Priority Development Project (PDP)
Storm Water Quality Management Plan (SWQMP)

Alvarado Creek Apartments

[Insert Permit Application Number]

[Insert Drawing Number (if applicable) and Internal Order Number (if applicable)]

☐ **Check if electing for offsite alternative compliance**

Engineer of Work:

Jayne Janda-Timba , RCE #70649, Exp. 06/23

Provide Wet Signature and Stamp Above Line

Prepared For:

Pacific West Communities, Inc.

430 E. State Street, Suite 100

Eagle, ID 83616

208-461-0022

Prepared By:

Rick Engineering Company
5620 Friars Road
San Diego, California 92110
(619) 291-0707

Date:

September 24, 2021

Approved by: City of San Diego Date

The City of SAN DIEGO

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Acronyms

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

ALVARADO CREEK APARTMENTS

5th Submittal Revision Page

September 24, 2021

No comments were received from the City on the 4th submittal review applicant to this document This document has been updated to incorporate a revised storm drain alignment to be consistent with project grading and utility plans.

ALVARADO CREEK APARTMENTS

4th Submittal Revision Page

July 23, 2021

Pursuant to the review comments completed on May 28, 2021, regarding the PDP SWQMP dated May 3, 2021, the following comments were addressed. Below is a list of the comments, followed by Rick Engineering Company's response:

REVIEW COMMENTS

Reviewing Discipline: LDR-Engineering Review

Stormwater Issues

77. Please revise the proposed storm drain system on the hydrology exhibit, grading plans, and DMA/HMP exhibits to show all the "multiple" BMPs that serve ONE DMA to be hydraulically connected before being connected to the rest of the system (each set of BMPs to have one connection to the SD system).

    Also, please identify what pipes are public and what are private, and whether the southerly pipe and riprap discharging to the Alvarado Creek is private or public. Additional comments may follow upon response.

    Response: The proposed storm drain system on the hydrology exhibit, grading plans, and DMA/HMP exhibits have been revised to show a single BMP for each DMA or to show that the "multiple" BMPs that serve a single DMA are hydraulically connected before being connected to the rest of the system.
    Pipes have been identified as public or private on the exhibits and plans.

Certification Page

Project Name:
Permit Application

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

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

Engineer of Work's Signature

70649

PE#

06/23

Expiration Date

Jayne Janda-Timba

Print Name

Rick Engineering Company

Company

09/24/2021

Date

Engineer's Stamp

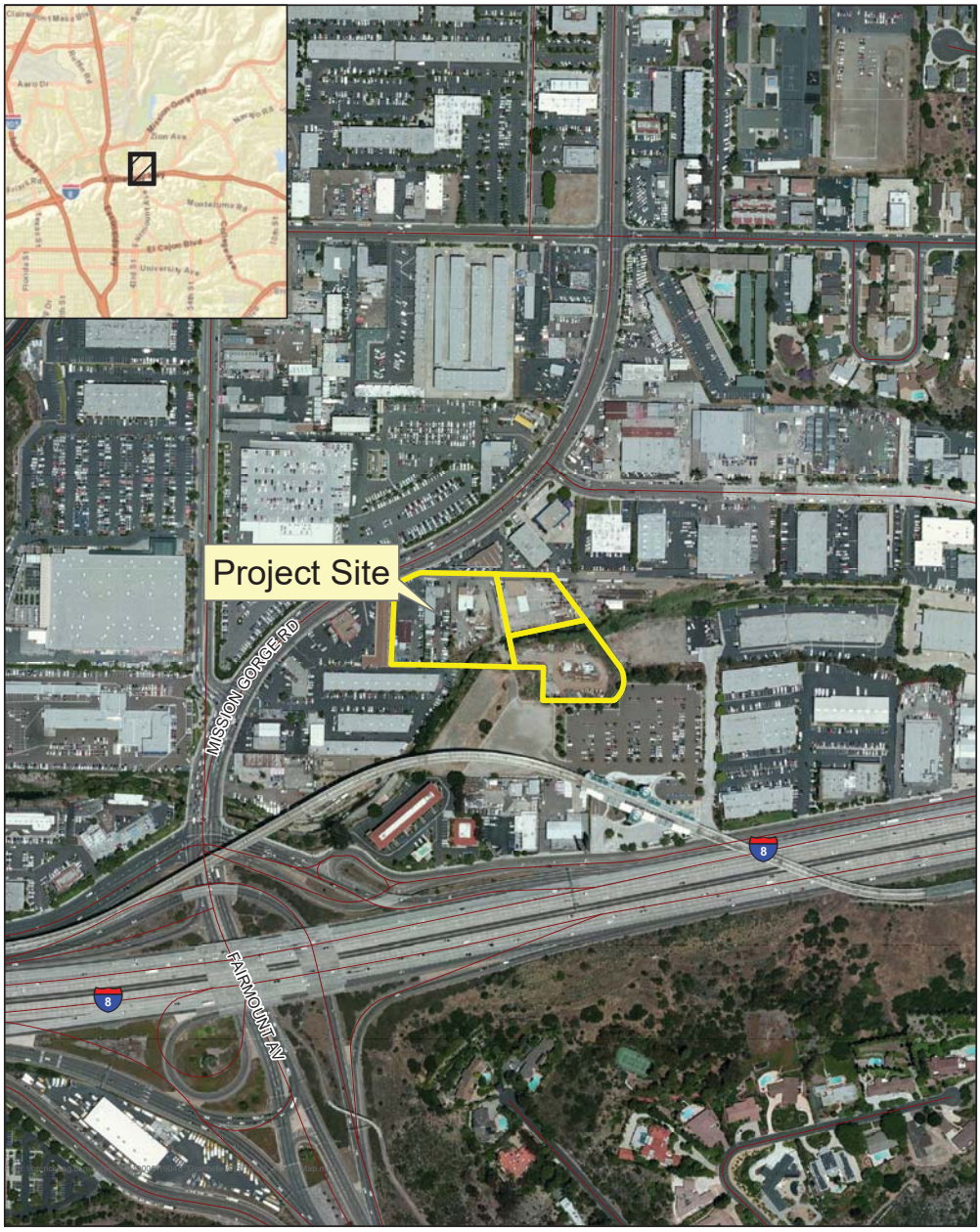
Submittal Record

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

Submittal Number	Date	Project Status	Changes
1	8/18/2020	☑ **Preliminary Design/Planning/CEQA** ☐ **Final Design**	**Initial Submittal**
2	2/2/2021	☑ **Preliminary Design/Planning/CEQA** ☐ **Final Design**	Second Submittal
3	5/3/21	☑ **Preliminary Design/Planning/CEQA** ☐ **Final Design**	Third Submittal
4	7/23/2021	☑ **Preliminary Design/Planning/CEQA** ☐ **Final Design**	Fourth Submittal

Project Vicinity Map

Project Name: Alvarado Creek Apartments
Permit Application



RICK ENGINEERING COMPANY

Feet
0 100 200 300 400 500

North

Date of Exhibit: 03.2020
DigitalGlobe Aerial Image: 05.2012

Vicinity Map

J-19048

City of San Diego Form DS-560 Storm Water Requirements Applicability Checklist

Attach DS-560 form.

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

Storm Water Requirements Applicability Checklist

FORM
DS-560
November 2018

Project Address: 5901 Mission Gorge Rd, San Diego, CA 92120

Project Number: 671912

SECTION 1. Construction Storm Water BMP Requirements:

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

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

PART A: Determine Construction Phase Storm Water Requirements.

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

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

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

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

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

   ☐ Yes; WPCP required, skip question 4 ☐ No; next question

4. Does the project only include the following Permit types listed below?

   - Electrical Permit, Fire Alarm Permit, Fire Sprinkler Permit, Plumbing Permit, Sign Permit, Mechanical Permit, Spa Permit.
   - Individual Right of Way Permits that exclusively include only ONE of the following activities: water service, sewer lateral, or utility service.
   - Right of Way Permits with a project footprint less than 150 linear feet that exclusively include only ONE of the following activities: curb ramp, sidewalk and driveway apron replacement, pot holing, curb and gutter replacement, and retaining wall encroachments.

   ☐ Yes; no document required

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

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

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

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

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

PART B: Determine Construction Site Priority

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

Complete PART B and continued to Section 2

Based on size of project and anticipated grading duration project is assumed to be a medium priority. The project priority will be reevaluated during final engineering.

1. ☐ **ASBS**
   a. Projects located in the ASBS watershed.

2. ☐ **High Priority**
   a. Projects that qualify as Risk Level 2 or Risk Level 3 per the Construction General Permit (CGP) and not located in the ASBS watershed.
   b. Projects that qualify as LUP Type 2 or LUP Type 3 per the CGP and not located in the ASBS watershed.

3. ☒ **Medium Priority**
   a. Projects that are not located in an ASBS watershed or designated as a High priority site.
   b. Projects that qualify as Risk Level 1 or LUP Type 1 per the CGP and not located in an ASBS watershed.
   c. WPCP projects (>5,000sf of ground disturbance) located within the Los Penasquitos watershed management area.

4. ☐ **Low Priority**
   a. Projects not subject to a Medium or High site priority designation and are not located in an ASBS watershed.

SECTION 2. Permanent Storm Water BMP Requirements.

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

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

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

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

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

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

PART D: PDP Exempt Requirements.

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

If "yes" was checked for any questions in Part D, continue to Part F and check the box labeled "PDP Exempt."

If "no" was checked for all questions in Part D, continue to Part E.

1. **Does the project ONLY include new or retrofit sidewalks, bicycle lanes, or trails that:**
   - **Are designed and constructed to direct storm water runoff to adjacent vegetated areas, or other non-erodible permeable areas? Or;**
   - **Are designed and constructed to be hydraulically disconnected from paved streets and roads? Or;**
   - **Are designed and constructed with permeable pavements or surfaces in accordance with the Green Streets guidance in the City's Storm Water Standards manual?**

   ☐ Yes; PDP exempt requirements apply ☒ No; next question

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

   ☐ Yes; PDP exempt requirements apply ☒ No; project not exempt.

PART E: Determine if Project is a Priority Development Project (PDP).

Projects that match one of the definitions below are subject to additional requirements including preparation of a Storm Water Quality Management Plan (SWQMP).

If "yes" is checked for any number in PART E, continue to PART F and check the box labeled "Priority Development Project".

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

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

7. **New development or redevelopment discharging directly to an Environmentally Sensitive Area.** The project creates and/or replaces 2,500 square feet of impervious surface (collectively over project site), and discharges directly to an Environmentally Sensitive Area (ESA). "Discharging directly to" includes flow that is conveyed overland a distance of 200 feet or less from the project to the ESA, or conveyed in a pipe or open channel any distance as an isolated flow from the project to the ESA (i.e. not commingled with flows from adjacent lands). ☐ Yes ☒ No

8. **New development or redevelopment projects of a retail gasoline outlet (RGO) that create and/or replaces 5,000 square feet of impervious surface.** The development project meets the following criteria: (a) 5,000 square feet or more or (b) has a projected Average Daily Traffic (ADT) of 100 or more vehicles per day. ☐ Yes ☒ No

9. **New development or redevelopment projects of an automotive repair shops that creates and/or replaces 5,000 square feet or more of impervious surfaces.** Development projects categorized in any one of Standard Industrial Classification (SIC) codes 5013, 5014, 5541, 7532-7534, or 7536-7539. ☐ Yes ☒ No

10. **Other Pollutant Generating Project.** The project is not covered in the categories above, results in the disturbance of one or more acres of land and is expected to generate pollutants post construction, such as fertilizers and pesticides. This does not include projects creating less than 5,000 sf of impervious surface and where added landscaping does not require regular use of pesticides and fertilizers, such as slope stabilization using native plants. Calculation of the square footage of impervious surface need not include linear pathways that are for infrequent vehicle use, such as emergency maintenance access or bicycle pedestrian use, if they are built with pervious surfaces of if they sheet flow to surrounding pervious surfaces. ☐ Yes ☒ No

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

1. The project is **NOT SUBJECT TO PERMANENT STORM WATER REQUIREMENTS**. ☐

2. The project is a **STANDARD DEVELOPMENT PROJECT**. Site design and source control BMP requirements apply. See the Storm Water Standards Manual for guidance. ☐

3. The project is **PDP EXEMPT**. Site design and source control BMP requirements apply. See the Storm Water Standards Manual for guidance. ☐

4. The project is a **PRIORITY DEVELOPMENT PROJECT**. Site design, source control, and structural pollutant control BMP requirements apply. See the Storm Water Standards Manual for guidance on determining if project requires a hydromodification plan management ☒

Name of Owner or Agent *(Please Print)* Title

Signature Date

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Project Name: Alvarado Creek Apartments

Applicability of Permanent, Post-Construction Storm Water BMP Requirements	Form I-1
Project Identification	
Project Name: Alvarado Creek Apartments	
Permit Application Number:	Date: 5/3/2021

Determination of Requirements

The purpose of this form is to identify permanent, post-construction requirements that apply to the project. This form serves as a short summary of applicable requirements, in some cases referencing separate forms that will serve as the backup for the determination of requirements.

Answer each step below, starting with **Step 1** and progressing through each step until reaching "Stop". Refer to the manual sections and/or separate forms referenced in each step below.

Step	Answer	Progression
Step 1: Is the project a "development project"? See Section 1.3 of the manual (Part 1 of Storm Water Standards) for guidance.	☑ Yes	Go to **Step 2**.
	☐ No	**Stop**. Permanent BMP requirements do not apply. No SWQMP will be required. Provide discussion below.
Discussion / justification if the project is not a "development project" (e.g., the project includes *only* interior remodels within an existing building):		
Step 2: Is the project a Standard Project, PDP, or PDP Exempt? To answer this item, see Section 1.4 of the manual in its entirety for guidance AND complete Form DS-560, Storm Water Requirements Applicability Checklist.	☐ Standard Project	**Stop.** Standard Project requirements apply
	☑ PDP	PDP requirements apply, including PDP SWQMP. Go to **Step 3**.
	☐ PDP Exempt	**Stop.** Standard Project requirements apply. Provide discussion and list any additional requirements below.
Discussion / justification, and additional requirements for exceptions to PDP definitions, if applicable:		

Project Name: Alvarado Creek Apartments

Form I-1 Page 2 of 2		
Step	**Answer**	**Progression**
Step 3. Is the project subject to earlier PDP requirements due to a prior lawful approval? See Section 1.10 of the manual (Part 1 of Storm Water Standards) for guidance.	☐ Yes	Consult the City Engineer to determine requirements. Provide discussion and identify requirements below. Go to **Step 4**.
	☑ No	BMP Design Manual PDP requirements apply. Go to **Step 4**.
Discussion / justification of prior lawful approval, and identify requirements (not required if prior lawful approval does not apply):		
Step 4. Do hydromodification control requirements apply? See Section 1.6 of the manual (Part 1 of Storm Water Standards) for guidance.	☑ Yes	PDP structural BMPs required for pollutant control (Chapter 5) and hydromodification control (Chapter 6). Go to **Step 5**.
	☐ No	**Stop**. PDP structural BMPs required for pollutant control (Chapter 5) only. Provide brief discussion of exemption to hydromodification control below.
Discussion / justification if hydromodification control requirements do not apply:		
Step 5. Does protection of critical coarse sediment yield areas apply? See Section 6.2 of the manual (Part 1 of Storm Water Standards) for guidance.	☐ Yes	Management measures required for protection of critical coarse sediment yield areas (Chapter 6.2). **Stop**.
	☑ No	Management measures not required for protection of critical coarse sediment yield areas. Provide brief discussion below. **Stop**.
Discussion / justification if protection of critical coarse sediment yield areas does not apply: There are no PCCSYAs within the project site.		

HMP Exemption Exhibit

Attach a HMP Exemption Exhibit that shows direct storm water runoff discharge from the project site to HMP exempt area. Include project area, applicable underground storm drain line and/or concrete lined channels, outfall information and exempt waterbody. Reference applicable drawing number(s).

Exhibit must be provided on 11"x17" or larger paper.

Exemption is N/A for this project.
See Attachment 2 for HMP analysis.

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Project Name: Alvarado Creek Apartments

Site Information Checklist For PDPs	Form I-3B
Project Summary Information	
Project Name	Alvarado Creek Apartments
Project Address	5901 Mission Gorge Rd San Diego, CA 92120
Assessor's Parcel Number(s) (APN(s))	461-320-06, 461-320-08, 461-320-09
Permit Application Number	
Project Watershed	Select One: ☐ San Dieguito River ☐ Penasquitos ☐ Mission Bay ☑ San Diego River ☐ San Diego Bay ☐ Tijuana River
Hydrologic subarea name with Numeric Identifier up to two decimal places (9XX.XX)	HSA Mission San Diego 907.11, HU-San Diego, HA Lower San Diego
Project Area (total area of Assessor's Parcel(s) associated with the project or total area of the right-of-way)	3.92 Acres (170,607 Square Feet)
Area to be disturbed by the project (Project Footprint)	2.96 Acres (128,888 Square Feet)
Project Proposed Impervious Area (subset of Project Footprint)	1.58 Acres (68,869 Square Feet)
Project Proposed Pervious Area (subset of Project Footprint)	1.38 Acres (60,019 Square Feet)
Note: Proposed Impervious Area + Proposed Pervious Area = Area to be Disturbed by the Project. This may be less than the Project Area.	
The proposed increase or decrease in impervious area in the proposed condition as compared to the pre-project condition	-30 %

Project Name: Alvarado Creek Apartments

Form I-3B Page 2 of 11
Description of Existing Site Condition and Drainage Patterns
Current Status of the Site (select all that apply): ☑ Existing development ☐ Previously graded but not built out ☐ Agricultural or other non-impervious use ☑ Vacant, undeveloped/natural Description / Additional Information: The majority of the site is developed including buildings, roadways and parking lots.
Existing Land Cover Includes (select all that apply): ☑ Vegetative Cover ☑ Non-Vegetated Pervious Areas ☑ Impervious Areas Description / Additional Information: Impervious Area - Buildings, roadways, parking lots Pervious area - Vacant lot, DG Pathway and Alvarado Creek
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: ☐ Groundwater Depth < 5 feet ☑ 5 feet < Groundwater Depth < 10 feet ☐ 10 feet < Groundwater Depth < 20 feet ☐ Groundwater Depth > 20 feet
Existing Natural Hydrologic Features (select all that apply): ☑ Watercourses ☐ Seeps ☐ Springs ☐ Wetlands ☐ None Description / Additional Information: Alvarado Creek

Form I-3B Page 3 of 11
Description of Existing Site Topography and Drainage
How is storm water runoff conveyed from the site? At a minimum, this description should answer: 1. Whether existing drainage conveyance is natural or urban; 2. If runoff from offsite is conveyed through the site? If yes, quantification of all offsite drainage areas, design flows, and locations where offsite flows enter the project site and summarize how such flows are conveyed through the site; 3. Provide details regarding existing project site drainage conveyance network, including storm drains, concrete channels, swales, detention facilities, storm water treatment facilities, and natural and constructed channels; 4. Identify all discharge locations from the existing project along with a summary of the conveyance system size and capacity for each of the discharge locations. Provide summary of the pre-project drainage areas and design flows to each of the existing runoff discharge locations.
Descriptions/Additional Information
The site includes three parcels (APN: 461-320-06, -08 and -09), each currently occupied by small structures, asphalt cover, and pervious/landscaped areas.

Form I-3B Page 4 of 11
Description of Proposed Site Development and Drainage Patterns
Project Description / Proposed Land Use and/or Activities: The proposed site improvements for the Alvarado Creek Apartments Project include a podium-type structure to accommodate affordable housing units and the associated hardscape and landscape improvements.
List/describe proposed impervious features of the project (e.g., buildings, roadways, parking lots, courtyards, athletic courts, other impervious features): Impervious features include buildings, sidewalks, ADA ramps, bike parking areas and hardscape.
List/describe proposed pervious features of the project (e.g., landscape areas): Pervious areas include landscaped areas, tree and sidewalk planters, natural hillside, DG pathways and biofiltration planters.
Does the project include grading and changes to site topography? ☑ Yes ☐ No Description / Additional Information: The project proposes to place fill along the north side of Alvarado Creek to facilitate the design of the first finished floor being a minimum of two (2) feet above the Alvarado Creek base flood elevation (BFE) associated with the proposed structure and lowest adjacent grade for each structure being above the BFE. The project proposes excavation and export along the south side of the creek within the property limits, to improve the hydraulic conveyance of Alvarado Creek.

Form I-3B Page 5 of 11

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

☑ Yes

☐ No

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

Description / Additional Information:

Please see the Drainage Study for details regarding site drainage.

Form I-3B Page 6 of 11

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

- ☑ Onsite 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

Description/Additional Information:

1. All proposed storm drain inlets shall be marked with the words “No Dumping! Flows to Bay” or similar (i.e. Lagoon/Ocean) and maintained periodically to replace inlet markings. The proposed on-site storm drain network complies with the latest stormwater regulations for pollutant control and hydromodification management.

2. Landscaping areas shall be maintained using minimum or no pesticides. Pesticides shall be used only after monitoring indicates they are needed according to established guidelines.

3. The proposed parking lots/garages will drain to structural BMPs before entering the storm drain system.

Form I-3B Page 7 of 11
Identification and Narrative of Receiving Water
Narrative describing flow path from discharge location(s), through urban storm conveyance system, to receiving creeks, rivers, and lagoons and ultimate discharge location to Pacific Ocean (or bay, lagoon, lake or reservoir, as applicable) Alvarado Creek flows generally east to west through where the project site. The Alvarado Creek confluence with the San Diego River is approximately 2,000 feet downstream (west) of the project. The San Diego River flows west towards the Pacific Ocean and outfalls at Ocean Beach Dog Park.
Provide a summary of all beneficial uses of receiving waters downstream of the project discharge locations Agricultural Supply (AGR), Industrial Service Supply (IND), Water Contact Recreation (REC1), Noncontact water recreation (REC2), Preservation of Biological Habitats of Special Significance (BIOL), Warm Freshwater Habitat (WARM), Wildlife Habitat (WILD), Rare, Threatened, or Endangered (RARE)
Identify all ASBS (areas of special biological significance) receiving waters downstream of the project discharge locations There are no ASBS receiving waters downstream of the project discharge location.
Provide distance from project outfall location to impaired or sensitive receiving waters Alvarado Creek is located adjacent to the project development area. The San Diego River is next the closest impaired receiving water and is located approximately 2,000 feet downstream of the project site.
Summarize information regarding the proximity of the permanent, post-construction storm water BMPs to the City's Multi-Habitat Planning Area and environmentally sensitive lands A MHPA is located approximately 1,300-feet to the west of the project site in the San Diego River.

Form I-3B Page 8 of 11

Identification of Receiving Water Pollutants of Concern

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

303(d) Impaired Water Body (Refer to Appendix K)	Pollutant(s)/Stressor(s) (Refer to Appendix K)	TMDLs/WQIP Highest Priority Pollutant (Refer to Table 1-4 in Chapter 1)
Lower San Diego River	Indicator Bacteria	Bacteria
	Dissolved Oxygen	
	Cadmium, Nitrogen, Phosphorus	
	Total Dissolved Solids, Toxicity	
	Benthic Community Effects	
Alvarado Creek	Nitrogen, Selenium	Bacteria
Pacific Ocean at Dog Beach	Indicator Bacteria	Bacteria

Identification of Project Site Pollutants*

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

Identify pollutants anticipated from the project site based on all proposed use(s) of the site (see 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	☐	☐	☐
Oil & Grease	☐	☐	☐
Bacteria & Viruses	☐	☐	☐
Pesticides	☐	☐	☐

Form I-3B Page 9 of 11

Hydromodification Management Requirements

Do hydromodification management requirements apply (see Section 1.6)?

☑ Yes, hydromodification management flow control structural BMPs required.

☐ No, the project will discharge runoff directly to existing underground storm drains discharging directly to water storage reservoirs, lakes, enclosed embayments, or the Pacific Ocean.

☐ No, the project will discharge runoff directly to conveyance channels whose bed and bank are concrete-lined all the way from the point of discharge to water storage reservoirs, lakes, enclosed embayments, or the Pacific Ocean.

☐ No, the project will discharge runoff directly to an area identified as appropriate for an exemption by the WMAA for the watershed in which the project resides.

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

Note: If "No" answer has been selected the SWQMP must include an exhibit that shows the storm water conveyance system from the project site to an exempt water body. The exhibit should include details about the conveyance system and the outfall to the exempt water body.

Critical Coarse Sediment Yield Areas*

*This Section only required if hydromodification management requirements apply

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

☐ Yes

☑ No

Discussion / Additional Information:

There are no potential critical course sediment yield (PCCSYAs) within the project area. PCCSYAs exist upstream of Alvarado Creek.

Form I-3B Page 10 of 11
Flow Control for Post-Project Runoff*   ***This Section only required if hydromodification management requirements apply**
List and describe point(s) of compliance (POCs) for flow control for hydromodification management (see Section 6.3.1). For each POC, provide a POC identification name or number correlating to the project's HMP Exhibit and a receiving channel identification name or number correlating to the project's HMP Exhibit.   The point of compliance (POC-1) for flow control and hydromodification management is located in the southeastern corner of the site adjacent to Alvarado Creek.   The project has a second POC (POC-2) that receives runoff from the ADA/ Green Street areas of the site.
Has a geomorphic assessment been performed for the receiving channel(s)?   ☑ No, the low flow threshold is $0.1Q_2$ (default low flow threshold)   ☐ Yes, the result is the low flow threshold is $0.1Q_2$ ☐ Yes, the result is the low flow threshold is $0.3Q_2$ ☐ Yes, the result is the low flow threshold is $0.5Q_2$ If a geomorphic assessment has been performed, provide title, date, and preparer:
Discussion / Additional Information: (optional)

Form I-3B Page 11 of 11
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.

Project Name: Alvarado Creek Apartments

Source Control BMP Checklist for PDPs	Form I-4B

Source Control BMPs

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

Answer each category below pursuant to the following.

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

Source Control Requirement	Applied?		
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 material storage areas are anticipated on the project site at this time.			
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 are anticipated on the project site at this time.			
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:			

Project Name: Alvarado Creek Apartments

Form I-4B Page 2 of 2			
Source Control Requirement	Applied?		
4.2.6 Additional BMPs Based on Potential Sources of Runoff Pollutants (must answer for each source listed below)			
On-site storm drain inlets	☑ Yes	☐ No	☐ N/A
Interior floor drains and elevator shaft sump pumps	☑ Yes	☐ No	☐ N/A
Interior parking garages	☑ Yes	☐ No	☐ N/A
Need for future indoor & structural pest control	☐ Yes	☐ No	☑ N/A
Landscape/Outdoor Pesticide Use	☑ Yes	☐ No	☐ N/A
Pools, spas, ponds, decorative fountains, and other water features	☑ Yes	☐ No	☐ N/A
Food service	☐ Yes	☐ No	☑ N/A
Refuse areas	☑ Yes	☐ No	☐ N/A
Industrial processes	☐ Yes	☐ No	☑ N/A
Outdoor storage of equipment or materials	☐ Yes	☐ No	☑ N/A
Vehicle/Equipment Repair and Maintenance	☐ Yes	☐ No	☑ N/A
Fuel Dispensing Areas	☐ Yes	☐ No	☑ N/A
Loading Docks	☐ Yes	☐ No	☑ N/A
Fire Sprinkler Test Water	☑ Yes	☐ No	☐ N/A
Miscellaneous Drain or Wash Water	☐ Yes	☐ No	☑ N/A
Plazas, sidewalks, and parking lots	☑ Yes	☐ No	☐ N/A
SC-6A: Large Trash Generating Facilities	☐ Yes	☐ No	☑ N/A
SC-6B: Animal Facilities	☐ Yes	☐ No	☑ N/A
SC-6C: Plant Nurseries and Garden Centers	☐ Yes	☐ No	☑ N/A
SC-6D: Automotive Facilities	☐ 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 all "No" answers shown above.

Interior floor drains, interior parking garages, refuse areas and sidewalks are anticipated on the project site at this time.

Project Name: Alvarado Creek Apartments

Site Design BMP Checklist for PDPs	Form I-5B

Site Design BMPs

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

Answer each category below pursuant to the following.

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

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

Site Design Requirement	Applied?		
4.3.1 Maintain Natural Drainage Pathways and Hydrologic Features	☑ Yes	☐ No	☐ N/A
Discussion / justification if 4.3.1 not implemented: Grading is above Alvarado Creek only to widen conveyance. However natural drainage pathways and hydrologic features will be maintained.			
1-1 Are existing natural drainage pathways and hydrologic features mapped on the site map?	☑ Yes	☐ No	☐ N/A
1-2 Are trees implemented? If yes, are they shown on the site map?	☐ Yes	☐ No	☑ N/A
1-3 Implemented trees meet the design criteria in 4.3.1 Fact Sheet (e.g. soil volume, maximum credit, etc.)?	☐ Yes	☐ No	☑ N/A
1-4 Is tree credit volume calculated using Appendix B.2.2.1 and SD-1 Fact Sheet in Appendix E?	☐ Yes	☐ No	☑ N/A
4.3.2 Have natural areas, soils and vegetation been conserved?	☑ Yes	☐ No	☐ N/A
Discussion / justification if 4.3.2 not implemented: The sidewalk and ADA ramps adjacent to the alley are ADA accessible route (ingress/egress to buildings). Project ADA features do not require post construction BMPs, however, the redevelopment of the alley utilizes BMP options listed in the Green Streets Municipal Handbook 4 according to the applicability guidelines by incorporating planter area adjacent to and down gradient from sidewalk where feasible.			

Project Name: Alvarado Creek Apartments

Form I-5B Page 2 of 4			
Site Design Requirement	Applied?		
4.3.3 Minimize Impervious Area	☑ Yes	☐ No	☐ N/A
Discussion / justification if 4.3.3 not implemented: Where possible, pervious area is created/maintained. The majority of the impervious area is from the building roof, sidewalk, ADA ramps and outdoor hardscape. DMA 4 and 17 will be self mitigating (SD-D) and are 100% pervious. The areas are sloped and have native soils and landscaping with a DG trail to mimic the natural pervious condition. DMA 4 has articulated block across the creek.			
4.3.4 Minimize Soil Compaction	☑ Yes	☐ No	☐ N/A
Discussion / justification if 4.3.4 not implemented: The site in the existing condition has already been developed and compacted. Grading and compaction is limited to developed area north of Alvarado Creek. Other areas of the site will not be compacted.			
4.3.5 Impervious Area Dispersion	☑ Yes	☐ No	☐ N/A
Discussion / justification if 4.3.5 not implemented: Sidewalks that will be non-contiguous and runoff will sheet flow from impervious area onto pervious area. The planter areas, south and west of the project site will be designed as self-retaining by impervious area dispersion (SD-B). The sidewalk will drain onto amended soils (SD-F).The ratio of impervious to pervious ratio is 2:1 or less. DMA 14 will be self-retaining by impervious area dispersion (SD-B). The HSG is type 'A' and the ratio of impervious area to pervious area is 0.5:1. DMA 16 will be self-retaining by impervious area dispersion (SD-B). The HSG is type 'A' and the ratio of impervious area to pervious area is 0.8:1.			
5-1 Is the pervious area receiving runon from impervious area identified on the site map?	☑ Yes	☐ No	☐ N/A
5-2 Does the pervious area satisfy the design criteria in 4.3.5 Fact Sheet in Appendix E (e.g. maximum slope, minimum length, etc.)	☑ Yes	☐ No	☐ N/A
5-3 Is impervious area dispersion credit volume calculated using Appendix B.2.1.1 and 4.3.5 Fact Sheet in Appendix E?	☑ Yes	☐ No	☐ N/A

Project Name: Alvarado Creek Apartments

Form I-5B Page 3 of 4			
Site Design Requirement	Applied?		
4.3.6 Runoff Collection	☑ Yes	☐ No	☐ N/A
Discussion / justification if 4.3.6 not implemented: The access road at the east side of the project will be pervious pavement or articulated block.			
6a-1 Are green roofs implemented in accordance with design criteria in 4.3.6A Fact Sheet? If yes, are they shown on the site map?	☐ Yes	☐ No	☑ N/A
6a-2 Is the green roof credit volume calculated using Appendix B.2.1.2 and 4.3.6A Fact Sheet in Appendix E?	☐ Yes	☐ No	☑ N/A
6b-1 Are permeable pavements implemented in accordance with design criteria in 4.3.6B Fact Sheet? If yes, are they shown on the site map?	☐ Yes	☐ No	☑ N/A
6b-2 Is the permeable pavement credit volume calculated using Appendix B.2.1.3 and 4.3.6B Fact Sheet in Appendix E?	☐ Yes	☐ No	☑ N/A
4.3.7 Landscaping with Native or Drought Tolerant Species	☑ Yes	☐ No	☐ N/A
Discussion / justification if 4.3.7 not implemented: Landscaping will consist of native or drought tolerant species.			
4.3.8 Harvest and Use Precipitation	☐ Yes	☑ No	☐ N/A
Discussion / justification if 4.3.8 not implemented: The site is being developed into affordable housing, as such access to rain barrels cannot be controlled in the future and results in a health threat to the residences.			
8-1 Are rain barrels implemented in accordance with design criteria in 4.3.8 Fact Sheet? If yes, are they shown on the site map?	☐ Yes	☐ No	☑ N/A
8-2 Is the rain barrel credit volume calculated using Appendix B.2.2.2 and 4.3.8 Fact Sheet in Appendix E?	☐ Yes	☐ No	☑ N/A

Project Name: Alvarado Creek Apartments

Form I-5B Page 4 of 4
Insert Site Map with all site design BMPs identified:
See Drainage Management Area Exhibit in Attachment 1A

Summary of PDP Structural BMPs	Form I-6

PDP Structural BMPs

All PDPs must implement structural BMPs for storm water pollutant control (see Chapter 5 of the BMP Design Manual, Part 1 of Storm Water Standards). Selection of PDP structural BMPs for storm water pollutant control must be based on the selection process described in Chapter 5. PDPs subject to hydromodification management requirements must also implement structural BMPs for flow control for hydromodification management (see Chapter 6 of the BMP Design Manual). Both storm water pollutant control and flow control for hydromodification management can be achieved within the same structural BMP(s).

PDP structural BMPs must be verified by the City at the completion of construction. This includes requiring the project owner or project owner's representative to certify construction of the structural BMPs (complete Form DS-563). PDP structural BMPs must be maintained into perpetuity (see Chapter 7 of the BMP Design Manual).

Use this form to provide narrative description of the general strategy for structural BMP implementation at the project site in the box below. Then complete the PDP structural BMP summary information sheet (page 3 of this form) for each structural BMP within the project (copy the BMP summary information page as many times as needed to provide summary information for each individual structural BMP).

Describe the general strategy for structural BMP implementation at the site. This information must describe how the steps for selecting and designing storm water pollutant control BMPs presented in Section 5.1 of the BMP Design Manual were followed, and the results (type of BMPs selected). For projects requiring hydromodification flow control BMPs, indicate whether pollutant control and flow control BMPs are integrated or separate.

DMA 1: The driveway ramp along Mission Gorge Road will drain to a modular wetland (BF-1) adjacent to the alley and be connected to the underground retention system in the garage. The BMP is less than the minimum BMP sizing footprint of 3%. Worksheets have been provided to demonstrate volume retention has been satisfied. Please note that many other DMAs have impervious area flowing on pervious area; however we have demonstrated compliance at the DMA level for DMA 1 only.
DMA 2 and 11: Sidewalk and ADA ramps along the alley north of the project site and is an ADA accessible route (ingress/egress to buildings). Project ADA features do not require post construction BMPs, however, the redevelopment of the alley utilizes BMP options listed in the Green Streets Municipal Handbook 4 according to the applicability guidelines by incorporating planter area adjacent to and down gradient from sidewalk where feasible.
DMA 3: The loading area the east side of the project area will drain to a biofiltration (BF-1) planter box.

DMA 5, 6, 9, 10: On-site rooftops will drain to biofiltration (BF-1) planter boxes adjacent to buildings. Please note that roof top and podium level areas several smaller BMP planter boxes will treat the runoff.

DMA 7 (7A&7B): The podium area at the center of the building will drain southeast to a biofiltration (BF-1) box adjacent to the building.

(Continue on page 2 as necessary.)

(Continued from page 1)

DMA 8: The center of the roof area will drain to raised biofiltration (BF-1) planter boxes at the podium level within the podium area at the center of the building.

DMA 12 & 13:The biofiltration (BF-1)planter boxes around the pool area will be at the pool deck level. They will be designed to provide pollutant control.

DMA 15: The rooftop will drain to a biofiltration (BF-1) planter box adjacent to the building.

DMA 18: De minimus DMA. A portion of the driveway apron and sidewalk will drain to Mission Gorge Road and is less than 250 sq-ft and is considered de minimus.

General Note: All the biofiltration planter boxes will be connected to the underground HMP vault system in the garage. The planter areas will contain area drains that will also be connected to the underground retention system.

See Form I-5B for DMA 14 & 16 (Self-Retaining by impervious area dispersion) and DMAs 4 & 17 (Self-Mitigating). DMAs 4 & 17 are at exterior of project and meet the criteria to be considered self-mitigating DMAs.

Project Name: Alvarado Creek Apartments

Form I-6 Page 3 of 26 (Copy as many as needed)	
Structural BMP Summary Information	
Structural BMP ID No. BMP-1	
Construction Plan Sheet No. 2	
Type of Structural BMP: ☐ Retention by harvest and use (e.g. HU-1, cistern) ☐ 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) ☐ 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 form DS-563	Project Engineer Rick Engineering Company Jayne Janda-Timba: (619) 291-0707
Who will be the final owner of this BMP?	Pacific West Communities
Who will maintain this BMP into perpetuity?	Pacific West Communities
What is the funding mechanism for maintenance?	Pacific West Communities

Form I-6 Page 4 of 26 (Copy as many as needed)
Structural BMP ID No. BMP-1
Construction Plan Sheet No. 2
Discussion (as needed; must include worksheets showing BMP sizing calculations in the SWQMPs): BMP Proposed: BioClean Modular Wetland ® MWS-L 4-4, Unit Size 4 ft X 4 ft Treatment Capacity 0.051 cfs See worksheets in Attachment 1e.

Project Name: Alvarado Creek Apartments

Form I-6 Page 5 of 26 (Copy as many as needed)	
Structural BMP Summary Information	
Structural BMP ID No. BMP-3	
Construction Plan Sheet No. 2, 5	
Type of Structural BMP: ☐ Retention by harvest and use (e.g. HU-1, cistern) ☐ 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) ☐ 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 form DS-563	Project Engineer Rick Engineering Company Jayne Janda-Timba: (619) 291-0707
Who will be the final owner of this BMP?	Pacific West Communities
Who will maintain this BMP into perpetuity?	Pacific West Communities
What is the funding mechanism for maintenance?	Pacific West Communities

Project Name: Alvarado Creek Apartments

Form I-6 Page 6 of 26 (Copy as many as needed)
Structural BMP ID No. BMP-3
Construction Plan Sheet No. 2, 5
Discussion (as needed; must include worksheets showing BMP sizing calculations in the SWQMPs): See worksheets in Attachment 1e.

Note: If additional copies of Form I-6 are needed to list all BMPs, insert extra sheets in Attachment 1

Project Name: Alvarado Creek Apartments

Form I-6 Page 7 of 26 (Copy as many as needed)	
Structural BMP Summary Information	
Structural BMP ID No. BMP-5A Through BMP-5E	
Construction Plan Sheet No. 2, 5	
Type of Structural BMP: ☐ Retention by harvest and use (e.g. HU-1, cistern) ☐ 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) ☐ 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 form DS-563	Project Engineer Rick Engineering Company Jayne Janda-Timba: (619) 291-0707
Who will be the final owner of this BMP?	Pacific West Communities
Who will maintain this BMP into perpetuity?	Pacific West Communities
What is the funding mechanism for maintenance?	Pacific West Communities

Project Name: Alvarado Creek Apartments

Form I-6 Page 8 of 26 (Copy as many as needed)
Structural BMP ID No. BMP-5A Through BMP-5E
Construction Plan Sheet No. 2, 5
Discussion (as needed; must include worksheets showing BMP sizing calculations in the SWQMPs): See worksheets in Attachment 1e.

Note: If additional copies of Form I-6 are needed to list all BMPs, insert extra sheets in Attachment 1

Project Name: Alvarado Creek Apartments

Form I-6 Page 9 of 26 (Copy as many as needed)	
Structural BMP Summary Information	
Structural BMP ID No. BMP-6A Through BMP-6C	
Construction Plan Sheet No. 2, 5	
Type of Structural BMP: ☐ Retention by harvest and use (e.g. HU-1, cistern) ☐ 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) ☐ 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 form DS-563	Project Engineer Rick Engineering Company Jayne Janda-Timba: (619) 291-0707
Who will be the final owner of this BMP?	Pacific West Communities
Who will maintain this BMP into perpetuity?	Pacific West Communities
What is the funding mechanism for maintenance?	Pacific West Communities

Project Name: Alvarado Creek Apartments

Form I-6 Page 10 of 26 (Copy as many as needed)
Structural BMP ID No. BMP-6A Through BMP-6C
Construction Plan Sheet No. 2, 5
Discussion (as needed; must include worksheets showing BMP sizing calculations in the SWQMPs): See worksheets in Attachment 1e.

Note: If additional copies of Form I-6 are needed to list all BMPs, insert extra sheets in Attachment 1

Project Name: Alvarado Creek Apartments

Form I-6 Page 11 of 26 (Copy as many as needed)	
Structural BMP Summary Information	
Structural BMP ID No. BMP-7	
Construction Plan Sheet No. 2, 5	
Type of Structural BMP: ☐ Retention by harvest and use (e.g. HU-1, cistern) ☐ 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) ☐ 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 form DS-563	Project Engineer Rick Engineering Company Jayne Janda-Timba: (619) 291-0707
Who will be the final owner of this BMP?	Pacific West Communities
Who will maintain this BMP into perpetuity?	Pacific West Communities
What is the funding mechanism for maintenance?	Pacific West Communities

Project Name: Alvarado Creek Apartments

Form I-6 Page 12 of 26 (Copy as many as needed)
Structural BMP ID No. BMP-7
Construction Plan Sheet No. 2, 5
Discussion (as needed; must include worksheets showing BMP sizing calculations in the SWQMPs): See worksheets in Attachment 1e.

Note: If additional copies of Form I-6 are needed to list all BMPs, insert extra sheets in Attachment 1

Project Name: Alvarado Creek Apartments

Form I-6 Page 13 of 26 (Copy as many as needed)	
Structural BMP Summary Information	
Structural BMP ID No. BMP-8A Through BMP-8E	
Construction Plan Sheet No. 2, 5	
Type of Structural BMP: ☐ Retention by harvest and use (e.g. HU-1, cistern) ☐ 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) ☐ 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 form DS-563	Project Engineer Rick Engineering Company Jayne Janda-Timba: (619) 291-0707
Who will be the final owner of this BMP?	Pacific West Communities
Who will maintain this BMP into perpetuity?	Pacific West Communities
What is the funding mechanism for maintenance?	Pacific West Communities

Form I-6 Page 14 of 26 (Copy as many as needed)
Structural BMP ID No. BMP-8A Through BMP-8E
Construction Plan Sheet No. 2, 5
Discussion (as needed; must include worksheets showing BMP sizing calculations in the SWQMPs): See worksheets in Attachment 1e.

Note: If additional copies of Form I-6 are needed to list all BMPs, insert extra sheets in Attachment 1

Project Name: Alvarado Creek Apartments

Form I-6 Page 15 of 26 (Copy as many as needed)	
Structural BMP Summary Information	
Structural BMP ID No. BMP-9A Through BMP-9C	
Construction Plan Sheet No. 2, 5	
Type of Structural BMP: ☐ Retention by harvest and use (e.g. HU-1, cistern) ☐ 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) ☐ 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 form DS-563	Project Engineer Rick Engineering Company Jayne Janda-Timba: (619) 291-0707
Who will be the final owner of this BMP?	Pacific West Communities
Who will maintain this BMP into perpetuity?	Pacific West Communities
What is the funding mechanism for maintenance?	Pacific West Communities

Project Name: Alvarado Creek Apartments

Form I-6 Page 16 of 26 (Copy as many as needed)
Structural BMP ID No. BMP-9A Through BMP-9C
Construction Plan Sheet No. 2, 5
Discussion (as needed; must include worksheets showing BMP sizing calculations in the SWQMPs): See worksheets in Attachment 1e.

Note: If additional copies of Form I-6 are needed to list all BMPs, insert extra sheets in Attachment 1

Project Name: Alvarado Creek Apartments

Form I-6 Page 17 of 26 (Copy as many as needed)	
Structural BMP Summary Information	
Structural BMP ID No. BMP-10A Through BMP-10C	
Construction Plan Sheet No. 2, 5	
Type of Structural BMP: ☐ Retention by harvest and use (e.g. HU-1, cistern) ☐ 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) ☐ 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 form DS-563	Project Engineer Rick Engineering Company Jayne Janda-Timba: (619) 291-0707
Who will be the final owner of this BMP?	Pacific West Communities
Who will maintain this BMP into perpetuity?	Pacific West Communities
What is the funding mechanism for maintenance?	Pacific West Communities

Project Name: Alvarado Creek Apartments

Form I-6 Page 18 of 26 (Copy as many as needed)
Structural BMP ID No. BMP-10A Through BMP-10C
Construction Plan Sheet No. 2, 5
Discussion (as needed; must include worksheets showing BMP sizing calculations in the SWQMPs): See worksheets in Attachment 1e.

