584	3,642	18	2 - $^{7}/_{8}$" [8]	2.50	16[9]	3.0
3	0.495	626	18	1-0.5"	2.50	8	3.0

Notes:
(1): Area of amended soil equal to area of gravel
(2): Gravel depth needed to comply with hydromodification purposes. Includes 6" of filter material.
(3): Diameter of orifice in gravel layer with invert at bottom of layer; tied with hydromod min threshold ($0.1 \cdot Q_2$).
(4): Depth of ponding beneath riser structure's surface spillway.
(5): Overflow length, the internal perimeter of the riser is 8 ft (2 ft x 2 ft internal dimensions).
(6): Total surface depth of BMP from top of amended soil to crest elevation.
(7): Tributary area to basin not including area of BMP.
(8): BMP 2 has two riser structures 2-2 and 2-3 which drain to POC-2 and POC-3 respectively. Each one has one LID low orifice, measuring 0.875".
(9): Structure 2-2 and 2-3 each has an 8 foot perimeter weir.

TABLE 5 – SUMMARY OF OUTLET DETAILS:

BASIN	Low Surface Orifices		Lower Slot		Emergency Weir	
	# - dia (in)	Elev. (ft) [1]	W (in) x H (in)	Elev. (ft)[1]	L (ft)	Elev. (ft)[1]
1	4 - 1"	1.25	72 x 3 (4 slots 18 x 3)	2.50	12	3.50
2 [2]	2- ¾"	1.25	36 x 3 (2 slots, 18 x 3 each)	2.00	8	2.50
2 [3]	n/a	n/a	36 x 3 (2 slots, 18 x 3 each)	2.00	8	2.50
3	1- 1"	1.25	n/a	n/a	8	2.50

Notes:
(1): All elevations measured from the top of the amended soil (amended soil/mulch interphase)
(2): This is structure 2-2, which drains to POC-2
(3): This is the outlet structure of BMP-2 that drains to POC-3 (identical than the other but with no low surface orifices)

The developed condition peak flows calculated using the modified rational method were then routed through the detention facilities on the project site in HEC-HMS. The HMS Modified-Puls results are summarized in Table 6.

TABLE 6 – SUMMARY OF DETENTION BASIN ROUTING

Detention Basin	100-Year Peak Inflow (cfs)	100-Year Peak Outflow (cfs)	Peak Water Surface Elevation (ft)[(1)]
BMP-1	24.05	7.19	5.32
BMP-2	6.01	4.11	4.18
BMP-3	2.36	2.09	4.92

(1) : Biofiltraion layer included as part of basin depth – volume reduced by voids accordingly

It should be noted that as a conservative design approach, it has been assumed that the 85th percentile water quality event volume was stored in the detention facilities prior to the routing of the 100-year event storm. 85th percentile volumes are provided in Chapter 6 of this report. The volumes are a conservative hydraulic design methodology only. For water quality discussion and BMP sizing analysis, please refer to the site specific SWMP.

Additionally, as the detention facilities are multiple purpose water quality and hydromodfication BMPs, there is available storage provided in the biofiltration layers of the basins; namely the engineered fill soil layer and the underlying gravel base layer. As HEC-HMS uses an elevation-storage-discharge function to model the basin volume (stage-storage) and basin discharge (stage-discharge) relationships, the available storage volume provided by these aforementioned sub-layers is accounted for by reducing the total sub-basin volume by the corresponding void ratio for each layer (0.4 for gravel and 0.3 for soil respectively).

Rational method hydrographs, stage-storage, stage-discharge relationships and HEC-HMS model output is provided in Chapter 6 of this report.

1.4 - Summary of Results

Table 7 summarizes existing and developed (mitigated) condition drainage areas and resultant 100-year peak flow rates at the POC discharge locations from the Greenhills Ranch – Phase 2 site. Per County of San Diego rainfall isolpluvial maps, the design 100-year rainfall depth for the site area is 2.86 inches.

TABLE 7 – SUMMARY OF PEAK FLOWS

Discharge Location	Area (ac)			100 Year Peak Flow (cfs)		
	Existing	Developed	Difference	Existing	Developed	Difference
POC-1	11.45	11.49	0.04	14.9	8.2	-6.7
POC-2	1.03	1.08	0.05	1.8	1.7	-0.1
POC-3	1.68	1.75	0.07	2.7	2.4	-0.3
POC-4	7.02	6.86	-0.16	-	-	-
POC-5	1.6	1.6	-	-	-	-
POC-6	2.0	2.0	-	-	-	-
POC-7	1.6	1.6	-	-	-	-
POC-8	2.7	2.7	-	-	-	-
POC-9	1.2	1.2	-	-	-	-
POC-10	1.6	1.6	-	-	-	-
Total	31.88	31.88	0.0	19.4	12.3	-7.1

As shown in the above table, the proposed Greenhills Ranch – Phase 2 project site will result in a net decrease of peak flow discharged from the project site by approximately 7.1 cfs.

All developed runoff will receive water quality treatment in accordance with the site specific SWQMP. Additionally, the POC is HMP compliant as analyzed in the Hydromodification Technical Memo.

Final design details will be provided at the final engineering phase of the development.

1.5 - References

"*County of San Diego Hydrology Manual*", June 2003.

"*Q100 Routing Analysis for Greenhills Ranch – Phase 2*", prepared by REC Consultants, Inc., January 2016.

"*Storm Water Quality Management Plan for Greenhills Ranch – Phase 2*", prepared by REC Consultants, Inc., April 2018.

"*Technical Memorandum: SWMM Modeling for Greenhills Ranch – Phase 2*", prepared by REC Consultants, Inc., April 2018

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1.6 - Declaration of Responsible Charge

THIS DRAINAGE STUDY HAS BEEN PREPARED UNDER THE DIRECTION OF THE FOLLOWING REGISTERED CIVIL ENGINEER. THE REGISTERED ENGINEER ATTESTS TO THE TECHNICAL INFORMATION CONTAINED HEREIN AND THE ENGINEERING DATA UPON WHICH RECOMMENDATIONS, CONCLUSIONS, AND DECISIONS ARE BASED.

Jonathan Raab Rydeen R.C.E. 64811

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CHAPTER 2: METHODOLOGY – RATIONAL METHOD PEAK FLOWRATE DETERMINATION

2.1 – County of San Diego Design Criteria

SECTION 3
RATIONAL METHOD AND MODIFIED RATIONAL METHOD

3.1 THE RATIONAL METHOD

The Rational Method (RM) is a mathematical formula used to determine the maximum runoff rate from a given rainfall. It has particular application in urban storm drainage, where it is used to estimate peak runoff rates from small urban and rural watersheds for the design of storm drains and small drainage structures. The RM is recommended for analyzing the runoff response from drainage areas up to approximately 1 square mile in size. It should not be used in instances where there is a junction of independent drainage systems or for drainage areas greater than approximately 1 square mile in size. In these instances, the Modified Rational Method (MRM) should be used for junctions of independent drainage systems in watersheds up to approximately 1 square mile in size (see Section 3.4); or the NRCS Hydrologic Method should be used for watersheds greater than approximately 1 square mile in size (see Section 4).

The RM can be applied using any design storm frequency (e.g., 100-year, 50-year, 10-year, etc.). The local agency determines the design storm frequency that must be used based on the type of project and specific local requirements. A discussion of design storm frequency is provided in Section 2.3 of this manual. A procedure has been developed that converts the 6-hour and 24-hour precipitation isopluvial map data to an Intensity-Duration curve that can be used for the rainfall intensity in the RM formula as shown in Figure 3-1. The RM is applicable to a 6-hour storm duration because the procedure uses Intensity-Duration Design Charts that are based on a 6-hour storm duration.

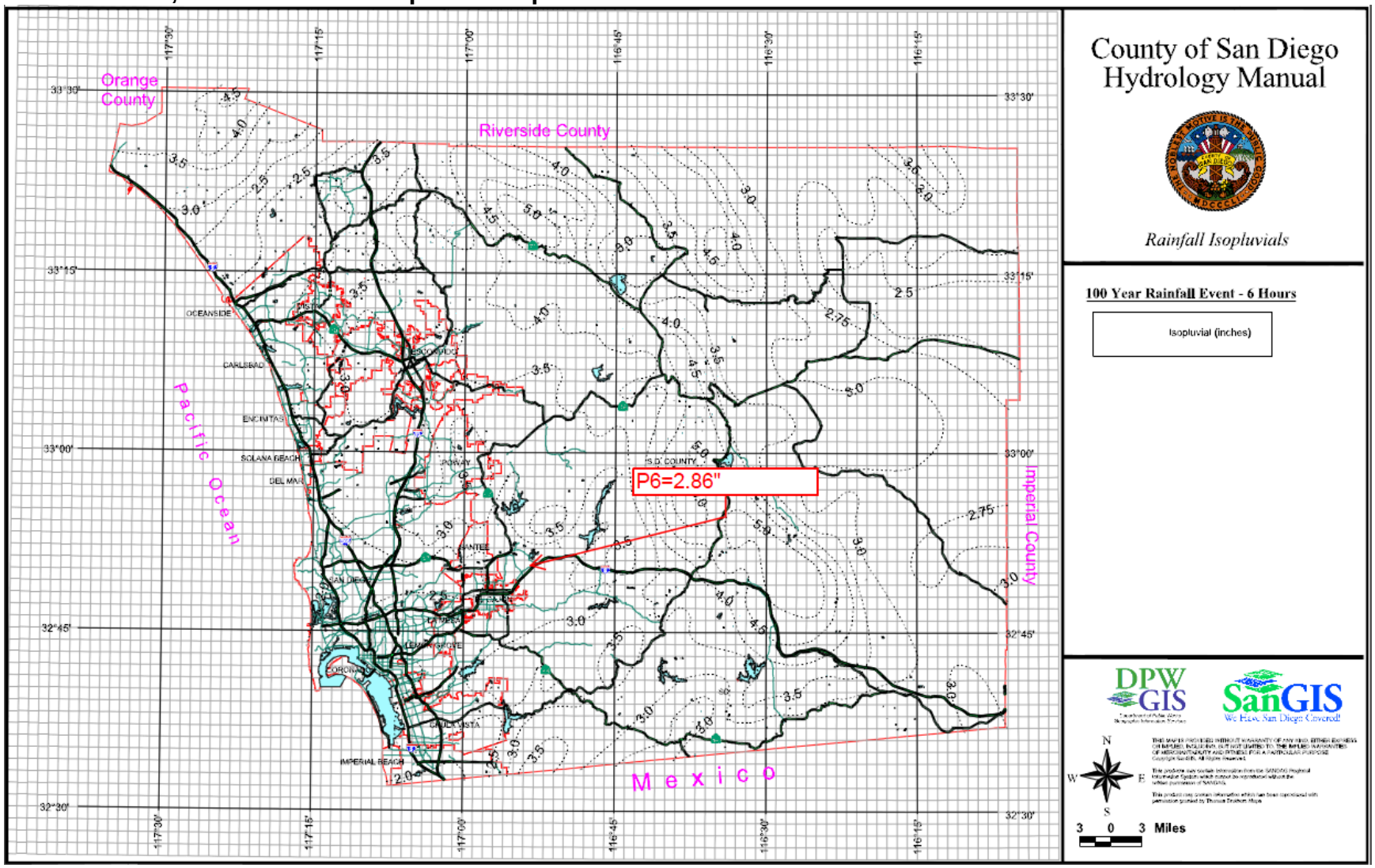
3.1.1 Rational Method Formula

The RM formula estimates the peak rate of runoff at any location in a watershed as a function of the drainage area (A), runoff coefficient (C), and rainfall intensity (I) for a duration equal to the time of concentration (T_c), which is the time required for water to

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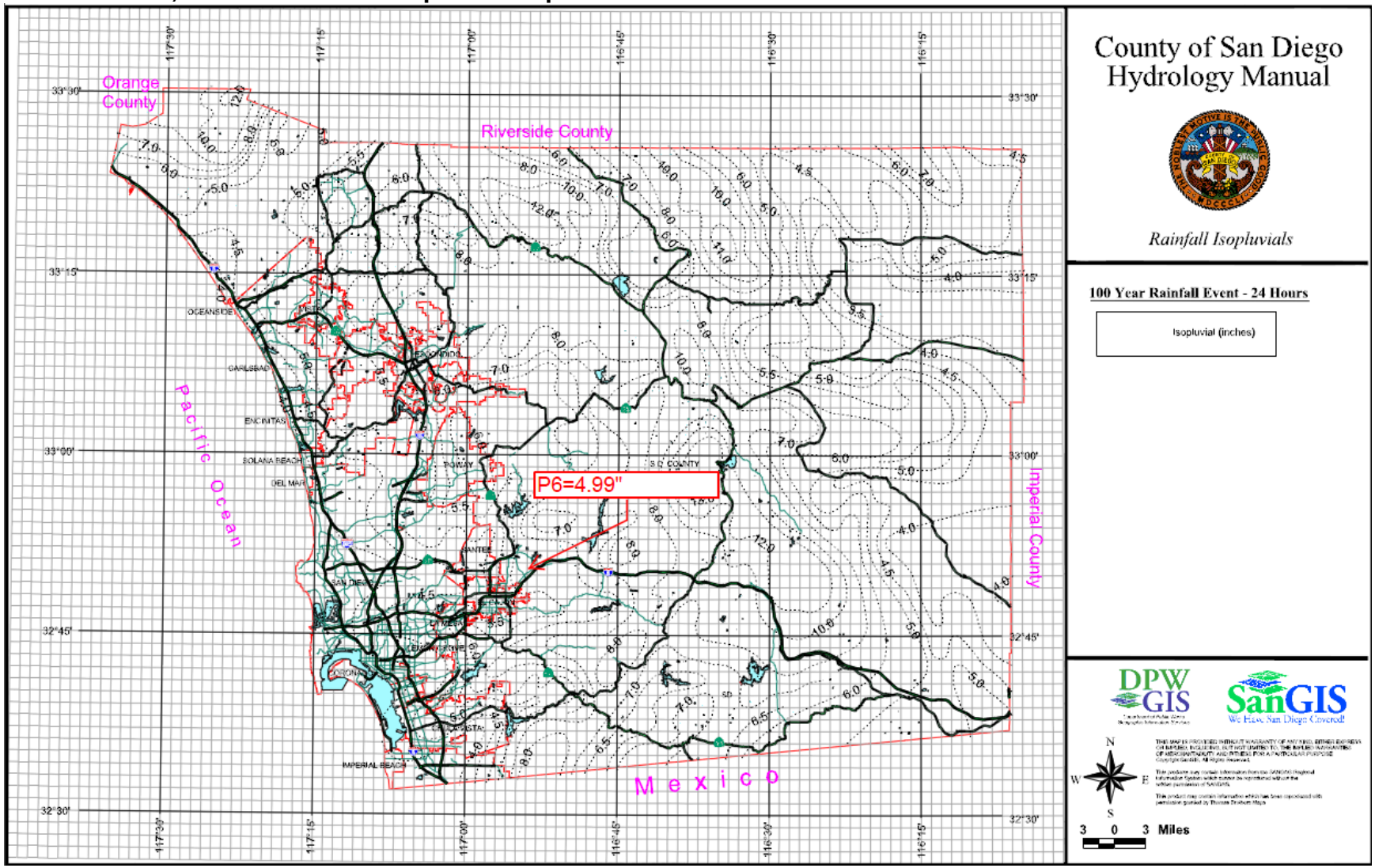
2.2 – Design Rainfall Determination

2.2.1 – 100-Year, 6-Hour Rainfall Isopluvial Map



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2.2.2 – 100-Year, 24-Hour Rainfall Isopluvial Map



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2.3 – Runoff Coefficient Determination

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service

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PRE DEVELOPED AREAS

	Type C HSG		Type D HSG			
Area	Area (ac)	C	Area (ac)	C	Total Area (ac)	Weighted C
1	22.80	0.36	2.80	0.41	25.6	0.37
2	4.66	0.30	18.10	0.35	22.8	0.34
3	0.81	0.30	6.22	0.35	7.0	0.34
4	0.00	0.30	4.14	0.35	4.1	0.35
5	0.00	0.30	2.12	0.35	2.1	0.35
6	0.00	0.30	1.63	0.35	1.6	0.35
Total	28.3		35.0		63.3	

POST DEVELOPED AREAS

	Type C HSG		Type D HSG			
Area	Area (ac)	C	Area (ac)	C	Total Area (ac)	Weighted C
1	11.73	0.48	0.09	0.52	11.8	0.48
Bypass 1	11.15	0.30	2.71	0.35	13.9	0.31
2	2.55	0.54	0.50	0.57	3.0	0.54
Bypass 2	2.20	0.30	17.65	0.35	19.9	0.34
3	0.68	0.30	6.13	0.35	6.8	0.35
4	0.00	0.30	4.14	0.35	4.1	0.35
5	0.00	0.30	2.12	0.35	2.1	0.35
6	0.00	0.30	1.63	0.35	1.6	0.35
Total	28.3		35.0		63.3	

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2.4 – Urban Watershed Overland Time of flow Nomograph

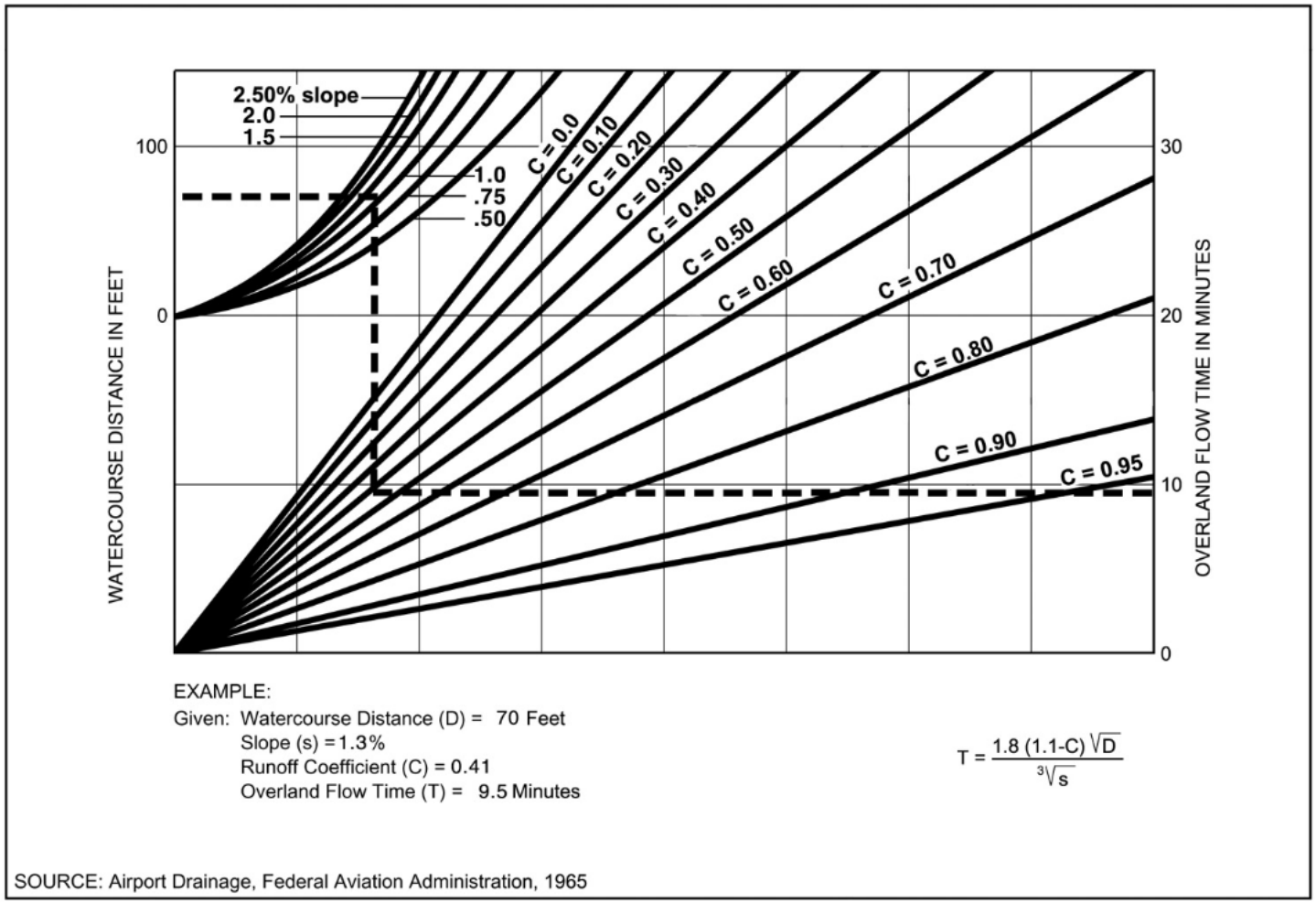
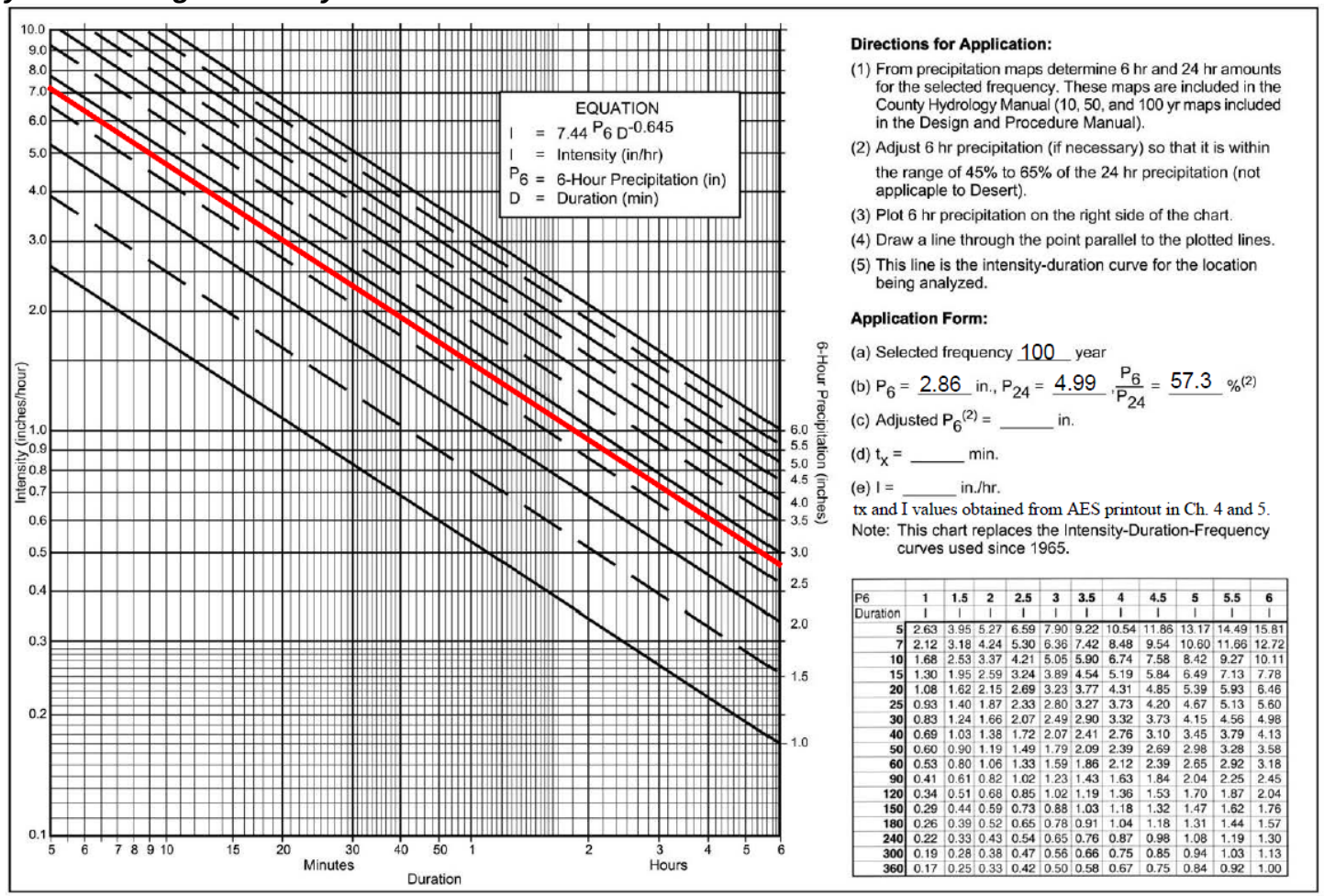


FIGURE 3-3

Rational Formula - Overland Time of Flow Nomograph

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2.5 – County of San Diego Intensity-Duration Curve



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 2.86 in., P_{24} = 4.99, $\frac{P_6}{P_{24}}$ = 57.3 %(2)

(c) Adjusted $P_6^{(2)}$ = _____ in.

(d) t_x = _____ min.

(e) I = _____ in./hr.

tx and I values obtained from AES printout in Ch. 4 and 5.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE 3-1

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2.6– Model Development Summary (from County of San Diego Hydrology Manual)

3.2 Developing Input Data for the Rational Method

This section describes the development of the necessary data to perform RM calculations. Section 3.3 describes the RM calculation process. Input data for calculating peak flows and T_c's with the RM should be developed as follows:

1. On a topographic base map, outline the overall drainage area boundary, showing adjacent drains, existing and proposed drains, and overland flow paths.

2. Verify the accuracy of the drainage map in the field.

3. Divide the drainage area into subareas by locating significant points of interest. These divisions should be based on topography, soil type, and land use. Ensure that an appropriate first subarea is delineated. For natural areas, the first subarea flow path length should be less than or equal to 4,000 feet plus the overland flow length (Table 3-2). For developed areas, the initial subarea flow path length should be consistent with Table 3-2. The topography and slope within the initial subarea should be generally uniform.

4. Working from upstream to downstream, assign a number representing each subarea in the drainage system to each point of interest. Figure 3-8 provides guidelines for node numbers for geographic information system (GIS)-based studies.

5. Measure each subarea in the drainage area to determine its size in acres (A).

6. Determine the length and effective slope of the flow path in each subarea.

7. Identify the soil type for each subarea.

8. Determine the runoff coefficient (C) for each subarea based on Table 3-1. If the subarea contains more than one type of development classification, use a proportionate average for C. In determining C for the subarea, use future land use taken from the applicable community plan, Multiple Species Conservation Plan, National Forest land use plan, etc.

9. Calculate the CA value for the subarea.

10. Calculate the Σ(CA) value(s) for the subareas upstream of the point(s) of interest.

11. Determine P_6 and P_{24} for the study using the isopluvial maps provided in Appendix B. If necessary, adjust the value for P_6 to be within 45% to 65% of the value for P_{24}.

See Section 3.3 for a description of the RM calculation process.

3.3 Performing Rational Method Calculations

This section describes the RM calculation process. Using the input data, calculation of peak flows and T_c's should be performed as follows:

1. Determine T_i for the first subarea. Use Table 3-2 or Figure 3-3 as discussed in Section 3.1.4. If the watershed is natural, the travel time to the downstream end of the first subarea can be added to T_i to obtain the T_c. Refer to paragraph 3.1.4.2 (a).

2. Determine I for the subarea using Figure 3-1. If T_i was less than 5 minutes, use the 5 minute time to determine intensity for calculating the flow.

3. Calculate the peak discharge flow rate for the subarea, where $Q_p = \Sigma(CA)\, I$.
In case that the downstream flow rate is less than the upstream flow rate, due to the long travel time that is not offset by the additional subarea runoff, use the upstream peak flow for design purposes until downstream flows increase again.

4. Estimate the T_t to the next point of interest.

5. Add the T_t to the previous T_c to obtain a new T_c.

6. Continue with step 2, above, until the final point of interest is reached.

Note: The MRM should be used to calculate the peak discharge when there is a junction from independent subareas into the drainage system.

3.4 MODIFIED RATIONAL METHOD (FOR JUNCTION ANALYSIS)

The purpose of this section is to describe the steps necessary to develop a hydrology report for a small watershed using the MRM. It is necessary to use the MRM if the watershed contains junctions of independent drainage systems. The process is based on the design manuals of the City/County of San Diego. The general process description for using this method, including an example of the application of this method, is described below.

The engineer should only use the MRM for drainage areas up to approximately 1 square mile in size. If the watershed will significantly exceed 1 square mile then the NRCS method described in Section 4 should be used. The engineer may choose to use either the RM or the MRM for calculations for up to an approximately 1-square-mile area and then transition the study to the NRCS method for additional downstream areas that exceed approximately 1 square mile. The transition process is described in Section 4.

3.4.1 Modified Rational Method General Process Description

The general process for the MRM differs from the RM only when a junction of independent drainage systems is reached. The peak Q, T_c, and I for each of the independent drainage systems at the point of the junction are calculated by the RM. The independent drainage systems are then combined using the MRM procedure described below. The peak Q, T_c, and I for each of the independent drainage systems at the point of the junction must be calculated prior to using the MRM procedure to combine the independent drainage systems, as these

values will be used for the MRM calculations. After the independent drainage systems have been combined, RM calculations are continued to the next point of interest.

3.4.2 Procedure for Combining Independent Drainage Systems at a Junction

Calculate the peak Q, T_c, and I for each of the independent drainage systems at the point of the junction. These values will be used for the MRM calculations.

At the junction of two or more independent drainage systems, the respective peak flows are combined to obtain the maximum flow out of the junction at T_c. Based on the approximation that total runoff increases directly in proportion to time, a general equation may be written to determine the maximum Q and its corresponding T_c using the peak Q, T_c, and I for each of the independent drainage systems at the point immediately before the junction. The general equation requires that contributing Q's be numbered in order of increasing T_c.

Let Q_1, T_1, and I_1 correspond to the tributary area with the shortest T_c. Likewise, let Q_2, T_2, and I_2 correspond to the tributary area with the next longer T_c; Q_3, T_3, and I_3 correspond to the tributary area with the next longer T_c; and so on. When only two independent drainage systems are combined, leave Q_3, T_3, and I_3 out of the equation. Combine the independent drainage systems using the junction equation below:

Junction Equation: $T_1 < T_2 < T_3$

$$Q_{T1} = Q_1 + \frac{T_1}{T_2} Q_2 + \frac{T_1}{T_3} Q_3$$

$$Q_{T2} = Q_2 + \frac{I_2}{I_1} Q_1 + \frac{T_2}{T_3} Q_3$$

$$Q_{T3} = Q_3 + \frac{I_3}{I_1} Q_1 + \frac{I_3}{I_2} Q_2$$

Calculate Q_{T1}, Q_{T2}, and Q_{T3}. Select the largest Q and use the T_c associated with that Q for further calculations (see the three Notes for options). If the largest calculated Q's are equal (e.g., $Q_{T1} = Q_{T2} > Q_{T3}$), use the shorter of the T_c's associated with that Q.

This equation may be expanded for a junction of more than three independent drainage systems using the same concept. The concept is that when Q from a selected subarea (e.g., Q_2) is combined with Q from another subarea with a shorter T_c (e.g., Q_1), the Q from the subarea with the shorter T_c is reduced by the ratio of the I's (I_2/I_1); and when Q from a selected subarea (e.g., Q_2) is combined with Q from another subarea with a longer T_c (e.g., Q_3), the Q from the subarea with the longer T_c is reduced by the ratio of the T_c's (T_2/T_3).

Note #1: At a junction of two independent drainage systems that have the same T_c, the tributary flows may be added to obtain the Q_p.

$$Q_p = Q_1 + Q_2 \text{; when } T_1 = T_2 \text{; and } T_c = T_1 = T_2$$

This can be verified by using the junction equation above. Let Q_3, T_3, and $I_3 = 0$. When T_1 and T_2 are the same, I_1 and I_2 are also the same, and T_1/T_2 and $I_2/I_1 = 1$. T_1/T_2 and I_2/I_1 are cancelled from the equations. At this point, $Q_{T1} = Q_{T2} = Q_1 + Q_2$.

Note #2: In the upstream part of a watershed, a conservative computation is acceptable. When the times of concentration (T_c's) are relatively close in magnitude (within 10%), use the shorter T_c for the intensity and the equation $Q = \Sigma(CA)I$.

Note #3: . An optional method of determining the T_c is to use the equation
$T_c = [(\Sigma (CA)7.44\ P_6)/Q]^{1.55}$

This equation is from $Q = \Sigma(CA)I = \Sigma(CA)(7.44\ P_6/T_c^{.645})$ and solving for T_c. The advantage in this option is that the T_c is consistent with the peak flow Q, and avoids inappropriate fluctuation in downstream flows in some cases.

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CHAPTER 3 - 100-Year Hydrologic Analysis for Existing Conditions

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            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2015 Advanced Engineering Software (aes)
              Ver. 22.0 Release Date: 07/01/2015  License ID 1643

                            Analysis prepared by:

                               REC Consultants
                               2442 Second St.
                              San Diego, Ca 92101


 ************************* DESCRIPTION OF STUDY *************************
* Existing Condition Hydrology                                           *
* 100 Year Storm                                                         *
* Greenhills Ranch - Phase 2                                             *
 ************************************************************************

  FILE NAME: 1083PRE.DAT
  TIME/DATE OF STUDY: 16:03 04/10/2018
------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.860
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE      1.01 TO NODE      1.02 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .3700
  S.C.S. CURVE NUMBER (AMC II) =  98
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =    765.59
  DOWNSTREAM ELEVATION(FEET) =    760.00
  ELEVATION DIFFERENCE(FEET) =      5.59
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    7.404
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.850
  SUBAREA RUNOFF(CFS) =      0.61
  TOTAL AREA(ACRES) =      0.28   TOTAL RUNOFF(CFS) =      0.61

****************************************************************************
```

```
  FLOW PROCESS FROM NODE      1.02 TO NODE      1.03 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    760.00  DOWNSTREAM(FEET) =    657.25
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1178.00   CHANNEL SLOPE =  0.0872
  CHANNEL BASE(FEET) =   50.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   2.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.524
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .3700
  S.C.S. CURVE NUMBER (AMC II) =  98
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       8.27
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.22
  AVERAGE FLOW DEPTH(FEET) =   0.07   TRAVEL TIME(MIN.) =   8.84
  Tc(MIN.) =   16.25
  SUBAREA AREA(ACRES) =    11.17       SUBAREA RUNOFF(CFS) =   14.56
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.370
  TOTAL AREA(ACRES) =       11.4         PEAK FLOW RATE(CFS) =      14.93

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.10   FLOW VELOCITY(FEET/SEC.) =   2.81
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.03 =    1278.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.02 TO NODE      1.03 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   16.25
  RAINFALL INTENSITY(INCH/HR) =   3.52
  TOTAL STREAM AREA(ACRES) =    11.45
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     14.93

****************************************************************************
  FLOW PROCESS FROM NODE      2.01 TO NODE      2.02 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  NATURAL DESERT LANDSCAPING RUNOFF COEFFICIENT = .3000
  S.C.S. CURVE NUMBER (AMC II) =  98
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =    732.00
  DOWNSTREAM ELEVATION(FEET) =    726.00
  ELEVATION DIFFERENCE(FEET) =      6.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    7.925
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.599
  SUBAREA RUNOFF(CFS) =      0.17
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.17

****************************************************************************
  FLOW PROCESS FROM NODE      2.02 TO NODE      2.03 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    726.00  DOWNSTREAM(FEET) =    702.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    54.00   CHANNEL SLOPE =  0.4444
  CHANNEL BASE(FEET) =   50.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   2.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.349
  *USER SPECIFIED(SUBAREA):
  NATURAL DESERT LANDSCAPING RUNOFF COEFFICIENT = .3200
  S.C.S. CURVE NUMBER (AMC II) =  98
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.96
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.55
  AVERAGE FLOW DEPTH(FEET) =   0.01   TRAVEL TIME(MIN.) =   0.58
  Tc(MIN.) =    8.51
```

```
  SUBAREA AREA(ACRES) =     0.93       SUBAREA RUNOFF(CFS) =    1.59
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.318
  TOTAL AREA(ACRES) =        1.0         PEAK FLOW RATE(CFS) =       1.75

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.02   FLOW VELOCITY(FEET/SEC.) =   1.93
  LONGEST FLOWPATH FROM NODE      2.01 TO NODE      2.03 =     154.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      2.02 TO NODE      2.03 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.51
  RAINFALL INTENSITY(INCH/HR) =   5.35
  TOTAL STREAM AREA(ACRES) =     1.03
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.75

****************************************************************************
  FLOW PROCESS FROM NODE      3.01 TO NODE      3.02 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  NATURAL DESERT LANDSCAPING RUNOFF COEFFICIENT = .3000
  S.C.S. CURVE NUMBER (AMC II) =  98
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =    780.00
  DOWNSTREAM ELEVATION(FEET) =    750.00
  ELEVATION DIFFERENCE(FEET) =     30.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.684
  WARNING: THE MAXIMUM OVERLAND FLOW SLOPE, 10.%, IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.248
  SUBAREA RUNOFF(CFS) =      0.19
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.19

****************************************************************************
  FLOW PROCESS FROM NODE      3.02 TO NODE      3.03 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    750.00  DOWNSTREAM(FEET) =    720.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   160.00   CHANNEL SLOPE =  0.1875
  CHANNEL BASE(FEET) =   50.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   2.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.342
  *USER SPECIFIED(SUBAREA):
  NATURAL DESERT LANDSCAPING RUNOFF COEFFICIENT = .3000
  S.C.S. CURVE NUMBER (AMC II) =  98
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.46
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.45
  AVERAGE FLOW DEPTH(FEET) =   0.02   TRAVEL TIME(MIN.) =   1.84
  Tc(MIN.) =    8.52
  SUBAREA AREA(ACRES) =     1.56       SUBAREA RUNOFF(CFS) =    2.50
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.300
  TOTAL AREA(ACRES) =        1.7         PEAK FLOW RATE(CFS) =       2.66

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.03   FLOW VELOCITY(FEET/SEC.) =   1.91
  LONGEST FLOWPATH FROM NODE      3.01 TO NODE      3.03 =     260.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.02 TO NODE      3.03 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.52
```

```
  RAINFALL INTENSITY(INCH/HR) =   5.34
  TOTAL STREAM AREA(ACRES) =     1.66
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.66
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        1.7  TC(MIN.) =      8.52
  PEAK FLOW RATE(CFS)   =       2.66
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