Note: If additional copies of Form I-6 are needed to list all BMPs, insert extra sheets in Attachment 1

Project Name: Alvarado Creek Apartments

Form I-6 Page 19 of 26 (Copy as many as needed)	
Structural BMP Summary Information	
Structural BMP ID No. BMP-12A Through BMP-12B	
Construction Plan Sheet No. 2, 5	
Type of Structural BMP: ☐ Retention by harvest and use (e.g. HU-1, cistern) ☐ 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) ☐ 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 form DS-563	Project Engineer Rick Engineering Company Jayne Janda-Timba: (619) 291-0707
Who will be the final owner of this BMP?	Pacific West Communities
Who will maintain this BMP into perpetuity?	Pacific West Communities
What is the funding mechanism for maintenance?	Pacific West Communities

Project Name: Alvarado Creek Apartments

Form I-6 Page 20 of 26 (Copy as many as needed)
Structural BMP ID No. BMP-12A Through BMP-12B
Construction Plan Sheet No. 2, 5
Discussion (as needed; must include worksheets showing BMP sizing calculations in the SWQMPs): See worksheets in Attachment 1e.

Note: If additional copies of Form I-6 are needed to list all BMPs, insert extra sheets in Attachment 1

Project Name: Alvarado Creek Apartments

Form I-6 Page 21 of 26 (Copy as many as needed)	
Structural BMP Summary Information	
Structural BMP ID No. BMP-13	
Construction Plan Sheet No. 2, 5	
Type of Structural BMP: ☐ Retention by harvest and use (e.g. HU-1, cistern) ☐ 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) ☐ 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 form DS-563	Project Engineer Rick Engineering Company Jayne Janda-Timba: (619) 291-0707
Who will be the final owner of this BMP?	Pacific West Communities
Who will maintain this BMP into perpetuity?	Pacific West Communities
What is the funding mechanism for maintenance?	Pacific West Communities

Project Name: Alvarado Creek Apartments

Form I-6 Page 22 of 26 (Copy as many as needed)
Structural BMP ID No. BMP-13
Construction Plan Sheet No. 2, 5
Discussion (as needed; must include worksheets showing BMP sizing calculations in the SWQMPs): See worksheets in Attachment 1e.

Note: If additional copies of Form I-6 are needed to list all BMPs, insert extra sheets in Attachment 1

Project Name: Alvarado Creek Apartments

Form I-6 Page 23 of 26 (Copy as many as needed)	
Structural BMP Summary Information	
Structural BMP ID No. BMP-15	
Construction Plan Sheet No. 2, 5	
Type of Structural BMP: ☐ Retention by harvest and use (e.g. HU-1, cistern) ☐ 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) ☐ 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 form DS-563	Project Engineer Rick Engineering Company Jayne Janda-Timba: (619) 291-0707
Who will be the final owner of this BMP?	Pacific West Communities
Who will maintain this BMP into perpetuity?	Pacific West Communities
What is the funding mechanism for maintenance?	Pacific West Communities

Project Name: Alvarado Creek Apartments

Form I-6 Page 24 of 26 (Copy as many as needed)
Structural BMP ID No. BMP-15
Construction Plan Sheet No. 2, 5
Discussion (as needed; must include worksheets showing BMP sizing calculations in the SWQMPs): See worksheets in Attachment 1e.

Note: If additional copies of Form I-6 are needed to list all BMPs, insert extra sheets in Attachment 1

Project Name: Alvarado Creek Apartments

Form I-6 Page 25 of 26 (Copy as many as needed)	
Structural BMP Summary Information	
Structural BMP ID No. Underground HMP vault system in the garage	
Construction Plan Sheet No. 5, 6, & 11	
Type of Structural BMP: ☐ Retention by harvest and use (e.g. HU-1, cistern) ☐ 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) ☐ 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 form DS-563	Project Engineer Rick Engineering Company Jayne Janda-Timba: (619) 291-0707
Who will be the final owner of this BMP?	Pacific West Communities
Who will maintain this BMP into perpetuity?	Pacific West Communities
What is the funding mechanism for maintenance?	Pacific West Communities

Project Name: Alvarado Creek Apartments

Form I-6 Page 26 of 26 (Copy as many as needed)
Structural BMP ID No. Underground HMP vault system in the garage
Construction Plan Sheet No. 5, 6, & 11
Discussion (as needed; must include worksheets showing BMP sizing calculations in the SWQMPs): See worksheets in Attachment 1e.

Note: If additional copies of Form I-6 are needed to list all BMPs, insert extra sheets in Attachment 1

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Attachment 1
Backup For PDP Pollutant Control BMPs

This is the cover sheet for Attachment 1.

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Project Name: Alvarado Creek Apartments

Indicate which Items are Included:

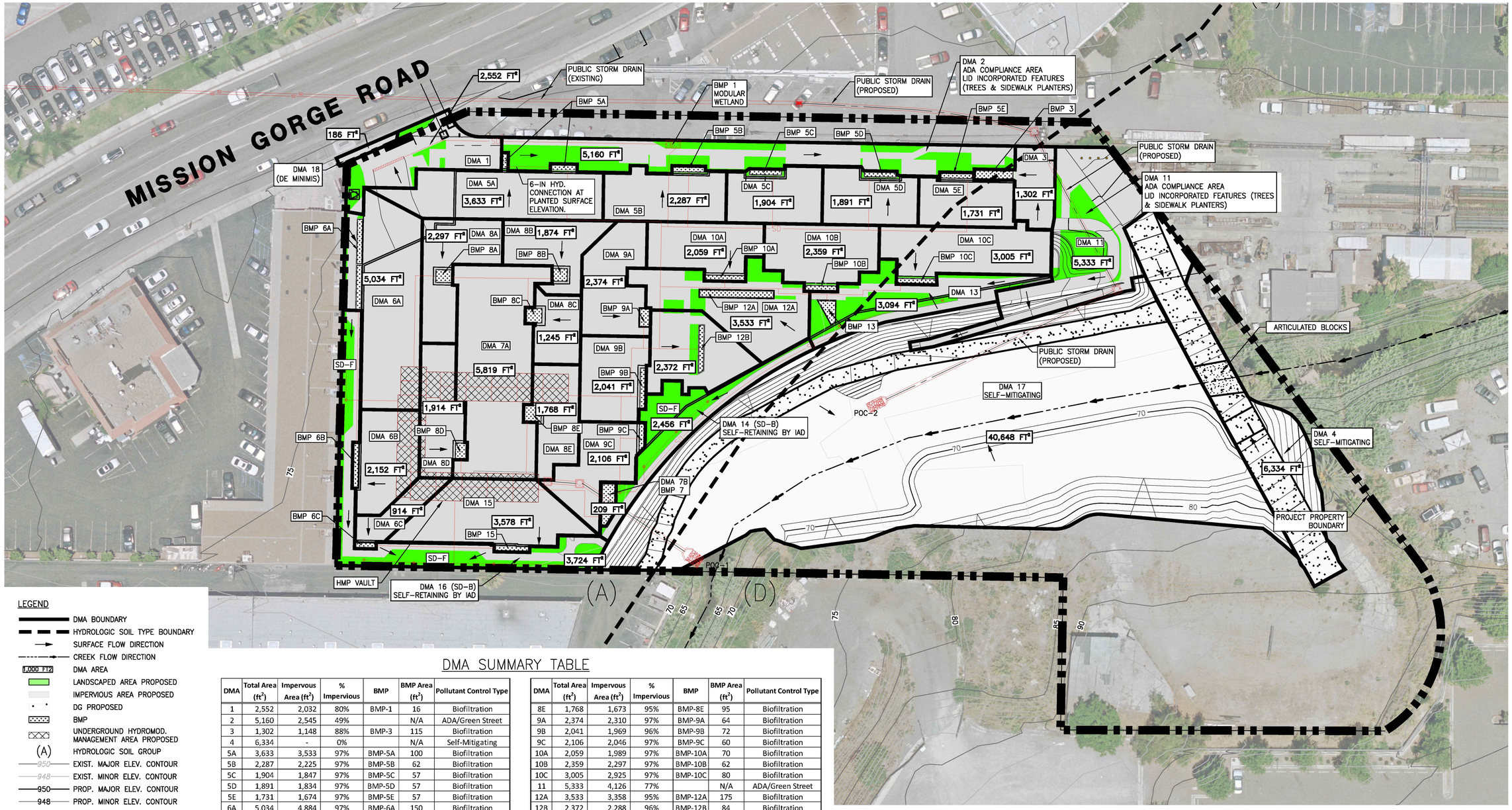
Attachment Sequence	Contents	Checklist
Attachment 1a	DMA Exhibit (Required) See DMA Exhibit Checklist.	☑ Included
Attachment 1b	Tabular Summary of DMAs Showing DMA ID matching DMA Exhibit, DMA Area, and DMA Type (Required)* *Provide table in this Attachment OR on DMA Exhibit in Attachment 1a	☑ Included on DMA Exhibit in Attachment 1a ☐ Included as Attachment 1b, separate from DMA Exhibit
Attachment 1c	Form I-7, Harvest and Use Feasibility Screening Checklist (Required unless the entire project will use infiltration BMPs) Refer to Appendix B.3-1 of the BMP Design Manual to complete Form I-7.	☑ Included ☐ Not included because the entire project will use infiltration BMPs
Attachment 1d	Infiltration Feasibility Information. Contents of Attachment 1d depend on the infiltration condition: • No Infiltration Condition: o Infiltration Feasibility Condition Letter (***Note: must be stamped and signed by licensed geotechnical engineer***) o Form I-8A (optional) o Form I-8B (optional) • Partial Infiltration Condition: o Infiltration Feasibility Condition Letter (***Note: must be stamped and signed by licensed geotechnical engineer***) o Form I-8A o Form I-8B • Full Infiltration Condition: o Form I-8A o Form I-8B o Worksheet C.4-3 o Form I-9 Refer to Appendices C and D of the BMP Design Manual for guidance.	☑ Included ☐ Not included because the entire project will use harvest and use BMPs
Attachment 1e	Pollutant Control BMP Design Worksheets / Calculations (Required) Refer to Appendices B and E of the BMP Design Manual for structural pollutant control BMP design guidelines and site design credit calculations	☑ Included

Project Name: Alvarado Creek Apartments

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 grading
- ☑ Proposed impervious features
- ☑ Proposed design features and surface treatments used to minimize imperviousness
- ☑ Drainage management area (DMA) boundaries, DMA ID numbers, and DMA areas (square footage or acreage), and DMA type (i.e., drains to BMP, self-retaining, or self-mitigating)
- ☑ Potential pollutant source areas and corresponding required source controls (see Chapter 4, Appendix E.1, and Form I-3B)
- ☑ Structural BMPs (identify location, type of BMP, size/detail, and include cross-section)



LEGEND

- DMA BOUNDARY
- HYDROLOGIC SOIL TYPE BOUNDARY
- SURFACE FLOW DIRECTION
- CREEK FLOW DIRECTION
- 1,000 FT2 — DMA AREA
- LANDSCAPED AREA PROPOSED
- IMPERVIOUS AREA PROPOSED
- DG PROPOSED
- BMP
- UNDERGROUND HYDROMOD. MANAGEMENT AREA PROPOSED
- (A) — HYDROLOGIC SOIL GROUP
- 950 — EXIST. MAJOR ELEV. CONTOUR
- 948 — EXIST. MINOR ELEV. CONTOUR
- 950 — PROP. MAJOR ELEV. CONTOUR
- 948 — PROP. MINOR ELEV. CONTOUR
- SD — STORM DRAIN
- AREA DRAIN
- POC-1 — POINT OF COMPLIANCE

DMA SUMMARY TABLE

DMA	Total Area (ft^2)	Impervous Area (ft^2)	% Impervious	BMP	BMP Area (ft^2)	Pollutant Control Type
1	2,552	2,032	80%	BMP-1	16	Biofiltration
2	5,160	2,545	49%		N/A	ADA/Green Street
3	1,302	1,148	88%	BMP-3	115	Biofiltration
4	6,334	-	0%		N/A	Self-Mitigating
5A	3,633	3,533	97%	BMP-5A	100	Biofiltration
5B	2,287	2,225	97%	BMP-5B	62	Biofiltration
5C	1,904	1,847	97%	BMP-5C	57	Biofiltration
5D	1,891	1,834	97%	BMP-5D	57	Biofiltration
5E	1,731	1,674	97%	BMP-5E	57	Biofiltration
6A	5,034	4,884	97%	BMP-6A	150	Biofiltration
6B	2,152	2,072	96%	BMP-6B	80	Biofiltration
6C	914	878	96%	BMP-6C	36	Biofiltration
7	6,028	5,853	97%	BMP-7	175	Biofiltration
8A	2,297	2,225	97%	BMP-8A	72	Biofiltration
8B	1,874	1,809	97%	BMP-8B	65	Biofiltration
8C	1,245	1,163	93%	BMP-8C	82	Biofiltration
8D	1,914	1,854	97%	BMP-8D	60	Biofiltration

DMA	Total Area (ft^2)	Impervous Area (ft^2)	% Impervious	BMP	BMP Area (ft^2)	Pollutant Control Type
8E	1,768	1,673	95%	BMP-8E	95	Biofiltration
9A	2,374	2,310	97%	BMP-9A	64	Biofiltration
9B	2,041	1,969	96%	BMP-9B	72	Biofiltration
9C	2,106	2,046	97%	BMP-9C	60	Biofiltration
10A	2,059	1,989	97%	BMP-10A	70	Biofiltration
10B	2,359	2,297	97%	BMP-10B	62	Biofiltration
10C	3,005	2,925	97%	BMP-10C	80	Biofiltration
11	5,333	4,126	77%		N/A	ADA/Green Street
12A	3,533	3,358	95%	BMP-12A	175	Biofiltration
12B	2,372	2,288	96%	BMP-12B	84	Biofiltration
13	3,094	1,486	48%	BMP-13	90	Biofiltration
14	2,456	863	35%		N/A	Self-Retaining by IAD
15	3,578	3,478	97%	BMP-15	100	Biofiltration
16	3,724	1,648	44%		N/A	Self-Retaining by IAD
17	40,648	-	0%		N/A	Self-Mitigating
18	186	186	100%		N/A	De mimimis

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NOTES:
1. DEPTH TO GROUNDWATER IS APPROXIMATELY 9 FT BGS
2. NO PCCSYAS ON SITE
3. UNLESS NOTED OTHERWISE, STORM DRAIN SHOWN IS PRIVATE

N

30 15 0 30 60 90
GRAPHIC SCALE: 1"=30'

DMA EXHIBIT
ALVARADO CREEK APARTMENTS
SAN DIEGO, CA 92120

DATE: SEPT. 2021

J-19048

SHEET 1 OF 1

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NOT FOR CONSTRUCTION – EXHIBIT FOR PDP SWQMP ONLY

Worksheet B-1: Tabular Summary of DMAs

Tabular Summary of DMAs							Worksheet B-1		
DMA Unique Identifier	Area (acres)	Impervious Area (acres)	% Imp	HSG	Area Weighted Runoff Coefficient	DCV (cubic feet)	Treated By (BMP ID)	Pollutant Control Type	Drains to (POC ID)
1	0.059	0.047	80%	A	0.74	88	BMP-1	Biofiltration	POC-1
2	0.118	0.058	49%	A	0.49	119		ADA/Green Street	POC-2
3	0.030	0.026	88%	A	0.81	49	BMP-3	Biofiltration	POC-1
4	0.145	0.000	0%	D	0.30	89		Self-Mitigating	
5A	0.083	0.081	97%	A	0.86	146	BMP-5A	Biofiltration	POC-1
5B	0.053	0.051	97%	A	0.88	94	BMP-5B	Biofiltration	POC-1
5C	0.044	0.042	97%	A	0.88	78	BMP-5C	Biofiltration	POC-1
5D	0.043	0.042	97%	A	0.88	77	BMP-5D	Biofiltration	POC-1
5E	0.040	0.038	97%	A	0.87	71	BMP-5E	Biofiltration	POC-1
6A	0.116	0.112	97%	A	0.88	206	BMP-6A	Biofiltration	POC-1
6B	0.049	0.048	96%	A	0.87	87	BMP-6B	Biofiltration	POC-1
6C	0.021	0.020	96%	A	0.87	37	BMP-6C	Biofiltration	POC-1
7A & 7B	0.138	0.134	97%	A	0.88	247	BMP-7	Biofiltration	POC-1
8A	0.053	0.051	97%	A	0.87	94	BMP-8A	Biofiltration	POC-1
8B	0.043	0.042	97%	A	0.87	76	BMP-8A	Biofiltration	POC-1
8C	0.029	0.027	93%	A	0.85	49	BMP-8A	Biofiltration	POC-1
8D	0.044	0.043	97%	A	0.87	78	BMP-8A	Biofiltration	POC-1
8E	0.041	0.038	95%	A	0.86	71	BMP-8A	Biofiltration	POC-1
9A	0.054	0.053	97%	A	0.88	97	BMP-9A	Biofiltration	POC-1
9B	0.047	0.045	96%	A	0.87	83	BMP-9B	Biofiltration	POC-1
9C	0.048	0.047	97%	A	0.88	86	BMP-9C	Biofiltration	POC-1
10A	0.047	0.046	97%	A	0.87	84	BMP-10A	Biofiltration	POC-1
10B	0.054	0.053	97%	A	0.88	97	BMP-10B	Biofiltration	POC-1
10C	0.069	0.067	97%	D	0.88	123	BMP-10C	Biofiltration	POC-1
11	0.122	0.095	77%	A	0.72	179	BMP-11	ADA/Green Street	POC-2
12A	0.081	0.077	95%	A	0.73	121	BMP-12A	Biofiltration	POC-1
12B	0.054	0.053	96%	A	0.87	96	BMP-12B	Biofiltration	POC-1
13	0.071	0.034	48%	A	0.48	70	BMP-13	Biofiltration	POC-1
14	0.056	0.020	35%	A	0.38	44		Self-Retaining by IAD	POC-1
15	0.085	0.081	96%	A	0.86	149	BMP-15	Biofiltration	POC-1
16	0.083	0.038	46%	A	0.46	78		Self-Retaining by IAD	POC-1
17	0.933	0.000	0%	D	0.30	569		Self-Mitigating	
18	0.004	0.004	100%	A	0.90	8		De mimimis	
Summary of DMA Information (Must match project description and SWQMP Narrative)									
No. of DMAs	Total DMA Area (acres)	Total Impervious Area (acres)	% Imp		Area Weighted Runoff Coefficient	Total DCV (cubic feet)	Total Area Treated (acres)		No. of POCs
18	2.96	1.61	55%		0.61	3,639	2.96		2

Where: DMA = Drainage Management Area; Imp = Imperviousness; HSG = Hydrologic Soil Group; DCV= Design Capture Volume; BMP = Best Management Practice; POC = Point of Compliance; ID = identifier; No. = Number

Harvest and Use Feasibility Checklist	Worksheet B.3-1 : Form I-7

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

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

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

Assume: 250 Family units; 4 residents per family unit; 9.3 gallons per resident - 24 hours
(9.3 Gallons/24 hrs) X 1,000 Residents X 36 hrs (1 ft3 / 7.48 gal) = 1,865 ft3 per 36 hrs

Irrigation: Assume 1470 gal/ac in 36 hours
0.05 ac X (1470 gal/ac per 36 hr) X (1 ft3 / 7.48 gal) = 9.8 ft3 per 36 hrs

3. Calculate the DCV using worksheet B-2.1.
DCV = 3,192 (cubic feet)
[Provide a summary of calculations here]

C= 0.61: d= 0.56 in (85th % Storm): A = 129,082 ft2

129,082 ft2 X 0.61 X 0.56 in X (1ft/12in) = 3,675 ft3

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.

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.

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions[1]	Worksheet C.4-1: Form I-8A[2]
Part 1 - Full Infiltration Feasibility Screening Criteria	
DMA(s) Being Analyzed:	Project Phase:
All	Preliminary Engineering

Criteria 1: Infiltration Rate Screening	
1A	Is the mapped hydrologic soil group according to the NRCS Web Soil Survey or UC Davis Soil Web Mapper Type A or B and corroborated by available site soil data[3]? ◉ Yes; the DMA may feasibly support full infiltration. Answer "Yes" to Criteria 1 Result or continue to Step 1B if the applicant elects to perform infiltration testing. ○ No; the mapped soil types are A or B but is not corroborated by available site soil data (continue to Step 1B). ○ No; the mapped soil types are C, D, or "urban/unclassified" and is corroborated by available site soil data. Answer "No" to Criteria 1 Result. ○ No; the mapped soil types are C, D, or "urban/unclassified" but is not corroborated by available site soil data (continue to Step 1B).
1B	Is the reliable infiltration rate calculated using planning phase methods from Table D.3-1? ◉ Yes; Continue to Step 1C. ○ No; Skip to Step 1D.
1C	Is the reliable infiltration rate calculated using planning phase methods from Table D.3-1 greater than 0.5 inches per hour? ◉ Yes; the DMA may feasibly support full infiltration. Answer "Yes" to Criteria 1 Result. ○ No; full infiltration is not required. Answer "No" to Criteria 1 Result.
1D	**Infiltration Testing Method.** Is the selected infiltration testing method suitable during the design phase (see Appendix D.3)? Note: Alternative testing standards may be allowed with appropriate rationales and documentation. ◉ Yes; continue to Step 1E. ○ No; select an appropriate infiltration testing method.

[1] Note that it is not required to investigate each and every criterion in the worksheet, a single "no" answer in Part 1, Part 2, Part 3, or Part 4 determines a full, partial, or no infiltration condition.

[2] This form must be completed each time there is a change to the site layout that would affect the infiltration feasibility condition. Previously completed forms shall be retained to document the evolution of the site storm water design.

[3] Available data includes site-specific sampling or observation of soil types or texture classes, such as obtained from borings or test pits necessary to support other design elements.

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Worksheet C.4-1: Form I-8A[2]
1E	**Number of Percolation/Infiltration Tests.** Does the infiltration testing method performed satisfy the minimum number of tests specified in Table D.3-2? ◉ Yes; continue to Step 1F. ○ No; conduct appropriate number of tests.
IF	**Factor of Safety.** Is the suitable Factor of Safety selected for full infiltration design? See guidance in D.5; Tables D.5-1 and D.5-2; and Worksheet D.5-1 (Form I-9). ◉ Yes; continue to Step 1G. ○ No; select appropriate factor of safety.
1G	**Full Infiltration Feasibility.** Is the average measured infiltration rate divided by the Factor of Safety greater than 0.5 inches per hour? ◉ Yes; answer "Yes" to Criteria 1 Result. ○ No; answer "No" to Criteria 1 Result.
Criteria 1 Result	Is the estimated reliable infiltration rate greater than 0.5 inches per hour within the DMA where runoff can reasonably be routed to a BMP? ◉ Yes; the DMA may feasibly support full infiltration. Continue to Criteria 2. ○ No; full infiltration is not required. Skip to Part 1 Result.

Summarize infiltration testing methods, testing locations, replicates, and results and summarize estimates of reliable infiltration rates according to procedures outlined in D.5. Documentation should be included in project geotechnical report.

See Attached infiltration report.

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
Criteria 2: Geologic/Geotechnical Screening			
2A	If all questions in Step 2A are answered "Yes," continue to Step 2B. For any "No" answer in Step 2A answer "No" to Criteria 2, and submit an "Infiltration Feasibility Condition Letter" that meets the requirements in Appendix C.1.1. The geologic/geotechnical analyses listed in Appendix C.2.1 do not apply to the DMA because one of the following setbacks cannot be avoided and therefore result in the DMA being in a no infiltration condition. The setbacks must be the closest horizontal radial distance from the surface edge (at the overflow elevation) of the BMP.		
2A-1	Can the proposed full infiltration BMP(s) avoid areas with existing fill materials greater than 5 feet thick below the infiltrating surface?	○ Yes	⊙ No
2A-2	Can the proposed full infiltration BMP(s) avoid placement within 10 feet of existing underground utilities, structures, or retaining walls?	○ Yes	⊙ No
2A-3	Can the proposed full infiltration BMP(s) avoid placement within 50 feet of a natural slope (>25%) or within a distance of 1.5H from fill slopes where H is the height of the fill slope?	○ Yes	⊙ No
2B	When full infiltration is determined to be feasible, a geotechnical investigation report must be prepared that considers the relevant factors identified in Appendix C.2.1. If all questions in Step 2B are answered "Yes," then answer "Yes" to Criteria 2 Result. If there are "No" answers continue to Step 2C.		
2B-1	**Hydroconsolidation.** Analyze hydroconsolidation potential per approved ASTM standard due to a proposed full infiltration BMP. Can full infiltration BMPs be proposed within the DMA without increasing hydroconsolidation risks?	⊙ Yes	○ No
2B-2	**Expansive Soils.** Identify expansive soils (soils with an expansion index greater than 20) and the extent of such soils due to proposed full infiltration BMPs. Can full infiltration BMPs be proposed within the DMA without increasing expansive soil risks?	⊙ Yes	○ No

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
2B-3	**Liquefaction**. If applicable, identify mapped liquefaction areas. Evaluate liquefaction hazards in accordance with Section 6.4.2 of the City of San Diego's Guidelines for Geotechnical Reports (2011 or most recent edition). Liquefaction hazard assessment shall take into account any increase in groundwater elevation or groundwater mounding that could occur as a result of proposed infiltration or percolation facilities. Can full infiltration BMPs be proposed within the DMA without increasing liquefaction risks?	◉ Yes	○ No
2B-4	**Slope Stability**. If applicable, perform a slope stability analysis in accordance with the ASCE and Southern California Earthquake Center (2002) Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California to determine minimum slope setbacks for full infiltration BMPs. See the City of San Diego's Guidelines for Geotechnical Reports (2011) to determine which type of slope stability analysis is required. Can full infiltration BMPs be proposed within the DMA without increasing slope stability risks?	◉ Yes	○ No
2B-5	**Other Geotechnical Hazards.** Identify site-specific geotechnical hazards not already mentioned (refer to Appendix C.2.1). Can full infiltration BMPs be proposed within the DMA without increasing risk of geologic or geotechnical hazards not already mentioned?	◉ Yes	○ No
2B-6	**Setbacks.** Establish setbacks from underground utilities, structures, and/or retaining walls. Reference applicable ASTM or other recognized standard in the geotechnical report. Can full infiltration BMPs be proposed within the DMA using established setbacks from underground utilities, structures, and/or retaining walls?	○ Yes	◉ No

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
2C	**Mitigation Measures.** Propose mitigation measures for each geologic/geotechnical hazard identified in Step 2B. Provide a discussion of geologic/geotechnical hazards that would prevent full infiltration BMPs that cannot be reasonably mitigated in the geotechnical report. See Appendix C.2.1.8 for a list of typically reasonable and typically unreasonable mitigation measures. Can mitigation measures be proposed to allow for full infiltration BMPs? If the question in Step 2 is answered "Yes," then answer "Yes" to Criteria 2 Result. If the question in Step 2C is answered "No," then answer "No" to Criteria 2 Result.	○ Yes	⊙ No
Criteria 2 Result	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geologic or geotechnical hazards that cannot be reasonably mitigated to an acceptable level?	⊙ Yes	○ No
Summarize findings and basis; provide references to related reports or exhibits. The BMP location will be in fill material, within 10 feet of structures and within 50 feet of a natural slope and therefore infiltration is not feasible.			

Part 1 Result – Full Infiltration Geotechnical Screening [4]	Result
If answers to both Criteria 1 and Criteria 2 are "Yes", a full infiltration design is potentially feasible based on Geotechnical conditions only. If either answer to Criteria 1 or Criteria 2 is "No", a full infiltration design is not required.	○ Full infiltration Condition ⊙ Complete Part 2

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

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Worksheet C.4-1: Form I-8A[2]
Part 2 – Partial vs. No Infiltration Feasibility Screening Criteria	
DMA(s) Being Analyzed:	Project Phase:
All	Preliminary Engineering

Criteria 3 : Infiltration Rate Screening	
3A	**NRCS Type C, D, or "urban/unclassified":** Is the mapped hydrologic soil group according to the NRCS Web Soil Survey or UC Davis Soil Web Mapper is Type C, D, or "urban/unclassified" and corroborated by available site soil data? ○ Yes; the site is mapped as C soils and a reliable infiltration rate of 0.15 in/hr. is used to size partial infiltration BMPS. Answer "Yes" to Criteria 3 Result. ○ Yes; the site is mapped as D soils or "urban/unclassified" and a reliable infiltration rate of 0.05 in/hr. is used to size partial infiltration BMPS. Answer "Yes" to Criteria 3 Result. ◉ No; infiltration testing is conducted (refer to Table D.3-1), continue to Step 3B.
3B	**Infiltration Testing Result:** Is the reliable infiltration rate (i.e. average measured infiltration rate/2) greater than 0.05 in/hr. and less than or equal to 0.5 in/hr? ◉ Yes; the site may support partial infiltration. Answer "Yes" to Criteria 3 Result. ○ No; the reliable infiltration rate (i.e. average measured rate/2) is less than 0.05 in/hr., partial infiltration is not required. Answer "No" to Criteria 3 Result.
Criteria 3 Result	Is the estimated reliable infiltration rate (i.e., average measured infiltration rate/2) greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour at any location within each DMA where runoff can reasonably be routed to a BMP? ◉ Yes; Continue to Criteria 4. ○ No: Skip to Part 2 Result.

Summarize infiltration testing and/or mapping results (i.e. soil maps and series description used for infiltration rate).

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
Criteria 4: Geologic/Geotechnical Screening			
4A	If all questions in Step 4A are answered "Yes," continue to Step 2B. For any "No" answer in Step 4A answer "No" to Criteria 4 Result, and submit an "Infiltration Feasibility Condition Letter" that meets the requirements in Appendix C.1.1. The geologic/geotechnical analyses listed in Appendix C.2.1 do not apply to the DMA because one of the following setbacks cannot be avoided and therefore result in the DMA being in a no infiltration condition. The setbacks must be the closest horizontal radial distance from the surface edge (at the overflow elevation) of the BMP.		
4A-1	Can the proposed partial infiltration BMP(s) avoid areas with existing fill materials greater than 5 feet thick?	○ Yes	⊙ No
4A-2	Can the proposed partial infiltration BMP(s) avoid placement within 10 feet of existing underground utilities, structures, or retaining walls?	○ Yes	⊙ No
4A-3	Can the proposed partial infiltration BMP(s) avoid placement within 50 feet of a natural slope (>25%) or within a distance of 1.5H from fill slopes where H is the height of the fill slope?	○ Yes	⊙ No
4B	When full infiltration is determined to be feasible, a geotechnical investigation report must be prepared that considers the relevant factors identified in Appendix C.2.1. If all questions in Step 4B are answered "Yes," then answer "Yes" to Criteria 4 Result. If there are any "No" answers continue to Step 4C.		
4B-1	**Hydroconsolidation.** Analyze hydroconsolidation potential per approved ASTM standard due to a proposed full infiltration BMP. Can partial infiltration BMPs be proposed within the DMA without increasing hydroconsolidation risks?	⊙ Yes	○ No
4B-2	**Expansive Soils.** Identify expansive soils (soils with an expansion index greater than 20) and the extent of such soils due to proposed full infiltration BMPs. Can partial infiltration BMPs be proposed within the DMA without increasing expansive soil risks?	⊙ Yes	○ No
4B-3	**Liquefaction**. If applicable, identify mapped liquefaction areas. Evaluate liquefaction hazards in accordance with Section 6.4.2 of the City of San Diego's Guidelines for Geotechnical Reports (2011). Liquefaction hazard assessment shall take into account any increase in groundwater elevation or groundwater mounding that could occur as a result of proposed infiltration or percolation facilities. Can partial infiltration BMPs be proposed within the DMA without increasing liquefaction risks?	⊙ Yes	○ No

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
4B-4	**Slope Stability**. If applicable, perform a slope stability analysis in accordance with the ASCE and Southern California Earthquake Center (2002) Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California to determine minimum slope setbacks for full infiltration BMPs. See the City of San Diego's Guidelines for Geotechnical Reports (2011) to determine which type of slope stability analysis is required. Can partial infiltration BMPs be proposed within the DMA without increasing slope stability risks?	◉ Yes	○ No
4B-5	**Other Geotechnical Hazards.** Identify site-specific geotechnical hazards not already mentioned (refer to Appendix C.2.1). Can partial infiltration BMPs be proposed within the DMA without increasing risk of geologic or geotechnical hazards not already mentioned?	◉ Yes	○ No
4B-6	**Setbacks.** Establish setbacks from underground utilities, structures, and/or retaining walls. Reference applicable ASTM or other recognized standard in the geotechnical report. Can partial infiltration BMPs be proposed within the DMA using recommended setbacks from underground utilities, structures, and/or retaining walls?	○ Yes	⊙ No
4C	**Mitigation Measures.** Propose mitigation measures for each geologic/geotechnical hazard identified in Step 4B. Provide a discussion on geologic/geotechnical hazards that would prevent partial infiltration BMPs that cannot be reasonably mitigated in the geotechnical report. See Appendix C.2.1.8 for a list of typically reasonable and typically unreasonable mitigation measures. Can mitigation measures be proposed to allow for partial infiltration BMPs? If the question in Step 4C is answered "Yes," then answer "Yes" to Criteria 4 Result. If the question in Step 4C is answered "No," then answer "No" to Criteria 4 Result.	○ Yes	⊙ No
Criteria 4 Result	Can infiltration of greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour be allowed without increasing the risk of geologic or geotechnical hazards that cannot be reasonably mitigated to an acceptable level?	○ Yes	⊙ No

Krazan & ASSOCIATES, INC.

GEOTECHNICAL ENGINEERING • ENVIRONMENTAL ENGINEERING
CONSTRUCTION TESTING & INSPECTION

January 8, 2020 KA No. 112-19097

Mr. Darren Berberian
The Pacific Companies
430 E. State Street, Suite 100
Eagle, ID 83616

RE: Results of Infiltration Testing
Proposed Mission Gorge Road Grantville Development
5901-5927 Mission Gorge Road
San Diego, California

Dear Mr. Berberian:

In accordance with your request and authorization we have performed infiltration testing at the subject site in San Diego, California. Infiltration testing was performed at four (4) locations within the proposed infiltration areas located at the subject site. The approximate test locations are identified on the attached site plan. In order to perform these tests, four (4) borings were drilled to a depth of approximately five (5) feet below existing site grades. Infiltration testing has been performed at each of the boring locations. Infiltration testing has been performed using open borehole percolation testing. The infiltration rates have been calculated using the Inverse Borehole procedures.

Prior to infiltration testing, approximately four inches of gravel was placed at the bottom of each borehole. The borehole was pre-soaked prior to testing using clean water. The depth of the borehole was measured at each reading to verify the overall depth. The depth of water in the borehole was measured using a water level indicator or well sounder.

Infiltration Test Results

The estimated infiltration rates were determined using the results of open borehole percolation testing at four (4) locations at the subject site. In accordance with the County of San Diego, Infiltration Rate Assessment Methods, infiltration rates have been calculated using the Inverse Borehole procedures. The infiltration rates have been adjusted to reflect vertical flow.

The infiltration testing performed in the near surfaces silty sands encountered in the western portion of the site indicate infiltration rates at the end of the tests of approximately 0.51 and 0.55 inch per hour at a depth of approximately five (5) feet below site grades. Infiltration testing performed in the near surface clayey sands encountered in the eastern portion of the site indicate infiltration rates of 0.20 and 0.29 inch per hour at a depth of approximately five (5) feet below site grades.

Detailed results of the infiltration testing are included as an attachment to this report. The soil infiltration rates are based on tests conducted with clean water. The infiltration rates may vary with time as a result of soil clogging from water impurities. A factor of safety should be incorporated into the design of the

infiltration system to compensate for these factors as determined appropriate by the designer. In addition, routine maintenance consisting of clearing the system of clogged soils and debris should be expected.

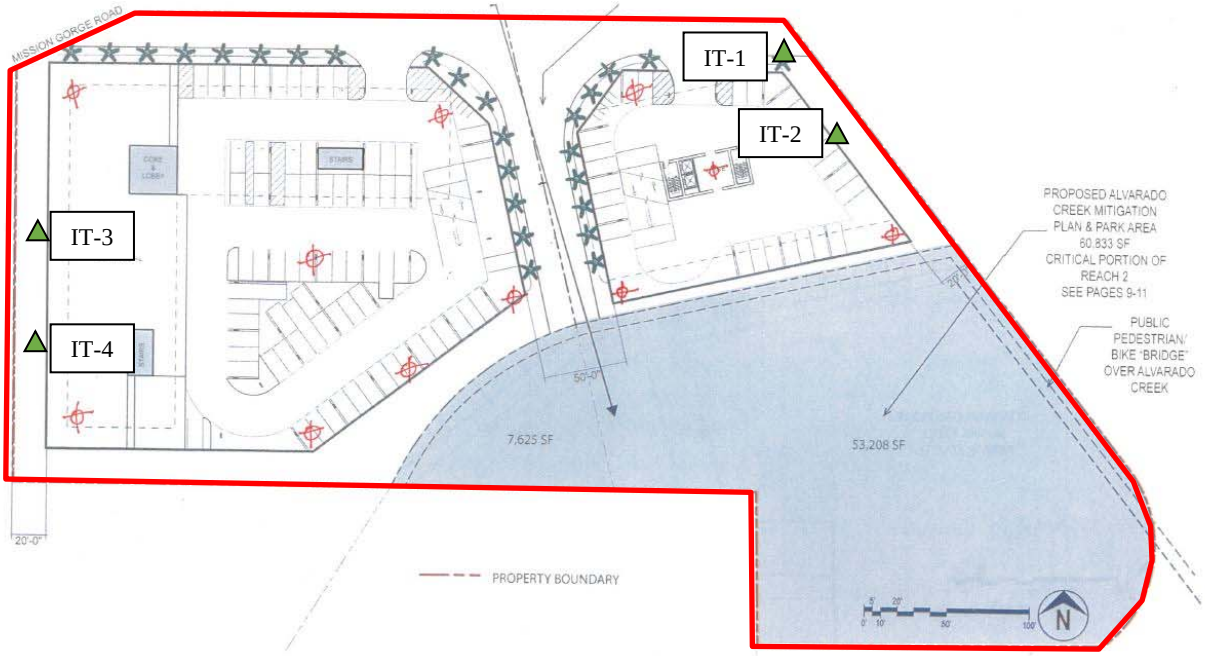
If there are any questions or if we can be of further assistance, please do not hesitate to contact our office at (951) 273-1011.

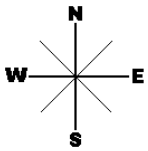
Respectfully submitted,
KRAZAN & ASSOCIATES, INC.

James M. Kellogg, PE, GE
Managing Engineer
RCE No. 65092, GE No. 2902

Jorge Pelayo
Jorge A. Pelayo, E.I.T.
Staff Engineer

Attachment: Infiltration Test Results



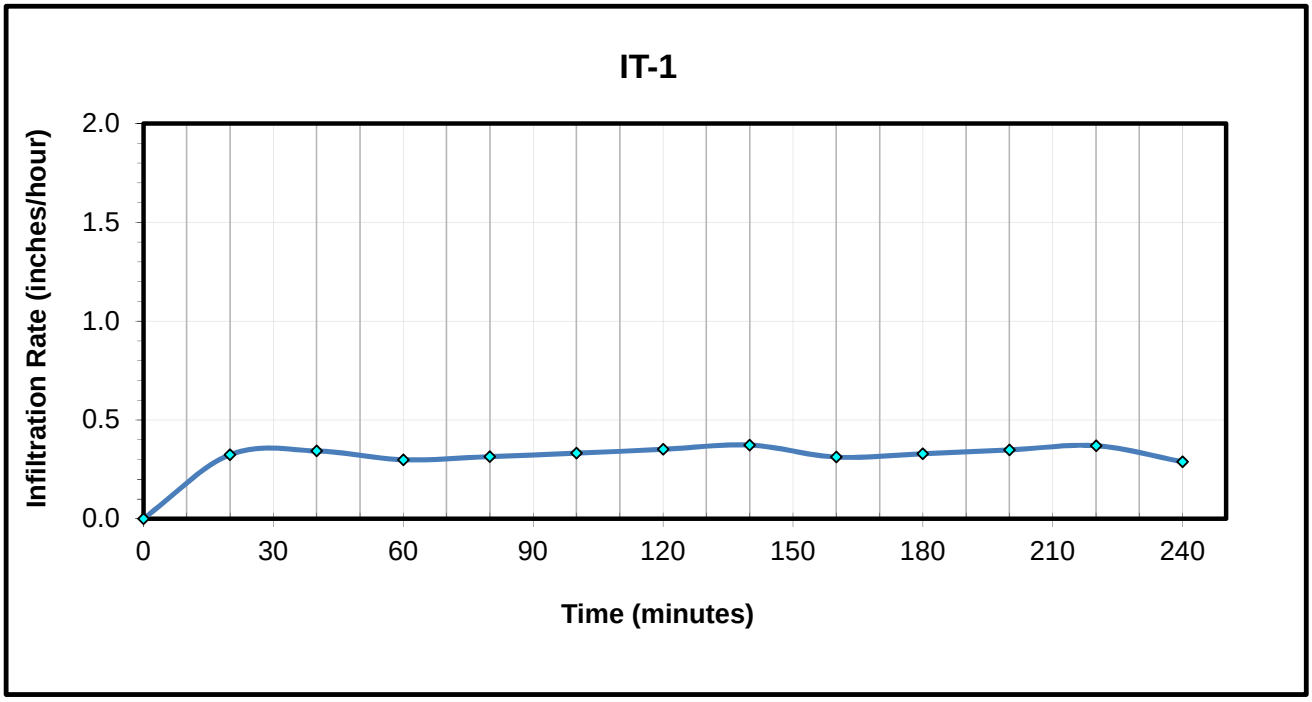


▲ APPROXIMATE INFILTRATION TEST LOCATION

PERCOLATION TEST LOCATION SITE MAP	**Scale:** NTS	**Date:** January, 2020	Krazan GEOTECHNICAL ENGINEERING
PROPOSED GRANTVILLE DEVELOPMENT AT MISSION GORGE ROAD 5901 – 5927 MISSION GORGE ROAD SAN DIEGO, CALIFORNIA	**Drawn by:** JP	**Approved by:** JK	
	Project No. 112-19097	**Figure No.** 1	

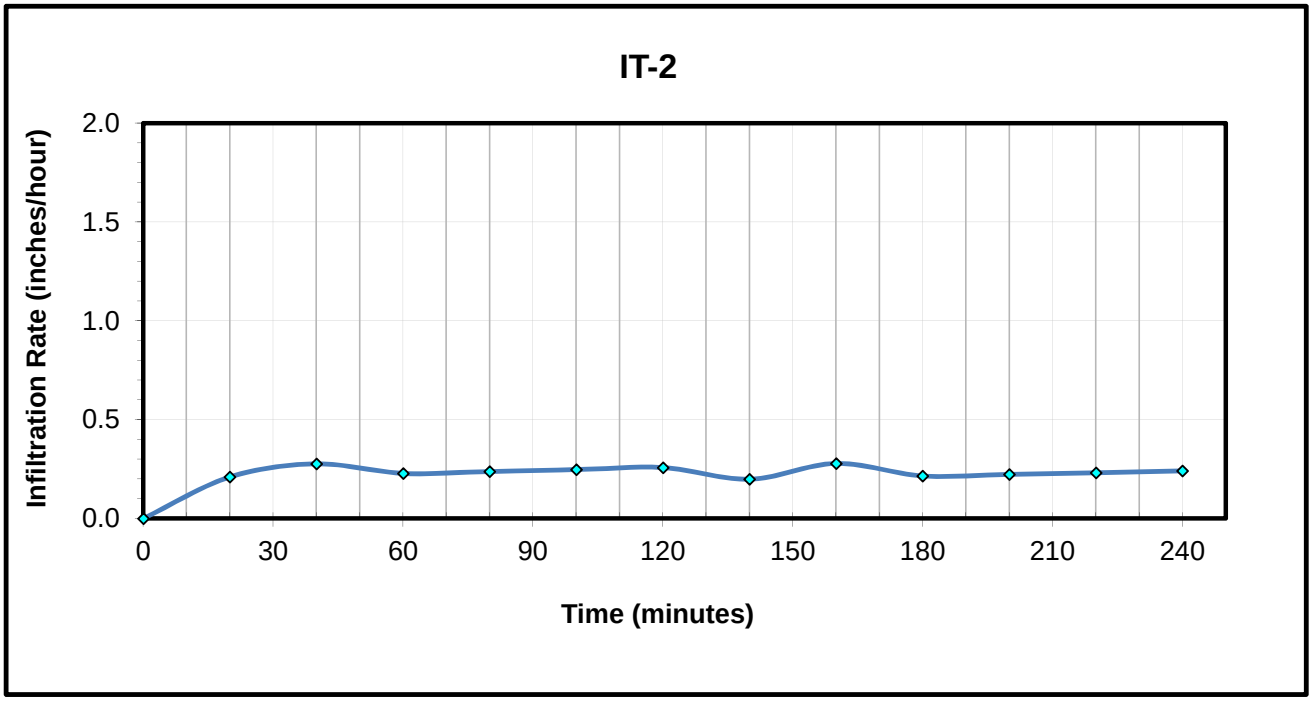
RESULTS OF INFILTRATION TESTS - REVERSE BOREHOLE						
Project #	**11219097**				**Date**	**1/8/2020**
Project Name	Mission Gorge Road					
Project Address	San Diego, CA					
Test No:	IT-1	**Total Depth (in.)**		60	**Test Size (in)**	8
Depth To Water	9'	**Soil Classification**		SC		

Reading	Elasped Time(min.)	Incremental Time (min.)	Initial Depth To Water(in.)	Final Depth To Water(in.)	Incremental Fall of Water(in.)	Incremental Infiltration Rate (in/hr)
Start	0	0.00		2.0	--	--
1	20.00	20.00	2.0	5.0	3.00	0.32
2	40.00	20.00	5.0	8.0	3.00	0.34
3	60.00	20.00	8.0	10.5	2.50	0.30
4	80.00	20.00	10.5	13.0	2.50	0.31
5	100.00	20.00	13.0	15.5	2.50	0.33
6	120.00	20.00	15.5	18.0	2.50	0.35
7	140.00	20.00	18.0	20.5	2.50	0.37
8	160.00	20.00	20.5	22.5	2.00	0.31
9	180.00	20.00	22.5	24.5	2.00	0.33
10	200.00	20.00	24.5	26.5	2.00	0.35
11	220.00	20.00	26.5	28.5	2.00	0.37
12	240.00	20.00	28.5	30.0	1.50	0.29
	Infiltration Rate in Inches per Hour					**0.29**



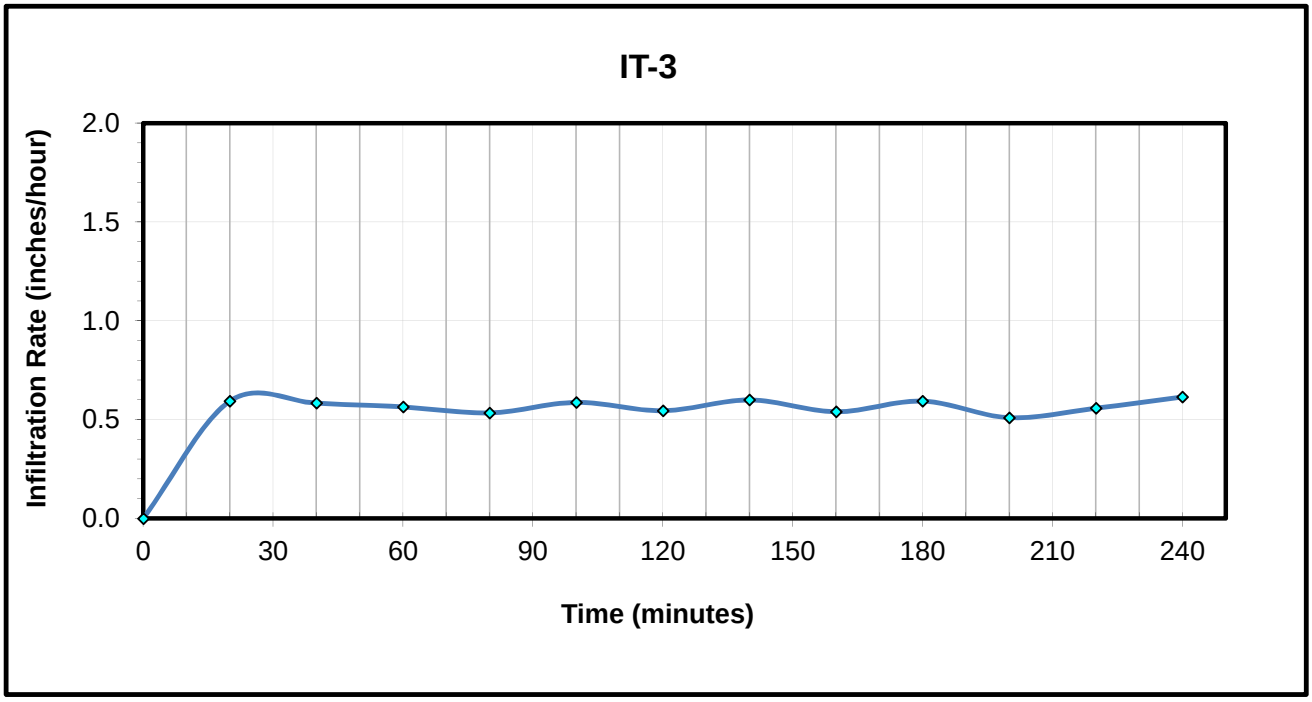
RESULTS OF INFILTRATION TESTS - REVERSE BOREHOLE						
Project #	**11219097**				**Date**	**1/8/2020**
Project Name	Mission Gorge Road					
Project Address	San Diego, CA					
Test No:	IT-2	**Total Depth (in.)**		60	**Test Size (in)**	8
Depth To Water	9'	**Soil Classification**		SC		

Reading	Elasped Time(min.)	Incremental Time (min.)	Initial Depth To Water(in.)	Final Depth To Water(in.)	Incremental Fall of Water(in.)	Incremental Infiltration Rate (in/hr)
Start	0	0.00		2.0	--	--
1	20.00	20.00	2.0	4.0	2.00	0.21
2	40.00	20.00	4.0	6.5	2.50	0.28
3	60.00	20.00	6.5	8.5	2.00	0.23
4	80.00	20.00	8.5	10.5	2.00	0.24
5	100.00	20.00	10.5	12.5	2.00	0.25
6	120.00	20.00	12.5	14.5	2.00	0.26
7	140.00	20.00	14.5	16.0	1.50	0.20
8	160.00	20.00	16.0	18.0	2.00	0.28
9	180.00	20.00	18.0	19.5	1.50	0.22
10	200.00	20.00	19.5	21.0	1.50	0.22
11	220.00	20.00	21.0	22.5	1.50	0.23
12	240.00	20.00	22.5	24.0	1.50	0.24
	Infiltration Rate in Inches per Hour					**0.20**



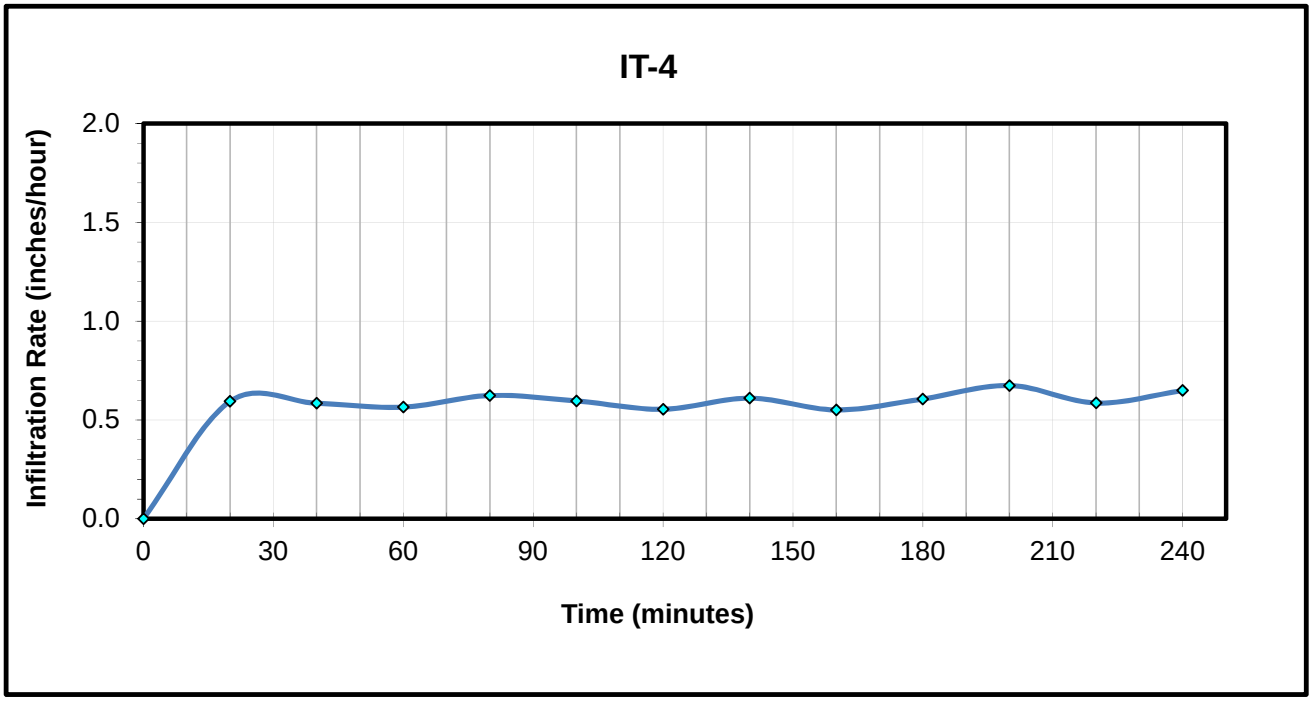
RESULTS OF INFILTRATION TESTS - REVERSE BOREHOLE						
Project #	**11219097**				**Date**	**1/8/2020**
Project Name	Mission Gorge Road					
Project Address	San Diego, CA					
Test No:	IT-3	**Total Depth (in.)**		60	**Test Size (in)**	8
Depth To Water	9'	**Soil Classification**		SM		

Reading	Elasped Time(min.)	Incremental Time (min.)	Initial Depth To Water(in.)	Final Depth To Water(in.)	Incremental Fall of Water(in.)	Incremental Infiltration Rate (in/hr)
Start	0	0.00		4.0	--	--
1	20.00	20.00	4.0	9.0	5.00	0.59
2	40.00	20.00	9.0	13.5	4.50	0.58
3	60.00	20.00	13.5	17.5	4.00	0.56
4	80.00	20.00	17.5	21.0	3.50	0.54
5	100.00	20.00	21.0	24.5	3.50	0.59
6	120.00	20.00	24.5	27.5	3.00	0.55
7	140.00	20.00	27.5	30.5	3.00	0.60
8	160.00	20.00	30.5	33.0	2.50	0.54
9	180.00	20.00	33.0	35.5	2.50	0.59
10	200.00	20.00	35.5	37.5	2.00	0.51
11	220.00	20.00	37.5	39.5	2.00	0.56
12	240.00	20.00	39.5	41.5	2.00	0.62
	Infiltration Rate in Inches per Hour					**0.51**



RESULTS OF INFILTRATION TESTS - REVERSE BOREHOLE						
Project #	**11219097**				**Date**	**1/8/2020**
Project Name	Mission Gorge Road					
Project Address	San Diego, CA					
Test No:	IT-4	**Total Depth (in.)**		60	**Test Size (in)**	8
Depth To Water	9'	**Soil Classification**		SM		

Reading	Elasped Time(min.)	Incremental Time (min.)	Initial Depth To Water(in.)	Final Depth To Water(in.)	Incremental Fall of Water(in.)	Incremental Infiltration Rate (in/hr)
Start	0	0.00		4.0	--	--
1	20.00	20.00	4.0	9.0	5.00	0.59
2	40.00	20.00	9.0	13.5	4.50	0.58
3	60.00	20.00	13.5	17.5	4.00	0.56
4	80.00	20.00	17.5	21.5	4.00	0.62
5	100.00	20.00	21.5	25.0	3.50	0.60
6	120.00	20.00	25.0	28.0	3.00	0.55
7	140.00	20.00	28.0	31.0	3.00	0.61
8	160.00	20.00	31.0	33.5	2.50	0.55
9	180.00	20.00	33.5	36.0	2.50	0.61
10	200.00	20.00	36.0	38.5	2.50	0.67
11	220.00	20.00	38.5	40.5	2.00	0.59
12	240.00	20.00	40.5	42.5	2.00	0.65
	Infiltration Rate in Inches per Hour					**0.55**



Project Name	Alvarado Creek Apartments
BMP ID	BMP-1

Worksheet B.6-1: Flow-Thru (Flow-Based) Design Flows

Flow-thru Design Flows		Worksheet B.6-1		
1	DCV	DCV	88	cubic-feet
2	DCV retained	$DCV_{retained}$	0	cubic-feet
3	DCV biofiltered	$DCV_{biofiltered}$	0	cubic-feet
4	DCV requiring flow-thru (Line 1 – Line 2 – 0.67*Line 3)	$DCV_{flow\text{-}thru}$	88	cubic-feet
5	Adjustment factor (Line 4 / Line 1)	AF=	1	unitless
6	Design rainfall intensity	i=	0.30	in/hr.
7	Area tributary to BMP (s)	A=	0.059	acres
8	Area-weighted runoff factor (estimate using Appendix B.2)	C=	0.74	unitless
9	Calculate Flow Rate = AF x (C x i x A)	Q=	0.0130	cfs

1. Adjustment factor shall be estimated considering only retention and biofiltration BMPs located upstream of flow-thru BMPs. That is, if the flow-thru BMP is upstream of the project's retention and biofiltration BMPs then the flow-thru BMP shall be sized using an adjustment factor of 1.

2. Volume based (e.g., dry extended detention basin) flow-thru treatment control BMPs shall be sized to the volume in Line 4 and flow based (e.g., vegetated swales) shall be sized to flow rate in Line 9. Sand filter and media filter can be designed either by volume in Line 4 or flow rate in Line 9.

3. Proprietary BMPs, if used, shall provide certified treatment capacity equal to or greater than the calculated flow rate in Line 9; certified treatment capacity per unit shall be consistent with third party certifications.

BMP Proposed: BioClean Modular Wetland ®
MWS-L 4-4, Unit Size 4 ft X 4 ft
Treatment Capacity 0.051 cfs

Note: The project is not proposing a flow-thru BMP but rather flow-based biofiltraion BMP. Worksheet B.6-1 is used to demonstrate flow-base design is adequate using the safety factor of 1.5 (i.e., 1.5 X 0.2 in/hr intensity) as required by Appendix F of the City of San Diego Storm Water Standards Manual.

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments	
	BMP ID	BMP-1	
Sizing Method for Volume Retention Criteria		**Worksheet B.5-2**	
1	Area draining to the BMP	2,552	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.74	
3	85th percentile 24-hour rainfall depth	0.56	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	88	cu. ft.
Volume Retention Requirement			
5	Measured infiltration rate in the DMA Note: When mapped hydrologic soil groups are used enter 0.10 for NRCS Type D soils and for NRCS Type C soils enter 0.30 When in no infiltration condition and the actual measured infiltration rate is unknown enter 0.0 if there are geotechnical and/or groundwater hazards identified in Appendix C or enter 0.05	0	in/hr.
6	Factor of safety	2	
7	Reliable infiltration rate, for biofiltration BMP sizing [Line 5 / Line 6]	0	in/hr.
8	Average annual volume reduction target (Figure B.5-2) When Line 7 > 0.01 in/hr. = Minimum (40, 166.9 x Line 7 +6.62) When Line 7 ≤ 0.01 in/hr. = 3.5%	3.5	%
9	Fraction of DCV to be retained (Figure B.5-3) When Line 8 > 8% = $0.0000013 \times \text{Line } 8^3 - 0.000057 \times \text{Line } 8^2 + 0.0086 \times \text{Line } 8 - 0.014$ When Line 8 ≤ 8% = 0.023	0.023	
10	Target volume retention [Line 9 x Line 4]	2	cu. ft.

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments
	BMP ID	BMP-1

Volume Retention for No Infiltration Condition		Worksheet B.5-6	
1	Area draining to the biofiltration BMP	2,552	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.74	
3	Effective impervious area draining to the BMP [Line 1 x Line 2]	1888	sq. ft.
4	Required area for Evapotranspiration [Line 3 x 0.03]	57	sq. ft.
5	Biofiltration BMP Footprint	16	sq. ft.

Landscape Area (must be identified on DS-3247)

		Identification	1	2	3	4	5
6	Landscape area that meet the requirements in SD-B and SD-F Fact Sheet (sq. ft.)		110	84	260		
7	Impervious area draining to the landscape area (sq. ft.)		0	144	34		
8	Impervious to Pervious Area ratio [Line 7/Line 6]		0.00	1.71	0.13	0.00	0.00
9	Effective Credit Area If (Line 8 >1.5, Line 6, Line 7/1.5]		0	84	23	0	0
10	Sum of Landscape area [sum of Line 9 Id's 1 to 5]				107		sq. ft.
11	Provided footprint for evapotranspiration [Line 5 + Line 10]				123		sq. ft.

Volume Retention Performance Standard

12	Is Line 11 ≥ Line 4?	Volume Retention Performance Standard is Met	
13	Fraction of the performance standard met through the BMP footprint and/or landscaping [Line 11/Line 4]	2.17	
14	Target Volume Retention [Line 10 from Worksheet B.5.2]	2	cu. ft.
15	Volume retention required from other site design BMPs [(1-Line 13) x Line 14]	-2.371553184	cu. ft.

Site Design BMP

	Identification	Site Design Type	Credit	
16	1			cu. ft.
	2			cu. ft.
	3			cu. ft.
	4			cu. ft.
	5			cu. ft.
	Sum of volume retention benefits from other site design BMPs (e.g. trees; rain barrels etc.). [sum of Line 16 Credits for Id's 1 to 5] Provide documentation of how the site design credit is calculated in the PDP SWQMP.		0	cu. ft.
17	Is Line 16 ≥ Line 15?	Volume Retention Performance Standard is Met		

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments	
	BMP ID	BMP-3	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	1,302	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.81	
3	85th percentile 24-hour rainfall depth	0.56	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	49	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	12	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	21	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	24	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	27	inches
15	Total Depth Treated [Line 13 + Line 14]	57	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	74	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	16	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	37	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	16	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.0300	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	32	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	32	sq. ft.
23	Provided BMP Footprint	115	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments	
	BMP ID	BMP-5A	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	3,633	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.88	
3	85th percentile 24-hour rainfall depth	0.56	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	149	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	21	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	224	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	58	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	112	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	83	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.0300	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	96	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	96	sq. ft.
23	Provided BMP Footprint	100	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments	
	BMP ID	BMP-5B	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	2,287	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.88	
3	85th percentile 24-hour rainfall depth	0.56	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	94	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	21	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	141	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	37	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	70	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	52	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.0300	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	60	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	60	sq. ft.
23	Provided BMP Footprint	62	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments	
	BMP ID	BMP-5C	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	1,904	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.88	
3	85th percentile 24-hour rainfall depth	0.56	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	78	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	21	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	117	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	30	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	59	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	43	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.0300	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	50	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	50	sq. ft.
23	Provided BMP Footprint	57	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments	
	BMP ID	BMP-5D	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	1,891	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.88	
3	85th percentile 24-hour rainfall depth	0.56	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	78	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	21	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	116	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	30	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	58	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	43	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.0300	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	50	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	50	sq. ft.
23	Provided BMP Footprint	57	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments	
	BMP ID	BMP-5E	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	1,731	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.87	
3	85th percentile 24-hour rainfall depth	0.56	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	70	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	21	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	105	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	27	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	53	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	39	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.0300	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	45	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	45	sq. ft.
23	Provided BMP Footprint	57	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments	
	BMP ID	BMP-6A	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	5,034	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.88	
3	85th percentile 24-hour rainfall depth	0.56	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	207	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	21	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	310	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	81	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	155	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	115	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.0300	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	133	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	133	sq. ft.
23	Provided BMP Footprint	150	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments	
	BMP ID	BMP-6B	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	2,152	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.87	
3	85th percentile 24-hour rainfall depth	0.56	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	87	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	21	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	131	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	34	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	66	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	49	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.0300	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	56	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	56	sq. ft.
23	Provided BMP Footprint	80	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments	
	BMP ID	BMP-6C	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	914	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.87	
3	85th percentile 24-hour rainfall depth	0.56	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	37	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	21	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	56	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	14	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	28	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	21	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.0300	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	24	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	24	sq. ft.
23	Provided BMP Footprint	36	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments	
	BMP ID	BMP-7	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	6,028	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.85	
3	85th percentile 24-hour rainfall depth	0.56	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	239	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	21	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	359	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	93	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	179	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	133	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.0300	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	154	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	154	sq. ft.
23	Provided BMP Footprint	175	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments	
	BMP ID	BMP-8A	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	2,297	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.87	
3	85th percentile 24-hour rainfall depth	0.56	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	93	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	21	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	140	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	36	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	70	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	52	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.03	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	60	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	60	sq. ft.
23	Provided BMP Footprint	72	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments	
	BMP ID	BMP-8B	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	1,874	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.87	
3	85th percentile 24-hour rainfall depth	0.56	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	76	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	21	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	114	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	30	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	57	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	42	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.03	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	49	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	49	sq. ft.
23	Provided BMP Footprint	65	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments	
	BMP ID	BMP-8C	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	1,245	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.85	
3	85th percentile 24-hour rainfall depth	0.56	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	49	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	21	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	74	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	19	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	37	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	27	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.03	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	32	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	32	sq. ft.
23	Provided BMP Footprint	82	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments	
	BMP ID	BMP-8D	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	1,914	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.87	
3	85th percentile 24-hour rainfall depth	0.56	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	78	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	21	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	117	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	30	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	58	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	43	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.03	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	50	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	50	sq. ft.
23	Provided BMP Footprint	60	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments	
	BMP ID	BMP-8E	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	1,768	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.86	
3	85th percentile 24-hour rainfall depth	0.56	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	71	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	21	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	106	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	28	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	53	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	39	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.03	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	46	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	46	sq. ft.
23	Provided BMP Footprint	95	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments	
	BMP ID	BMP-9A	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	2,374	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.88	
3	85th percentile 24-hour rainfall depth	0.56	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	97	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	21	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	146	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	38	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	73	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	54	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.0300	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	63	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	63	sq. ft.
23	Provided BMP Footprint	64	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments	
	BMP ID	BMP-9B	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	2,041	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.87	
3	85th percentile 24-hour rainfall depth	0.56	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	83	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	21	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	124	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	32	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	62	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	46	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.0300	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	53	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	53	sq. ft.
23	Provided BMP Footprint	72	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments	
	BMP ID	BMP-9C	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	2,106	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.88	
3	85th percentile 24-hour rainfall depth	0.56	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	86	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	21	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	130	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	34	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	65	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	48	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.0300	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	56	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	56	sq. ft.
23	Provided BMP Footprint	60	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments	
	BMP ID	BMP-10A	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	2,059	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.87	
3	85th percentile 24-hour rainfall depth	0.56	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	84	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	21	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	125	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	33	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	63	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	46	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.0300	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	54	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	54	sq. ft.
23	Provided BMP Footprint	70	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments	
	BMP ID	BMP-10B	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	2,359	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.88	
3	85th percentile 24-hour rainfall depth	0.56	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	97	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	21	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	145	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	38	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	73	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	54	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.0300	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	62	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	62	sq. ft.
23	Provided BMP Footprint	62	sq. ft.
24	Is Line 23 ≥ Line 22?	**No, Increase the BMP Footprint**	

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments	
	BMP ID	BMP-10C	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	3,005	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.88	
3	85th percentile 24-hour rainfall depth	0.56	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	123	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	21	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	185	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	48	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	93	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	69	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.0300	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	79	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	79	sq. ft.
23	Provided BMP Footprint	80	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments	
	BMP ID	BMP-12A	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	3,533	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.86	
3	85th percentile 24-hour rainfall depth	0.56	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	142	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	21	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	213	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	55	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	106	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	79	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.03	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	91	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	91	sq. ft.
23	Provided BMP Footprint	175	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments	
	BMP ID	BMP-12B	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	2,372	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.87	
3	85th percentile 24-hour rainfall depth	0.56	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	96	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	21	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	144	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	38	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	72	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	54	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.03	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	62	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	62	sq. ft.
23	Provided BMP Footprint	84	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments	
	BMP ID	BMP-13	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	3,094	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.52	
3	85th percentile 24-hour rainfall depth	0.56	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	75	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	21	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	113	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	29	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	56	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	42	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.0300	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	48	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	48	sq. ft.
23	Provided BMP Footprint	90	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Alvarado Creek Apartments	
	BMP ID	BMP-15	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	3,578	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.88	
3	85th percentile 24-hour rainfall depth	0.56	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	147	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	21	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	220	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	57	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	110	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	82	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.030	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	94	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	94	sq. ft.
23	Provided BMP Footprint	100	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

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

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

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

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

Section 1: Biofiltration Criteria Checklist (Appendix F)

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

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

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

Provide basis for Criteria 1 and 3:

Feasibility Analysis:

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

If Partial Infiltration Condition:

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

If No Infiltration Condition:

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

The compact biofiltration BMPs are located near building footprint and infiltration is not feasible.

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

Provide basis for Criteria 2:

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

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

Provide basis for Criteria 4:

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

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

Provide basis for Criteria 5:

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

The proposed compact biofiltration device will be planted with appropriate vegetation, and the vegetation will be maintained so that the device will provide sustained biological treatment of the stormwater being conveyed through the device media, vegetation root system, and microbiome. The final engineering O&M Plan will specific that the media and vegetation be periodically replace (e.g., when needed or every 10 years, whichever occurs first).

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

Provide basis for Criteria 6:

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

Calculations provided demonstrating that flow based design is appropriate.

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

Provide basis for Criteria 7:

Include copy of manufacturer guidelines and conditions of third-party certification in the maintenance agreement. PDP SWQMP must include a statement that the compact BMP will be maintained in accordance with manufacturer guidelines and conditions of third-party certification.

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

WASHINGTON STATE DEPARTMENT OF ECOLOGY

April 2014

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

For the

MWS-Linear Modular Wetland

Ecology's Decision:

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

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

4. Ecology approves the MWS - Linear Modular Wetland Stormwater Treatment System units for Basic, Phosphorus, and Enhanced treatment at the hydraulic loading rate listed above. Designers shall calculate the water quality design flow rates using the following procedures:

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

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

Ecology's Conditions of Use:

Applicants shall comply with the following conditions:

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

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

first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections.

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

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

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

Application Documents:

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

Applicant's Use Level Request:

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

Applicant's Performance Claims:

- The MWS – Linear Modular wetland is capable of removing a minimum of 80-percent of TSS from stormwater with influent concentrations between 100 and 200 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 50-percent of Total Phosphorus from stormwater with influent concentrations between 0.1 and 0.5 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 30-percent of dissolved Copper from stormwater with influent concentrations between 0.005 and 0.020 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 60-percent of dissolved Zinc from stormwater with influent concentrations between 0.02 and 0.30 mg/l.

Ecology Recommendations:

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

Findings of Fact:

Laboratory Testing

The MWS-Linear Modular wetland has the:

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

Field Testing

- Modular Wetland Systems, Inc. conducted monitoring of an MWS-Linear (Model # MWS-L-4-13) from April 2012 through May 2013, at a transportation maintenance facility in Portland, Oregon. The manufacturer collected flow-weighted composite

samples of the system's influent and effluent during 28 separate storm events. The system treated approximately 75 percent of the runoff from 53.5 inches of rainfall during the monitoring period. The applicant sized the system at 1 gpm/sq ft. (wetland media) and 3gpm/sq ft. (prefilter).

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

Issues to be addressed by the Company:

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

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

Contact Information:

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Applicant website: http://www.modularwetlands.com/

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

Ecology: Douglas C. Howie, P.E.
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Water Quality Program
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Revision History

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

September 2019

GENERAL USE LEVEL DESIGNATION FOR BASIC (TSS), ENHANCED, PHOSPHORUS & OIL TREATMENT

For

Contech Engineered Solutions Filterra® Bioscape™

Ecology's Decision:

Based on Contech's submissions, including the Final Technical Evaluation Reports, dated August 2019, March, 2014, December 2009 and additional information provided to Ecology, Ecology hereby issues the following use level designations:

1. A General Use Level Designation for Basic, Enhanced, Phosphorus, and Oil Treatment for the Filterra® Bioscape System constructed with a minimum media thickness of 21 inches (1.75 feet), at the following water quality design hydraulic loading rates:

Treatment	Infiltration Rate (in/hr) for use in BMP Sizing
Basic	175
Phosphorus	100
Oil	50
Enhanced	175

2. The Filterra® Bioscape™ unit is not appropriate for oil spill-control purposes.
3. Ecology approves the Filterra® Bioscape™ units for treatment at the hydraulic loading rates listed above, to achieve the maximum water quality design flow rate. Calculate the water quality design flow rates using the following procedures:

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

4. This General Use Level Designation has no expiration date but Ecology may revoke or amend the designation, and is subject to the conditions specified below.

Ecology's Conditions of Use:

Filterra Bioscape systems shall comply with the following conditions:

1. Design, assemble, install, operate, and maintain the Filterra Bioscape systems in accordance with applicable Contech Filterra manuals, document, and the Ecology Decision.

2. The minimum size filter surface-area for use in Washington is determined by using the design water quality flow rate (as determined in this Ecology Decision, Item 3, above) and the Infiltration Rate from the table above (use the lowest applicable Infiltration Rate depending on the level of treatment required). Calculate the required area by dividing the water quality design flow rate (cu-ft/sec) by the Infiltration Rate (converted to ft/sec) to obtain required surface area (sq-ft) of the Filterra unit.

3. Each site plan must undergo Contech Filterra review before Ecology can approve the unit for site installation. This will ensure that design parameters including site grading and slope are appropriate for use of a Filterra Bioscape unit.
4. Filterra Bioscape media shall conform to the specifications submitted to and approved by Ecology and shall be sourced from Contech Engineered Solutions, LLC with no substitutions.
5. Maintenance includes removing trash, degraded mulch, and accumulated debris from the filter surface and replacing the mulch layer. Use inspections to determine the site-specific maintenance schedules and requirements. Follow maintenance procedures given in the most recent version of the Filterra® Bioscape™ Operation and Maintenance Manual.
6. Maintenance: The required maintenance interval for stormwater treatment devices is often dependent upon the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured filter treatment device.
    - Contech designs Filterra systems for a target maintenance interval of 6 months in the Pacific Northwest. Maintenance includes removing and replacing the mulch layer above the media along with accumulated sediment, trash, and captured organic materials therein, evaluating plant health, and pruning the plant if deemed necessary.
    - Conduct maintenance following manufacturer's guidelines.
7. Bioscape™ systems may or may not utilize an underdrain. Bioscape systems without an underdrain shall be designed with a temporary water storage area beneath the treatment media to provide a detention reservoir. Water shall not saturate the treatment media at any time
8. The distance from the point of entry of water to the most distant point on the surface of the Filterra Bioscape treatment media shall not exceed 12-feet. The Filterra Bioscape requires water to flow across the entire surface area to obtain optimal performance.

9. Install the Filterra Bioscape in such a manner that flows exceeding the maximum Filterra operating rate are conveyed around the Filterra Bioscape mulch and media and will not resuspend captured sediment.
10. Discharges from the Filterra® units shall not cause or contribute to water quality standards violations in receiving waters.

Applicant: Contech Engineered Solutions, LLC.

Applicant's Address: 11815 NE Glenn Widing Drive
Portland, OR 97220

Application Documents:

- State of Washington Department of Ecology Application for Conditional Use Designation, Americast (September 2006)
- Quality Assurance Project Plan Filterra® Bioretention Filtration System Performance Monitoring, Americast (April 2008)
- Quality Assurance Project Plan Addendum Filterra® Bioretention Filtration System Performance Monitoring, Americast (June 2008)
- Draft Technical Evaluation Report Filterra® Bioretention Filtration System Performance Monitoring, Americast (August 2009)
- Final Technical Evaluation Report Filterra® Bioretention Filtration System Performance Monitoring, Americast (December 2009)
- Technical Evaluation Report Appendices Filterra® Bioretention Filtration System Performance Monitoring, Americast (August 2009)
- Memorandum to Department of Ecology Dated October 9, 2009 from Americast, Inc. and Herrera Environmental Consultants
- Quality Assurance Project Plan Filterra® Bioretention System Phosphorus treatment and Supplemental Basic and Enhanced Treatment Performance Monitoring, Americast (November 2011)
- Filterra® letter August 24, 2012 regarding sizing for the Filterra® Shallow System.
- University of Virginia Engineering Department Memo by Joanna Crowe Curran, Ph. D dated March 16, 2013 concerning capacity analysis of Filterra® internal weir inlet tray.
- Filterra® Bioscape™ Bioretention System Model Configuration Approval Request, January 2014
- Terraphase Engineering letter to Jodi Mills, P.E. dated April 2, 2013 regarding Terraflume Hydraulic Test, Filterra® Bioretention System and attachments.
- Technical Evaluation Report, Filterra® System Phosphorus Treatment and Supplemental Basic Treatment Performance Monitoring. March 27th, 2014.
- State of Washington Department of Ecology Application for Conditional Use Level Designation, Contech Engineered Solutions (May 2015)
- Quality Assurance Project Plan Filterra® Bioretention System, Contech Engineered Solutions (May 2015)
- Filterra Bioretention System Armco Avenue General Use Level Designation Technical Evaluation Report, Contech Engineered Solutions (August 2019)

Applicant's Use Level Request:

General Level Use Designation for Basic, Enhanced, Phosphorus, and Oil Treatment.

Applicant's Performance Claims:

Field-testing and laboratory testing show that the Filterra® unit is promising as a stormwater treatment best management practice and can meet Ecology's performance goals for basic, enhanced, phosphorus, and oil treatment.

Findings of Fact:

Field Testing 2015-2019

1. Contech completed field testing of a 4 ft. x 4 ft. Filterra® unit at one site in Hillsboro, Oregon from September 2015 to July 2019. Throughout the monitoring period a total of 24 individual storm events were sampled, of which 23 qualified for TAPE sampling criteria.
2. Contech encountered several unanticipated events and challenges that prevented them from collecting continuous flow and rainfall data. An analysis of the flow data from the sampled events, including both the qualifying and non-qualifying events, demonstrated the system treated over 99 % of the influent flows. Peak flows during these events ranged from 25 % to 250 % of the design flow rate of 29 gallons per minute.
3. Of the 23 TAPE qualified sample events, 13 met requirements for TSS analysis. Influent concentrations ranged from 20.8 mg/L to 83 mg/L, with a mean concentration of 46.3 mg/L. The UCL95 mean effluent concentration was 15.9 mg/L, meeting the 20 mg/L performance goal for Basic Treatment.
4. All 23 TAPE qualified sample events met requirements for dissolved zinc analysis. Influent concentrations range from 0.0384 mg/L to 0.2680 mg/L, with a mean concentration of 0.0807 mg/L. The LCL 95 mean percent removal was 62.9 %, meeting the 60 % performance goal for Enhanced Treatment.
5. Thirteen of the 23 TAPE qualified sample events met requirements for dissolved copper analysis. Influent concentrations ranged from 0.00543 mg/L to 0.01660 mg/L, with a mean concentration of 0.0103 mg/L. The LCL 95 mean percent removal was 41.2 %, meeting the 30 % performance goal for Enhanced Treatment.
6. Total zinc concentrations were analyzed for all 24 sample events. Influent EMCs for total zinc ranged from 0.048 mg/L to 5.290 mg/L with a median of 0.162 mg/L. Corresponding effluent EMCs for total zinc ranged from 0.015 mg/L to 0.067 mg/L with a median of 0.029 mg/L. Total event loadings for the study for total zinc were 316.85 g at the influent and 12.92 g at the effluent sampling location, resulting in a summation of loads removal efficiency of 95.9 %.
7. Total copper concentrations were analyzed for all 24 sample events. Influent EMCs for

total copper ranged from 0.003 mg/L to 35.600 mg/L with a median value of 0.043 mg/L. Corresponding effluent EMCs for total copper ranged from 0.002 mg/L to 0.015 mg/L with a median of 0.004 mg/L. Total event loadings for total copper for the study were 1,810.06 g at the influent and 1.90 g at the effluent sampling location, resulting in a summation of loads removal efficiency of 99.9 %.

Field Testing 2013

1. Filterra® completed field-testing of a 6.5 ft x 4 ft. unit at one site in Bellingham, Washington. Continuous flow and rainfall data collected from January 1, 2013 through July 23, 2013 indicated that 59 storm events occurred. The monitoring obtained water quality data from 22 storm events. Not all the sampled storms produced information that met TAPE criteria for storm and/or water quality data.
2. The system treated 98.9 percent of the total 8-month runoff volume during the testing period. Consequently, the system achieved the goal of treating 91 percent of the volume from the site. Stormwater runoff bypassed during four of the 59 storm events.
3. Of the 22 sampled events, 18 qualified for TSS analysis (influent TSS concentrations ranged from 25 to 138 mg/L). The data were segregated into sample pairs with influent concentration greater than and less than 100 mg/L. The UCL95 mean effluent concentration for the data with influent less than 100 mg/L was 5.2 mg/L, below the 20-mg/L threshold. Although the TAPE guidelines do not require an evaluation of TSS removal efficiency for influent concentrations below 100 mg/L, the mean TSS removal for these samples was 90.1 percent. Average removal of influent TSS concentrations greater than 100 mg/L (three events) was 85 percent. In addition, the system consistently exhibited TSS removal greater than 80 percent at flow rates at a 100 inches per hour [in/hr] infiltration rate and was observed at 150 in/hr.
4. Ten of the 22 sampled events qualified for TP analysis. Americast augmented the dataset using two sample pairs from previous monitoring at the site. Influent TP concentrations ranged from 0.11 to 0.52 mg/L. The mean TP removal for these twelve events was 72.6 percent. The LCL95 mean percent removal was 66.0, well above the TAPE requirement of 50 percent. Treatment above 50 percent was evident at 100 in/hr infiltration rate and as high as 150 in/hr. Consequently, the Filterra® test system met the TAPE Phosphorus Treatment goal at 100 in/hr. Influent ortho-P concentrations ranged from 0.005 to 0.012 mg/L; effluent ortho-P concentrations ranged from 0.005 to 0.013 mg/L. The reporting limit/resolution for the ortho-P test method is 0.01 mg/L, therefore the influent and effluent ortho-P concentrations were both at or near non-detect concentrations.

Field Testing 2008-2009

1. Filterra® completed field-testing at two sites at the Port of Tacoma. Continuous flow and rainfall data collected during the 2008-2009 monitoring period indicated that 89 storm events occurred. The monitoring obtained water quality data from 27 storm events. Not all the sampled storms produced information that met TAPE criteria for storm and/or water quality data.

2. During the testing at the Port of Tacoma, 98.96 to 99.89 percent of the annual influent runoff volume passed through the POT1 and POT2 test systems respectively. Stormwater runoff bypassed the POT1 test system during nine storm events and bypassed the POT2 test system during one storm event. Bypass volumes ranged from 0.13% to 15.3% of the influent storm volume. Both test systems achieved the 91 percent water quality treatment-goal over the 1-year monitoring period.
3. Consultants observed infiltration rates as high as 133 in/hr during the various storms. Filterra® did not provide any paired data that identified percent removal of TSS, metals, oil, or phosphorus at an instantaneous observed flow rate.
4. The maximum storm average hydraulic loading rate associated with water quality data is <40 in/hr, with the majority of flow rates < 25 in/hr. The average instantaneous hydraulic loading rate ranged from 8.6 to 53 inches per hour.
5. The field data showed a removal rate greater than 80% for TSS with an influent concentration greater than 20 mg/l at an average instantaneous hydraulic loading rate up to 53 in/hr (average influent concentration of 28.8 mg/l, average effluent concentration of 4.3 mg/l).
6. The field data showed a removal rate generally greater than 54% for dissolved zinc at an average instantaneous hydraulic loading rate up to 60 in/hr and an average influent concentration of 0.266 mg/l (average effluent concentration of 0.115 mg/l).
7. The field data showed a removal rate generally greater than 40% for dissolved copper at an average instantaneous hydraulic loading rate up to 35 in/hr and an average influent concentration of 0.0070 mg/l (average effluent concentration of 0.0036 mg/l).
8. The field data showed an average removal rate of 93% for total petroleum hydrocarbon (TPH) at an average instantaneous hydraulic loading rate up to 53 in/hr and an average influent concentration of 52 mg/l (average effluent concentration of 2.3 mg/l). The data also shows achievement of less than 15 mg/l TPH for grab samples. Filterra® provided limited visible sheen data due to access limitations at the outlet monitoring location.
9. The field data showed low percentage removals of total phosphorus at all storm flows at an average influent concentration of 0.189 mg/l (average effluent concentration of 0.171 mg/l). We may relate the relatively poor treatment performance of the Filterra® system at this location to influent characteristics for total phosphorus that are unique to the Port of Tacoma site. It appears that the Filterra® system will not meet the 50 percent removal performance goal when you expect the majority of phosphorus in the runoff to be in the dissolved form.

<u>Laboratory Testing</u>

1. Filterra® performed laboratory testing on a scaled down version of the Filterra® unit. The lab data showed an average removal from 83-91% for TSS with influents ranging from 21 to 320 mg/L, 82-84% for total copper with influents ranging from 0.94 to 2.3 mg/L, and 50-61% for orthophosphate with influents ranging from 2.46 to 14.37 mg/L.
2. Filterra® conducted permeability tests on the soil media.

3. Lab scale testing using Sil-Co-Sil 106 showed percent removals ranging from 70.1% to 95.5% with a median percent removal of 90.7%, for influent concentrations ranging from 8.3 to 260 mg/L. Filterra® ran these laboratory tests at an infiltration rate of 50 in/hr.
4. Supplemental lab testing conducted in September 2009 using Sil-Co-Sil 106 showed an average percent removal of 90.6%. These laboratory tests were run at infiltration rates ranging from 25 to 150 in/hr for influent concentrations ranging from 41.6 to 252.5 mg/l. Regression analysis results indicate that the Filterra® system's TSS removal performance is independent of influent concentration in the concentration rage evaluated at hydraulic loading rates of up to 150 in/hr.

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Applicant's Website: http://www.conteches.com

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

Ecology: Douglas C. Howie, P.E.
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Water Quality Program
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douglas.howie@ecy.wa.gov

Date	Revision
July 2014	GULD for Basic, Enhanced, Phosphorus and Oil granted
March 2015	Revised Contact Information
December 2015	Revised device name from Filterra® Boxless™ to Filterra® Bioscape™
June 2016	Revised text regarding Hydraulic conductivity value
November 2016	Changed Contech contact information
September 2019	GULD for Basic and Enhanced at 175 in/hr infiltration rate

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.

Project Name: Alvarado Creek Apartments

Indicate which Items are Included:

Attachment Sequence	Contents	Checklist
Attachment 2a	Hydromodification Management Exhibit (Required)	☑ Included See Hydromodification Management Exhibit Checklist.
Attachment 2b	Management of Critical Coarse Sediment Yield Areas (WMAA Exhibit is required, additional analyses are optional) See Section 6.2 of the BMP Design Manual.	☑ Exhibit showing project drainage boundaries marked on WMAA Critical Coarse Sediment Yield Area Map (Required) Optional analyses for Critical Coarse Sediment Yield Area Determination ☐ 6.2.1 Verification of Geomorphic Landscape Units Onsite ☐ 6.2.2 Downstream Systems Sensitivity to Coarse Sediment ☐ 6.2.3 Optional Additional Analysis of Potential Critical Coarse Sediment Yield Areas Onsite
Attachment 2c	Geomorphic Assessment of Receiving Channels (Optional) See Section 6.3.4 of the BMP Design Manual.	☑ Not Performed ☐ Included ☐ Submitted as separate stand-alone document
Attachment 2d	Flow Control Facility Design and Structural BMP Drawdown Calculations (Required) Overflow Design Summary for each structural BMP See Chapter 6 and Appendix G of the BMP Design Manual	☑ Included ☐ Submitted as separate stand-alone document

Project Name: Alvarado Creek Apartments

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 OR provide a separate map showing that the project site is outside of any critical coarse sediment yield areas
- ☑ 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).

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HYDROMODIFICATION MANAGEMENT ANALYSIS REPORT FOR ALVARADO CREEK APARTMENT PROJECT

Job Number 19048

August 18, 2020
Revised February 2, 2021
Revised May 3, 2021
Revised September 24, 2021

RICK ENGINEERING COMPANY
ENGINEERING COMPANY
RICK ENGINEERING CO

RICK™
ENGINEERING COMPANY

HYDROMODIFICATION MANAGEMENT ANALYSIS REPORT

FOR

ALVARADO CREEK APARTMENT PROJECT

Job Number 19048

Jayne M. Janda-Timba, P.E.
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August 18, 2020
Revised February 2, 2021
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APPENDICES

APPENDIX A: DISCHARGE RATING TABLES & DRAWDOWN CALCULATIONS

MAP POCKET 1: PRE-DEVELOPED CONDITION DMA EXHIBIT

MAP POCKET 2: POST-PROJECT CONDITION DMA EXHIBIT

1.0 INTRODUCTION, PURPOSE, AND SCOPE

The proposed site improvements for the Alvarado Creek Apartments Project (herein referred to as "project") is a proposed affordable housing development located in Grantville, which is a community in the City of San Diego, California. The project site address is at 5901 Mission Gorge Road. The site is currently occupied by small structures, asphalt cover, pervious/landscaped areas, and Alvarado Creek area totaling approximately 3.2 acres. The project includes a proposed podium structure with associated hardscape and landscape areas with a total developed area of approximately 1.69 acres. A vicinity map is provided as Figure 1-1.

The purpose of this report is to document the methods, parameters, and results of the hydromodification analysis, which was performed pursuant to the guidance described in Part 1 of the City of San Diego's *Storm Water Standards Part 1: BMP Design Manual Appendices*, dated January 16, 2016 (herein referred to as "Storm Water Standards Manual") (City of San Diego, 2016).