CHAPTER 4 - 100-Year Hydrologic Analysis for Developed Conditions - Unmitigated

```
**************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2015 Advanced Engineering Software (aes)
              Ver. 22.0 Release Date: 07/01/2015  License ID 1643

                          Analysis prepared by:

                             REC Consultants
                             2442 Second St.
                           San Diego, Ca 92101


 ************************* DESCRIPTION OF STUDY *************************
* Proposed Conditions Hydrology - Unmitigated                             *
* 100 Year Storm                                                         *
* Greenhills Ranch Phase 2                                               *
 **************************************************************************

  FILE NAME: 1083PSTU.DAT
  TIME/DATE OF STUDY: 08:07 07/19/2019
--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.860
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

**************************************************************************
  FLOW PROCESS FROM NODE      1.11 TO NODE      1.12 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =    770.00
  DOWNSTREAM ELEVATION(FEET) =    767.08
  ELEVATION DIFFERENCE(FEET) =      2.92
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    7.562
```

```
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    93.80
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.770
  SUBAREA RUNOFF(CFS) =      0.28
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.28

****************************************************************************
  FLOW PROCESS FROM NODE      1.12 TO NODE      1.13 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  767.08  DOWNSTREAM ELEVATION(FEET) =  729.22
  STREET LENGTH(FEET) =   480.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.82
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.24
    HALFSTREET FLOOD WIDTH(FEET) =    4.28
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    5.10
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.22
  STREET FLOW TRAVEL TIME(MIN.) =   1.57   Tc(MIN.) =    9.13
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.109
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.480
  SUBAREA AREA(ACRES) =    1.26      SUBAREA RUNOFF(CFS) =    3.09
  TOTAL AREA(ACRES) =        1.4        PEAK FLOW RATE(CFS) =       3.34

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.29   HALFSTREET FLOOD WIDTH(FEET) =   6.91
  FLOW VELOCITY(FEET/SEC.) =  5.38   DEPTH*VELOCITY(FT*FT/SEC.) =   1.54
  LONGEST FLOWPATH FROM NODE      1.11 TO NODE      1.13 =     580.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.13 TO NODE      1.14 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   726.22  DOWNSTREAM(FEET) =   693.47
  FLOW LENGTH(FEET) =   460.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   9.0 INCH PIPE IS   6.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.76
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.34
  PIPE TRAVEL TIME(MIN.) =   0.71    Tc(MIN.) =    9.84
  LONGEST FLOWPATH FROM NODE      1.11 TO NODE      1.14 =    1040.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.13 TO NODE      1.14 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
```

```
==========================================================================

**************************************************************************
  FLOW PROCESS FROM NODE      1.21 TO NODE      1.22 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    55.00
  UPSTREAM ELEVATION(FEET) =    731.72
  DOWNSTREAM ELEVATION(FEET) =    729.62
  ELEVATION DIFFERENCE(FEET) =      2.10
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    5.296
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.261
  SUBAREA RUNOFF(CFS) =      0.12
  TOTAL AREA(ACRES) =      0.04   TOTAL RUNOFF(CFS) =      0.12

**************************************************************************
  FLOW PROCESS FROM NODE      1.22 TO NODE      1.23 IS CODE =  62
--------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
==========================================================================
  UPSTREAM ELEVATION(FEET) =  729.62  DOWNSTREAM ELEVATION(FEET) =  698.92
  STREET LENGTH(FEET) =  1180.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.06
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.35
    HALFSTREET FLOOD WIDTH(FEET) =   10.27
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.58
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.24
  STREET FLOW TRAVEL TIME(MIN.) =   5.50   Tc(MIN.) =   10.79
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.587
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.480
  SUBAREA AREA(ACRES) =    3.47      SUBAREA RUNOFF(CFS) =    7.64
  TOTAL AREA(ACRES) =        3.5        PEAK FLOW RATE(CFS) =       7.72

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.41   HALFSTREET FLOOD WIDTH(FEET) =  13.71
  FLOW VELOCITY(FEET/SEC.) =  4.12   DEPTH*VELOCITY(FT*FT/SEC.) =   1.68
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.23 =    1235.00 FEET.

**************************************************************************
  FLOW PROCESS FROM NODE      1.23 TO NODE      1.24 IS CODE =  31
--------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
==========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   695.92  DOWNSTREAM(FEET) =   694.92
  FLOW LENGTH(FEET) =     6.00   MANNING'S N =  0.013
```

```
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   6.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  18.43
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       7.72
  PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =   10.80
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.24 =    1241.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.23 TO NODE      1.24 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.80
  RAINFALL INTENSITY(INCH/HR) =   4.59
  TOTAL STREAM AREA(ACRES) =     3.51
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      7.72

****************************************************************************
  FLOW PROCESS FROM NODE      1.31 TO NODE      1.32 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    95.00
  UPSTREAM ELEVATION(FEET) =    724.18
  DOWNSTREAM ELEVATION(FEET) =    720.59
  ELEVATION DIFFERENCE(FEET) =      3.59
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.984
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.074
  SUBAREA RUNOFF(CFS) =      0.35
  TOTAL AREA(ACRES) =      0.12   TOTAL RUNOFF(CFS) =      0.35

****************************************************************************
  FLOW PROCESS FROM NODE      1.32 TO NODE      1.33 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  720.59  DOWNSTREAM ELEVATION(FEET) =  698.97
  STREET LENGTH(FEET) =   535.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.87
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.27
    HALFSTREET FLOOD WIDTH(FEET) =    5.84
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.76
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.00
  STREET FLOW TRAVEL TIME(MIN.) =   2.37   Tc(MIN.) =    9.36
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.030
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =   0
```

```
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.480
  SUBAREA AREA(ACRES) =    1.26      SUBAREA RUNOFF(CFS) =    3.04
  TOTAL AREA(ACRES) =        1.4        PEAK FLOW RATE(CFS) =       3.33

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.31   HALFSTREET FLOOD WIDTH(FEET) =   8.34
  FLOW VELOCITY(FEET/SEC.) =  4.09   DEPTH*VELOCITY(FT*FT/SEC.) =   1.27
  LONGEST FLOWPATH FROM NODE      1.31 TO NODE      1.33 =     630.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.33 TO NODE      1.24 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   695.97  DOWNSTREAM(FEET) =   694.92
  FLOW LENGTH(FEET) =    25.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   5.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.92
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.33
  PIPE TRAVEL TIME(MIN.) =   0.05    Tc(MIN.) =    9.40
  LONGEST FLOWPATH FROM NODE      1.31 TO NODE      1.24 =     655.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.33 TO NODE      1.24 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    9.40
  RAINFALL INTENSITY(INCH/HR) =   5.01
  TOTAL STREAM AREA(ACRES) =     1.38
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      3.33

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        7.72    10.80        4.586          3.51
      2        3.33     9.40        5.014          1.38

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       10.05     9.40       5.014
      2       10.76    10.80       4.586

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      10.76   Tc(MIN.) =   10.80
  TOTAL AREA(ACRES) =        4.9
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.24 =    1241.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.24 TO NODE      1.14 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   694.92  DOWNSTREAM(FEET) =   693.47
  FLOW LENGTH(FEET) =    41.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS  11.2 INCHES
```

```
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.93
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      10.76
  PIPE TRAVEL TIME(MIN.) =   0.06    Tc(MIN.) =   10.86
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.14 =    1282.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.21 TO NODE      1.14 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1       10.76    10.86       4.569        4.89
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.14 =    1282.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1        3.34     9.84       4.868        1.36
  LONGEST FLOWPATH FROM NODE      1.11 TO NODE      1.14 =    1040.00 FEET.

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
      1      13.09       9.84        4.868
      2      13.90      10.86        4.569

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      13.90   Tc(MIN.) =   10.86
  TOTAL AREA(ACRES) =        6.2

****************************************************************************
  FLOW PROCESS FROM NODE      1.14 TO NODE      1.15 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   693.47  DOWNSTREAM(FEET) =   688.33
  FLOW LENGTH(FEET) =    65.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS  10.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  15.97
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      13.90
  PIPE TRAVEL TIME(MIN.) =   0.07    Tc(MIN.) =   10.93
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.15 =    1347.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.14 TO NODE      1.15 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.93
  RAINFALL INTENSITY(INCH/HR) =   4.55
  TOTAL STREAM AREA(ACRES) =     6.25
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     13.90

****************************************************************************
  FLOW PROCESS FROM NODE      1.41 TO NODE      1.42 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
```

```
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =    770.00
  DOWNSTREAM ELEVATION(FEET) =    769.00
  ELEVATION DIFFERENCE(FEET) =      1.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    9.337
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    70.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.037
  SUBAREA RUNOFF(CFS) =      0.11
  TOTAL AREA(ACRES) =      0.04   TOTAL RUNOFF(CFS) =      0.11

****************************************************************************
  FLOW PROCESS FROM NODE      1.42 TO NODE      1.43 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  769.00  DOWNSTREAM ELEVATION(FEET) =  691.67
  STREET LENGTH(FEET) =   790.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.67
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.22
    HALFSTREET FLOOD WIDTH(FEET) =    3.16
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    5.90
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.29
  STREET FLOW TRAVEL TIME(MIN.) =   2.23   Tc(MIN.) =   11.57
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.387
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.480
  SUBAREA AREA(ACRES) =    1.49      SUBAREA RUNOFF(CFS) =    3.14
  TOTAL AREA(ACRES) =        1.5        PEAK FLOW RATE(CFS) =       3.23

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.27   HALFSTREET FLOOD WIDTH(FEET) =   6.28
  FLOW VELOCITY(FEET/SEC.) =  5.91   DEPTH*VELOCITY(FT*FT/SEC.) =   1.62
  LONGEST FLOWPATH FROM NODE      1.41 TO NODE      1.43 =     890.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.43 TO NODE      1.15 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   688.67  DOWNSTREAM(FEET) =   688.33
  FLOW LENGTH(FEET) =     8.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   9.0 INCH PIPE IS   7.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.57
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
```

```
  PIPE-FLOW(CFS) =       3.23
  PIPE TRAVEL TIME(MIN.) =   0.02    Tc(MIN.) =   11.58
  LONGEST FLOWPATH FROM NODE      1.41 TO NODE      1.15 =     898.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.43 TO NODE      1.15 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.58
  RAINFALL INTENSITY(INCH/HR) =   4.38
  TOTAL STREAM AREA(ACRES) =     1.53
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      3.23

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1       13.90    10.93        4.550          6.25
      2        3.23    11.58        4.383          1.53

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       16.94    10.93       4.550
      2       16.61    11.58       4.383

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      16.94   Tc(MIN.) =   10.93
  TOTAL AREA(ACRES) =        7.8
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.15 =    1347.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.15 TO NODE      1.16 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   688.33  DOWNSTREAM(FEET) =   676.92
  FLOW LENGTH(FEET) =   175.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  10.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  15.74
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      16.94
  PIPE TRAVEL TIME(MIN.) =   0.19    Tc(MIN.) =   11.11
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.16 =    1522.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.15 TO NODE      1.16 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE      1.51 TO NODE      1.52 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =   0
```

```
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
  UPSTREAM ELEVATION(FEET) =    726.60
  DOWNSTREAM ELEVATION(FEET) =    724.73
  ELEVATION DIFFERENCE(FEET) =      1.87
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.729
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.221
  SUBAREA RUNOFF(CFS) =      0.15
  TOTAL AREA(ACRES) =      0.05   TOTAL RUNOFF(CFS) =      0.15

****************************************************************************
  FLOW PROCESS FROM NODE      1.52 TO NODE      1.53 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  724.73  DOWNSTREAM ELEVATION(FEET) =  691.37
  STREET LENGTH(FEET) =   492.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.44
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.20
    HALFSTREET FLOOD WIDTH(FEET) =    2.00
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    5.65
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.12
  STREET FLOW TRAVEL TIME(MIN.) =   1.45   Tc(MIN.) =    8.18
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.486
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.480
  SUBAREA AREA(ACRES) =    0.22      SUBAREA RUNOFF(CFS) =    0.58
  TOTAL AREA(ACRES) =        0.3        PEAK FLOW RATE(CFS) =       0.71

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.20   HALFSTREET FLOOD WIDTH(FEET) =   2.00
  FLOW VELOCITY(FEET/SEC.) =  5.65   DEPTH*VELOCITY(FT*FT/SEC.) =   1.12
  LONGEST FLOWPATH FROM NODE      1.51 TO NODE      1.53 =     562.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.53 TO NODE      1.54 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   688.37  DOWNSTREAM(FEET) =   688.00
  FLOW LENGTH(FEET) =    10.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   6.0 INCH PIPE IS   3.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.75
  ESTIMATED PIPE DIAMETER(INCH) =   6.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.71
  PIPE TRAVEL TIME(MIN.) =   0.03    Tc(MIN.) =    8.21
  LONGEST FLOWPATH FROM NODE      1.51 TO NODE      1.54 =     572.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.53 TO NODE      1.54 IS CODE =   1
----------------------------------------------------------------------------
```

```
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.21
  RAINFALL INTENSITY(INCH/HR) =   5.47
  TOTAL STREAM AREA(ACRES) =     0.27
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.71

****************************************************************************
  FLOW PROCESS FROM NODE      1.61 TO NODE      1.62 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
  UPSTREAM ELEVATION(FEET) =    726.60
  DOWNSTREAM ELEVATION(FEET) =    725.00
  ELEVATION DIFFERENCE(FEET) =      1.60
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    7.088
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.016
  SUBAREA RUNOFF(CFS) =      0.12
  TOTAL AREA(ACRES) =      0.04   TOTAL RUNOFF(CFS) =      0.12

****************************************************************************
  FLOW PROCESS FROM NODE      1.62 TO NODE      1.63 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  725.00  DOWNSTREAM ELEVATION(FEET) =  691.43
  STREET LENGTH(FEET) =   480.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.40
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.22
    HALFSTREET FLOOD WIDTH(FEET) =    3.09
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    5.02
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.09
  STREET FLOW TRAVEL TIME(MIN.) =   1.59   Tc(MIN.) =    8.68
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.278
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.480
  SUBAREA AREA(ACRES) =    1.02      SUBAREA RUNOFF(CFS) =    2.58
  TOTAL AREA(ACRES) =        1.1        PEAK FLOW RATE(CFS) =       2.69

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.27   HALFSTREET FLOOD WIDTH(FEET) =   6.22
  FLOW VELOCITY(FEET/SEC.) =  4.98   DEPTH*VELOCITY(FT*FT/SEC.) =   1.36
  LONGEST FLOWPATH FROM NODE      1.61 TO NODE      1.63 =     550.00 FEET.

****************************************************************************
```

```
  FLOW PROCESS FROM NODE      1.63 TO NODE      1.54 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   688.43  DOWNSTREAM(FEET) =   688.02
  FLOW LENGTH(FEET) =    30.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   7.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.52
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.69
  PIPE TRAVEL TIME(MIN.) =   0.09    Tc(MIN.) =    8.77
  LONGEST FLOWPATH FROM NODE      1.61 TO NODE      1.54 =     580.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.63 TO NODE      1.54 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.77
  RAINFALL INTENSITY(INCH/HR) =   5.24
  TOTAL STREAM AREA(ACRES) =     1.06
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.69

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        0.71     8.21        5.473          0.27
      2        2.69     8.77        5.243          1.06

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1        3.22     8.21       5.473
      2        3.37     8.77       5.243

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       3.37   Tc(MIN.) =    8.77
  TOTAL AREA(ACRES) =        1.3
  LONGEST FLOWPATH FROM NODE      1.61 TO NODE      1.54 =     580.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.54 TO NODE      1.16 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   688.02  DOWNSTREAM(FEET) =   676.52
  FLOW LENGTH(FEET) =   135.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   9.0 INCH PIPE IS   5.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  11.58
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.37
  PIPE TRAVEL TIME(MIN.) =   0.19    Tc(MIN.) =    8.97
  LONGEST FLOWPATH FROM NODE      1.61 TO NODE      1.16 =     715.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.54 TO NODE      1.16 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 2 WITH THE MAIN-STREAM MEMORY<<<<<
```

```
==========================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1        3.37     8.97       5.170        1.33
  LONGEST FLOWPATH FROM NODE      1.61 TO NODE      1.16 =     715.00 FEET.

  ** MEMORY BANK #  2 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1       16.94    11.11       4.501        7.78
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.16 =    1522.00 FEET.

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
      1      17.04       8.97        5.170
      2      19.87      11.11        4.501

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      19.87   Tc(MIN.) =   11.11
  TOTAL AREA(ACRES) =        9.1

**************************************************************************
  FLOW PROCESS FROM NODE      1.16 TO NODE      1.17 IS CODE =  31
--------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
==========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   676.52  DOWNSTREAM(FEET) =   668.52
  FLOW LENGTH(FEET) =   110.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  11.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  17.01
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      19.87
  PIPE TRAVEL TIME(MIN.) =   0.11    Tc(MIN.) =   11.22
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.17 =    1632.00 FEET.

**************************************************************************
  FLOW PROCESS FROM NODE      1.16 TO NODE      1.17 IS CODE =   1
--------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
==========================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.22
  RAINFALL INTENSITY(INCH/HR) =   4.47
  TOTAL STREAM AREA(ACRES) =     9.11
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     19.87

**************************************************************************
  FLOW PROCESS FROM NODE      1.71 TO NODE      1.72 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
  UPSTREAM ELEVATION(FEET) =    691.20
  DOWNSTREAM ELEVATION(FEET) =    685.00
  ELEVATION DIFFERENCE(FEET) =      6.20
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.513
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.535
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
```

```
  SUBAREA RUNOFF(CFS) =      0.14
  TOTAL AREA(ACRES) =      0.04   TOTAL RUNOFF(CFS) =      0.14

****************************************************************************
  FLOW PROCESS FROM NODE      1.72 TO NODE      1.73 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  685.00  DOWNSTREAM ELEVATION(FEET) =  671.86
  STREET LENGTH(FEET) =   175.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.61
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.20
    HALFSTREET FLOOD WIDTH(FEET) =    2.00
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    5.95
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.18
  STREET FLOW TRAVEL TIME(MIN.) =   0.49   Tc(MIN.) =    5.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.532
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.480
  SUBAREA AREA(ACRES) =    0.26      SUBAREA RUNOFF(CFS) =    0.94
  TOTAL AREA(ACRES) =        0.3        PEAK FLOW RATE(CFS) =       1.08

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.20   HALFSTREET FLOOD WIDTH(FEET) =   2.00
  FLOW VELOCITY(FEET/SEC.) =  5.95   DEPTH*VELOCITY(FT*FT/SEC.) =   1.18
  LONGEST FLOWPATH FROM NODE      1.71 TO NODE      1.73 =     245.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.73 TO NODE      1.17 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   668.86  DOWNSTREAM(FEET) =   668.52
  FLOW LENGTH(FEET) =    26.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   9.0 INCH PIPE IS   5.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.35
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.08
  PIPE TRAVEL TIME(MIN.) =   0.10    Tc(MIN.) =    5.10
  LONGEST FLOWPATH FROM NODE      1.71 TO NODE      1.17 =     271.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.73 TO NODE      1.17 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    5.10
```

```
  RAINFALL INTENSITY(INCH/HR) =   7.44
  TOTAL STREAM AREA(ACRES) =     0.30
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.08

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1       19.87    11.22        4.473          9.11
      2        1.08     5.10        7.437          0.30

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       10.12     5.10       7.437
      2       20.53    11.22       4.473

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      20.53   Tc(MIN.) =   11.22
  TOTAL AREA(ACRES) =        9.4
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.17 =    1632.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.17 TO NODE      1.18 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   668.52  DOWNSTREAM(FEET) =   668.00
  FLOW LENGTH(FEET) =     8.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  16.36
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      20.53
  PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =   11.23
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.18 =    1640.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.18 TO NODE      1.18 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.23
  RAINFALL INTENSITY(INCH/HR) =   4.47
  TOTAL STREAM AREA(ACRES) =     9.41
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     20.53

****************************************************************************
  FLOW PROCESS FROM NODE      1.81 TO NODE      1.82 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
  UPSTREAM ELEVATION(FEET) =    700.84
  DOWNSTREAM ELEVATION(FEET) =    699.03
  ELEVATION DIFFERENCE(FEET) =      1.81
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.803
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.178
  SUBAREA RUNOFF(CFS) =      0.24
```

```
  TOTAL AREA(ACRES) =      0.08   TOTAL RUNOFF(CFS) =      0.24

 ****************************************************************************
  FLOW PROCESS FROM NODE      1.82 TO NODE      1.18 IS CODE =  62
 ----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
 ============================================================================
  UPSTREAM ELEVATION(FEET) =  699.03  DOWNSTREAM ELEVATION(FEET) =  671.81
  STREET LENGTH(FEET) =   380.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.31
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.26
    HALFSTREET FLOOD WIDTH(FEET) =    5.53
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.94
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.29
  STREET FLOW TRAVEL TIME(MIN.) =   1.28   Tc(MIN.) =    8.08
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.527
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.480
  SUBAREA AREA(ACRES) =    1.56      SUBAREA RUNOFF(CFS) =    4.14
  TOTAL AREA(ACRES) =        1.6        PEAK FLOW RATE(CFS) =       4.35

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.31   HALFSTREET FLOOD WIDTH(FEET) =   8.22
  FLOW VELOCITY(FEET/SEC.) =  5.46   DEPTH*VELOCITY(FT*FT/SEC.) =   1.69
  LONGEST FLOWPATH FROM NODE      1.81 TO NODE      1.18 =     450.00 FEET.

 ****************************************************************************
  FLOW PROCESS FROM NODE      1.82 TO NODE      1.18 IS CODE =   1
 ----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
 ============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.08
  RAINFALL INTENSITY(INCH/HR) =   5.53
  TOTAL STREAM AREA(ACRES) =     1.64
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      4.35

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1       20.53    11.23        4.471          9.41
      2        4.35     8.08        5.527          1.64

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
```

```
      1       20.96     8.08       5.527
      2       24.05    11.23       4.471

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      24.05   Tc(MIN.) =   11.23
  TOTAL AREA(ACRES) =       11.0
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.18 =    1640.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.18 TO NODE      1.19 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   671.81  DOWNSTREAM(FEET) =   670.00
  FLOW LENGTH(FEET) =    83.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  15.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  11.34
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      24.05
  PIPE TRAVEL TIME(MIN.) =   0.12    Tc(MIN.) =   11.35
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.19 =    1723.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.19 TO NODE      1.10 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   667.00  DOWNSTREAM(FEET) =   653.00
  FLOW LENGTH(FEET) =    60.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS  10.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  27.48
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      24.05
  PIPE TRAVEL TIME(MIN.) =   0.04    Tc(MIN.) =   11.39
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.10 =    1783.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.19 TO NODE      1.10 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.39
  RAINFALL INTENSITY(INCH/HR) =   4.43
  TOTAL STREAM AREA(ACRES) =    11.05
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     24.05

****************************************************************************
  FLOW PROCESS FROM NODE      1.91 TO NODE      1.92 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8700
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    80.00
  UPSTREAM ELEVATION(FEET) =    671.52
  DOWNSTREAM ELEVATION(FEET) =    667.35
  ELEVATION DIFFERENCE(FEET) =      4.17
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.136
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.535
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.46
```

```
  TOTAL AREA(ACRES) =      0.07   TOTAL RUNOFF(CFS) =      0.46

 ****************************************************************************
  FLOW PROCESS FROM NODE      1.92 TO NODE      1.11 IS CODE =  62
 ----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
 ============================================================================
  UPSTREAM ELEVATION(FEET) =  667.35  DOWNSTREAM ELEVATION(FEET) =  656.00
  STREET LENGTH(FEET) =   210.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.41
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.20
    HALFSTREET FLOOD WIDTH(FEET) =    2.00
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    5.05
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.00
  STREET FLOW TRAVEL TIME(MIN.) =   0.69   Tc(MIN.) =    2.83
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.535
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8700
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.870
  SUBAREA AREA(ACRES) =    0.29      SUBAREA RUNOFF(CFS) =    1.90
  TOTAL AREA(ACRES) =        0.4        PEAK FLOW RATE(CFS) =       2.36

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.21   HALFSTREET FLOOD WIDTH(FEET) =   2.72
  FLOW VELOCITY(FEET/SEC.) =  4.54   DEPTH*VELOCITY(FT*FT/SEC.) =   0.96
  LONGEST FLOWPATH FROM NODE      1.91 TO NODE      1.11 =     290.00 FEET.

 ****************************************************************************
  FLOW PROCESS FROM NODE      1.11 TO NODE      1.11 IS CODE =   1
 ----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
 ============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    2.83
  RAINFALL INTENSITY(INCH/HR) =   7.54
  TOTAL STREAM AREA(ACRES) =     0.36
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.36

  ** CONFLUENCE DATA **
  STREAM     RUNOFF        Tc       INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1       24.05    11.39        4.431         11.05
      2        2.36     2.83        7.535          0.36

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
```

```
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       16.50     2.83       7.535
      2       25.43    11.39       4.431

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      25.43   Tc(MIN.) =   11.39
  TOTAL AREA(ACRES) =       11.4
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.11 =    1783.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.11 TO NODE      1.12 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   653.00  DOWNSTREAM(FEET) =   652.00
  FLOW LENGTH(FEET) =   100.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  27.0 INCH PIPE IS  19.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.51
  ESTIMATED PIPE DIAMETER(INCH) =  27.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      25.43
  PIPE TRAVEL TIME(MIN.) =   0.20    Tc(MIN.) =   11.58
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.12 =    1883.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.12 TO NODE      1.12 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.383
  USER-SPECIFIED RUNOFF COEFFICIENT = .8700
  S.C.S. CURVE NUMBER (AMC II) =  98
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.4949
  SUBAREA AREA(ACRES) =    0.08   SUBAREA RUNOFF(CFS) =    0.31
  TOTAL AREA(ACRES) =       11.5   TOTAL RUNOFF(CFS) =      25.43
  TC(MIN.) =   11.58
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

****************************************************************************
  FLOW PROCESS FROM NODE      1.12 TO NODE      1.12 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.58
  RAINFALL INTENSITY(INCH/HR) =   4.38
  TOTAL STREAM AREA(ACRES) =    11.49
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     25.43

****************************************************************************
  FLOW PROCESS FROM NODE      2.11 TO NODE      2.12 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .5400
  S.C.S. CURVE NUMBER (AMC II) =  98
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   118.00
  UPSTREAM ELEVATION(FEET) =    731.62
  DOWNSTREAM ELEVATION(FEET) =    728.33
  ELEVATION DIFFERENCE(FEET) =      3.29
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.863
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    91.82
           (Reference: Table 3-1B of Hydrology Manual)
```

```
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.143
 SUBAREA RUNOFF(CFS) =      0.50
 TOTAL AREA(ACRES) =      0.15   TOTAL RUNOFF(CFS) =      0.50

****************************************************************************
 FLOW PROCESS FROM NODE      2.12 TO NODE      2.13 IS CODE =  62
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
 UPSTREAM ELEVATION(FEET) =  728.33  DOWNSTREAM ELEVATION(FEET) =  724.50
 STREET LENGTH(FEET) =   750.00   CURB HEIGHT(INCHES) =  8.0
 STREET HALFWIDTH(FEET) = 30.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.018
 OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
 STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
 Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
 Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.42
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
   STREET FLOW DEPTH(FEET) =  0.41
   HALFSTREET FLOOD WIDTH(FEET) =   13.71
   AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.83
   PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.75
 STREET FLOW TRAVEL TIME(MIN.) =   6.83   Tc(MIN.) =   13.70
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.934
 *USER SPECIFIED(SUBAREA):
 USER-SPECIFIED RUNOFF COEFFICIENT = .5400
 S.C.S. CURVE NUMBER (AMC II) =  98
 AREA-AVERAGE RUNOFF COEFFICIENT =  0.540
 SUBAREA AREA(ACRES) =    2.68      SUBAREA RUNOFF(CFS) =    5.69
 TOTAL AREA(ACRES) =        2.8        PEAK FLOW RATE(CFS) =       6.01

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.47   HALFSTREET FLOOD WIDTH(FEET) =  17.30
 FLOW VELOCITY(FEET/SEC.) =  2.10   DEPTH*VELOCITY(FT*FT/SEC.) =   0.99
 LONGEST FLOWPATH FROM NODE      2.11 TO NODE      2.13 =     868.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      2.13 TO NODE      2.14 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   721.50  DOWNSTREAM(FEET) =   719.00
 FLOW LENGTH(FEET) =   100.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  15.0 INCH PIPE IS   8.4 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   8.50
 ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       6.01
 PIPE TRAVEL TIME(MIN.) =   0.20    Tc(MIN.) =   13.89
 LONGEST FLOWPATH FROM NODE      2.11 TO NODE      2.14 =     968.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      2.14 TO NODE      2.15 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   716.00  DOWNSTREAM(FEET) =   630.00
```

```
  FLOW LENGTH(FEET) =   290.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   9.0 INCH PIPE IS   5.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  21.39
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.01
  PIPE TRAVEL TIME(MIN.) =   0.23    Tc(MIN.) =   14.12
  LONGEST FLOWPATH FROM NODE      2.11 TO NODE      2.15 =    1258.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      2.14 TO NODE      2.15 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   14.12
  RAINFALL INTENSITY(INCH/HR) =   3.86
  TOTAL STREAM AREA(ACRES) =     2.83
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      6.01

****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   14.12
  RAINFALL INTENSITY(INCH/HR) =   3.86
  TOTAL STREAM AREA(ACRES) =     2.83
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      6.01
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.8  TC(MIN.) =     14.12
  PEAK FLOW RATE(CFS)   =       6.01
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

CHAPTER 5 - 100-Year Hydrologic Analysis for Developed Conditions - Mitigated

```
**************************************************************************

           RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                        2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2015 Advanced Engineering Software (aes)
             Ver. 22.0 Release Date: 07/01/2015  License ID 1643

                          Analysis prepared by:

                             REC Consultants
                             2442 Second St.
                           San Diego, Ca 92101


 ************************* DESCRIPTION OF STUDY *************************
* Proposed Conditions Hydrology - Mitigated                             *
* 100 Year Storm                                                        *
* Greenhills Ranch Phase - 2                                            *
 ************************************************************************

  FILE NAME: 1083PSTD.DAT
  TIME/DATE OF STUDY: 18:18 04/10/2018
------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.860
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

**************************************************************************
  FLOW PROCESS FROM NODE      1.11 TO NODE      1.12 IS CODE =  21
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
========================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =  98
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =    770.00
  DOWNSTREAM ELEVATION(FEET) =    767.08
  ELEVATION DIFFERENCE(FEET) =      2.92
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    7.562
```

```
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    93.80
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.770
  SUBAREA RUNOFF(CFS) =      0.28
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.28

****************************************************************************
  FLOW PROCESS FROM NODE      1.12 TO NODE      1.13 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  767.08  DOWNSTREAM ELEVATION(FEET) =  729.22
  STREET LENGTH(FEET) =   480.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.82
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.24
    HALFSTREET FLOOD WIDTH(FEET) =    4.28
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    5.10
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.22
  STREET FLOW TRAVEL TIME(MIN.) =   1.57   Tc(MIN.) =    9.13
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.109
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =  98
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.480
  SUBAREA AREA(ACRES) =    1.26      SUBAREA RUNOFF(CFS) =    3.09
  TOTAL AREA(ACRES) =        1.4        PEAK FLOW RATE(CFS) =       3.34

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.29   HALFSTREET FLOOD WIDTH(FEET) =   6.91
  FLOW VELOCITY(FEET/SEC.) =  5.38   DEPTH*VELOCITY(FT*FT/SEC.) =   1.54
  LONGEST FLOWPATH FROM NODE      1.11 TO NODE      1.13 =     580.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.13 TO NODE      1.14 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   726.22  DOWNSTREAM(FEET) =   693.47
  FLOW LENGTH(FEET) =   460.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   9.0 INCH PIPE IS   6.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.76
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.34
  PIPE TRAVEL TIME(MIN.) =   0.71    Tc(MIN.) =    9.84
  LONGEST FLOWPATH FROM NODE      1.11 TO NODE      1.14 =    1040.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.13 TO NODE      1.14 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
```

```
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE      1.21 TO NODE      1.22 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =  98
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    55.00
  UPSTREAM ELEVATION(FEET) =    731.72
  DOWNSTREAM ELEVATION(FEET) =    729.62
  ELEVATION DIFFERENCE(FEET) =      2.10
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    5.296
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.261
  SUBAREA RUNOFF(CFS) =      0.12
  TOTAL AREA(ACRES) =      0.04   TOTAL RUNOFF(CFS) =      0.12

****************************************************************************
  FLOW PROCESS FROM NODE      1.22 TO NODE      1.23 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  729.62  DOWNSTREAM ELEVATION(FEET) =  698.92
  STREET LENGTH(FEET) =  1180.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.06
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.35
    HALFSTREET FLOOD WIDTH(FEET) =   10.27
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.58
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.24
  STREET FLOW TRAVEL TIME(MIN.) =   5.50   Tc(MIN.) =   10.79
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.587
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =  98
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.480
  SUBAREA AREA(ACRES) =    3.47      SUBAREA RUNOFF(CFS) =    7.64
  TOTAL AREA(ACRES) =        3.5        PEAK FLOW RATE(CFS) =       7.72

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.41   HALFSTREET FLOOD WIDTH(FEET) =  13.71
  FLOW VELOCITY(FEET/SEC.) =  4.12   DEPTH*VELOCITY(FT*FT/SEC.) =   1.68
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.23 =    1235.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.23 TO NODE      1.24 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   695.92  DOWNSTREAM(FEET) =   694.92
  FLOW LENGTH(FEET) =     6.00   MANNING'S N =  0.013
```

```
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   6.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  18.43
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       7.72
  PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =   10.80
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.24 =    1241.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.23 TO NODE      1.24 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.80
  RAINFALL INTENSITY(INCH/HR) =   4.59
  TOTAL STREAM AREA(ACRES) =     3.51
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      7.72

****************************************************************************
  FLOW PROCESS FROM NODE      1.31 TO NODE      1.32 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =  98
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    95.00
  UPSTREAM ELEVATION(FEET) =    724.18
  DOWNSTREAM ELEVATION(FEET) =    720.59
  ELEVATION DIFFERENCE(FEET) =      3.59
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.984
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.074
  SUBAREA RUNOFF(CFS) =      0.35
  TOTAL AREA(ACRES) =      0.12   TOTAL RUNOFF(CFS) =      0.35

****************************************************************************
  FLOW PROCESS FROM NODE      1.32 TO NODE      1.33 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  720.59  DOWNSTREAM ELEVATION(FEET) =  698.97
  STREET LENGTH(FEET) =   535.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.87
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.27
    HALFSTREET FLOOD WIDTH(FEET) =    5.84
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.76
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.00
  STREET FLOW TRAVEL TIME(MIN.) =   2.37   Tc(MIN.) =    9.36
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.030
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =  98
```

```
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.480
  SUBAREA AREA(ACRES) =    1.26      SUBAREA RUNOFF(CFS) =    3.04
  TOTAL AREA(ACRES) =        1.4        PEAK FLOW RATE(CFS) =       3.33

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.31   HALFSTREET FLOOD WIDTH(FEET) =   8.34
  FLOW VELOCITY(FEET/SEC.) =  4.09   DEPTH*VELOCITY(FT*FT/SEC.) =   1.27
  LONGEST FLOWPATH FROM NODE      1.31 TO NODE      1.33 =     630.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.33 TO NODE      1.24 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   695.97  DOWNSTREAM(FEET) =   694.92
  FLOW LENGTH(FEET) =    25.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   5.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.92
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.33
  PIPE TRAVEL TIME(MIN.) =   0.05    Tc(MIN.) =    9.40
  LONGEST FLOWPATH FROM NODE      1.31 TO NODE      1.24 =     655.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.33 TO NODE      1.24 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    9.40
  RAINFALL INTENSITY(INCH/HR) =   5.01
  TOTAL STREAM AREA(ACRES) =     1.38
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      3.33

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        7.72    10.80        4.586          3.51
      2        3.33     9.40        5.014          1.38

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       10.05     9.40       5.014
      2       10.76    10.80       4.586

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      10.76   Tc(MIN.) =   10.80
  TOTAL AREA(ACRES) =        4.9
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.24 =    1241.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.24 TO NODE      1.14 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   694.92  DOWNSTREAM(FEET) =   693.47
  FLOW LENGTH(FEET) =    41.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS  11.2 INCHES
```

```
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.93
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      10.76
  PIPE TRAVEL TIME(MIN.) =   0.06    Tc(MIN.) =   10.86
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.14 =    1282.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.21 TO NODE      1.14 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1       10.76    10.86       4.569        4.89
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.14 =    1282.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1        3.34     9.84       4.868        1.36
  LONGEST FLOWPATH FROM NODE      1.11 TO NODE      1.14 =    1040.00 FEET.

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
      1      13.09       9.84        4.868
      2      13.90      10.86        4.569

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      13.90   Tc(MIN.) =   10.86
  TOTAL AREA(ACRES) =        6.2

****************************************************************************
  FLOW PROCESS FROM NODE      1.14 TO NODE      1.15 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   693.47  DOWNSTREAM(FEET) =   688.33
  FLOW LENGTH(FEET) =    65.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS  10.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  15.97
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      13.90
  PIPE TRAVEL TIME(MIN.) =   0.07    Tc(MIN.) =   10.93
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.15 =    1347.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.14 TO NODE      1.15 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.93
  RAINFALL INTENSITY(INCH/HR) =   4.55
  TOTAL STREAM AREA(ACRES) =     6.25
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     13.90

****************************************************************************
  FLOW PROCESS FROM NODE      1.41 TO NODE      1.42 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
```

```
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =  98
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =    770.00
  DOWNSTREAM ELEVATION(FEET) =    769.00
  ELEVATION DIFFERENCE(FEET) =      1.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    9.337
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    70.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.037
  SUBAREA RUNOFF(CFS) =      0.11
  TOTAL AREA(ACRES) =      0.04   TOTAL RUNOFF(CFS) =      0.11

****************************************************************************
  FLOW PROCESS FROM NODE      1.42 TO NODE      1.43 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  769.00  DOWNSTREAM ELEVATION(FEET) =  691.67
  STREET LENGTH(FEET) =   790.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.67
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.22
    HALFSTREET FLOOD WIDTH(FEET) =    3.16
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    5.90
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.29
  STREET FLOW TRAVEL TIME(MIN.) =   2.23   Tc(MIN.) =   11.57
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.387
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =  98
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.480
  SUBAREA AREA(ACRES) =    1.49      SUBAREA RUNOFF(CFS) =    3.14
  TOTAL AREA(ACRES) =        1.5        PEAK FLOW RATE(CFS) =       3.23

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.27   HALFSTREET FLOOD WIDTH(FEET) =   6.28
  FLOW VELOCITY(FEET/SEC.) =  5.91   DEPTH*VELOCITY(FT*FT/SEC.) =   1.62
  LONGEST FLOWPATH FROM NODE      1.41 TO NODE      1.43 =     890.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.43 TO NODE      1.15 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   688.67  DOWNSTREAM(FEET) =   688.33
  FLOW LENGTH(FEET) =     8.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   9.0 INCH PIPE IS   7.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.57
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
```

```
  PIPE-FLOW(CFS) =       3.23
  PIPE TRAVEL TIME(MIN.) =   0.02    Tc(MIN.) =   11.58
  LONGEST FLOWPATH FROM NODE      1.41 TO NODE      1.15 =     898.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.43 TO NODE      1.15 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.58
  RAINFALL INTENSITY(INCH/HR) =   4.38
  TOTAL STREAM AREA(ACRES) =     1.53
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      3.23

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1       13.90    10.93        4.550          6.25
      2        3.23    11.58        4.383          1.53

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       16.94    10.93       4.550
      2       16.61    11.58       4.383

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      16.94   Tc(MIN.) =   10.93
  TOTAL AREA(ACRES) =        7.8
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.15 =    1347.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.15 TO NODE      1.16 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   688.33  DOWNSTREAM(FEET) =   676.92
  FLOW LENGTH(FEET) =   175.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  10.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  15.74
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      16.94
  PIPE TRAVEL TIME(MIN.) =   0.19    Tc(MIN.) =   11.11
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.16 =    1522.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.15 TO NODE      1.16 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE      1.51 TO NODE      1.52 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =  98
```

```
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
  UPSTREAM ELEVATION(FEET) =    726.60
  DOWNSTREAM ELEVATION(FEET) =    724.73
  ELEVATION DIFFERENCE(FEET) =      1.87
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.729
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.221
  SUBAREA RUNOFF(CFS) =      0.15
  TOTAL AREA(ACRES) =      0.05   TOTAL RUNOFF(CFS) =      0.15

****************************************************************************
  FLOW PROCESS FROM NODE      1.52 TO NODE      1.53 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  724.73  DOWNSTREAM ELEVATION(FEET) =  691.37
  STREET LENGTH(FEET) =   492.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.44
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.20
    HALFSTREET FLOOD WIDTH(FEET) =    2.00
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    5.65
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.12
  STREET FLOW TRAVEL TIME(MIN.) =   1.45   Tc(MIN.) =    8.18
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.486
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =  98
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.480
  SUBAREA AREA(ACRES) =    0.22      SUBAREA RUNOFF(CFS) =    0.58
  TOTAL AREA(ACRES) =        0.3        PEAK FLOW RATE(CFS) =       0.71

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.20   HALFSTREET FLOOD WIDTH(FEET) =   2.00
  FLOW VELOCITY(FEET/SEC.) =  5.65   DEPTH*VELOCITY(FT*FT/SEC.) =   1.12
  LONGEST FLOWPATH FROM NODE      1.51 TO NODE      1.53 =     562.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.53 TO NODE      1.54 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   688.37  DOWNSTREAM(FEET) =   688.00
  FLOW LENGTH(FEET) =    10.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   6.0 INCH PIPE IS   3.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.75
  ESTIMATED PIPE DIAMETER(INCH) =   6.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.71
  PIPE TRAVEL TIME(MIN.) =   0.03    Tc(MIN.) =    8.21
  LONGEST FLOWPATH FROM NODE      1.51 TO NODE      1.54 =     572.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.53 TO NODE      1.54 IS CODE =   1
----------------------------------------------------------------------------
```

```
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
==========================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.21
  RAINFALL INTENSITY(INCH/HR) =   5.47
  TOTAL STREAM AREA(ACRES) =     0.27
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.71

**************************************************************************
  FLOW PROCESS FROM NODE      1.61 TO NODE      1.62 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =  98
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
  UPSTREAM ELEVATION(FEET) =    726.60
  DOWNSTREAM ELEVATION(FEET) =    725.00
  ELEVATION DIFFERENCE(FEET) =      1.60
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    7.088
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.016
  SUBAREA RUNOFF(CFS) =      0.12
  TOTAL AREA(ACRES) =      0.04   TOTAL RUNOFF(CFS) =      0.12

**************************************************************************
  FLOW PROCESS FROM NODE      1.62 TO NODE      1.63 IS CODE =  62
--------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
==========================================================================
  UPSTREAM ELEVATION(FEET) =  725.00  DOWNSTREAM ELEVATION(FEET) =  691.43
  STREET LENGTH(FEET) =   480.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.40
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.22
    HALFSTREET FLOOD WIDTH(FEET) =    3.09
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    5.02
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.09
  STREET FLOW TRAVEL TIME(MIN.) =   1.59   Tc(MIN.) =    8.68
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.278
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =  98
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.480
  SUBAREA AREA(ACRES) =    1.02      SUBAREA RUNOFF(CFS) =    2.58
  TOTAL AREA(ACRES) =        1.1        PEAK FLOW RATE(CFS) =       2.69

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.27   HALFSTREET FLOOD WIDTH(FEET) =   6.22
  FLOW VELOCITY(FEET/SEC.) =  4.98   DEPTH*VELOCITY(FT*FT/SEC.) =   1.36
  LONGEST FLOWPATH FROM NODE      1.61 TO NODE      1.63 =     550.00 FEET.

**************************************************************************
```

```
  FLOW PROCESS FROM NODE      1.63 TO NODE      1.54 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   688.43  DOWNSTREAM(FEET) =   688.02
  FLOW LENGTH(FEET) =    30.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   7.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.52
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.69
  PIPE TRAVEL TIME(MIN.) =   0.09    Tc(MIN.) =    8.77
  LONGEST FLOWPATH FROM NODE      1.61 TO NODE      1.54 =     580.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.63 TO NODE      1.54 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.77
  RAINFALL INTENSITY(INCH/HR) =   5.24
  TOTAL STREAM AREA(ACRES) =     1.06
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.69

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        0.71     8.21        5.473          0.27
      2        2.69     8.77        5.243          1.06

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1        3.22     8.21       5.473
      2        3.37     8.77       5.243

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       3.37   Tc(MIN.) =    8.77
  TOTAL AREA(ACRES) =        1.3
  LONGEST FLOWPATH FROM NODE      1.61 TO NODE      1.54 =     580.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.54 TO NODE      1.16 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   688.02  DOWNSTREAM(FEET) =   676.52
  FLOW LENGTH(FEET) =   135.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   9.0 INCH PIPE IS   5.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  11.58
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.37
  PIPE TRAVEL TIME(MIN.) =   0.19    Tc(MIN.) =    8.97
  LONGEST FLOWPATH FROM NODE      1.61 TO NODE      1.16 =     715.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.54 TO NODE      1.16 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 2 WITH THE MAIN-STREAM MEMORY<<<<<
```

```
==============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1        3.37     8.97       5.170        1.33
  LONGEST FLOWPATH FROM NODE      1.61 TO NODE      1.16 =     715.00 FEET.

  ** MEMORY BANK #  2 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1       16.94    11.11       4.501        7.78
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.16 =    1522.00 FEET.

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
      1      17.04       8.97        5.170
      2      19.87      11.11        4.501

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      19.87   Tc(MIN.) =   11.11
  TOTAL AREA(ACRES) =        9.1

****************************************************************************
  FLOW PROCESS FROM NODE      1.16 TO NODE      1.17 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   676.52  DOWNSTREAM(FEET) =   668.52
  FLOW LENGTH(FEET) =   110.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  11.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  17.01
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      19.87
  PIPE TRAVEL TIME(MIN.) =   0.11    Tc(MIN.) =   11.22
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.17 =    1632.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.16 TO NODE      1.17 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.22
  RAINFALL INTENSITY(INCH/HR) =   4.47
  TOTAL STREAM AREA(ACRES) =     9.11
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     19.87

****************************************************************************
  FLOW PROCESS FROM NODE      1.71 TO NODE      1.72 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =  98
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
  UPSTREAM ELEVATION(FEET) =    691.20
  DOWNSTREAM ELEVATION(FEET) =    685.00
  ELEVATION DIFFERENCE(FEET) =      6.20
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.513
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.535
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
```

```
  SUBAREA RUNOFF(CFS) =      0.14
  TOTAL AREA(ACRES) =      0.04   TOTAL RUNOFF(CFS) =      0.14

****************************************************************************
  FLOW PROCESS FROM NODE      1.72 TO NODE      1.73 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  685.00  DOWNSTREAM ELEVATION(FEET) =  671.86
  STREET LENGTH(FEET) =   175.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.61
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.20
    HALFSTREET FLOOD WIDTH(FEET) =    2.00
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    5.95
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.18
  STREET FLOW TRAVEL TIME(MIN.) =   0.49   Tc(MIN.) =    5.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.532
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =  98
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.480
  SUBAREA AREA(ACRES) =    0.26      SUBAREA RUNOFF(CFS) =    0.94
  TOTAL AREA(ACRES) =        0.3        PEAK FLOW RATE(CFS) =       1.08

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.20   HALFSTREET FLOOD WIDTH(FEET) =   2.00
  FLOW VELOCITY(FEET/SEC.) =  5.95   DEPTH*VELOCITY(FT*FT/SEC.) =   1.18
  LONGEST FLOWPATH FROM NODE      1.71 TO NODE      1.73 =     245.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.73 TO NODE      1.17 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   668.86  DOWNSTREAM(FEET) =   668.52
  FLOW LENGTH(FEET) =    26.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   9.0 INCH PIPE IS   5.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.35
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.08
  PIPE TRAVEL TIME(MIN.) =   0.10    Tc(MIN.) =    5.10
  LONGEST FLOWPATH FROM NODE      1.71 TO NODE      1.17 =     271.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.73 TO NODE      1.17 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    5.10
```

```
  RAINFALL INTENSITY(INCH/HR) =   7.44
  TOTAL STREAM AREA(ACRES) =     0.30
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.08

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1       19.87    11.22        4.473          9.11
      2        1.08     5.10        7.437          0.30

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       10.12     5.10       7.437
      2       20.53    11.22       4.473

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      20.53   Tc(MIN.) =   11.22
  TOTAL AREA(ACRES) =        9.4
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.17 =    1632.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.17 TO NODE      1.18 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   668.52  DOWNSTREAM(FEET) =   668.00
  FLOW LENGTH(FEET) =     8.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  16.36
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      20.53
  PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =   11.23
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.18 =    1640.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.18 TO NODE      1.18 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.23
  RAINFALL INTENSITY(INCH/HR) =   4.47
  TOTAL STREAM AREA(ACRES) =     9.41
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     20.53

****************************************************************************
  FLOW PROCESS FROM NODE      1.81 TO NODE      1.82 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =  98
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
  UPSTREAM ELEVATION(FEET) =    700.84
  DOWNSTREAM ELEVATION(FEET) =    699.03
  ELEVATION DIFFERENCE(FEET) =      1.81
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.803
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.178
  SUBAREA RUNOFF(CFS) =      0.24
```

```
  TOTAL AREA(ACRES) =      0.08   TOTAL RUNOFF(CFS) =      0.24

 ****************************************************************************
  FLOW PROCESS FROM NODE      1.82 TO NODE      1.18 IS CODE =  62
 ----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
 ============================================================================
  UPSTREAM ELEVATION(FEET) =  699.03  DOWNSTREAM ELEVATION(FEET) =  671.81
  STREET LENGTH(FEET) =   380.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.31
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.26
    HALFSTREET FLOOD WIDTH(FEET) =    5.53
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.94
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.29
  STREET FLOW TRAVEL TIME(MIN.) =   1.28   Tc(MIN.) =    8.08
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.527
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4800
  S.C.S. CURVE NUMBER (AMC II) =  98
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.480
  SUBAREA AREA(ACRES) =    1.56      SUBAREA RUNOFF(CFS) =    4.14
  TOTAL AREA(ACRES) =        1.6        PEAK FLOW RATE(CFS) =       4.35

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.31   HALFSTREET FLOOD WIDTH(FEET) =   8.22
  FLOW VELOCITY(FEET/SEC.) =  5.46   DEPTH*VELOCITY(FT*FT/SEC.) =   1.69
  LONGEST FLOWPATH FROM NODE      1.81 TO NODE      1.18 =     450.00 FEET.

 ****************************************************************************
  FLOW PROCESS FROM NODE      1.82 TO NODE      1.18 IS CODE =   1
 ----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
 ============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.08
  RAINFALL INTENSITY(INCH/HR) =   5.53
  TOTAL STREAM AREA(ACRES) =     1.64
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      4.35

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1       20.53    11.23        4.471          9.41
      2        4.35     8.08        5.527          1.64

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
```

```
      1       20.96     8.08       5.527
      2       24.05    11.23       4.471

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      24.05   Tc(MIN.) =   11.23
  TOTAL AREA(ACRES) =       11.0
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.18 =    1640.00 FEET.

+----------------------------------------------------------------------------+
| The following outflows are per HEC-HMS printout for BMP-1.                 |
|                                                                            |
|                                                                            |
+----------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE      1.18 TO NODE      1.18 IS CODE =   7
----------------------------------------------------------------------------
  >>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<
============================================================================
  USER-SPECIFIED VALUES ARE AS FOLLOWS:
  TC(MIN) =  23.00   RAIN INTENSITY(INCH/HOUR) =  2.82
  TOTAL AREA(ACRES) =    11.00   TOTAL RUNOFF(CFS) =      7.19

****************************************************************************
  FLOW PROCESS FROM NODE      1.18 TO NODE      1.19 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   671.81  DOWNSTREAM(FEET) =   670.00
  FLOW LENGTH(FEET) =    83.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS   9.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.36
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       7.19
  PIPE TRAVEL TIME(MIN.) =   0.17    Tc(MIN.) =   23.17
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.19 =    1723.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.19 TO NODE      1.10 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   667.00  DOWNSTREAM(FEET) =   653.00
  FLOW LENGTH(FEET) =    60.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   9.0 INCH PIPE IS   6.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  20.00
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       7.19
  PIPE TRAVEL TIME(MIN.) =   0.05    Tc(MIN.) =   23.22
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.10 =    1783.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.19 TO NODE      1.10 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   23.22
  RAINFALL INTENSITY(INCH/HR) =   2.80
  TOTAL STREAM AREA(ACRES) =    11.00
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      7.19

****************************************************************************
```

```
  FLOW PROCESS FROM NODE      1.91 TO NODE      1.92 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8700
  S.C.S. CURVE NUMBER (AMC II) =  98
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    80.00
  UPSTREAM ELEVATION(FEET) =    671.52
  DOWNSTREAM ELEVATION(FEET) =    667.35
  ELEVATION DIFFERENCE(FEET) =      4.17
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.136
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.535
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.46
  TOTAL AREA(ACRES) =      0.07   TOTAL RUNOFF(CFS) =      0.46

****************************************************************************
  FLOW PROCESS FROM NODE      1.92 TO NODE      1.11 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  667.35  DOWNSTREAM ELEVATION(FEET) =  656.00
  STREET LENGTH(FEET) =   210.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.41
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.20
    HALFSTREET FLOOD WIDTH(FEET) =    2.00
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    5.05
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.00
  STREET FLOW TRAVEL TIME(MIN.) =   0.69   Tc(MIN.) =    2.83
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.535
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .8700
  S.C.S. CURVE NUMBER (AMC II) =  98
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.870
  SUBAREA AREA(ACRES) =    0.29      SUBAREA RUNOFF(CFS) =    1.90
  TOTAL AREA(ACRES) =        0.4        PEAK FLOW RATE(CFS) =       2.36

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.21   HALFSTREET FLOOD WIDTH(FEET) =   2.72
  FLOW VELOCITY(FEET/SEC.) =  4.54   DEPTH*VELOCITY(FT*FT/SEC.) =   0.96
  LONGEST FLOWPATH FROM NODE      1.91 TO NODE      1.11 =     290.00 FEET.

+----------------------------------------------------------------------------+
| The following outflows are per HEC-HMS for BMP-3.                          |
| The detained outflows from BMP-3 are to confluence with the detained       |
| flows from BMP-1.                                                          |
+----------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE      1.11 TO NODE      1.11 IS CODE =   7
----------------------------------------------------------------------------
```

```
  >>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<
============================================================================
  USER-SPECIFIED VALUES ARE AS FOLLOWS:
  TC(MIN) =   6.00   RAIN INTENSITY(INCH/HOUR) =  6.70
  TOTAL AREA(ACRES) =     0.40   TOTAL RUNOFF(CFS) =      2.09

****************************************************************************
  FLOW PROCESS FROM NODE      1.11 TO NODE      1.11 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    6.00
  RAINFALL INTENSITY(INCH/HR) =   6.70
  TOTAL STREAM AREA(ACRES) =     0.40
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.09

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        7.19    23.22        2.799         11.00
      2        2.09     6.00        6.699          0.40

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1        3.95     6.00       6.699
      2        8.06    23.22       2.799

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       8.06   Tc(MIN.) =   23.22
  TOTAL AREA(ACRES) =       11.4
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.11 =    1783.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.11 TO NODE      1.12 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   653.00  DOWNSTREAM(FEET) =   652.00
  FLOW LENGTH(FEET) =   100.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.42
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       8.06
  PIPE TRAVEL TIME(MIN.) =   0.26    Tc(MIN.) =   23.48
  LONGEST FLOWPATH FROM NODE      1.21 TO NODE      1.12 =    1883.00 FEET.

+--------------------------------------------------------------------------+
| Node 1.12 is POC-1.                                                      |
| The area added represent a bypass area (Q100) that goes directly to      |
| POC-1. Water quality and HMP for this area is addressed via tree well.   |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE      1.12 TO NODE      1.12 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.779
```

```
  USER-SPECIFIED RUNOFF COEFFICIENT = .8700
  S.C.S. CURVE NUMBER (AMC II) =  98
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.2557
  SUBAREA AREA(ACRES) =    0.08   SUBAREA RUNOFF(CFS) =    0.19
  TOTAL AREA(ACRES) =       11.5   TOTAL RUNOFF(CFS) =       8.16
  TC(MIN.) =   23.48

****************************************************************************
  FLOW PROCESS FROM NODE      1.12 TO NODE      1.12 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   23.48
  RAINFALL INTENSITY(INCH/HR) =   2.78
  TOTAL STREAM AREA(ACRES) =    11.48
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      8.16

****************************************************************************
  FLOW PROCESS FROM NODE      2.11 TO NODE      2.12 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .5400
  S.C.S. CURVE NUMBER (AMC II) =  98
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   118.00
  UPSTREAM ELEVATION(FEET) =    731.62
  DOWNSTREAM ELEVATION(FEET) =    728.33
  ELEVATION DIFFERENCE(FEET) =      3.29
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.863
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    91.82
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.143
  SUBAREA RUNOFF(CFS) =      0.50
  TOTAL AREA(ACRES) =      0.15   TOTAL RUNOFF(CFS) =      0.50

****************************************************************************
  FLOW PROCESS FROM NODE      2.12 TO NODE      2.13 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  728.33  DOWNSTREAM ELEVATION(FEET) =  724.50
  STREET LENGTH(FEET) =   750.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.42
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.41
    HALFSTREET FLOOD WIDTH(FEET) =   13.71
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.83
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.75
  STREET FLOW TRAVEL TIME(MIN.) =   6.83   Tc(MIN.) =   13.70
```

```
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.934
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .5400
S.C.S. CURVE NUMBER (AMC II) =  98
AREA-AVERAGE RUNOFF COEFFICIENT =  0.540
SUBAREA AREA(ACRES) =    2.68      SUBAREA RUNOFF(CFS) =    5.69
TOTAL AREA(ACRES) =        2.8        PEAK FLOW RATE(CFS) =       6.01

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) = 0.47   HALFSTREET FLOOD WIDTH(FEET) =  17.30
FLOW VELOCITY(FEET/SEC.) =  2.10   DEPTH*VELOCITY(FT*FT/SEC.) =   0.99
LONGEST FLOWPATH FROM NODE      2.11 TO NODE      2.13 =     868.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE      2.13 TO NODE      2.14 IS CODE =  31
----------------------------------------------------------------------------
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
ELEVATION DATA: UPSTREAM(FEET) =   721.50  DOWNSTREAM(FEET) =   719.00
FLOW LENGTH(FEET) =   100.00   MANNING'S N =  0.013
DEPTH OF FLOW IN  15.0 INCH PIPE IS   8.4 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) =   8.50
ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
PIPE-FLOW(CFS) =       6.01
PIPE TRAVEL TIME(MIN.) =   0.20    Tc(MIN.) =   13.89
LONGEST FLOWPATH FROM NODE      2.11 TO NODE      2.14 =     968.00 FEET.

+--------------------------------------------------------------------------+
| The following outflows are per HEC-HMS output for BMP-2 to POC-2.        |
|                                                                          |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
FLOW PROCESS FROM NODE      2.14 TO NODE      2.14 IS CODE =   7
----------------------------------------------------------------------------
>>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<
============================================================================
USER-SPECIFIED VALUES ARE AS FOLLOWS:
TC(MIN) =  17.00   RAIN INTENSITY(INCH/HOUR) =  3.42
TOTAL AREA(ACRES) =     1.00   TOTAL RUNOFF(CFS) =      1.69

****************************************************************************
FLOW PROCESS FROM NODE      2.14 TO NODE      2.15 IS CODE =  31
----------------------------------------------------------------------------
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
ELEVATION DATA: UPSTREAM(FEET) =   716.00  DOWNSTREAM(FEET) =   630.00
FLOW LENGTH(FEET) =   290.00   MANNING'S N =  0.013
DEPTH OF FLOW IN   6.0 INCH PIPE IS   3.2 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) =  15.65
ESTIMATED PIPE DIAMETER(INCH) =   6.00    NUMBER OF PIPES =   1
PIPE-FLOW(CFS) =       1.69
PIPE TRAVEL TIME(MIN.) =   0.31    Tc(MIN.) =   17.31
LONGEST FLOWPATH FROM NODE      2.11 TO NODE      2.15 =    1258.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE      2.14 TO NODE      2.15 IS CODE =   1
----------------------------------------------------------------------------
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
TOTAL NUMBER OF STREAMS =  2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
TIME OF CONCENTRATION(MIN.) =   17.31
```

```
  RAINFALL INTENSITY(INCH/HR) =   3.38
  TOTAL STREAM AREA(ACRES) =     1.00
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.69

+---------------------------------------------------------------------------+
| The following outflows are per HEC-HMS printout for BMP-2 to POC-3.       |
|                                                                           |
|                                                                           |
+---------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE =   7
----------------------------------------------------------------------------
  >>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<
============================================================================
  USER-SPECIFIED VALUES ARE AS FOLLOWS:
  TC(MIN) =  17.00   RAIN INTENSITY(INCH/HOUR) =  3.42
  TOTAL AREA(ACRES) =     1.70   TOTAL RUNOFF(CFS) =      2.42

****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   17.00
  RAINFALL INTENSITY(INCH/HR) =   3.42
  TOTAL STREAM AREA(ACRES) =     1.70
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.42
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        1.7  TC(MIN.) =     17.00
  PEAK FLOW RATE(CFS)   =       2.42
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

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CHAPTER 6 - MODIFIED-PULS DETENTION ROUTING

6.1 – Rational Method Hydrograph

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RUN DATE 1/28/2016
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 9 MIN.
6 HOUR RAINFALL 2.86 INCHES
BASIN AREA 11.41 ACRES
RUNOFF COEFFICIENT 0.37
PEAK DISCHARGE 14.93 CFS

POC-1, Pre.

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 9	DISCHARGE (CFS) = 0.1
TIME (MIN) = 18	DISCHARGE (CFS) = 0.7
TIME (MIN) = 27	DISCHARGE (CFS) = 0.7
TIME (MIN) = 36	DISCHARGE (CFS) = 0.8
TIME (MIN) = 45	DISCHARGE (CFS) = 0.8
TIME (MIN) = 54	DISCHARGE (CFS) = 0.8
TIME (MIN) = 63	DISCHARGE (CFS) = 0.8
TIME (MIN) = 72	DISCHARGE (CFS) = 0.9
TIME (MIN) = 81	DISCHARGE (CFS) = 0.9
TIME (MIN) = 90	DISCHARGE (CFS) = 0.9
TIME (MIN) = 99	DISCHARGE (CFS) = 1
TIME (MIN) = 108	DISCHARGE (CFS) = 1
TIME (MIN) = 117	DISCHARGE (CFS) = 1
TIME (MIN) = 126	DISCHARGE (CFS) = 1.1
TIME (MIN) = 135	DISCHARGE (CFS) = 1.1
TIME (MIN) = 144	DISCHARGE (CFS) = 1.2
TIME (MIN) = 153	DISCHARGE (CFS) = 1.3
TIME (MIN) = 162	DISCHARGE (CFS) = 1.4
TIME (MIN) = 171	DISCHARGE (CFS) = 1.4
TIME (MIN) = 180	DISCHARGE (CFS) = 1.6
TIME (MIN) = 189	DISCHARGE (CFS) = 1.7
TIME (MIN) = 198	DISCHARGE (CFS) = 1.9
TIME (MIN) = 207	DISCHARGE (CFS) = 2.1
TIME (MIN) = 216	DISCHARGE (CFS) = 2.6
TIME (MIN) = 225	DISCHARGE (CFS) = 2.9
TIME (MIN) = 234	DISCHARGE (CFS) = 4.3
TIME (MIN) = 243	DISCHARGE (CFS) = 12.9
TIME (MIN) = 252	DISCHARGE (CFS) = 14.93
TIME (MIN) = 261	DISCHARGE (CFS) = 3.5
TIME (MIN) = 270	DISCHARGE (CFS) = 2.3
TIME (MIN) = 279	DISCHARGE (CFS) = 1.8
TIME (MIN) = 288	DISCHARGE (CFS) = 1.5
TIME (MIN) = 297	DISCHARGE (CFS) = 1.3
TIME (MIN) = 306	DISCHARGE (CFS) = 1.2
TIME (MIN) = 315	DISCHARGE (CFS) = 1.1
TIME (MIN) = 324	DISCHARGE (CFS) = 1
TIME (MIN) = 333	DISCHARGE (CFS) = 0.9
TIME (MIN) = 342	DISCHARGE (CFS) = 0.9
TIME (MIN) = 351	DISCHARGE (CFS) = 0.8
TIME (MIN) = 360	DISCHARGE (CFS) = 0.8
TIME (MIN) = 369	DISCHARGE (CFS) = 0

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RUN DATE 1/28/2016
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 9 MIN.
6 HOUR RAINFALL 2.86 INCHES
BASIN AREA 1.489 ACRES
RUNOFF COEFFICIENT 0.32
PEAK DISCHARGE 2.54 CFS

POC-2, Pre.

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 9	DISCHARGE (CFS) = 0.1
TIME (MIN) = 18	DISCHARGE (CFS) = 0.1
TIME (MIN) = 27	DISCHARGE (CFS) = 0.1
TIME (MIN) = 36	DISCHARGE (CFS) = 0.1
TIME (MIN) = 45	DISCHARGE (CFS) = 0.1
TIME (MIN) = 54	DISCHARGE (CFS) = 0.1
TIME (MIN) = 63	DISCHARGE (CFS) = 0.1
TIME (MIN) = 72	DISCHARGE (CFS) = 0.1
TIME (MIN) = 81	DISCHARGE (CFS) = 0.1
TIME (MIN) = 90	DISCHARGE (CFS) = 0.1
TIME (MIN) = 99	DISCHARGE (CFS) = 0.1
TIME (MIN) = 108	DISCHARGE (CFS) = 0.1
TIME (MIN) = 117	DISCHARGE (CFS) = 0.1
TIME (MIN) = 126	DISCHARGE (CFS) = 0.1
TIME (MIN) = 135	DISCHARGE (CFS) = 0.1
TIME (MIN) = 144	DISCHARGE (CFS) = 0.1
TIME (MIN) = 153	DISCHARGE (CFS) = 0.1
TIME (MIN) = 162	DISCHARGE (CFS) = 0.2
TIME (MIN) = 171	DISCHARGE (CFS) = 0.2
TIME (MIN) = 180	DISCHARGE (CFS) = 0.2
TIME (MIN) = 189	DISCHARGE (CFS) = 0.2
TIME (MIN) = 198	DISCHARGE (CFS) = 0.2
TIME (MIN) = 207	DISCHARGE (CFS) = 0.2
TIME (MIN) = 216	DISCHARGE (CFS) = 0.3
TIME (MIN) = 225	DISCHARGE (CFS) = 0.3
TIME (MIN) = 234	DISCHARGE (CFS) = 0.5
TIME (MIN) = 243	DISCHARGE (CFS) = 0.6
TIME (MIN) = 252	DISCHARGE (CFS) = 2.54
TIME (MIN) = 261	DISCHARGE (CFS) = 0.4
TIME (MIN) = 270	DISCHARGE (CFS) = 0.3
TIME (MIN) = 279	DISCHARGE (CFS) = 0.2
TIME (MIN) = 288	DISCHARGE (CFS) = 0.2
TIME (MIN) = 297	DISCHARGE (CFS) = 0.1
TIME (MIN) = 306	DISCHARGE (CFS) = 0.1
TIME (MIN) = 315	DISCHARGE (CFS) = 0.1
TIME (MIN) = 324	DISCHARGE (CFS) = 0.1
TIME (MIN) = 333	DISCHARGE (CFS) = 0.1
TIME (MIN) = 342	DISCHARGE (CFS) = 0.1
TIME (MIN) = 351	DISCHARGE (CFS) = 0.1
TIME (MIN) = 360	DISCHARGE (CFS) = 0.1
TIME (MIN) = 369	DISCHARGE (CFS) = 0

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RUN DATE 1/28/2016
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 9 MIN.
6 HOUR RAINFALL 2.86 INCHES
BASIN AREA 1.555 ACRES
RUNOFF COEFFICIENT 0.3
PEAK DISCHARGE 2.66 CFS

POC-3, Pre.

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 9	DISCHARGE (CFS) = 0.1
TIME (MIN) = 18	DISCHARGE (CFS) = 0.1
TIME (MIN) = 27	DISCHARGE (CFS) = 0.1
TIME (MIN) = 36	DISCHARGE (CFS) = 0.1
TIME (MIN) = 45	DISCHARGE (CFS) = 0.1
TIME (MIN) = 54	DISCHARGE (CFS) = 0.1
TIME (MIN) = 63	DISCHARGE (CFS) = 0.1
TIME (MIN) = 72	DISCHARGE (CFS) = 0.1
TIME (MIN) = 81	DISCHARGE (CFS) = 0.1
TIME (MIN) = 90	DISCHARGE (CFS) = 0.1
TIME (MIN) = 99	DISCHARGE (CFS) = 0.1
TIME (MIN) = 108	DISCHARGE (CFS) = 0.1
TIME (MIN) = 117	DISCHARGE (CFS) = 0.1
TIME (MIN) = 126	DISCHARGE (CFS) = 0.1
TIME (MIN) = 135	DISCHARGE (CFS) = 0.1
TIME (MIN) = 144	DISCHARGE (CFS) = 0.1
TIME (MIN) = 153	DISCHARGE (CFS) = 0.1
TIME (MIN) = 162	DISCHARGE (CFS) = 0.2
TIME (MIN) = 171	DISCHARGE (CFS) = 0.2
TIME (MIN) = 180	DISCHARGE (CFS) = 0.2
TIME (MIN) = 189	DISCHARGE (CFS) = 0.2
TIME (MIN) = 198	DISCHARGE (CFS) = 0.2
TIME (MIN) = 207	DISCHARGE (CFS) = 0.2
TIME (MIN) = 216	DISCHARGE (CFS) = 0.3
TIME (MIN) = 225	DISCHARGE (CFS) = 0.3
TIME (MIN) = 234	DISCHARGE (CFS) = 0.5
TIME (MIN) = 243	DISCHARGE (CFS) = 0.6
TIME (MIN) = 252	DISCHARGE (CFS) = 2.66
TIME (MIN) = 261	DISCHARGE (CFS) = 0.4
TIME (MIN) = 270	DISCHARGE (CFS) = 0.3
TIME (MIN) = 279	DISCHARGE (CFS) = 0.2
TIME (MIN) = 288	DISCHARGE (CFS) = 0.2
TIME (MIN) = 297	DISCHARGE (CFS) = 0.2
TIME (MIN) = 306	DISCHARGE (CFS) = 0.1
TIME (MIN) = 315	DISCHARGE (CFS) = 0.1
TIME (MIN) = 324	DISCHARGE (CFS) = 0.1
TIME (MIN) = 333	DISCHARGE (CFS) = 0.1
TIME (MIN) = 342	DISCHARGE (CFS) = 0.1
TIME (MIN) = 351	DISCHARGE (CFS) = 0.1
TIME (MIN) = 360	DISCHARGE (CFS) = 0.1
TIME (MIN) = 369	DISCHARGE (CFS) = 0

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RUN DATE 4/9/2018
HYDROGRAPH FILE NAME BMP-2
TIME OF CONCENTRATION 14 MIN.
6 HOUR RAINFALL 2.86 INCHES
BASIN AREA 2.8 ACRES
RUNOFF COEFFICIENT 0.54
PEAK DISCHARGE 6.01 CFS

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 14	DISCHARGE (CFS) = 0.3
TIME (MIN) = 28	DISCHARGE (CFS) = 0.3
TIME (MIN) = 42	DISCHARGE (CFS) = 0.3
TIME (MIN) = 56	DISCHARGE (CFS) = 0.3
TIME (MIN) = 70	DISCHARGE (CFS) = 0.3
TIME (MIN) = 84	DISCHARGE (CFS) = 0.3
TIME (MIN) = 98	DISCHARGE (CFS) = 0.3
TIME (MIN) = 112	DISCHARGE (CFS) = 0.4
TIME (MIN) = 126	DISCHARGE (CFS) = 0.4
TIME (MIN) = 140	DISCHARGE (CFS) = 0.4
TIME (MIN) = 154	DISCHARGE (CFS) = 0.5
TIME (MIN) = 168	DISCHARGE (CFS) = 0.5
TIME (MIN) = 182	DISCHARGE (CFS) = 0.6
TIME (MIN) = 196	DISCHARGE (CFS) = 0.7
TIME (MIN) = 210	DISCHARGE (CFS) = 0.8
TIME (MIN) = 224	DISCHARGE (CFS) = 1.2
TIME (MIN) = 238	DISCHARGE (CFS) = 1.5
TIME (MIN) = 252	DISCHARGE (CFS) = 6.01
TIME (MIN) = 266	DISCHARGE (CFS) = 0.9
TIME (MIN) = 280	DISCHARGE (CFS) = 0.6
TIME (MIN) = 294	DISCHARGE (CFS) = 0.5
TIME (MIN) = 308	DISCHARGE (CFS) = 0.4
TIME (MIN) = 322	DISCHARGE (CFS) = 0.4
TIME (MIN) = 336	DISCHARGE (CFS) = 0.3
TIME (MIN) = 350	DISCHARGE (CFS) = 0.3
TIME (MIN) = 364	DISCHARGE (CFS) = 0.3
TIME (MIN) = 378	DISCHARGE (CFS) = 0

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RUN DATE 4/9/2018
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 11 MIN.
6 HOUR RAINFALL 2.86 INCHES
BASIN AREA 11 ACRES
RUNOFF COEFFICIENT 0.48
PEAK DISCHARGE 24.05 CFS

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 11	DISCHARGE (CFS) = 0.9
TIME (MIN) = 22	DISCHARGE (CFS) = 0.9
TIME (MIN) = 33	DISCHARGE (CFS) = 1
TIME (MIN) = 44	DISCHARGE (CFS) = 1
TIME (MIN) = 55	DISCHARGE (CFS) = 1
TIME (MIN) = 66	DISCHARGE (CFS) = 1.1
TIME (MIN) = 77	DISCHARGE (CFS) = 1.1
TIME (MIN) = 88	DISCHARGE (CFS) = 1.1
TIME (MIN) = 99	DISCHARGE (CFS) = 1.2
TIME (MIN) = 110	DISCHARGE (CFS) = 1.3
TIME (MIN) = 121	DISCHARGE (CFS) = 1.3
TIME (MIN) = 132	DISCHARGE (CFS) = 1.4
TIME (MIN) = 143	DISCHARGE (CFS) = 1.5
TIME (MIN) = 154	DISCHARGE (CFS) = 1.6
TIME (MIN) = 165	DISCHARGE (CFS) = 1.8
TIME (MIN) = 176	DISCHARGE (CFS) = 1.9
TIME (MIN) = 187	DISCHARGE (CFS) = 2.1
TIME (MIN) = 198	DISCHARGE (CFS) = 2.3
TIME (MIN) = 209	DISCHARGE (CFS) = 2.8
TIME (MIN) = 220	DISCHARGE (CFS) = 3.2
TIME (MIN) = 231	DISCHARGE (CFS) = 4.7
TIME (MIN) = 242	DISCHARGE (CFS) = 6.6
TIME (MIN) = 253	DISCHARGE (CFS) = 24.05
TIME (MIN) = 264	DISCHARGE (CFS) = 3.8
TIME (MIN) = 275	DISCHARGE (CFS) = 2.5
TIME (MIN) = 286	DISCHARGE (CFS) = 2
TIME (MIN) = 297	DISCHARGE (CFS) = 1.7
TIME (MIN) = 308	DISCHARGE (CFS) = 1.5
TIME (MIN) = 319	DISCHARGE (CFS) = 1.3
TIME (MIN) = 330	DISCHARGE (CFS) = 1.2
TIME (MIN) = 341	DISCHARGE (CFS) = 1.1
TIME (MIN) = 352	DISCHARGE (CFS) = 1
TIME (MIN) = 363	DISCHARGE (CFS) = 0.9
TIME (MIN) = 374	DISCHARGE (CFS) = 0

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RUN DATE 4/9/2018
HYDROGRAPH FILE NAME BMP-3
TIME OF CONCENTRATION 5 MIN.
6 HOUR RAINFALL 2.86 INCHES
BASIN AREA 0.4 ACRES
RUNOFF COEFFICIENT 0.87
PEAK DISCHARGE 2.36 CFS

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 5	DISCHARGE (CFS) = 0.1
TIME (MIN) = 10	DISCHARGE (CFS) = 0.1
TIME (MIN) = 15	DISCHARGE (CFS) = 0.1
TIME (MIN) = 20	DISCHARGE (CFS) = 0.1
TIME (MIN) = 25	DISCHARGE (CFS) = 0.1
TIME (MIN) = 30	DISCHARGE (CFS) = 0.1
TIME (MIN) = 35	DISCHARGE (CFS) = 0.1
TIME (MIN) = 40	DISCHARGE (CFS) = 0.1
TIME (MIN) = 45	DISCHARGE (CFS) = 0.1
TIME (MIN) = 50	DISCHARGE (CFS) = 0.1
TIME (MIN) = 55	DISCHARGE (CFS) = 0.1
TIME (MIN) = 60	DISCHARGE (CFS) = 0.1
TIME (MIN) = 65	DISCHARGE (CFS) = 0.1
TIME (MIN) = 70	DISCHARGE (CFS) = 0.1
TIME (MIN) = 75	DISCHARGE (CFS) = 0.1
TIME (MIN) = 80	DISCHARGE (CFS) = 0.1
TIME (MIN) = 85	DISCHARGE (CFS) = 0.1
TIME (MIN) = 90	DISCHARGE (CFS) = 0.1
TIME (MIN) = 95	DISCHARGE (CFS) = 0.1
TIME (MIN) = 100	DISCHARGE (CFS) = 0.1
TIME (MIN) = 105	DISCHARGE (CFS) = 0.1
TIME (MIN) = 110	DISCHARGE (CFS) = 0.1
TIME (MIN) = 115	DISCHARGE (CFS) = 0.1
TIME (MIN) = 120	DISCHARGE (CFS) = 0.1
TIME (MIN) = 125	DISCHARGE (CFS) = 0.1
TIME (MIN) = 130	DISCHARGE (CFS) = 0.1
TIME (MIN) = 135	DISCHARGE (CFS) = 0.1
TIME (MIN) = 140	DISCHARGE (CFS) = 0.1
TIME (MIN) = 145	DISCHARGE (CFS) = 0.1
TIME (MIN) = 150	DISCHARGE (CFS) = 0.1
TIME (MIN) = 155	DISCHARGE (CFS) = 0.1
TIME (MIN) = 160	DISCHARGE (CFS) = 0.1
TIME (MIN) = 165	DISCHARGE (CFS) = 0.1
TIME (MIN) = 170	DISCHARGE (CFS) = 0.1
TIME (MIN) = 175	DISCHARGE (CFS) = 0.1
TIME (MIN) = 180	DISCHARGE (CFS) = 0.1
TIME (MIN) = 185	DISCHARGE (CFS) = 0.1
TIME (MIN) = 190	DISCHARGE (CFS) = 0.2
TIME (MIN) = 195	DISCHARGE (CFS) = 0.2
TIME (MIN) = 200	DISCHARGE (CFS) = 0.2
TIME (MIN) = 205	DISCHARGE (CFS) = 0.2
TIME (MIN) = 210	DISCHARGE (CFS) = 0.2
TIME (MIN) = 215	DISCHARGE (CFS) = 0.2
TIME (MIN) = 220	DISCHARGE (CFS) = 0.3
TIME (MIN) = 225	DISCHARGE (CFS) = 0.3
TIME (MIN) = 230	DISCHARGE (CFS) = 0.4
TIME (MIN) = 235	DISCHARGE (CFS) = 0.5
TIME (MIN) = 240	DISCHARGE (CFS) = 1
TIME (MIN) = 245	DISCHARGE (CFS) = 2.36
TIME (MIN) = 250	DISCHARGE (CFS) = 0.4
TIME (MIN) = 255	DISCHARGE (CFS) = 0.3
TIME (MIN) = 260	DISCHARGE (CFS) = 0.2
TIME (MIN) = 265	DISCHARGE (CFS) = 0.2
TIME (MIN) = 270	DISCHARGE (CFS) = 0.2
TIME (MIN) = 275	DISCHARGE (CFS) = 0.1
TIME (MIN) = 280	DISCHARGE (CFS) = 0.1
TIME (MIN) = 285	DISCHARGE (CFS) = 0.1
TIME (MIN) = 290	DISCHARGE (CFS) = 0.1
TIME (MIN) = 295	DISCHARGE (CFS) = 0.1
TIME (MIN) = 300	DISCHARGE (CFS) = 0.1
TIME (MIN) = 305	DISCHARGE (CFS) = 0.1
TIME (MIN) = 310	DISCHARGE (CFS) = 0.1
TIME (MIN) = 315	DISCHARGE (CFS) = 0.1
TIME (MIN) = 320	DISCHARGE (CFS) = 0.1
TIME (MIN) = 325	DISCHARGE (CFS) = 0.1
TIME (MIN) = 330	DISCHARGE (CFS) = 0.1
TIME (MIN) = 335	DISCHARGE (CFS) = 0.1
TIME (MIN) = 340	DISCHARGE (CFS) = 0.1
TIME (MIN) = 345	DISCHARGE (CFS) = 0.1
TIME (MIN) = 350	DISCHARGE (CFS) = 0.1
TIME (MIN) = 355	DISCHARGE (CFS) = 0.1
TIME (MIN) = 360	DISCHARGE (CFS) = 0.1
TIME (MIN) = 365	DISCHARGE (CFS) = 0

6.2 – Stage-Storage & Stage-Discharge Relationships

Stage-Area for BMP 1

Elevation (ft)	Area (ft^2)	Volume (ft^3)	
0.00	10257	0	
0.25	10575	1042	TOP OF MULCH[2]
0.50	10898	3726	
0.75	11224	6491	
1.00	11553	9338	
1.25	11887	12268	BIOFILTRATION[1], SURFACE DISCHARGE[3]
1.50	12223	15281	
1.75	12565	18380	
2.00	12909	21564	
2.25	13257	24834	
2.50	13609	28193	
2.75	13964	31639	
3.00	14324	35175	
3.10	14467	36615	
3.25	14685	38801	
3.50	15051	42518	EMERGENCY WEIR[4]
4.00	15798	50230	
4.50	16550	58316	

SUB SURFACE STORAGE BMP 1

Elevation (ft)	Area (ft^2)	Volume (ft^3)	
-1.50	11887	5349	Amended Soil Base (0.3 voids)
-3.50	11887	9510	Gravel Base (0.4 voids)[5]

Gravel & Amended Soil	TOTAL =	14859	(ft^3)
Surface Total	TOTAL =	12268	(ft^3)
IMP	TOTAL =	27126	(ft^3)

(1): The area at this surface elevation corresponds to the area of gravel and amended soil (Bio-filtration layer)
(2): The volume for the first 3 inches of surface depth accounts for the voids of mulch
(3): Volume at this elevation coresponds with surface volume for WQ purposes (invert of lowest surface outlet)
(4): This elevation corresponds to the top of the riser elevation.
(5): Gravel Depth includes three (3) inches of storage below the LID orifice.

Effective Depth:	12.38 in	(hydromodification purposes)
Effective Depth:	11.48 in	(water quality purposes)

Stage-Area for BMP 2

Elevation (ft)	Area (ft^2)	Volume (ft^3)	
0.00	1810	0	
0.25	2239	202	TOP OF MULCH[2]
0.50	2694	818	
0.75	3147	1547	
1.00	3623	2393	
1.25	4121	3360	BIOFILTRATION[1], SURFACE DISCHARGE[3]
1.50	4607	4450	
1.75	5163	5671	
2.00	5722	7031	
2.25	6271	8530	
2.50	6871	10172	EMERGENCY WEIR[4]
2.75	7447	11961	
3.00	8047	13897	

SUB SURFACE STORAGE BMP 2

Elevation (ft)	Area (ft^2)	Volume (ft^3)	
-1.50	4121	1854	Amended Soil Base (0.3 voids)
-3.50	4121	3297	Gravel Base (0.4 voids)[5]
Gravel & Amended Soil	TOTAL =	5151	(ft^3)
Surface Total	TOTAL =	3360	(ft^3)
IMP	TOTAL =	8511	(ft^3)

(1): The area at this surface elevation corresponds to the area of gravel and amended soil (Bio-filtration layer)
(2): The volume for the first 3 inches of surface depth accounts for the voids of mulch
(3): Volume at this elevation coresponds with surface volume for WQ purposes (invert of lowest surface outlet)
(4): This elevation corresponds to the top of the riser elevation.
(5): Gravel Depth includes three (3) inches of storage below the LID orifice.

Effective Depth:	9.78 in	(hydromodification purposes)
Effective Depth:	8.88 in	(water quality purposes)

Stage-Area for BMP 3

Elevation (ft)	Area (ft^2)	Volume (ft^3)	
0.00	179	0	
0.25	225	20	TOP OF MULCH[2]
0.50	276	83	
0.75	333	159	
1.00	393	249	
1.25	459.3	356	BIOFILTRATION[1], SURFACE DISCHARGE[3]
1.50	530	479	
1.75	605	621	
2.00	687	782	
2.25	771	965	
2.50	861	1168	EMERGENCY WEIR[4]
2.75	956	1395	
3.00	1055	1647	

SUB SURFACE STORAGE BMP 3

Elevation (ft)	Area (ft^2)	Volume (ft^3)	
-1.50	459	207	Amended Soil Base (0.3 voids)
-3.50	459	367	Gravel Base (0.4 voids)[5]
Gravel & Amended Soil	**TOTAL =**	574	(ft^3)
Surface Total	**TOTAL =**	356	(ft^3)
IMP	**TOTAL =**	929	(ft^3)

(1): The area at this surface elevation corresponds to the area of gravel and amended soil (Bio-filtration layer)
(2): The volume for the first 3 inches of surface depth accounts for the voids of mulch
(3): Volume at this elevation coresponds with surface volume for WQ purposes (invert of lowest surface outlet)
(4): This elevation corresponds to the top of the riser elevation.
(5): Gravel Depth includes three (3) inches of storage below the LID orifice.

Effective Depth:	9.29 in	(hydromodification purposes)
Effective Depth:	8.39 in	(water quality purposes)

Outlet structure for Discharge of Detention Basin 1

(note: 0.0 elev corresponds to elev 1.25 ft from above top of ammended soil)

Discharge vs Elevation Table

Low orifice:	1 "	Lower slot		Emergency Weir	
Number:	4	Invert:	1.25 ft	Invert:	2.250 ft
Cg-low:	0.61 ft	B	6.00 ft	B:	12 ft
		h	0.250 ft		
Middle orifice:	1.5 "	Upper slot			
number of orif:	0	Invert:	0.000 ft		
Cg-middle:	0.61	B:	0.00 ft		
invert elev:	0.00 ft	h	0.000 ft		

h (ft)	H/D-low -	H/D-mid -	Qlow-orif (cfs)	Qlow-weir (cfs)	Qtot-low (cfs)	Qmid-orif (cfs)	Qmid-weir (cfs)	Qtot-med (cfs)	Qslot-low (cfs)	Qslot-upp (cfs)	Qemer (cfs)	Qtot (cfs)
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.083	1.000	0.667	0.022	0.021	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.021
0.167	2.000	1.333	0.038	0.050	0.038	0.000	0.000	0.000	0.000	0.000	0.000	0.038
0.250	3.000	2.000	0.049	0.057	0.049	0.000	0.000	0.000	0.000	0.000	0.000	0.049
0.333	4.000	2.667	0.058	0.095	0.058	0.000	0.000	0.000	0.000	0.000	0.000	0.058
0.417	5.000	3.333	0.065	0.382	0.065	0.000	0.000	0.000	0.000	0.000	0.000	0.065
0.500	6.000	4.000	0.072	0.723	0.072	0.000	0.000	0.000	0.000	0.000	0.000	0.072
0.583	7.000	4.667	0.079	0.786	0.079	0.000	0.000	0.000	0.000	0.000	0.000	0.079
0.667	8.000	5.333	0.084	0.844	0.084	0.000	0.000	0.000	0.000	0.000	0.000	0.084
0.750	9.000	6.000	0.090	0.899	0.090	0.000	0.000	0.000	0.000	0.000	0.000	0.090
0.833	10.000	6.667	0.095	0.950	0.095	0.000	0.000	0.000	0.000	0.000	0.000	0.095
0.917	11.000	7.333	0.100	0.999	0.100	0.000	0.000	0.000	0.000	0.000	0.000	0.100
1.000	12.000	8.000	0.105	1.045	0.105	0.000	0.000	0.000	0.000	0.000	0.000	0.105
1.083	13.000	8.667	0.109	1.090	0.109	0.000	0.000	0.000	0.000	0.000	0.000	0.109
1.167	14.000	9.333	0.113	1.133	0.113	0.000	0.000	0.000	0.000	0.000	0.000	0.113
1.250	15.000	10.000	0.117	1.174	0.117	0.000	0.000	0.000	0.000	0.000	0.000	0.117
1.333	16.000	10.667	0.121	1.214	0.121	0.000	0.000	0.000	0.447	0.000	0.000	0.569
1.417	17.000	11.333	0.125	1.252	0.125	0.000	0.000	0.000	1.266	0.000	0.000	1.391
1.500	18.000	12.000	0.129	1.290	0.129	0.000	0.000	0.000	2.325	0.000	0.000	2.454
1.583	19.000	12.667	0.133	1.326	0.133	0.000	0.000	0.000	3.352	0.000	0.000	3.484
1.667	20.000	13.333	0.136	1.361	0.136	0.000	0.000	0.000	3.966	0.000	0.000	4.102
1.750	21.000	14.000	0.140	1.396	0.140	0.000	0.000	0.000	4.497	0.000	0.000	4.636
1.833	22.000	14.667	0.143	1.430	0.143	0.000	0.000	0.000	4.971	0.000	0.000	5.114
1.917	23.000	15.333	0.146	1.462	0.146	0.000	0.000	0.000	5.404	0.000	0.000	5.550
2.000	24.000	16.000	0.149	1.495	0.149	0.000	0.000	0.000	5.805	0.000	0.000	5.954
2.083	25.000	16.667	0.153	1.526	0.153	0.000	0.000	0.000	6.180	0.000	0.000	6.333
2.167	26.000	17.333	0.156	1.557	0.156	0.000	0.000	0.000	6.533	0.000	0.000	6.689
2.250	27.000	18.000	0.159	1.587	0.159	0.000	0.000	0.000	6.869	0.000	0.000	7.027
2.333	28.000	18.667	0.162	1.617	0.162	0.000	0.000	0.000	7.188	0.000	0.895	8.245
2.417	29.000	19.333	0.165	1.646	0.165	0.000	0.000	0.000	7.494	0.000	2.531	10.190
2.500	30.000	20.000	0.167	1.674	0.167	0.000	0.000	0.000	7.788	0.000	4.650	12.606
2.583	31.000	20.667	0.170	1.703	0.170	0.000	0.000	0.000	8.072	0.000	7.159	15.401
2.667	32.000	21.333	0.173	1.730	0.173	0.000	0.000	0.000	8.345	0.000	10.005	18.523
2.750	33.000	22.000	0.176	1.758	0.176	0.000	0.000	0.000	8.610	0.000	13.152	21.938
2.833	34.000	22.667	0.178	1.784	0.178	0.000	0.000	0.000	8.867	0.000	16.574	25.619
2.917	35.000	23.333	0.181	1.811	0.181	0.000	0.000	0.000	9.117	0.000	20.249	29.547
3.000	36.000	24.000	0.184	1.837	0.184	0.000	0.000	0.000	9.360	0.000	24.162	33.706
3.083	37.000	24.667	0.186	1.863	0.186	0.000	0.000	0.000	9.597	0.000	28.299	38.083
3.167	38.000	25.333	0.189	1.888	0.189	0.000	0.000	0.000	9.829	0.000	32.648	42.666
3.250	39.000	26.000	0.191	1.913	0.191	0.000	0.000	0.000	10.055	0.000	37.200	47.446

Outlet structure for Discharge of Detention Basin 2

(note: 0.0 elev corresponds to elev 1.25 ft from above top of ammended soil)

Discharge vs Elevation Table

Low orifice:	0.75 "	Lower slot		Emergency Weir	
Number:	2	Invert:	0.75 ft	Invert:	1.250 ft
Cg-low:	0.61 ft	B	6.00 ft	B:	16 ft
		h	0.250 ft		
Middle orifice:	1 "	Upper slot			
number of orif:	0	Invert:	0.000 ft		
Cg-middle:	0.61	B:	0.00 ft		
invert elev:	0.25 ft	h	0.000 ft		

h (ft)	H/D-low -	H/D-mid -	Qlow-orif (cfs)	Qlow-weir (cfs)	Qtot-low (cfs)	Qmid-orif (cfs)	Qmid-weir (cfs)	Qtot-med (cfs)	Qslot-low (cfs)	Qslot-upp (cfs)	Qemer (cfs)	Qtot (cfs)
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.042	0.667	0.000	0.003	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.003
0.083	1.333	0.000	0.007	0.008	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.007
0.125	2.000	0.000	0.009	0.012	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.009
0.167	2.667	0.000	0.011	0.014	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.011
0.208	3.333	0.000	0.013	0.014	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.013
0.250	4.000	0.000	0.014	0.023	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.014
0.292	4.667	0.500	0.015	0.057	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.015
0.333	5.333	1.000	0.017	0.147	0.017	0.000	0.000	0.000	0.000	0.000	0.000	0.017
0.375	6.000	1.500	0.018	0.176	0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.018
0.417	6.667	2.000	0.019	0.186	0.019	0.000	0.000	0.000	0.000	0.000	0.000	0.019
0.458	7.333	2.500	0.020	0.196	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.020
0.500	8.000	3.000	0.021	0.206	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.021
0.542	8.667	3.500	0.021	0.215	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.021
0.583	9.333	4.000	0.022	0.223	0.022	0.000	0.000	0.000	0.000	0.000	0.000	0.022
0.625	10.000	4.500	0.023	0.231	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.023
0.667	10.667	5.000	0.024	0.239	0.024	0.000	0.000	0.000	0.000	0.000	0.000	0.024
0.708	11.333	5.500	0.025	0.247	0.025	0.000	0.000	0.000	0.000	0.000	0.000	0.025
0.750	12.000	6.000	0.025	0.255	0.025	0.000	0.000	0.000	0.000	0.000	0.000	0.025
0.792	12.667	6.500	0.026	0.262	0.026	0.000	0.000	0.000	0.158	0.000	0.000	0.184
0.833	13.333	7.000	0.027	0.269	0.027	0.000	0.000	0.000	0.447	0.000	0.000	0.474
0.875	14.000	7.500	0.028	0.276	0.028	0.000	0.000	0.000	0.822	0.000	0.000	0.850
0.917	14.667	8.000	0.028	0.283	0.028	0.000	0.000	0.000	1.266	0.000	0.000	1.294
0.958	15.333	8.500	0.029	0.289	0.029	0.000	0.000	0.000	1.769	0.000	0.000	1.798
1.000	16.000	9.000	0.030	0.296	0.030	0.000	0.000	0.000	2.325	0.000	0.000	2.355
1.042	16.667	9.500	0.030	0.302	0.030	0.000	0.000	0.000	2.930	0.000	0.000	2.960
1.083	17.333	10.000	0.031	0.308	0.031	0.000	0.000	0.000	3.352	0.000	0.000	3.382
1.125	18.000	10.500	0.031	0.314	0.031	0.000	0.000	0.000	3.671	0.000	0.000	3.703
1.167	18.667	11.000	0.032	0.320	0.032	0.000	0.000	0.000	3.966	0.000	0.000	3.998
1.208	19.333	11.500	0.033	0.326	0.033	0.000	0.000	0.000	4.239	0.000	0.000	4.272
1.250	20.000	12.000	0.033	0.332	0.033	0.000	0.000	0.000	4.497	0.000	0.000	4.530
1.292	20.667	12.500	0.034	0.337	0.034	0.000	0.000	0.000	4.740	0.000	0.422	5.195
1.333	21.333	13.000	0.034	0.343	0.034	0.000	0.000	0.000	4.971	0.000	1.193	6.199
1.375	22.000	13.500	0.035	0.348	0.035	0.000	0.000	0.000	5.192	0.000	2.192	7.419
1.417	22.667	14.000	0.035	0.354	0.035	0.000	0.000	0.000	5.404	0.000	3.375	8.814
1.458	23.333	14.500	0.036	0.359	0.036	0.000	0.000	0.000	5.608	0.000	4.716	10.361
1.500	24.000	15.000	0.036	0.364	0.036	0.000	0.000	0.000	5.805	0.000	6.200	12.041
1.542	24.667	15.500	0.037	0.369	0.037	0.000	0.000	0.000	5.995	0.000	7.813	13.845
1.583	25.333	16.000	0.037	0.374	0.037	0.000	0.000	0.000	6.180	0.000	9.545	15.763
1.625	26.000	16.500	0.038	0.379	0.038	0.000	0.000	0.000	6.359	0.000	11.390	17.787
1.667	26.667	17.000	0.038	0.384	0.038	0.000	0.000	0.000	6.533	0.000	13.340	19.912
1.708	27.333	17.500	0.039	0.389	0.039	0.000	0.000	0.000	6.703	0.000	15.390	22.132
1.750	28.000	18.000	0.039	0.394	0.039	0.000	0.000	0.000	6.869	0.000	17.536	24.444

Outlet structure for Discharge of Detention Basin 2 (Riser 2-2)

(note: 0.0 elev corresponds to elev 1.25 ft from above top of ammended soi

Discharge vs Elevation Table

Low orifice:	0.75 "	Lower slot		Emergency Weir	
Number:	2	Invert:	0.75 ft	Invert:	1.250 ft
Cg-low:	0.61 ft	B	3.00 ft	B:	8 ft
		h	0.250 ft		
Middle orifice:	1 "	Upper slot			
number of orif:	0	Invert:	0.000 ft		
Cg-middle:	0.61	B:	0.00 ft		
invert elev:	0.25 ft	h	0.000 ft		

h (ft)	H/D-low -	H/D-mid -	Qlow-orif (cfs)	Qlow-weir (cfs)	Qtot-low (cfs)	Qmid-orif (cfs)	Qmid-weir (cfs)	Qtot-med (cfs)	Qslot-low (cfs)	Qslot-upp (cfs)	Qemer (cfs)	Qtot (cfs)
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.042	0.667	0.000	0.003	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.003
0.083	1.333	0.000	0.007	0.008	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.007
0.125	2.000	0.000	0.009	0.012	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.009
0.167	2.667	0.000	0.011	0.014	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.011
0.208	3.333	0.000	0.013	0.014	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.013
0.250	4.000	0.000	0.014	0.023	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.014
0.292	4.667	0.500	0.015	0.057	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.015
0.333	5.333	1.000	0.017	0.147	0.017	0.000	0.000	0.000	0.000	0.000	0.000	0.017
0.375	6.000	1.500	0.018	0.176	0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.018
0.417	6.667	2.000	0.019	0.186	0.019	0.000	0.000	0.000	0.000	0.000	0.000	0.019
0.458	7.333	2.500	0.020	0.196	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.020
0.500	8.000	3.000	0.021	0.206	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.021
0.542	8.667	3.500	0.021	0.215	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.021
0.583	9.333	4.000	0.022	0.223	0.022	0.000	0.000	0.000	0.000	0.000	0.000	0.022
0.625	10.000	4.500	0.023	0.231	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.023
0.667	10.667	5.000	0.024	0.239	0.024	0.000	0.000	0.000	0.000	0.000	0.000	0.024
0.708	11.333	5.500	0.025	0.247	0.025	0.000	0.000	0.000	0.000	0.000	0.000	0.025
0.750	12.000	6.000	0.025	0.255	0.025	0.000	0.000	0.000	0.000	0.000	0.000	0.025
0.792	12.667	6.500	0.026	0.262	0.026	0.000	0.000	0.000	0.079	0.000	0.000	0.105
0.833	13.333	7.000	0.027	0.269	0.027	0.000	0.000	0.000	0.224	0.000	0.000	0.251
0.875	14.000	7.500	0.028	0.276	0.028	0.000	0.000	0.000	0.411	0.000	0.000	0.439
0.917	14.667	8.000	0.028	0.283	0.028	0.000	0.000	0.000	0.633	0.000	0.000	0.661
0.958	15.333	8.500	0.029	0.289	0.029	0.000	0.000	0.000	0.884	0.000	0.000	0.913
1.000	16.000	9.000	0.030	0.296	0.030	0.000	0.000	0.000	1.162	0.000	0.000	1.192
1.042	16.667	9.500	0.030	0.302	0.030	0.000	0.000	0.000	1.465	0.000	0.000	1.495
1.083	17.333	10.000	0.031	0.308	0.031	0.000	0.000	0.000	1.676	0.000	0.000	1.707
1.125	18.000	10.500	0.031	0.314	0.031	0.000	0.000	0.000	1.836	0.000	0.000	1.867
1.167	18.667	11.000	0.032	0.320	0.032	0.000	0.000	0.000	1.983	0.000	0.000	2.015
1.208	19.333	11.500	0.033	0.326	0.033	0.000	0.000	0.000	2.120	0.000	0.000	2.152
1.250	20.000	12.000	0.033	0.332	0.033	0.000	0.000	0.000	2.248	0.000	0.000	2.281
1.292	20.667	12.500	0.034	0.337	0.034	0.000	0.000	0.000	2.370	0.000	0.211	2.615
1.333	21.333	13.000	0.034	0.343	0.034	0.000	0.000	0.000	2.486	0.000	0.597	3.116
1.375	22.000	13.500	0.035	0.348	0.035	0.000	0.000	0.000	2.596	0.000	1.096	3.727
1.417	22.667	14.000	0.035	0.354	0.035	0.000	0.000	0.000	2.702	0.000	1.687	4.425
1.458	23.333	14.500	0.036	0.359	0.036	0.000	0.000	0.000	2.804	0.000	2.358	5.198
1.500	24.000	15.000	0.036	0.364	0.036	0.000	0.000	0.000	2.903	0.000	3.100	6.039
1.542	24.667	15.500	0.037	0.369	0.037	0.000	0.000	0.000	2.998	0.000	3.906	6.941
1.583	25.333	16.000	0.037	0.374	0.037	0.000	0.000	0.000	3.090	0.000	4.773	7.900
1.625	26.000	16.500	0.038	0.379	0.038	0.000	0.000	0.000	3.180	0.000	5.695	8.913
1.667	26.667	17.000	0.038	0.384	0.038	0.000	0.000	0.000	3.267	0.000	6.670	9.975
1.708	27.333	17.500	0.039	0.389	0.039	0.000	0.000	0.000	3.352	0.000	7.695	11.086
1.750	28.000	18.000	0.039	0.394	0.039	0.000	0.000	0.000	3.434	0.000	8.768	12.242