The scope of the report includes:

1. General Methodology
2. Pre-developed condition analysis
3. Post-project condition analysis
4. Post processing results

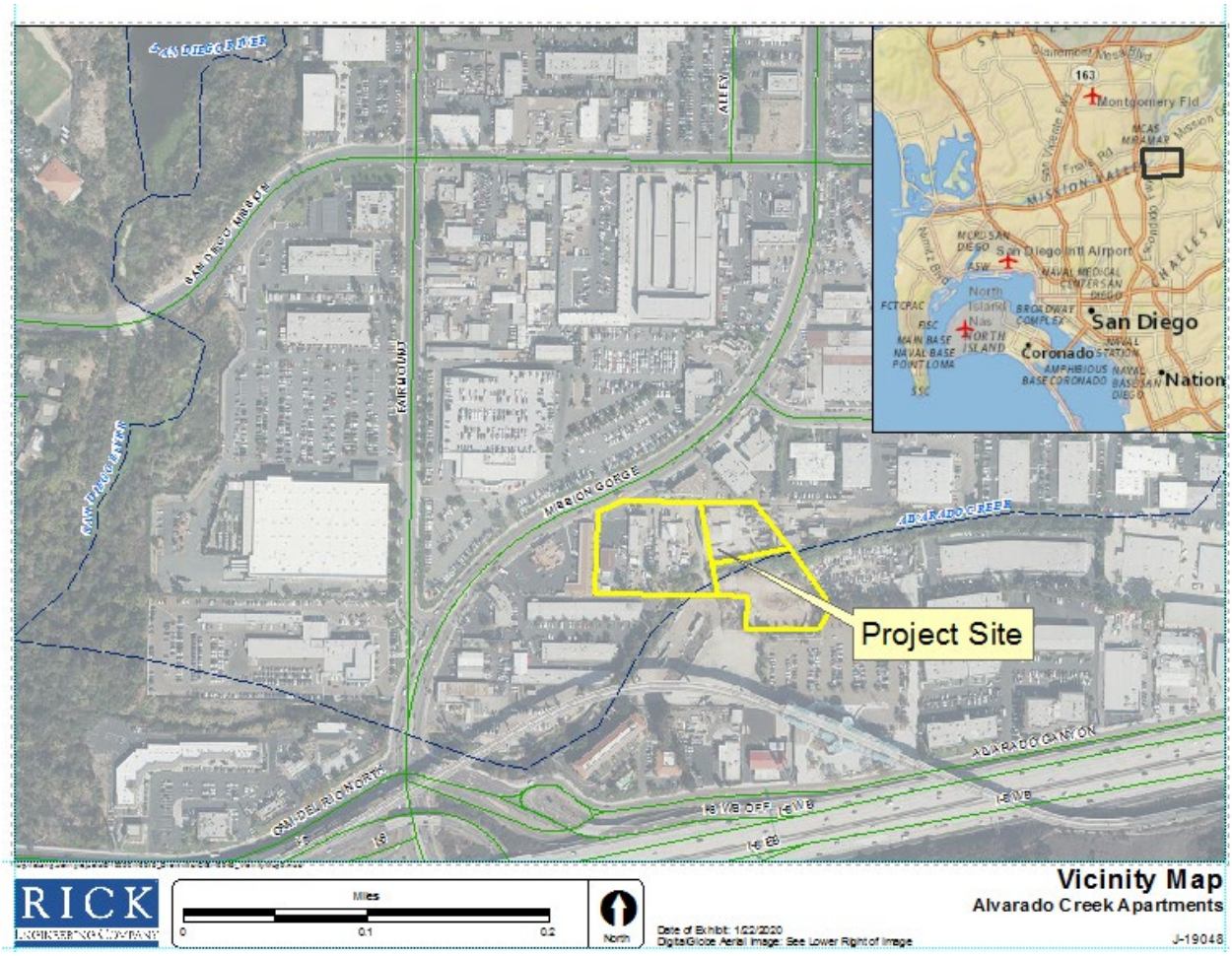


Figure 1-1. Vicinity Map

2.0 GENERAL METHODOLOGY

In accordance with the Storm Water Standards Manual, a hydromodification management analysis was performed to demonstrate that flows at the point of compliance (POC) in post-project conditions will not be greater than flows at the POC in the pre-developed condition for both peak flow rate and duration for range of flows of concern. In the existing condition, runoff from the site flows into Alvarado Creek through a combination of an existing 18-inch storm drain, a swale along an existing access road (in a similar alignment as the existing 18-inch storm drain), and sheet flow. As such, for the purpose of the flow frequency and duration comparison, the POC is the existing downstream most site connection with Alvarado Creek at the southwest corner of the project site, where flows in the proposed condition will enter Alvarado Creek from the proposed 18-inch outfall from the flow control vault system. The range of flows of concern for this project is between the 10% of the 2-year peak flow and the 10-year peak flow. The pre-developed and post-project conditions continuous simulation modeling was performed using the US Environmental Protection Agency (EPA) Storm Water Management Model (SWMM) 5.1. Fashion Valley Rain Gage data, obtained from the Project Cleanwater website (http://www.projectcleanwater.org/), were incorporated into the SWMM analysis. Hourly data from the SWMM modeling were exported to Excel spreadsheets for post-processing analysis. Based on the data presented in the Excel spreadsheets, BMP parameters were adjusted until the management criteria were met (i.e., orifice diameters and basin depths were designed through an iterative process modeling, post-processing, and adjusting parameters).

3.0 PRE-DEVELOPED CONDITION MODELING

3.1 Drainage Area Delineations

Based on the project topographic survey, the pre-developed (existing) condition drainage area was determined for the site. For the purpose of the hydromodification management analysis the post-project drainage management areas (DMAs) that include areas of proposed redevelopment/improvements (e.g., buildings, roads, sidewalks, etc.) were compared to the same area in the pre-developed condition. Meaning, the post-project DMAs were overlain on the existing condition drainage map to determine areas, soil groups, and slope parameters that were then incorporated into the pre-developed condition SWMM model. Table 3-1 provides a summary of the pre-developed areas.

Table 3-1. Subarea Summary, Pre-Development Condition

DMA	Total Area Area (Acres)	"A" Soils Area (Acres)	"D" Soils Area (Acres)	Impervious Fraction
Natural	0.077	0.071	0.007	5%
Urban	1.463	1.34	0.124	95%
Total	**1.54**	**1.411**	**0.131**	**100%**

3.2 Catchment Modeling Parameters

In accordance the Table G.1-4 of the Storm Water Standards Manual, the parameters presented in Table 3-2 were incorporated into the SWMM analysis for the pre-developed condition.

Table 3-2. Summary of Pre-Developed Condition SWMM Catchment Parameters

Parameter	Value	Notes
% Imperv	0%	
N-Imperv	0.012	Manning's n for impervious.
N-Perv	0.1	Manning's n for pervious.
Dstore-Imperv	0.05	Depth of depression storage on impervious portion.
Dstore-Perv	0.1	Depth of depression storage on pervious portion.
Subarea Routing	Outlet	
Infiltration Method	Green-Ampt	
Suction Head	1.5 or 9	Soil capillary suction head. (soil group A or D)
Conductivity(in/hr)	A Soil: 0.3 Natural, 0.225 Urban D Soil: 0.025 Natural, 0.01875 Urban	Soil saturated hydraulic conductivity. (areas beneath pavement and concrete)
Initial Deficit	0.33 or 0.31	Difference between soil porosity and initial moisture content (a fraction) (soil group A or D)
Evaporation	CIMIS Zone 6 Values	

4.0 POST-PROJECT CONDITION MODELING

4.1 Drainage Area Delineations

Based on the proposed project topography, the post-developed condition drainage areas were determined for the site. The areas where impervious improvements are proposed were divided into one DMAs, draining to several pollutant control features, including biofiltration planters and impervious area dispersion, and on flow control vault system. Based on the proposed improvements, the impervious areas and pervious areas were determined. The impervious areas included building rooftops and parking lots. The pervious areas included landscaped areas and the BMPs proposed for the site. Because the landscaped areas and BMPs are on the proposed podium structure, there will be no infiltration. At this preliminary level, the developed area, including landscaped areas, are considered as impervious for the SWMM analysis. During final engineering, the landscaped areas will be incorporated into modeling, which will most likely reduce the size of the vault system needed. Please note that project includes grading along the north and south side of Alvarado Creek. The creek grading areas will mimic that of natural pervious area, are considered as self-mitigating, and thus not included as part of the is SWMM analysis. Similarly, the frontage area of the project is considered a retrofit of an existing road or alley and has been designed consistent with EPA guidance for green streets and therefore the frontage alley area has been excluded from the SWMM analysis. Table 4-1 provides a summary of the post-project areas. The Post-Project Condition Hydromodification Exhibit is provided as map attached to this document and shows the areas.

Table 4-1. Subarea Summary

DMA	Pervious Area (Acres)	Impervious Area (Acres)	Total Area (Acres)	Impervious Fraction
DMA 1	0	1.54	1.54	100%

4.2 Catchment Modeling Parameters

In accordance the Table G.1-4 of the Storm Water Standards Manual, the parameters presented in Table 4-2 were incorporated into the SWMM analysis for the post-project condition.

Table 4-2. Summary of Post-Project Condition SWMM Catchment Parameters

Parameter	Value	Notes
% Imperv	Varies	See Table 4-1.
N-Imperv	0.012	Manning's n for impervious.
N-Perv	0.1	Manning's n for pervious.
Dstore-Imperv	0.05	Depth of depression storage on impervious portion.
Dstore-Perv	0.1	Depth of depression storage on pervious portion.
Subarea Routing	Outlet	
Infiltration Method	Green-Ampt	
Suction Head	1.5 or 9	Soil capillary suction head. (soil group A or D)
Conductivity	A Soil: 0.225 Urban D Soil: 0.01875 Urban	Soil saturated hydraulic conductivity. (areas beneath pavement and concrete)
Initial Deficit	0.33 or 0.31	Difference between soil porosity and initial moisture content (a fraction) (soil group A or D)
Evaporation	CIMIS Zone 6 Values	

4.3 BMP Modeling Methodology

The proposed BMPs were modeled using a combination of the SWMM Storage Units, Outlet Links, and Junction Nodes. Parameters were incorporated into the model in accordance with the Stormwater Standards Appendix G guidance. Storage Units were utilized to simulate vault type BMPs. Discharges from the Storage Unit was simulated using Outlet Links with a rating curve. The rating curve is based on the combination of orifice and weir calculations performed in an Excel spreadsheet provided in hard copy format as an attachment to this report and as a digital file in the submittal package. For the underground vault system, a Thirsty Duck Outlet product is proposed, and the rating curve data obtained from manufacturer were incorporated into the rating curves. Attachment 3 includes documentation by Thirsty Duck for a third-party study performed for the development of the Thirsty Duck rating curve.

Unlike typical outlet works, which only achieve the design peak outflow rate when the storage volume is full and therefore creates the most head over the weir or orifice, Thirsty Duck maintains constant discharge as the buoyant expandable outlet works conduit rises and falls at a fixed depth below the water surface, thereby maintaining a constant fixed head (i.e., a floating weir or orifice). Therefore, by incorporating Thirsty Duck, the peak flow rate is achieved earlier and is constant throughout the inflow which reduces the volume required to store the peak flow rate and therefore reduces the footprint required to meet HMP design requirements. The ratings curves reflect the constant discharge as shown in the attachments.

5.0 POST-PROCESSING

5.1 Post-Processing Methodology

A post-processing spreadsheets was prepared in accordance the guidance provided in Section G.1.6 of the Storm Water Standards Manual. In general, the spreadsheet includes 100 flow bins of equal flow delta between the low-flow threshold and the 10-year frequency storm event. For each flow bin, the number of pre-developed and post-project exceedances were tallied and compared.

Regression equations developed by the USGS were utilized to determine the 2-year and 10-year frequencies peak flow rates. The USGS has performed extensive research of natural watershed in developing the regression equations, and thus these equations provide an accurate estimation of these key peak values. The equations below were obtained from the Methods for Determining Magnitude and Frequency of Floods in California, Based on Data through Water Year 2006, dated 2012, prepared by the USGS (USGS, 2012).

2-Year Frequency Peak Flow: $Q_2 = 3.6\ (A^{0.672})\ (P^{0.753})$

10-Year Frequency Peak Flow: $Q_{10} = 6.56\ (A^{0.783})\ (P^{1.07})$

Where:

A is the area in square miles

P is the annual average precipitation (inches/year)

For the value of annual precipitation, 10.75 inches was utilized based on the average annual precipitation recorded by the Fashion Valley Rain Gage.

5.2 Post-Processing Results

Table 5-1 provides a summary of the statistical analysis key values used to prepare the flow frequency and duration table and graph. The outlet structure for each basin was designed through an iterative process which included adjustments to the configuration of orifices, weirs and overflow structures followed by subsequent analyses through the SWMM modeling software. With every iteration, peak flow rates and durations for the range of flows of concern were compared against the pre-developed conditions. The process continued until the proposed basins and overflow structures met the requirements for hydromodification management mitigation.

Table 5-1. Post-Processing Key Parameter Values Used to Develop Flow Frequency and Duration Table and Graph

Parameter	Value
Low-flow Threshold:	10%
0.1xQ2 (Pre):	0.037 cfs
Q10 (Pre):	0.741 cfs
Ordinate #:	100
Incremental Q (Pre):	0.00711 cfs
Total Hourly Data:	354,263 hours

Table 5-2 and Figure 5-2 show the results of the comparison between the pre-developed and post-project conditions flow frequencies and durations for the range of flows of concern. The analysis shows that the project must and will provide flow mitigation to below the regression equation low-flow threshold for all storm events up to the 10-year frequency. This is a result of the regression equation setting the low-flow threshold and the SWMM modeling of small sites with Hydrologic Soil Group A resulting in very little to no runoff.

Table 5-2. Flow Frequencies and Durations Comparison Results

Beginning of Interval	Pre-develop. Flow (cfs)	Pre-develop. Hours	Pre-develop. % Time Exceeding	Post-project Hours	Post-project % Time Exceeding	Percentage	Pass/Fail
1	0.037	0	0	0	0	0%	Pass
2	0.045	0	0	0	0	0%	Pass
3	0.052	0	0	0	0	0%	Pass
4	0.059	0	0	0	0	0%	Pass
5	0.066	0	0	0	0	0%	Pass
6	0.073	0	0	0	0	0%	Pass
7	0.080	0	0	0	0	0%	Pass
8	0.087	0	0	0	0	0%	Pass
9	0.094	0	0	0	0	0%	Pass
10	0.101	0	0	0	0	0%	Pass
11	0.109	0	0	0	0	0%	Pass
12	0.116	0	0	0	0	0%	Pass
13	0.123	0	0	0	0	0%	Pass
14	0.130	0	0	0	0	0%	Pass
15	0.137	0	0	0	0	0%	Pass
16	0.144	0	0	0	0	0%	Pass
17	0.151	0	0	0	0	0%	Pass
18	0.158	0	0	0	0	0%	Pass
19	0.165	0	0	0	0	0%	Pass

Table 5-2. Flow Frequencies and Durations Comparison Results

Beginning of Interval	Pre-develop. Flow (cfs)	Pre-develop. Hours	Pre-develop. % Time Exceeding	Post-project Hours	Post-project % Time Exceeding	Percentage	Pass/Fail
20	0.173	0	0	0	0	0%	Pass
21	0.180	0	0	0	0	0%	Pass
22	0.187	0	0	0	0	0%	Pass
23	0.194	0	0	0	0	0%	Pass
24	0.201	0	0	0	0	0%	Pass
25	0.208	0	0	0	0	0%	Pass
26	0.215	0	0	0	0	0%	Pass
27	0.222	0	0	0	0	0%	Pass
28	0.229	0	0	0	0	0%	Pass
29	0.237	0	0	0	0	0%	Pass
30	0.244	0	0	0	0	0%	Pass
31	0.251	0	0	0	0	0%	Pass
32	0.258	0	0	0	0	0%	Pass
33	0.265	0	0	0	0	0%	Pass
34	0.272	0	0	0	0	0%	Pass
35	0.279	0	0	0	0	0%	Pass
36	0.286	0	0	0	0	0%	Pass
37	0.293	0	0	0	0	0%	Pass
38	0.301	0	0	0	0	0%	Pass
39	0.308	0	0	0	0	0%	Pass
40	0.315	0	0	0	0	0%	Pass
41	0.322	0	0	0	0	0%	Pass
42	0.329	0	0	0	0	0%	Pass
43	0.336	0	0	0	0	0%	Pass
44	0.343	0	0	0	0	0%	Pass
45	0.350	0	0	0	0	0%	Pass
46	0.357	0	0	0	0	0%	Pass
47	0.365	0	0	0	0	0%	Pass
48	0.372	0	0	0	0	0%	Pass
49	0.379	0	0	0	0	0%	Pass
50	0.386	0	0	0	0	0%	Pass
51	0.393	0	0	0	0	0%	Pass
52	0.400	0	0	0	0	0%	Pass
53	0.407	0	0	0	0	0%	Pass
54	0.414	0	0	0	0	0%	Pass
55	0.421	0	0	0	0	0%	Pass
56	0.429	0	0	0	0	0%	Pass

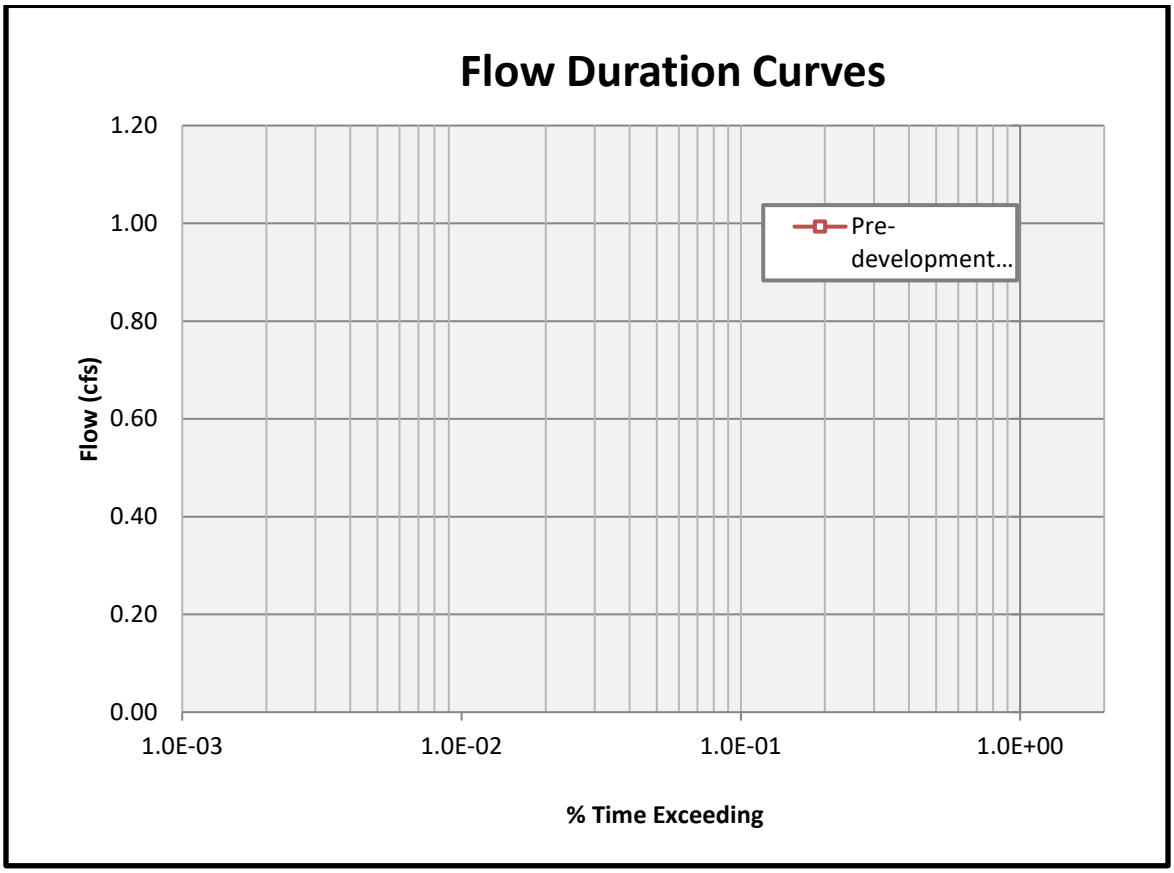
Table 5-2. Flow Frequencies and Durations Comparison Results

Beginning of Interval	Pre-develop. Flow (cfs)	Pre-develop. Hours	Pre-develop. % Time Exceeding	Post-project Hours	Post-project % Time Exceeding	Percentage	Pass/Fail
57	0.436	0	0	0	0	0%	Pass
58	0.443	0	0	0	0	0%	Pass
59	0.450	0	0	0	0	0%	Pass
60	0.457	0	0	0	0	0%	Pass
61	0.464	0	0	0	0	0%	Pass
62	0.471	0	0	0	0	0%	Pass
63	0.478	0	0	0	0	0%	Pass
64	0.485	0	0	0	0	0%	Pass
65	0.493	0	0	0	0	0%	Pass
66	0.500	0	0	0	0	0%	Pass
67	0.507	0	0	0	0	0%	Pass
68	0.514	0	0	0	0	0%	Pass
69	0.521	0	0	0	0	0%	Pass
70	0.528	0	0	0	0	0%	Pass
71	0.535	0	0	0	0	0%	Pass
72	0.542	0	0	0	0	0%	Pass
73	0.549	0	0	0	0	0%	Pass
74	0.557	0	0	0	0	0%	Pass
75	0.564	0	0	0	0	0%	Pass
76	0.571	0	0	0	0	0%	Pass
77	0.578	0	0	0	0	0%	Pass
78	0.585	0	0	0	0	0%	Pass
79	0.592	0	0	0	0	0%	Pass
80	0.599	0	0	0	0	0%	Pass
81	0.606	0	0	0	0	0%	Pass
82	0.613	0	0	0	0	0%	Pass
83	0.621	0	0	0	0	0%	Pass
84	0.628	0	0	0	0	0%	Pass
85	0.635	0	0	0	0	0%	Pass
86	0.642	0	0	0	0	0%	Pass
87	0.649	0	0	0	0	0%	Pass
88	0.656	0	0	0	0	0%	Pass
89	0.663	0	0	0	0	0%	Pass
90	0.670	0	0	0	0	0%	Pass
91	0.677	0	0	0	0	0%	Pass
92	0.685	0	0	0	0	0%	Pass
93	0.692	0	0	0	0	0%	Pass
94	0.699	0	0	0	0	0%	Pass

Table 5-2. Flow Frequencies and Durations Comparison Results

Beginning of Interval	Pre-develop. Flow (cfs)	Pre-develop. Hours	Pre-develop. % Time Exceeding	Post-project Hours	Post-project % Time Exceeding	Percentage	Pass/Fail
95	0.706	0	0	0	0	0%	Pass
96	0.713	0	0	0	0	0%	Pass
97	0.720	0	0	0	0	0%	Pass
98	0.727	0	0	0	0	0%	Pass
99	0.734	0	0	0	0	0%	Pass
100	0.741	0	0	0	0	0%	Pass

Figure 5-1. Hydromodification Management Analysis Flow Duration Curve



The SWMM analysis included a StormTrap vault system consisting of 33 units, each 15.33 feet by 8.42 feet with an inside height of six feet and a porosity of 0.9. The outlet structure design for the flow control vault system is provided in Table 5-3.

Table 5-3. Flow Control Vault Outlet Design

Orifice	Diameter (inches)	Invert Height (feet)
Lower Orifice	1.25	0 *
Top Orifice	18	4.5

*Thirsty Duck TDP 184 Series Device with operating head of 8.0 inches.

6.0 DRAWDOWN CALCULATIONS

6.1 Drawdown Modeling

The drawdown calculations in this report were performed to ensure the proposed vault system meets the requirements set forth in the City of San Diego Storm Water Standards Manual. Specifically, the Storm Water Standards Manual states that surface ponding must drawdown within a maximum of 96 hours. For the calculations within this report, the ponding depth was taken at the water depth equal to the invert of the top orifice (emergency overflow). To calculate the drawdown time, incremental time steps were utilized to determine the discharge rate at each step and the resulting volume and depth. The drawdown calculations were performed over the incremental time steps until the ponding depth reached near zero, which corresponds to the bottom of the basin. The total elapsed time for the ponding to reach an elevation of near zero represents the vault drawdown time.

6.2 Drawdown Results

As mentioned previously, the ponding within the proposed vault must drawdown within a maximum of 96 hours. The results of the drawdown calculations are provided in Table 6-1.

Table 6-1: Drawdown Summary Table

Vault	Drawdown Time (Hours)
1	>96

The drawdown calculations performed in this analysis determined that the HMP ponding in the vault system will drawdown in greater than 96 hours. As previous mentioned, during final engineering, the SWMM analysis will incorporate the pervious areas of the podium structure, and the vault system size will most like be reduced, which in turn may allow for drawdown of less than 96 hours. Additionally, the stream susceptibility may be evaluated during the final engineering level, which if found to be moderate or low (as opposed to assuming high susceptibility) will significantly reduce the drawdown time. Never-the-less, if during final engineering the estimated drawdown is greater than 96 hours a vector control plan will be prepared as part of the final engineering document set. The complete drawdown calculations and results are provided in Appendix A.

7.0 SUMMARY

A hydromodification management analysis was performed in accordance with the Storm Water Standards Manual using SWMM software. The results of the analysis indicate that the proposed project as designed complies with the current hydromodification management criteria and drawdown requirements. Compliance has been demonstrated through proposed implementation of an underground vault system. This document has been prepared based on the entitlement engineering documents. Site changes, if applicable, will be incorporated into the SWMM analysis and this document will be updated accordingly.

8.0 REFERENCES

City of San Diego, 2017. *Drainage Design Manual.* January 2017.

City of San Diego, 2018. *Storm Water Standards Manual.* October 1, 2018.

USGS (US Geological Survey), 2012. *Methods for Determining Magnitude and Frequency of Floods in California, Based on Data through Water Year 2006.* 2012.

APPENDIX A

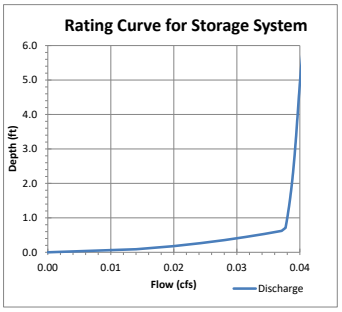
DISCHARGE RATING TABLES & DRAWDOWN CALCULATIONS

Alvarado Creek Apartment Project_HMP Vault Discharge Rating Curve and Drawdown Calculations

Low Flow Orifice (Underdrain)	
Num. of Orfices =	1
Orifice Invert (ft) =	0
Orifice Diameter (in) =	1.25
Cg =	0.6

Midflow Orfice	
Num. of Orfices =	1
Orifice Invert (ft) =	0
Orifice Diameter (in) =	0
Cg =	0.6

Top Outlet (horizontal pipe)	
Num. of Pipes =	1
Pipe Invert (ft) =	4.5
Pipe Diameter (in) =	18
Cg (orifice) =	0.6



Storage System Properties

Depth (ft)	Effective Area (ft2)	Storage (cf)
0	3,832	0
1	3,832	3,832
2	3,832	7,664
3	3,832	11,496
4	3,832	15,328
5	3,832	19,160
6	3,832	22,992

TD Rating Incr = 0.088888888

Outlet Link Rating Curve (Input to SWMM)

h (in)	h (ft)	Lower Orifice Flow (cfs)	Midflow Orfice Flow (cfs)	Outlet Pipe Flow (cfs)	Total Flow (cfs)
0.0	0.00	0.0000000			0.0000
0.5	0.09	0.0140282			0.0140
1.0	0.18	0.0198389			0.0198
1.5	0.27	0.0242976			0.0243
2.0	0.36	0.0280564			0.0281
2.5	0.44	0.0313680			0.0314
3.0	0.53	0.0343620			0.0344
3.5	0.62	0.0371152			0.0371
4.0	0.71	0.0377337			0.0377
4.5	0.80	0.0378204			0.0378
5.0	0.89	0.0379042			0.0379
5.5	0.98	0.0379851			0.0380
6.0	1.07	0.0380632			0.0381
6.5	1.15	0.0381387			0.0381
7.0	1.24	0.0382115			0.0382
7.5	1.33	0.0382819			0.0383
8.0	1.42	0.0383499			0.0383
8.5	1.51	0.0384155			0.0384
9.0	1.60	0.0384789			0.0385
9.5	1.69	0.0385402			0.0385
10.0	1.78	0.0385994			0.0386
10.5	1.86	0.0386567			0.0387
11.0	1.95	0.0387120			0.0387
11.5	2.04	0.0387656			0.0388
12.0	2.13	0.0388174			0.0388
12.5	2.22	0.0388676			0.0389
13.0	2.31	0.0389163			0.0389
13.5	2.40	0.0389634			0.0390
14.0	2.49	0.0390092			0.0390
14.5	2.58	0.0390536			0.0391
15.0	2.66	0.0390968			0.0391
15.5	2.75	0.0391388			0.0391
16.0	2.84	0.0391798			0.0392
16.5	2.93	0.0392198			0.0392
17.0	3.02	0.0392588			0.0393
17.5	3.11	0.0392969			0.0393
18.0	3.20	0.0393343			0.0393
18.5	3.29	0.0393710			0.0394
19.0	3.37	0.0394070			0.0394
19.5	3.46	0.0394425			0.0394
20.0	3.55	0.0394775			0.0395
20.5	3.64	0.0395122			0.0395
21.0	3.73	0.0395464			0.0395
21.5	3.82	0.0395805			0.0396
22.0	3.91	0.0396143			0.0396
22.5	4.00	0.0396480			0.0396
23.0	4.08	0.0396817			0.0397
23.5	4.17	0.0397154			0.0397
24.0	4.26	0.0397493			0.0397
24.5	4.35	0.0397833			0.0398
25.0	4.44	0.0398176			0.0398
25.5	4.53	0.0398521			0.0399
26.0	4.62	0.0398871			0.0399
26.5	4.71	0.0399225			0.0399
27.0	4.80	0.0399585			0.0400
27.5	4.88	0.0399951			0.0400
28.0	4.97	0.0400323			0.0400
28.5	5.06	0.0400703			0.0401
29.0	5.15	0.0401092			0.0401
29.5	5.24	0.0401489			0.0401
30.0	5.33	0.0401895			0.0402
30.5	5.42	0.0402312			0.0402
31.0	5.51	0.0402739			0.0403
31.5	5.59	0.0403178			0.0403
32.0	5.68	0.0403630			0.0404
32.5	5.77	0.0404094			0.0404
33.0	5.86	0.0404571			0.0405
33.5	5.95	0.0405063			0.0405

Drawdown Calculations, Day 1

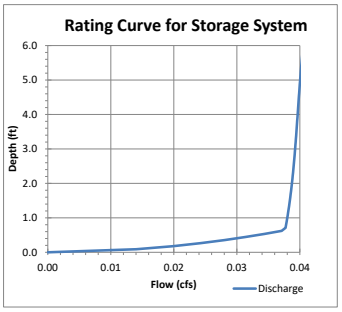
Time (hrs)	Storage (cf)	Depth (ft)	Discharge (cfs)
0	17,244	4.500	0.03984
0.167	17,220	4.494	0.03984
0.333	17,196	4.488	0.03983
0.5	17,172	4.481	0.03983
0.667	17,148	4.475	0.03983
0.833	17,125	4.469	0.03983
1	17,101	4.463	0.03982
1.167	17,077	4.456	0.03982
1.333	17,053	4.450	0.03982
1.5	17,029	4.444	0.03985
1.667	17,005	4.438	0.03982
1.833	16,981	4.431	0.03981
2	16,957	4.425	0.03981
2.167	16,933	4.419	0.03981
2.333	16,910	4.413	0.03981
2.5	16,886	4.406	0.0398
2.667	16,862	4.400	0.0398
2.833	16,838	4.394	0.0398
3	16,814	4.388	0.0398
3.167	16,790	4.382	0.03979
3.333	16,766	4.375	0.03979
3.5	16,742	4.369	0.03979
3.667	16,718	4.363	0.03979
3.833	16,695	4.357	0.03978
4	16,671	4.350	0.03978
4.167	16,647	4.344	0.03978
4.333	16,623	4.338	0.03978
4.5	16,599	4.332	0.03977
4.667	16,575	4.325	0.03977
4.833	16,552	4.319	0.03977
5	16,528	4.313	0.03977
5.167	16,504	4.307	0.03976
5.333	16,480	4.301	0.03976
5.5	16,456	4.294	0.03976
5.667	16,432	4.288	0.03976
5.833	16,408	4.282	0.03976
6	16,384	4.276	0.03975
6.167	16,361	4.269	0.03975
6.333	16,337	4.263	0.03978
6.5	16,313	4.257	0.03975
6.667	16,289	4.251	0.03974
6.833	16,265	4.245	0.03974
7	16,241	4.238	0.03974
7.167	16,218	4.232	0.03974
7.333	16,194	4.226	0.03973
7.5	16,170	4.220	0.03973
7.667	16,146	4.213	0.03973
7.833	16,122	4.207	0.03973
8	16,098	4.201	0.03972
8.167	16,074	4.195	0.03972
8.333	16,051	4.189	0.03972
8.5	16,027	4.182	0.03972
8.667	16,003	4.176	0.03975
8.833	15,979	4.170	0.03971
9	15,955	4.164	0.03971
9.167	15,932	4.157	0.03971
9.333	15,908	4.151	0.03971
9.5	15,884	4.145	0.0397
9.667	15,860	4.139	0.0397
9.833	15,836	4.133	0.0397
10	15,812	4.126	0.0397
10.167	15,789	4.120	0.03969
10.333	15,765	4.114	0.03969
10.5	15,741	4.108	0.03969
10.667	15,717	4.102	0.03969
10.833	15,693	4.095	0.03968
11	15,670	4.089	0.03968
11.167	15,646	4.083	0.03968
11.333	15,622	4.077	0.03968
11.5	15,598	4.071	0.03967
11.667	15,574	4.064	0.03967
11.833	15,551	4.058	0.03967
12	15,527	4.052	0.03967
12.167	15,503	4.046	0.03967
12.333	15,479	4.039	0.03966
12.5	15,455	4.033	0.03966
12.667	15,432	4.027	0.03966
12.833	15,408	4.021	0.03966
13	15,384	4.015	0.03965
13.167	15,360	4.008	0.03965
13.333	15,336	4.002	0.03965
13.5	15,313	3.996	0.03968
13.667	15,289	3.990	0.03964
13.833	15,265	3.984	0.03964
14	15,241	3.977	0.03964
14.167	15,217	3.971	0.03964

Alvarado Creek Apartment Project_HMP Vault Discharge Rating Curve and Drawdown Calculations

Low Flow Orifice (Underdrain)	
Num. of Orfices =	1
Orifice Invert (ft) =	0
Orifice Diameter (in) =	1.25
Cg =	0.6

Midflow Orfice	
Num. of Orfices =	1
Orifice Invert (ft) =	0
Orifice Diameter (in) =	0
Cg =	0.6

Top Outlet (horizontal pipe)	
Num. of Pipes =	1
Pipe Invert (ft) =	4.5
Pipe Diameter (in) =	18
Cg (orifice) =	0.6



Storage System Properties

Depth (ft)	Effective Area (ft2)	Storage (cf)
0	3,832	0
1	3,832	3,832
2	3,832	7,664
3	3,832	11,496
4	3,832	15,328
5	3,832	19,160
6	3,832	22,992

TD Rating Incr = 0.088888888

Outlet Link Rating Curve (Input to SWMM)

h (in)	h (ft)	Lower Orifice Flow (cfs)	Midflow Orfice Flow (cfs)	Outlet Pipe Flow (cfs)	Total Flow (cfs)

Drawdown Calculations, Day 1

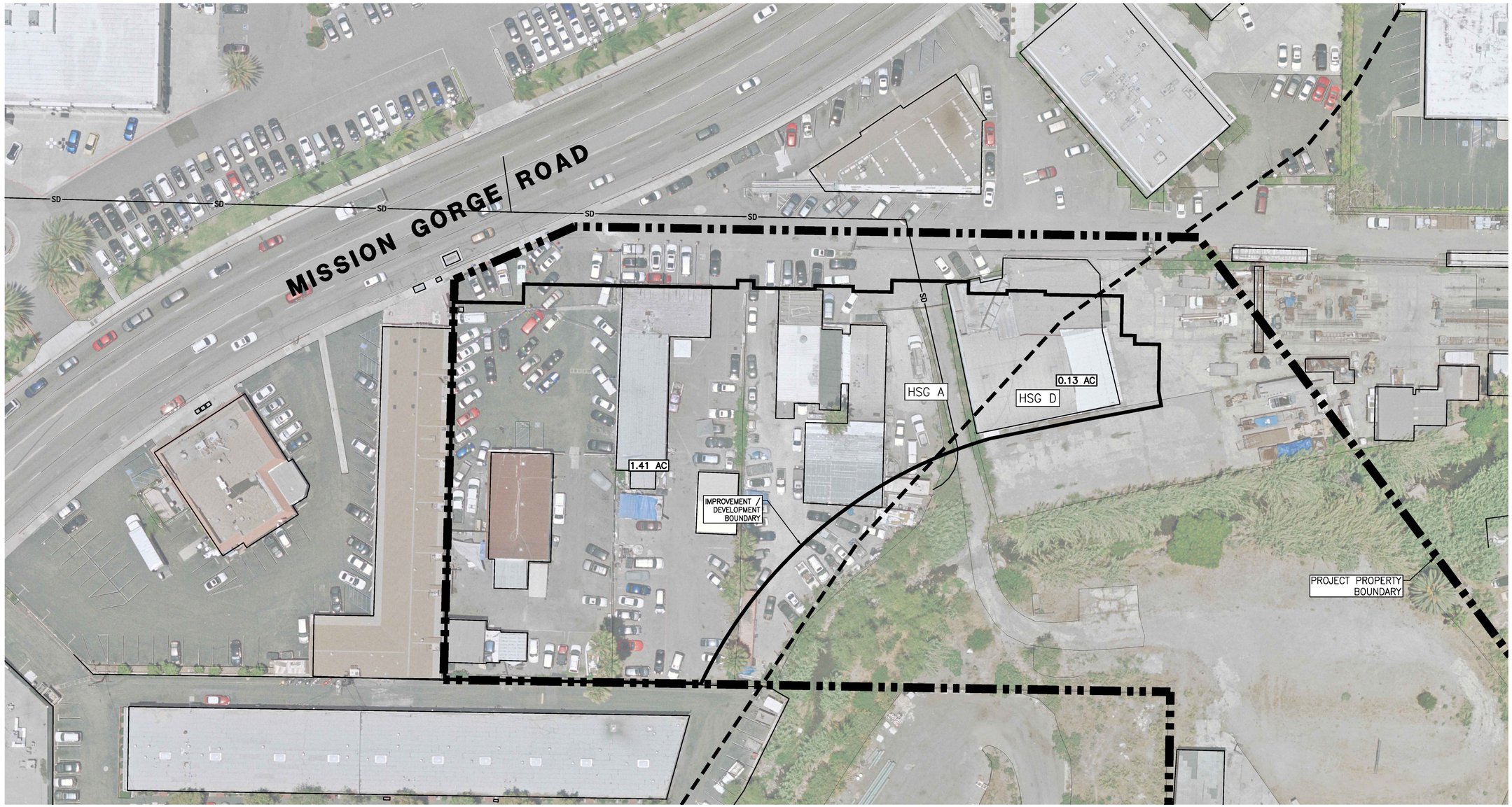
Time (hrs)	Storage (cf)	Depth (ft)	Discharge (cfs)
14.333	15,194	3.965	0.03963
14.5	15,170	3.959	0.03963
14.667	15,146	3.953	0.03963
14.833	15,122	3.946	0.03963
15	15,099	3.940	0.03963
15.167	15,075	3.934	0.03962
15.333	15,051	3.928	0.03962
15.5	15,027	3.922	0.03962
15.667	15,004	3.915	0.03962
15.833	14,980	3.909	0.03965
16	14,956	3.903	0.03961
16.167	14,932	3.897	0.03961
16.333	14,909	3.891	0.03961
16.5	14,885	3.884	0.0396
16.667	14,861	3.878	0.0396
16.833	14,837	3.872	0.0396
17	14,813	3.866	0.0396
17.167	14,790	3.860	0.03959
17.333	14,766	3.853	0.03959
17.5	14,742	3.847	0.03959
17.667	14,718	3.841	0.03959
17.833	14,695	3.835	0.03959
18	14,671	3.829	0.03958
18.167	14,647	3.822	0.03961
18.333	14,623	3.816	0.03958
18.5	14,600	3.810	0.03958
18.667	14,576	3.804	0.03957
18.833	14,552	3.798	0.03957
19	14,528	3.791	0.03957
19.167	14,505	3.785	0.03957
19.333	14,481	3.779	0.03956
19.5	14,457	3.773	0.03956
19.667	14,433	3.767	0.03956
19.833	14,410	3.760	0.03956
20	14,386	3.754	0.03955
20.167	14,362	3.748	0.03955
20.333	14,339	3.742	0.03955
20.5	14,315	3.736	0.03955
20.667	14,291	3.729	0.03954
20.833	14,267	3.723	0.03954
21	14,244	3.717	0.03954
21.167	14,220	3.711	0.03954
21.333	14,196	3.705	0.03954
21.5	14,173	3.698	0.03953
21.667	14,149	3.692	0.03953
21.833	14,125	3.686	0.03953
22	14,101	3.680	0.03953
22.167	14,078	3.674	0.03952
22.333	14,054	3.668	0.03952
22.5	14,030	3.661	0.03952
22.667	14,007	3.655	0.03952
22.833	13,983	3.649	0.03951
23	13,959	3.643	0.03955
23.167	13,935	3.637	0.03951
23.333	13,912	3.630	0.03951
23.5	13,888	3.624	0.0395
23.667	13,864	3.618	0.0395
23.833	13,841	3.612	0.0395
24	13,817	3.606	0.0395