Outlet structure for Discharge of Detention Basin 2 (Riser 2-3)

(note: 0.0 elev corresponds to elev 1.25 ft from above top of ammended soi

Discharge vs Elevation Table

Low orifice:	0.75 "	Lower slot		Emergency Weir	
Number:	0	Invert:	0.75 ft	Invert:	1.250 ft
Cg-low:	0.61 ft	B	3.00 ft	B:	8 ft
		h	0.250 ft		
Middle orifice:	1 "	Upper slot			
number of orif:	0	Invert:	0.000 ft		
Cg-middle:	0.61	B:	0.00 ft		
invert elev:	0.25 ft	h	0.000 ft		

h (ft)	H/D-low -	H/D-mid -	Qlow-orif (cfs)	Qlow-weir (cfs)	Qtot-low (cfs)	Qmid-orif (cfs)	Qmid-weir (cfs)	Qtot-med (cfs)	Qslot-low (cfs)	Qslot-upp (cfs)	Qemer (cfs)	Qtot (cfs)
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.042	0.667	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.083	1.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.125	2.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.167	2.667	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.208	3.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.250	4.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.292	4.667	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.333	5.333	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.375	6.000	1.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.417	6.667	2.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.458	7.333	2.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.500	8.000	3.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.542	8.667	3.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.583	9.333	4.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.625	10.000	4.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.667	10.667	5.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.708	11.333	5.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.750	12.000	6.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.792	12.667	6.500	0.000	0.000	0.000	0.000	0.000	0.000	0.079	0.000	0.000	0.079
0.833	13.333	7.000	0.000	0.000	0.000	0.000	0.000	0.000	0.224	0.000	0.000	0.224
0.875	14.000	7.500	0.000	0.000	0.000	0.000	0.000	0.000	0.411	0.000	0.000	0.411
0.917	14.667	8.000	0.000	0.000	0.000	0.000	0.000	0.000	0.633	0.000	0.000	0.633
0.958	15.333	8.500	0.000	0.000	0.000	0.000	0.000	0.000	0.884	0.000	0.000	0.884
1.000	16.000	9.000	0.000	0.000	0.000	0.000	0.000	0.000	1.162	0.000	0.000	1.162
1.042	16.667	9.500	0.000	0.000	0.000	0.000	0.000	0.000	1.465	0.000	0.000	1.465
1.083	17.333	10.000	0.000	0.000	0.000	0.000	0.000	0.000	1.676	0.000	0.000	1.676
1.125	18.000	10.500	0.000	0.000	0.000	0.000	0.000	0.000	1.836	0.000	0.000	1.836
1.167	18.667	11.000	0.000	0.000	0.000	0.000	0.000	0.000	1.983	0.000	0.000	1.983
1.208	19.333	11.500	0.000	0.000	0.000	0.000	0.000	0.000	2.120	0.000	0.000	2.120
1.250	20.000	12.000	0.000	0.000	0.000	0.000	0.000	0.000	2.248	0.000	0.000	2.248
1.292	20.667	12.500	0.000	0.000	0.000	0.000	0.000	0.000	2.370	0.000	0.211	2.581
1.333	21.333	13.000	0.000	0.000	0.000	0.000	0.000	0.000	2.486	0.000	0.597	3.082
1.375	22.000	13.500	0.000	0.000	0.000	0.000	0.000	0.000	2.596	0.000	1.096	3.692
1.417	22.667	14.000	0.000	0.000	0.000	0.000	0.000	0.000	2.702	0.000	1.687	4.390
1.458	23.333	14.500	0.000	0.000	0.000	0.000	0.000	0.000	2.804	0.000	2.358	5.162
1.500	24.000	15.000	0.000	0.000	0.000	0.000	0.000	0.000	2.903	0.000	3.100	6.002
1.542	24.667	15.500	0.000	0.000	0.000	0.000	0.000	0.000	2.998	0.000	3.906	6.904
1.583	25.333	16.000	0.000	0.000	0.000	0.000	0.000	0.000	3.090	0.000	4.773	7.863
1.625	26.000	16.500	0.000	0.000	0.000	0.000	0.000	0.000	3.180	0.000	5.695	8.875
1.667	26.667	17.000	0.000	0.000	0.000	0.000	0.000	0.000	3.267	0.000	6.670	9.937
1.708	27.333	17.500	0.000	0.000	0.000	0.000	0.000	0.000	3.352	0.000	7.695	11.047
1.750	28.000	18.000	0.000	0.000	0.000	0.000	0.000	0.000	3.434	0.000	8.768	12.202

Outlet structure for Discharge of Detention Basin 3

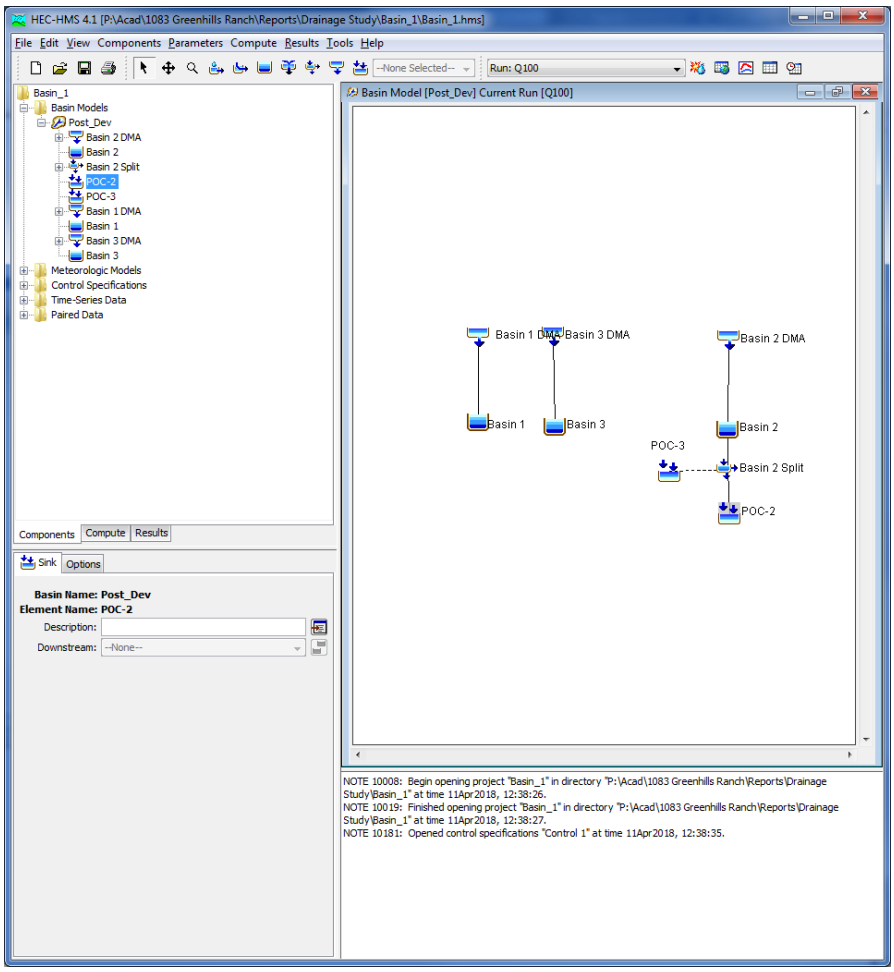
(note: 0.0 elev corresponds to elev 1.25 ft from above top of ammended soil)

Discharge vs Elevation Table

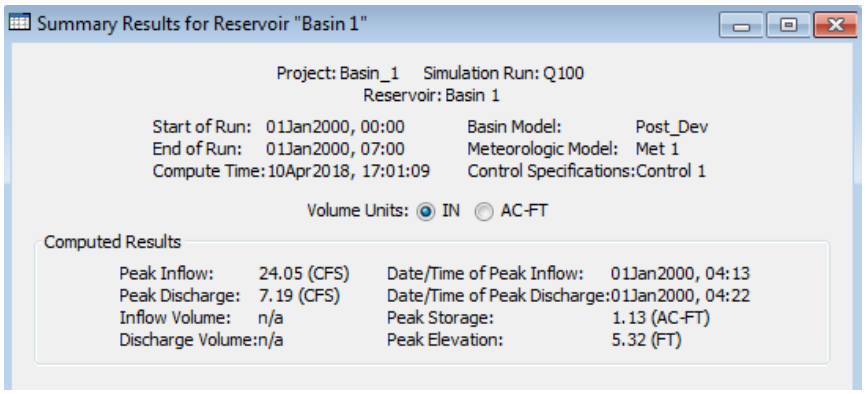
Low orifice:	1 "	Lower slot		Emergency Weir	
Number:	1	Invert:	0.00 ft	Invert:	1.250 ft
Cg-low:	0.61 ft	B	0.00 ft	B:	8 ft
		h	0.167 ft		
Middle orifice:	1 "	Upper slot			
number of orif:	0	Invert:	0.000 ft		
Cg-middle:	0.61	B:	0.00 ft		
invert elev:	0.25 ft	h	0.083 ft		

h (ft)	H/D-low -	H/D-mid -	Qlow-orif (cfs)	Qlow-weir (cfs)	Qtot-low (cfs)	Qmid-orif (cfs)	Qmid-weir (cfs)	Qtot-med (cfs)	Qslot-low (cfs)	Qslot-upp (cfs)	Qemer (cfs)	Qtot (cfs)
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.042	0.500	0.000	0.000	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.002
0.083	1.000	0.000	0.005	0.005	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.005
0.125	1.500	0.000	0.008	0.009	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.008
0.167	2.000	0.000	0.009	0.013	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.009
0.208	2.500	0.000	0.011	0.014	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.011
0.250	3.000	0.000	0.012	0.014	0.012	0.000	0.000	0.000	0.000	0.000	0.000	0.012
0.292	3.500	0.500	0.013	0.016	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.013
0.333	4.000	1.000	0.014	0.024	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.014
0.375	4.500	1.500	0.015	0.046	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.015
0.417	5.000	2.000	0.016	0.095	0.016	0.000	0.000	0.000	0.000	0.000	0.000	0.016
0.458	5.500	2.500	0.017	0.172	0.017	0.000	0.000	0.000	0.000	0.000	0.000	0.017
0.500	6.000	3.000	0.018	0.181	0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.018
0.542	6.500	3.500	0.019	0.189	0.019	0.000	0.000	0.000	0.000	0.000	0.000	0.019
0.583	7.000	4.000	0.020	0.197	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.020
0.625	7.500	4.500	0.020	0.204	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.020
0.667	8.000	5.000	0.021	0.211	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.021
0.708	8.500	5.500	0.022	0.218	0.022	0.000	0.000	0.000	0.000	0.000	0.000	0.022
0.750	9.000	6.000	0.022	0.225	0.022	0.000	0.000	0.000	0.000	0.000	0.000	0.022
0.792	9.500	6.500	0.023	0.231	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.023
0.833	10.000	7.000	0.024	0.238	0.024	0.000	0.000	0.000	0.000	0.000	0.000	0.024
0.875	10.500	7.500	0.024	0.244	0.024	0.000	0.000	0.000	0.000	0.000	0.000	0.024
0.917	11.000	8.000	0.025	0.250	0.025	0.000	0.000	0.000	0.000	0.000	0.000	0.025
0.958	11.500	8.500	0.026	0.256	0.026	0.000	0.000	0.000	0.000	0.000	0.000	0.026
1.000	12.000	9.000	0.026	0.261	0.026	0.000	0.000	0.000	0.000	0.000	0.000	0.026
1.042	12.500	9.500	0.027	0.267	0.027	0.000	0.000	0.000	0.000	0.000	0.000	0.027
1.083	13.000	10.000	0.027	0.272	0.027	0.000	0.000	0.000	0.000	0.000	0.000	0.027
1.125	13.500	10.500	0.028	0.278	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.028
1.167	14.000	11.000	0.028	0.283	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.028
1.208	14.500	11.500	0.029	0.288	0.029	0.000	0.000	0.000	0.000	0.000	0.000	0.029
1.250	15.000	12.000	0.029	0.293	0.029	0.000	0.000	0.000	0.000	0.000	0.000	0.029
1.292	15.500	12.500	0.030	0.299	0.030	0.000	0.000	0.000	0.000	0.000	0.211	0.241
1.333	16.000	13.000	0.030	0.303	0.030	0.000	0.000	0.000	0.000	0.000	0.597	0.627
1.375	16.500	13.500	0.031	0.308	0.031	0.000	0.000	0.000	0.000	0.000	1.096	1.127
1.417	17.000	14.000	0.031	0.313	0.031	0.000	0.000	0.000	0.000	0.000	1.687	1.719
1.458	17.500	14.500	0.032	0.318	0.032	0.000	0.000	0.000	0.000	0.000	2.358	2.390
1.500	18.000	15.000	0.032	0.322	0.032	0.000	0.000	0.000	0.000	0.000	3.100	3.132
1.542	18.500	15.500	0.033	0.327	0.033	0.000	0.000	0.000	0.000	0.000	3.906	3.939
1.583	19.000	16.000	0.033	0.332	0.033	0.000	0.000	0.000	0.000	0.000	4.773	4.806
1.625	19.500	16.500	0.034	0.336	0.034	0.000	0.000	0.000	0.000	0.000	5.695	5.729
1.667	20.000	17.000	0.034	0.340	0.034	0.000	0.000	0.000	0.000	0.000	6.670	6.704
1.708	20.500	17.500	0.034	0.345	0.034	0.000	0.000	0.000	0.000	0.000	7.695	7.730
1.750	21.000	18.000	0.035	0.349	0.035	0.000	0.000	0.000	0.000	0.000	8.768	8.803

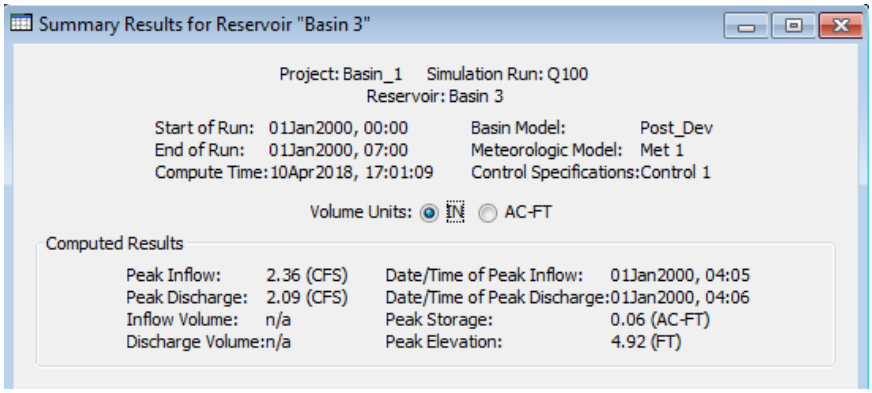
6.3 – HEC-HMS Modified-Puls Routing Results



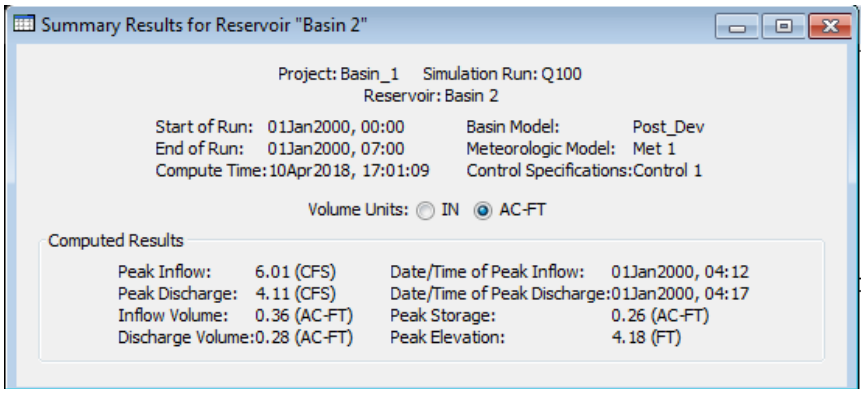
Basin 1 Summary Results



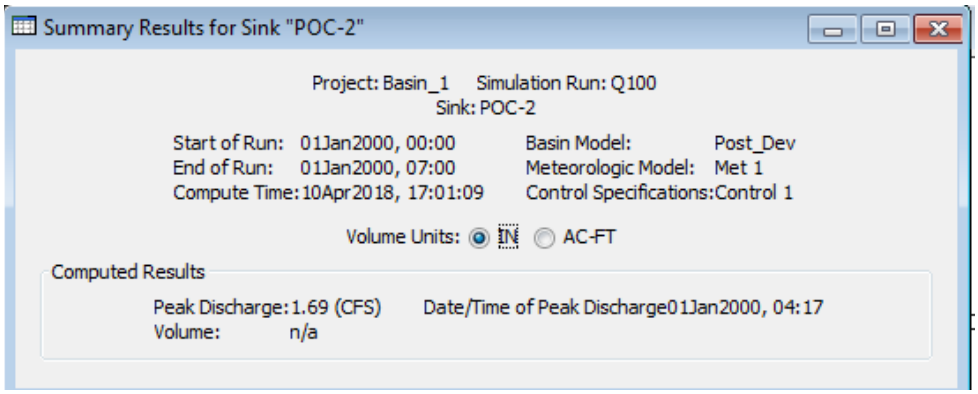
Basin 3 Summary Results

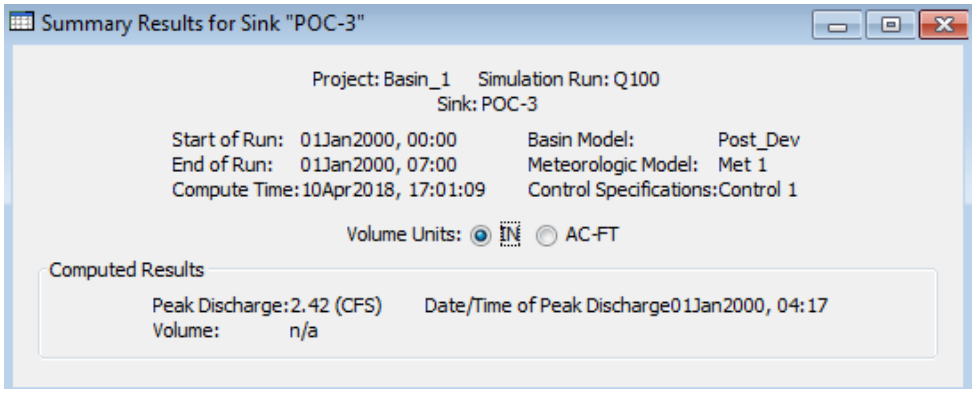


Basin 2 Summary Results



POC-2

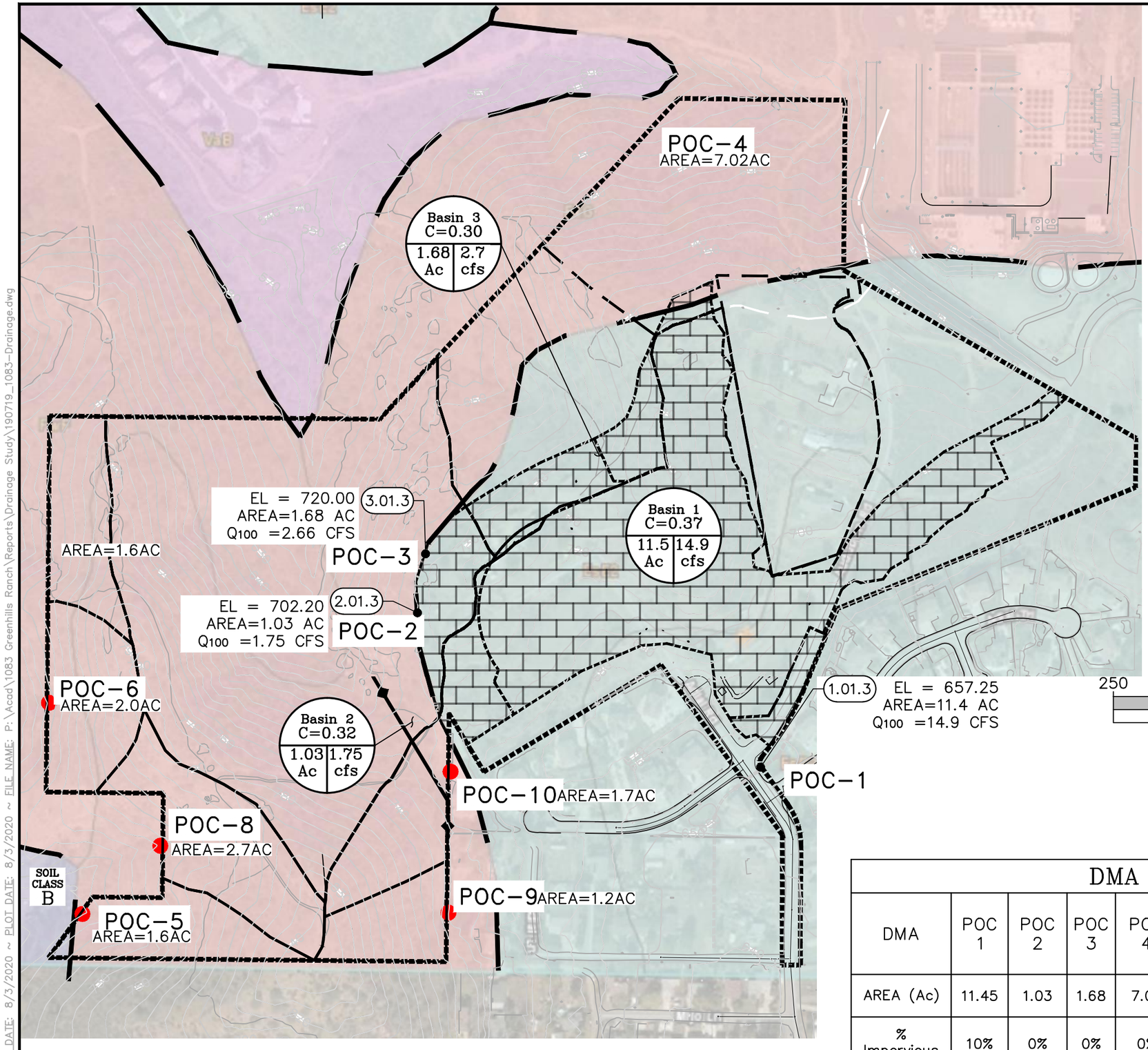




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CHAPTER 7 - Hydrology Maps

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LEGEND

- SOIL TYPE A–B
- SOIL TYPE C
- SOIL TYPE D
- AREA ANALYZED
- DMA BOUNDARY (EXISTING)
- SOIL CLASS BOUNDARY

NODE ELEV. EL=1000.0

NODE NUMBER — BASIN # — SUB-BASIN # — NODE # (3.01.5)

FLOW-LINE

BASIN DESIGNATOR

AREA (AC)

Q (CFS)

250 125 0 250 500 750

SCALE: 1" = 250'

DMA DATA TABLE

DMA	POC 1	POC 2	POC 3	POC 4	POC 5	POC 6	POC 7	POC 8	POC 9	POC 10
AREA (Ac)	11.45	1.03	1.68	7.02	1.6	2.0	1.6	2.7	1.2	1.6
% Impervious	10%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Civil Engineering · Environmental
Land Surveying
2442 Second Avenue
San Diego, CA 92101
(619)232-9200 (619)232-9210 Fax
R·E·C Consultants, Inc.

DATE: 07.19.19
SCALE: 1" = 250'
DRAWN: GMB
CHECKED: JRR

SHEET TITLE: DRAINAGE STUDY - EXISTING CONDITIONS

PROJECT: GREENHILLS RANCH - PHASE 2
9385 ADLAI ROAD
LAKESIDE, CA 92040

SHEET 1 OF 1 SHEETS

SAVE DATE: 8/3/2020 ~ PLOT DATE: 8/3/2020 ~ FILE NAME: P:\Acad\1083 Greenhills Ranch\Reports\Drainage Study\190719_1083-Drainage.dwg

SAVE DATE: 8/3/2020 — PLOT DATE: 8/3/2020 — FILE NAME: P:\Acad\1083 Greenhills Ranch\Reports\Drainage Study\190719_1083-Drainage.dwg

LEGEND

- DMA BOUNDARY
- SOIL CLASS BOUNDARY
- (1.11) NODE
- NODE ELEV. EL=1000.0
- PROPERTY BOUNDARY

SOIL CLASS A

SOIL CLASS D

SOIL CLASS C

SOIL CLASS B

NOT A PART

POC-4
AREA=6.86AC

POC-7
AREA=1.6AC

POC-6
AREA=2.0AC

POC-8
AREA=2.7AC

POC-5
AREA=1.6AC

POC-9
AREA=1.2AC

POC-10
AREA=1.7AC

POC-3
EL = 720.00
AREA=1.75 AC
Q_{100} =2.4 CFS*
*AFTER BASIN ROUTING AND CONLUENCE

POC-2
EL = 702.20
AREA=1.08 AC
Q_{100} =1.7 CFS*
*AFTER BASIN ROUTING AND CONLUENCE

BMP-2
BIOFILTRATION BASIN
3,642 SF
719.00 FS
716.00 IE OUT
Q_{100}(in)=6.01 CFS
Q_{100}(out)=1.7 CFS (TO POC-2)
Q_{100}(out)=2.4 CFS (TO POC-3)

BMP-1
BIOFILTRATION BASIN
13,066 SF
670.00 FS
667.00 IE OUT
Q_{100}(in)=24.05 CFS
Q_{100}(out)=7.19 CFS

BMP-3
BIOFILTRATION BASIN
626 SF
656.00 FS
653.00 IE IN
653.00 IE OUT
Q_{100}(in)=2.36 CFS
Q_{100}(out)=2.09 CFS

EL = 657.25
AREA=11.49 AC
Q_{100} =8.16 CFS*
*AFTER BASIN ROUTING AND CONLUENCE

1-1-D
2-2-C
3-1-C
2-2-D
1-3-C

770.00 FG
767.08 FG
769.00 FG
731.62 FG
729.22 FG
726.22 IE
731.72 FG
728.33 FG
729.62 FG
724.50 FG
721.50 IE
720.59 FG
724.18 FG
693.47 IE
691.67 FG
688.67 IE
694.92 IE
698.97 FG
695.97 IE
688.33 IE
699.03 FG
668.00 IE
700.84 FG
724.73 FG
726.60 FG
725.00 FG
691.37 FG
688.37 IE
688.00 IE
691.43 FG
688.43 IE
691.20 FG
685.00 FG
676.52 IE
668.52 IE
671.86 FG
668.86 IE
671.52 FG
667.35 FG
656.00 FG

100 50 0 100 200 300
SCALE: 1" = 100'

DMA DATA TABLE

DMA	1-1-C	1-1-D	1-3-C	2-2-C	2-2-D	3-1-C
AREA (SqFt)	478,667	3,457	16,002	122,909	23,392	72,105
Pervious (SqFt)	219,365	3,457	5,875	55,859	11,473	72,105
Impervious (SqFt)*	259,302	0	10,127	67,050	11,919	0
% Impervious	54.1%	0.0%	63.2%	54.6%	51.0%	0.0%
SLOPE						
FLOW WIDTH (L.F.)						

* EACH LOT WILL INCLUDE APPROX. 3,500 SqFt OF IMPERVIOUS SURFACE, INCLUDING RESIDENCE, WALKWAYS AND DRIVEWAY.

NOTE:
POCS 5-10 WILL REMAIN UNCHANGED AFTER DEVELOPMENT OF THIS PROJECT

REC Consultants, Inc.
Civil Engineering - Environmental
2442 Second Avenue
San Diego, CA 92101
(619)232-9200 (619)232-9210 Fax

GREENHILLS RANCH-PHASE 2
HYDROLOGY MAP
PROPOSED CONDITIONS

ATTACHMENT 7

Copy of Project's Geotechnical and Groundwater Investigation Report

This is the cover sheet for Attachment 7.

If hardcopy or CD is not attached, the following information should be provided:

Title: Update Geotechnical Investigation; Greenhills Ranch – Phase 2
Prepared By: Geocon Incorporated
Date: February 2017

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UPDATE
GEOTECHNICAL INVESTIGATION

GREENHILLS RANCH – PHASE 2
SAN DIEGO COUNTY, CALIFORNIA

GEOCON
INCORPORATED

GEOTECHNICAL
ENVIRONMENTAL
MATERIALS

PREPARED FOR

GOODMAN IRREVOCABLE FAMILY TRUST
% ATLAS INVESTMENTS
LOS ANGELES, CALIFORNIA

FEBRUARY 16, 2017
PROJECT NO. G1117-52-03

Project No. G1117-52-03
February 16, 2017

Goodman Irrevocable Family Trust
c/o Atlas Investments
11661 San Vicente Boulevard, Suite 701
Los Angeles, California 90049

Attention: Mr. Robert Furey

Subject: UPDATE GEOTECHNICAL INVESTIGATION
GREENHILLS RANCH – PHASE 2
SAN DIEGO COUNTY, CALIFORNIA

Dear Mr. Furey:

In accordance with your authorization of our proposal LG-16444 dated November 10, 2016, we herein submit the results of our update geotechnical investigation for the subject site. We prepared this report to evaluate the underlying soil and geologic conditions and potential geologic hazards for the proposed residential development. The accompanying report presents the results of our study and conclusions and recommendations pertaining to the geotechnical aspects for the proposed construction of the residential development and associated improvements. The site is considered suitable for the proposed project provided the recommendations of this report are followed.

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

Very truly yours,

GEOCON INCORPORATED

Lilian E. Rodriguez
RCE 83227

John Hoobs
CEG 1524

Shawn Foy Weedon
GE 2714

LER:JH:SFW:dmc

(e-mail) Addressee

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UPDATE GEOTECHNICAL INVESTIGATION

1. PURPOSE AND SCOPE

This report presents the results of our update geotechnical investigation for the proposed Greenhills Ranch – Phase 2 development located in San Diego County, California (see Vicinity Map, Figure 1). The purpose of this report is to evaluate the surface and subsurface soil conditions and general site geology, and to identify geotechnical constraints that may impact development of the property including faulting, liquefaction, settlement, slope stability and seismic shaking based on the 2016 CBC seismic design criteria. In addition, the purpose of this report is to provide recommendations for remedial grading, excavation of rock materials and soil characteristics, foundation design criteria, preliminary pavement design, concrete slab-on-grade, concrete flatwork, and retaining walls and lateral loads.

The scope of this update geotechnical report included a review of:

1. *Preliminary Grading Plan, Greenhills Ranch – Phase 2, County of San Diego,* prepared by REC Consultants Incorporated, dated December 19, 2016.

2. *Tentative Map, Greenhills Ranch – Phase 2, County of San Diego,* prepared by REC Consultants Incorporated, dated December 19, 2016.

3. *Geotechnical Investigation, Greenhills Ranch – Phase 2, San Diego County, California*, prepared by Geocon Incorporated, dated July 20, 2009.

We also reviewed aerial photographs, the previous geotechnical investigation report prepared for the site, readily available published and unpublished geologic literature (see List of References); performed engineering analyses; and prepared this update geotechnical report.

We previously performed a field investigation dated July 20, 2009, that included excavating 14 exploratory trenches to a maximum depth of approximately 12 feet and performed two seismic refraction survey lines. Appendix A presents the trench logs and other details of the field investigation. The results of the seismic refraction surveys prepared by Southwest Geophysics are presented in Appendix B. Appendix C presents a rippability summary of the existing soil and rock materials based on the field data. We tested selected soil samples obtained during the previous field investigation to evaluate pertinent physical and chemical properties for engineering analyses and to assist in providing recommendations for site grading. Details of the laboratory tests and a summary of the test results are presented in Appendix D. Appendix E presents the storm water infiltration investigation for the property. We used the preliminary grading plan provided by REC Consultants, Inc. dated December 19, 2016 as the base to prepare our geologic map and geologic cross-section.

2. SITE AND PROJECT DESCRIPTION

The Greenhills Ranch – Phase 2 project is located in the community of Lakeside in the County of San Diego, California. The property is located west of Lake Jennings Park Road, northwest of Audubon Road and north of the northern terminus of Adlai Road. The Helix Water District's treatment plant and Lake Jennings is located to the northeast of the property. Residential homes are located to the south and open space is located to the north.

The roughly 36-acre property consists of a central ridge that slopes to drainages flowing to the north and south. Site elevations range from approximately 660 feet Mean Sea Level (MSL) adjacent to Adlai Road on the southern portion of the property to approximately 782 feet MSL at the apex of the ridge. Proposed pad elevations range from 690 feet MSL to 767 feet MSL. The site is not within the downstream drainage path of Lake Jennings which has a dam elevation of about 700 feet MSL. Vegetation consists of native scrub and grassland locally disturbed by existing use.

The site is currently occupied by a single-family residence on proposed Lots 51 through 54 serviced by a septic system on the central portion of the property and an active horse training facility that has several paddocks, corrals and storage sheds. A second single-family residence is located on proposed Lots 1 through 4 and is also planned to be demolished. Three existing residential homes located on the northwest side of Audubon Road will remain in place with planned improvements to their driveways. An existing SDG&E easement is located to the northeast of the site with numerous overhead power lines. A 48-inch Helix Water District waterline is located within Audubon Road along with additional underground and overhead utilities. In addition, a well-house is located on a portion of proposed Private Street "A" that will require destruction.

The proposed development includes the construction of 63 single-family detached residential homes with a minimum lot size of about 5,000 square feet. Southern access to the development will be provided from the existing Audubon Road off Adlai Road, and eastern access will be provided from a northeastern extension of Audubon Road to Lake Jennings Road. The residential lots will be accessed by the proposed extension of Audubon Road and Private Streets "A", "B" and "C". Maximum cut and fill depths will be on the order of 50 and 35 feet, respectively. Proposed cut and fill slopes will be constructed at inclinations of 2:1 (horizontal to vertical) with a maximum height of about 30 and 40 feet, respectively. In addition, two biofiltration basins are proposed on Lot B located within the southern end of the site adjacent to Adlai and Audubon Road and one basin on the northwestern end of the site adjacent to Lots 15 through 20 along the top of a proposed fill slope.

The site description and proposed development are based on a site reconnaissance and review of the preliminary grading plans and tentative map prepared by REC Consultants Incorporated. If development plans differ from those described herein, Geocon Incorporated should be contacted for review of the plans and provide possible revisions to this report.

3. GEOLOGIC MATERIALS

We encountered three surficial soil types and two geologic formations during our previous investigation. The surficial soil units consist of undocumented fill, topsoil, and colluvium. The geologic formations are granitic and metamorphic rocks that have been subjected to various degrees of weathering and range in age from Cretaceous to Triassic. The formational units include the Cretaceous-age Granitic Rock (Kgr) and Triassic-age Julian Schist (Trm). The California Geological Survey's El Cajon Quadrangle geologic map indicates the geology as Cretaceous-age metavolcanic rock. However, based on our observations during trenching, this unit more closely resembles the quartzite schists of the Julian Schist. The formational and surficial units are discussed herein in order of increasing age. The approximate lateral extent of the surficial soil and formational materials is presented on the Geologic Map, Figure 2 (map pocket). Figure 3 presents a Geologic Cross-Section depicting the approximate subsurface relationships between the geologic units.

3.1 Undocumented Fill (Qudf)

Undocumented fill has been placed at several locations associated with the horse facility and an access road on the east side of the property. In general, the undocumented fill consists of loose to medium dense, dry to damp, silty, fine to medium sand with cobble and boulders to about 2½-feet in diameter and locally containing trash and roots. The undocumented fill has a "very low" expansion potential (expansion index of 20 or less) and is considered compressible. In its present condition, the undocumented fill is not suitable for support of additional fill or structures and remedial grading will be necessary. The undocumented fill soil is generally suitable for reuse as compacted fill provided it is substantially free of debris and trash. Stockpiles of horse manure located along the north side of the property and localized areas of manure mixed within the undocumented fill will not be suitable for use as compacted fill and will require export from the site. The undocumented fill is suitable for use as capping material if the oversize material is screened.

3.2 Topsoil (unmapped)

Holocene-age topsoil is present as a thin veneer locally overlying formational materials across the site. The topsoil has a maximum thickness of approximately 5 feet and can be characterized as loose to medium dense, dry to damp, reddish brown, silty, fine to medium sand with cobble and boulders up to approximately 2-feet in diameter. The topsoil has a "very low" expansion potential and is considered compressible. Topsoil is considered unsuitable for support of compacted fill and structural loads in its present condition and will require remedial grading. Topsoil is suitable for use as compacted fill and as capping material if the oversize material is screened. Due to its relatively thin thickness, topsoil is not shown on the geologic map.

3.3 Colluvium (Qc)

Holocene-age colluvium, derived from weathering of the underlying bedrock materials at higher elevations and deposited by gravity and sheet-flow, is present on the side slopes and the upper portions of the drainages. The colluvium can be characterized as loose, dry to damp, reddish brown, silty, fine to medium sand with varying amounts of gravel and cobble to 1½-foot diameter. The thickness of colluvium generally ranges from approximately 5 to 7 feet, but may be thicker along the lower portions of canyons and natural slopes. The colluvium is considered unsuitable for support of compacted fill and structural loads in its present condition and will require remedial grading. Colluvium is suitable for use as compacted fill soil and as capping material if the oversize material is screened.

3.4 Granitic Rock (Kgr)

Cretaceous-aged Granitic Rock is located on the western portion of the site and is characterized as moderately strong to very strong, moderately weathered to fresh, yellowish to greenish gray, fine- to medium-grained rock. Minor widely spaced joints were observed in a general northeast direction. This unit will be very difficult to excavate and significant portions will be non-rippable. The majority of the cuts within this unit will likely require blasting to excavate to the proposed grades and undercut elevations. Excavation will result in the generation of oversize material requiring special placement techniques and fill placement restrictions or crushing. The granitic rock is suitable for the support of compacted fill and structural loads. A detailed excavation and placement of oversize rock materials discussion is presented herein.

3.5 Julian Schist (Trm)

Triassic-age Julian Schist composed of metamorphosed quartizite and pelitic schist rock is present in the central and eastern portions of the site. The metamorphic rock is generally moderately strong to very strong, moderately to slightly weathered with some fractures and joints. This unit will likely be very difficult to excavate and the majority of the cuts within this unit will likely require blasting to excavate to the proposed grades and undercut elevations. Excavation will result in the generation of oversized material. The metamorphic rock is suitable for the support of compacted fill and structural loads.

4. GEOLOGIC STRUCTURE

The geologic structure within the rock units is characterized as a hard rock mass displaying a relatively consistent, northeast-southwest trending foliation and joint pattern with dips generally ranging between 75 degrees to near vertical to the southeast with the schist and dipping to the northwest in the granitic rock. The dominant structural feature within the rock mass is jointing. Joints are surfaces, fractures or partings within a rock mass that do not show evidence of displacement.

Jointing within the rock mass was formed as a result of regional tectonic stresses. The joints are generally moderately to poorly developed and are typically spaced 1 to 3 feet apart. Geologic structure within the hard rock units can be variable and should be individually evaluated for each proposed cut slope during grading.

5. GROUNDWATER

We did not encounter groundwater or seepage in the previous exploratory excavations performed for at the site. It is not uncommon for seepage conditions to develop where none previously existed due to irrigation practices and the permeability characteristics of the geologic units encountered on site. Seepage is dependent on seasonal precipitation, irrigation, and land use, among other factors, and varies as a result. Proper surface drainage will be critical to future performance of the project.

6. GEOLOGIC HAZARDS

6.1 Faulting and Seismicity

A review of the referenced geologic materials and our knowledge of the general area indicate that the site is not underlain by active, potentially active, or inactive faults. An active fault is defined by the California Geological Survey (CGS) as a fault showing evidence for activity within the last 11,000 years. The site is not located within a State of California Earthquake Fault Zone.

According to the computer program *EZ-FRISK* (Version 7.65), 7 known active faults are located within a search radius of 50 miles from the property. We used the 2008 USGS fault database that provides several models and combinations of fault data to evaluate the fault information. Based on this database, the nearest known active fault is the Newport-Inglewood and Rose Canyon Fault system, located approximately 18 miles west of the site, and is the dominant source of potential ground motion. Earthquakes that might occur on the Newport-Inglewood and Rose Canyon Faults or other faults within the southern California and northern Baja California area are potential generators of significant ground motion at the site. The estimated deterministic maximum earthquake magnitude and peak ground acceleration for the Newport-Inglewood Fault are 7.5 and 0.21g, respectively. Table 6.1.1 lists the estimated maximum earthquake magnitude and peak ground acceleration for the most dominant faults in relationship to the site location. We calculated peak ground acceleration (PGA) using Boore-Atkinson (2008) NGA USGS2008, Campbell-Bozorgnia (2008) NGA USGS 2008, and Chiou-Youngs (2007) NGA USGS2008 acceleration-attenuation relationships.

TABLE 6.1.1
DETERMINISTIC SPECTRA SITE PARAMETERS

Fault Name	Distance from Site (miles)	Maximum Earthquake Magnitude (Mw)	Peak Ground Acceleration		
			Boore-Atkinson 2008 (g)	Campbell-Bozorgnia 2008 (g)	Chiou-Youngs 2007 (g)
Newport - Inglewood	18	7.5	0.21	0.15	0.18
Rose Canyon	18	6.9	0.17	0.13	0.13
Elsinore	25	7.9	0.20	0.13	0.17
Earthquake Valley	29	6.8	0.12	0.08	0.08
Coronado Bank	30	7.4	0.15	0.10	0.11
Palos Verdes Connected	30	7.7	0.17	0.11	0.13
San Jacinto	45	7.9	0.13	0.09	0.11

We used the computer program *EZ-FRISK* to perform a probabilistic seismic hazard analysis. The computer program *EZ-FRISK* operates under the assumption that the occurrence rate of earthquakes on each mappable Quaternary fault is proportional to the faults slip rate. The program accounts for fault rupture length as a function of earthquake magnitude, and site acceleration estimates are made using the earthquake magnitude and distance from the site to the rupture zone. The program also accounts for uncertainty in each of following: (1) earthquake magnitude, (2) rupture length for a given magnitude, (3) location of the rupture zone, (4) maximum possible magnitude of a given earthquake, and (5) acceleration at the site from a given earthquake along each fault. By calculating the expected accelerations from considered earthquake sources, the program calculates the total average annual expected number of occurrences of site acceleration greater than a specified value. We utilized acceleration-attenuation relationships suggested by Boore-Atkinson (2008) NGA USGS 2008, Campbell-Bozorgnia (2008) NGA USGS 2008, and Chiou-Youngs (2007) NGA USGS2008 in the analysis. Table 6.1.2 presents the site-specific probabilistic seismic hazard parameters including acceleration-attenuation relationships and the probability of exceedence.

TABLE 6.1.2
PROBABILISTIC SEISMIC HAZARD PARAMETERS

Probability of Exceedence	Peak Ground Acceleration		
	Boore-Atkinson, 2008 (g)	Campbell-Bozorgnia, 2008 (g)	Chiou-Youngs, 2007 (g)
2% in a 50 Year Period	0.44	0.36	0.42
5% in a 50 Year Period	0.34	0.28	0.31
10% in a 50 Year Period	0.27	0.22	0.23

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

6.2 Ground Rupture

Ground surface rupture occurs when movement along a fault is sufficient to cause a gap or rupture where the upper edge of the fault zone intersects the earth surface. The potential for ground rupture is considered to be negligible due to the absence of active faults at the subject site.

6.3 Liquefaction and Seismically Induced Settlement

Liquefaction typically occurs when a site is located in a zone with seismic activity, on-site soils are cohesionless silts or clays with low plasticity, groundwater is encountered within 50 feet of the surface, and soil relative densities are less than about 70 percent. If the four previous criteria are met, a seismic event could result in a rapid pore-water pressure increase from the earthquake-generated ground accelerations. Seismically induced settlement may occur whether the potential for liquefaction exists or not. The potential for liquefaction and seismically induced settlement occurring at the site is considered to be very low due to the lack of near-surface permanent groundwater within 50 feet from proposed grade and the dense nature of the proposed compacted fill and formational rock materials.

6.4 Expansive Soil

The majority of the geologic units will likely possess a “very low” expansion potential (Expansion Index of 20 or less). However, some clayey portions within the surficial units may exhibit a “very low” to “low” expansive potential (Expansion Index of 50 or less). We do not expect special grading requirements due to expansive soil.

6.5 Landslides

Examination of aerial stereo photographs in our files, our geologic reconnaissance, and review of available geotechnical and geologic reports for the site vicinity indicate that landslides are not present at the property or at a location that could impact the subject site.

6.6 Slope Stability

We reviewed the proposed slope configurations, as depicted on the Geologic Map, to evaluate both surficial and global stability based on the current geologic information. The portions of the site planned for development are generally underlain by Quaternary-age surficial soil and Cretaceous and

Triassic-age granitic and metamorphic rock. The stability of graded cut slopes composed of bedrock is highly dependent on the degree of weathering and the geologic structure of the slope face.

In general, it is our opinion that permanent, graded fill slopes or cut slopes at the site with gradients of 2:1 (horizontal to vertical) or flatter would possess calculated Factors of Safety of 1.5 or greater. The majority of bedrock cut slopes should be comprised of *good quality* (from Hoek and Bray, 1981), moderately strong to very strong granitic and metamorphic rock. Based on the results of our slope stability analyses, cut slopes composed of moderately to slightly weathered granitic and metamorphic rock should possess Factors of Safety of 1.5 or greater against large-scale, deep-seated slope failures at their proposed slope inclinations. Graded fill slopes constructed of granular soil derived from on site topsoil, undocumented fill or the granular portions of the formational rock materials should possess Factors of Safety of 1.5 or greater against deep-seated and surficial slope failures at their proposed slope inclinations. Figures 4, 5, and 6 present the slope stability analysis for cut and fill slopes and surficial slope stability analysis, respectively.

Because of the potential presence of adverse geologic structures, the geologic structure of permanent and temporary slopes composed of bedrock material should be analyzed in the field in detail by the geotechnical engineer and/or engineering geologist during the grading operations. Additional recommendations for slope stabilization may be necessary if adverse geologic structure is encountered. Grading of cut and fill slopes should be designed in accordance with the requirements of the County of San Diego building codes or the 2016 California Building Code (CBC).

6.7 Rock Fall Hazard

The proposed grading of the property will remove the natural slopes on the site. The hard rock slopes located below the proposed development do not have inclinations that would create a rock fall hazard affecting the site or adjacent properties. Therefore, the risk of rock fall hazard affecting the site is considered very low.

6.8 Tsunamis and Seiches

A tsunami is a series of long-period waves generated in the ocean by a sudden displacement of large volumes of water. The site is located approximately 20 miles from the Pacific Ocean, at elevations ranging from approximately 650 to 782 feet MSL. The risk of a tsunami impacting the site is considered negligible due to the relatively high elevation and distance from the ocean.

A seiche is a run-up of water within a lake or embayment triggered by fault- or landslide-induced ground displacement. The site is not located down stream of Lake Jennings. It is our opinion that the proposed site elevations are sufficient to mitigate the risk of a seiche. Therefore, the potential of seiches affecting the site is considered very low.

6.9 Dam Inundation

Lake Jennings Dam outfall drainage channel is located approximately 1,500 feet north of the site with the bottom of the dam elevation at roughly 540 feet MSL. The northern portion of the property is at an elevation of roughly 750 feet MSL which is roughly 50 feet above the top of the dam and will provide a natural barrier if the dam where to fail. Therefore, the risk of dam inundation of the site is considered very low.

7. ROCK RIPPABILITY

7.1 Seismic Refraction Surveys

Southwest Geophysics previously performed a seismic refraction survey to evaluate the bedrock rippability along two seismic lines. The locations of the seismic traverses are presented on the Geologic Map, Figure 2, and the report is presented in Appendix B.

We have summarized the estimated rippability characteristics for mass grading and trenching operations related to results of seismic velocity in Table 7.1. Estimates for mass grading rippability are based on using a D-10N Caterpillar Tractor equipped with a single shank hydraulic ripper. Estimates for trenching rippability are based on using a Koehring 505 excavator. It has been our experience that it can often be more cost effective to pre-blast marginally rippable bedrock.

TABLE 7.1
SUMMARY OF ESTIMATED RIPPABILITY FROM SEISMIC REFRACTION

Excavation Method	Seismic Velocity (ft/s)	Estimated Rippability
Mass Grading	Less than 4,500	Rippable
	4,500 to 5,500	Marginal Ripping (Possible Blasting)
	Greater than 5,500	Non-Rippable (Pre-Blasting Required)
Trenching	Less than 3,800	Rippable
	3,800 to 4,300	Marginal Ripping
	Greater than 4,300	Non-Rippable

The results of the seismic refraction surveys indicate that velocities less than approximately 2,000 ft/s are likely associated with surficial soil. Velocities between 3,000 and 4,500 ft/s are likely associated with highly to moderately weathered bedrock. Velocities between 4,500 and 7,000 ft/s are likely associated with slightly weathered bedrock, with higher velocities associated with non-weathered bedrock. Rippability is highly dependent upon the degree of weathering, fracturing, and jointing within bedrock and the rippability of the various soil and rock units is, correspondingly, variable. Appendix C presents a summary of the seismic refraction surveys indicating rippable and non-

rippable depths estimated using approximately 4,500 ft/s as a cut-off between rippable and marginally to non-rippable for the corresponding geologic units during grading operations. The results of the seismic refraction surveys indicate a highly variable velocity in relation to depth as indicated on the tomography seismic profiles. This indicates that the rock materials are affected by weathering, jointing and fractures that give a variable depth and direction of rippability.

We previously performed exploratory trenches and seismic traverses in the rock units located generally in proposed cut areas, to evaluate rock rippability characteristics. The rippability of the rock units is variable, and generally limited to the depth of the weathered mantle. Proposed excavations within the rock may require blasting as excavations extend beyond the rippable weathered mantle. Based on a review of the excavator trenches and seismic shear wave velocities of 4,500 ft/s, the thickness of the rippable granitic and metamorphic rock mantle is estimated to vary from 2 to 15 feet. Estimates for the rippable depth at each of the exploratory excavation and seismic line locations are presented on Table C-I in Appendix C and on the Geologic Map, Figure 2.

Non-economic ripping and/or blasting should also be expected in areas of concentrated rock outcroppings located at the surface. Estimates of the expected volume of hard rock materials generated from proposed excavations should be evaluated by the contractor based on the information from each excavation and seismic traverse location. Roadway/utility corridor and lot undercutting criteria should also be considered when calculating the volume of hard rock. Proposed cuts in hard rock areas can be expected to generate oversized material (rocks greater than 12 inches in dimension) which will necessitate typical hard rock handling and placement procedures during grading operations.

The grading contractor is responsible for performing their own independent rippability analysis based on their experience on grading and blasting rock materials and the type of equipment used. The data presented in this report can be used in this analysis, however the information on the depth of rippable rock and capping material provided herein should not be used for bidding purposes. The analysis should include calculations on the amount of soil and rock materials generated during grading to evaluate if sufficient quantities of capping material exist for building pads, roadways and slope zones and if sufficient areas exist for the placement of blasted rock materials taking into account the bulk and shrink of the existing materials. Based on this grading analysis, grade adjustment may reduce the total cost of grading the site. If insufficient capping material exists on the site, then crushing of rock materials may be necessary to meet the capping specifications.

7.2 Capping Material

Capping material refers to select material placed within 3 feet from building pad grade, 8 feet from roadway grade, and/or at least 2 feet below the deepest utility within roadways consisting of "soil" fill with an approximate maximum particle dimension of 6 inches and a minimum of 40 percent soil passing the ¾ inch sieve and, in the upper 3 feet of pad grade, 20 percent soil passing the No. 4 screen. In general, capping material can be readily obtained from the surficial units. However, screening will be necessary to remove cobble and rock fragments larger than 6 inches in diameter within portions of the surficial units and the highly weathered portions of the rock materials. The availability of capping material easily obtained from the rock units is considerably less and screening and possible crushing operations may be necessary to generate sufficient capping material. Estimates for the thicknesses of capping material at each of the exploratory excavation and seismic line locations are presented in Appendix C and on the Geologic Map, Figure 2.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 General

8.1.1 It is our opinion that no soil or geologic conditions were encountered during the investigation that would preclude the proposed development of Greenhills Ranch – Phase 2 provided the recommendations presented herein are followed and implemented during construction.

8.1.2 Potential geologic hazards at the site include seismic shaking and compressible soil. Based on our previous investigation and available geologic information, active or potentially active faults are not present underlying or trending toward the site.

8.1.3 The existing onsite surficial soil units including undocumented fill, topsoil, and colluvium materials are potentially compressible and unsuitable in their present condition for the support of compacted fill or settlement-sensitive improvements. Remedial grading of the unsuitable surficial soil units will be required and recommendations for remedial grading are provided herein. The rock units are suitable for the support of compacted fill and structural loads.

8.1.4 We did not encounter groundwater during our previous subsurface exploration and we do not expect it to be a constraint to project development. However, seepage may be encountered during the grading operations during rainy seasons.

8.1.5 We expect the rippability of the surficial units will range between easy and moderate. These units will generate some oversized material during grading and some screening and/or crushing should be expected. The rippability of the rock units is variable and ranges between moderate to very difficult. Rock breaking and blasting should be expected during grading within the bedrock units.

8.1.6 In general, cut slopes composed of hard rock should possess factors of safety greater than 1.5 at inclinations of 2:1 (horizontal to vertical), or flatter. The geologic structure of cut slopes composed of hard rock should be evaluated during grading operations by the geotechnical consultant. The planned proposed fill slopes should possess factors of safety greater than 1.5 at inclinations of 2:1 (horizontal to vertical), or flatter.

8.1.7 The proposed structures and site retaining walls may be supported on conventional foundations bearing in either competent formational materials or engineered fill. Geocon Incorporated should evaluate the foundation systems when the locations of these structures have been finalized. Transitioning foundations and slabs from bedrock to engineered fill

should not occur. Where engineered fill will be utilized for foundation support, foundations should be underlain by properly compacted fill. Bedrock over-excavations will be required where engineered fill is to be utilized for foundation support. General recommendations for the design of shallow foundations are provided herein.

8.1.8 Due to the existence of hard rock at or near the proposed grades at many locations throughout the site, the building pads, streets, and utility corridors underlain by hard rock should be overexcavated to facilitate the excavation of footings, subgrade, landscaping and utility trenches. Recommendations for overexcavation operations are provided herein.

8.1.9 Canyon subdrains will not be required on this project due to the lack of well developed drainages within the limits of grading. However, if a previously installed canyon subdrain is encountered within the undocumented fill on the south side of the project, then the subdrain will need to be maintained prior to the placement of compacted fill.

8.1.10 Proper drainage should be maintained in order to preserve the engineered properties of the fill. Recommendations for site drainage are provided herein.

8.2 Soil Characteristics

8.2.1 The soil encountered in the previous field investigation is considered to be "non-expansive" (expansion index [EI] of 20 or less) as defined by 2016 California Building Code (CBC) Section 1803.5.3. Table 8.2 presents soil classifications based on the expansion index. We expect a majority of the soil encountered possess a "very low" to "low" expansion potential (EI of 50 or less). Additional testing for expansion potential should be performed once final grades are achieved.

TABLE 8.2
EXPANSION CLASSIFICATION BASED ON EXPANSION INDEX

Expansion Index (EI)	ASTM D 4829 Expansion Classification	2016 CBC Expansion Classification
0 – 20	Very Low	Non-Expansive
21 – 50	Low	Expansive
51 – 90	Medium	
91 – 130	High	
Greater Than 130	Very High	

8.2.2 We previously performed laboratory tests on samples of the site materials to evaluate the percentage of water-soluble sulfate content. Appendix D presents results of the laboratory

water-soluble sulfate content tests. The test results indicate the on-site materials at the locations tested possess "S0" sulfate exposure to concrete structures as defined by 2016 CBC Section 1904 and ACI 318-14 Chapter 19. The presence of water-soluble sulfates is not a visually discernible characteristic; therefore, other soil samples from the site could yield different concentrations. Additionally, over time landscaping activities (i.e., addition of fertilizers and other soil nutrients) may affect the concentration.

8.2.3 We tested samples for potential of hydrogen (pH) and resistivity laboratory tests to aid in evaluating the corrosion potential to subsurface metal structures. The laboratory test results are presented in Appendix D.

8.2.4 Geocon Incorporated does not practice in the field of corrosion engineering. Therefore, further evaluation by a corrosion engineer may be performed if improvements susceptible to corrosion are planned.

8.3 Seismic Design Criteria

8.3.1 We used the computer program *U.S. Seismic Design Maps*, provided by the USGS to evaluate the seismic design criteria. Table 8.3.1 summarizes site-specific design criteria obtained from the 2016 California Building Code (CBC; Based on the 2015 International Building Code [IBC] and ASCE 7-10), Chapter 16 Structural Design, Section 1613 Earthquake Loads. The short spectral response uses a period of 0.2 second. The building structures and improvements underlain by 20 feet or less of fill should be designed using a Site Class C, and structures and improvements underlain by greater than 20 feet should be designed using a Site Class D. We evaluated the Site Class based on the discussion in Section 1613.3.2 of the 2016 CBC and Table 20.3-1 of ASCE 7-10. The values presented in Table 8.3.1 are for the risk-targeted maximum considered earthquake (MCE_R).

TABLE 8.3.1
2016 CBC SEISMIC DESIGN PARAMETERS

Parameter	Value		2016 CBC Reference
Site Class	C	D	Section 1613.3.2
Fill Thickness, T (feet)	T≤20	T>20	--
Spectral Response – Class B (short), S_S	0.902g	0.902g	Figure 1613.3.1(1)
Spectral Response – Class B (1 sec), S_1	0.345g	0.345g	Figure 1613.3.1(2)
Site Coefficient, F_a	1.039	1.139	Table 1613.3.3(1)
Site Coefficient, F_v	1.455	1.710	Table 1613.3.3(2)
Maximum Considered Earthquake Spectral Response Acceleration (short), S_{MS}	0.938g	1.028g	Section 1613.3.3 (Eqn 16-37)
Maximum Considered Earthquake Spectral Response Acceleration – (1 sec), S_{M1}	0.502g	0.590g	Section 1613.3.3 (Eqn 16-38)
5% Damped Design Spectral Response Acceleration (short), S_{DS}	0.625g	0.685g	Section 1613.3.4 (Eqn 16-39)
5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.335g	0.393g	Section 1613.3.4 (Eqn 16-40)

8.3.2 Table 8.3.2 presents additional seismic design parameters for projects located in Seismic Design Categories of D through F in accordance with ASCE 7-10 for the mapped maximum considered geometric mean (MCE_G).

TABLE 8.3.2
2016 CBC SITE ACCELERATION DESIGN PARAMETERS

Parameter	Value		ASCE 7-10 or 2016 CBC Reference
Site Class	C	D	Section 1613.3.2 (CBC)
Mapped MCE_G Peak Ground Acceleration, PGA	0.338g	0.338	Figure 22-7 (ASCE)
Site Coefficient, F_{PGA}	1.062	1.162	Table 11.8-1 (ASCE)
Site Class Modified MCE_G Peak Ground Acceleration, PGA_M	0.359g	0.393g	Section 11.8.3 (Eqn 11.8-1) (ASCE)

8.3.3 Conformance to the criteria in Tables 8.3.1 and 8.3.2 for seismic design does not constitute any kind of guarantee or assurance that significant structural damage or ground failure will not occur if a large earthquake occurs. The primary goal of seismic design is to protect life, not to avoid all damage, since such design may be economically prohibitive.

8.4 Grading

8.4.1 Grading should be performed in accordance with the *Recommended Grading Specifications* contained in Appendix F and the County of San Diego Grading Ordinance.

8.4.2 Prior to commencing grading, a preconstruction conference should be held at the site with the owner or developer, grading contractor, civil engineer, county representative and geotechnical engineer in attendance. Special soil and rock handling and/or the grading plans can be discussed at that time.

8.4.3 Site preparation should begin with the removal of deleterious material, debris and vegetation. The depth of removal should be such that material exposed in cut areas or soil to be used as fill is relatively free of organic matter and debris. Material generated during stripping and/or site demolition should be exported from the site. The undocumented fill will require removal of the trash and some portions of the undocumented fill will not be suitable for reuse as fill soil due to high concentrations of horse manure.

8.4.4 Abandoned foundations, septic systems and buried utilities should be removed and the resultant depressions and/or trenches should be filled as necessary with properly compacted material as part of the remedial grading. In addition, the water well located on proposed Lot 8 should be properly destroyed in accordance with the requirements of the County of San Diego Department of Environmental Health.

8.4.5 Topsoil, colluvium, undocumented fill, and highly weathered or decomposed rock within the limits of grading should be removed to expose firm formational materials. The estimated removal depths are depicted on the Geologic Map, Figure 2. The actual depth of removal should be evaluated by the geotechnical engineering consultant during the grading operations. The bottom of the excavations should be scarified, moisture conditioned as necessary, and properly compacted.

8.4.6 The geotechnical engineering consultant should observe the removal bottoms to check that a suitable base has been achieved prior to the placement of compacted fill.

8.4.7 The site should be brought to final subgrade elevations with fill placed and compacted in layers. The layers of fill should be no thicker than will allow for adequate bonding and compaction. Fill, including backfill and scarified ground surfaces, should be compacted to a dry density of at least 90 percent of the laboratory maximum dry density near to slightly above optimum moisture content in accordance with ASTM D 1557. Fill materials placed

below optimum moisture content may require additional moisture conditioning prior to placing additional fill.

8.4.8 To reduce the potential for differential settlement, the building pads with cut-fill transitions should be undercut at least 3 feet, sloped 1 percent to the adjacent street or deepest fill, and replaced with properly compacted "very low" to "low" expansive fill soil. Where the thickness of the fill below the building pad exceeds 15 feet, the depth of the undercut should be increased to one-fifth of the maximum fill thickness.

8.4.9 Building pads underlain by hard rock units at grade should also be undercut to facilitate future trenching operations for foundations and utilities. Building pads should be undercut a minimum of 3 feet and replaced with properly compacted fill and undercuts should be sloped a minimum of 1 percent and drain toward the adjacent on-site streets.

8.4.10 Roadways underlain by hard rock units at grade should be undercut a minimum of 8 feet for the areas inside of the public right-of-way (including joint utility structures and sidewalk areas). The undercut zone should be extended to at least 1 foot below the lowest utility or drain line. Figure 7 presents a typical detail for the overexcavation of street sections.

8.4.11 Recommendations for the handling and disposal of oversized rock are presented in Figure 8 and in Appendix F. In general, structural fill placed and compacted at the site should consist of material that can be classified into four zones:

Zone A: Material placed within 3 feet from building pad grade, 8 feet from roadway grade, and to at least 1 foot below the deepest utility within roadways consisting of "soil" fill with an approximate maximum particle dimension of 6 inches and a minimum of 40 percent soil passing the ¾ inch sieve and, in the upper 3 feet of pad grade, a minimum of 20 percent passing the No. 4 sieve.

Zone B: Material placed below 8 feet from grade (below *Zone A* and *C*) may consist of "rock" fill or "soil/rock" fill (as defined in Appendix F). Blasted rock should generally consist of 2 foot minus rock material with occasional rock up to 4 foot in maximum dimension. Alternatively, "soil" fill may be placed in Zone B containing rock with a maximum dimension of 2 feet, placed in windrows. Rocks up to 4 feet in maximum dimension can be placed in a properly compacted soil matrix with rocks separated at least 12 feet apart.

Zone C: Within 3 to 8 feet of pad grade and between 5 and 15 feet from face of slope, fill material should consist of "soil" fill with an approximate maximum particle dimension of 1 foot. Rocks up to 2 feet in maximum dimension may be placed, provided they are distributed in a matrix of compacted "soil" fill.

Zone D: Within the outer 5 feet of fill slopes, the fill should consist of rock up to 1 foot in maximum dimension in a matrix of compacted "soil" fill.

8.4.12 Import fill (if necessary) should consist of granular materials with a "very low" to "low" expansion potential (EI of 50 or less) generally free of deleterious material and rock fragments larger than 6 inches and should be compacted as recommended herein. Geocon Incorporated should be notified of the import soil source and should perform laboratory testing of import soil prior to its arrival at the site to evaluate its suitability as fill material.

8.4.13 Cut slopes exposing rock with unfavorable geologic structure may require stability fills. The backcut for the stability fills should commence at least 10 feet from the top of the proposed finish-graded slope and should extend at least 3 feet into formational material below the lowest adjacent pad grade and incorporating a subdrain. Specific recommendations will be provided during grading if a stability fill is required.

8.4.14 Cut slope excavations should be observed during grading operations to check that geologic conditions do not differ significantly from those expected. The grading contractor should scale any loose rock from the face of cut slopes during the grading operations.

8.4.15 The outer 5 feet of fill slopes should be composed of properly compacted granular "soil" fill to reduce the potential for surficial sloughing. In general, soil with an Expansion Index of 50 or less or at least 35 percent sand-size particles should be acceptable as "soil" fill. Fill slopes should be overbuilt at least 2 feet and cut back or be compacted by backrolling with a loaded sheepsfoot roller at vertical intervals not to exceed 4 feet. The slopes should be track-walked shortly after the completion of each slope such that the fill is compacted to a dry density of at least 90 percent of the laboratory maximum dry density near to slightly above optimum moisture content to the face of the finished sloped. Rock fills may be placed to the face of the fill slope without affecting overall slope stability; however, the landscape planting material will be highly restricted to ground cover. In addition, toe of slope brow ditches will need to be added to capture the nuisance water in areas where seepage can affect adjacent properties or lots. Rock subdrains may be required at the toe of rock fills to capture nuisance water and direct it to an approved outlet location.

8.4.16 Placement of rock fills should be planned in the deeper fill areas to facilitate rock disposal. Overexcavation of fill areas may be required to accommodate the necessary rock volumes generated during blasting. Capping material used for placement near finish grade within roadways, building pads, and slope zones should be stockpiled during remedial grading operations. Overexcavation of weathered rock units that generate capping material may be required to achieve sufficient volumes to achieve finish grade.

8.4.17 Rock fill placement should be performed in accordance with the Recommended Grading Specifications provided in Appendix F. Blasting of rock material should be performed to maximize rock breakage to 2-foot minus material. Rock fill placement should generally be limited to 2-foot-thick horizontal layers and compacted using rock trucks. Significant volumes of water are typically required during rock fill placement.

8.4.18 Finished slopes should be landscaped with drought-tolerant vegetation having variable root depths and requiring minimal landscape irrigation. In addition, the slopes should be drained and properly maintained to reduce erosion. Rock cut and fill slopes will have restricted plant growth and will likely be limited to ground cover plant material.

8.5 Earthwork Grading Factors

8.5.1 Estimates of bulking and shrinkage factors are based on empirical judgments comparing the material in its natural state as encountered in the exploratory excavations to a compacted state. Variations in natural soil density and in compacted fill density, render shrinkage value estimates very approximate. As an example, the contractor can compact the fill to a dry density of 90 percent or higher of the laboratory maximum dry density. Thus, the contractor has an approximately 10 percent range of control over the fill volume. Bulking of rock units is a function of rock density, structure, overburden pressure, and the physical behavior of blasted material. Based on our experience, the shrinkage and bulking factors presented in Table 8.5 can be used as a basis for estimating how much the on-site soil may shrink or swell (bulk) when excavated from their natural state and placed as compacted fill. Please note that these estimates are for preliminary quantity estimates only. Due to the variations in the actual shrinkage/bulking factors, a balance area should be provided to accommodate these variations.

TABLE 8.5
SHRINKAGE AND BULK FACTORS

Soil Unit	Shrink/Bulk Factor
Undocumented Fill (Qudf)	10-15% shrink
Topsoil (unmapped)	10-15% shrink
Colluvium (Qc)	10-15% shrink
Granitic and Metamorphic Rock (Kgr and Trm) – rippable	10-15% bulk
Granitic and Metamorphic Rock (Kgr and Trm) – blasted	25-30% bulk

8.6 Foundation and Concrete Slabs-On-Grade Recommendations

8.6.1 The foundation recommendations herein are for proposed one- to three-story residential structures. The foundation recommendations have been separated into three categories based on either the maximum and differential fill thickness or Expansion Index. The foundation category criteria are presented in Table 8.6.1.

TABLE 8.6.1
FOUNDATION CATEGORY CRITERIA

Foundation Category	Maximum Fill Thickness, T (feet)	Differential Fill Thickness, D (feet)	Expansion Index (EI)
I	T<20	--	EI≤50
II	20≤T<50	10≤D<20	50<EI≤90
III	T≥50	D≥20	90<EI≤130

8.6.2 We will provide final foundation categories for each building or lot after finish pad grades have been achieved and we perform laboratory testing of the subgrade soil.

8.6.3 Table 8.6.2 presents minimum foundation and interior concrete slab design criteria for conventional foundation systems.

TABLE 8.6.2
CONVENTIONAL FOUNDATION RECOMMENDATIONS BY CATEGORY

Foundation Category	Minimum Footing Embedment Depth (inches)	Continuous Footing Reinforcement	Interior Slab Reinforcement
I	12	Two No. 4 bars, one top and one bottom	6 x 6 - 10/10 welded wire mesh at slab mid-point
II	18	Four No. 4 bars, two top and two bottom	No. 3 bars at 24 inches on center, both directions at slab mid-point
III	24	Four No. 5 bars, two top and two bottom	No. 3 bars at 18 inches on center, both directions at slab mid-point

8.6.4 The embedment depths presented in Table 8.6.2 should be measured from the lowest adjacent pad grade for both interior and exterior footings. The conventional foundations should have a minimum width of 12 inches and 24 inches for continuous and isolated footings, respectively. A wall/column footing dimension detail is presented in Figure 9.

8.6.5 The concrete slab-on-grade should be a minimum of 4 inches thick for Foundation Categories I and II and 5 inches thick for Foundation Category III.

8.6.6 Slabs that may receive moisture-sensitive floor coverings or may be used to store moisture-sensitive materials should be underlain by a vapor retarder. The vapor retarder design should be consistent with the guidelines presented in the American Concrete Institute's (ACI) *Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials* (ACI 302.2R-06). The vapor retarder used should be specified by the project architect or developer based on the type of floor covering that will be installed and if the structure will possess a humidity controlled environment.

8.6.7 The bedding sand thickness should be determined by the project foundation engineer, architect, and/or developer. However, we should be contacted to provide recommendations if the bedding sand is thicker than 6 inches. It is common to see 3 inches and 4 inches of sand below the concrete slab-on-grade for 5-inch and 4-inch thick slabs, respectively, in the southern California area. The foundation design engineer should provide appropriate concrete mix design criteria and curing measures to assure proper curing of the slab by reducing the potential for rapid moisture loss and subsequent cracking and/or slab curl. We suggest that the foundation design engineer present the concrete mix design and proper curing methods on the foundation plans. It is critical that the foundation contractor understands and follows the recommendations presented on the foundation plans.

8.6.8 As an alternative to the conventional foundation recommendations, consideration should be given to the use of post-tensioned concrete slab and foundation systems for the support of the proposed structures. The post-tensioned systems should be designed by a structural engineer experienced in post-tensioned slab design and design criteria of the Post-Tensioning Institute (PTI) DC 10.5-12 *Standard Requirements for Design and Analysis of Shallow Post-Tensioned Concrete Foundations on Expansive Soils* or *WRI/CRSI Design of Slab-on-Ground Foundations*, as required by the 2016 California Building Code (CBC Section 1808.6.2). Although this procedure was developed for expansive soil conditions, it can also be used to reduce the potential for foundation distress due to differential fill settlement. The post-tensioned design should incorporate the geotechnical parameters presented in Table 8.6.3 for the particular Foundation Category designated. The parameters presented in Table 8.6.3 are based on the guidelines presented in the PTI DC 10.5 design manual.

TABLE 8.6.3
POST-TENSIONED FOUNDATION SYSTEM DESIGN PARAMETERS

Post-Tensioning Institute (PTI), Third Edition Design Parameters	Foundation Category		
	I	II	III
Thornthwaite Index	-20	-20	-20
Equilibrium Suction	3.9	3.9	3.9
Edge Lift Moisture Variation Distance, e_M (feet)	5.3	5.1	4.9
Edge Lift, y_M (inches)	0.61	1.10	1.58
Center Lift Moisture Variation Distance, e_M (feet)	9.0	9.0	9.0
Center Lift, y_M (inches)	0.30	0.47	0.66

8.6.9 The foundations for the post-tensioned slabs should be embedded in accordance with the recommendations of the structural engineer. If a post-tensioned mat foundation system is planned, the slab should possess a thickened edge with a minimum width of 12 inches and extend below the clean sand or crushed rock layer.

8.6.10 If the structural engineer proposes a post-tensioned foundation design method other than PTI DC 10.5:

- The deflection criteria presented in Table 8.6.3 are still applicable.
- Interior stiffener beams should be used for Foundation Categories II and III.
- The width of the perimeter foundations should be at least 12 inches.
- The perimeter footing embedment depths should be at least 12 inches, 18 inches and 24 inches for foundation categories I, II, and III, respectively. The embedment depths should be measured from the lowest adjacent pad grade.

8.6.11 Foundation systems for the lots that possess a foundation Category I and a "very low" expansion potential (expansion index of 20 or less) can be designed using the method described in Section 1808 of the 2016 CBC. If post-tensioned foundations are planned, an alternative, commonly accepted design method (other than PTI DC 10.5) can be used. However, the post-tensioned foundation system should be designed with a total and differential deflection of 1 inch. Geocon Incorporated should be contacted to review the plans and provide additional information, if necessary.

8.6.12 If an alternate design method is contemplated, Geocon Incorporated should be contacted to evaluate if additional expansion index testing should be performed to identify the lots that possess a "very low" expansion potential (expansion index of 20 or less).

8.6.13 Our experience indicates post-tensioned slabs may be susceptible to excessive edge lift, regardless of the underlying soil conditions. Placing reinforcing steel at the bottom of the perimeter footings and the interior stiffener beams may mitigate this potential. The structural engineer should design the foundation system to reduce the potential of edge lift occurring for the proposed structures.

8.6.14 During the construction of the post-tension foundation system, the concrete should be placed monolithically. Under no circumstances should cold joints form between the footings/grade beams and the slab during the construction of the post-tension foundation system unless designed by the structural engineer.

8.6.15 Category I, II, or III foundations may be designed for an allowable soil bearing pressure of 2,000 pounds per square foot (psf) (dead plus live load). This bearing pressure may be increased by one-third for transient loads due to wind or seismic forces. The estimated maximum total and differential settlement for the planned structures due to foundation loads is 1 inch and ½ inch, respectively.

8.6.16 Isolated footings outside of the slab area, if present, should have the minimum embedment depth and width recommended for conventional foundations for a particular Foundation Category. The use of isolated footings, which are located beyond the perimeter of the building and support structural elements connected to the building, are not recommended for Category III. Where this condition cannot be avoided, the isolated footings should be connected to the building foundation system with grade beams. In addition, consideration should be given to connecting patio slabs, which exceed 5 feet in width, to the building foundation to reduce the potential for future separation to occur.

8.6.17 Interior stiffening beams should be incorporated into the design of the foundation system in accordance with the PTI design procedures.

8.6.18 Special subgrade presaturation is not deemed necessary prior to placing concrete; however, the exposed foundation and slab subgrade soil should be moisture conditioned, as necessary, to maintain a moist condition as would be expected in any such concrete placement.

8.6.19 Where buildings or other improvements are planned near the top of a slope 3:1 (horizontal to vertical) or steeper, special foundation and/or design considerations are recommended due to the tendency for lateral soil movement to occur.

- For fill slopes less than 20 feet high or cut slopes regardless of height, footings should be deepened such that the bottom outside edge of the footing is at least 7 feet horizontally from the face of the slope.

- When located next to a descending 3:1 (horizontal to vertical) fill slope or steeper, the foundations should be extended to a depth where the minimum horizontal distance is equal to H/3 (where H equals the vertical distance from the top of the fill slope to the base of the fill soil) with a minimum horizontal distance of 7 feet. The horizontal distance is measured from the outer, deepest edge of the footing to the face of the slope. A post-tensioned slab and foundation system can be used to reduce the potential for distress in the structures associated with strain softening and lateral fill extension. In addition, the minimum horizontal distance can be reduced to 7 feet when using a post-tensioned slab.

- If swimming pools are planned, Geocon Incorporated should be contacted for a review of specific site conditions.

- Swimming pools located within 7 feet of the top of cut or fill slopes are not recommended. Where such a condition cannot be avoided, the portion of the swimming pool wall within 7 feet of the slope face be designed assuming that the adjacent soil provides no lateral support. This recommendation applies to fill slopes up to 30 feet in height, and cut slopes regardless of height. For swimming pools located near the top of fill slopes greater than 30 feet in height, additional recommendations may be required and Geocon Incorporated should be contacted for a review of specific site conditions.

- Although other improvements, which are relatively rigid or brittle, such as concrete flatwork or masonry walls, may experience some distress if located near the top of a slope, it is generally not economical to mitigate this potential. It may be possible, however, to incorporate design measures which would permit some lateral soil movement without causing extensive distress. Geocon Incorporated should be consulted for specific recommendations.

8.6.20 The recommendations of this report are intended to reduce the potential for cracking of slabs and foundations due to expansive soil (if present), differential settlement of fill soil with varying thicknesses. However, even with the incorporation of the recommendations presented herein, foundations, stucco walls, and slabs-on-grade placed on such conditions may still exhibit some cracking due to soil movement and/or shrinkage. The occurrence of concrete shrinkage cracks is independent of the supporting soil characteristics. Their occurrence may be reduced by limiting the slump of the concrete, proper concrete placement and curing, and by the placement of crack control joints at periodic intervals, in particular, where re-entrant slab corners occur.

8.6.21 Concrete slabs should be provided with adequate crack-control joints, construction joints and/or expansion joints to reduce unsightly shrinkage cracking. The design of joints should consider criteria of the American Concrete Institute (ACI) when establishing crack-control

spacing. Additional steel reinforcing, concrete admixtures and/or closer crack control joint spacing should be considered where concrete-exposed finished floors are planned.

8.6.22 Geocon Incorporated should be consulted to provide additional design parameters as required by the structural engineer.

8.7 Concrete Flatwork

8.7.1 Exterior concrete flatwork not subject to vehicular traffic should be constructed in accordance with the recommendations herein. Slab panels should be a minimum of 4 inches thick and, when in excess of 8 feet square, should be reinforced with 6 x 6 - W2.9/W2.9 (6 x 6 - 6/6) welded wire mesh or No. 3 reinforcing bars spaced at least 18 inches center-to-center in both directions to reduce the potential for cracking. In addition, concrete flatwork should be provided with crack control joints to reduce and/or control shrinkage cracking. Crack control spacing should be determined by the project structural engineer based upon the slab thickness and intended usage. Criteria of the American Concrete Institute (ACI) should be taken into consideration when establishing crack control spacing. Subgrade soil for exterior slabs not subjected to vehicle loads should be compacted in accordance with criteria presented in the grading section prior to concrete placement. Subgrade soil should be properly compacted and the moisture content of subgrade soil should be checked prior to placing concrete.

8.7.2 Even with the incorporation of the recommendations within this report, the exterior concrete flatwork has a likelihood of experiencing some uplift due to expansive soil beneath grade; therefore, the steel reinforcement should overlap continuously in flatwork to reduce the potential for vertical offsets within flatwork. Additionally, flatwork should be structurally connected to the curbs, where possible, to reduce the potential for offsets between the curbs and the flatwork.

8.7.3 Where exterior flatwork abuts the structure at entrant or exit points, the exterior slab should be dowelled into the structure's foundation stemwall. This recommendation is intended to reduce the potential for differential elevations that could result from differential settlement or minor heave of the flatwork. Dowelling details should be designed by the project structural engineer.

8.7.4 The recommendations presented herein are intended to reduce the potential for cracking of slabs and foundations as a result of differential movement. However, even with the incorporation of the recommendations presented herein, foundations and slabs-on-grade will still crack. The occurrence of concrete shrinkage cracks is independent of the soil

supporting characteristics. Their occurrence may be reduced and/or controlled by limiting the slump of the concrete, the use of crack control joints and proper concrete placement and curing. Literature provided by the Portland Concrete Association (PCA) and American Concrete Institute (ACI) present recommendations for proper concrete mix, construction, and curing practices, and should be incorporated into project construction.

8.8 Retaining Walls

8.8.1 Retaining walls not restrained at the top and having a level backfill surface should be designed for an active soil pressure equivalent to the pressure exerted by a fluid density of 35 pounds per cubic foot (pcf). Where the backfill will be inclined at 2:1 (horizontal to vertical), we recommend an active soil pressure of 50 pcf. Soil with an expansion index (EI) of greater than 50 should not be used as backfill material behind retaining walls.

8.8.2 Retaining walls shall be designed to ensure stability against overturning sliding, excessive foundation pressure and water uplift. Where a keyway is extended below the wall base with the intent to engage passive pressure and enhance sliding stability, it is not necessary to consider active pressure on the keyway.

8.8.3 Unrestrained walls are those that are allowed to rotate more than 0.001H (where H equals the height of the retaining portion of the wall) at the top of the wall. Where walls are restrained from movement at the top (at-rest condition), an additional uniform pressure of 7H psf should be added to the active soil pressure for walls 8 feet or less. For walls greater than 8 feet tall, an additional uniform pressure of 13H psf should be applied to the wall starting at 8 feet from the base of the wall. For retaining walls subject to vehicular loads within a horizontal distance equal to two-thirds the wall height, a surcharge equivalent to 2 feet of fill soil should be added.

8.8.4 Drainage openings through the base of the wall (weep holes) should not be used where the seepage could be a nuisance or otherwise adversely affect the property adjacent to the base of the wall. The recommendations herein assume a properly compacted granular (EI of 50 or less) free-draining backfill material with no hydrostatic forces or imposed surcharge load. Figure 10 presents a typical retaining wall drainage detail. If conditions different than those described are expected, or if specific drainage details are desired, Geocon Incorporated should be contacted for additional recommendations.

8.8.5 The structural engineer should determine the Seismic Design Category for the project in accordance with Section 1613.3.5 of the 2016 CBC or Section 11.6 of ASCE 7-10. For structures assigned to Seismic Design Category of D, E, or F, retaining walls that support

more than 6 feet of backfill should be designed with seismic lateral pressure in accordance with Section 1803.5.12 of the 2016 CBC. The seismic load is dependent on the retained height where H is the height of the wall, in feet, and the calculated loads result in pounds per square foot (psf) exerted at the base of the wall and zero at the top of the wall. A seismic load of 13H should be used for design. We used the peak ground acceleration adjusted for Site Class effects, PGA_M, of 0.393g calculated from ASCE 7-10 Section 11.8.3 and applied a pseudo-static coefficient of 0.3.

8.8.6 The retaining walls may be designed using either the active and restrained (at-rest) loading condition or the active and seismic loading condition as suggested by the structural engineer. Typically, it appears the design of the restrained condition for retaining wall loading may be adequate for the seismic design of the retaining walls. However, the active earth pressure combined with the seismic design load should be reviewed and also considered in the design of the retaining walls.

8.8.7 In general, wall foundations having a minimum depth and width of 1 foot may be designed for an allowable soil bearing pressure of 2,000 psf. The allowable soil bearing pressure may be increased by an additional 300 psf for each additional foot of depth and width, to a maximum allowable bearing capacity of 3,000 psf. The proximity of the foundation to the top of a slope steeper than 3:1 could impact the allowable soil bearing pressure. Therefore, retaining wall foundations should be deepened such that the bottom outside edge of the footing is at least 7 feet horizontally from the face of the slope.

8.8.8 The recommendations presented herein are generally applicable to the design of rigid concrete or masonry retaining walls having a maximum height of 8 feet. In the event that walls higher than 8 feet or other types of walls (such as mechanically stabilized earth [MSE] walls, soil nail walls, or soldier pile walls) are planned, Geocon Incorporated should be consulted for additional recommendations.

8.8.9 Unrestrained walls will move laterally when backfilled and loading is applied. The amount of lateral deflection is dependent on the wall height, the type of soil used for backfill, and loads acting on the wall. The retaining walls and improvements above the retaining walls should be designed to incorporate an appropriate amount of lateral deflection as determined by the structural engineer.

8.8.10 Soil contemplated for use as retaining wall backfill, including import materials, should be identified in the field prior to backfill. At that time, Geocon Incorporated should obtain samples for laboratory testing to evaluate its suitability. Modified lateral earth pressures may be necessary if the backfill soil does not meet the required expansion index or shear

strength. City or regional standard wall designs, if used, are based on a specific active lateral earth pressure and/or soil friction angle. In this regard, on-site soil to be used as backfill may or may not meet the values for standard wall designs. Geocon Incorporated should be consulted to assess the suitability of the on-site soil for use as wall backfill if standard wall designs will be used.

8.9 Lateral Loading

8.9.1 To resist lateral loads, a passive pressure exerted by an equivalent fluid density of 350 pounds per cubic foot (pcf) should be used for the design of footings or shear keys. The allowable passive pressure assumes a horizontal surface extending at least 5 feet, or three times the surface generating the passive pressure, whichever is greater. The upper 12 inches of material in areas not protected by floor slabs or pavement should not be included in design for passive resistance.

8.9.2 If friction is to be used to resist lateral loads, an allowable coefficient of friction between soil and concrete of 0.4 should be used for design. The friction coefficient may be reduced depending on the vapor barrier or waterproofing material used for construction in accordance with the manufacturer's recommendations.

8.9.3 The passive and frictional resistant loads can be combined for design purposes. The lateral passive pressures may be increased by one-third when considering transient loads due to wind or seismic forces.

8.10 Mechanically Stabilized Earth (MSE) Retaining Walls

8.10.1 Mechanized stabilized earth (MSE) retaining walls can be used on the property. MSE retaining walls are alternative walls that consist of modular block facing units with geogrid reinforced earth behind the block. The reinforcement grid attaches to the block units and is typically placed at specified vertical intervals and embedment lengths. The grid length and spacing will be determined by the wall designer.

8.10.2 The geotechnical parameters listed in Table 8.10 can be used for preliminary design of the MSE walls. Laboratory testing should be performed to check that the shear strength parameters used in the design of the MSE walls meet the required strength within the reinforced zone. We expect that some soil screening will be required to achieve the required gradation requirements shown on the designer's plans.

TABLE 8.10
GEOTECHNICAL PARAMETERS FOR MSE WALLS

Parameter	Reinforced Zone	Retained Zone	Foundation Zone
Angle of Internal Friction	32 degrees	32 degrees	32 degrees
Cohesion	200 psf	200 psf	200 psf
Wet Unit Density	130 pcf	130 pcf	130 pcf

8.10.3 The soil parameters presented in Table 8.10 are based on our experience and direct shear-strength tests performed during the geotechnical investigation and represent some of the on-site materials. The wet unit density values presented in Table 8.10 can be used for design but actual in-place densities may range from approximately 90 to 135 pounds per cubic foot. Geocon has no way of knowing which materials will actually be used as backfill behind the wall during construction. It is up to the wall designers to use their judgment in selection of the design parameters. As such, once backfill materials have been selected and/or stockpiled, sufficient shear tests should be conducted on samples of the proposed backfill materials to check that they conform to actual design values. Results should be provided to the designer to re-evaluate stability of the walls. Dependent upon test results, the designer may require modifications to the original wall design (e.g., longer reinforcement embedment lengths and/or steel reinforcement).

8.10.4 The foundation zone is the area where the footing is embedded, the reinforced zone is the area of the backfill that possesses the reinforcing fabric, and the retained zone is the area behind the reinforced zone.

8.10.5 Wall foundations having a minimum depth and width of one foot may be designed for an allowable soil bearing pressure of 2,000 psf. This soil pressure may be increased by 300 psf and 500 psf for each additional foot of foundation width and depth, respectively, up to a maximum allowable soil bearing pressure of 3,500 psf.

8.10.6 Backfill materials within the reinforced zone should be compacted to a dry density of at least 90 percent of the laboratory maximum dry density near to slightly above optimum moisture content in accordance with ASTM D 1557. This is applicable to the entire embedment width of the reinforcement. Typically, wall designers specify no heavy compaction equipment within 3 feet of the face of the wall. However, smaller equipment (e.g., walk-behind, self-driven compactors or hand whackers) can be used to compact the materials without causing deformation of the wall. If the designer specifies no compactive effort for this zone, the materials are essentially not properly compacted and the reinforcement grid within the uncompacted zone should not be relied upon for

reinforcement, and overall embedment lengths will have to be increased to account for the difference.

8.10.7 Select backfill materials may be required to be in accordance with the MSE retaining wall system. Materials as outlined in the specifications of the retaining wall plans may be generated and stockpiled during grading, if encountered, or may require import. Geocon should perform laboratory tests during the backfill materials to check that soil properties are in accordance with the retaining wall plans and specifications.

8.10.8 The wall should be provided with a drainage system sufficient to prevent excessive seepage through the wall and the base of the wall, thus preventing hydrostatic pressures behind the wall.

8.10.9 Geosynthetic reinforcement must elongate to develop full tensile resistance. This elongation generally results in movement at the top of the wall. The amount of movement is dependent upon the height of the wall (e.g., higher walls rotate more) and the type of reinforcing grid used. In addition, over time the reinforcement grid has been known to exhibit creep (sometimes as much as 5 percent) and can undergo additional movement. Given this condition, the owner should be aware that structures and pavement placed within the reinforced and retained zones of the wall may undergo movement.

8.10.10 The MSE wall contractor should provide the estimated deformation of wall and adjacent ground in associated with wall construction. The calculated horizontal and vertical deformations should be determined by the wall designer. The estimated movements should be provided to the project structural engineer to determine if the planned improvements can tolerate the expected movements.

8.10.11 The MSE wall designer/contractor should review this report, including the slope stability requirements, and incorporate our recommendations as presented herein. We should be provided the plans for the MSE walls to check if they are in conformance with our recommendations prior to issuance of a permit and construction.

8.11 Preliminary Pavement Recommendations

8.11.1 We calculated the flexible pavement sections in general conformance with the *Caltrans Method of Flexible Pavement Design* (Highway Design Manual, Section 608.4) two estimated Traffic Indices (TI) of 5.0 and 5.5. The project civil engineer and owner should review the pavement designations to determine the appropriate traffic index for the private streets based on the anticipated traffic loading conditions. The final pavement sections

should be based on the R-Value of the subgrade soil encountered at final subgrade elevation. We have assumed an R-Value of 19 and 78 for the subgrade soil and base materials, respectively, for the purposes of this preliminary analysis. Table 8.11.1 presents the preliminary flexible pavement sections.

TABLE 8.11.1
PRELIMINARY FLEXIBLE PAVEMENT SECTION

Location	Assumed Traffic Index	Assumed Subgrade R-Value	Asphalt Concrete (inches)	Class 2 Aggregate Base (inches)
Private Streets	5.0	19	3	8
Private Streets	5.5	19	3	9

8.11.2 Prior to placing base materials, the upper 12 inches of the subgrade soil should be scarified, moisture conditioned as necessary, and recompacted to a dry density of at least 95 percent of the laboratory maximum dry density near to slightly above optimum moisture content as determined by ASTM D 1557. Similarly, the base material should be compacted to a dry density of at least 95 percent of the laboratory maximum dry density near to slightly above optimum moisture content. Asphalt concrete should be compacted to a density of at least 95 percent of the laboratory Hveem density in accordance with ASTM D 2726.