Drawdown Calculations, Day 2				Drawdown Calculations, Day 3				Drawdown Calculations, Day 4			
Time (hrs)	Storage (cf)	Depth (ft)	Discharge (cfs)	Time (hrs)	Storage (cf)	Depth (ft)	Discharge (cfs)	Time (hrs)	Storage (cf)	Depth (ft)	Discharge (cfs)
24	13,817	3.606	0.0395	48	10,420	2.719	0.03912	72	7,061	1.843	0.03864
24.167	13,793	3.599	0.03949	48.167	10,397	2.713	0.03912	72.167	7,037	1.836	0.03864
24.333	13,770	3.593	0.03949	48.333	10,374	2.707	0.03912	72.333	7,014	1.830	0.03863
24.5	13,746	3.587	0.03949	48.5	10,350	2.701	0.03911	72.5	6,991	1.824	0.03863
24.667	13,722	3.581	0.03949	48.667	10,326	2.695	0.03911	72.667	6,968	1.818	0.03863
24.833	13,699	3.575	0.03949	48.833	10,303	2.689	0.03911	72.833	6,945	1.812	0.03862
25	13,675	3.569	0.03948	49	10,280	2.683	0.0391	73	6,922	1.806	0.03862
25.167	13,651	3.562	0.03948	49.167	10,256	2.676	0.0391	73.167	6,898	1.800	0.03861
25.333	13,627	3.556	0.03948	49.333	10,233	2.670	0.0391	73.333	6,875	1.794	0.03861
25.5	13,604	3.550	0.03948	49.5	10,209	2.664	0.03914	73.5	6,852	1.788	0.03861
25.667	13,580	3.544	0.03947	49.667	10,186	2.658	0.03909	73.667	6,829	1.782	0.0386
25.833	13,556	3.538	0.03947	49.833	10,162	2.652	0.03909	73.833	6,806	1.776	0.03866
26	13,533	3.531	0.03947	50	10,139	2.646	0.03909	74	6,783	1.770	0.03859
26.167	13,509	3.525	0.03947	50.167	10,116	2.640	0.03908	74.167	6,760	1.764	0.03859
26.333	13,485	3.519	0.03946	50.333	10,092	2.634	0.03908	74.333	6,736	1.758	0.03859
26.5	13,462	3.513	0.03946	50.5	10,069	2.628	0.03908	74.5	6,713	1.752	0.03858
26.667	13,438	3.507	0.03946	50.667	10,045	2.621	0.03907	74.667	6,690	1.746	0.03858
26.833	13,414	3.501	0.03946	50.833	10,022	2.615	0.03907	74.833	6,667	1.740	0.03857
27	13,391	3.494	0.03945	51	9,998	2.609	0.03907	75	6,644	1.734	0.03857
27.167	13,367	3.488	0.03945	51.167	9,975	2.603	0.03907	75.167	6,621	1.728	0.03857
27.333	13,343	3.482	0.03945	51.333	9,951	2.597	0.03906	75.333	6,598	1.722	0.03856
27.5	13,320	3.476	0.03945	51.5	9,928	2.591	0.03906	75.5	6,574	1.716	0.03856
27.667	13,296	3.470	0.03944	51.667	9,905	2.585	0.03906	75.667	6,551	1.710	0.03855
27.833	13,272	3.464	0.03948	51.833	9,881	2.579	0.03905	75.833	6,528	1.704	0.03855
28	13,249	3.457	0.03944	52	9,858	2.572	0.03905	76	6,505	1.698	0.03855
28.167	13,225	3.451	0.03944	52.167	9,834	2.566	0.03905	76.167	6,482	1.692	0.03854
28.333	13,201	3.445	0.03943	52.333	9,811	2.560	0.03904	76.333	6,459	1.685	0.03854
28.5	13,178	3.439	0.03943	52.5	9,787	2.554	0.03904	76.5	6,436	1.679	0.03853
28.667	13,154	3.433	0.03943	52.667	9,764	2.548	0.03904	76.667	6,413	1.673	0.03853
28.833	13,130	3.427	0.03943	52.833	9,741	2.542	0.03904	76.833	6,389	1.667	0.03853
29	13,107	3.420	0.03942	53	9,717	2.536	0.03903	77	6,366	1.661	0.03852
29.167	13,083	3.414	0.03942	53.167	9,694	2.530	0.03903	77.167	6,343	1.655	0.03852
29.333	13,059	3.408	0.03942	53.333	9,670	2.524	0.03903	77.333	6,320	1.649	0.03851
29.5	13,036	3.402	0.03942	53.5	9,647	2.517	0.03902	77.5	6,297	1.643	0.03851
29.667	13,012	3.396	0.03941	53.667	9,624	2.511	0.03902	77.667	6,274	1.637	0.0385
29.833	12,989	3.389	0.03941	53.833	9,600	2.505	0.03902	77.833	6,251	1.631	0.0385
30	12,965	3.383	0.03941	54	9,577	2.499	0.03901	78	6,228	1.625	0.0385
30.167	12,941	3.377	0.03944	54.167	9,553	2.493	0.03901	78.167	6,205	1.619	0.03849
30.333	12,918	3.371	0.0394	54.333	9,530	2.487	0.03905	78.333	6,182	1.613	0.03849
30.5	12,894	3.365	0.0394	54.5	9,507	2.481	0.03901	78.5	6,159	1.607	0.03848
30.667	12,870	3.359	0.0394	54.667	9,483	2.475	0.039	78.667	6,135	1.601	0.03848
30.833	12,847	3.352	0.0394	54.833	9,460	2.469	0.039	78.833	6,112	1.595	0.03848
31	12,823	3.346	0.03939	55	9,436	2.463	0.039	79	6,089	1.589	0.03847
31.167	12,799	3.340	0.03939	55.167	9,413	2.456	0.03899	79.167	6,066	1.583	0.03847
31.333	12,776	3.334	0.03939	55.333	9,389	2.450	0.03899	79.333	6,043	1.577	0.03846
31.5	12,752	3.328	0.03939	55.5	9,366	2.444	0.03899	79.5	6,020	1.571	0.03846
31.667	12,728	3.322	0.03938	55.667	9,343	2.438	0.03898	79.667	5,997	1.565	0.03845
31.833	12,705	3.315	0.03938	55.833	9,319	2.432	0.03898	79.833	5,974	1.559	0.03845
32	12,681	3.309	0.03938	56	9,296	2.426	0.03898	80	5,951	1.553	0.03845
32.167	12,658	3.303	0.03938	56.167	9,273	2.420	0.03897	80.167	5,928	1.547	0.03844
32.333	12,634	3.297	0.03937	56.333	9,249	2.414	0.03897	80.333	5,905	1.541	0.03844
32.5	12,610	3.291	0.03937	56.5	9,226	2.408	0.03897	80.5	5,882	1.535	0.03843
32.667	12,587	3.285	0.03937	56.667	9,202	2.401	0.03896	80.667	5,859	1.529	0.03843
32.833	12,563	3.278	0.03937	56.833	9,179	2.395	0.03896	80.833	5,835	1.523	0.03842
33	12,539	3.272	0.03936	57	9,156	2.389	0.03896	81	5,813	1.517	0.03842
33.167	12,516	3.266	0.03936	57.167	9,132	2.383	0.03895	81.167	5,789	1.511	0.03848
33.333	12,492	3.260	0.03936	57.333	9,109	2.377	0.03895	81.333	5,766	1.505	0.03841
33.5	12,469	3.254	0.03936	57.5	9,086	2.371	0.03895	81.5	5,743	1.499	0.03841
33.667	12,445	3.248	0.03935	57.667	9,062	2.365	0.03894	81.667	5,720	1.493	0.0384
33.833	12,421	3.242	0.03935	57.833	9,039	2.359	0.03894	81.833	5,697	1.487	0.0384
34	12,398	3.235	0.03935	58	9,016	2.353	0.03894	82	5,674	1.481	0.03839
34.167	12,374	3.229	0.03935	58.167	8,992	2.347	0.03894	82.167	5,651	1.475	0.03839
34.333	12,351	3.223	0.03934	58.333	8,969	2.340	0.03893	82.333	5,628	1.469	0.03838
34.5	12,327	3.217	0.03934	58.5	8,946	2.334	0.03893	82.5	5,605	1.463	0.03838
34.667	12,303	3.211	0.03934	58.667	8,922	2.328	0.03893	82.667	5,582	1.457	0.03838
34.833	12,280	3.205	0.03934	58.833	8,899	2.322	0.03892	82.833	5,559	1.451	0.03837
35	12,256	3.198	0.03937	59	8,875	2.316	0.03892	83	5,536	1.445	0.03837
35.167	12,233	3.192	0.03933	59.167	8,852	2.310	0.03896	83.167	5,513	1.439	0.03836
35.333	12,209	3.186	0.03933	59.333	8,829	2.304	0.03891	83.333	5,490	1.433	0.03836
35.5	12,185	3.180	0.03933	59.5	8,805	2.298	0.03891	83.5	5,467	1.427	0.03835
35.667	12,162	3.174	0.03932	59.667	8,782	2.292	0.03891	83.667	5,444	1.421	0.03841
35.833	12,138	3.168	0.03932	59.833	8,759	2.286	0.0389	83.833	5,421	1.415	0.03834
36	12,115	3.161	0.03932	60	8,735	2.280	0.0389	84	5,398	1.409	0.03834
36.167	12,091	3.155	0.03932	60.167	8,712	2.273	0.0389	84.167	5,375	1.403	0.03834
36.333	12,068	3.149	0.03931	60.333	8,689	2.267	0.03889	84.333	5,352	1.397	0.03833
36.5	12,044	3.143	0.03931	60.5	8,665	2.261	0.03889	84.5	5,329	1.391	0.03833
36.667	12,020	3.137	0.03931	60.667	8,642	2.255	0.03889	84.667	5,306	1.385	0.03832
36.833	11,997	3.131	0.03931	60.833	8,619	2.249	0.03888	84.833	5,283	1.379	0.03832
37	11,973	3.125	0.0393	61	8,595	2.243	0.03888	85	5,260	1.373	0.03831
37.167	11,950	3.118	0.0393	61.167	8,572	2.237	0.03888	85.167	5,237	1.367	0.03831
37.333	11,926	3.112	0.0393	61.333	8,549	2.231	0.03887	85.333	5,214	1.361	0.0383
37.5	11,902	3.106	0.03929	61.5	8,525	2.225	0.03887	85.5	5,191	1.355	0.0383
37.667	11,879	3.100	0.03929	61.667	8,502	2.219	0.03887	85.667	5,168	1.349	0.03829
37.833	11,855	3.094	0.03929	61.833	8,479	2.213	0.03886	85.833	5,145	1.343	0.03829
38	11,832	3.088	0.03929	62	8,456	2.207	0.03886	86	5,122	1.337	0.03828
38.167	11,808	3.081	0.03928	62.167	8,432	2.200	0.03886	86.167	5,099	1.331	0.03828

Drawdown Calculations, Day 2				Drawdown Calculations, Day 3				Drawdown Calculations, Day 4			
Time (hrs)	Storage (cf)	Depth (ft)	Discharge (cfs)	Time (hrs)	Storage (cf)	Depth (ft)	Discharge (cfs)	Time (hrs)	Storage (cf)	Depth (ft)	Discharge (cfs)
38.333	11,785	3.075	0.03928	62.333	8,409	2.194	0.03885	86.333	5,076	1.325	0.03828
38.5	11,761	3.069	0.03928	62.5	8,386	2.188	0.03885	86.5	5,053	1.319	0.03827
38.667	11,737	3.063	0.03928	62.667	8,362	2.182	0.03884	86.667	5,030	1.313	0.03827
38.833	11,714	3.057	0.03927	62.833	8,339	2.176	0.03884	86.833	5,007	1.307	0.03826
39	11,690	3.051	0.03927	63	8,316	2.170	0.03884	87	4,985	1.301	0.03826
39.167	11,667	3.045	0.03927	63.167	8,292	2.164	0.03883	87.167	4,962	1.295	0.03825
39.333	11,643	3.038	0.03927	63.333	8,269	2.158	0.03883	87.333	4,939	1.289	0.03825
39.5	11,620	3.032	0.03926	63.5	8,246	2.152	0.03883	87.5	4,916	1.283	0.03824
39.667	11,596	3.026	0.03926	63.667	8,222	2.146	0.03882	87.667	4,893	1.277	0.03824
39.833	11,573	3.020	0.0393	63.833	8,199	2.140	0.03882	87.833	4,870	1.271	0.03823
40	11,549	3.014	0.03926	64	8,176	2.134	0.03882	88	4,847	1.265	0.03823
40.167	11,525	3.008	0.03925	64.167	8,153	2.127	0.03881	88.167	4,824	1.259	0.03822
40.333	11,502	3.002	0.03925	64.333	8,129	2.121	0.03881	88.333	4,801	1.253	0.03822
40.5	11,478	2.995	0.03925	64.5	8,106	2.115	0.03881	88.5	4,778	1.247	0.03821
40.667	11,455	2.989	0.03924	64.667	8,083	2.109	0.0388	88.667	4,755	1.241	0.03821
40.833	11,431	2.983	0.03924	64.833	8,059	2.103	0.0388	88.833	4,732	1.235	0.0382
41	11,408	2.977	0.03924	65	8,036	2.097	0.0388	89	4,709	1.229	0.0382
41.167	11,384	2.971	0.03924	65.167	8,013	2.091	0.03879	89.167	4,686	1.223	0.03819
41.333	11,361	2.965	0.03923	65.333	7,990	2.085	0.03879	89.333	4,663	1.217	0.03819
41.5	11,337	2.959	0.03923	65.5	7,966	2.079	0.03879	89.5	4,641	1.211	0.03818
41.667	11,313	2.952	0.03923	65.667	7,943	2.073	0.03878	89.667	4,618	1.205	0.03818
41.833	11,290	2.946	0.03923	65.833	7,920	2.067	0.03878	89.833	4,595	1.199	0.03817
42	11,266	2.940	0.03922	66	7,897	2.061	0.03878	90	4,572	1.193	0.03817
42.167	11,243	2.934	0.03922	66.167	7,873	2.055	0.03877	90.167	4,549	1.187	0.03816
42.333	11,219	2.928	0.03922	66.333	7,850	2.049	0.03877	90.333	4,526	1.181	0.03816
42.5	11,196	2.922	0.03921	66.5	7,827	2.042	0.03876	90.5	4,503	1.175	0.03815
42.667	11,172	2.916	0.03921	66.667	7,804	2.036	0.03876	90.667	4,480	1.169	0.03815
42.833	11,149	2.909	0.03921	66.833	7,780	2.030	0.03876	90.833	4,457	1.163	0.03814
43	11,125	2.903	0.03921	67	7,757	2.024	0.03875	91	4,435	1.157	0.03814
43.167	11,102	2.897	0.0392	67.167	7,734	2.018	0.03875	91.167	4,412	1.151	0.03813
43.333	11,078	2.891	0.0392	67.333	7,710	2.012	0.03875	91.333	4,389	1.145	0.03813
43.5	11,055	2.885	0.0392	67.5	7,687	2.006	0.03874	91.5	4,366	1.139	0.03812
43.667	11,031	2.879	0.0392	67.667	7,664	2.000	0.03874	91.667	4,343	1.133	0.03812
43.833	11,008	2.873	0.03919	67.833	7,641	1.994	0.03874	91.833	4,320	1.127	0.03811
44	10,984	2.866	0.03919	68	7,618	1.988	0.03873	92	4,297	1.121	0.03811
44.167	10,961	2.860	0.03919	68.167	7,594	1.982	0.03873	92.167	4,274	1.115	0.0381
44.333	10,937	2.854	0.03918	68.333	7,571	1.976	0.03872	92.333	4,252	1.109	0.0381
44.5	10,914	2.848	0.03918	68.5	7,548	1.970	0.03872	92.5	4,229	1.104	0.03809
44.667	10,890	2.842	0.03922	68.667	7,525	1.964	0.03872	92.667	4,206	1.098	0.03809
44.833	10,867	2.836	0.03918	68.833	7,501	1.958	0.03871	92.833	4,183	1.092	0.03808
45	10,843	2.830	0.03917	69	7,478	1.952	0.03871	93	4,160	1.086	0.03808
45.167	10,820	2.823	0.03917	69.167	7,455	1.945	0.03871	93.167	4,137	1.080	0.03807
45.333	10,796	2.817	0.03917	69.333	7,432	1.939	0.0387	93.333	4,115	1.074	0.03807
45.5	10,773	2.811	0.03916	69.5	7,409	1.933	0.0387	93.5	4,092	1.068	0.03806
45.667	10,749	2.805	0.03916	69.667	7,385	1.927	0.03869	93.667	4,069	1.062	0.03806
45.833	10,726	2.799	0.03916	69.833	7,362	1.921	0.03869	93.833	4,046	1.056	0.03805
46	10,702	2.793	0.03916	70	7,339	1.915	0.03869	94	4,023	1.050	0.03805
46.167	10,679	2.787	0.03915	70.167	7,316	1.909	0.03868	94.167	4,000	1.044	0.03804
46.333	10,655	2.781	0.03915	70.333	7,292	1.903	0.03868	94.333	3,978	1.038	0.03804
46.5	10,632	2.774	0.03915	70.5	7,269	1.897	0.03868	94.5	3,955	1.032	0.03803
46.667	10,608	2.768	0.03914	70.667	7,246	1.891	0.03867	94.667	3,932	1.026	0.03803
46.833	10,585	2.762	0.03914	70.833	7,223	1.885	0.03867	94.833	3,909	1.020	0.03802
47	10,561	2.756	0.03914	71	7,200	1.879	0.03866	95	3,886	1.014	0.03802
47.167	10,538	2.750	0.03914	71.167	7,177	1.873	0.03866	95.167	3,864	1.008	0.03801
47.333	10,514	2.744	0.03913	71.333	7,153	1.867	0.03866	95.333	3,841	1.002	0.03801
47.5	10,491	2.738	0.03913	71.5	7,130	1.861	0.03865	95.5	3,818	0.996	0.038
47.667	10,467	2.732	0.03913	71.667	7,107	1.855	0.03865	95.667	3,795	0.990	0.038
47.833	10,444	2.725	0.03912	71.833	7,084	1.849	0.03865	95.833	3,772	0.984	0.03799
48	10,420	2.719	0.03912	72	7,061	1.843	0.03864	96	3,750	0.979	0.03799

MAP POCKET 1

PRE-DEVELOPED CONDITION DMA EXHIBIT



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N

30 15 0 30 60 90
GRAPHIC SCALE: 1"=30'

HMP DMA EXHIBIT, PRE-PROJECT
ALVARADO CREEK APARTMENT PROEJCT
SAN DIEGO, CA

DATE: MAY 2021

J-19048

SHEET 1 OF 1

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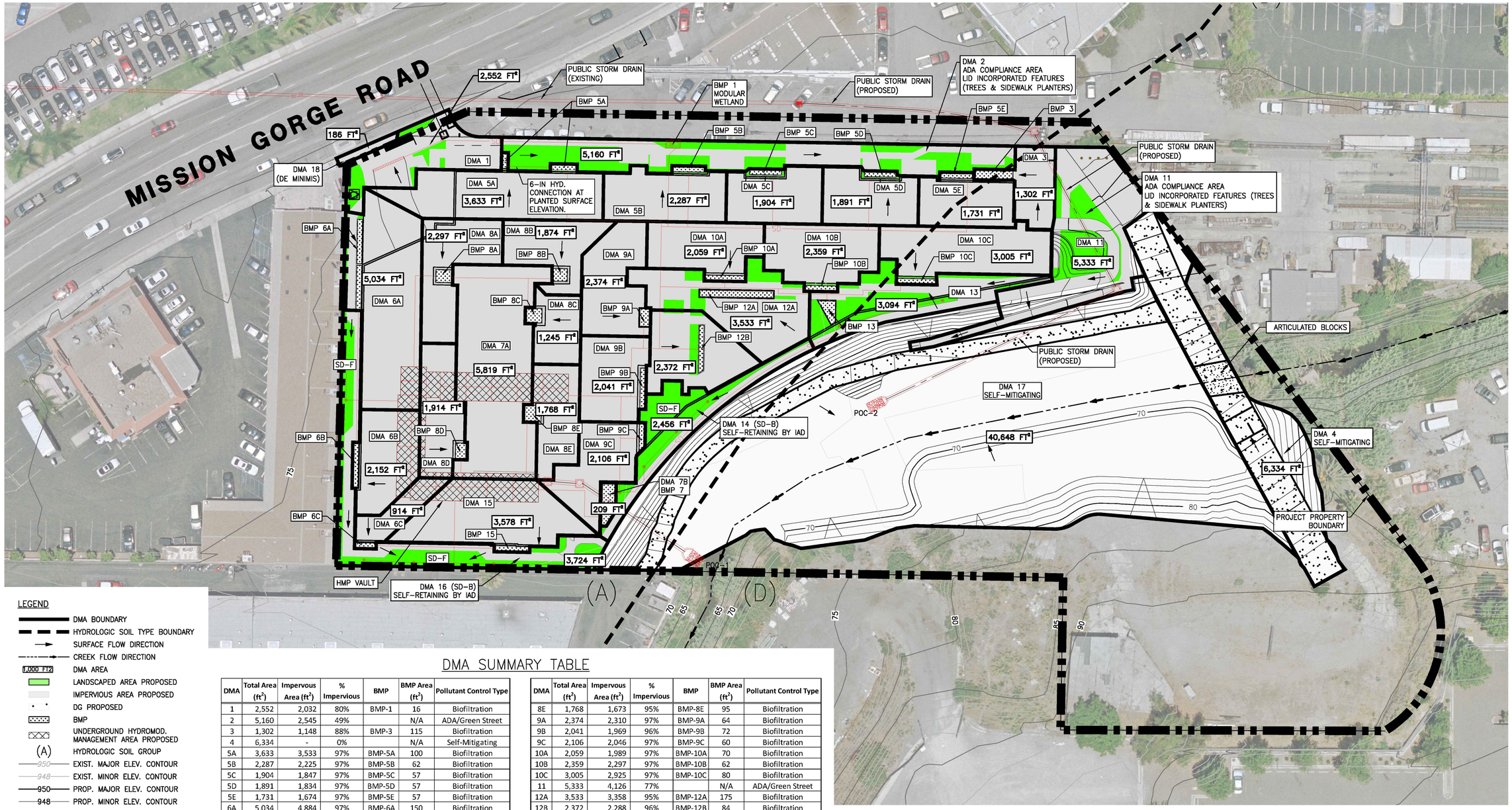
NOT FOR CONSTRUCTION – EXHIBIT FOR PDP SWQMP ONLY

MAP POCKET 2

POST-PROJECT CONDITION DMA EXHIBIT



LEGEND

- DMA BOUNDARY
- HYDROLOGIC SOIL TYPE BOUNDARY
- SURFACE FLOW DIRECTION
- CREEK FLOW DIRECTION
- 1,000 FT2 — DMA AREA
- LANDSCAPED AREA PROPOSED
- IMPERVIOUS AREA PROPOSED
- DG PROPOSED
- BMP
- UNDERGROUND HYDROMOD. MANAGEMENT AREA PROPOSED
- (A) — HYDROLOGIC SOIL GROUP
- 950 — EXIST. MAJOR ELEV. CONTOUR
- 948 — EXIST. MINOR ELEV. CONTOUR
- 950 — PROP. MAJOR ELEV. CONTOUR
- 948 — PROP. MINOR ELEV. CONTOUR
- SD — STORM DRAIN
- AREA DRAIN
- POC-1 — POINT OF COMPLIANCE

DMA SUMMARY TABLE

DMA	Total Area (ft^2)	Impervous Area (ft^2)	% Impervious	BMP	BMP Area (ft^2)	Pollutant Control Type
1	2,552	2,032	80%	BMP-1	16	Biofiltration
2	5,160	2,545	49%		N/A	ADA/Green Street
3	1,302	1,148	88%	BMP-3	115	Biofiltration
4	6,334	-	0%		N/A	Self-Mitigating
5A	3,633	3,533	97%	BMP-5A	100	Biofiltration
5B	2,287	2,225	97%	BMP-5B	62	Biofiltration
5C	1,904	1,847	97%	BMP-5C	57	Biofiltration
5D	1,891	1,834	97%	BMP-5D	57	Biofiltration
5E	1,731	1,674	97%	BMP-5E	57	Biofiltration
6A	5,034	4,884	97%	BMP-6A	150	Biofiltration
6B	2,152	2,072	96%	BMP-6B	80	Biofiltration
6C	914	878	96%	BMP-6C	36	Biofiltration
7	6,028	5,853	97%	BMP-7	175	Biofiltration
8A	2,297	2,225	97%	BMP-8A	72	Biofiltration
8B	1,874	1,809	97%	BMP-8B	65	Biofiltration
8C	1,245	1,163	93%	BMP-8C	82	Biofiltration
8D	1,914	1,854	97%	BMP-8D	60	Biofiltration

DMA	Total Area (ft^2)	Impervous Area (ft^2)	% Impervious	BMP	BMP Area (ft^2)	Pollutant Control Type
8E	1,768	1,673	95%	BMP-8E	95	Biofiltration
9A	2,374	2,310	97%	BMP-9A	64	Biofiltration
9B	2,041	1,969	96%	BMP-9B	72	Biofiltration
9C	2,106	2,046	97%	BMP-9C	60	Biofiltration
10A	2,059	1,989	97%	BMP-10A	70	Biofiltration
10B	2,359	2,297	97%	BMP-10B	62	Biofiltration
10C	3,005	2,925	97%	BMP-10C	80	Biofiltration
11	5,333	4,126	77%		N/A	ADA/Green Street
12A	3,533	3,358	95%	BMP-12A	175	Biofiltration
12B	2,372	2,288	96%	BMP-12B	84	Biofiltration
13	3,094	1,486	48%	BMP-13	90	Biofiltration
14	2,456	863	35%		N/A	Self-Retaining by IAD
15	3,578	3,478	97%	BMP-15	100	Biofiltration
16	3,724	1,648	44%		N/A	Self-Retaining by IAD
17	40,648	-	0%		N/A	Self-Mitigating
18	186	186	100%		N/A	De mimimis

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NOTES:
1. DEPTH TO GROUNDWATER IS APPROXIMATELY 9 FT BGS
2. NO PCCSYAS ON SITE
3. UNLESS NOTED OTHERWISE, STORM DRAIN SHOWN IS PRIVATE

N

30 15 0 30 60 90
GRAPHIC SCALE: 1"=30'

HMP EXHIBIT, POST-PROJECT
ALVARADO CREEK APARTMENTS
SAN DIEGO, CA 92120

DATE: SEPT. 2021

J-19048 SHEET 1 OF 1

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NOT FOR CONSTRUCTION – EXHIBIT FOR PDP SWQMP ONLY

Attachment 3
Structural BMP Maintenance Information

This is the cover sheet for Attachment 3.

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Project Name: Alvarado Creek Apartments

Indicate which Items are Included:

Attachment Sequence	Contents	Checklist
Attachment 3	Maintenance Agreement (Form DS-3247) (when applicable)	☑ Included ☐ Not applicable

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

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

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

Notes:
SWMDCMA related attachments (exhibits) will be provided during final engineering submittal.

The City of SAN DIEGO

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

_____

_____

_____ _____

(THIS SPACE IS FOR RECORDER'S USE ONLY)

STORM WATER MANAGEMENT AND DISCHARGE CONTROL MAINTENANCE AGREEMENT

APPROVAL NUMBER:	ASSESSORS PARCEL NUMBER:	PROJECT NUMBER:
_____	461-320-06, -08, -09	671912

This agreement is made by and between the City of San Diego, a municipal corporation [City] and _____

_____,

the owner or duly authorized representative of the owner [Property Owner] of property located at

5901 Mission Gorge Rd., San Diego, CA 92120

(PROPERTY ADDRESS)

and more particularly described as: _____

_____

(LEGAL DESCRIPTION OF PROPERTY)

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

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

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

Continued on Page 2

NOW, THEREFORE, the parties agree as follows:

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

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

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

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

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

See Attached Exhibit(s): _____

_____
(Owner Signature)

_____
(Print Name and Title)

_____
(Company/Organization Name)

_____
(Date)

THE CITY OF SAN DIEGO

APPROVED:

_____
(City Control Engineer Signature)

_____
(Print Name)

_____
(Date)

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

Reset Button Page 2

Attachment 4
Copy of Plan Sheets Showing Permanent Storm Water BMPs

This is the cover sheet for Attachment 4.

Project Name: Alvarado Creek Apartments

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

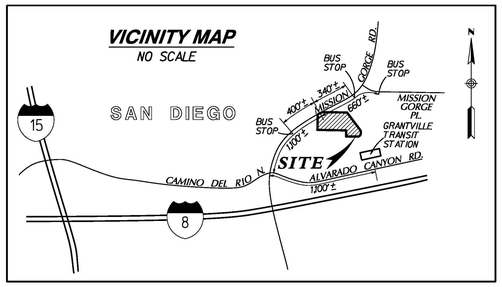
The plans must identify:

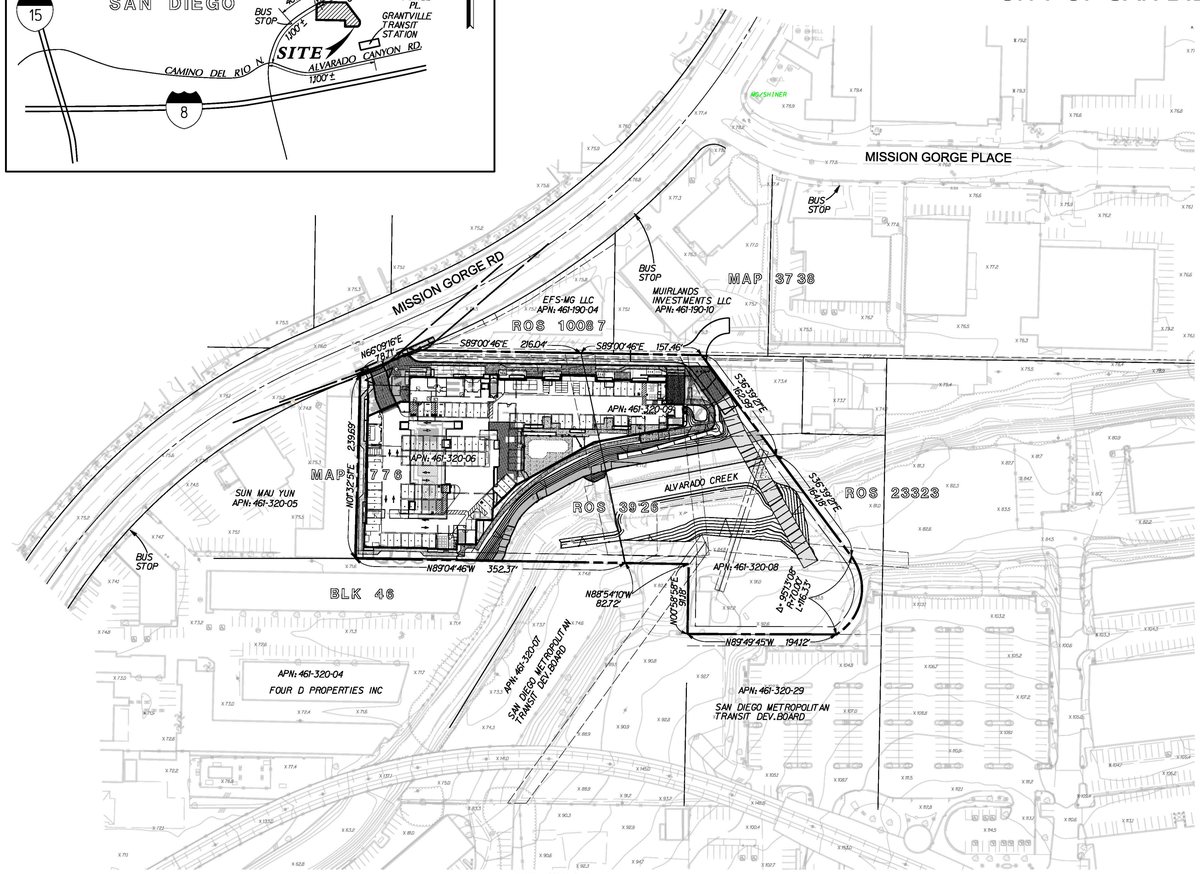
- [x] Structural BMP(s) with ID numbers matching Form I-6 Summary of PDP Structural BMPs
- [x] The grading and drainage design shown on the plans must be consistent with the delineation of DMAs shown on the DMA exhibit
- [x] Details and specifications for construction of structural BMP(s)
- [x] Signage indicating the location and boundary of structural BMP(s) as required by the City Engineer
- [x] How to access the structural BMP(s) to inspect and perform maintenance
- [x] 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)
- [x] 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)
- [x] All BMPs must be fully dimensioned on the plans
- [ ] When proprietary BMPs are used, site specific cross section with outflow, inflow and model number shall be provided. Broucher photocopies are not allowed.

NDP xxxxxxx

ALVARADO CREEK APARTMENTS

CITY OF SAN DIEGO, CALIFORNIA





KEY MAP
NOT TO SCALE

DEVELOPMENT SUMMARY/GENERAL NOTES

BULLET POINT NARRATIVE

A. THE PROJECT SITE IS CURRENTLY LOCATED IN THE PLANNING AREA OF THE NAVAJO-GRANTVILLE COMMUNITY PLAN. THE PROPOSED PROJECT INCLUDES THE CONSTRUCTION OF A 5-STORY, 227 UNIT RESIDENTAIL APARTMENT BUILDING WITH THE FOLLOWING TABULATED INFORMATION FOR DEVELOPMENT:

UNITS	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4	LEVEL 5	LEVEL 6	%	TOTAL
STUDIOS								
S1	0	10	11	11	11	11	24%	54
TOTAL	0	10	11	11	11	11	24%	54
1 BEDROOMS								
A1	0	8	8	8	8	8	18%	40
A2	0	2	3	3	3	3	6%	14
TOTAL	0	10	11	11	11	11	24%	54
2 BEDROOMS								
B1	0	11	12	12	12	12	26%	59
TOTAL	0	11	12	12	12	12	26%	59
3 BEDROOMS								
C1	0	4	4	4	4	4	9%	20
C2	0	8	8	8	8	8	18%	40
TOTAL	0	12	12	12	12	12	26%	60
GRAND TOTALS:	0 DU	43 DU	46 DU	46 DU	46 DU	46 DU	100%	227 DU

B. THE PROJECT PROPOSES A DENSITY OF APPROXIMATELY 80 DWELLINGS PER NET ACRE. THE SITE WILL INCLUDE A 5 STORY TYPE III-A 227 UNIT RESIDENTIAL APARTMENT BUILDING OVER ONE LEVEL TYPE I-A ABOVE GROUIND PODIUM STRUCTURE.

C. THIS PROJECT WILL REQUIRE THE FOLLOWING PERMITS/APPROVALS: NEIGHBORHOOD DEVELOPMENT PERMIT; GRADING PERMIT, PUBLIC IMPROVEMENT PERMIT, PARCEL MAP, AND BUILDING DEPARTMENT PERMIT.

D. ALL PROPOSED UTILITIES WILL BE UNDERGROUNDED IN THE AREAS FOR PROPOSED GRADING, IMPROVEMENTS AND DEVELOPMENT PER SAN DIEGO MUNICIPAL CODE.

E. THE GEOLOGIC HAZARD CATEGORIES FOUND ON THIS SITE ARE FLAT AND LEVEL TERRAIN, AND IS LOCATED IN AN AREA DESIGNATED AS A LIQUEFACTION HAZARD ZONE BY THE SAN DIEGO SEISMIC HAZARD MAP, SEE GEOTECHNICAL REPORT TITLED "GEOTECHNICAL ENGNEERING INVESTIGATION, "PROPOSED GRANTVILLE DEVELOPMENT" DATED NOVEMBER 27, 2019.

F. PRIOR TO THE ISSUANCE OF ANY CONSTRUCTION PERMIT, THE OWNER/PERMITTEE SHALL INCORPORATE ANY CONSTRUCTION BEST MANAGEMENT PRACTICES NECESSARY TO COMPLY WITH CHAPTER 14, ARTICLE 2, DIVISION 1 (GRADING REGULATIONS) OF THE SAN DIEGO MUNICIPAL CODE, INTO THE CONSTRUCTION PLANS OR SPECIFICATIONS.

G. SPECIAL FLOOD HAZARD AREA ZONE AE DESIGNATION

H. THE PROJECT IS REQUESTING A DEVIATION FROM STANDARDS AS THE PROJECT IS NOT PROVIDING 45 LF OF FULL HEIGHT CURB BETWEEN DRIVEWAYS SERVING THE SAME PROPERTY AS REQUIRED PER SDMC SECTION 142.0560(J)(6).

LEGEND

ITEM	SYMBOL
PROPOSED IMPROVEMENTS ✳	
PROJECT BOUNDARY	
PROPERTY LINE	
LOT LINE/ROW	
CENTERLINE	
PROPOSED EASEMENT	
CONCRETE CURB & GUTTER (PVT)	
SIDEWALK	
ASHPALT PAVING	
CONCRETE	
PAD ELEVATION	PE=487.2
FINISH FLOOR ELEVATION	FF=492.5
DIRECTION OF FLOW	1.0%
DAYLIGHT LINE/GRADING LIMIT	
PROPOSED MAJOR CONTOUR	420
PROPOSED MINOR CONTOUR	
2:1 SLOPE (MAX)	
BROW DITCH	
SWALE	
ADA PATH OF TRAVEL	
RETAINING WALL	
STORM DRAIN -------18" UNLESS OTHERWISE NOTED	SD
CATCH BASIN	
TYPE A-4 CLEAN OUT	
CURB INLET	
STORM DRAIN HEADWALL	
RIPRAP	
SEWER MANHOLE	
SEWER --- 8" UNLESS OTHERWISE NOTED	S
WATER --- 8" UNLESS OTHERWISE NOTED	W
WATER METER W/BACKFLOW (PUBLIC)	W
FIRE SERVICE --- 8" UNLESS OTHERWISE NOTED	FS
FIRE SERVICE W/BACKFLOW	FS
FIRE HYDRANT	
STREET LIGHT	
EXISTING CONDITIONS	
EXISTING MAJOR CONTOUR	420
EXISTING MINOR CONTOUR	
EXISTING ROAD	
EXISTING TREE OR BUSH	
EXISTING BUILDING OR MANMADE STRUCTURE	
EXISTING LIGHT FIXTURE	
EXISTING SIGN	
EXISTING FENCE	
EXISTING PARKING SPACES	

NOTE:
THE PROPOSED PROJECT WILL COMPLY WITH ALL THE REQUIREMENTS OF THE CURRENT CITY OF SAN DIEGO STORM WATER STANDARDS MANUAL BEFORE A GRADING OR BUILDING PERMIT IS ISSUED. IT IS THE RESPONSIBILITY OF THE OWNER/DESIGNER/APPLICANT TO ENSURE THAT THE CURRENT STORM WATER PERMANENT BMP DESIGN STANDARDS ARE INCORPORATED INTO THE PROJECT.

PROJECT TEAM

OWNER/DEVELOPER/AGENT

PACIFIC WEST COMMUNITIES
430 E. STATE STREET, STE. 100
EAGLE, ID. 83616
PHONE: (208) 461-0022

CALEB ROOPE — DATE
PRESIDENT
PACIFIC WEST COMMUNITIES

PLANNING/CIVIL ENGINEER/LANDSCAPE ARCHITECT

RICK ENGINEERING COMPANY
5620 FRIARS ROAD
SAN DIEGO, CALIFORNIA. 92110

PHONE: (619) 291-0707

ENVIRONMENTAL CONSULTANT

ASCENT ENVIRONMENTAL, INC.
1230 COLUMBIA STREET, STE. 440
SAN DIEGO, CA 92101

PHONE: (619) 219-8000

GEOTECHNICAL ENGINEER

KRAZAN & ASSOCIATES, INC.
1100 OLYMPIC DRIVE, STE. 103
CORONA, CA 92881

PHONE: (951) 273-1011

SHEET INDEX

1. LAND USE PLAN/TITLE SHEET
2. DETAILS AND SECTIONS
3. TOPOGRAPHIC AND MAPPING CONSTRAINTS MAP
4. SLOPE ANALYSIS EXHIBIT
5. SITE PLAN
6. GRADING & DRAINAGE PLAN
7. SITE CROSS SECTIONS
8. ACCESSIBILITY PLAN
9. FIRE ACCESS PLAN
10. SITE PHOTO EXHIBIT
11. STORM TRAP DETAILS
12. TRAFFIC STRIPING EXHIBIT
13. DMA EXHIBIT

ABBREVIATIONS

HT	HEIGHT
FF	FINISH FLOOR
FS	FINISH SURFACE
FL	FLOW LINE
IOD	IRREVOCABLE OFFER OF DEDICATION
I.E.	INVERT ELEVATION
PE	PAD ELEVATION
PI	POINT OF INTERSECTION
PVT	PRIVATE
TG	TOP OF GRADE
TP	TOP OF PIPE

LEGAL DESCRIPTION

THAT PORTION OF LOTS 1 AND 2 IN BLOCK 46, OF THE AMENDED MAP NO. 1 OF GRANTVILLE AND OUT LOTS, IN THE CITY OF SAN DIEGO, COUNTY OF SAN DIEGO, STATE OF CALIFORNIA, ACCORDING TO THE MAP THEREOF NO. 776, FILED IN THE OFFICE OF THE COUNTY RECORDER OF SAN DIEGO COUNTY, FEBRUARY 16, 1894
AND
BLOCK 51 OF THE "AMENDED MAP NO. 1 OF GRANTVILLE AND OUT LOTS", IN THE COUNTY OF SAN DIEGO, STATE OF CALIFORNIA, ACCORDING TO MAP THEREOF NO. 776, FILED IN THE OFFICE OF THE COUNTY RECORDER OF SAN DIEGO COUNTY, FEBRUARY 18, 1984.

BASIS OF BEARINGS

THE BASIS OF BEARINGS FOR THIS SURVEY IS THE CALIFORNIA COORDINATE SYSTEM ZONE 6, EPOCH 1991.35 AND IS DETERMINED BY RTK G.P.S. MEASUREMENTS TAKEN ON July 14, 2016 AT POINT #217 AND POINT #876, PER RECORD OF SURVEY MAP No 14492.

BEARING AND DISTANCE #217 TO #876: S36° 12'04"W 2178.58' GRID

QUOTED BEARINGS FROM REFERENCE MAPS/DEEDS MAY OR MAY NOT BE IN TERMS OF SAID SYSTEM.

BASIS OF ELEVATIONS

THE BENCHMARK FOR THIS SURVEY IS THE BRASS PLUG ON TOP OF CONCRETE CURB AT THE SOUTHEAST CORNER OF MISSION GORGE ROAD AND MISSION GORGE PLACE, PER CITY OF SAN DIEGO VERTICAL CONTROL BOOK DATED AUGUST 1989. ELEVATION = 78.03, NGVD 29 MSL

ASSESSORS PARCEL NUMBER

461-320-06
461-320-08
461-320-09

TYPE OF CONSTRUCTION

S-2 PARKING STRUCTURE
A, CLUBHOUSE FITNESS
B, LEASING OFFICE
R-2 RESIDENTIAL

OCCUPANCY CLASSIFICATION

RESIDENTIAL OCCUPANCY

PROJECT SITE AREA

GROSS LOT AREA: 2.03 AC.
NET LOT AREA: 2.01 AC. (EXCLUDES MISSION GORGE ROAD DEDICATION)

COMMUNITY PLAN AREA

NAVAJO - GRANTVILLE

ZONING DESIGNATION

EXISTING ZONING: CC-3-9

SETBACK REQUIREMENTS

FRONT: 10'
SIDE: 10'
STREET SIDE: 10'
REAR: 10'

PROPOSED USE

A 227 UNIT MULTI-FAMILY APARTMENT PROJECT CONSISTING OF 5-STORY TYPE III-A RESIDENTIAL BUILDING OVER 1-LEVEL TYPE I-A ABOVE GROUND PODIUM STRUCTURE.

EXISTING USE:

ALL EXISTING COMMERCIAL STRUCTURES LOCATED ON SITE HAVE BEEN BUILT BETWEEN THE LATE 1950S TO EARLY 1970S AND ARE TO BE DEMOLISHED IN ADVANCE OF PROPOSED DEVELOPMENT.

GRADING TABULATIONS:

TOTAL AMOUNT OF SITE TO BE GRADED: 2.315 AC

% OF TOTAL SITE: 60%

AMOUNT OF CUT: 3,000 CY

MAXIMUM OF CUT: 16.9'

AMOUNT OF FILL: 15,700 CY

MAXIMUM DEPTH OF FILL: 10.3'

MAXIMUM HT. OF FILL SLOPE: 8.0'

SLOPE RATIO: 2:1

MAXIMUM HT. OF CUT SLOPES: 16.9'

SLOPE RATION: 2:1

AMOUNT OF IMPORT SOIL: 12,700 CY

RETAINING WALLS:
•LENGTH: 608'
•MAXIMUM HEIGHT: 7.5'

IMPERVIOUS TABLE

A. TOTAL DISURBANCE AREA: 2.03 AC.

B. EXISTING AMOUNT OF IMPERVIOUS AREA: 101,800 SF

C. PROPOSED AMOUNT OF IMPERVIOUS AREA: 88,800 SF

D. AMOUNT OF REPLACED IMPREVIOUS AREA: 88,800 SF

E. TOTAL IMPERVIOUS AREA: 88,800 SF

F. IMPERVIOUS % DECREASE: 13%

NOTE
IMPREVIOUS AREA SHALL INCLUDE:
ROOF, SIDEWALK, PARKING AREA,
WALKWAYS, POOLS, POOL, DECKS, ETC.

DIGALERT 811

REGISTERED PROFESSIONAL ENGINEER KAREN S. VAN ERT No. 56991 CIVIL STATE OF CALIFORNIA

ENGINEER OF WORK

KAREN S. VAN ERT — DATE
R.C.E. No. 56991
EXP. DATE: 9-30-2021

RICK ENGINEERING COMPANY
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Riverside - Orange - Sacramento - San Luis Obispo - Phoenix - Tucson - Denver

LAMBERT COORDINATES: 222-1737	PTS: 671912
NAD83: 1862-6297	I.O.: xxxxxxxx
PREPARED BY: RICK ENGINEERING COMPANY	REVISION 1: 2/01/2021
ADDRESS: 5620 FRIARS ROAD, SAN DIEGO, CA. 92110, (619) 291-0707	REVISION 2: 4/29/2021
	REVISION 3: 8/05/2021
	REVISION 4: 9/27/2021
	REVISION 5:
PROJECT NAME: ALVARADO CREEK APTS NDP	REVISION 6:
SHEET TITLE: TITLE SHEET	REVISION 7:
	ORIGINAL DATE: 08/24/2020
	SHEET 1 OF 13

JOB NUMBER: 19048

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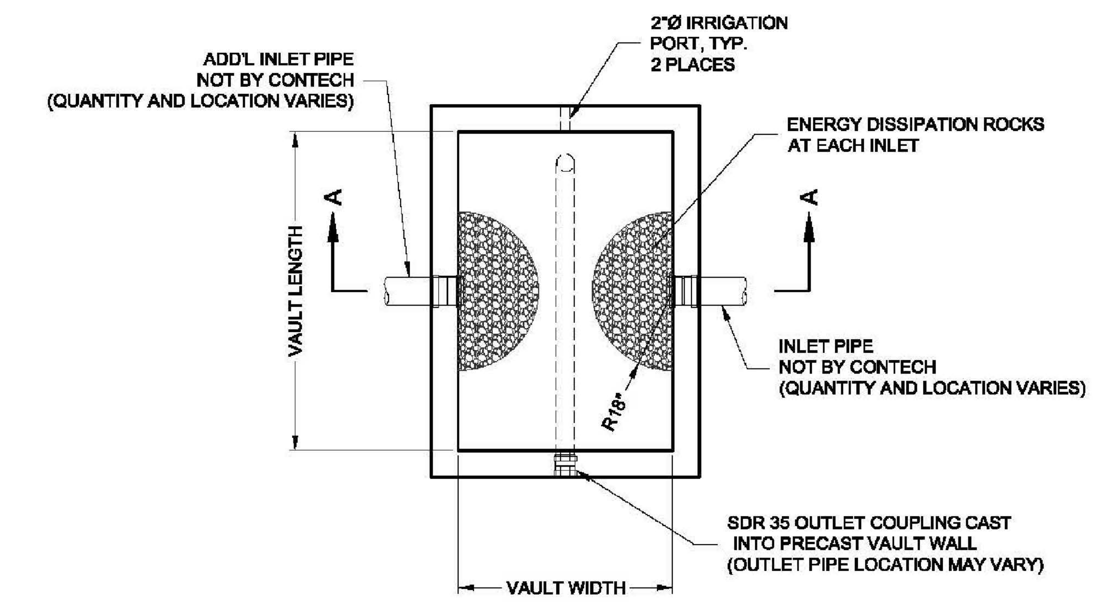
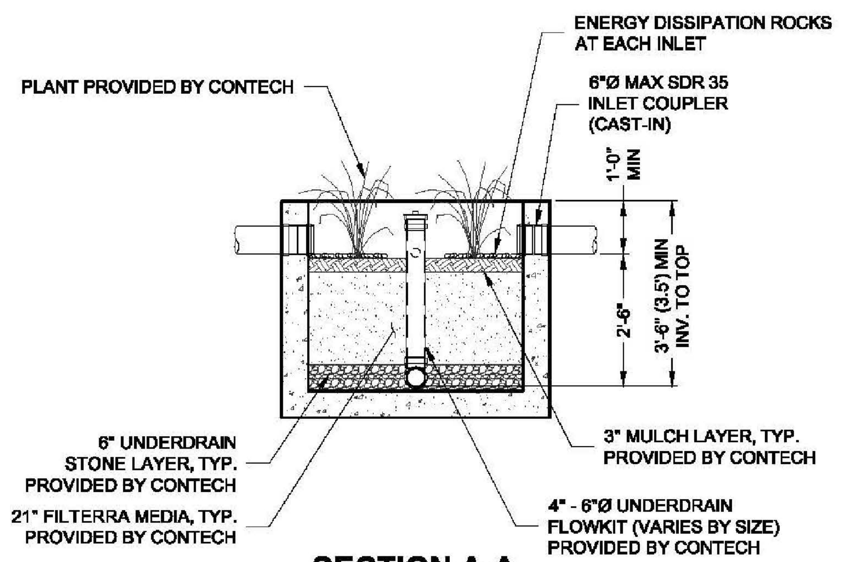


PLAN VIEW



SECTION A-A

INTERNAL PIPE CONFIGURATION MAY VARY
DEPENDING UPON OUTLET LOCATION.

FTBSV-P CONFIGURATION					
DESIGNATION	AVAILABILITY	MEDIA BAY SIZE	VAULT SIZE (L x W)	OUTLET PIPE	MIN NO. OF INLET PIPES
FTBSV0404-P	ALL	4 x 4	4 x 4	4" SDR 35	1
FTBSV0604-P	N/A CA	6 x 4	6 x 4	4" SDR 35	1
FTBSV0606-P	ALL	6 x 6	6 x 6	4" SDR 35	1
FTBSV06504-P	CA ONLY	6.5 x 4	6.5 x 4	4" SDR 35	1
FTBSV078045-P	MID-ATL ONLY	7.83 x 4.5	7.83 x 4.5	4" SDR 35	1
FTBSV0804-P	N/A MID-ATL	8 x 4	8 x 4	4" SDR 35	1
FTBSV0806-P	ALL	8 x 6	8 x 6	4" SDR 35	1
FTBSV1006-P	ALL	10 x 6	10 x 6	6" SDR 35	2
FTBSV1206-P	ALL	12 x 6	12 x 6	6" SDR 35	2
FTBSV1307-P	ALL	13 x 7	13 x 7	6" SDR 35	2
FTBSV1408-P	CALL CONTECH	14 x 8	14 x 8	6" SDR 35	3
FTBSV1608-P	CALL CONTECH	16 x 8	16 x 8	6" SDR 35	3
FTBSV1808-P	CALL CONTECH	18 x 8	18 x 8	6" SDR 35	3
FTBSV2008-P	CALL CONTECH	20 x 8	20 x 8	6" SDR 35	4
FTBSV2208-P	CALL CONTECH	22 x 8	22 x 8	6" SDR 35	4

N/A = NOT AVAILABLE

BMP-3
BMP-5A THRU BMP-10C
BMP-12A THRU BMP-13
BMP-15
BMP-17

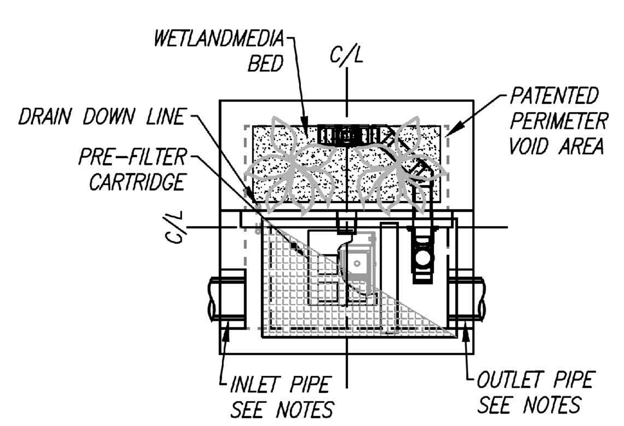
filterra

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

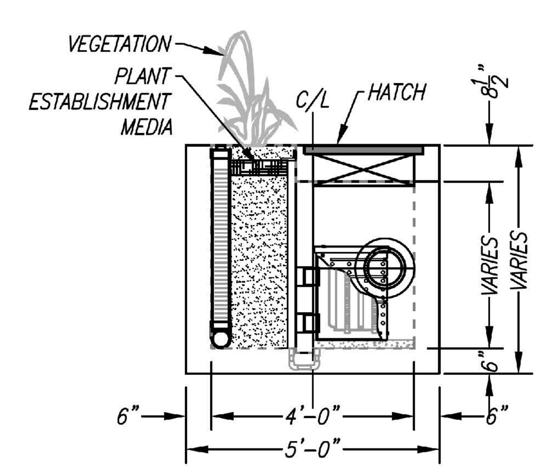
FILTERRA BIOSCAPE VAULT OFFLINE WITH PIPE INLET (FTBSV-P) CONFIGURATION DETAIL

SITE SPECIFIC DATA			
PROJECT NUMBER			
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
N/A		0.052	
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			OFFLINE
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2	N/A	N/A	N/A
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PEDESTRIAN		
FRAME & COVER	24" X 42"	OPEN PLANTER	N/A
NOTES:			

* PRELIMINARY NOT FOR CONSTRUCTION



PLAN VIEW



LEFT END VIEW

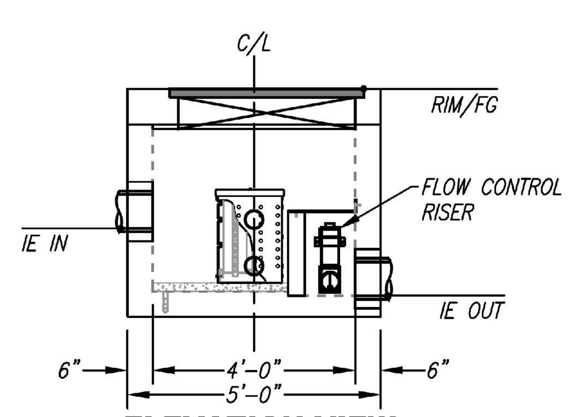
INSTALLATION NOTES

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURERS CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE TO VERIFY PROJECT ENGINEERS RECOMMENDED BASE SPECIFICATIONS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE. (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL PIPES SHALL BE SEALED WATER TIGHT PER MANUFACTURERS STANDARD CONNECTION DETAIL.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. VEGETATION SUPPLIED AND INSTALLED BY OTHERS. ALL UNITS WITH VEGETATION MUST HAVE DRIP OR SPRAY IRRIGATION SUPPLIED AND INSTALLED BY OTHERS.
7. CONTRACTOR RESPONSIBLE FOR CONTACTING BIO CLEAN FOR ACTIVATION OF UNIT. MANUFACTURERS WARRANTY IS VOID WITH OUT PROPER ACTIVATION BY A BIO CLEAN REPRESENTATIVE.

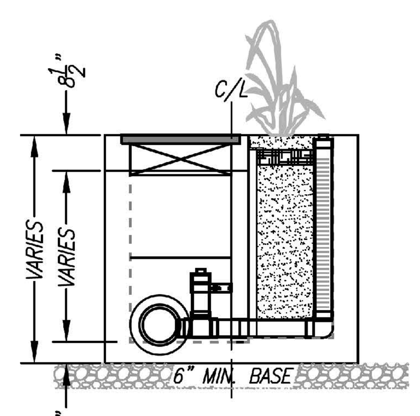
GENERAL NOTES

1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT BIO CLEAN.

5/23/19TOLEE



ELEVATION VIEW



RIGHT END VIEW

BMP-1	
TREATMENT FLOW (CFS)	0.052
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	1.0
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

MODULAR WETLANDS

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING US PATENTS: 7,425,262; 7,470,362; 7,674,378; 8,303,816; RELATED FOREIGN PATENTS OR OTHER PATENTS PENDING

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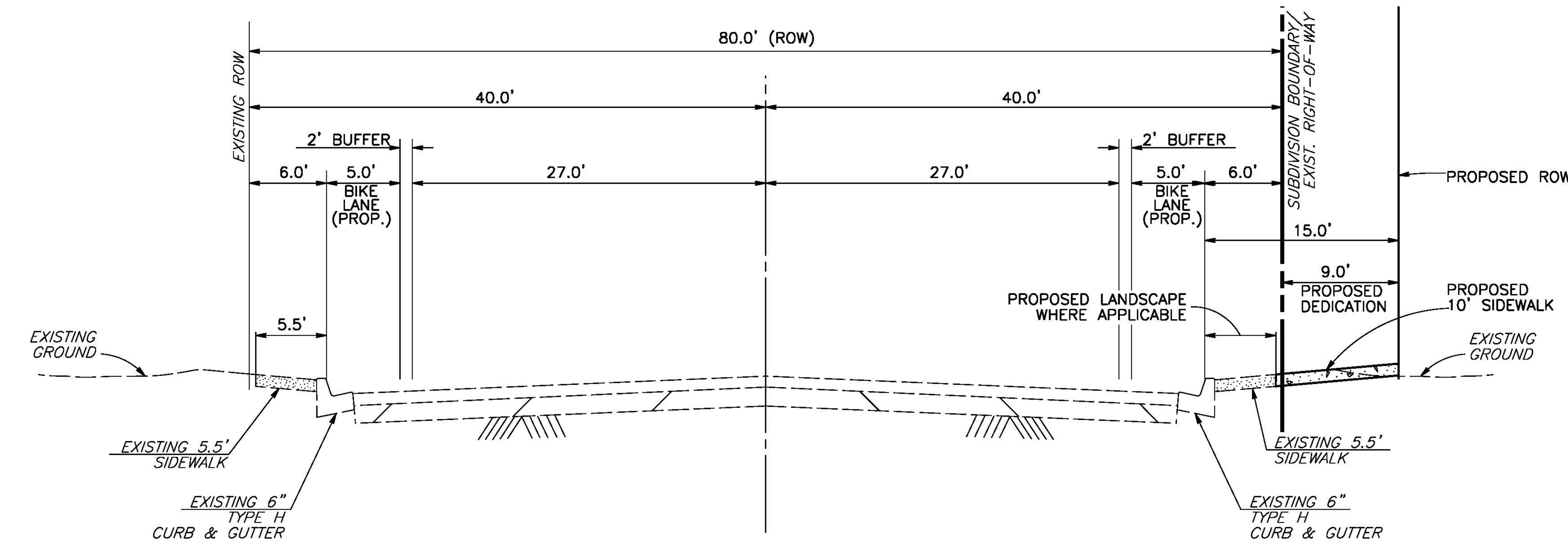
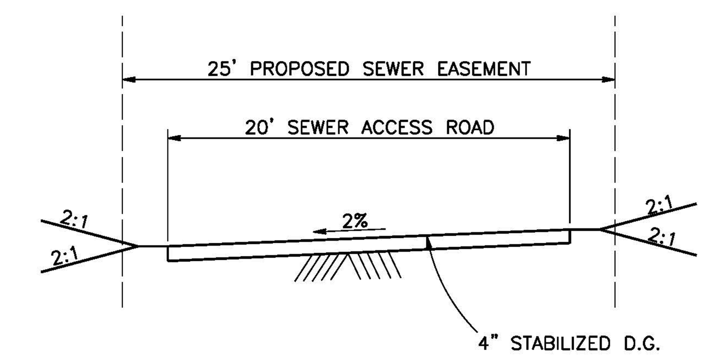
Bio Clean
A Forterra Company

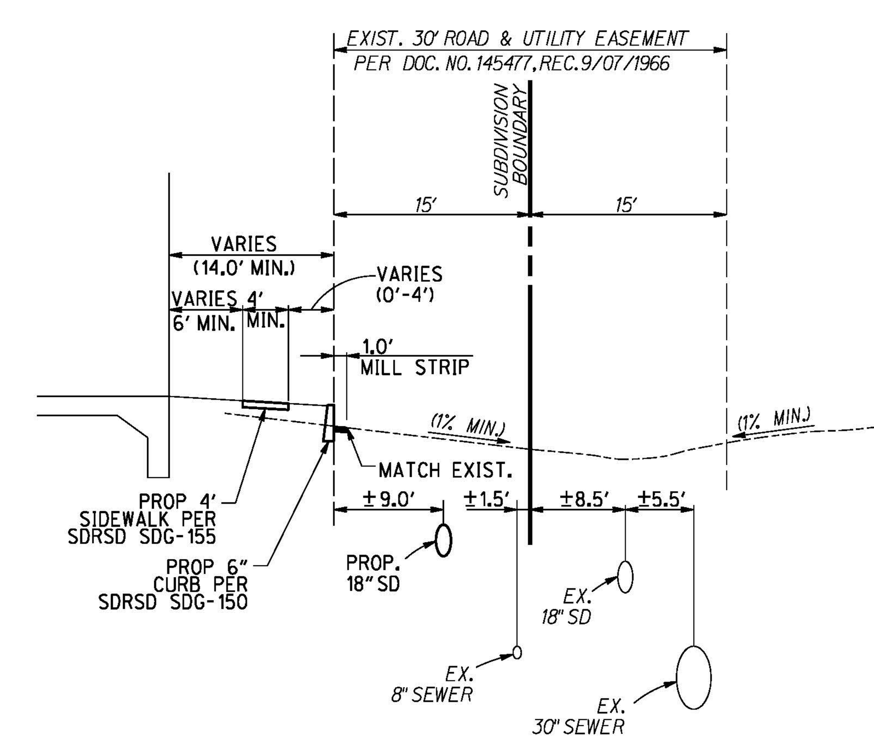
MWS-L-4-4-V
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL



PUBLIC STREET - MISSION GORGE ROAD
STREET CLASSIFICATION: 4-LANE MAJOR
NOT TO SCALE



SEWER ACCESS ROAD
NOT TO SCALE



PRIVATE ROAD & ACCESS EASEMENT
NOT TO SCALE

DIGALERT 811

LAMBERT COORDINATES: 222–1737	PTS: 671912
NAD83: 1862–6297	I.O.: xxxxxxxx

PREPARED BY:
RICK ENGINEERING COMPANY

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(619) 291–0707

REVISION 1: 2/01/2021
REVISION 2: 4/29/2021
REVISION 3: 8/05/2021
REVISION 4: 9/27/2021
REVISION 5:
REVISION 6:
REVISION 7:

PROJECT NAME:
ALVARADO CREEK APTS NDP

SHEET TITLE:
DETAILS AND SECTIONS

ORIGINAL DATE: 08/24/2020

SHEET 2 OF 13

JOB NUMBER: 19048

REGISTERED PROFESSIONAL ENGINEER KAREN S. VAN ERT No. 56991 CIVIL STATE OF CALIFORNIA

ENGINEER OF WORK

KAREN S. VAN ERT
R.C.E. No. 56991
EXP. DATE: 9–30–2021

DATE

J–19048A

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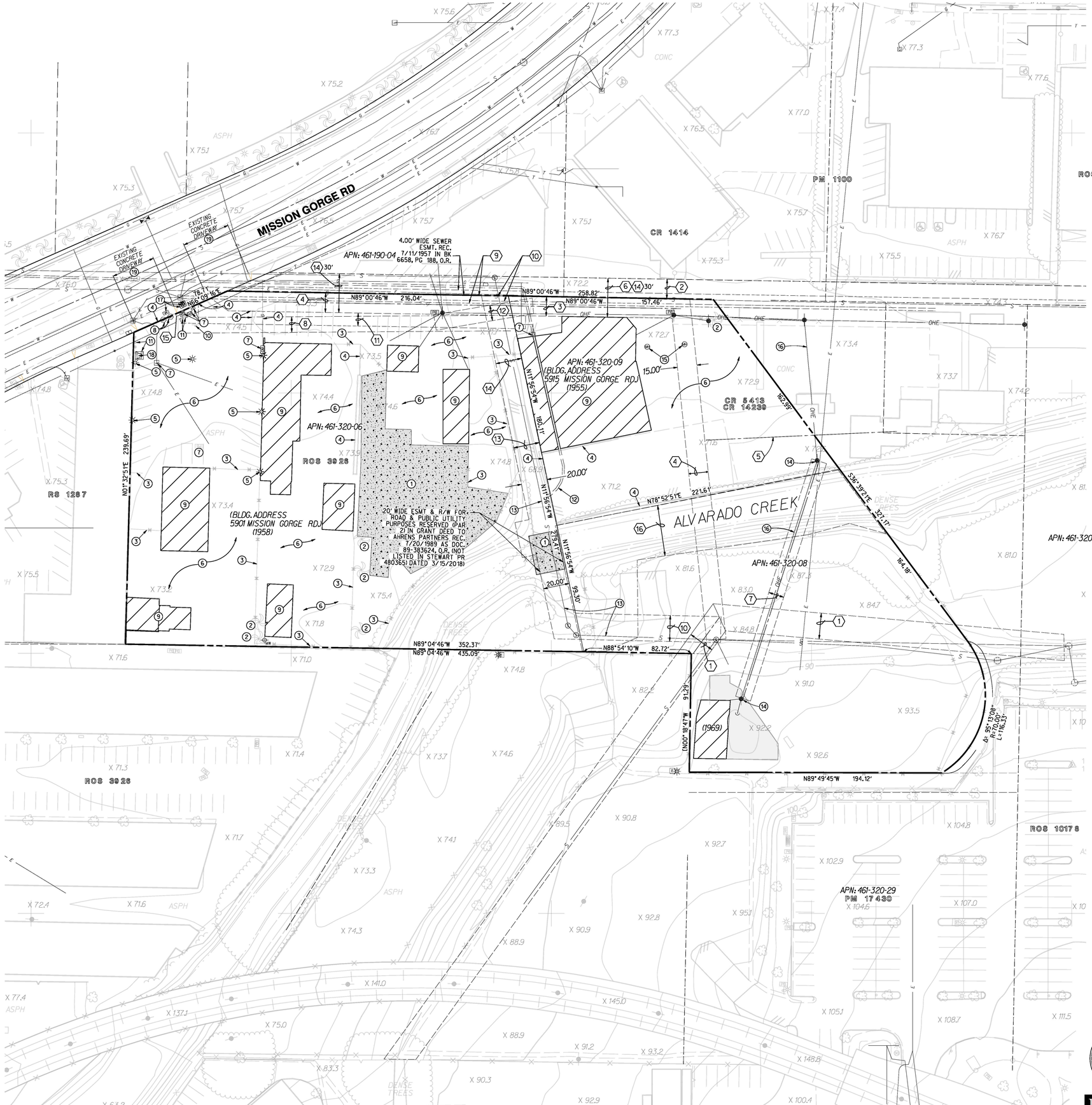

GENERAL NOTES

1. TOPOGRAPHIC SOURCE: RICK ENGINEERING COMPANY DATED: 07-14-2016
2. EXISTING CONTOURS ARE SHOWN AT 2' INTERVALS

EXISTING EASEMENTS

1	04-11-1950	BK 3575, PG 213	CITY OF SAN DIEGO SEWER ESMT.
2	06-05-1950	DOC. 62001	ROAD & PUBLIC UTILITY ESMT SOUTHERN TITLE & TRUST CO.
3	06-05-1950	BK 3646, PG 81	ROAD & PUBLIC UTILITY ESMT SOUTHERN TITLE & TRUST CO.
4	06-04-1951	BK 4122, PG 18	SEWER EASEMENT
5	06-20-1952	BK 4501, PG 575	SDG&E EASEMENT
6	01-07-1954	BK 5104, PG 550	ROAD & PUBLIC UTILITIES ESMT.
7	07-13-1955	BK 5713, PG 534	SDG&E EASEMENT
8	06-19-1956	BK 6146, PG 137	SDG&E EASEMENT
9	02-20-1957	BK 6464, PG 517	SDG&E EASEMENT
10	07-11-1957	BK 6658, PG 188	CITY OF SAN DIEGO SEWER ESMT.
11	04-14-1958	BK 7036, PG 200	WATER LINE EASEMENT
12	06-25-1958	BK 7138, PG 442	SDG&E EASEMENT
13	09-18-1962	1962-160879	CITY OF SAN DIEGO SEWER & STORM DRAIN EASEMENT
14	09-07-1966	NO. 145477	ROAD & PUBLIC UTILITY ESMT.
15	09-30-1981	81-311098	PACIFIC TELEPHONE & TELEGRAPH EASEMENT
16	10-02-1990	1990-537872	CITY OF SAN DIEGO NATURAL FLOWAGE OF WATERS

CONSTRUCTION NOTES

1. EXISTING CONCRETE TO BE REMOVED
2. EXISTING TREES TO BE REMOVED
3. EXISTING FENCE TO BE REMOVED
4. EXISTING RETAINING WALL TO BE REMOVED
5. EXISTING LIGHTING TO BE REMOVED
6. EXISTING ASPHALT TO BE REMOVED
7. EXISTING DRY UTILITIES TO BE REMOVED
8. EXISTING BACKFLOW PREVENTORS TO BE REMOVED
9. EXISTING BUILDING TO BE REMOVED
10. EXISTING STORE FRONT SIGNAGE TO BE REMOVED
11. EXISTING BOLLARDS TO BE REMOVED
12. EXISTING 18" STORM DRAIN TO BE RE-ROUTED. PROTECT IN PLACE UNTIL REALIGNMENT IS COMPLETE. EXIST. STORM DRAIN TO BE ABANDONED IN PLACE OER REMOVED IN ACCORDANCE WITH CITY STANDARDS.
13. EXISTING 30" SEWER TO BE ABANDONED IN PLACE IN ACCORDANCE WITH CITY STANDARDS. PROTECT IN PLACE UNTIL REALIGNMENT IS COMPLETE. SEE SHEET 5 FOR PROPOSED SEWER.
14. EXISTING POWER POLE TO BE PROTECTED IN PLACE
15. UNKNOWN UNDERGROUND UTILITY. CONTRACTOR TO VERIFY USAGE PRIOR TO REMOVAL
16. EXISTING OVERHEAD POWER LINES TO BE PROTECTED IN PLACE
17. EXISTING WATER METERS TO BE REMOVED. LATERALS TO BE KILLED AT MAIN DURING FINAL CONSTRUCTION IN ACCORDANCE WITH CITY STANDARDS.
18. EXISTING TRANSFORMER TO REMAIN. PROTECT IN PLACE
19. EXISTING CONCRETE DRIVEWAY TO BE REMOVED AND REPLACED. SEE SHEET 6 FOR PROPOSED DRIVEWAY.

30 15 0 30 60 90

GRAPHIC SCALE 1" = 30'

DIGALERT 811

ENGINEER OF WORK

KAREN S. VAN ERT
R.C.E. No. 56991
EXP. DATE: 9-30-2021

DATE

REGISTERED PROFESSIONAL ENGINEER KAREN S. VAN ERT No. 56991 CIVIL STATE OF CALIFORNIA

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LAMBERT COORDINATES: 222-1737	PTS: 671912
NAD83: 1862-6297	I.O.: xxxxxxxx
PREPARED BY: RICK ENGINEERING COMPANY ADDRESS: 5620 FRIARS ROAD SAN DIEGO, CA. 92110 (619) 291-0707	REVISION 1: 2/01/2021 REVISION 2: 4/29/2021 REVISION 3: 8/05/2021 REVISION 4: 9/27/2021 REVISION 5: REVISION 6: REVISION 7:
PROJECT NAME: ALVARADO CREEK APTS NDP SHEET TITLE: TOPOGRAPHIC AND MAPPING CONSTRAINTS SHEET	ORIGINAL DATE: 08/24/2020
	SHEET 3 OF 13

JOB NUMBER: 19048

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LEGEND:

SUBDIVISION BOUNDARY

0.00% - 25% SLOPE AREAS

25% AND GREATER SLOPE AREAS

PARCEL 1 (SEE SHT. 5)

SLOPES 0-25%: 2.01 AC. (99.5%)

SLOPES 25% AND GREATER: 0.009 AC. (0.05%)

TOTAL: 2.02 AC.

PARCEL 2 (SEE SHT. 5)

SUBDIVISION BOUNDARY

SLOPES 0 - 25%: 1.54 AC. (83.0%)

SLOPES 25% AND GREATER: 0.31AC. (17.0%)

TOTAL: 1.85 AC.

30 15 0 30 60 90

GRAPHIC SCALE 1" = 30'

REGISTERED PROFESSIONAL ENGINEER KAREN S. VAN ERT No. 56991 CIVIL STATE OF CALIFORNIA

ENGINEER OF WORK

KAREN S. VAN ERT
R.C.E. No. 56991
EXP. DATE: 9-30-2021

DATE

J-19048A

RICK ENGINEERING COMPANY
San Diego

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	REVISION 3: 8/05/2021
	REVISION 4: 9/27/2021
PROJECT NAME: ALVARADO CREEK APTS NDP	REVISION 5:
SHEET TITLE: SLOPE ANALYSIS EXHIBIT SHEET	REVISION 6:
	REVISION 7:
	ORIGINAL DATE: 08/24/2020
	SHEET 4 OF 13

JOB NUMBER: 19048

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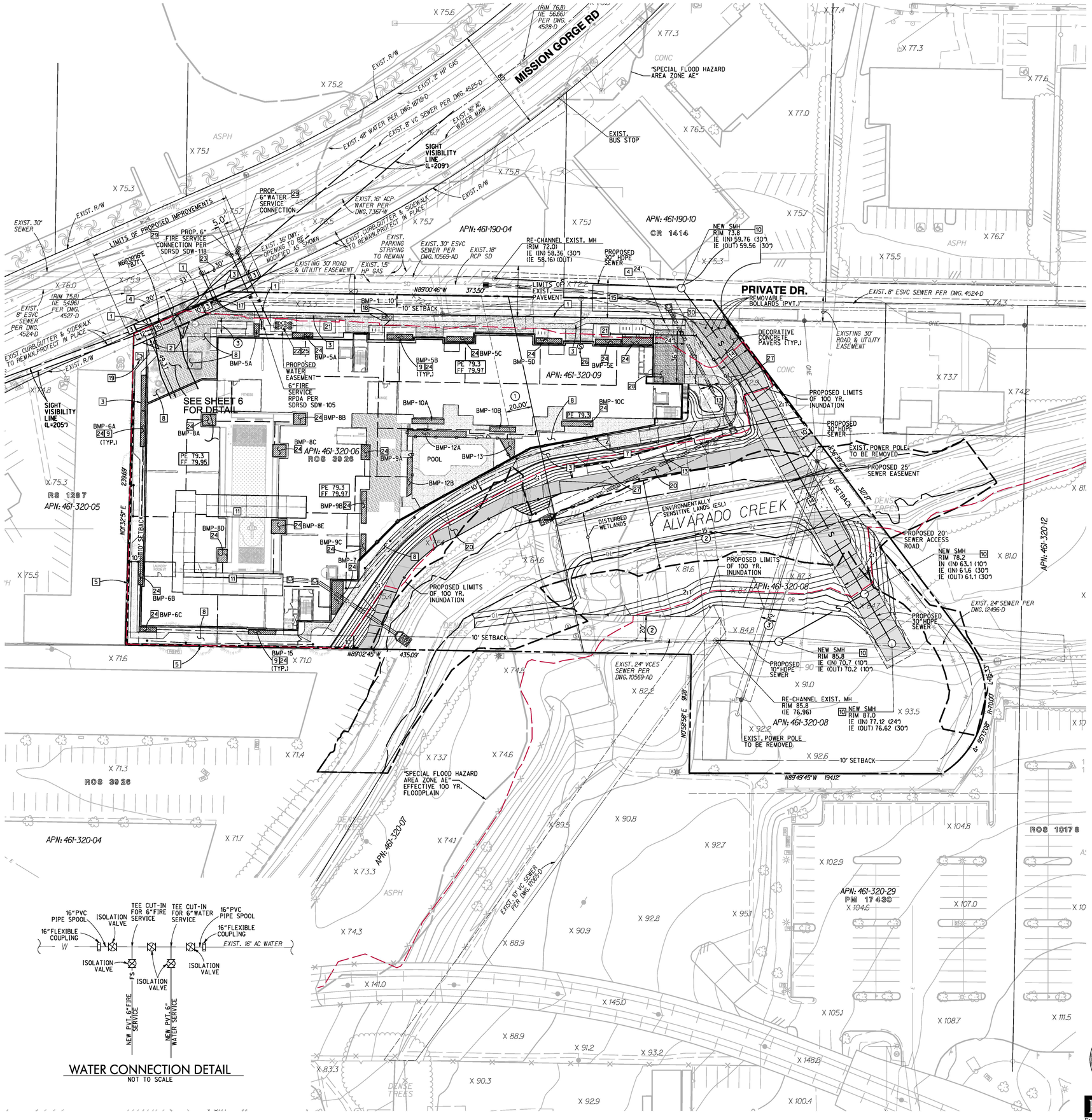

CONSTRUCTION NOTES

1. PROPOSED 6" CURB & GUTTER PER SDRSD SDG-150
2. PROPOSED SIGHT VISIBILITY TRIANGLES
3. PROPOSED SIDEWALK PER SDRSD SDG-155
4. PROPOSED CONCRETE DRIVEWAY PER SDRSD SDG-159
5. PROPOSED RETAINING WALL PER SDRSD C-03
6. PROPOSED RETAINING WALL PER SDRSD C-02
7. PROPOSED FENCING, SEE LANDSCAPE PLANS
8. PROPOSED LANDSCAPING, SEE LANDSCAPE PLANS
9. PROPOSED FILTERRA BIOSCAPE WQ PLANTER. SEE DETAIL, SHEET 2
10. PROPOSED SEWER MANHOLE PER SDRSD SDS-106
11. PROPOSED STORM TRAP DETENTION VAULT, SEE SHT. 10 FOR DETAILS
12. PROVIDE BUILDING ADDRESS NUMBERS, VISIBLE AND LEGIBLE FROM THE STREET OR ROAD FRONTING THE PROPERTY PER FHPS POLICY P-00-6 (UFC 901.4.4)
13. PROPOSED 15' PUBLIC STORM DRAIN EASEMENT
14. PROPOSED 25' PUBLIC SEWER EASEMENT
15. EXISTING ROAD & PUBLIC UTILITY EASEMENT
16. PROPOSED 15' RIGHT-OF-WAY
17. PROPOSED FIRE HYDRANT PER SDRSD SDW-104
18. PROPOSED MODULAR WETLAND SYSTEM (MWS-L-4-4)
19. EXISTING TRANSFORMER TO REMAIN, PROTECT IN PLACE
20. PROPOSED 10' MULTI-USE TRAIL
21. PROPOSED TRANSFORMER
22. PROPOSED DUAL 4" METER ASSEMBLY PER SDRSD SDW-157
23. PROPOSED 30' CONCRETE DRIVEWAY PER SDRSD SDG-162
24. PROPOSED LOCATION OF ROOF DRAINAGE DISCHARGE POINT
25. PROPOSED PRIVATE BACKFLOW DEVICE
26. PROPOSED PRIVATE SEWER LATERAL (EMRA REQUIRED)
27. PROPOSED PUBLIC ACCESS PATH TO TRAIL
28. PROPOSED MOVE-IN\TRASH STAGING AREA. DIMENSIONS (L/W/H)(36'/24'/17')
29. PROPOSED TEE CUT-IN & ISOLATION VALVES TO BE INSTALLED AT TIME OF CONNECTION. SEE WATER CONNECTION DETAIL, THIS SHEET
30. PROPOSED PVT. ROLLING GATE IS TO ALLOW ACCESS TO MOVE-IN TRUCKS, GARBAGE TRUCKS, AND CITY OF SAN DIEGO MAINTENANCE VEHICLE ACCESS TO THE PROPOSED STORM DRAIN EASEMENT.

LEGEND

ITEM	SYMBOL
SIDEWALK	
4" STABILIZED D.G./SEWER ACCESS ROAD (PVT.)	
CONCRETE	

EASEMENT VACATION NOTES

1. EXIST. STORM DRAIN & SEWER EASEMENT TO CITY OF SAN DIEGO TO BE VACATED
2. EXIST. SEWER EASEMENT TO CITY OF SAN DIEGO TO BE VACATED
3. EXIST. SDG&E EASEMENT TO BE VACATED

NOTES

1. NO OBSTRUCTION INCLUDING SOLID WALLS IN THE VISIBILITY ARE SHALL EXCEED 3 FEET IN HEIGHT. PLANT MATERIAL, OTHER THAN TREES, WITHIN THE PUBLIC RIGHT-OF-WAY THAT IS LOCATED WITHIN VISIBILITY AREA SHALL NOT EXCEED 24 INCHES, MEASURED FROM THE TOP OF ADJACENT CURB.
2. THOSE PORTIONS OF EXISTING IMPROVEMENTS, I.E. CURB, GUTTER AND SIDEWALK PANELS, THAT ARE DAMAGED DURING CONSTRUCTION SHALL BE REPLACED IN KIND WITH CURRENT CITY STANDARDS.
3. NON-UTILIZED PORTIONS OF EXISTING DRIVEWAYS SHALL BE REPLACED WITH CURB, GUTTER & SIDEWALK PER CURRENT CITY STANDARDS.
4. NO EXISTING OR PROPOSED PERMANENT STRUCTURES ARE ALLOWED WITHIN CITY EASEMENTS. ANY SUCH ENCROACHMENTS WOULD NEED CITY APPROVAL AND WOULD NEED TO BE SHOWN ON A RECORDED ENCROACHMENT MAINTENANCE AND REMOVAL AGREEMENT (EMRA) WITH THE CITY.
5. EXISTING WATER SERVICES NO LONGER SERVING PROJECT SITE ARE TO BE KILLED AT THE MAIN.
6. EXISTING SEWER SERVICES NO LONGER SERVING PROJECT SITE ARE TO BE ABANDONED AT THE PROPERTY LINE.
7. IF A 3" OR LARGER WATER METER IS REQUIRED FOR THIS PROJECT, THE OWNER/PERMITTEE SHALL CONSTRUCT THE NEW METER AND PRIVATE BACKFLOW DEVICE ON SITE, ABOVE GROUND, WITHIN AN ADEQUATELY SIZED WATER EASEMENT, AND IN A MANNER SATISFACTORY TO THE PUBLIC UTILITIES DIRECTOR AND THE CITY ENGINEER.
8. PROPOSED LATERALS CROSSING SEWER MAINS WILL MAINTAIN A MINIMUM OF 12" VERTICAL CLEARANCE SEPARATION

DIGALERT 811

REGISTERED PROFESSIONAL ENGINEER KAREN S. VAN ERT No. 56991 CIVIL STATE OF CALIFORNIA

ENGINEER OF WORK

KAREN S. VAN ERT
R.C.E. No. 56991
EXP. DATE: 9-30-2021
DATE

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J-19048A

LAMBERT COORDINATES: 222-1737	PTS: 671912
NADB3: 1862-6297	I.O.: xxxxxxxx
PREPARED BY: RICK ENGINEERING COMPANY	REVISION 1: 2/01/2021
ADDRESS: 5620 FRIARS ROAD SAN DIEGO, CA. 92110 (619) 291-0707	REVISION 2: 4/29/2021
	REVISION 3: 8/05/2021
	REVISION 4: 9/27/2021
	REVISION 5:
	REVISION 6:
PROJECT NAME: ALVARADO CREEK APTS NDP	REVISION 7:
SHEET TITLE: SITE PLAN	ORIGINAL DATE: 08/24/2020
	SHEET 5 OF 13

JOB NUMBER: 19048

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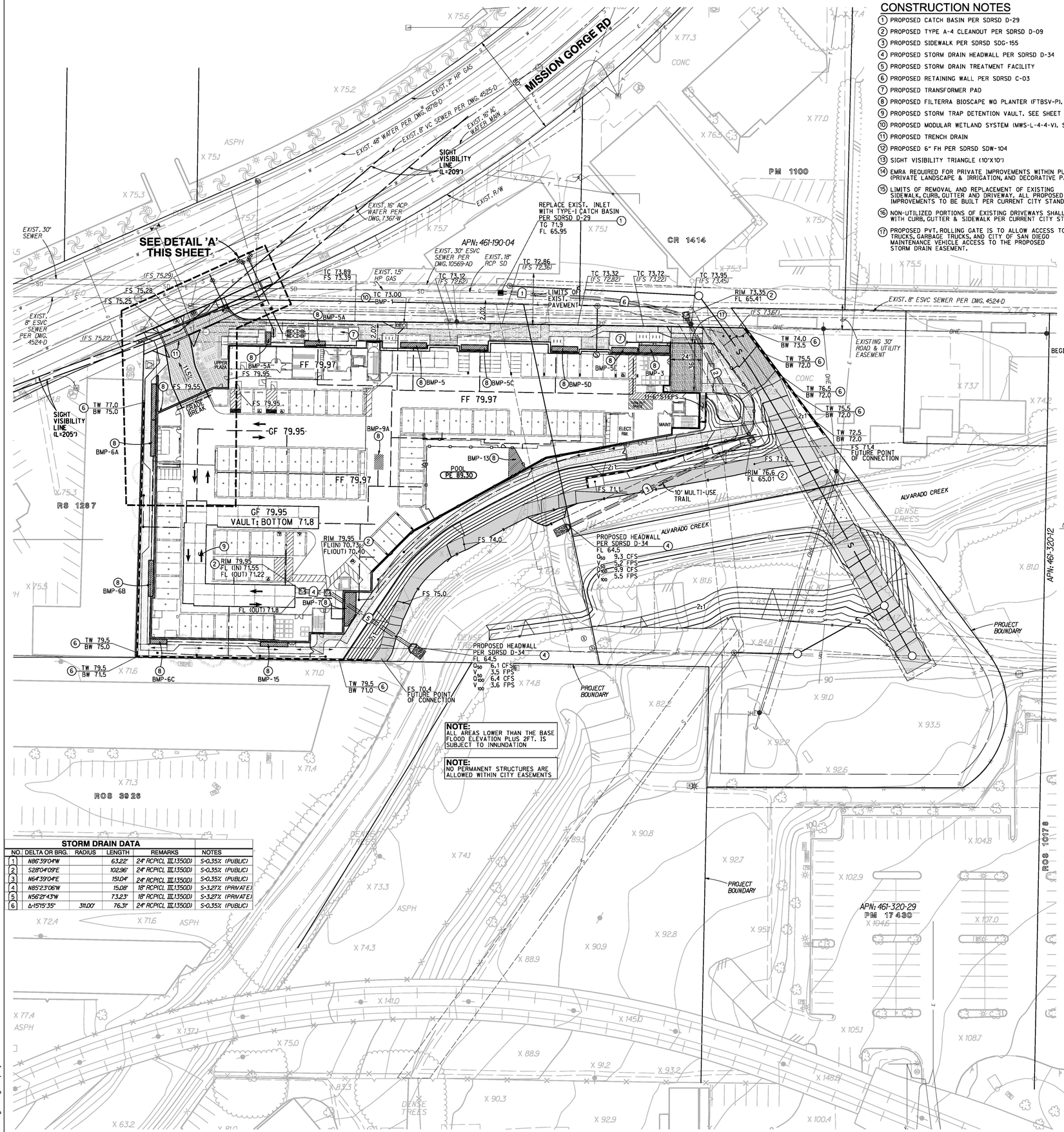
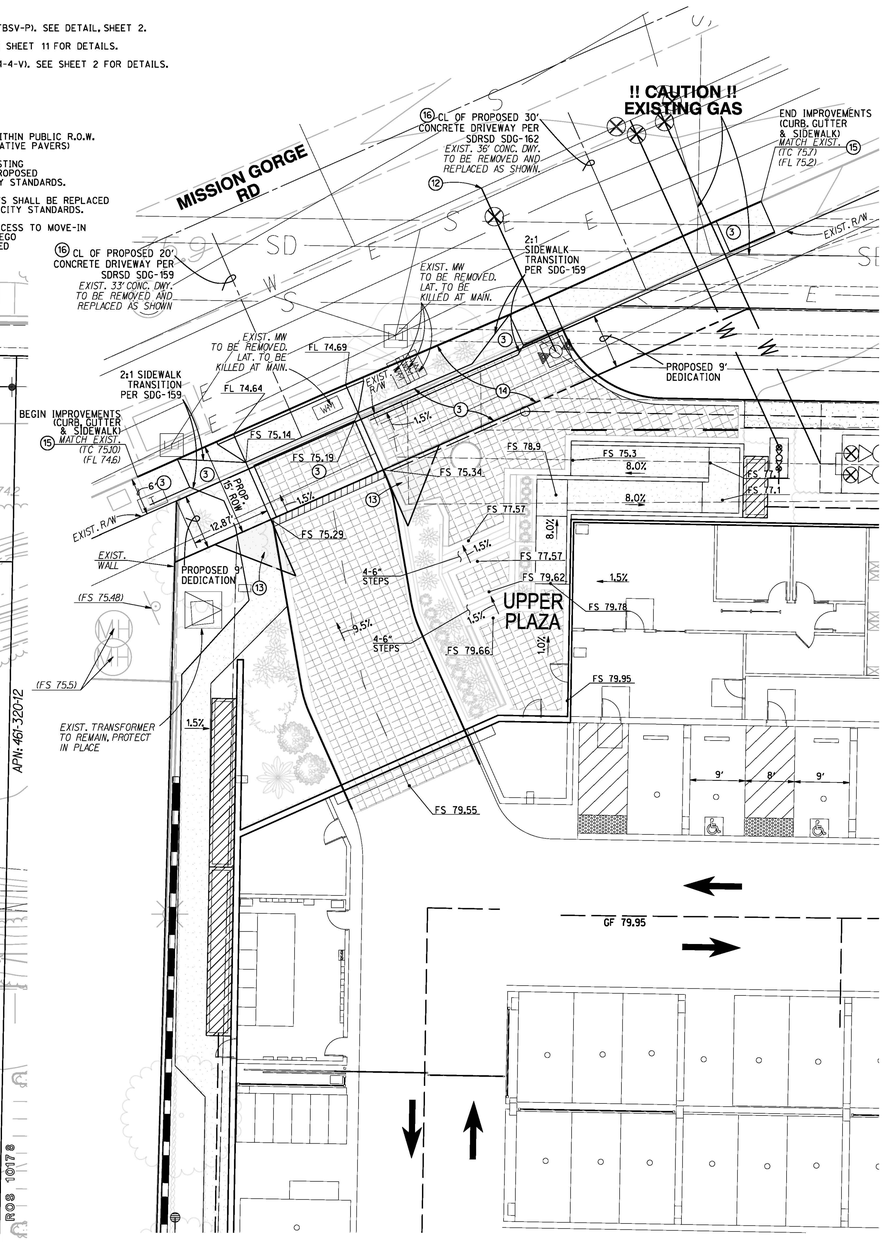
CONSTRUCTION NOTES

1. PROPOSED CATCH BASIN PER SDRSD D-29
2. PROPOSED TYPE A-4 CLEANOUT PER SDRSD D-09
3. PROPOSED SIDEWALK PER SDRSD SDG-155
4. PROPOSED STORM DRAIN HEADWALL PER SDRSD D-34
5. PROPOSED STORM DRAIN TREATMENT FACILITY
6. PROPOSED RETAINING WALL PER SDRSD C-03
7. PROPOSED TRANSFORMER PAD
8. PROPOSED FILTERRA BIOSCAPE WQ PLANTER (FTBSV-P). SEE DETAIL, SHEET 2.
9. PROPOSED STORM TRAP DETENTION VAULT. SEE SHEET 11 FOR DETAILS.
10. PROPOSED MODULAR WETLAND SYSTEM (MWS-L-4-4-V). SEE SHEET 2 FOR DETAILS.
11. PROPOSED TRENCH DRAIN
12. PROPOSED 6" FH PER SDRSD SDW-104
13. SIGHT VISIBILITY TRIANGLE (10'X10')
14. EMRA REQUIRED FOR PRIVATE IMPROVEMENTS WITHIN PUBLIC R.O.W. (PRIVATE LANDSCAPE & IRRIGATION, AND DECORATIVE PAVERS)
15. LIMITS OF REMOVAL AND REPLACEMENT OF EXISTING SIDEWALK, CURB, GUTTER AND DRIVEWAY. ALL PROPOSED IMPROVEMENTS TO BE BUILT PER CURRENT CITY STANDARDS.
16. NON-UTILIZED PORTIONS OF EXISTING DRIVEWAYS SHALL BE REPLACED WITH CURB, GUTTER & SIDEWALK PER CURRENT CITY STANDARDS.
17. PROPOSED PVT. ROLLING GATE IS TO ALLOW ACCESS TO MOVE-IN TRUCKS, GARBAGE TRUCKS, AND CITY OF SAN DIEGO MAINTENANCE VEHICLE ACCESS TO THE PROPOSED STORM DRAIN EASEMENT.