8.11.3 Base materials should conform to Section 26-1.028 of the *Standard Specifications for The State of California Department of Transportation (Caltrans)* with a ¾-inch maximum size aggregate. The asphalt concrete should conform to Section 203-6 of the *Standard Specifications for Public Works Construction (Greenbook).*

8.11.4 A rigid Portland cement concrete (PCC) pavement section should be placed in pavement cross-gutters. We calculated the rigid pavement section in general conformance with the procedure recommended by the American Concrete Institute report ACI 330R-08 *Guide for Design and Construction of Concrete Parking Lots* using the parameters presented in Table 8.11.2.

TABLE 8.11.2
RIGID PAVEMENT DESIGN PARAMETERS

Design Parameter	Design Value
Modulus of subgrade reaction, k	100 pci
Modulus of rupture for concrete, M_R	500 psi
Traffic Category, TC	C
Average daily truck traffic, ADTT	100

8.11.5 Based on the criteria presented herein, the PCC pavement sections should have a minimum thickness as presented in Table 8.11.3.

TABLE 8.11.3
RIGID PAVEMENT RECOMMENDATIONS

Location	Portland Cement Concrete (inches)
Street Cross-Gutters (TC=C)	7.0

8.11.6 The PCC pavement should be placed over subgrade soil that is compacted to a dry density of at least 95 percent of the laboratory maximum dry density near to slightly above optimum moisture content. This pavement section is based on a minimum concrete compressive strength of approximately 3,000 psi (pounds per square inch).

8.11.7 A thickened edge or integral curb should be constructed on the outside of concrete slabs subjected to wheel loads. The thickened edge should be 1.2 times the slab thickness or a minimum thickness of 2 inches, whichever results in a thicker edge, and taper back to the recommended slab thickness 4 feet behind the face of the slab (e.g., a 7-inch-thick slab would have a 9-inch-thick edge). Reinforcing steel will not be necessary within the concrete for geotechnical purposes with the possible exception of dowels at construction joints as discussed herein.

8.11.8 To control the location and spread of concrete shrinkage cracks, crack-control joints (weakened plane joints) should be included in the design of the concrete pavement slab. Crack-control joints should not exceed 30 times the slab thickness with a maximum spacing of 15 feet for the 7-inch-thick slabs and should be sealed with an appropriate sealant to prevent the migration of water through the control joint to the subgrade materials. The depth of the crack-control joints should be determined by the referenced ACI report. The depth of the crack-control joints should be at least ¼ of the slab thickness when using a conventional saw, or at least 1 inch when using early-entry saws on slabs 9

inches or less in thickness, as determined by the referenced ACI report discussed in the pavement section herein. Cuts at least ¼ inch wide are required for sealed joints, and a ⅜ inch wide cut is commonly recommended. A narrow joint width of $^{1}/_{10}$ to $^{1}/_{8}$ inches wide is common for unsealed joints.

8.11.9 To provide load transfer between adjacent pavement slab sections, a butt-type construction joint should be constructed. The butt-type joint should be thickened by at least 20 percent at the edge and taper back at least 4 feet from the face of the slab. As an alternative to the butt-type construction joint, dowelling can be used between construction joints for pavements of 7 inches or thicker. As discussed in the referenced ACI guide, dowels should consist of smooth, 1-inch-diameter reinforcing steel 14 inches long embedded a minimum of 6 inches into the slab on either side of the construction joint. Dowels should be located at the midpoint of the slab, spaced at 12 inches on center and lubricated to allow joint movement while still transferring loads. In addition, tie bars should be installed at the as recommended in Section 3.8.3 of the referenced ACI guide. The structural engineer should provide other alternative recommendations for load transfer.

8.11.10 Concrete curb/gutter should be placed on soil subgrade compacted to a dry density of at least 90 percent of the laboratory maximum dry density near to slightly above optimum moisture content. Cross-gutters should be placed on subgrade soil compacted to a dry density of at least 95 percent of the laboratory maximum dry density near to slightly above optimum moisture content. Base materials should not be placed below the curb/gutter, cross-gutters, or sidewalk so water is not able to migrate from the adjacent parkways to the pavement sections. Where flatwork is located directly adjacent to the curb/gutter, the concrete flatwork should be structurally connected to the curbs to help reduce the potential for offsets between the curbs and the flatwork.

8.12 Site Drainage and Moisture Protection

8.12.1 Adequate site drainage is critical to reduce the potential for differential soil movement, erosion and subsurface seepage. Under no circumstances should water be allowed to pond adjacent to footings. The site should be graded and maintained such that surface drainage is directed away from structures in accordance with 2016 CBC 1804.4 or other applicable standards. In addition, surface drainage should be directed away from the top of slopes into swales or other controlled drainage devices. Roof and pavement drainage should be directed into conduits that carry runoff away from the proposed structure.

8.12.2 Underground utilities should be leak free. Utility and irrigation lines should be checked periodically for leaks, and detected leaks should be repaired promptly. Detrimental soil

movement could occur if water is allowed to infiltrate the soil for prolonged periods of time.

8.12.3 Landscaping planters adjacent to paved areas are not recommended due to the potential for surface or irrigation water to infiltrate the pavement's subgrade and base course. Area drains to collect excess irrigation water and transmit it to drainage structures or impervious above-grade planter boxes can be used. In addition, where landscaping is planned adjacent to the pavement, construction of a cutoff wall along the edge of the pavement that extends at least 6 inches below the bottom of the base material should be considered.

8.13 Grading and Foundation Plan Review

8.13.1 Geocon Incorporated should review the final approved grading plans and foundation plans for the project prior to final design submittal to evaluate whether additional analysis and/or recommendations are required.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. We performed this investigation in accordance with generally accepted geotechnical engineering principles and practices. No warranty, expressed or implied, is made as to the conclusions and professional recommendations made in this report.

2. The firm that performed the geotechnical investigation for the project should be retained to provide testing and observation services during construction to provide continuity of geotechnical interpretation and to check that the recommendations presented for geotechnical aspects of site development are incorporated during site grading, construction of improvements, and excavation of foundations. If another geotechnical firm is selected to perform the testing and observation services during construction operations, that firm should prepare a letter indicating their intent to assume the responsibilities of project geotechnical engineer of record. A copy of the letter should be provided to the regulatory agency for their records. In addition, that firm should provide revised recommendations concerning the geotechnical aspects of the proposed development, or a written acknowledgement of their concurrence with the recommendations presented in our report. They should also perform additional analyses deemed necessary to assume the role of Geotechnical Engineer of Record.

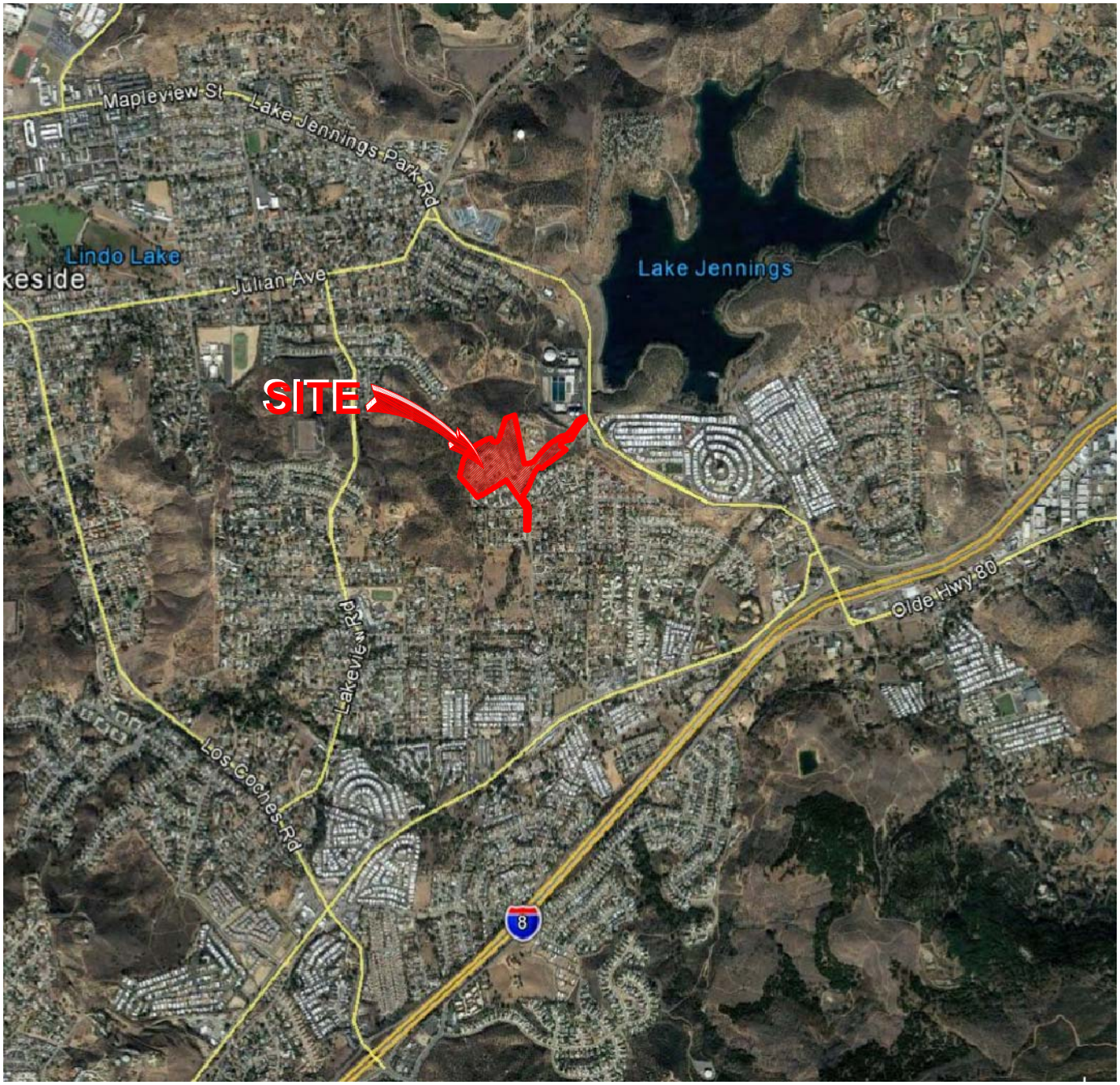
3. The recommendations of this report pertain only to the site investigated and are based on the assumption that the soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon Incorporated should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon Incorporated.

4. This report is issued with the understanding that it is the responsibility of the owner or his representative to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

5. The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and

should not be relied upon after a period of one year, without a review by this firm for verification of validity.

6. Water that flows improperly on the property or infiltrates into the underlying soil can cause distress and damage to existing and proposed improvements and lead to significant construction problems. Geocon Incorporated specifically disclaims liability for any and all damages, and assumes no responsibility or liability for, any loss or damage arising out of, relating to, or pertaining to the uncontrolled flow or infiltration of water on the subject property or adjacent properties.



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N

NO SCALE

VICINITY MAP

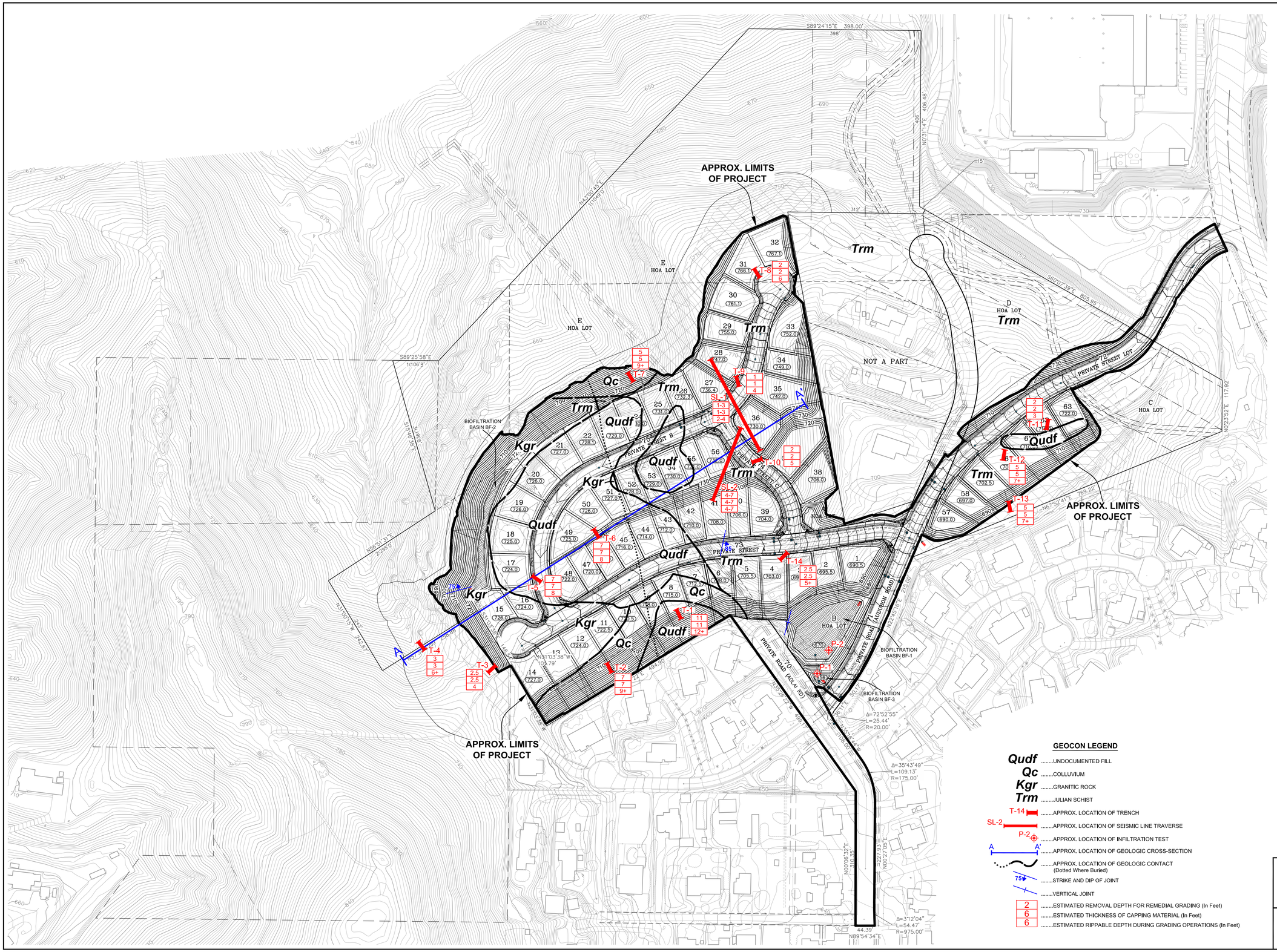
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GREENHILLS RANCH - PHASE 2
SAN DIEGO COUNTY, CALIFORNIA

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DATE 02 - 16 - 2017	PROJECT NO. G1117 - 11 - 03	FIG. 1

Plotted:02/16/2017 10:52AM | By:ALVIN LADRILLONO | File Location:Y:\PROJECTS\G1117-11-03 Greenhills Ranch Ph2\DETAILS\G1117-11-02 VicinityMap.dwg



GEOCON LEGEND

- **Qudf** .....UNDOCUMENTED FILL
- **Qc** .....COLLUVIUM
- **Kgr** .....GRANITIC ROCK
- **Trm** .....JULIAN SCHIST
- T-14 .....APPROX. LOCATION OF TRENCH
- SL-2 .....APPROX. LOCATION OF SEISMIC LINE TRAVERSE
- P-2 .....APPROX. LOCATION OF INFILTRATION TEST
- A — A' .....APPROX. LOCATION OF GEOLOGIC CROSS-SECTION
- .....APPROX. LOCATION OF GEOLOGIC CONTACT (Dotted Where Buried)
- 75 .....STRIKE AND DIP OF JOINT
- .....VERTICAL JOINT
- 2 .....ESTIMATED REMOVAL DEPTH FOR REMEDIAL GRADING (In Feet)
- 6 .....ESTIMATED THICKNESS OF CAPPING MATERIAL (In Feet)
- 6 .....ESTIMATED RIPPABLE DEPTH DURING GRADING OPERATIONS (In Feet)

0' 100' 200' 300' 400'

SCALE 1"=100' (On 36x24)

GEOLOGIC MAP

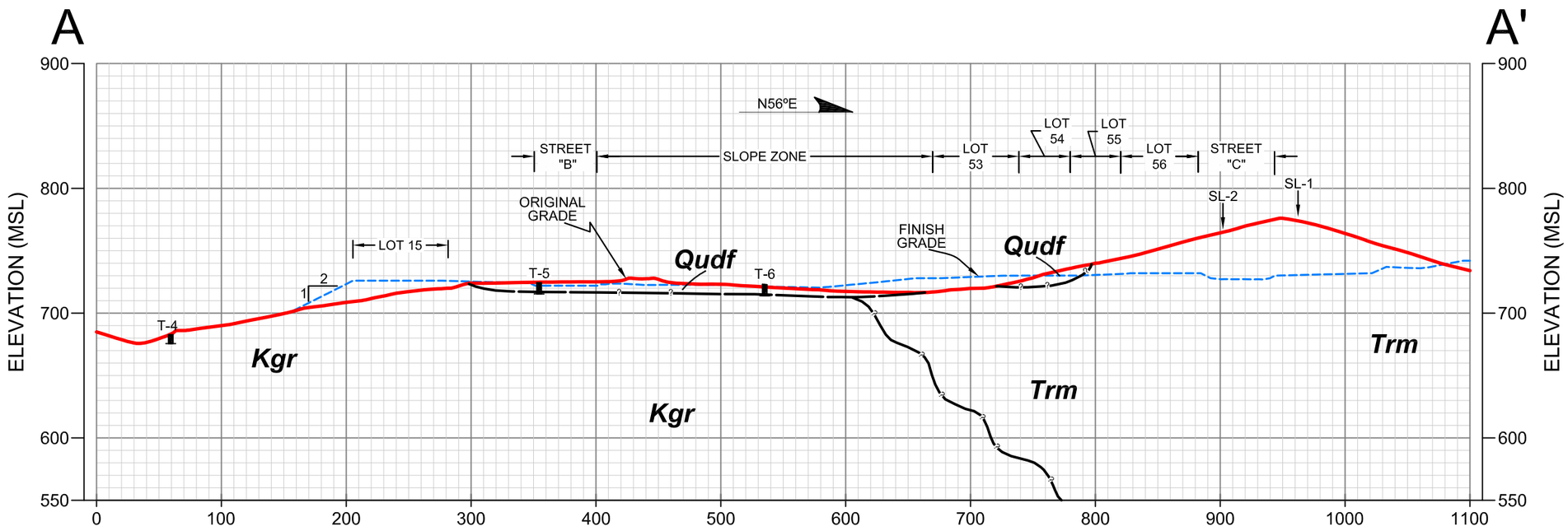
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SCALE	1" = 100'	DATE	02 - 16 - 2017
PROJECT NO.	G1117 - 11 - 03	FIGURE	2
SHEET	1 OF 1		

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GREENHILLS RANCH - PHASE 2
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DISTANCE (FEET)

GEOLOGIC CROSS-SECTION A-A'

SCALE: 1" = 100' (Vert. = Horiz.)

GEOCON LEGEND

Qudf .....UNDOCUMENTED FILL
Kgr .....GRANITIC ROCK
Trm .....JULIAN SCHIST
T-6 .....APPROX. LOCATION OF TRENCH
SL-2 .....APPROX. LOCATION OF SEISMIC TRAVERSE
?.....APPROX. LOCATION OF GEOLOGIC CONTACT (Queried Where Uncertain)

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FIGURE 3
DATE 02 - 16 - 2017

GEOLOGIC CROSS - SECTION A - A'

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ASSUMED CONDITIONS :

SLOPE HEIGHT	H	= 30 feet
SLOPE INCLINATION	2 : 1 (Horizontal : Vertical)	
TOTAL UNIT WEIGHT OF SOIL	γ_t	= 125 pounds per cubic foot
ANGLE OF INTERNAL FRICTION	ϕ	= 35 degrees
APPARENT COHESION	C	= 1,000 pounds per square foot
NO SEEPAGE FORCES		

ANALYSIS :

$\gamma_{c\phi}$	=	$\frac{\gamma_t H \tan\phi}{C}$	EQUATION (3-3), REFERENCE 1
FS	=	$\frac{NcfC}{\gamma_t H}$	EQUATION (3-2), REFERENCE 1
$\gamma_{c\phi}$	=	2.6	CALCULATED USING EQ. (3-3)
Ncf	=	14	DETERMINED USING FIGURE 10, REFERENCE 2
FS	=	3.7	FACTOR OF SAFETY CALCULATED USING EQ. (3-2)

REFERENCES :

1.....Janbu, N., Stability Analysis of Slopes with Dimensionless Parameters, Harvard Soil Mechanics, Series No. 46, 1954

2.....Janbu, N., Discussion of J.M. Bell, Dimensionless Parameters for Homogeneous Earth Slopes, Journal of Soil Mechanics and Foundation Design, No. SM6, November 1967.

SLOPE STABILITY ANALYSIS - CUT SLOPES

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ASSUMED CONDITIONS :

SLOPE HEIGHT	H	=	40 feet
SLOPE INCLINATION	2 : 1 (Horizontal : Vertical)		
TOTAL UNIT WEIGHT OF SOIL	γ_t	=	125 pounds per cubic foot
ANGLE OF INTERNAL FRICTION	ϕ	=	32 degrees
APPARENT COHESION	C	=	250 pounds per square foot
NO SEEPAGE FORCES			

ANALYSIS :

$\gamma_{c\phi}$	=	$\frac{\gamma_t H \tan\phi}{C}$	EQUATION (3-3), REFERENCE 1
FS	=	$\frac{NcfC}{\gamma_t H}$	EQUATION (3-2), REFERENCE 1
$\gamma_{c\phi}$	=	12.5	CALCULATED USING EQ. (3-3)
Ncf	=	37.5	DETERMINED USING FIGURE 10, REFERENCE 2
FS	=	1.9	FACTOR OF SAFETY CALCULATED USING EQ. (3-2)

REFERENCES :

1.....Janbu, N., Stability Analysis of Slopes with Dimensionless Parameters, Harvard Soil Mechanics, Series No. 46, 1954

2.....Janbu, N., Discussion of J.M. Bell, Dimensionless Parameters for Homogeneous Earth Slopes, Journal of Soil Mechanics and Foundation Design, No. SM6, November 1967.

SLOPE STABILITY ANALYSIS - FILL SLOPES

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Plotted:02/16/2017 10:50AM | By:ALVIN LADRILLONO | File Location:Y:\PROJECTS\G1117-11-03 Greenhills Ranch Ph2\DETAILS\Slope Stability Analyses-Fill (SSAF).dwg

ASSUMED CONDITIONS :

SLOPE HEIGHT	H	= Infinite
DEPTH OF SATURATION	Z	= 3 feet
SLOPE INCLINATION	2 : 1 (Horizontal : Vertical)	
SLOPE ANGLE	i	= 26.6 degrees
UNIT WEIGHT OF WATER	γ_w	= 62.4 pounds per cubic foot
TOTAL UNIT WEIGHT OF SOIL	γ_t	= 125 pounds per cubic foot
ANGLE OF INTERNAL FRICTION	ϕ	= 32 degrees
APPARENT COHESION	C	= 250 pounds per square foot

SLOPE SATURATED TO VERTICAL DEPTH Z BELOW SLOPE FACE

SEEPAGE FORCES PARALLEL TO SLOPE FACE

ANALYSIS :

$$FS = \frac{C + (\gamma_t - \gamma_w)\ Z\ cos^2\ i\ tan\ \phi}{\gamma_t\ Z\ sin\ i\ cos\ i} = 2.3$$

REFERENCES :

1.....Haefeli, R. *The Stability of Slopes Acted Upon by Parallel Seepage*, Proc. Second International Conference, SMFE, Rotterdam, 1948, 1, 57-62

2.....Skempton, A. W., and F.A. Delory, *Stability of Natural Slopes in London Clay*, Proc. Fourth International Conference, SMFE, London, 1957, 2, 378-81

SURFICIAL SLOPE STABILITY ANALYSIS

GEOCON INCORPORATED

GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS

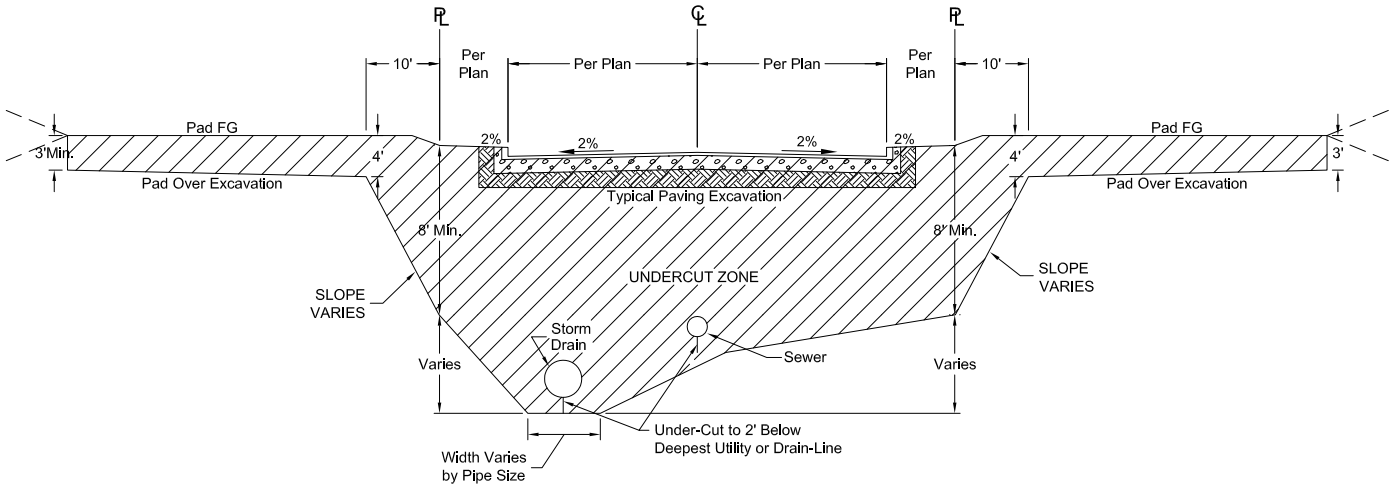
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974

PHONE 858 558-6900 - FAX 858 558-6159

GREENHILLS RANCH - PHASE 2
SAN DIEGO COUNTY, CALIFORNIA

LR / RA		DSK/GTYPD	DATE 02 - 16 - 2017	PROJECT NO. G1117 - 11 - 03	FIG. 6

Plotted:02/16/2017 10:50AM | By:ALVIN LADRILLONO | File Location:Y:\PROJECTS\G1117-11-03 Greenhills Ranch Ph2\DETAILS\Slope Stability Analyses-Surficial (SFSSA).dwg



NOT TO SCALE

NOTE:
UNDERCUT ZONE SHOULD BE BACKFILLED WITH COMPACTED SOIL FILL WITH MAXIMUM ROCK FRAGMENTS LESS THAN 6 INCHES IN DIMENSION AND A MINIMUM OF 40 PERCENT SOIL PASSING THE 3/4-INCH SIEVE

NO SCALE

TYPICAL STREET OVEREXCAVATION DETAIL

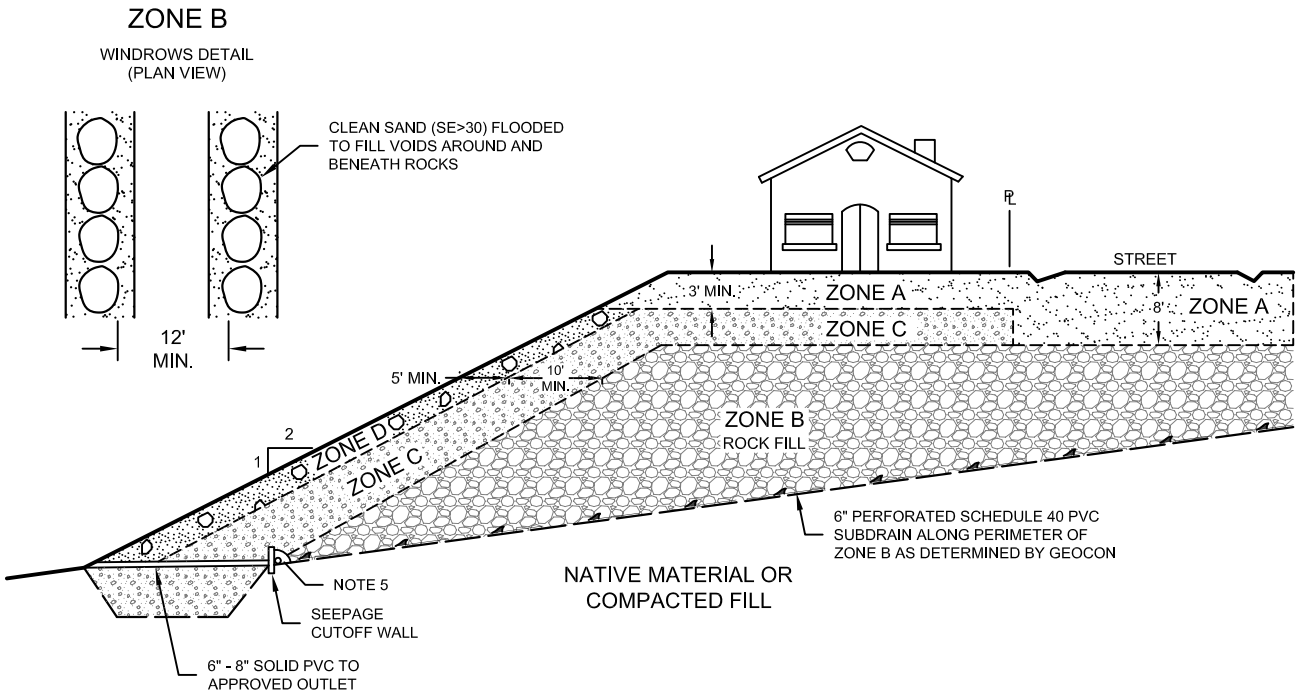
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GREENHILLS RANCH - PHASE 2
SAN DIEGO COUNTY, CALIFORNIA

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DATE 02 - 16 - 2017	PROJECT NO. G1117 - 11 - 03	FIG. 7

Plotted:02/16/2017 10:49AM | By:ALVIN LADRILLONO | File Location:Y:\PROJECTS\G1117-11-03 Greenhills Ranch Ph2\DETAILS\Typical Street Overexcavation Detail (Street Section).dwg



LEGEND

ZONE A: COMPACTED SOIL FILL. NO ROCK FRAGMENTS OVER 6 INCHES IN DIMENSION.

ZONE B: BLASTED ROCK FILL GENERALLY CONSISTING OF 2 FOOT MINUS MATERIAL WITH OCCASIONAL INDIVIDUAL ROCK UP TO 4 FEET MAXIMUM DIMENSION
ALTERNATE: ROCKS 2 TO 4 FEET IN MAXIMUM DIMENSION CAN BE PLACED IN WINDROWS IN COMPACTED SOIL FILL POSSESSING A SAND EQUIVALENT OF AT LEAST 30.

ZONE C: ROCKS UP TO 2 FEET IN MAXIMUM DIMENSION IN A MATRIX OF COMPACTED SOIL FILL WITHIN BUILDING PADS AND SLOPE AREAS ONLY.

ZONE D: ROCKS UP TO 1 FOOT IN MAXIMUM DIMENSION IN A MATRIX OF COMPACTED SOIL FILL.

NOTES

1. COMPACTED SOIL FILL IN UPPER 8 FEET SHALL CONTAIN AT LEAST 40 PERCENT SOIL PASSING THE 3/4 - INCH SIEVE (BY WEIGHT) AND IN THE UPPER 3 FEET OF PAD GRADE AT LEAST 20% SOIL PASSING THE NO. 4 SIEVE (BY WEIGHT) AND COMPACTED IN ACCORDANCE WITH SPECIFICATIONS FOR STRUCTURAL FILL.
2. CONTINUOUS OBSERVATION REQUIRED BY GEOCON DURING ROCK PLACEMENT.
3. ROCK FILL (LESS THAN 40 PERCENT SOIL SIZES) MAY BE PERMITTED IN DESIGNATED AREAS UPON THE RECOMMENDATION OF THE GEOTECHNICAL ENGINEER AND APPROVAL BY THE CITY ENGINEER.
4. DEPTH OF ZONE A SHOULD BE AT LEAST 8 FEET AND EXTENDED TO AT LEAST 1 FOOT BELOW DEEPEST UTILITY WITHIN ROADWAYS.
5. 6" PERFORATED SCHEDULE 40 PVC SUBDRAIN ALONG THE TOE AND PORTIONS OF THE PERIMETER OF ZONE B.
6. BASE OF ZONE B SHOULD SLOPE A MINIMUM OF 3 PERCENT.

NO SCALE

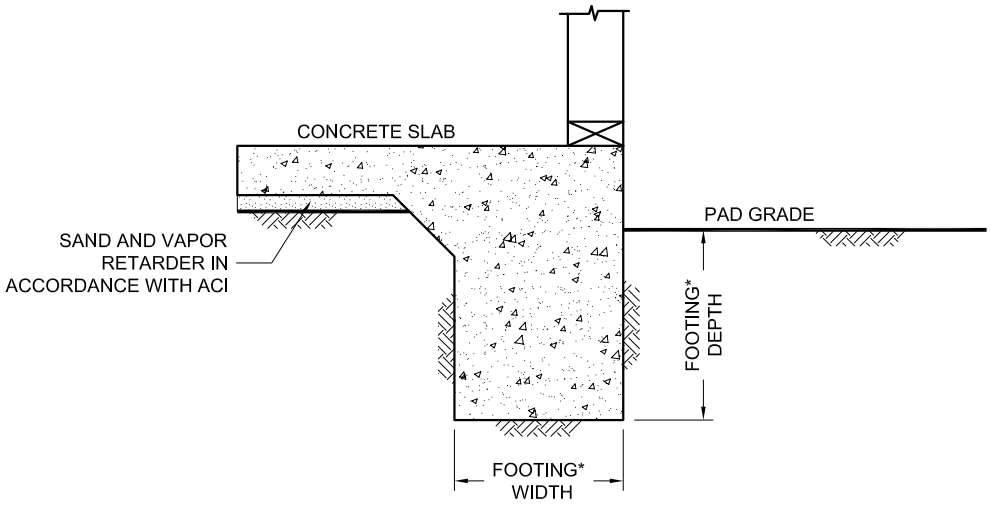
OVERSIZE ROCK DISPOSAL DETAIL

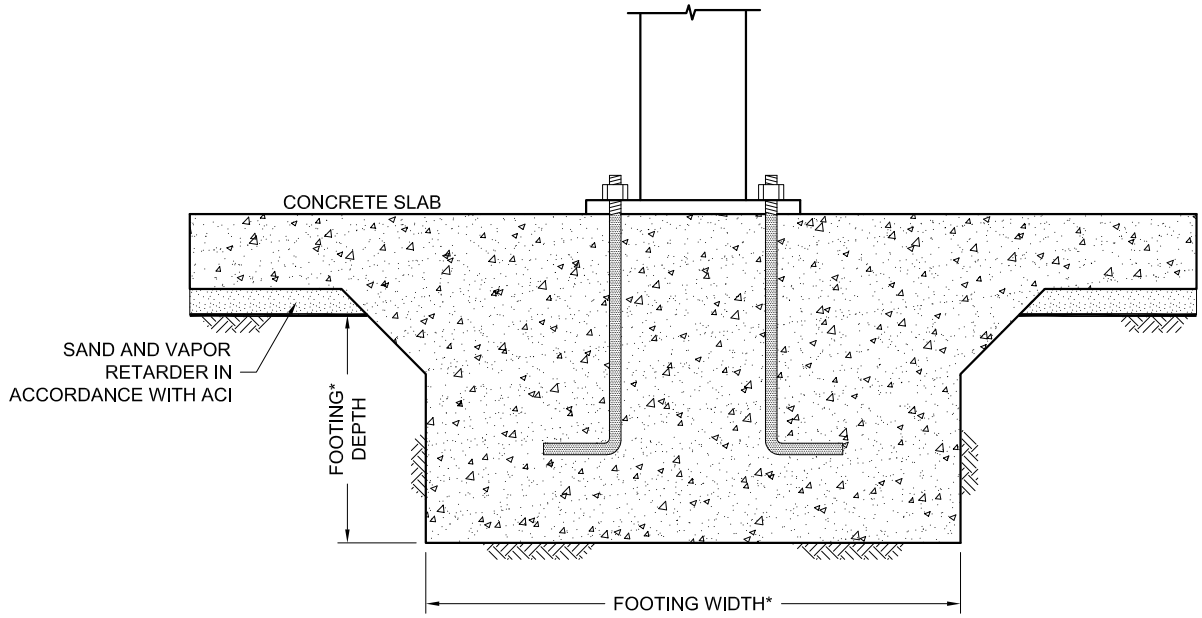
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GREENHILLS RANCH - PHASE 2
SAN DIEGO COUNTY, CALIFORNIA

LR / RA		DSK/GTYPD	DATE 02 - 16 - 2017	PROJECT NO. G1117 - 11 - 03	FIG. 8

Plotted:02/16/2017 10:52AM | By:ALVIN LADRILLONO | File Location:Y:\PROJECTS\G1117-11-03 Greenhills Ranch Ph2\DETAILS\Oversize Rock.dwg





*....SEE REPORT FOR FOUNDATION WIDTH AND DEPTH RECOMMENDATION

NO SCALE

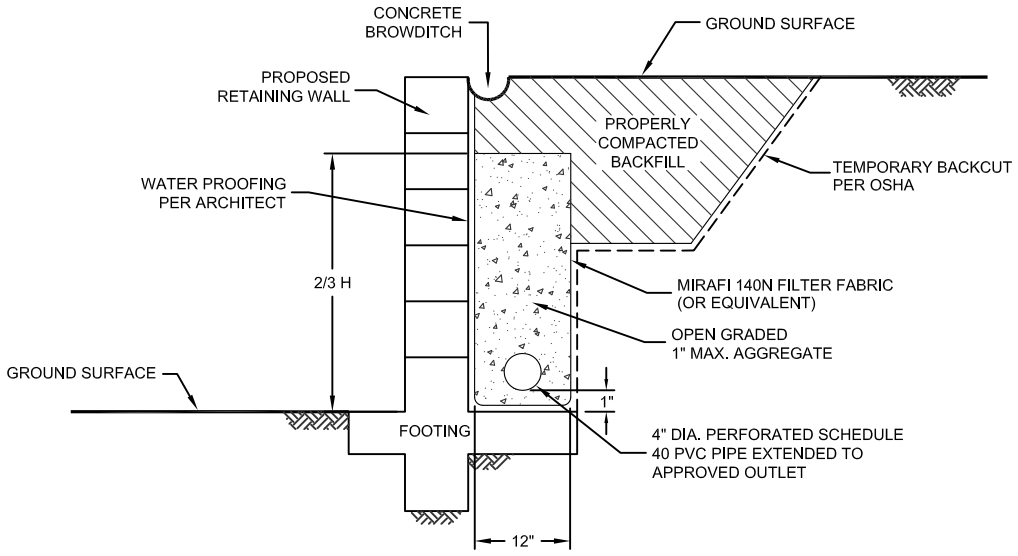
WALL / COLUMN FOOTING DIMENSION DETAIL

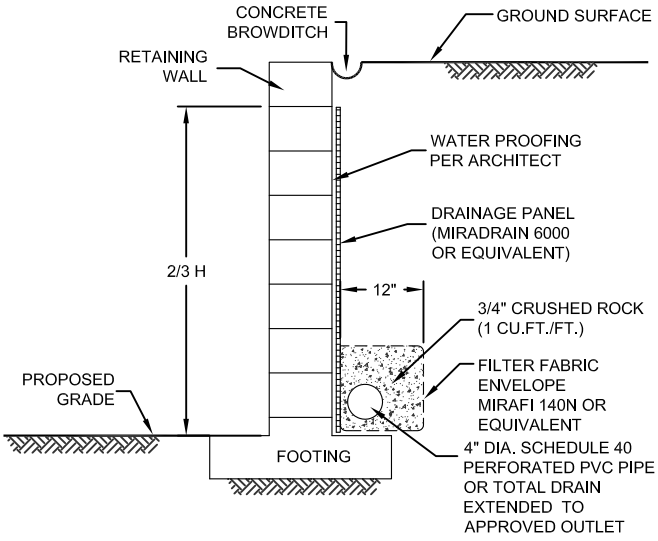
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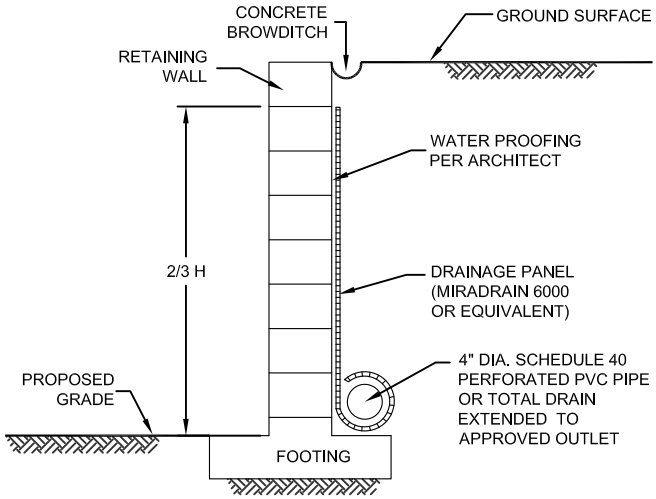
GREENHILLS RANCH - PHASE 2
SAN DIEGO COUNTY, CALIFORNIA

LR / RA		DSK/GTYPD	DATE 02 - 16 - 2017	PROJECT NO. G1117 - 11 - 03	FIG. 9

Plotted:02/16/2017 10:49AM | By:ALVIN LADRILLONO | File Location:Y:\PROJECTS\G1117-11-03 Greenhills Ranch Ph2\DETAILS\Wall-Column Footing Dimension Detail (COLFOOT2).dwg







NOTE :

DRAIN SHOULD BE UNIFORMLY SLOPED TO GRAVITY OUTLET OR TO A SUMP WHERE WATER CAN BE REMOVED BY PUMPING

NO SCALE

TYPICAL RETAINING WALL DRAIN DETAIL

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GREENHILLS RANCH - PHASE 2
SAN DIEGO COUNTY, CALIFORNIA

LR / RA		DSK/GTYPD

DATE 02 - 16 - 2017	PROJECT NO. G1117 - 11 - 03	FIG. 10

Plotted:02/16/2017 10:49AM | By:ALVIN LADRILLONO | File Location:Y:\PROJECTS\G1117-11-03 Greenhills Ranch Ph2\DETAILS\Typical Retaining Wall Drainage Detail (RWDD7A).dwg

APPENDIX A

APPENDIX A

EXPLORATORY EXCAVATIONS

The field investigation included the excavation of 14 excavator trenches. The approximate locations of the excavations are shown on the Geologic Map, Figure 2. The excavator trenches were excavated to a maximum depth of approximately 12 feet using a Komatsu PC 200 LC excavator with a 24-inch wide bucket. We logged and sampled the soil and geologic conditions as trenching proceeded.

We visually examined, classified and logged the soil conditions encountered in the excavations in general accordance with the Unified Soil Classification System (USCS). Logs of the exploratory excavator trenches are presented on Figures A-1 through A-14. The logs depict the general soil and geologic conditions encountered and the depth at which we obtained samples.

PROJECT NO. G1117-52-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 1 ELEV. (MSL.) 683' DATE COMPLETED 06-09-2009 EQUIPMENT KOMATSU PC 200 LC BY: J. HOOBS MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**UNDOCUMENTED FILL** Medium dense, dry to damp, reddish brown, Silty, fine to medium SAND with little gravel and minor roots			
2								
4								
6	T1-1				-Becomes yellowish brown and damp			
8								
10								
					JULIAN SCHIST Slightly weathered, yellow, strong SCHIST; fine- to medium-grained			
12					TRENCH TERMINATED AT 12 FEET No groundwater encountered			

Figure A-1,
Log of Trench T 1, Page 1 of 1

G1117-52-01.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1117-52-01

TRENCH T 2

ELEV. (MSL.) **690'** DATE COMPLETED **06-09-2009**

EQUIPMENT **KOMATSU PC 200 LC** BY: **J. HOOBS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
	T2-1			SM	**COLLUVIUM** Loose, damp, reddish brown, Silty, fine to medium SAND with little gravel			
2								
4					-Becomes medium dense			
6								
		+ +			**GRANITIC ROCK** Slightly weathered, greenish gray, strong GRANITIC ROCK; fine-grained			
8		+ +						
					TRENCH TERMINATED AT 9 FEET No groundwater encountered			

Figure A-2,
Log of Trench T 2, Page 1 of 1

G1117-52-01.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◹ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

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PROJECT NO. G1117-52-01

TRENCH T 3

ELEV. (MSL.) **711'** DATE COMPLETED **06-09-2009**

EQUIPMENT **KOMATSU PC 200 LC** BY: **J. HOOBS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Medium dense, damp, reddish brown, Silty, fine to medium SAND with gravel and cobble to 2 foot-diameter (40%)			
2					**GRANITIC ROCK** Slightly weathered, yellow, very strong GRANITIC ROCK; fine-grained			
4					REFUSAL AT 4 FEET No groundwater encountered			

Figure A-3,
Log of Trench T 3, Page 1 of 1

G1117-52-01.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

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PROJECT NO. G1117-52-01

TRENCH T 4

ELEV. (MSL.) **682'** DATE COMPLETED **06-09-2009**

EQUIPMENT **KOMATSU PC 200 LC** BY: **J. HOOBS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, damp, reddish brown, Silty, fine to medium SAND with some gravel			
2								
4					**GRANITIC ROCK** Moderately weathered, greenish gray, moderately strong, GRANITIC ROCK; fine- to coarse-grained			
6					TRENCH TERMINATED AT 6 FEET No groundwater encountered			

Figure A-4,
Log of Trench T 4, Page 1 of 1

G1117-52-01.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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PROJECT NO. G1117-52-01

TRENCH T 5

ELEV. (MSL.) **723'** DATE COMPLETED **06-09-2009**

EQUIPMENT **KOMATSU PC 200 LC** BY: **J. HOOBS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	T5-1			SM	**UNDOCUMENTED FILL** Loose, dry, reddish brown, Silty, fine to medium SAND with cobble and boulder to 2½ foot-diameter (20%) and some trash			
2								
4								
6								
8					**GRANITIC ROCK** Fresh, yellowish brown, very strong GRANITIC ROCK; fine- to medium-grained			
					REFUSAL AT 8 FEET No groundwater encountered			

Figure A-5,
Log of Trench T 5, Page 1 of 1

G1117-52-01.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1117-52-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 6 ELEV. (MSL.) 723' DATE COMPLETED 06-09-2009 EQUIPMENT KOMATSU PC 200 LC BY: J. HOOBS MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**UNDOCUMENTED FILL** Loose, dry to damp, brown, Silty, fine to medium SAND with cobble and boulder to 2 foot-diameter (10%) and some trash			
2								
4								
6								
		+ + + + + +			**GRANITIC ROCK** Slightly weathered, yellowish brown, very strong GRANITIC ROCK; fine- to medium-grained			
8					REFUSAL AT 8 FEET No groundwater encountered			

Figure A-6,
Log of Trench T 6, Page 1 of 1

G1117-52-01.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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PROJECT NO. G1117-52-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 7 ELEV. (MSL.) 709' DATE COMPLETED 06-09-2009 EQUIPMENT KOMATSU PC 200 LC BY: J. HOOBS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**COLLUVIUM** Loose, dry to damp, reddish brown, Silty, fine to medium SAND with gravel and cobble to 18 inch-diameter (20%)			
2	T7-1							
4								
6					**JULIAN SCHIST** Moderately weathered, light reddish brown, moderately strong SCHIST; medium-grained			
8	T7-2							
					TRENCH TERMINATED AT 9 FEET No groundwater encountered			

Figure A-7,
Log of Trench T 7, Page 1 of 1

G1117-52-01.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G1117-52-01

TRENCH T 8

ELEV. (MSL.) **778'** DATE COMPLETED **06-09-2009**

EQUIPMENT **KOMATSU PC 200 LC** BY: **J. HOOBS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry, reddish brown, Silty, fine to medium SAND with cobble and boulder to 2 foot-diameter (50%)			
2					**JULIAN SCHIST** Slightly weathered, yellowish brown, strong SCHIST; fine-grained			
4								
6					REFUSAL AT 6 FEET No groundwater encountered			

Figure A-8,
Log of Trench T 8, Page 1 of 1

G1117-52-01.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G1117-52-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 9 ELEV. (MSL.) 775' DATE COMPLETED 06-09-2009 EQUIPMENT KOMATSU PC 200 LC BY: J. HOOBS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**TOPSOIL** Medium dense, dry to damp, reddish brown, Silty, fine to medium SAND with cobble and boulder to 2-foot diameter (45%)			
					JULIAN SCHIST Slightly weathered, reddish brown, strong SCHIST; fine-grained. Excavates to cobble and boulder to 2 foot-diameter			
2								
4					REFUSAL AT 4 FEET No groundwater encountered			

Figure A-9,
Log of Trench T 9, Page 1 of 1

G1117-52-01.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G1117-52-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**TRENCH T 10** ELEV. (MSL.) **771'** DATE COMPLETED **06-09-2009** EQUIPMENT **KOMATSU PC 200 LC** BY: **J. HOOBS**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**TOPSOIL** Moderately dense, damp, reddish brown, Silty, fine to medium SAND with cobbles and boulders to 2 foot-diameter (45%)			
2					**JULIAN SCHIST** Moderately weathered, reddish brown, moderately strong SCHIST; fine- to medium-grained. Excavates to cobble and boulder to 2½ foot-diameter			
4					-Becomes strong at 4 feet and difficult to excavate			
					REFUSAL AT 5 FEET No groundwater encountered			

Figure A-10,
Log of Trench T 10, Page 1 of 1

G1117-52-01.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G1117-52-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 11 ELEV. (MSL.) 706' DATE COMPLETED 06-09-2009 EQUIPMENT KOMATSU PC 200 LC BY: J. HOOBS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0	T11-1			SM	**TOPSOIL** Medium dense, dry, reddish brown, Silty, fine to medium SAND with gravel and cobble to 6 inch-diameter (10%)			
2					**JULIAN SCHIST** Slightly weathered, greenish brown, very strong SCHIST; fine- to medium-grained			
					REFUSAL AT 3 FEET No groundwater encountered			

Figure A-11,
Log of Trench T 11, Page 1 of 1

G1117-52-01.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G1117-52-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 12 ELEV. (MSL.) 699' DATE COMPLETED 06-09-2009 EQUIPMENT KOMATSU PC 200 LC BY: J. HOOBS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**TOPSOIL** Loose, dry, reddish brown, Silty, fine to medium SAND with cobble to 6 inch-diameter (10%)			
2								
4								
					JULIAN SCHIST Moderately weathered, reddish brown, moderately strong SCHIST; fine- to medium-grained			
6								
					TRENCH TERMINATED AT 7 FEET No groundwater encountered			

Figure A-12,
Log of Trench T 12, Page 1 of 1

G1117-52-01.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◹ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1117-52-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 13 ELEV. (MSL.) 685' DATE COMPLETED 06-09-2009 EQUIPMENT KOMATSU PC 200 LC BY: J. HOOBS MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Medium dense, dry, reddish brown, Silty, fine to medium SAND with little cobble			
2								
4								
6					**JULIAN SCHIST** Moderately weathered, reddish brown, moderately strong SCHIST; fine- to medium-grained			
					TRENCH TERMINATED AT 7 FEET No groundwater encountered			

Figure A-13,
Log of Trench T 13, Page 1 of 1

G1117-52-01.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1117-52-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**TRENCH T 14** ELEV. (MSL.) **724'** DATE COMPLETED **06-09-2009** EQUIPMENT **KOMATSU PC 200 LC** BY: **J. HOOBS**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**TOPSOIL** Loose, dry, reddish brown, Silty, fine to medium SAND with gravel and cobble to 12 inch-diameter (20%)			
2					**JULIAN SCHIST** Moderately weathered, reddish brown, moderately strong SCHIST; fine- to medium-grained			
4					-Becomes strong at 4 feet and difficult to excavate			
					TRENCH TERMINATED AT 5 FEET No groundwater encountered			

Figure A-14,
Log of Trench T 14, Page 1 of 1

G1117-52-01.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

APPENDIX B

APPENDIX B

SEISMIC REFRACTION SURVEY REPORT

PREPARED BY

SOUTHWEST GEOPHYSICS, INC.,
DATED JUNE 10, 2009 (PROJECT NO. 109123)

FOR

GREENHILLS RANCH – PHASE 2
SAN DIEGO COUNTY, CALIFORNIA

SEISMIC REFRACTION SURVEY
GREENHILLS RANCH-PHASE 2
LAKESIDE, CALIFORNIA

PREPARED FOR:
Geocon Consultants, Inc.
6970 Flanders Drive
San Diego, CA 92121

PREPARED BY:
Southwest Geophysics, Inc.
8057 Raytheon Road, Suite 9
San Diego, CA 92111

June 10, 2009
Project No. 109123

SOUTHWEST GEOPHYSICS, INC.

YOUR SUBSURFACE SOLUTION

June 10, 2009
Project No. 109123

Mr. John Hoobs
Geocon Consultants, Inc.
6970 Flanders Drive
San Diego, CA 92121

Subject: Seismic Refraction Survey
Greenhills Ranch-Phase 2
Lakeside, California

Dear Mr. Hoobs:

In accordance with your authorization, we have performed a seismic refraction survey for the proposed Greenhills Ranch Residential Development, to be located in an area of generally undeveloped land along the northeast side of Adlai Road in the Lakeside area of San Diego County, California. Specifically, our survey consisted of performing two seismic refraction lines at the subject site. The purpose of our study was to develop a subsurface velocity profile of the areas surveyed, and to assess the apparent rippability of near surface materials. This data report presents our survey methodology, equipment used, analysis, and results.

We appreciate the opportunity to be of service on this project. Should you have any questions related to this report, please contact the undersigned at your convenience.

Sincerely,
SOUTHWEST GEOPHYSICS, INC.

Patrick Lehrmann

Patrick Lehrmann, P.G., R.Gp.
Principal Geologist/Geophysicist

Hans van de Vrugt

Hans van de Vrugt, C.E.G., R.Gp.
Principal Geologist/Geophysicist

REGISTERED GEOPHYSICIST
Hans van de Vrugt
No 1012
Exp. 2/28/10
STATE OF CALIFORNIA

HV/PFL/hv

Distribution: Addressee (electronic)

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1. INTRODUCTION

In accordance with your authorization, we have performed a seismic refraction survey for the proposed Greenhills Ranch Residential Development, to be located in an area of generally undeveloped land along the northeast side of Adlai Road in the Lakeside area of San Diego County, California (Figure 1). Specifically, our survey consisted of performing two seismic refraction lines at the subject site. The purpose of our study was to develop a subsurface velocity profile of the areas surveyed, and to assess the apparent rippability of near surface materials. This data report presents our survey methodology, equipment used, analysis, and results.

2. SCOPE OF SERVICES

Our scope of services included:

- Performance of two seismic refraction lines at the project site.
- Compilation and analysis of the data collected.
- Preparation of this data report presenting our results and conclusions.

3. SITE AND PROJECT DESCRIPTION

The project site generally includes south facing slopes just to the north of the intersection of Adlai Road and Audubon Road (Figure 1). The project area is situated just to the east of a single family residential property. The study area consists of undeveloped land along the top and southern flank of a moderately steep hill. Several outcrops of crystalline rock are present in and near the study area. Vegetation onsite consists of annual grass and scattered brush. Figures 2 and 3 illustrate the study area and general site conditions.

Based on our discussions with you, we understand that the study area is under consideration for grading and construction of new single family homes and associated roadways. Cuts up to roughly 45 feet deep are proposed.

4. SURVEY METHODOLOGY

A seismic P-wave (compression wave) refraction survey was conducted at the site to evaluate the depth to bedrock and apparent rippability characteristics of the subsurface materials, and to de-

velop a subsurface velocity profile of the areas surveyed. The seismic refraction method uses first-arrival times of refracted seismic waves to estimate the thicknesses and seismic velocities of subsurface layers. Seismic P-waves generated at the surface, using a hammer and plate, are refracted at boundaries separating materials of contrasting velocities. These refracted seismic waves are then detected by a series of surface vertical component geophones and recorded with a 24-channel Geometrics StrataView seismograph. The travel times of the seismic P-waves are used in conjunction with the shot-to-geophone distances to obtain thickness and velocity information on the subsurface materials.

Two seismic lines/profiles (SL-1 and SL-2) were conducted as part of our study. The general locations of the lines were selected by your office, and are depicted on Figure 2. Shot points were conducted at the ends, midpoint and several intermediate points along the lines (Figures 4a and 4b illustrate the shot locations).

The refraction method requires that subsurface velocities increase with depth. A layer having a velocity lower than that of the layer above will not be detectable by the seismic refraction method and, therefore, could lead to errors in the depth calculations of subsequent layers. In addition, lateral variations in velocity, such as those caused by core stones, fracture zones or intrusions can also result in the misinterpretation of the subsurface conditions.

In general, seismic wave velocities can be correlated to material density and/or rock hardness. The relationship between rippability and seismic velocity is empirical and assumes a homogenous mass. Localized areas of differing composition, texture, and/or structure may affect both the measured data and the actual rippability of the mass. The rippability of a mass is also dependent on the excavation equipment used and the skill and experience of the equipment operator.

The rippability values presented in Table 1 are based on our experience with similar materials and assumes that a Caterpillar D-9 dozer ripping with a single shank is used. We emphasize that the cutoffs in this classification scheme are approximate and that rock characteristics, such as

fracture spacing and orientation, play a significant role in determining rock rippability. These characteristics may also vary with location and depth.

For trenching operations, the rippability values should be scaled downward. For example, velocities as low as 3,500 feet/second may indicate difficult ripping during trenching operations. In addition, the presence of boulders, which can be troublesome in a narrow trench, should be anticipated.

Table 1 – Rippability Classification

Seismic P-wave Velocity	Rippability
0 to 2,000 feet/second	Easy
2,000 to 4,000 feet/second	Moderate
4,000 to 5,500 feet/second	Difficult, Possible Local Blasting
5,500 to 7,000 feet/second	Very Difficult, Probable Local to General Blasting
Greater than 7,000 feet/second	Blasting Generally Required

It should be noted that the rippability cutoffs presented in Table 1 are slightly more conservative than those published in the Caterpillar Performance Handbook (Caterpillar, 2004). Accordingly, the above classification scheme should be used with discretion, and contractors should not be relieved of making their own independent evaluation of the rippability of the on-site materials prior to submitting their bids.

5. RESULTS

As previously indicated, two seismic traverses were conducted as part of our study. The collected data were processed using SIPwin (Rimrock Geophysics, 2003) a seismic interpretation program and analyzed using both SIPwin and SeisOpt Pro (Optim, 2008). Both programs use first arrival picks and elevation data to produce subsurface velocity models. SIPwin uses layered based modeling techniques to produce layered velocity models, where changes in velocities are depicted as discrete contacts. SeisOpt Pro uses a nonlinear optimization technique called adaptive simulated annealing. The resulting velocity models provide a tomographic image of the estimated geologic conditions. Both vertical and lateral velocity information is contained in the tomography models.

Changes in layer velocity are revealed as gradients rather than discrete contacts, which typically are more representative of actual conditions.

Table 2 lists the approximate P-wave velocities and depths calculated from the seismic refraction traverses conducted during the evaluation. The approximate locations of the seismic refraction traverses are shown on the Seismic Line Location Map (Figure 2). The layer velocity profiles are included in Figures 4a and 4b. It should also be noted that, as a general rule, the effective depth of evaluation for a seismic refraction traverse is approximately one-third to one-fifth the length of the refraction line.

Table 2 – Seismic Traverse Results[1]

Traverse No. And Length	P-wave Velocity feet/second	Approximate Depth to Bottom of Layer in feet	Apparent Rippability[2]
SL-1 240 feet	V1 = 1,500 V2 = 4,850 V3 = 7,850	1 – 3 1 – 38 ---	Easy Difficult, Possible Blasting Blasting Generally Required
SL-2 180 feet	V1 = 1,900 V2 = 5,750 V3 = 7,500	4 – 9 0 – 24 ---	Easy Very Difficult, Probable Blasting Blasting Generally Required

1 Results based on models generated using SIP, 2003
2 Rippability criteria based on the use of a Caterpillar D-9 dozer ripping with a single shank

6. CONCLUSIONS

The results from our seismic survey revealed three distinct layers/zones at the locations surveyed. Based on our site observations and discussions with you, the layers detected have been interpreted to be surficial soil (colluvium or topsoil) overlying crystalline bedrock with varying degrees of weathering. Figures 4a and 4b provide the velocity models for the areas calculated from both SIPwin and SeisOpt Pro. In general the two models agree, with distinct lateral velocity variations evident in the tomographic profiles. In addition, higher velocity values for the bedrock materials were calculated in the tomography analysis.

Based on the results of our survey, significant variations in the subsurface materials are present in the study area. Accordingly, variability in the excavatability (including excavation depth) of the subsurface materials should be expected across the project area.

Blasting will likely be required to obtain proposed excavation depths depending on the location and desired rate of production. A contractor with excavation experience in similar difficult conditions should be consulted for expert advice on excavation methodology, equipment, production rate, and possibly oversized materials.

7. LIMITATIONS

The field evaluation and geophysical analyses presented in this report have been conducted in general accordance with current practice and the standard of care exercised by consultants performing similar tasks in the project area. No warranty, expressed or implied, is made regarding the conclusions, recommendations, and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be present. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface surveying will be performed upon request.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Southwest Geophysics, Inc. should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document. This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

8. SELECTED REFERENCES

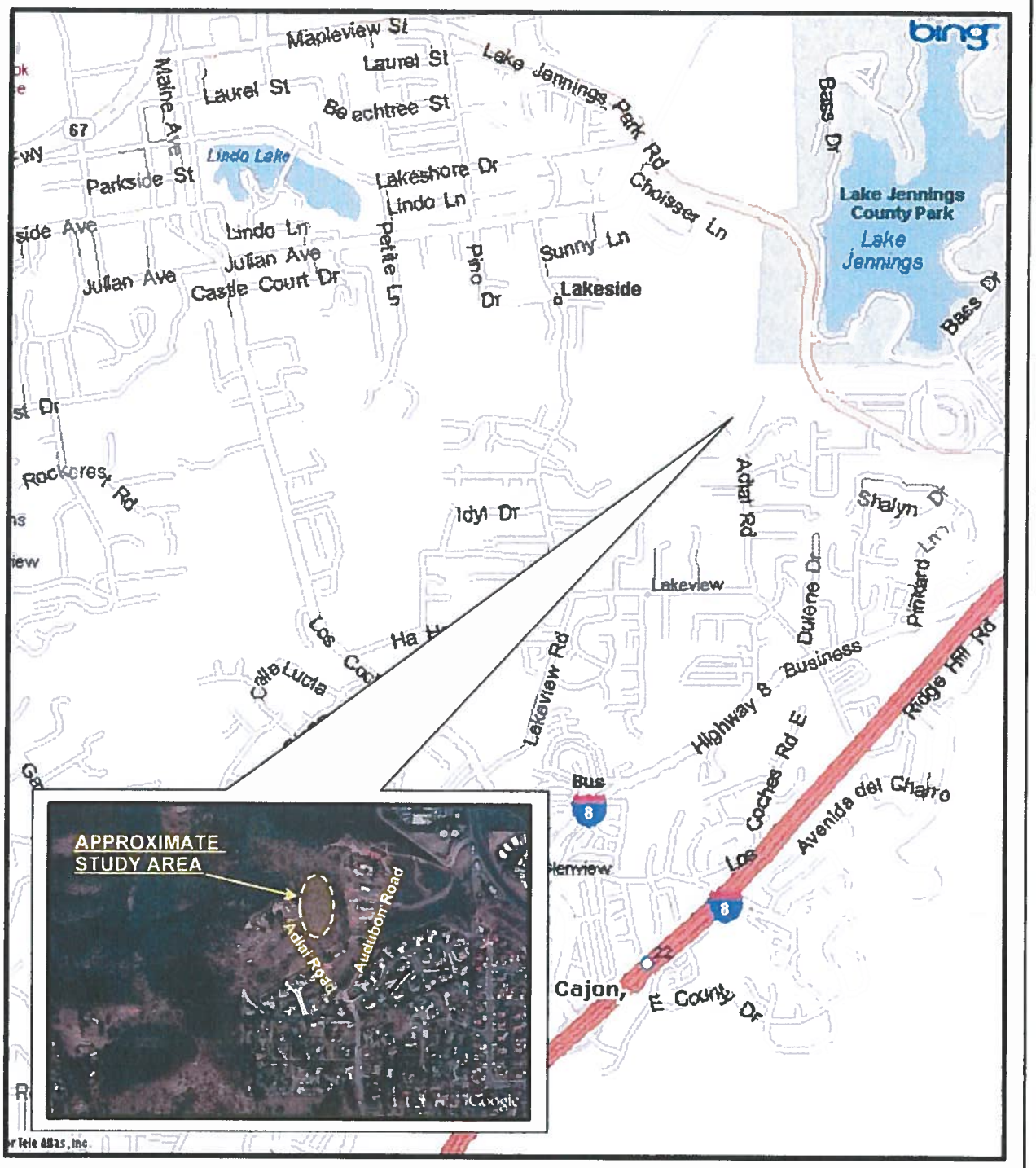
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SITE LOCATION MAP	N	Greenhills Ranch-Phase 2 Lakeside, California	SOUTHWEST GEOPHYSICS INC
		Project No.: 109123 | Date: 06/09	Figure 1



SEISMIC LINE LOCATION MAP

N

Greenhills Ranch-Phase 2
Lakeside, California

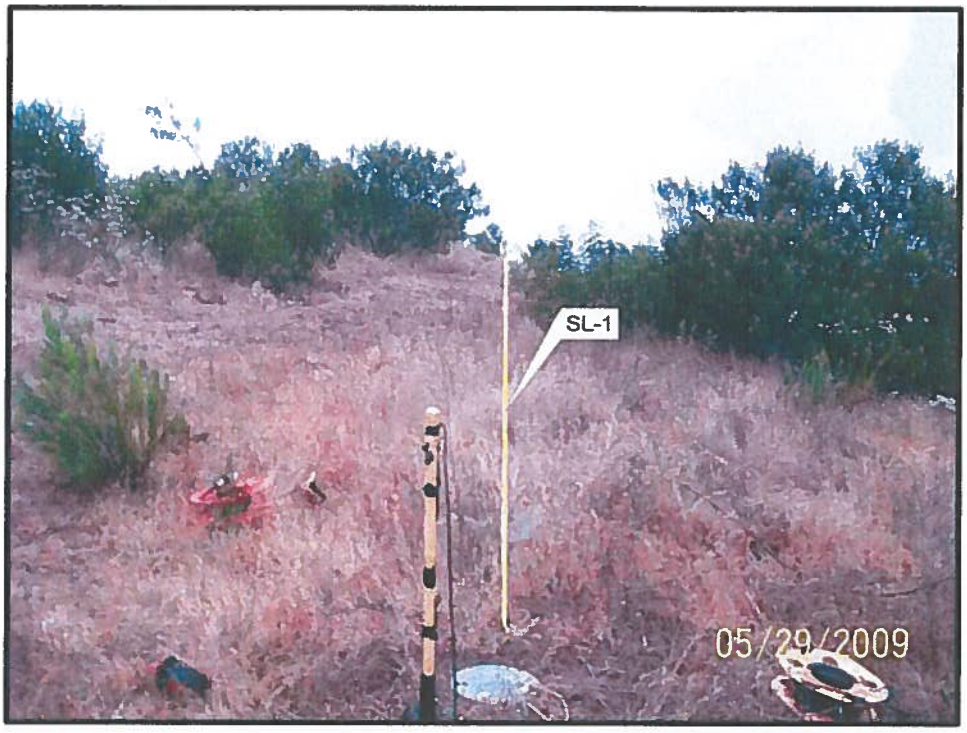
Project No.: 109123 | Date: 06/09

SOUTHWEST GEOPHYSICS INC

Figure 2

0 200 400

approximate scale in feet





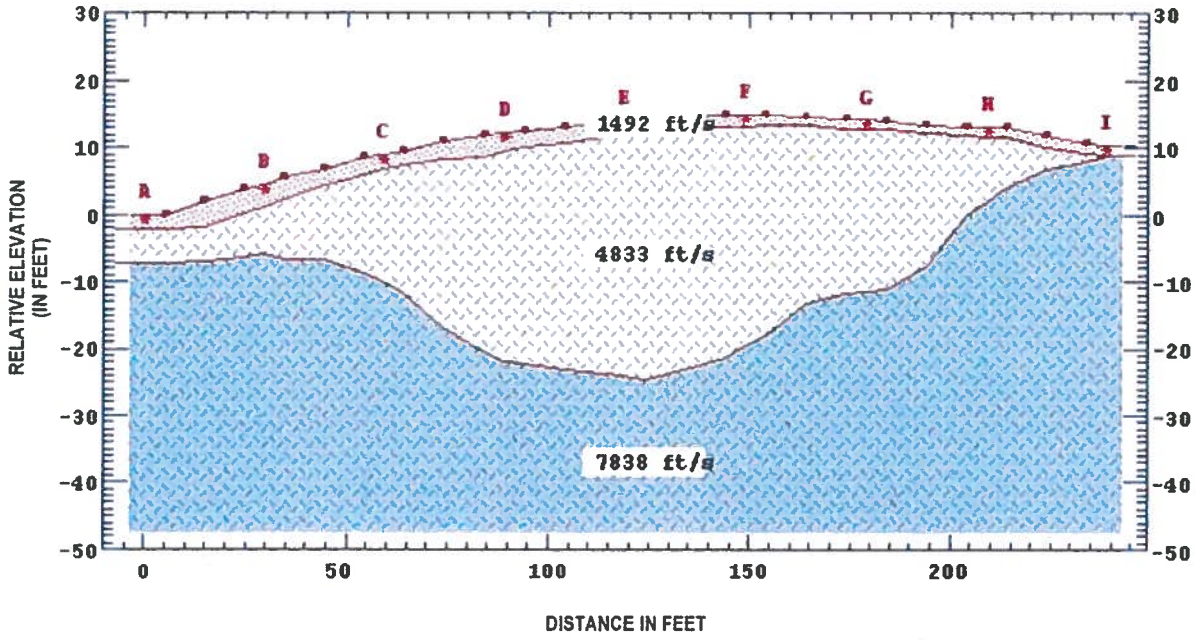
SITE PHOTOGRAPHS

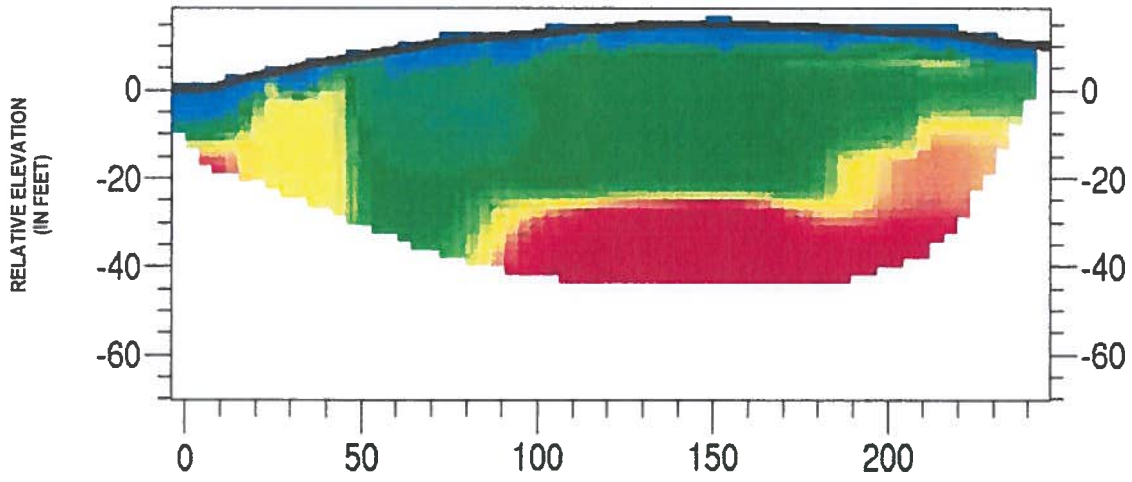
Greenhills Ranch-Phase 2
Lakeside, California

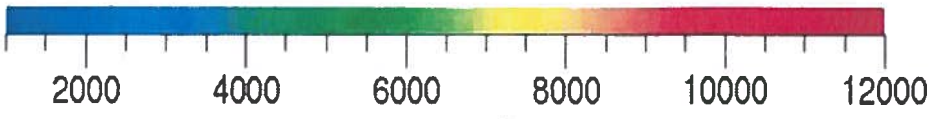
Project No.: 109123 | Date: 06/09

SOUTHWEST GEOPHYSICS INC

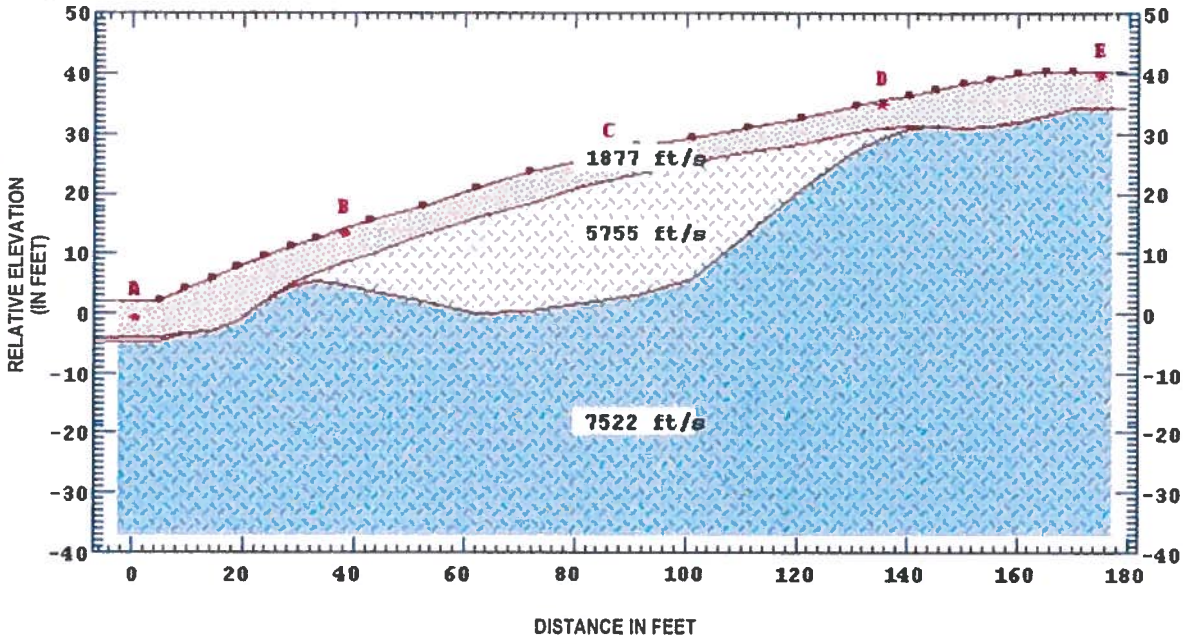
Figure 3

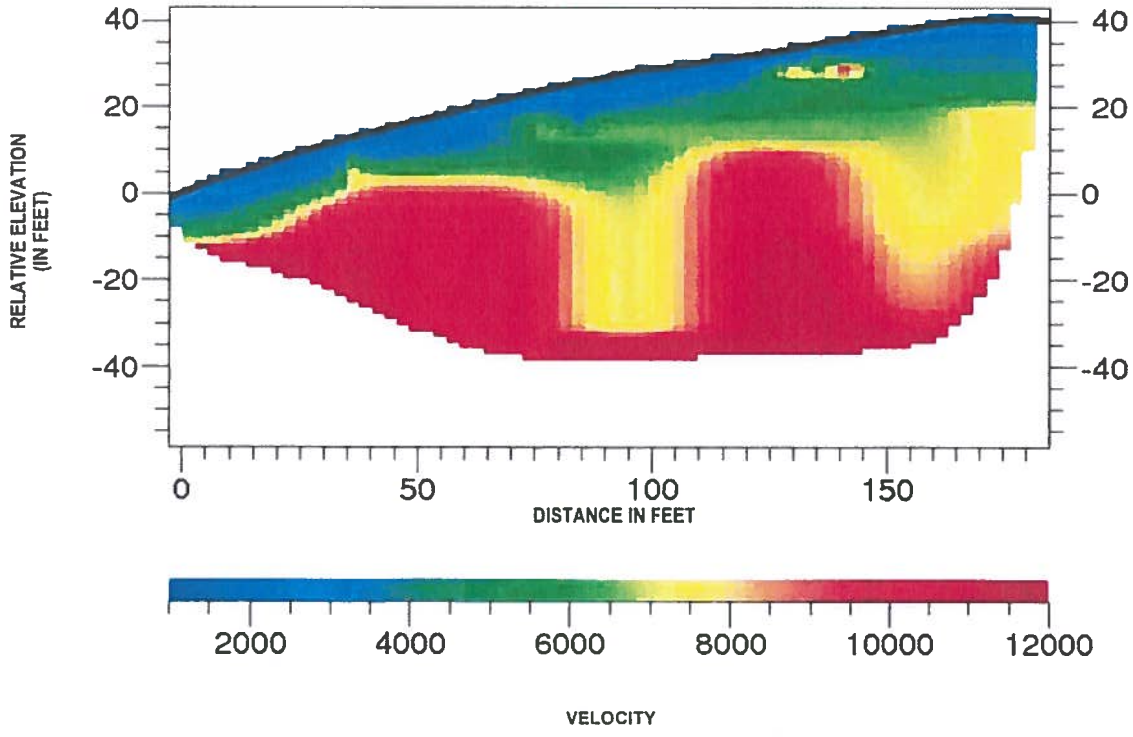






SEISMIC PROFILE SL-1	Greenhills Ranch-Phase 2 Lakeside, California	SOUTHWEST GEOPHYSICS INC
	Project No.: 109123 / Date: 06/09	Figure 4a





SEISMIC PROFILE
SL-2

Greenhills Ranch-Phase 2
Lakeside, California

Project No.: 109123 | Date: 06/09

SOUTHWEST GEOPHYSICS INC

Figure 4b

APPENDIX C

APPENDIX C

RIPPABILITY SUMMARY

Our subsurface investigation included 2 seismic-refraction surveys and 14 excavator trenches. We used information from our subsurface exploration to estimate the approximate thickness of capping material and the depth to marginally to non-rippable rock summarized in Table C-I for each excavation location. The rippability information is also presented on the Geologic Map, Figure 2 at each excavation and seismic location.

TABLE C-I
RIPPABILITY SUMMARY

Seismic and Excavation No.	Geologic Formation	Estimated Thickness of Capping Material After Screening (Feet)	Estimated Rippable Depth (Feet)
SL-1	Metamorphic Rock (Trm)	1-3	Varies from 2-4
SL-2	Metamorphic Rock (Trm)	4-7	Varies from 4-7
T-1	Undocumented Fill and Metamorphic Rock (Qudf and Trm)	11	12+
T-2	Colluvium and Granitic Rock (Qc and Kgr)	7	9+
T-3	Topsoil and Granitic Rock (Kgr)	2 ½	4
T-4	Topsoil and Granitic Rock (Kgr)	3	6+
T-5	Undocumented fill and Granitic Rock (Qudf and Kgr)	7	8
T-6	Undocumented Fill and Granitic Rock (Qudf and Kgr)	7	8
T-7	Colluvium and Metamorphic Rock (Qc and Trm)	5	9+
T-8	Topsoil and Metamorphic Rock (Trm)	2	6
T-9	Topsoil and Metamorphic Rock (Trm)	1	4
T-10	Topsoil and Metamorphic Rock (Trm)	2	5
T-11	Topsoil and Metamorphic Rock (Trm)	2	3
T-12	Topsoil and Metamorphic Rock (Trm)	5	7+
T-13	Topsoil and Metamorphic Rock (Trm)	5	7+
T-14	Topsoil and Metamorphic Rock (Trm)	2 ½	5+

APPENDIX D

APPENDIX D

LABORATORY TESTING

We performed laboratory tests in accordance with generally accepted, current test methods of the American Society for Testing and Materials (ASTM) or other suggested procedures. We analyzed selected soil samples for maximum dry density and optimum moisture content, expansion potential, shear strength, water-soluble sulfate content, chloride ion content, pH and resistivity, and R-Value. The results of the laboratory tests are presented on Tables D-I through D-VII.

TABLE D-I
SUMMARY OF LABORATORY MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT TEST RESULTS
ASTM D 1557

Sample No.	Description	Maximum Dry Density (pcf)	Optimum Moisture Content (% dry wt.)
T5-1	Brown, Silty, fine to medium SAND with trace gravel	118.5	12.0
T7-2	Brown, Silty fine to medium SAND with trace gravel	122.8	11.9

TABLE D-II
SUMMARY OF LABORATORY DIRECT SHEAR TEST RESULTS
ASTM D 3080

Sample No.	Dry Density (pcf)	Moisture Content (%)		Peak [Ultimate] Cohesion (psf)	Peak [Ultimate] Angle of Shear Resistance (degrees)
		Initial	Final		
T5-1*	106.4	12.3	17.2	270 [200]	35 [36]

* Sample remolded to a dry density of approximately 90 percent of the laboratory maximum dry density near optimum moisture content.

TABLE D-III
SUMMARY OF LABORATORY EXPANSION INDEX TEST RESULTS
ASTM D 4829

Sample No.	Moisture Content (%)		Dry Density (pcf)	Expansion Index	ASTM Expansion Classification	2016 CBC Expansion Classification
	Before Test	After Test				
T2-1	9.6	17.5	110.4	5	Very Low	Non-Expansive
T5-1	8.3	15.3	114.7	0	Very Low	Non-Expansive
T7-2	8.8	17.6	112.6	0	Very Low	Non-Expansive

TABLE D-IV
SUMMARY OF LABORATORY WATER-SOLUBLE SULFATE TEST RESULTS
CALIFORNIA TEST NO. 417

Sample No.	Water-Soluble Sulfate (%)	Water-Soluble Sulfate (ppm)	Sulfate Class
T1-1	0.006	60	S0
T2-1	0.001	10	S0
T7-2	0.001	10	S0

TABLE D-V
SUMMARY OF LABORATORY CHLORIDE ION CONTENT TEST RESULTS
AASHTO TEST NO. T 291

Sample No.	Chloride Ion Content (%)	Chloride Ion Content (ppm)
T7-1	0.004	41

TABLE D-VI
SUMMARY OF LABORATORY POTENTIAL OF HYDROGEN (PH) AND RESISTIVITY TEST RESULTS
CALIFORNIA TEST METHOD 643

Sample No.	pH	Minimum Resistivity (ohm-centimeters)
T7-1	7.3	10,000

TABLE D-VII
SUMMARY OF LABORATORY RESISTANCE VALUE (R-VALUE) TEST RESULTS
ASTM D 2844

Sample No.	R-Value
T11-1	19

APPENDIX E

APPENDIX E

STORM WATER MANAGEMENT INVESTIGATION

We understand storm water management devices will be used in accordance with the *2016 County of San Diego BMP Design Manual*. If not properly constructed, there is a potential for distress to improvements and properties located hydrologically down gradient or adjacent to these devices. Factors such as the amount of water to be detained, its residence time, and soil permeability have an important effect on seepage transmission and the potential adverse impacts that may occur if the storm water management features are not properly designed and constructed. We have not performed a hydrogeological study at the site. If infiltration of storm water runoff occurs, downstream properties may be subjected to seeps, springs, slope instability, raised groundwater, movement of foundations and slabs, or other undesirable impacts as a result of water infiltration.

Hydrologic Soil Group

The United States Department of Agriculture (USDA), Natural Resources Conservation Services, possesses general information regarding the existing soil conditions for areas within the United States. The USDA website also provides the Hydrologic Soil Group. Table E-I presents the descriptions of the hydrologic soil groups. 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. In addition, the USDA website also provides an estimated saturated hydraulic conductivity for the existing soil.

TABLE E-I
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.

Table E-II presents the information from the USDA website for the subject property. The Hydrologic Soil Group Map, provided at the end of this appendix, presents output from the USDA website showing the limits of the soil units.

TABLE E-II
USDA WEB SOIL SURVEY – HYDROLOGIC SOIL GROUP

Map Unit Name	Map Unit Symbol	Approximate Percentage of Property	Hydrologic Soil Group	k_{SAT} of Most Limiting Layer (Inches/ Hour)
Escondido, very fine sandy loam, 9 to 15 percent slopes, eroded	EsD2	20	C	0.57 – 1.98
Escondido, very fine sandy loam, 15 to 30 percent slopes, eroded	OhF	74	C	0.57 – 1.98
Friant, rocky fine sandy loam, 30 to 70 percent slopes	FxG	6	D	1.98 – 5.95

In-Situ Testing

The infiltration rate, percolation rates and saturated hydraulic conductivity are different and have different meanings. Percolation rates tend to overestimate infiltration rates and saturated hydraulic conductivities by a factor of 10 or more. Table E-III describes the differences in the definitions.

TABLE E-III
SOIL PERMEABILITY DEFINITIONS

Term	Definition
Infiltration Rate	The observation of the flow of water through a material into the ground downward into a given soil structure under long term conditions. This is a function of layering of soil, density, pore space, discontinuities and initial moisture content.
Percolation Rate	The observation of the flow of water through a material into the ground downward and laterally into a given soil structure under long term conditions. This is a function of layering of soil, density, pore space, discontinuities and initial moisture content.
Saturated Hydraulic Conductivity (k_{SAT}, Permeability)	The volume of water that will move in a porous medium under a hydraulic gradient through a unit area. This is a function of density, structure, stratification, fines content and discontinuities. It is also a function of the properties of the liquid as well as of the porous medium.

The degree of soil compaction or in-situ density has a significant impact on soil permeability and infiltration. Based on our experience and other studies we performed; an increase in compaction results in a decrease in soil permeability.

We performed 2 Aardvark Permeameter tests at locations shown on the attached Geologic Map, Figure 2. The test borings were 4 inches in diameter. The results of the tests provide parameters regarding the saturated hydraulic conductivity and infiltration characteristics of on-site soil and geologic units. Table E-IV presents the results of the estimated field saturated hydraulic conductivity and estimated infiltration rates obtained from the Aardvark Permeameter tests. The field sheets are also attached herein. We used a factor of safety applied to the test results on the worksheet values. The designer of storm water devices should apply an appropriate factor of safety. Soil infiltration rates from in-situ tests can vary significantly from one location to another due to the heterogeneous characteristics inherent to most soil. Based on a discussion in the County of Riverside *Design Handbook for Low Impact Development Best Management Practices*, the infiltration rate should be considered equal to the saturated hydraulic conductivity rate.

TABLE E-IV
FIELD PERMEAMETER INFILTRATION TEST RESULTS

Test Location	Test Depth (feet, below grade)	Geologic Unit	Field-Saturated Infiltration Rate, k_{sat} (inch/hour)	C.4-1 Worksheet Infiltration Rate[1], k_{sat} (inch/hour)
P-1	3.5	Trm	0.06	0.03
P-2	4.0	Trm	0.02	0.01
		Average:	0.04	0.02

[1] Using a factor of safety of 2.

STORM WATER MANAGEMENT CONCLUSIONS

The Geologic Map, Figure 2, depicts the existing property and the locations of the field excavations and the in-situ infiltration test locations.

Soil Types

Undocumented Fill – Undocumented fill exists on several locations associated with an existing horse facility and access road on the east site of the property. In general, the undocumented fill consists of loose to medium dense, dry to damp, silty, fine to medium sand with cobble and boulders to about 2½-feet in diameter and locally containing trash and roots. The undocumented fill will be removed as part of the grading for the site due to its present condition, and may be used for reuse as compacted fill provided it is substantially free of debris and trash. The undocumented fill does not underlie the locations of the proposed Biofiltration Basins BF-1 through BF-3. Therefore, we do not expect infiltration to occur within the undocumented fill in its current state. Infiltration should not occur within undocumented fill due to its potential for hydroconsolidation and loose nature of the soil.

Topsoil – The topsoil is present as a thin veneer locally overlying formational materials across the site with a maximum thickness of approximately 5 feet. The topsoil consists of loose to medium dense, dry to damp, reddish brown, silty, fine to medium sand with cobble and boulders up to approximately 2-feet in diameter. The topsoil will be removed as part of the grading for the site due to its present condition, and may be used for reuse as compacted fill. Therefore, we do not expect infiltration to occur within the topsoil in its current state.

Colluvium – The colluvium is present on the side slopes and upper portions of the drainages. The thickness of colluvium generally ranges from approximately 5 to 7 feet, but may be thicker along lower portions of canyons and natural slopes. The colluvium can be characterized as loose, silty, fine to medium sand with varying amounts of gravel and cobble. The colluvium will be removed as part of the grading to support the planned improvements due its present condition, and may be used for reuse as compacted fill. The existing colluvium does not underlie the locations of the proposed Biofiltration Basins BF-1 through BF-3. Therefore, we do not expect infiltration to occur within the colluvium in its current state.

Granitic Rock – Cretaceous-aged Granitic Rock is located on the western portion of the site and is characterized as moderately strong to very strong, moderately weathered to fresh, yellowish to greenish gray, fine- to medium-grained rock. This unit will be very difficult to excavate and significant portions will be non-rippable. The majority of the cuts within this unit may require blasting to excavate to the proposed grades and undercut elevations. The Granitic Rock encountered at the site is not conducive to infiltration due to its high density and rock composition. Therefore, full and partial infiltration into the Granitic Rock should be considered infeasible.

Julian Schist – Triassic-age Julian Schist composed of metamorphosed quartizite and pelitic schist rock is present in the central and eastern portions of the site. The metamorphic rock is generally moderately strong to very strong, moderately to slightly weathered with some fractures and joints. This unit will be very difficult to excavate and the majority of the cuts within this unit will require blasting to excavate to the proposed grades and undercut elevations. We expect Biofiltration Basin BF-3 will be underlain by Julian Schist. The Julian Schist encountered at the site is not conducive to infiltration due to its density and rock composition. Therefore, full and partial infiltration into the Julian Schist should be considered infeasible.

Proposed Compacted Fill – Compacted fill will be placed on the property during site grading and improvements. A portion of Biofiltration Basin BF-1 and Biofiltration Basin BF-3 will be underlain by up to approximately 10 feet of fill. Basin BF-2 will be located completely within compacted fill at the top of a descending manufactured fill slope. The fill will be compacted to a dry density of at least 90 percent of the laboratory maximum dry density and used to support the planned improvements. In our experience, compacted fill does not possess infiltration rates appropriate for infiltration. Compacted fill loses soils strength and swells when it becomes saturated from infiltration and will

result in reduced soil support for planned improvements. Therefore, full and partial infiltration should be considered infeasible.

Infiltration Rates

We performed 2 Aardvark Permeameter tests at depths ranging from approximately 3.5 to 4 feet within the weathered portion of Julian Schist. The test results indicate the approximate infiltration rates range from 0.02 to 0.05 inches per hour (0.01 to 0.03 inches per hour with an applied factor of safety of 2). Full infiltration should be considered infeasible at the site because the average infiltration rate is less than 0.5 inches per hour. Mitigation measures do not exist that allow an increase to the infiltration rates.

Groundwater Elevations

We expect groundwater is greater than 50 feet below the existing grade. Therefore, infiltration associated with groundwater elevations would be considered feasible.

New or Existing Utilities

Utilities exist adjacent to the proposed locations of Biofiltration Basins BF-1 and BF-3 within the existing Audubon and Adlai Roads. Full or partial infiltration should not be allowed in the areas adjacent to utilities to help prevent potential damage/distress to improvements. Mitigation measures to prevent water from infiltrating the utilities consist of setbacks, installing cutoff walls around the utilities and installing subdrains and/or installing liners. The basins should be set back a minimum of 10 feet from the utility or outside a 1:1 plane from the base of the utility plus 5 feet from the centerline, whichever results in a larger setback.