STORM DRAIN DATA

NO.	DELTA OR BRG.	RADIUS	LENGTH	REMARKS	NOTES
1	N86°39'04"W		63.22'	24" RCP(CL III,1350D)	S=0.35% (PUBLIC)
2	S28°04'09"E		102.96'	24" RCP(CL III,1350D)	S=0.35% (PUBLIC)
3	N64°39'04"E		151.04'	24" RCP(CL III,1350D)	S=0.35% (PUBLIC)
4	N85°23'06"W		15.08'	18" RCP(CL III,1350D)	S=3.27% (PRIVATE)
5	N56°21'43"W		73.23'	18" RCP(CL III,1350D)	S=3.27% (PRIVATE)
6	Δ=15°15'35"	311.00'	76.31'	24" RCP(CL III,1350D)	S=0.35% (PUBLIC)



DETAIL 'A'
SCALE: 1"=10'

DIGALERT 811

GRAPHIC SCALE 1" = 30'

ENGINEER OF WORK

KAREN S. VAN ERT
R.C.E. No. 56991
EXP. DATE: 9-30-2021
DATE

REGISTERED PROFESSIONAL ENGINEER KAREN S. VAN ERT No. 56991 CIVIL STATE OF CALIFORNIA

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NAD83: 1862-6297	I.O.: xxxxxxxx
PREPARED BY: RICK ENGINEERING COMPANY	REVISION 1: 2/01/2021
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	REVISION 3: 8/05/2021
	REVISION 4: 9/27/2021
PROJECT NAME: ALVARADO CREEK APTS NDP	REVISION 5:
SHEET TITLE: GRADING AND DRAINAGE PLANS	REVISION 6:
	REVISION 7:
	ORIGINAL DATE: 08/24/2020
	SHEET 6 OF 13

JOB NUMBER: 19048

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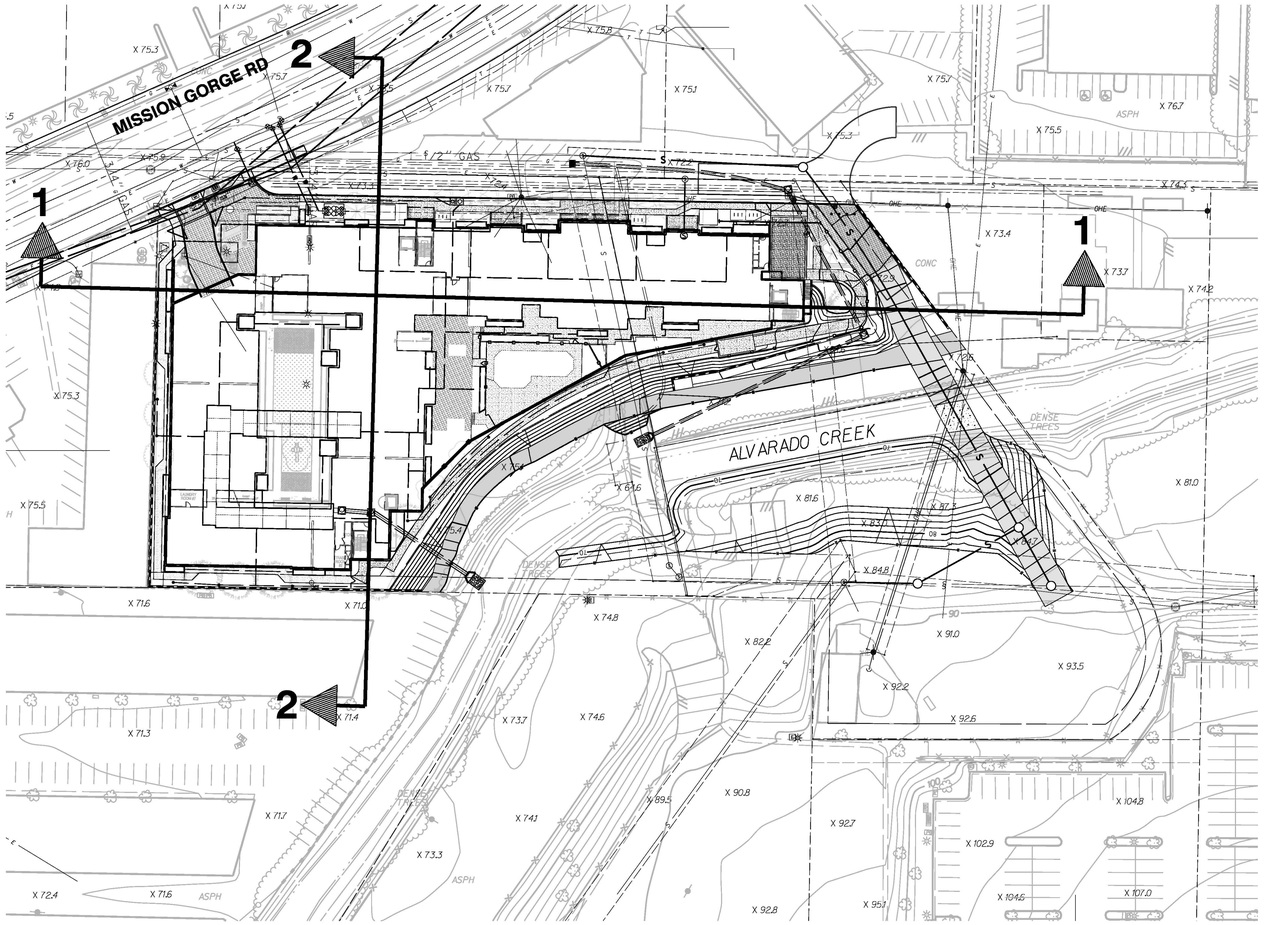
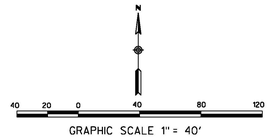
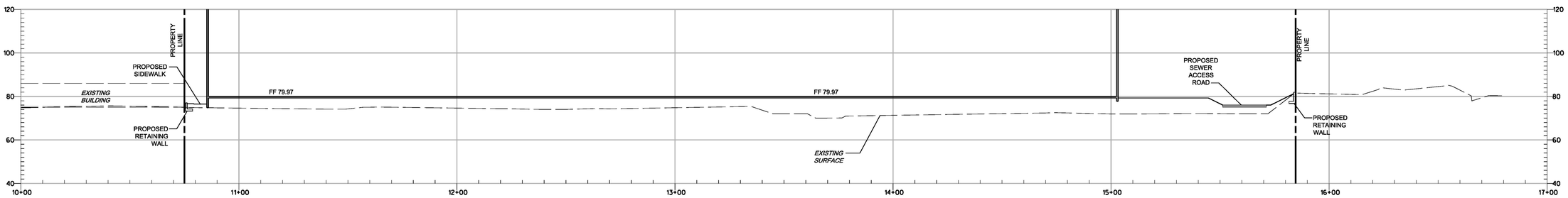
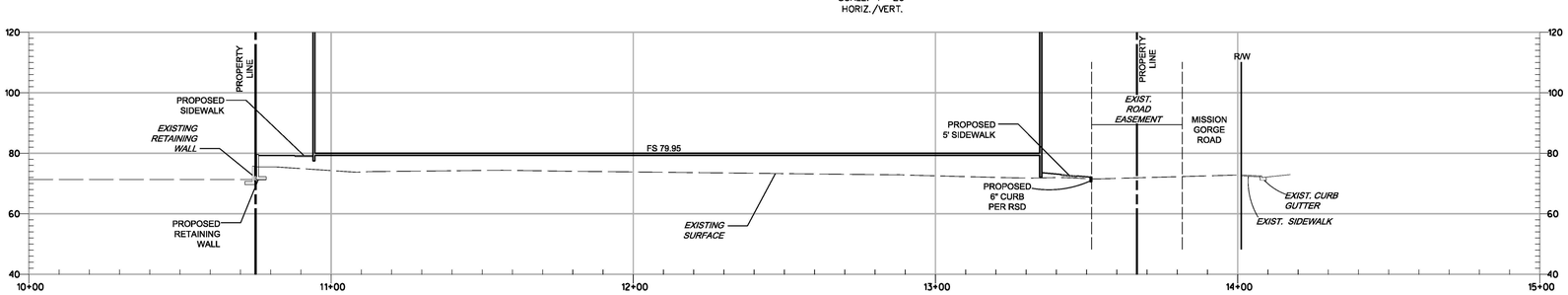






SITE SECTION 1-1

SCALE: 1"=20'
HORIZ./VERT.



SITE SECTION 2-2

SCALE: 1"=20'
HORIZ./VERT.

DIGALERT 811

ENGINEER OF WORK

KAREN S. VAN ERT
R.C.E. No. 56991
EXP. DATE: 9-30-2021

DATE

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NAD83: 1862-6297	I.O.: xxxxxxxx
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	REVISION 3: 8/05/2021
	REVISION 4: 9/27/2021
	REVISION 5:
PROJECT NAME: ALVARADO CREEK APTS NDP	REVISION 6:
SHEET TITLE: SITE SECTIONS	REVISION 7:
	ORIGINAL DATE: 08/24/2020
	SHEET 7 OF 13

JOB NUMBER: 19048

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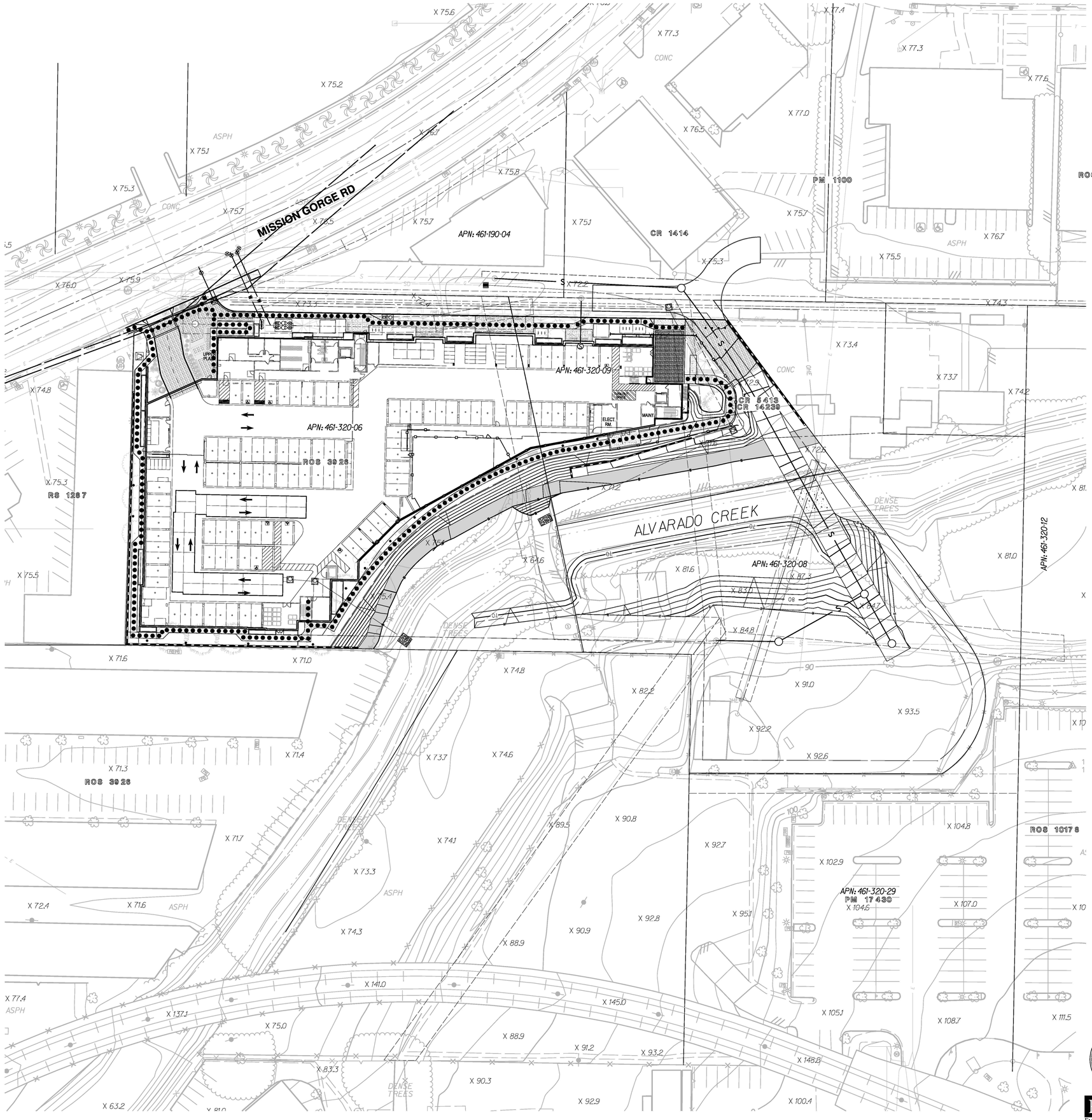

PARKING CALCULATIONS

RESIDENTIAL PAKING SPACES REQUIRED

TOTAL NO. UNITS,		SPACE/UNIT RATIO		REQUIRED TOTAL NO. SPACES
227	X	0.00	=	0.0

LEASING PARKING SPACES REQUIRED

- 3

ACCESSIBLE PARKING REQUIRED

- 4

ELECTRIC VEHICLE PARKING REQUIRED

- 100 COMMON SPACES X 0.1 = 10 EV PARKING SPACES (RESIDENTIAL)
- 3 COMMON SPACES X 0.1 = 1 EV PARKING SPACES (GUEST/LEASING)

TOTAL ON SITE VEHICLE PARKING

- TOTAL ONSITE VEHICLE PARKING REQUIRED: 0
- TOTAL ONSITE VEHICLE PARKING PROVIDED: 100

MOTORCYCLE PARKING REQUIRED PER UNIT

(PER TABLE 142-05C, SAN DIEGO MUNICIPAL CODE)

TOTAL NO. UNITS,		SPACES/UNIT RATIO		REQUIRED TOTAL NO. SPACES
227	X	0.1	=	27

MINIMUM MOTORCYCLE PARKING REQUIRED: 27 STALLS

TOTAL MOTORCYCLE PARKING PROVIDED: 27 STALLS

BICYCLE PARKING REQUIRED PER UNIT

(PER TABLE 142-05C, SAN DIEGO MUNICIPAL CODE)

TOTAL NO. STUDIO UNITS,		SPACES/UNIT RATIO		REQUIRED TOTAL NO. SPACES
54	X	0.3	=	16
TOTAL NO. 1 BDRM UNITS,		SPACES/UNIT RATIO		REQUIRED TOTAL NO. SPACES
54	X	0.4	=	21
TOTAL NO. 2 BDRM UNITS,		SPACES/UNIT RATIO		REQUIRED TOTAL NO. SPACES
59	X	0.5	=	30
TOTAL NO. 2 BDRM UNITS,		SPACES/UNIT RATIO		REQUIRED TOTAL NO. SPACES
60	X	0.6	=	36

MINIMUM BICYCLE PARKING REQUIRED: 103 STALLS

TOTAL BICYCLE PARKING PROVIDED: 103 STALLS

LEGEND

ADA ACCESS ROUTE .....

GRAPHIC SCALE 1" = 30'

ENGINEER OF WORK

KAREN S. VAN ERT
R.C.E. No. 56991
EXP. DATE: 9-30-2021

DATE

REGISTERED PROFESSIONAL ENGINEER — KAREN S. VAN ERT — No. 56991 CIVIL — STATE OF CALIFORNIA

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LAMBERT COORDINATES:	222-1737	PTS:	671912
NAD83:	1862-6297	I.O.:	xxxxxxxx

PREPARED BY:
RICK ENGINEERING COMPANY

ADDRESS:
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(619) 291-0707

PROJECT NAME:
ALVARADO CREEK APTS NDP

SHEET TITLE:
ADA PLAN

REVISION 1:	2/01/2021
REVISION 2:	4/29/2021
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REVISION 4:	9/27/2021
REVISION 5:	
REVISION 6:	
REVISION 7:	
ORIGINAL DATE:	08/24/2020

SHEET 8 OF 13

JOB NUMBER: 19048

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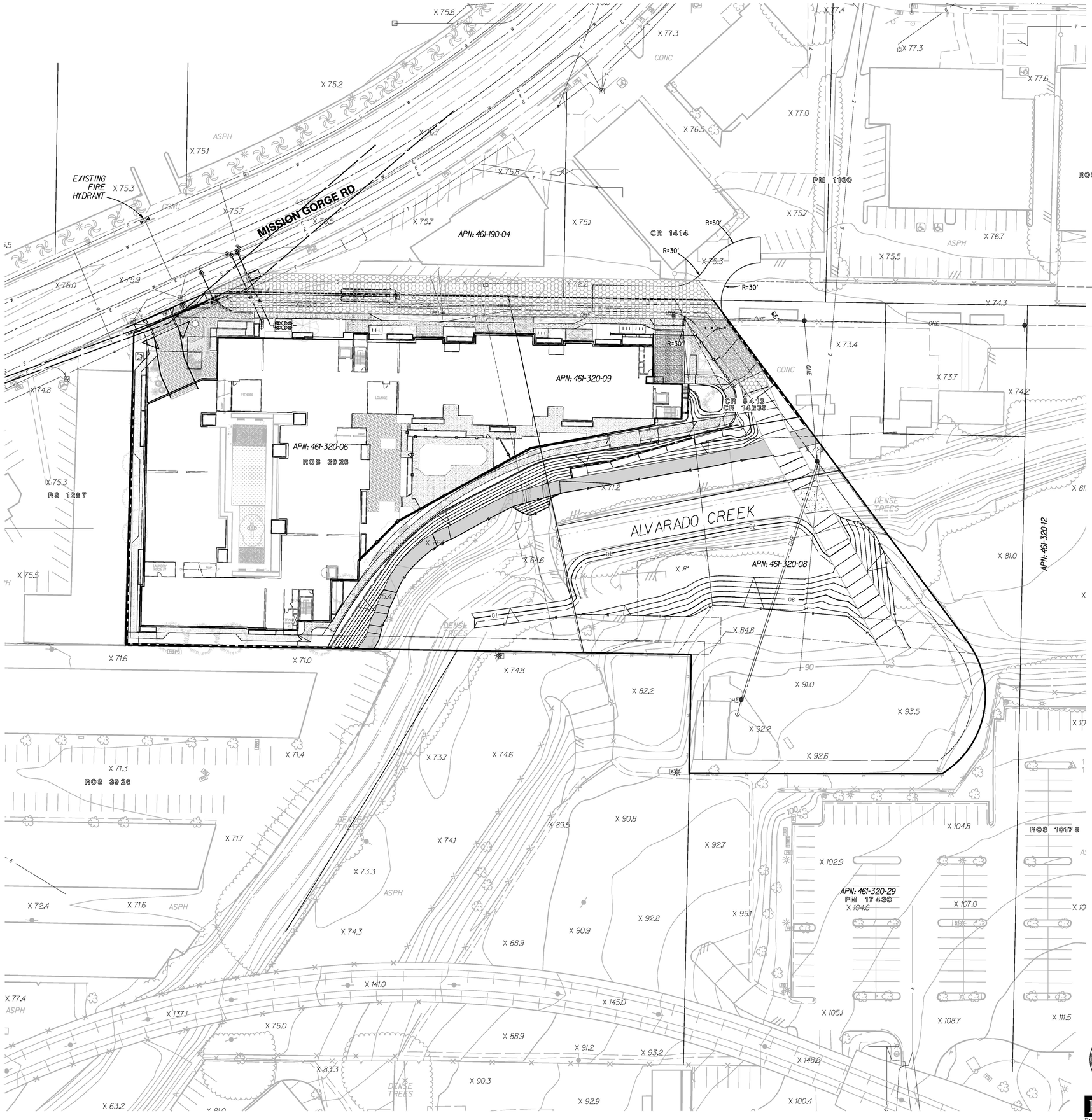


LEGEND

FIRE HYDRANT

FIRE ACCESS PATH OF VEHICULAR TRAVEL

NOTES

1. FPB POLICY A-14-1 - FIRE ACCESS ROADWAY SIGNS OR RED CURBS SHALL BE PROVIDED ALONG ALL PRIVATE DRIVEWAYS LESS THAN 28' AND ARE DESIGNATED A VEHICULAR FIRE ACCESS PATH PER THIS PLAN.

2. SAN DIEGO MUNICIPAL CODE SECTION 55.0507 - POST INDICATOR VALVES, FIRE DEPARTMENT CONNECTIONS, AND ALARM BELL ARE TO BE LOCATED ON THE ADDRESS/ACCESS SIDE OF THE STRUCTURE.

3. FHPS POLICY 1-00-6 - AN ILLUMINATED DIRECTORY SHALL BE PROVIDED.

4. ALL STREETS LESS THAN 28' SHALL HAVE PARKING PROHIBITED ON BOTH SIDES.

5. SAN DIEGO MUNICIPAL CODE SECTION 92.0209 - PROVIDE BUILDING ADDRESS NUMBERS, VISIBLE AND LEGIBLE FROM THE STREET, OR ROAD FRONTING THE PROPERTY.

6. CFC SECTION 506 - AN APPROVED VEHICLE STROBE DETECTOR SYSTEM, WITH KNOX KEYSWITCH OVERRIDE, SATISFACTORY TO THE FIRE MARSHAL, SHALL BE PROVIDED ON ALL VEHICLE MAIN ENTRY AND EMERGENCY ENTRY POINTS TO THIS PROJECT.

7. ALL FIRE ACCESS ROADS SHALL COMPLY PER CITY OF SAN DIEGO FIRE DEPARTMENT BFLS POLICY A-96-9.

8. CFC 505.2 - TEMPORARY STREET SIGNS DURING CONSTRUCTION ARE REQUIRED.

9. CFC 503.2.3 - FIRE APPARATUS ACCESS ROADS SHALL BE DESIGNED AND MAINTAINED TO SUPPORT THE IMPOSED LOADS OF FIRE APPARATUS, AND SHALL BE SURFACED SO AS TO PROVIDE ALL WEATHER DRIVING CAPABILITIES.

10. CFC 501.4 - FIRE APPARATUS ACCESS ROADS AND WATER SUPPLIES FOR FIRE PROTECTION SHALL BE INSTALLED, AND MADE SERVICEABLE PRIOR TO AND DURING TIME OF CONSTRUCTION.

11. SAN DIEGO MUNICIPAL CODE SECTION 55.0507 - ITEM (c) HYDRANT LOCATIONS SHALL BE IDENTIFIED BY THE INSTALLATION OF REFLECTIVE BLUE COLORED MARKERS. SUCH MARKERS SHALL BE AFFIXED TO THE ROADWAY SURFACE, APPROXIMATELY CENTERED BETWEEN CURBS, AND AT A RIGHT ANGLE TO THE HYDRANT.

12. CFC 507.5.5 - CLEAR SPACE AROUND HYDRANTS - A 3 FOOT CLEAR SPACE SHALL BE MAINTAINED AROUND THE CIRCUMFERENCE OF FIRE HYDRANTS, EXCEPT AS OTHERWISE REQUIRED OR APPROVED.

13. CFC 507.5.6 - PHYSICAL PROTECTION - IF ADDITIONAL HYDRANTS ARE REQUIRED, AND WHERE FIRE HYDRANTS ARE SUBJECT TO IMPACT BY A MOTOR VEHICLE, GUARD POSTS OR OTHER APPROVED MEANS SHALL COMPLY WITH SECTION CFC 312.

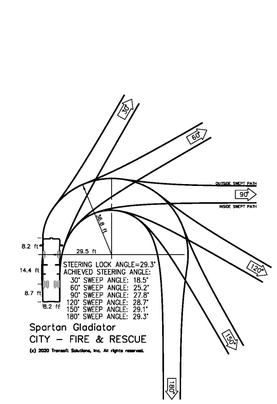
14. STRUCTURES UNDER CONSTRUCTION, ALTERATION OR DEMOLITION SHALL BE PROVIDED WITH NOT LESS THAN ONE APPROVED FIRE EXTINGUISHER IN ACCORDANCE WITH SECTION 906, AND SIZED FOR NOT LESS THAN ORDINARY HAZARD (2A10BC) AS FOLLOWS:
   1. AT EACH STAIRWAY ON ALL FLOOR LEVELS WHERE COMBUSTIBLE MATERIALS HAVE ACCUMULATED.
   2. IN EVERY STORAGE AND CONSTRUCTION SHED.
   3. CFC 3315 - ADDITIONAL PORTABLE FIRE EXTINGUISHERS SHALL BE PROVIDED WHERE SPECIAL HAZARDS EXIST INCLUDING, BUT NOT LIMITED TO, THE STORAGE AND USE OF FLAMMABLE AND COMBUSTIBLE LIQUIDS.

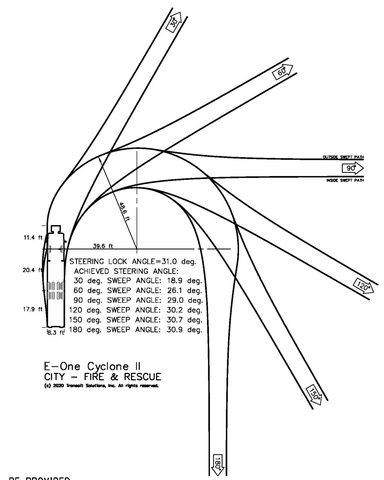
15. CFC 504 - EXTERIOR DOORS AND OPENINGS REQUIRED BY THIS CODE OR THE CBC SHALL BE MAINTAINED READILY ACCESSIBLE FOR EMERGENCY ACCESS BY THE FIRE DEPARTMENT. AN APPROVED ACCESS WALKWAY LEADING FROM FIRE APPARATUS ACCESS ROADS TO EXTERIOR OPENINGS SHALL BE PROVIDED WHEN REQUIRED BY THE FIRE CODE OFFICIAL.

16. ALL BUILDINGS AND SITES UNDERGOING CONSTRUCTION, ALTERATION, OR DEMOLITION SHALL COMPLY WITH THE REQUIREMENTS OF CHAPTER 33 OF THE CFC.

17. CFC 105.4.4 - CONSTRUCTION DOCUMENTS APPROVED BY THE FIRE CODE OFFICIAL ARE APPROVED WITH THE INTENT THAT SUCH CONSTRUCTION DOCUMENTS COMPLY IN ALL RESPECTS WITH THE CFC. REVIEW AND APPROVAL BY THE FIRE CODE OFFICIAL SHALL NOT RELIEVE THE APPLICANT OF THE RESPONSIBILITY OF COMPLIANCE WITH THIS CODE.

18. POST INDICATOR VALVES, FIRE DEPARTMENT CONNECTIONS, AND ALARM BELL ARE TO BE LOCATED ON THE ADDRESS/ACCESS SIDE OF THE STRUCTURE.





NOTE

ANY HAMMERHEAD/TURNAROUND/CUL-DE-SAC SHALL BE PROVIDED IN ACCORDANCE WITH APPENDIX D103.1.
ALL DIMENSIONS HAVE BEEN SHOWN ON THE FIRE ACCESS PLAN.
TURN RADIUS 30' INSIDE/50' OUTSIDE. SDFD DPB POLICY A-14-1.

N

30 15 0 30 60 90

GRAPHIC SCALE 1" = 30'

DIGALERT 811

REGISTERED PROFESSIONAL ENGINEER KAREN S. VAN ERT No. 56991 CIVIL STATE OF CALIFORNIA

ENGINEER OF WORK

KAREN S. VAN ERT
R.C.E. No. 56991
EXP. DATE: 9-30-2021

DATE

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PREPARED BY: RICK ENGINEERING COMPANY	REVISION 1: 2/01/2021
ADDRESS: 5620 FRIARS ROAD SAN DIEGO, CA. 92110 (619) 291-0707	REVISION 2: 4/29/2021
	REVISION 3: 8/05/2021
	REVISION 4: 9/27/2021
	REVISION 5:
PROJECT NAME: ALVARADO CREEK APTS NDP	REVISION 6:
SHEET TITLE: FIRE ACCESS PLAN	REVISION 7:
	ORIGINAL DATE: 08/24/2020
	SHEET 9 OF 13

JOB NUMBER: 19048

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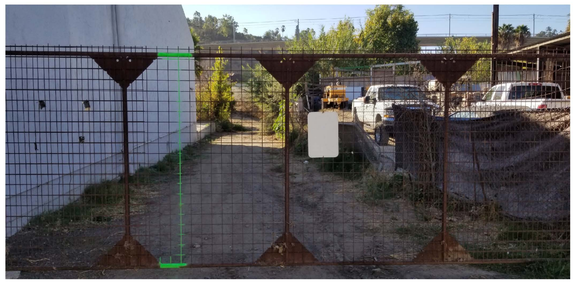
PHOTO ④

PHOTO ③

PHOTO ②



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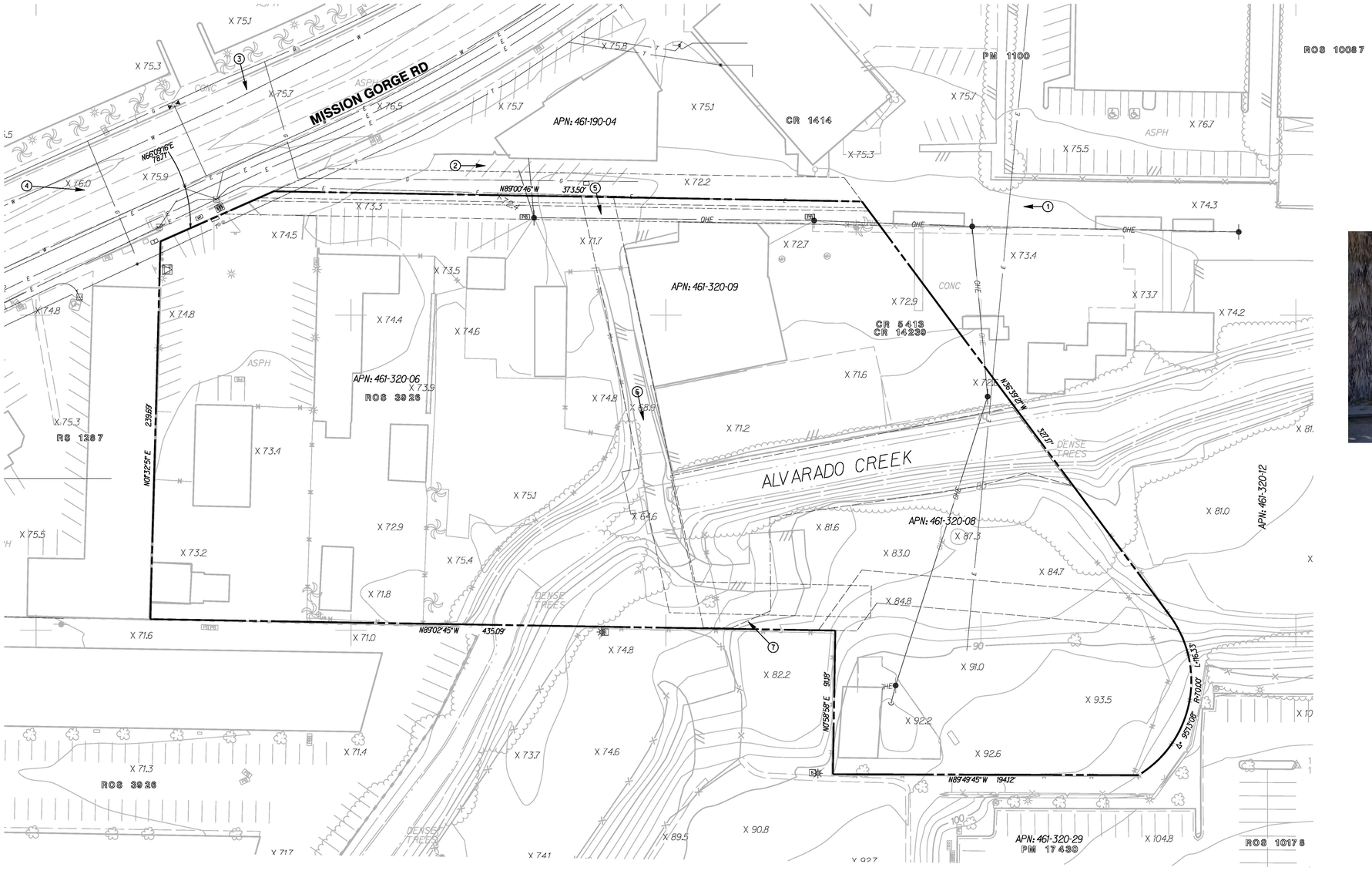

PHOTO ①

PHOTO ⑥

PHOTO ⑦

GRAPHIC SCALE 1" = 30'

ENGINEER OF WORK

KAREN S. VAN ERT
R.C.E. No. 56991
EXP. DATE: 9-30-2021

DATE

REGISTERED PROFESSIONAL ENGINEER
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	REVISION 3: 8/05/2021
	REVISION 4: 9/27/2021
	REVISION 5:
	REVISION 6:
PROJECT NAME: ALVARADO CREEK APTS NDP	REVISION 7:
SHEET TITLE: SITE PHOTO EXHIBIT	ORIGINAL DATE: 08/24/2020
	SHEET 10 OF 13

JOB NUMBER: 19048

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STORMTRAP SYSTEM INFORMATION		
WATER STORAGE REQ'D:	20000	CUBIC FEET
WATER STORAGE PROV:	21379.17	CUBIC FEET
UNIT HEADROOM:	5' 0 "	SINGLETRAP
UNIT QUANTITY:	42	TOTAL PIECES

STORMTRAP STRUCTURAL DESIGN CRITERIA

1. STORMTRAP MODULES SHALL BE MANUFACTURED AND INSTALLED ACCORDING TO SHOP DRAWINGS APPROVED BY THE INSTALLING CONTRACTOR AND ENGINEER OF RECORD. THE SHOP DRAWINGS SHALL INDICATE SIZE AND LOCATION OF ROOF OPENINGS AND INLET/ OUTLET PIPE TYPES, SIZES, INVERT ELEVATIONS AND SIZE OF OPENINGS.
2. COVER RANGE: MIN. 1.08' MAX. 10.00'(CONSULT STORMTRAP FOR ADDITIONAL COVER OPTIONS).
3. ALL DIMENSIONS AND SOIL CONDITIONS, INCLUDING BUT NOT LIMITED TO GROUNDWATER AND SOIL BEARING CAPACITY ARE REQUIRED TO BE VERIFIED IN THE FIELD BY OTHERS PRIOR TO STORMTRAP INSTALLATION.

StormTrap®
MODULAR CONCRETE STORMWATER MANAGEMENT

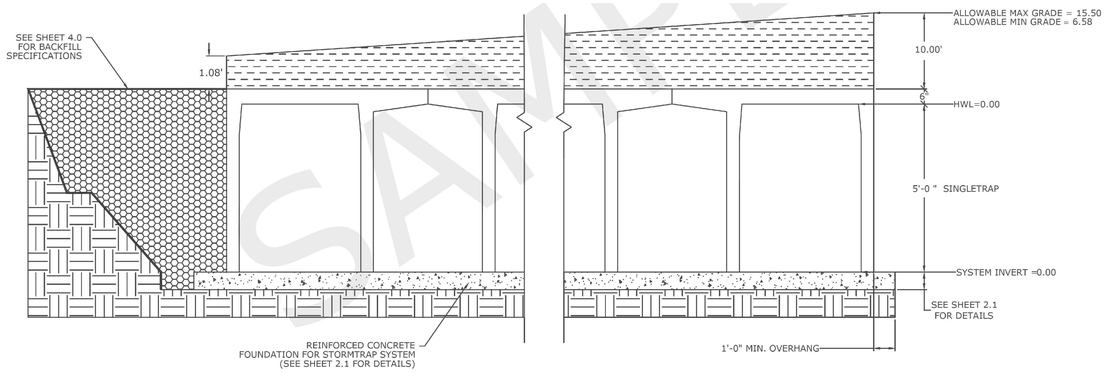
CONTACT STORMTRAP TO REQUEST A DESIGN AND BUDGET FOR YOUR SPECIFIC PROJECT NEEDS.

SHEET INDEX

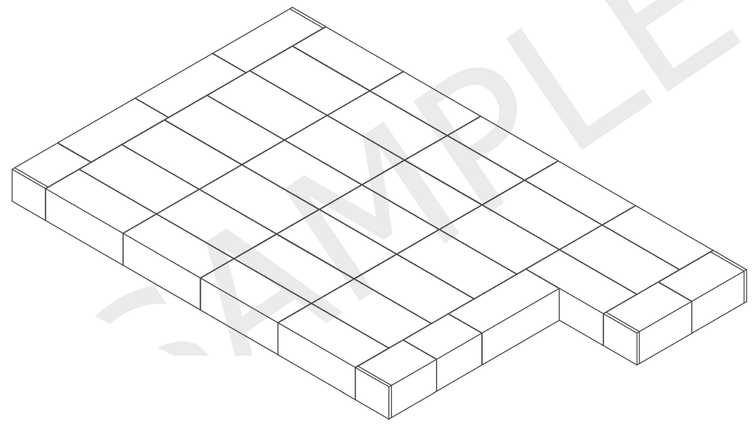
PAGE	DESCRIPTION
0.0	COVER SHEET
1.0	SINGLETRAP DESIGN CRITERIA
2.0	SINGLETRAP SYSTEM LAYOUT
2.1	SINGLETRAP FOUNDATION LAYOUT
3.0	SINGLETRAP INSTALLATION SPECIFICATIONS
3.1	SINGLETRAP INSTALLATION SPECIFICATIONS
4.0	SINGLETRAP BACKFILL SPECIFICATIONS
5.0	RECOMMENDED PIPE / ACCESS OPENING SPECIFICATIONS
6.0	SINGLETRAP MODULE TYPES

STORMTRAP CONTACT INFORMATION

STORM TRAP SUPPLIER:	STORMTRAP
CONTACT NAME:	STORMTRAP
CELL PHONE:	STORMTRAP
SALES EMAIL:	STORMTRAP



5'-0 " SINGLETRAP



RECOMMENDED ACCESS OPENING SPECIFICATION

1. A TYPICAL ACCESS OPENING FOR THE STORMTRAP SYSTEM ARE 2'-0" IN DIAMETER. ACCESS OPENINGS LARGER THAN 3'-0" IN DIAMETER NEED TO BE APPROVED BY STORMTRAP. ALL OPENINGS MUST RETAIN AT LEAST 1'-0" OF CLEARANCE FROM THE END OF THE STORMTRAP MODULE UNLESS NOTED OTHERWISE. ALL ACCESS OPENINGS TO BE LOCATED ON INSIDE LEG UNLESS OTHERWISE SPECIFIED.

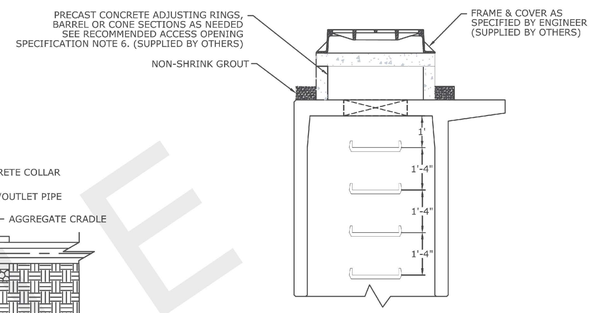
2. PLASTIC COATED STEEL STEPS PRODUCED BY M.A. INDUSTRIES PART #PS3-PFC OR APPROVED EQUAL (SEE STEP DETAIL) ARE PROVIDED INSIDE ANY MODULE WHERE DEEMED NECESSARY. THE HIGHEST STEP IN THE MODULE IS TO BE PLACED A DISTANCE OF 1'-0" FROM THE INSIDE EDGE OF THE STORMTRAP MODULES. ALL ENSUING STEPS SHALL BE PLACED WITH A MAXIMUM DISTANCE OF 1'-4" BETWEEN THEM. STEPS MAY BE MOVED OR ALTERED TO AVOID OPENINGS OR OTHER IRREGULARITIES IN THE MODULE.

3. STORMTRAP LIFTING INSERTS MAY BE RELOCATED TO AVOID INTERFERENCE WITH ACCESS OPENINGS OR THE CENTER OF GRAVITY OF THE MODULE AS NEEDED.

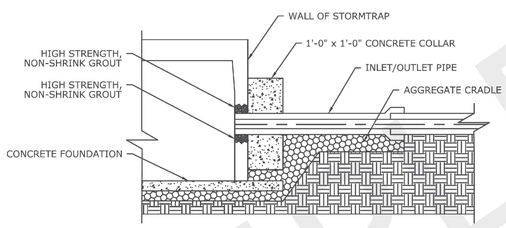
4. STORMTRAP ACCESS OPENINGS MAY BE RELOCATED TO AVOID INTERFERENCE WITH INLET AND/OR OUTLET PIPE OPENINGS SO PLACEMENT OF STEPS IS ATTAINABLE.

5. ACCESS OPENINGS SHOULD BE LOCATED IN ORDER TO MEET THE APPROPRIATE MUNICIPAL REQUIREMENTS. STORMTRAP RECOMMENDS AT LEAST TWO ACCESS OPENINGS PER SYSTEM FOR ACCESS AND INSPECTION.

6. USE PRECAST ADJUSTING RINGS AS NEEDED TO MEET GRADE. STORMTRAP RECOMMENDS FOR COVER OVER 2' TO USE PRECAST BARREL OR CONE INSPECTIONS. (PROVIDED BY OTHERS)



RISER / STAIR DETAIL



RECOMMENDED PIPE OPENING SPECIFICATION

1. MINIMUM EDGE DISTANCE FOR AN OPENING ON THE OUTSIDE WALL SHALL BE NO LESS THAN 1'-0".

2. MAXIMUM OPENING SIZE TO BE DETERMINED BY THE MODULE HEIGHT. PREFERRED OPENING SIZE Ø 36" OR LESS. ANY OPENING NEEDED THAT DOES NOT FIT THIS CRITERIA SHALL BE BROUGHT TO THE ATTENTION OF STORMTRAP FOR REVIEW.

3. CONNECTING PIPES SHALL BE INSTALLED WITH A 1'-0" CONCRETE COLLAR, AND AN AGGREGATE CRADLE FOR AT LEAST ONE PIPE LENGTH (SEE PIPE CONNECTION DETAIL). A STRUCTURAL GRADE CONCRETE OR HIGH STRENGTH, NON-SHRINK GROUT WITH A MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 3000 PSI SHALL BE USED.

4. THE ANNULAR SPACE BETWEEN THE PIPE AND THE HOLE SHALL BE FILLED WITH HIGH STRENGTH NON-SHRINK GROUT.

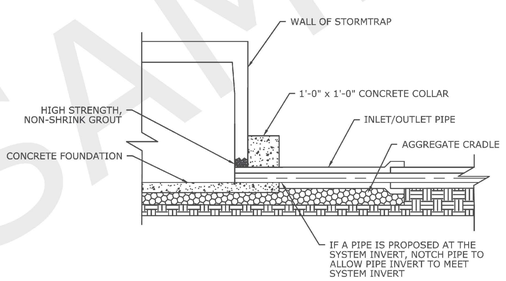
RECOMMENDED PIPE INSTALLATION INSTRUCTIONS

1. CLEAN AND LIGHTLY LUBRICATE ALL OF THE PIPE TO BE INSERTED INTO STORMTRAP.

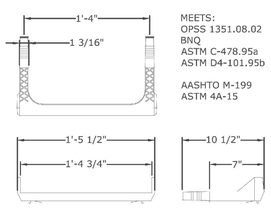
2. IF PIPE IS CUT, CARE SHOULD BE TAKEN TO ALLOW NO SHARP EDGES. BEVEL AND LUBRICATE LEAD END OF PIPE.

3. ALIGN CENTER OF PIPE TO CORRECT ELEVATION AND INSERT INTO OPENING.

NOTE: ALL ANCILLARY PRODUCTS RECOMMENDED AND SHOWN ON THIS SHEET ARE RECOMMENDATIONS ONLY AND SUBJECT TO CHANGE PER THE INSTALLING CONTRACTOR.



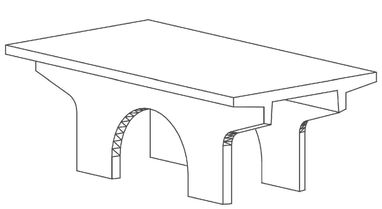
PIPE CONNECTION DETAIL



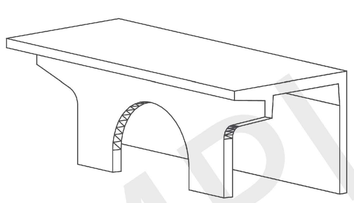
MEETS:
OPSS 1351.08.02
BNQ
ASTM C-478.95a
ASTM D4-101.95b

AASHTO M-199
ASTM 4A-15

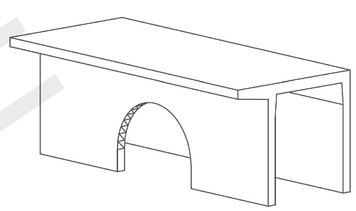
STEP DETAIL



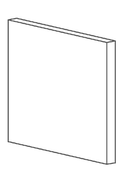
TYPE I



TYPE III



TYPE IV



TYPE IV
END PANEL

NOTES:
1. OPENING LOCATIONS AND SHAPES MAY VARY.
2. SP - INDICATES A MODULE WITH MODIFICATIONS.
3. P - INDICATES A MODULE WITH A PANEL ATTACHMENT.
4. POCKET WINDOW OPENINGS ARE OPTIONAL.