Existing and Planned Structures

Existing single family homes exist to the east, west and south of proposed Biofiltration Basins BF-1 and BF-3. The existing homes to the east are at an elevation lower than the proposed basins. Water should not be allowed to infiltrate in areas where it could affect the existing and neighboring properties and existing and adjacent structures, improvements and roadways. Mitigation for existing structures consists of not allowing water infiltration within a 1:1 plane from existing foundations and extending the infiltration areas at least 10 feet below the existing foundations and into formational materials. In addition, the basins could be deepened such that water would not affect the homes; however, very strong rock with a very low infiltration rate would be encountered. Therefore, full and partial infiltration should be considered infeasible for Basins BF-1 and BF-3 due to the lateral migration characteristics of the soil.

Slopes and Other Geologic Hazards

A proposed descending 2:1 (horizontal to vertical) fill slope with a height of approximately 20 feet will extend to the northwest from the edge of proposed Biofiltration Basin BF-2. In addition, a natural slope exists to the northwest of the proposed fill slope extending into an existing drainage. Water that infiltrates the soil within Biofiltration Basin BF-2 will affect the proposed fill slope and the existing natural slope to the northwest. Water migration and the resulting seepage forces can negatively affect the stability of slopes and cause daylight seepage, erosion and surficial slope instability. The proposed fill slope can develop seepage forces if infiltration were allowed at the top of a manufactured fill slope that will reduce the factor of safety below acceptable industry standards and county requirements. Due to the potential for lateral water migration within the existing soil, full or partial infiltration should be considered infeasible within Biofiltration Basin BF-2.

Storm Water Management Devices

Liners and subdrains should be incorporated into the design and construction of the planned storm water devices. The liners should be impermeable (e.g. High-density polyethylene, HDPE, with a thickness of about 30 mil or equivalent Polyvinyl Chloride**,** PVC) to prevent water migration. The subdrains should be perforated within the liner area, installed at the base and above the liner, be at least 3 inches in diameter and consist of Schedule 40 PVC pipe. The subdrains outside of the liner should consist of solid pipe. The penetration of the liners at the subdrains should be properly waterproofed. The subdrains should be connected to a proper outlet. The devices should also be installed in accordance with the manufacturer's recommendations.

Storm Water Standard Worksheets

The SWS requests the geotechnical engineer complete the *Categorization of Infiltration Feasibility Condition* (Worksheet C.4-1 or I-8) worksheet information to help evaluate the potential for infiltration on the property. The attached Worksheet C.4-1 presents the completed information for the submittal process.

The regional storm water standards also have a worksheet (Worksheet D.5-1 or Form I-9) that helps the project civil engineer estimate the factor of safety based on several factors. Table E-V describes the suitability assessment input parameters related to the geotechnical engineering aspects for the factor of safety determination.

TABLE E-V
SUITABILITY ASSESSMENT RELATED CONSIDERATIONS FOR INFILTRATION FACILITY SAFETY FACTORS

Consideration	High Concern – 3 Points	Medium Concern – 2 Points	Low Concern – 1 Point
Assessment Methods	Use of soil survey maps or simple texture analysis to estimate short-term infiltration rates. Use of well permeameter or borehole methods without accompanying continuous boring log. Relatively sparse testing with direct infiltration methods	Use of well permeameter or borehole methods with accompanying continuous boring log. Direct measurement of infiltration area with localized infiltration measurement methods (e.g., Infiltrometer). Moderate spatial resolution	Direct measurement with localized (i.e. small-scale) infiltration testing methods at relatively high resolution or use of extensive test pit infiltration measurement methods.
Predominant Soil Texture	Silty and clayey soils with significant fines	Loamy soils	Granular to slightly loamy soils
Site Soil Variability	Highly variable soils indicated from site assessment or unknown variability	Soil boring/test pits indicate moderately homogenous soils	Soil boring/test pits indicate relatively homogenous soils
Depth to Groundwater/ Impervious Layer	<5 feet below facility bottom	5-15 feet below facility bottom	>15 feet below facility bottom

Based on our geotechnical investigation and the previous table, Table E-VI presents the estimated factor values for the evaluation of the factor of safety. This table only presents the suitability assessment safety factor (Part A) of the worksheet. The project civil engineer should evaluate the safety factor for design (Part B) and use the combined safety factor for the design infiltration rate.

TABLE E-VI
FACTOR OF SAFETY WORKSHEET DESIGN VALUES – PART A[1]

Suitability Assessment Factor Category	Assigned Weight (w)	Factor Value (v)	Product (p = w x v)
Assessment Methods	0.25	2	0.50
Predominant Soil Texture	0.25	1	0.25
Site Soil Variability	0.25	2	0.50
Depth to Groundwater/ Impervious Layer	0.25	1	0.25
Suitability Assessment Safety Factor, $S_A = \Sigma p$			1.50

[1] The project civil engineer should complete Worksheet D.5-1 or Form I-9 using the data on this table. Additional information is required to evaluate the design factor of safety.

Categorization of Infiltration Feasibility Condition — Worksheet C.4-1

Part 1 - Full Infiltration Feasibility Screening Criteria

Would infiltration of the full design volume be feasible from a physical perspective without any undesirable consequences that cannot be reasonably mitigated?

Criteria	Screening Question	Yes	No
1	**Is the estimated reliable infiltration rate below proposed facility locations greater than 0.5 inches per hour?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.		X

Provide basis:

We performed 2 Aardvark Permeameter tests at the site within the weathered portion of the Julian Schist. The following presents the results of our field infiltration tests:

P-1 at 3.5 feet: 0.05 inches/hour (0.03 inches/hour with FOS=2)
P-2 at 4.0 feet: 0.02 inches/hour (0.01 inches/hour with FOS=2)

These tests result in an average of 0.02 inches/hour. The measured rates are less than 0.5 inches per hour and full infiltration is not considered feasible.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.

2	**Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.		X

Provide basis:

We expect compacted fill and Julian Schist will underlie the proposed basins. These materials possess unpredictable vertical and lateral infiltration characteristics. Lateral water migration would cause instability to adjacent slopes, right of ways, and the utilities and fill underlying the right of ways. Water would migrate into the compacted fill associated with the right of way and could cause settlement and distress to roadway pavements and underlying utilities. In addition, if infiltration is allowed, water migration and the resulting seepage forces can negatively affect the stability of the proposed fill slope to the northwest of Biofiltration Basin BF-2 and cause daylight seepage, erosion and surficial slope instability. Therefore, full and partial infiltration should be considered infeasible.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.

Worksheet C.4-1 Page 2 of 4			
Criteria	Screening Question	**Yes**	**No**
X	**Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of groundwater contamination (shallow water table, storm water pollutants or other factors) that cannot be mitigated to an acceptable level?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	X	
Provide basis: We expect groundwater is at least 50 feet from the existing elevations. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
4	**Can infiltration greater than 0.5 inches per hour be allowed without causing potential water balance issues such as change of seasonality of ephemeral streams or increased discharge of contaminated groundwater to surface waters?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	X	
Provide basis: We do not expect infiltration will cause water balance issues such as seasonality of ephemeral streams or increased discharge of contaminated groundwater to surface waters. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
Part 1 Result*	If all answers to rows 1 - 4 are "**Yes**" a full infiltration design is potentially feasible. The feasibility screening category is **Full Infiltration** If any answer from row 1-4 is "**No**", infiltration may be possible to some extent but would not generally be feasible or desirable to achieve a "full infiltration" design. Proceed to Part 2		No Full Infiltration

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City to substantiate findings.

Worksheet C.4-1 Page 3 of 4

Part 2 – Partial Infiltration vs. No Infiltration Feasibility Screening Criteria
Would infiltration of water in any appreciable amount be physically feasible without any negative consequences that cannot be reasonably mitigated?

Criteria	Screening Question	Yes	No
5	**Do soil and geologic conditions allow for infiltration in any appreciable rate or volume?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.	X	

Provide basis:
We performed 2 Aardvark Permeameter tests at the site within the weathered portion of the Julian Schist. The following presents the results of our field infiltration tests:

P-1 at 3.5 feet: 0.05 inches/hour (0.03 inches/hour with FOS=2)
P-2 at 4.0 feet: 0.02 inches/hour (0.01 inches/hour with FOS=2)

These tests result in an average of 0.02 inches/hour.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.

6	**Can Infiltration in any appreciable quantity be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level**? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.		X

Provide basis:

We expect compacted fill and Julian Schist will underlie the proposed basins. These materials possess unpredictable vertical and lateral infiltration characteristics. Lateral water migration would cause instability to adjacent slopes, right of ways, and the utilities and fill underlying the right of ways. Water would migrate into the compacted fill associated with the right of way and could cause settlement and distress to roadway pavements and underlying utilities. In addition, if infiltration is allowed, water migration and the resulting seepage forces can negatively affect the stability of the proposed fill slope to the northwest of Biofiltration Basin BF-2 and cause daylight seepage, erosion and surficial slope instability. Therefore, full and partial infiltration should be considered infeasible.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.

Worksheet C.4-1 Page 4 of 4			
Criteria	Screening Question	**Yes**	**No**
7	**Can Infiltration in any appreciable quantity be allowed without posing significant risk for groundwater related concerns (shallow water table, storm water pollutants or other factors)?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	X	
Provide basis: We expect groundwater is at least 50 feet from the existing elevations. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.			
8	**Can infiltration be allowed without violating downstream water rights**? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	X	
Provide basis: We did not provide a study regarding water rights. However, these rights are not typical in the San Diego County area. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.			
Part 2 Result*	If all answers from row 1-4 are yes then partial infiltration design is potentially feasible. The feasibility screening category is **Partial Infiltration.** If any answer from row 5-8 is no, then infiltration of any volume is considered to be **infeasible** within the drainage area. The feasibility screening category is **No Infiltration.**		No Infiltration

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City to substantiate findings.

GEOCON

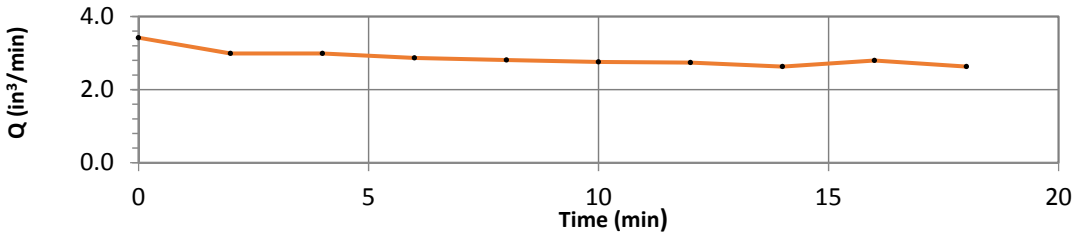
Aardvark Permeameter Data Analysis

Project Name:	Greenhills Ranch	Date:	11/6/2016
Project Number:	G1117-52-03	By:	LR
Test Number:	P-1		

Borehole Diameter, d (in.):	4.00	Ref. EL (feet, MSL):	662.0
Borehole Depth, **H** (in):	42.00	Bottom EL (feet, MSL):	658.5
Distance Between Reservoir & Top of Borehole (in.):	24.00		
Estimated Depth to Water Table, **S** (feet):	100.00		
Height APM Raised from Bottom (in.):	11.00		
Pressure Reducer Used:	No		

Distance Between Resevoir and APM Float, **D** (in.):	47.75
Head Height Calculated, **h** (in.):	14.66
Head Height Measured, **h** (in.):	14.00
Distance Between Constant Head and Water Table, **L** (in.):	1172.00

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	2.00	0.247	6.84	3.420
3	2.00	0.216	5.98	2.991
4	2.00	0.216	5.98	2.991
5	2.00	0.207	5.73	2.866
6	2.00	0.203	5.62	2.811
7	2.00	0.199	5.51	2.755
8	2.00	0.198	5.48	2.742
9	2.00	0.190	5.26	2.631
10	2.00	0.202	5.59	2.797
11	2.00	0.190	5.26	2.631
			Steady Flow Rate, Q (in^3/min):	2.631



Soil Matric Flux Potential, Φ_m

Φ_m= 0.038 in^2/min

Field-Saturated Hydraulic Conductivity (Infiltration Rate)

K_{sat} = 9.67E-04 in/min 0.058 in/hr

GEOCON

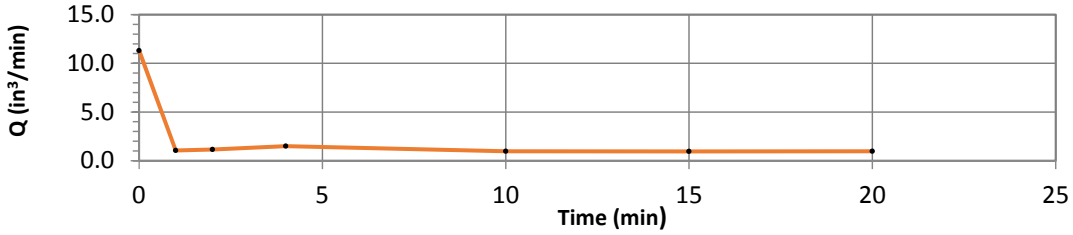
Aardvark Permeameter Data Analysis

Project Name:	Greenhills Ranch	Date:	11/6/2016
Project Number:	G1117-52-03	By:	LR
Test Number:	P-2	Ref. EL (feet, MSL):	666.0
		Bottom EL (feet, MSL):	664.7

Borehole Diameter, d (in.):	4.00
Borehole Depth, **H** (in):	16.00
Distance Between Reservoir & Top of Borehole (in.):	24.00
Estimated Depth to Water Table, **S** (feet):	100.00
Height APM Raised from Bottom (in.):	12.00
Pressure Reducer Used:	No

Distance Between Resevoir and APM Float, **D** (in.):	20.75
Head Height Calculated, **h** (in.):	15.57
Head Height Measured, **h** (in.):	16.00
Distance Between Constant Head and Water Table, **L** (in.):	1200.00

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	1.00	0.000	0.00	0.000
3	1.00	0.004	0.11	0.111
4	2.00	0.816	22.60	11.298
5	6.00	0.229	6.34	1.057
6	5.00	0.208	5.76	1.152
7	5.00	0.269	7.45	1.490
8	5.00	0.176	4.87	0.975
9	5.00	0.172	4.76	0.953
10	5.00	0.176	4.87	0.975
			Steady Flow Rate, Q (in^3/min):	0.975



Soil Matric Flux Potential, Φ_m

Φ_m= 0.013 in^2/min

Field-Saturated Hydraulic Conductivity (Infiltration Rate)

K_{sat} = 3.33E-04 in/min 0.020 in/hr

Custom Soil Resource Report
Soil Map



Map Scale: 1:3,890 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

APPENDIX F

APPENDIX F

RECOMMENDED GRADING SPECIFICATIONS

FOR

GREENHILLS RANCH – PHASE 2
SAN DIEGO COUNTY, CALIFORNIA

PROJECT NO. G1117-52-03

RECOMMENDED GRADING SPECIFICATIONS

1. GENERAL

1.1 These Recommended Grading Specifications shall be used in conjunction with the Geotechnical Report for the project prepared by Geocon. The recommendations contained in the text of the Geotechnical Report are a part of the earthwork and grading specifications and shall supersede the provisions contained hereinafter in the case of conflict.

1.2 Prior to the commencement of grading, a geotechnical consultant (Consultant) shall be employed for the purpose of observing earthwork procedures and testing the fills for substantial conformance with the recommendations of the Geotechnical Report and these specifications. The Consultant should provide adequate testing and observation services so that they may assess whether, in their opinion, the work was performed in substantial conformance with these specifications. It shall be the responsibility of the Contractor to assist the Consultant and keep them apprised of work schedules and changes so that personnel may be scheduled accordingly.

1.3 It shall be the sole responsibility of the Contractor to provide adequate equipment and methods to accomplish the work in accordance with applicable grading codes or agency ordinances, these specifications and the approved grading plans. If, in the opinion of the Consultant, unsatisfactory conditions such as questionable soil materials, poor moisture condition, inadequate compaction, and/or adverse weather result in a quality of work not in conformance with these specifications, the Consultant will be empowered to reject the work and recommend to the Owner that grading be stopped until the unacceptable conditions are corrected.

2. DEFINITIONS

2.1 **Owner** shall refer to the owner of the property or the entity on whose behalf the grading work is being performed and who has contracted with the Contractor to have grading performed.

2.2 **Contractor** shall refer to the Contractor performing the site grading work.

2.3 **Civil Engineer** or **Engineer of Work** shall refer to the California licensed Civil Engineer or consulting firm responsible for preparation of the grading plans, surveying and verifying as-graded topography.

2.4 **Consultant** shall refer to the soil engineering and engineering geology consulting firm retained to provide geotechnical services for the project.

2.5 **Soil Engineer** shall refer to a California licensed Civil Engineer retained by the Owner, who is experienced in the practice of geotechnical engineering. The Soil Engineer shall be responsible for having qualified representatives on-site to observe and test the Contractor's work for conformance with these specifications.

2.6 **Engineering Geologist** shall refer to a California licensed Engineering Geologist retained by the Owner to provide geologic observations and recommendations during the site grading.

2.7 **Geotechnical Report** shall refer to a soil report (including all addenda) which may include a geologic reconnaissance or geologic investigation that was prepared specifically for the development of the project for which these Recommended Grading Specifications are intended to apply.

3. MATERIALS

3.1 Materials for compacted fill shall consist of any soil excavated from the cut areas or imported to the site that, in the opinion of the Consultant, is suitable for use in construction of fills. In general, fill materials can be classified as *soil* fills, *soil-rock* fills or *rock* fills, as defined below.

3.1.1 **Soil fills** are defined as fills containing no rocks or hard lumps greater than 12 inches in maximum dimension and containing at least 40 percent by weight of material smaller than ¾ inch in size.

3.1.2 **Soil-rock fills** are defined as fills containing no rocks or hard lumps larger than 4 feet in maximum dimension and containing a sufficient matrix of soil fill to allow for proper compaction of soil fill around the rock fragments or hard lumps as specified in Paragraph 6.2. **Oversize rock** is defined as material greater than 12 inches.

3.1.3 **Rock fills** are defined as fills containing no rocks or hard lumps larger than 3 feet in maximum dimension and containing little or no fines. Fines are defined as material smaller than ¾ inch in maximum dimension. The quantity of fines shall be less than approximately 20 percent of the rock fill quantity.

3.2 Material of a perishable, spongy, or otherwise unsuitable nature as determined by the Consultant shall not be used in fills.

3.3 Materials used for fill, either imported or on-site, shall not contain hazardous materials as defined by the California Code of Regulations, Title 22, Division 4, Chapter 30, Articles 9

and 10; 40CFR; and any other applicable local, state or federal laws. The Consultant shall not be responsible for the identification or analysis of the potential presence of hazardous materials. However, if observations, odors or soil discoloration cause Consultant to suspect the presence of hazardous materials, the Consultant may request from the Owner the termination of grading operations within the affected area. Prior to resuming grading operations, the Owner shall provide a written report to the Consultant indicating that the suspected materials are not hazardous as defined by applicable laws and regulations.

3.4 The outer 15 feet of *soil-rock* fill slopes, measured horizontally, should be composed of properly compacted *soil* fill materials approved by the Consultant. *Rock* fill may extend to the slope face, provided that the slope is not steeper than 2:1 (horizontal:vertical) and a soil layer no thicker than 12 inches is track-walked onto the face for landscaping purposes. This procedure may be utilized provided it is acceptable to the governing agency, Owner and Consultant.

3.5 Samples of soil materials to be used for fill should be tested in the laboratory by the Consultant to determine the maximum density, optimum moisture content, and, where appropriate, shear strength, expansion, and gradation characteristics of the soil.

3.6 During grading, soil or groundwater conditions other than those identified in the Geotechnical Report may be encountered by the Contractor. The Consultant shall be notified immediately to evaluate the significance of the unanticipated condition.

4. CLEARING AND PREPARING AREAS TO BE FILLED

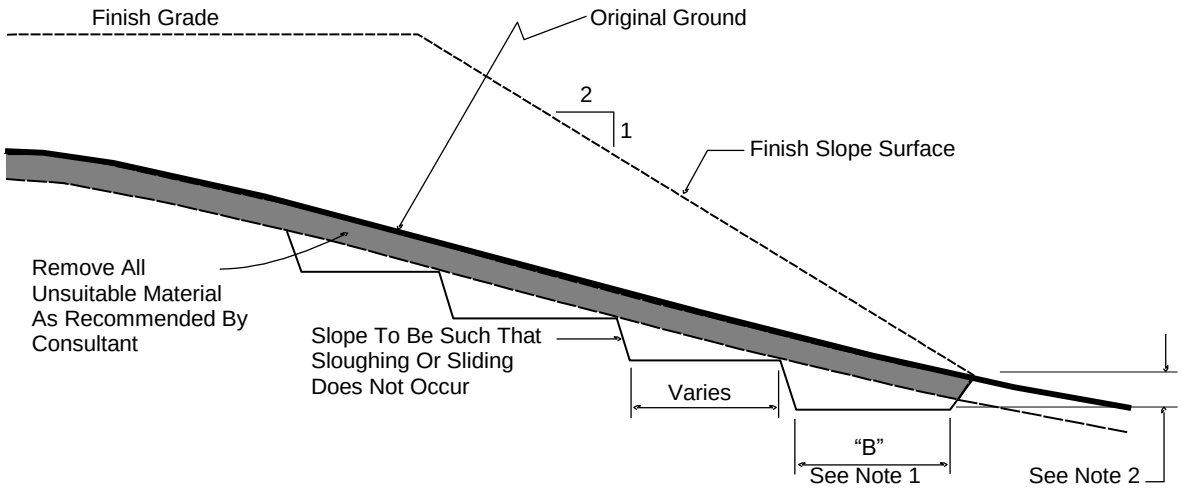
4.1 Areas to be excavated and filled shall be cleared and grubbed. Clearing shall consist of complete removal above the ground surface of trees, stumps, brush, vegetation, man-made structures, and similar debris. Grubbing shall consist of removal of stumps, roots, buried logs and other unsuitable material and shall be performed in areas to be graded. Roots and other projections exceeding 1½ inches in diameter shall be removed to a depth of 3 feet below the surface of the ground. Borrow areas shall be grubbed to the extent necessary to provide suitable fill materials.

4.2 Asphalt pavement material removed during clearing operations should be properly disposed at an approved off-site facility or in an acceptable area of the project evaluated by Geocon and the property owner. Concrete fragments that are free of reinforcing steel may be placed in fills, provided they are placed in accordance with Section 6.2 or 6.3 of this document.

4.3 After clearing and grubbing of organic matter and other unsuitable material, loose or porous soils shall be removed to the depth recommended in the Geotechnical Report. The depth of removal and compaction should be observed and approved by a representative of the Consultant. The exposed surface shall then be plowed or scarified to a minimum depth of 6 inches and until the surface is free from uneven features that would tend to prevent uniform compaction by the equipment to be used.

4.4 Where the slope ratio of the original ground is steeper than 5:1 (horizontal:vertical), or where recommended by the Consultant, the original ground should be benched in accordance with the following illustration.

TYPICAL BENCHING DETAIL



No Scale

DETAIL NOTES: (1) Key width "B" should be a minimum of 10 feet, or sufficiently wide to permit complete coverage with the compaction equipment used. The base of the key should be graded horizontal, or inclined slightly into the natural slope.

(2) The outside of the key should be below the topsoil or unsuitable surficial material and at least 2 feet into dense formational material. Where hard rock is exposed in the bottom of the key, the depth and configuration of the key may be modified as approved by the Consultant.

4.5 After areas to receive fill have been cleared and scarified, the surface should be moisture conditioned to achieve the proper moisture content, and compacted as recommended in Section 6 of these specifications.

5. COMPACTION EQUIPMENT

5.1 Compaction of *soil* or *soil-rock* fill shall be accomplished by sheepsfoot or segmented-steel wheeled rollers, vibratory rollers, multiple-wheel pneumatic-tired rollers, or other types of acceptable compaction equipment. Equipment shall be of such a design that it will be capable of compacting the *soil* or *soil-rock* fill to the specified relative compaction at the specified moisture content.

5.2 Compaction of *rock* fills shall be performed in accordance with Section 6.3.

6. PLACING, SPREADING AND COMPACTION OF FILL MATERIAL

6.1 *Soil* fill, as defined in Paragraph 3.1.1, shall be placed by the Contractor in accordance with the following recommendations:

6.1.1 *Soil* fill shall be placed by the Contractor in layers that, when compacted, should generally not exceed 8 inches. Each layer shall be spread evenly and shall be thoroughly mixed during spreading to obtain uniformity of material and moisture in each layer. The entire fill shall be constructed as a unit in nearly level lifts. Rock materials greater than 12 inches in maximum dimension shall be placed in accordance with Section 6.2 or 6.3 of these specifications.

6.1.2 In general, the *soil* fill shall be compacted at a moisture content at or above the optimum moisture content as determined by ASTM D 1557.

6.1.3 When the moisture content of *soil* fill is below that specified by the Consultant, water shall be added by the Contractor until the moisture content is in the range specified.

6.1.4 When the moisture content of the *soil* fill is above the range specified by the Consultant or too wet to achieve proper compaction, the *soil* fill shall be aerated by the Contractor by blading/mixing, or other satisfactory methods until the moisture content is within the range specified.

6.1.5 After each layer has been placed, mixed, and spread evenly, it shall be thoroughly compacted by the Contractor to a relative compaction of at least 90 percent. Relative compaction is defined as the ratio (expressed in percent) of the in-place dry density of the compacted fill to the maximum laboratory dry density as determined in accordance with ASTM D 1557. Compaction shall be continuous over the entire area, and compaction equipment shall make sufficient passes so that the specified minimum relative compaction has been achieved throughout the entire fill.

6.1.6 Where practical, soils having an Expansion Index greater than 50 should be placed at least 3 feet below finish pad grade and should be compacted at a moisture content generally 2 to 4 percent greater than the optimum moisture content for the material.

6.1.7 Properly compacted *soil* fill shall extend to the design surface of fill slopes. To achieve proper compaction, it is recommended that fill slopes be over-built by at least 3 feet and then cut to the design grade. This procedure is considered preferable to track-walking of slopes, as described in the following paragraph.

6.1.8 As an alternative to over-building of slopes, slope faces may be back-rolled with a heavy-duty loaded sheepsfoot or vibratory roller at maximum 4-foot fill height intervals. Upon completion, slopes should then be track-walked with a D-8 dozer or similar equipment, such that a dozer track covers all slope surfaces at least twice.

6.2 *Soil-rock* fill, as defined in Paragraph 3.1.2, shall be placed by the Contractor in accordance with the following recommendations:

6.2.1 Rocks larger than 12 inches but less than 4 feet in maximum dimension may be incorporated into the compacted *soil* fill, but shall be limited to the area measured 15 feet minimum horizontally from the slope face and 5 feet below finish grade or 3 feet below the deepest utility, whichever is deeper.

6.2.2 Rocks or rock fragments up to 4 feet in maximum dimension may either be individually placed or placed in windrows. Under certain conditions, rocks or rock fragments up to 10 feet in maximum dimension may be placed using similar methods. The acceptability of placing rock materials greater than 4 feet in maximum dimension shall be evaluated during grading as specific cases arise and shall be approved by the Consultant prior to placement.

6.2.3 For individual placement, sufficient space shall be provided between rocks to allow for passage of compaction equipment.

6.2.4 For windrow placement, the rocks should be placed in trenches excavated in properly compacted *soil* fill. Trenches should be approximately 5 feet wide and 4 feet deep in maximum dimension. The voids around and beneath rocks should be filled with approved granular soil having a Sand Equivalent of 30 or greater and should be compacted by flooding. Windrows may also be placed utilizing an "open-face" method in lieu of the trench procedure, however, this method should first be approved by the Consultant.

6.2.5 Windrows should generally be parallel to each other and may be placed either parallel to or perpendicular to the face of the slope depending on the site geometry. The minimum horizontal spacing for windrows shall be 12 feet center-to-center with a 5-foot stagger or offset from lower courses to next overlying course. The minimum vertical spacing between windrow courses shall be 2 feet from the top of a lower windrow to the bottom of the next higher windrow.

6.2.6 Rock placement, fill placement and flooding of approved granular soil in the windrows should be continuously observed by the Consultant.

6.3 *Rock* fills, as defined in Section 3.1.3, shall be placed by the Contractor in accordance with the following recommendations:

6.3.1 The base of the *rock* fill shall be placed on a sloping surface (minimum slope of 2 percent). The surface shall slope toward suitable subdrainage outlet facilities. The *rock* fills shall be provided with subdrains during construction so that a hydrostatic pressure buildup does not develop. The subdrains shall be permanently connected to controlled drainage facilities to control post-construction infiltration of water.

6.3.2 *Rock* fills shall be placed in lifts not exceeding 3 feet. Placement shall be by rock trucks traversing previously placed lifts and dumping at the edge of the currently placed lift. Spreading of the *rock* fill shall be by dozer to facilitate *seating* of the rock. The *rock* fill shall be watered heavily during placement. Watering shall consist of water trucks traversing in front of the current rock lift face and spraying water continuously during rock placement. Compaction equipment with compactive energy comparable to or greater than that of a 20-ton steel vibratory roller or other compaction equipment providing suitable energy to achieve the required compaction or deflection as recommended in Paragraph 6.3.3 shall be utilized. The number of passes to be made should be determined as described in Paragraph 6.3.3. Once a *rock* fill lift has been covered with *soil* fill, no additional *rock* fill lifts will be permitted over the *soil* fill.

6.3.3 Plate bearing tests, in accordance with ASTM D 1196, may be performed in both the compacted *soil* fill and in the *rock* fill to aid in determining the required minimum number of passes of the compaction equipment. If performed, a minimum of three plate bearing tests should be performed in the properly compacted *soil* fill (minimum relative compaction of 90 percent). Plate bearing tests shall then be performed on areas of *rock* fill having two passes, four passes and six passes of the compaction equipment, respectively. The number of passes required for the *rock* fill shall be determined by comparing the results of the plate bearing tests for the *soil* fill and the *rock* fill and by evaluating the deflection

variation with number of passes. The required number of passes of the compaction equipment will be performed as necessary until the plate bearing deflections are equal to or less than that determined for the properly compacted *soil* fill. In no case will the required number of passes be less than two.

6.3.4 A representative of the Consultant should be present during *rock* fill operations to observe that the minimum number of "passes" have been obtained, that water is being properly applied and that specified procedures are being followed. The actual number of plate bearing tests will be determined by the Consultant during grading.

6.3.5 Test pits shall be excavated by the Contractor so that the Consultant can state that, in their opinion, sufficient water is present and that voids between large rocks are properly filled with smaller rock material. In-place density testing will not be required in the *rock* fills.

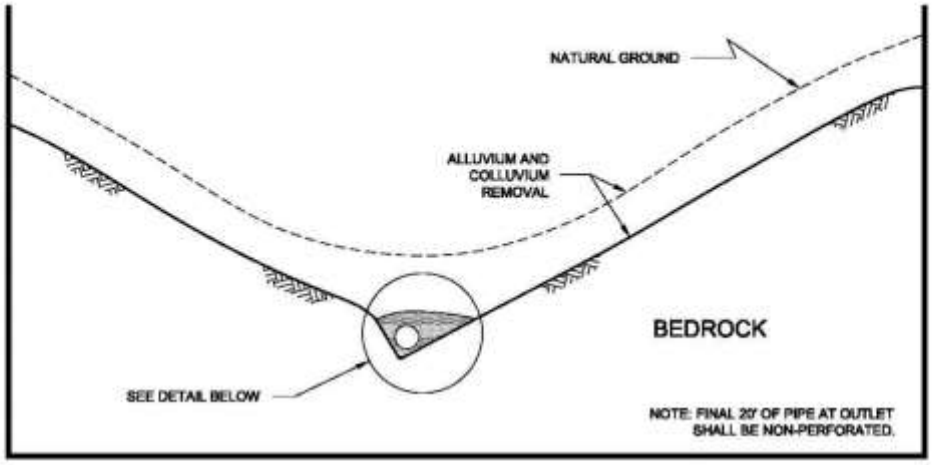
6.3.6 To reduce the potential for "piping" of fines into the *rock* fill from overlying *soil* fill material, a 2-foot layer of graded filter material shall be placed above the uppermost lift of *rock* fill. The need to place graded filter material below the *rock* should be determined by the Consultant prior to commencing grading. The gradation of the graded filter material will be determined at the time the *rock* fill is being excavated. Materials typical of the *rock* fill should be submitted to the Consultant in a timely manner, to allow design of the graded filter prior to the commencement of *rock* fill placement.

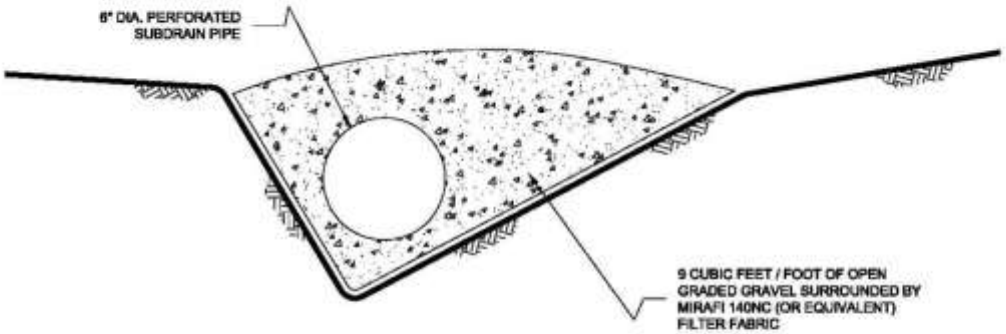
6.3.7 *Rock* fill placement should be continuously observed during placement by the Consultant.

7. SUBDRAINS

7.1 The geologic units on the site may have permeability characteristics and/or fracture systems that could be susceptible under certain conditions to seepage. The use of canyon subdrains may be necessary to mitigate the potential for adverse impacts associated with seepage conditions. Canyon subdrains with lengths in excess of 500 feet or extensions of existing offsite subdrains should use 8-inch-diameter pipes. Canyon subdrains less than 500 feet in length should use 6-inch-diameter pipes.

TYPICAL CANYON DRAIN DETAIL





NOTES:

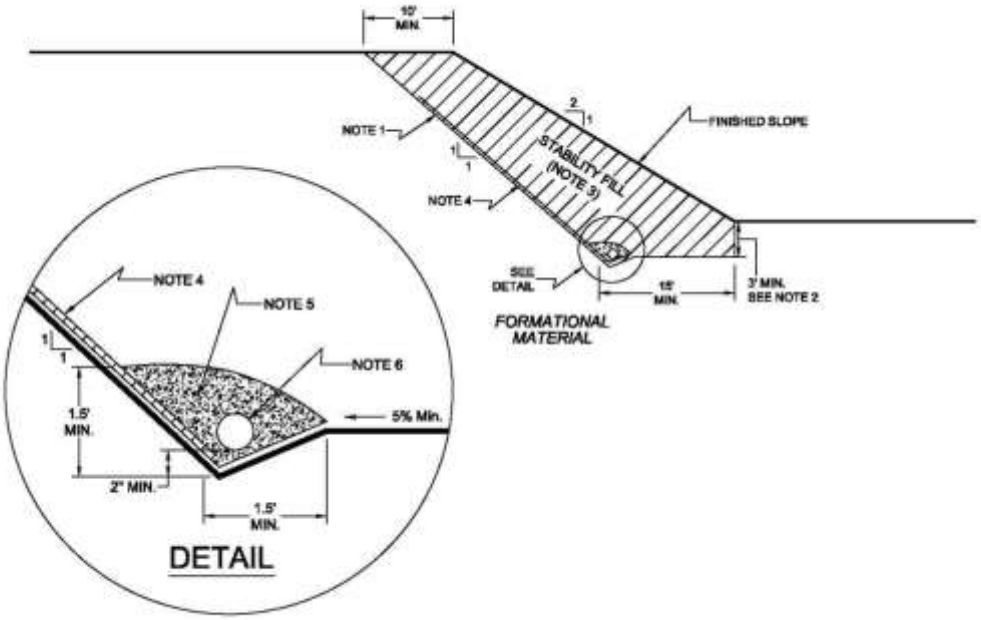
1.....6-INCH DIAMETER, SCHEDULE 80 PVC PERFORATED PIPE FOR FILLS IN EXCESS OF 100-FEET IN DEPTH OR A PIPE LENGTH OF LONGER THAN 500 FEET.

2.....6-INCH DIAMETER, SCHEDULE 40 PVC PERFORATED PIPE FOR FILLS LESS THAN 100-FEET IN DEPTH OR A PIPE LENGTH SHORTER THAN 500 FEET.

NO SCALE

7.2 Slope drains within stability fill keyways should use 4-inch-diameter (or lager) pipes.

TYPICAL STABILITY FILL DETAIL



NOTES:

1....EXCAVATE BACKCUT AT 1:1 INCLINATION (UNLESS OTHERWISE NOTED).

2....BASE OF STABILITY FILL TO BE 3 FEET INTO FORMATIONAL MATERIAL, SLOPING A MINIMUM 5% INTO SLOPE.

3....STABILITY FILL TO BE COMPOSED OF PROPERLY COMPACTED GRANULAR SOIL.

4....CHIMNEY DRAINS TO BE APPROVED PREFABRICATED CHIMNEY DRAIN PANELS (MIRADRAIN G200N OR EQUIVALENT) SPACED APPROXIMATELY 20 FEET CENTER TO CENTER AND 4 FEET WIDE. CLOSER SPACING MAY BE REQUIRED IF SEEPAGE IS ENCOUNTERED.

5....FILTER MATERIAL TO BE 3/4-INCH, OPEN-GRADED CRUSHED ROCK ENCLOSED IN APPROVED FILTER FABRIC (MIRAFI 140NC).

6....COLLECTOR PIPE TO BE 4-INCH MINIMUM DIAMETER, PERFORATED, THICK-WALLED PVC SCHEDULE 40 OR EQUIVALENT, AND SLOPED TO DRAIN AT 1 PERCENT MINIMUM TO APPROVED OUTLET.

NO SCALE

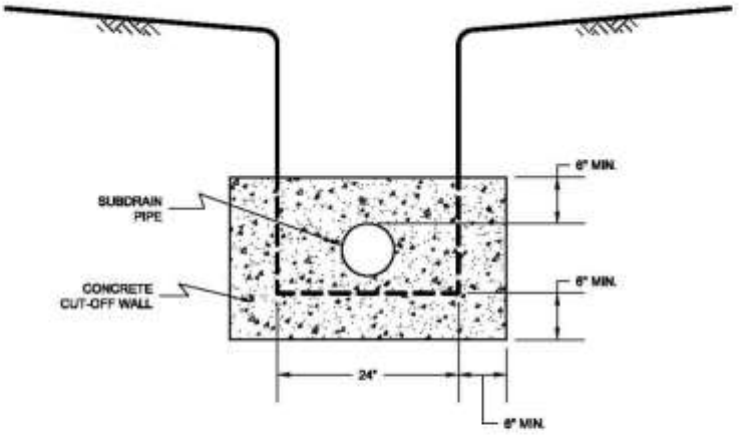
7.3 The actual subdrain locations will be evaluated in the field during the remedial grading operations. Additional drains may be necessary depending on the conditions observed and the requirements of the local regulatory agencies. Appropriate subdrain outlets should be evaluated prior to finalizing 40-scale grading plans.

7.4 *Rock* fill or *soil-rock* fill areas may require subdrains along their down-slope perimeters to mitigate the potential for buildup of water from construction or landscape irrigation. The subdrains should be at least 6-inch-diameter pipes encapsulated in gravel and filter fabric. *Rock* fill drains should be constructed using the same requirements as canyon subdrains.

7.5 Prior to outletting, the final 20-foot segment of a subdrain that will not be extended during future development should consist of non-perforated drainpipe. At the non-perforated/ perforated interface, a seepage cutoff wall should be constructed on the downslope side of the pipe.

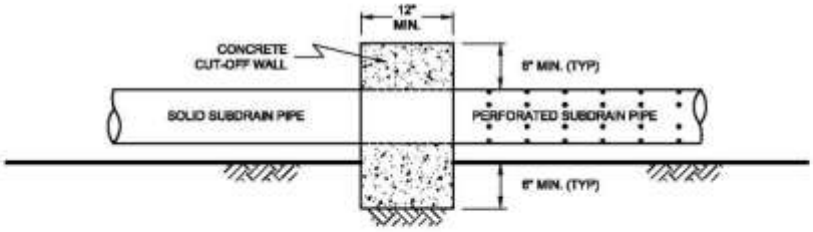
TYPICAL CUT OFF WALL DETAIL

FRONT VIEW



NO SCALE

SIDE VIEW

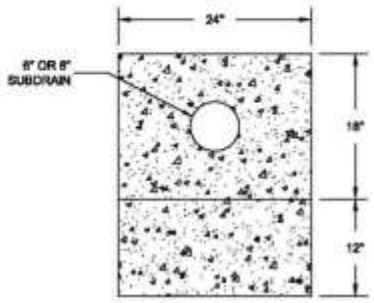


NO SCALE

7.6 Subdrains that discharge into a natural drainage course or open space area should be provided with a permanent headwall structure.

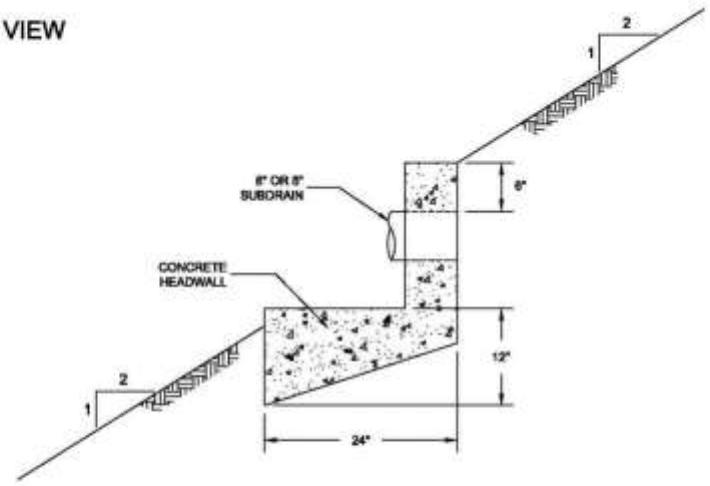
TYPICAL HEADWALL DETAIL

FRONT VIEW



NO SCALE

SIDE VIEW



NOTE: HEADWALL SHOULD OUTLET AT TOE OF FILL SLOPE OR INTO CONTROLLED SURFACE DRAINAGE

NO SCALE

7.7 The final grading plans should show the location of the proposed subdrains. After completion of remedial excavations and subdrain installation, the project civil engineer should survey the drain locations and prepare an "as-built" map showing the drain locations. The final outlet and connection locations should be determined during grading operations. Subdrains that will be extended on adjacent projects after grading can be placed on formational material and a vertical riser should be placed at the end of the subdrain. The grading contractor should consider videoing the subdrains shortly after burial to check proper installation and functionality. The contractor is responsible for the performance of the drains.

8. OBSERVATION AND TESTING

8.1 The Consultant shall be the Owner's representative to observe and perform tests during clearing, grubbing, filling, and compaction operations. In general, no more than 2 feet in vertical elevation of *soil* or *soil-rock* fill should be placed without at least one field density test being performed within that interval. In addition, a minimum of one field density test should be performed for every 2,000 cubic yards of *soil* or *soil-rock* fill placed and compacted.

8.2 The Consultant should perform a sufficient distribution of field density tests of the compacted *soil* or *soil-rock* fill to provide a basis for expressing an opinion whether the fill material is compacted as specified. Density tests shall be performed in the compacted materials below any disturbed surface. When these tests indicate that the density of any layer of fill or portion thereof is below that specified, the particular layer or areas represented by the test shall be reworked until the specified density has been achieved.

8.3 During placement of *rock* fill, the Consultant should observe that the minimum number of passes have been obtained per the criteria discussed in Section 6.3.3. The Consultant should request the excavation of observation pits and may perform plate bearing tests on the placed *rock* fills. The observation pits will be excavated to provide a basis for expressing an opinion as to whether the *rock* fill is properly seated and sufficient moisture has been applied to the material. When observations indicate that a layer of *rock* fill or any portion thereof is below that specified, the affected layer or area shall be reworked until the *rock* fill has been adequately seated and sufficient moisture applied.

8.4 A settlement monitoring program designed by the Consultant may be conducted in areas of *rock* fill placement. The specific design of the monitoring program shall be as recommended in the Conclusions and Recommendations section of the project Geotechnical Report or in the final report of testing and observation services performed during grading.

8.5 We should observe the placement of subdrains, to check that the drainage devices have been placed and constructed in substantial conformance with project specifications.

8.6 Testing procedures shall conform to the following Standards as appropriate:

8.6.1 Soil and Soil-Rock Fills:

8.6.1.1 Field Density Test, ASTM D 1556, *Density of Soil In-Place By the Sand-Cone Method.*

8.6.1.2 Field Density Test, Nuclear Method, ASTM D 6938, *Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth).*

8.6.1.3 Laboratory Compaction Test, ASTM D 1557, *Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-Pound Hammer and 18-Inch Drop*.

8.6.1.4. Expansion Index Test, ASTM D 4829, *Expansion Index Test*.

9. PROTECTION OF WORK

9.1 During construction, the Contractor shall properly grade all excavated surfaces to provide positive drainage and prevent ponding of water. Drainage of surface water shall be controlled to avoid damage to adjoining properties or to finished work on the site. The Contractor shall take remedial measures to prevent erosion of freshly graded areas until such time as permanent drainage and erosion control features have been installed. Areas subjected to erosion or sedimentation shall be properly prepared in accordance with the Specifications prior to placing additional fill or structures.

9.2 After completion of grading as observed and tested by the Consultant, no further excavation or filling shall be conducted except in conjunction with the services of the Consultant.

10. CERTIFICATIONS AND FINAL REPORTS

10.1 Upon completion of the work, Contractor shall furnish Owner a certification by the Civil Engineer stating that the lots and/or building pads are graded to within 0.1 foot vertically of elevations shown on the grading plan and that all tops and toes of slopes are within 0.5 foot horizontally of the positions shown on the grading plans. After installation of a section of subdrain, the project Civil Engineer should survey its location and prepare an *as-built* plan of the subdrain location. The project Civil Engineer should verify the proper outlet for the subdrains and the Contractor should ensure that the drain system is free of obstructions.

10.2 The Owner is responsible for furnishing a final as-graded soil and geologic report satisfactory to the appropriate governing or accepting agencies. The as-graded report should be prepared and signed by a California licensed Civil Engineer experienced in geotechnical engineering and by a California Certified Engineering Geologist, indicating that the geotechnical aspects of the grading were performed in substantial conformance with the Specifications or approved changes to the Specifications.

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