NOTE:
BMP DETAILS SHOWN ARE FOR REFERENCE ONLY.
SIZE WILL BE DETERMINED DURING FINAL DESIGN

DIGALERT 811

SINGLETRAP® - DETENTION SAMPLE DRAWING

StormTrap®
PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]
1-877-867-6872

ENGINEER INFORMATION:

PROJECT INFORMATION:
SINGLETRAP
DETENTION

CURRENT ISSUE DATE:

ISSUED FOR:
SAMPLE PROJECT

REV.	DATE:	ISSUED FOR:	DWN BY:

SCALE:
NTS

SHEET TITLE:
COVER SHEET

SHEET NUMBER:
0.0

ENGINEER OF WORK

KAREN S. VAN ERT
R.C.E. No. 56991
EXP. DATE: 9-30-2021
DATE

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SAN DIEGO, CA 92110
619-291-0707
(FAX) 619-291-4165
J-19048A
rickengineering.com
Riverside - Orange - Sacramento - San Luis Obispo - Phoenix - Tucson - Denver

PROJECT NAME:
ALVARADO CREEK APTS NDP
SHEET TITLE:
STORM TRAP DETAILS

LAMBERT COORDINATES: 222-1737
NAD83: 1862-6297

PTS: 671912
I.O.: xxxxxxxx

PREPARED BY:
RICK ENGINEERING COMPANY

ADDRESS:
5620 FRIARS ROAD
SAN DIEGO, CA. 92110
(619) 291-0707

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REVISION 3:	8/05/2021
REVISION 4:	9/27/2021
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REVISION 6:	
REVISION 7:	

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SHEET 11 OF 13

JOB NUMBER: 19048

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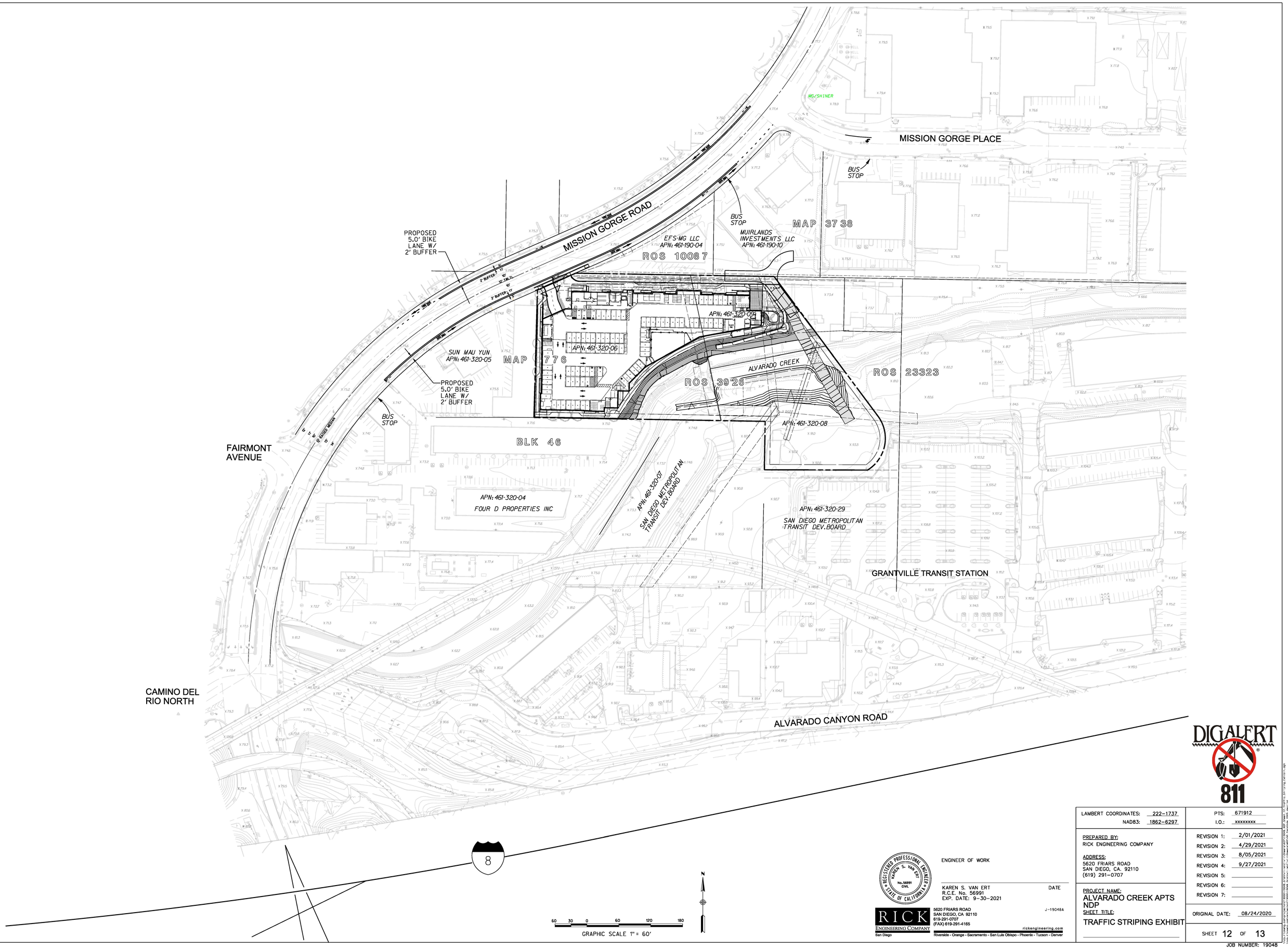
SAMPLE



LAMBERT COORDINATES: 222-1737	PTS: 671912
NAD83: 1862-6297	I.O.: xxxxxxxx

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PROJECT NAME:
ALVARADO CREEK APTS NDP

SHEET TITLE:
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REVISION 7:	
ORIGINAL DATE:	08/24/2020

SHEET 12 OF 13

ENGINEER OF WORK

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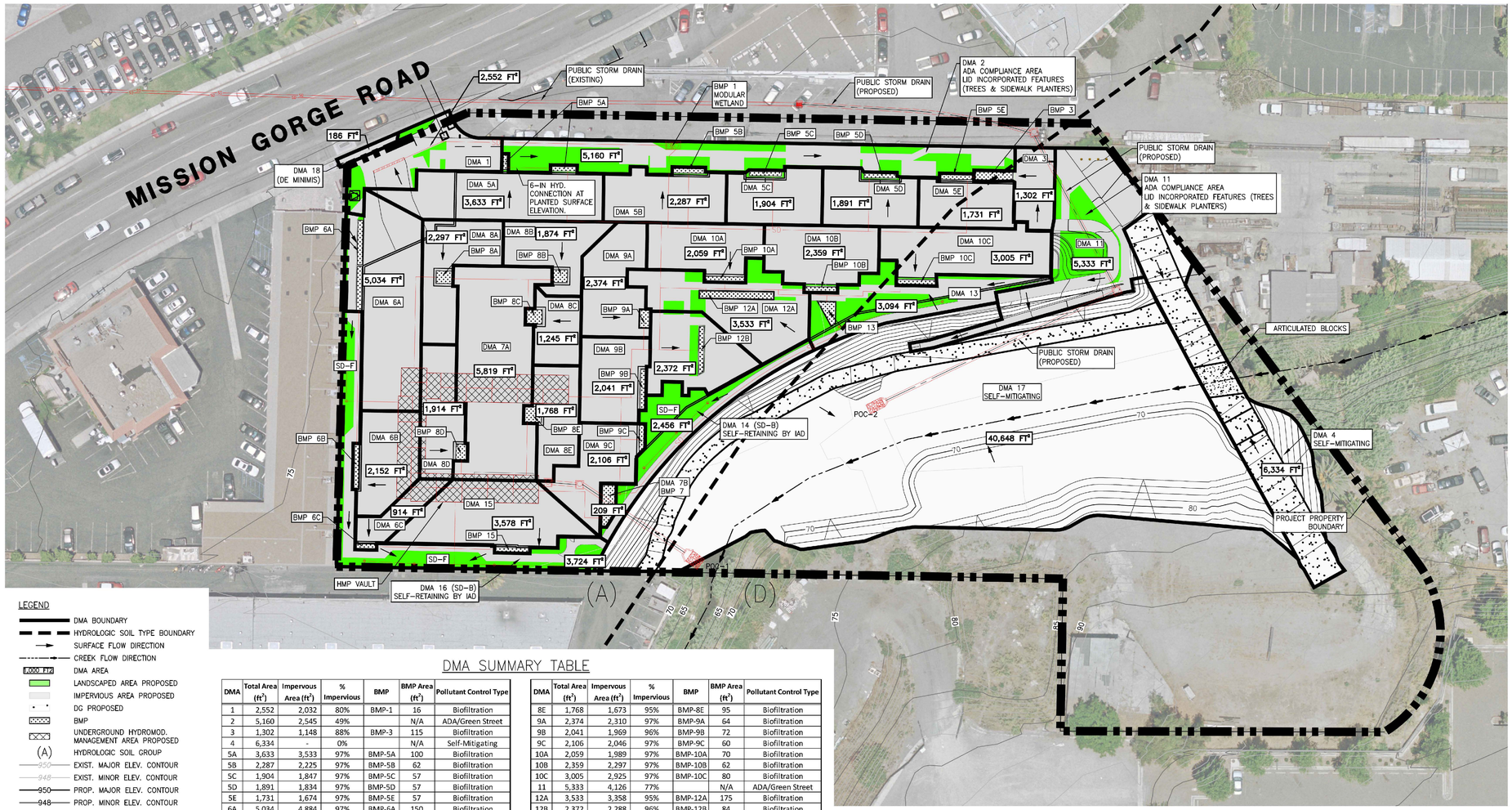

LEGEND

- DMA BOUNDARY
- HYDROLOGIC SOIL TYPE BOUNDARY
- SURFACE FLOW DIRECTION
- CREEK FLOW DIRECTION
- DMA AREA
- LANDSCAPED AREA PROPOSED
- IMPERVIOUS AREA PROPOSED
- DG PROPOSED
- BMP
- UNDERGROUND HYDROMOD. MANAGEMENT AREA PROPOSED
- (A) HYDROLOGIC SOIL GROUP
- 950 EXIST. MAJOR ELEV. CONTOUR
- 948 EXIST. MINOR ELEV. CONTOUR
- 950 PROP. MAJOR ELEV. CONTOUR
- 948 PROP. MINOR ELEV. CONTOUR
- STORM DRAIN
- AREA DRAIN
- POC-1 POINT OF COMPLIANCE

DMA SUMMARY TABLE

DMA	Total Area (ft^2)	Impervous Area (ft^2)	% Impervious	BMP	BMP Area (ft^2)	Pollutant Control Type
1	2,552	2,032	80%	BMP-1	16	Biofiltration
2	5,160	2,545	49%		N/A	ADA/Green Street
3	1,302	1,148	88%	BMP-3	115	Biofiltration
4	6,334	-	0%		N/A	Self-Mitigating
5A	3,633	3,533	97%	BMP-5A	100	Biofiltration
5B	2,287	2,225	97%	BMP-5B	62	Biofiltration
5C	1,904	1,847	97%	BMP-5C	57	Biofiltration
5D	1,891	1,834	97%	BMP-5D	57	Biofiltration
5E	1,731	1,674	97%	BMP-5E	57	Biofiltration
6A	5,034	4,884	97%	BMP-6A	150	Biofiltration
6B	2,152	2,072	96%	BMP-6B	80	Biofiltration
6C	914	878	96%	BMP-6C	36	Biofiltration
7	6,028	5,853	97%	BMP-7	175	Biofiltration
8A	2,297	2,225	97%	BMP-8A	72	Biofiltration
8B	1,874	1,809	97%	BMP-8B	65	Biofiltration
8C	1,245	1,163	93%	BMP-8C	82	Biofiltration
8D	1,914	1,854	97%	BMP-8D	60	Biofiltration

DMA	Total Area (ft^2)	Impervous Area (ft^2)	% Impervious	BMP	BMP Area (ft^2)	Pollutant Control Type
8E	1,768	1,673	95%	BMP-8E	95	Biofiltration
9A	2,374	2,310	97%	BMP-9A	64	Biofiltration
9B	2,041	1,969	96%	BMP-9B	72	Biofiltration
9C	2,106	2,046	97%	BMP-9C	60	Biofiltration
10A	2,059	1,989	97%	BMP-10A	70	Biofiltration
10B	2,359	2,297	97%	BMP-10B	62	Biofiltration
10C	3,005	2,925	97%	BMP-10C	80	Biofiltration
11	5,333	4,126	77%		N/A	ADA/Green Street
12A	3,533	3,358	95%	BMP-12A	175	Biofiltration
12B	2,372	2,288	96%	BMP-12B	84	Biofiltration
13	3,094	1,486	48%	BMP-13	90	Biofiltration
14	2,456	863	35%		N/A	Self-Retaining by IAD
15	3,578	3,478	97%	BMP-15	100	Biofiltration
16	3,724	1,648	44%		N/A	Self-Retaining by IAD
17	40,648	-	0%		N/A	Self-Mitigating
18	186	186	100%		N/A	De mimimis

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NOTES:
1. DEPTH TO GROUNDWATER IS APPROXIMATELY 9 FT BGS
2. NO PCCSYAS ON SITE
3. UNLESS NOTED OTHERWISE, STORM DRAIN SHOWN IS PRIVATE

N

30 15 0 30 60 90
GRAPHIC SCALE: 1"=30'

DMA EXHIBIT
ALVARADO CREEK APARTMENTS
SAN DIEGO, CA 92120

DATE: SEPT. 2021

J-19048 SHEET 1 OF 1

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(619) 291-0707

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SHEET 13 OF 13

REGISTERED PROFESSIONAL ENGINEER KAREN S. VAN ERT No. 56991 CIVIL STATE OF CALIFORNIA

ENGINEER OF WORK

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JOB NUMBER: 19048

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Attachment 5
Drainage Report

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

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DRAINAGE STUDY
FOR
ALVARADO CREEK APARTMENTS

Job Number 19048

August 18, 2020
Revised: February 2, 2021
Revised: May 3, 2021
Revised: July 23, 2021
Revised: September 24, 2021

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DRAINAGE STUDY

FOR

ALVARADO CREEK APARTMENTS

Job Number 19048

Jayne Janda-Timba
R.C.E. #70649
Exp. 06/23

Prepared for:

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430 E. State Street, Suite 100
Eagle, Idaho 83616

Prepared by:

Rick Engineering Company
Water Resources Division
5620 Friars Road
San Diego, California 92110-2596
(619) 291-0707

August 18, 2020
Revised: February 2, 2021
Revised: May 3, 2021
Revised: July 23, 2021
Revised: September 24, 2021

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APPENDICES

Appendix A: AES Program Output and Support Material - Local Drainage Basin
Appendix B: On-Grade Inlet Intercept Calculations
Appendix C: Detention Analysis

MAP POCKETS:

Map Pocket 1: Drainage Study Map, Pre-Project Condition
Map Pocket 2: Drainage Study Map, Post-Project Condition

ALVARADO CREEK APARTMENTS

5th Submittal Revision Page

September 24, 2021

No comments were received from the City on the 4th submittal review applicant to this document This document has been updated to incorporate a revised storm drain alignment to be consistent with project grading and utility plans.

ALVARADO CREEK APARTMENTS

4th Submittal Revision Page

July 23, 2021

Pursuant to the review comments completed on May 28, 2021, regarding the subject reports dated May 3, 2021, the following comments were addressed. Below is a list of the comments, followed by Rick Engineering Company's response:

REVIEW COMMENTS

Drainage Study Issues

Reviewing Discipline: LDR-Engineering Review

Drainage Study Issues

27. Please revise the pre and post development hydrology exhibits to include the following information:
a) Q & V and IEs
b) Points of Compliance
c) Area of each basin
d) impervious vs pervious tables
Also, please use a different lineweight and color for the existing and proposed storm drain systems for legibility.

Response: Please see response to Comment 77.

58. Following up with comment#27: Comment has been partially addressed. Please revise the pre and post development hydrology exhibits to add the Q & V at all discharge points and to show existing and proposed storm drain systems in different line weight and color for legibility.

Response: Please see response to Comment 77.

Stormwater Issues

77. Following up with comments#27 & 58: The Q & V on the Grading Plans and not consistent with the hydrology exhibits. Please revise all plans and exhibits to be consistent.
(Continued)

Response: Q & V labeled for all discharge points and existing and proposed storm drain systems clearly shown on the pre- and post-project hydrology exhibits. The Q & V labels are shown on the grading plan, and labels are consistent with the drainage study hydrology exhibits.

78. Please revise the proposed storm drain system on the hydrology exhibit, grading plans, and DMA/HMP exhibits to show all the "multiple" BMPs that serve ONE DMA to be hydraulically connected before being connected to the rest of the system (each set of BMPs to have one connection to the SD system).

    Also, please identify what pipes are public and what are private, and whether the southerly pipe and riprap discharging to the Alvarado Creek is private or public. Additional comments may follow upon response.

    Response: The proposed storm drain system on the hydrology exhibit, grading plans, and DMA/HMP exhibits have been revised to show a single BMP for each DMA or to show that the "multiple" BMPs that serve a single DMA are hydraulically connected before being connected to the rest of the system.

    Pipes have been identified as public or private on the exhibits and plans.

ALVARADO CREEK APARTMENTS

3rd Submittal Revision Page

May 3, 2021

Pursuant to the review comments completed on March 12, 2021 regarding the subject reports dated February 2, 2021, the following comments were addressed. Below is a list of the comments, followed by Rick Engineering Company's response:

REVIEW COMMENTS

Drainage Study Issues

Reviewing Discipline: Storm Water Department – Operations

1. The O&M Engineering division (Storm Water Operations) has reviewed all applicable documents to submitted. Please see below comments from O&M Engineering: (New Issue)

   Response: Noted. Comments reviewed and addressed.

2. As indicated in the Cities Drainage and design manual, "Within floodplain and floodplain fringe areas as defined by the Federal Emergency Management Agency (FEMA), the runoff criteria shall be based upon a 100-year frequency storm. Under City requirements, the minimum elevation of the finished, first floor elevation of any building is two (2) feet above the 100-year frequency flood elevation."

   a) Since this project is within a FEMA flood zone, the Drainage Report needs to be adjusted to evaluate a 100 year storm event and not only the 50 year accounted by the consultant team. (continued) (New Issue)

   Response: Both the 50-year and 100-year storm events have been analyzed and are presented in the drainage study.

3. b) Consistent analysis needs to be provided across all studies. (New Issue)

   Response: There is consistent analysis across all studies.

4. The hydraulic analysis indicates that the first finished floor (included basements) will be elevated two feet of more , at 79 ft of elevation in order to comply with City of San Diego Municipal Code 143.046(c)(6).

   a) Does this also include any parking Structures?

b) Due to the proximity to Alvarado Creek, being within the FEMA flood zone, and the known flooding within this area, it is recommended that no underground parking structures be installed in this location. (continued) (New Issue)

Response: a & b: The project is not proposing underground parking and does not include a basement. The parking is at the same elevation as some of the habitable spaces, which is at least two feet above the base flood elevations. Please note that coordinate with City staff after this cycle review was performed. City staff has informed the project team that the review of the CLOMR (under separate cover) has been deferred until final engineering/ministerial permitting.

5. c) The first finished floor should include all parking structures, electrical rooms, and any other essential services/area that are used to provided services to the homes of the residents. (New Issue)

Response: Please see response to Comment 4.

6. All water from the project should be conveyed and collected at the Detention Vault.

   a) The project current discharges water directly from the alley way to the Alvarado Creek.

   b) This vault need to be sized to withhold a minimum of 100 year storm and have a delayed discharge time into Alvarado Creek. This will minimize the amount of added flow that could be originated from the development of this project and potential flood from high peak events. (New Issue)

Response: All runoff from the project will be conveyed to the proposed vault system. In order to address this comment, additional analysis has performed and is presented in the drainage study, include a detention analysis for the 100-year storm event.

7. Vacated and proposed storm drains and energy dissipators

   a) Storm drains should be removed/vacated per the City Standards. These location should be shared in further detail to Stormwater to asset record keeping.

   b) All storm drains and energy dissipators need to be sized and installed in accordance to the City Drainage and Design manual. (continued) (New Issue)

Response:
a) Final engineering construction documents will include the vacating drainage easements where storm drain is proposed to be removed and will include new easement for proposed storm drain pipe and other utilities, as applicable.

b) Storm drains and energy dissipators have been designed in accordance with the City Drainage and Design Manual and SDD-104.

8. c) Energy dissipators should be installed to the lowest defined point, outside of the highest WSE of Alvarado Creek to avoid damage to the energy dissipator and further erosion of the side slopes, where they are currently being proposed for installation. (New Issue)

   Response: The energy dissipators have been located at highest point possible along the creek; however, these locations are within the 100-year limits of inundation, and this is unavoidable. During final engineering, additional riprap design calculations will be performed that will evaluate two scenarios: (1) the 100-year unmitigated peak flow rate from the project site with no flow in the creek and (2) the 100-year flow in the creek across the project riprap pad.

9. Stormwater Water Quality Improvement
   The Stormwater Check list indicates that the project is low priority, but based on the location of the project and the acreage, being disturbed is greater than an acre. Please provide determination from Regional Waterboard Webpage to indicate that this is not a Medium Priority (CGP- RL1) or High Priority (CGP-RL2). (New Issue)

   Response: Based on the small project area and the anticipated short grading duration, it is anticipated that the project will be low priority. This will be evaluated and verified or updated during final engineering when additional project detail is known. A note has been added to Form D560 to state as much.

10. Not all PDP questions were answered to reflect the changes to site drainage and reflecting the designed Storm drain system. Update all applicable questions. (New Issue)

    Response: All PDP question have been answered in the current submittal.

11. If you have any questions pertaining to the comments or the review by O&M Engineering division staff please contact Anna Wernet, AWernet@sandiego.gov, 619-527-7514. (New Issue)

    Response: A coordination meeting was performed on March 24, 2021 to discuss each O&M comment and determine the appropriate approach to address each. We believe that we fully address each to the satisfaction of the entitlement review. We appreciate the feedback thus far and look forward to continuing work with City staff on this project.

Reviewing Discipline: LDR-Engineering Review

Drainage Study Issues

28. Please add a discussion to the Drainage Study stating if the proposed project is required to obtain approval from the Regional Water Quality Control Board Under Federal Clean Water Act (CWA) section 401 or 404. A complete explanation must be provided. Please note, if the proposed project is subject to regulations as set forth in CWA 401/404, approval from the California Regional Water Quality Control Board must be obtained prior to permit issuance.

    Cleared

29. Please make sure to refer to the current city's storm water manual dated October 2018.

    Cleared

30. Please note that Hydrology must be analyzed for 100 year frequency storm. Hydraulics must be analyzed for 50 year frequency storm. Revise the drainage study accordingly.

    Cleared

31. Please revise the pre and post development hydrology exhibits to include the following information:

e) Q & V and IEs
f) Points of Compliance
g) Area of each basin
h) impervious vs pervious tables

Also, please use a different lineweight and color for the existing and proposed storm drain systems for legibility.

Response: Please see response to Comment 58.

32. Please address the velocity values in the drainage study.

    Cleared

33. Please provide a summary table to compare the pre and post construction onsite and offsite Q, A, C & V values and provide calculations for the C values (if weighted C values are used).

    Cleared

34. Please remove the water quality related sections from the drainage study. This information should be part of the storm water report.

    Cleared

35. If there are no negative impacts to any adjacent properties or downstream system, a statement should be added to the conclusion in the report.

    Cleared

2nd Submittal Comments

59. Following up with comment#27: Comment has been partially addressed. Please revise the pre and post development hydrology exhibits to add the Q & V at all discharge points and to show existing and proposed storm drain systems in different line weight and color for legibility.

    Response: Q & V labeled for all discharge points and existing and proposed storm drain systems clearly shown on the pre- and post-project hydrology exhibits.

ALVARADO CREEK APARTMENTS

2nd Submittal Revision Page

February 2, 2021

Pursuant to the review comments completed on November 17, 2020 regarding the subject reports dated August 18, 2020, the following comments were addressed. Below is a list of the comments, followed by Rick Engineering Company's response:

REVIEW COMMENTS

Drainage Study Issues

19 Please add a discussion to the Drainage Study stating if the proposed project is required to obtain approval from the Regional Water Quality Control Board Under Federal Clean Water Act (CWA) section 401 or 404. A complete explanation must be provided. Please note, if the proposed project is subject to regulations as set forth in CWA 401/404, approval from the California Regional Water Quality Control Board must be obtained prior to permit issuance.

Response: Section 1.7 Environmental Permitting has been added to the Drainage Study address this comment.

20 Please make sure to refer to the current city's storm water manual dated October 2018.

Response: The City of San Diego Drainage Design Manual dated January 2017 and the City of San Diego Stormwater Standards Manual dated October 2018 are referenced in the Drainage Study.

21 Please note that Hydrology must be analyzed for 100 year frequency storm. Hydraulics must be analyzed for 50 year frequency storm. Revise the drainage study accordingly.

Response: The Drainage Study has been revised to include the 100-year frequency storm event analysis.

22 Please revise the pre and post development hydrology exhibits to include the following information:

a) Q & V and IEs
b) Points of Compliance
c) Area of each basin
d) impervious vs pervious tables

Also, please use a different lineweight and color for the existing and proposed storm drain systems for legibility.

Response: The hydrology exhibits have been revised as requested.

23 Please address the velocity values in the drainage study.

Response: Velocity values have been added to Table 2-2.

24 Please provide a summary table to compare the pre and post construction onsite and offsite Q, A, C & V values and provide calculations for the C values (if weighted C values are used).

Response: Flow (Q) and area (A) are on Table 2-3 and velocity (V) has been added to this Table 2-3. A discussion of the runoff coefficients used has been added to the Section 2.1.

25 Please remove the water quality related sections from the drainage study. This information should be part of the storm water report.

Response: The Water Quality Section has been revised to only reference the separate PDP SWQMP for the project.

26 If there are no negative impacts to any adjacent properties or downstream system, a statement should be added to the conclusion in the report.

Response: The conclusion has been revised as recommended.

FEMA Issues

27 Please note: Project is located in flood zone AE. Applicant must comply with all requirements.

Response: Noted.

28 Please resubmit showing and calling out FEMA flood plain boundaries and base flood level on the Grading Plan. Further review of the disturbance of soil in FEMA flood plains is required. If any grading is done in Zone AE or A applicant will be required to comply with all FEMA regulations. Flood plain review may be required.

Response: 100-year base flood elevation limits of inundation provided on grading plan.

29 The project is required to submit an approved Conditional Letter of Map Revision (CLOMR) from the Federal Emergency Management Agency for the subject project prior to the environmental document being circulated for public comment. The developer must provide all documentation, engineering calculations, and fees which are required by FEMA.

Response: A request for a CLOMR has been submitted under separate cover.

30 The developer shall denote on the final map and the improvement plans "Subject to Inundation" all areas lower than the base flood elevation plus 2 feet.

Response: Final map will include above note.

31 FYI: Fill placed in the SFHA for the purpose of creating a building pad must be compacted to 95% of the maximum density obtainable with the Standard Proctor Test Fill method issued by the American Society for Testing and Materials (ASTM Standard D-698). Granular fill slopes must have adequate protection for a minimum flood water velocity of five feet per second.

Response: Final engineering grading plan will include above guidance.

32 FYI: The developer shall enter into an agreement with the City waiving the right to oppose a special assessment initiated for the construction of flood control facilities and their perpetual maintenance.

Response: Noted.

1.0 INTRODUCTION

1.1 Project Description

This drainage study has been prepared to support the proposed Alvarado Creek Apartments Project (hereafter referred to as the "project"). This document provides details of the methodologies and results of the hydrologic and hydraulic analyses performed to support the improvements proposed as part of this project. Hydrologic analysis of the existing conditions was performed to assess the existing drainage patterns. Hydrologic analysis of the proposed (i.e., post-project) condition was performed in order to compare to the existing condition results and in support of the design of drainage features (e.g., proposed storm drain). The hydraulic calculations were then assessed under the proposed conditions to estimate the performance of the system with the proposed improvements.

1.2 Project Location

The project site current zoned as industrial land use and is in Grantville, which is a community in the City of San Diego. The project site address is at 5901 Mission Gorge Road. The project site consists of three parcels: 461-320-06, 461-320-08, and 461-320-09. The project site is bound by commercial properties to the southwest and west, Mission Gorge Road to the northwest, an ally and commercial properties to the north, and industrial properties to the northeast. Alvarado Creek transects the approximate center of the project site and flows in an east-northeast to southeast direction through the project site. A vicinity map of the project location is provided in Figure 1-1.

Figure 1-1: Vicinity Map

RICK ENGINEERING COMPANY

Feet
0 100 200 300 400 500

North

Date of Exhibit: 03.2020
DigitalGlobe Aerial Image: 05.2012

Vicinity Map

J-19048

1.3 Land Use and Drainage Characteristics

Analyses of the topographic data were performed in order to ascertain the drainage areas associated with the project. Additional information on the source of the topographic data is provided in the paragraph below. North of Alvarado Creek, the drainage from the site generally flows towards the middle of the north project site boundary and there is either collected by an inlet and storm drain pipe that conveys flows to the south into Alvarado Creek or surface flows onto an unnamed access road that conveys flows to the south into Alvarado. Based on As-Built Drawings 10515-2-D and 10515-5-D, the above-mentioned storm drain pipe has a diameter of 18 inches, is reinforced concrete pipe (RCP), and conveys flows collected by an existing Type B Curb Inlet located along the west side of Mission Gorge Road. Flow from off-site properties surface flows onto the site property and towards the above-mentioned inlet and access road location near the middle of the north project site boundary, including off-site flows from north and northeast properties.

As part of a planning project that included the preparation of the *Grantville Trolley Station/Alvarado Creek Revitalization Study*, dated August 2017, the City of San Diego provided to the public the topographic survey data collected in support of that project. These survey data were collected on July 14, 2016. The horizontal basis of coordinates for this survey is referenced to the California Coordinate System of 1983 (CCS83) Zone 6, North American Datum of 1983 (NAD83), and elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29). Data from the surveys were compiled into computer aided drafting and design (CADD) files that included ground elevation data as well as key features, such as storm water conveyances (e.g., channels flowlines, culverts, etc.).

In the post-project condition, the flow pattern will be similar. That is off-site flows will be collected in inlets and conveyed south to Alvarado Creek. Runoff generated on-site will be directed into water quality and hydromodification management features. The hydromodification management system outlet flows will be conveyed south into Alvarado Creek. The existing 18-inch RCP storm drain will be rerouted around the proposed building and into Alvarado Creek.

1.4 Hydrology and Hydraulic Analyses

The hydrologic and hydraulic analyses were performed in general conformance with the *City of San Diego Transportation & Storm Water Design Manual, Drainage Design Manual* (City Drainage Design Manual), dated January 2017. A hydrologic analysis was performed to estimate peak flow rates for a 50-year and 100-year storm event peak flow rates to align with the City Drainage Design Manual for drainage areas less than 0.5 square miles. Details of the

methodologies and results of the hydrology and hydraulic analyses are provided in Sections 2.0 and 3.0, respectively.

1.5 Detention Analysis

Based on the post-project impervious area proposed as less than the pre-project impervious area and the resulting decrease in the peak flow rate, detention analysis is not required for the project. However, as requested by City review staff a detention analysis was performed and is presented in Section 2.3.

1.6 Water Quality and Hydromodification Management

In accordance with *The City of San Diego Storm Water Standards manual* (SWSM), dated October 1, 2018, the project is considered a priority development project (PDP) and obligated to implement water quality and hydromodification management measures pursuant to the guidance within the SWSM. The proposed water quality and hydromodification management measures along with supporting calculation are provided under separate cover in a PDP Storm Water Quality Management Plan (PDP SWQMP) for the project.

1.7 Environmental Permitting

Alteration to Alvarado Creek would require the preparation and submission of applications for regulatory permits to the U.S. Army Corps of Engineers (USACE), pursuant to Section 404 of the federal Clean Water Act (CWA). Projects impacting drainage and water quality are also required to obtain a Section 401 Water Quality Certification. This permit is obtained through the California Water Quality Control Board (RWQCB) pursuant to Section 401 of the federal CWA. Additionally, a Section 1600 Streambed Alteration Agreement of the California Endangered Species Act Consultation would be required through the California Department of Fish and Wildlife (CDFW). The project property is located within the August 2017 Grantville Revitalization Study Area; however, the project has been designed with development outside of the revitalization study preferred alternative footprint so that the revitalization study preferred alternative creek enhancement can be permitted and constructed in the future separate from this project. This project does include grading along the creek, and as such the need for a CWA 401 and 404 and Streambed Alternation permits will most likely be required prior to the issuance of the grading permit for the project. This drainage study has been prepared for the preliminary phase (i.e., Neighborhood Development Permit [NDP] phase) of the project. The project drainage study will accompany the regulatory permitting applications when submitted by others.

2.0 HYDROLOGIC ANALYSES

The existing and proposed hydrologic conditions were analyzed as part of this study to determine the runoff associated with the design storm event at key locations. This section details the methodology and results performed, which were used in subsequent hydraulic analyses as outlined in Section 3.0. Refer to Section 1.3 for land use and drainage characteristics.

2.1 Rational Method Hydrologic Analysis Methodology

The hydrologic analysis was performed in general conformance with the City Drainage Design Manual. The purpose of the hydrologic analysis was to determine peak flow rates associated with the 50-year and 100-year frequency design storm events. The 100-year frequency is the appropriate flood control design storm to compare pre-project and post-project conditions. The 50-year return frequency is the appropriate flood control design storm for storm drain systems pursuant to the City Drainage Design Manual for drainage areas less than 0.5 square miles. Rainfall intensity data was taken from Figure A-1 in the City Drainage Design Manual. The Modified Rational Method was used in accordance City Drainage Design Manual to determine the peak flow rates at key locations.

Advance Engineering Software (AES) computer software was used to perform Modified Rational Method calculations to determine the peak flow rates expected to reach the key locations within the project area and adjacent area. The hydrologic model was developed by first dividing each watershed into several subareas. The delineation of each subarea was determined so that the area within each subarea is comprised of similar land use and storm drain conveyance system (e.g., pipe size). Nodes were identified at the upstream and downstream extents of each subarea, and subarea hydrologic data were determined, such as drainage facility geometry, elevations, and lengths. Next, the hydrologic data describing each subarea were incorporated into the AES software in order to create a node-link model for each watershed. For each subarea the AES software performs calculations for the specific hydrologic process occurring in the subarea. There are 15 different hydrologic processes programed into the software, and each process is assigned a code number that is presented on the model results. The AES Rational Method computer software hydrologic processes code numbers are described in Table 2-1.

Table 2-1: Summary of AES Processes

Code	Subarea Type
Code 1	Confluence analysis at a node
Code 2	Initial subarea analysis
Code 3	Pipe flow travel time (computer-estimated pipe sizes)
Code 4	Pipe flow travel time (user-specified pipe size)
Code 5	Trapezoidal channel travel time
Code 6	Street flow analysis through a subarea
Code 7	User-specified information at a node
Code 8	Addition of the subarea runoff to mainline
Code 9	V-Gutter flow through subarea
Code 10	Copy mainstream data onto a memory bank
Code 11	Confluence a memory bank with the mainstream memory
Code 12	Clear a memory bank
Code 13	Clear the mainstream memory
Code 14	Copy a memory bank onto the mainstream memory
Code 15	Hydrologic data bank storage functions

Key hydrologic parameters utilized in the analysis in accordance with the City Drainage Design Manual are shown on the AES printout provided in Appendix A.

The percent impervious value was used to determine the runoff coefficient for both the pre-project and post-project conditions following Table A-1 from the Drainage Design Manual. The runoff coefficient generally varied between 0.95 (90% impervious) or 0.85 (80% impervious) depending on the percentage of impervious cover for each subarea. For the subareas that are not either 80% or 90% impervious area, the runoff coefficient was calculated based on the percentage of impervious area pursuant to the guidance provided in the footnotes of Table A-1 from the Drainage Design Manual. A summary of the runoff coefficient calculations is provided in Table 2-2.

Table 2-2. Runoff Coefficient Calculations

Subarea	Area (acres)	Impervious Percentage	Runoff C
105 (Code 8)	0.09	65%	0.69
106 (Code 8)	0.3	0%	0.50
304.5 to 305	0.11	0%	0.50

In order to be conservative, the post-project on-site subarea (Nodes 201 to 202) was analyzed assuming a time of concentration (Tc) of five minutes. During final engineering, the on-site drainage may be analyzed in more detail once site improvement design detail is known.

2.2 Hydrologic Analysis Results

Tables 2-3 and 2-4 provide a summary of flow rates at key locations for the 50-year and 100-years storm event, respectfully, which were used in the storm drain hydraulic analysis discussed in Section 3.0. The hydrologic analysis included analyzing the peak flow at the Mission Gorge Road existing curb inlet in order to provide preliminary sizing for the proposed extension / rerouting of the existing 18-inch storm drain pipe through the project. The drainage area maps and detailed Modified Rational Method results are included in Map Pockets 1 and 2 and Appendix A, respectively.

Table 2-3. 50-Year Storm Event Hydrologic Summary at Key Locations

Node	Pre-Project				Post-Project			
	Area (acres)	Tc (min.)	Velocity (ft/s)	Flow (cfs)	Area (acres)	Tc (min.)	Velocity (ft/s)	Flow (cfs)
104	2.5	5.9	3.2	9.5	2.4	5.9	5.2 [1]	9.2 [4]
106	3.3	6.6	6.3	12.0	2.8	7.4	5.2 [2]	9.3 [4]
204	1.0	5.0	4.1	4.0	1.5	5.5	3.5 [2]	6.1
305	1.4	5.9	3.2	5.2	1.4	5.6	4.6	5.0
Total	**5.6**	**6.6**	**Creek [2]**	**20.8**	**5.6**	**7.4**	**Creek [3]**	**19.5**
Mission Gorge Existing Inlet	**3.6**	**11.4**	**1.6**	**10.4**	**3.6**	**11.4**	**1.6**	**10.4**

[1] Post-project flow at Node 104 is within proposed pipe.

[2] Post-project flow at Nodes 106 and 204 is at the pipe outfall / connection with the creek.

[3] Total flow shown is project site on-site and off-site runoff confluenced within Alvarado Creek where flow will comingle with Alvarado Creek flow minus the Alvarado Creek flow (FEMA Q_{50} is 4,500 cfs for Alvarado Creek at confluence with San Diego River).

[4] Based on inlet calculation (see Section 3.2), additional 2.3 cfs from Mission Gorge (velocity = 6.5 ft/s).

Table 2-4. 100-Year Storm Event Hydrologic Summary at Key Locations

Node	Pre-Project				Post-Project			
	Area (acres)	Tc (min.)	Velocity (ft/s)	Flow (cfs)	Area (acres)	Tc (min.)	Velocity (ft/s)	Flow (cfs)
104	2.5	5.9	3.3	10.0	2.4	5.9	5.5 [1]	9.7
106	3.3	6.6	6.3	12.7	2.8	7.3	5.5 [2]	9.9
204	1.0	5.0	4.1	4.1	1.5	5.5	3.6 [2]	6.4
305	1.4	5.9	3.3	5.5	1.4	5.6	4.7	5.3
Total	**5.6**	**6.6**	**Creek [2]**	**21.9**	**5.6**	**7.3**	**Creek [3]**	**20.7**
Mission Gorge Existing Inlet	**3.6**	**11.4**	**1.6**	**11.2**	**3.6**	**11.4**	**1.6**	**11.2**

[1] Post-project flow at Node 104 is within proposed pipe.

[2] Post-project flow at Nodes 106 and 204 is at the pipe outfall / connection with the creek.

[3] Total flow shown is project site on-site and off-site runoff confluenced within Alvarado Creek where flow will comingle with Alvarado Creek flow minus the Alvarado Creek flow (FEMA Q_{100} is 5,100 cfs for Alvarado Creek at confluence with San Diego River).

[4] Based on inlet calculation (see Section 3.2), additional 2.3 cfs from Mission Gorge (velocity = 6.9 ft/s).

2.3 Detention Analysis

A detention analysis was performed to demonstrate how the project drainage features will function to mitigate peak flow rate in comparison to both the unmitigated post-project and pre-project conditions. It should be noted that based on the post-project impervious area proposed as less than the pre-project impervious area and the resulting decrease in the peak flow rate, detention analysis is not required for the project. However, a detention analysis was performed to evaluate and present the post-project discharge from project for the 100-year storm event with the proposed hydromodification management features in place.

As discussed in Section 1.6, the project is required to implement hydromodifications measures designed to demonstrate that flows leaving the site will not be greater than the flows leaving the site in the pre-developed conditions for storm events between the low-flow threshold of 10 percent of the 2-year frequency storm event peak flow rate and the 10-year frequency storm event peak flow rate. In order to demonstrate that the project will comply with the hydromodification management criteria, a SWMM analysis was prepared and a long-term simulation of both the pre-developed and post-project conditions were modeled and compared. Additional detail related to the preparation of SWMM analysis is provided in the project PDP SWQMP. As part of the detention analysis, the hydromodification SWMM analysis was utilized to analyze the 100-year storm event. That is, instead of performing a long-term simulation, the SWMM analysis included a single 100-year event. First, a time-series hydrograph was created for the unmitigated post-project condition following the guidance of the Drainage Design Manual, which in turn references the County of San Diego Hydrology Manual (June 2003). The Direct Inflow option was utilized

to input the hydrograph time-series data into the SWMM analysis for the on-site drainage basin areas. Figure 2-1 shows the results in comparison to the post-project unmitigated flow rates, and Table 2-5 provides a tabular summary of the comparison.

Figure 2-1. Post-Project Flow Mitigation Results

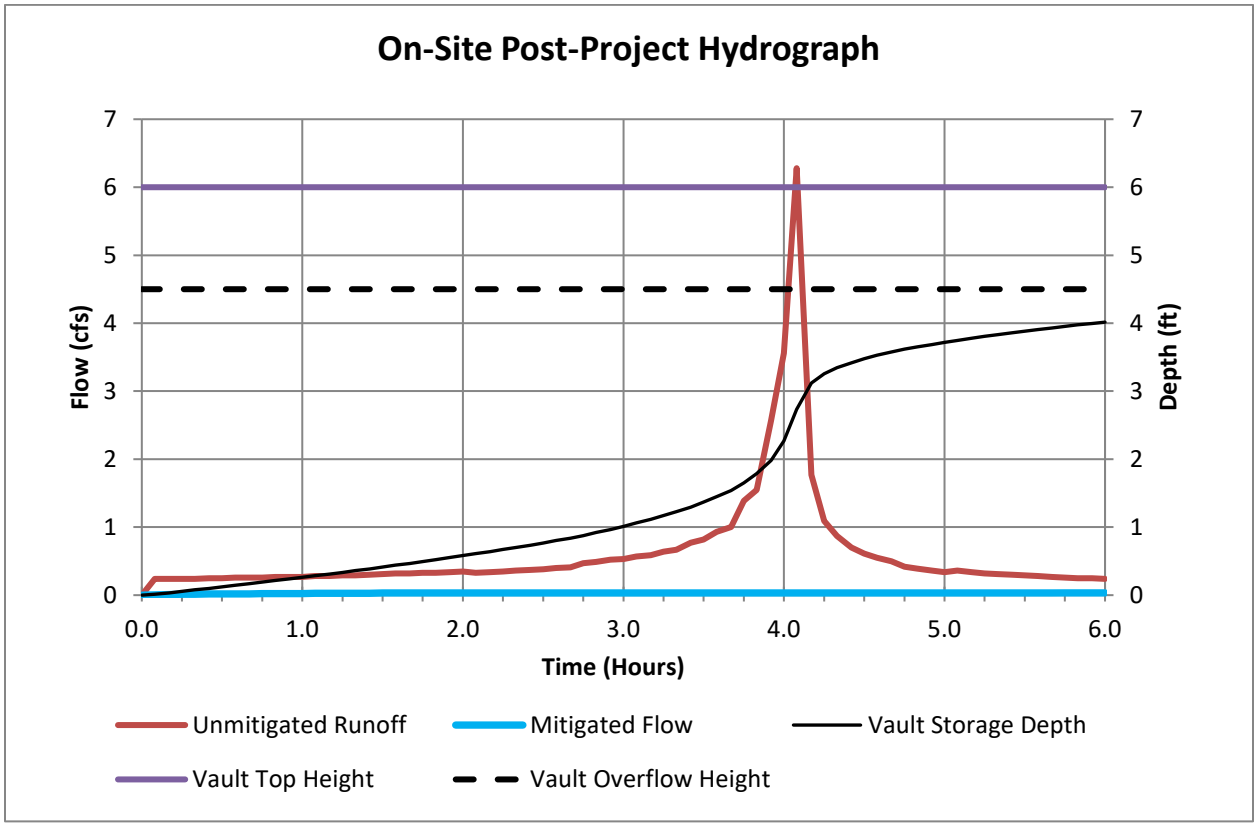

Table 2-5. Detention Analysis Results Summary

Condition	Peak Flow Rate
Unmitigated Flow	6.3 cfs
Mitigated Flow	0.04 cfs

The results indicate that the project, as proposed with hydromodification management features, will capture, temporarily store, and very slowly release the entire analyzed 100-year storm event. Appendix C includes the input hydrograph used in the analysis along with a summary of the results. Digital SWMM files are included as part of the submittal for this project.

3.0 HYDRAULIC ANALYSIS

Hydraulic analyses were performed to determine the flow conveyed by the existing Type B Curb Inlet located along Mission Gorge Road and in support of the preliminary design of proposed conveyance features, including storm drain inlets and pipes.

3.1 Curb Inlets on Grade Calculations Methodology

Curb inlet on a continuous grade calculations were performed to evaluate the capacity of the existing Type B Curb Inlet located along Mission Gorge Road, west of the project. The purpose of these calculations was to estimate the 50-year frequency peak flow rate conveyed by the inlet into the storm drain, which in turn was utilized in pipe capacity hydraulic calculations. The following curb inlet capacity equation was used:

$$Q = 0.7\,L(a + y)^{3/2}$$

Where:

Q = interception capacity of the curb inlet (cfs);
L = length of clear opening of inlet for total interception (ft);
y = depth of flow approaching the curb inlet (ft); and
a = depth of depression of curb at the inlet (ft)
(City Drainage Design Manual, dated January 2017)

The existing curb inlet analyzed has a localized depressed curb and gutter of approximately 0.17 feet (a = 0.17 feet) and a length of opening (L) of three feet. Flow depths (y) were determined from performing using Manning's Formula in combination with the results of the AES analysis.

3.2 Curb Inlets on Grade Calculations Results

The results of the curb inlet on continuous grade are provided in Table 3-1. Additional information related to the curb inlet on grade calculations are provided in Appendix B.

Table 3-1. Curb Inlet on Continuous Grade Calculations Results

Location (Node) Existing Mission Gorge Inlet (Node 405)	Q (cfs)	L_T (feet)	$Q_{CAPACITY}$ (cfs)	Efficiency
50-Year Storm Event	10.4	3.0	2.26	21.7%
100-Year Storm Event	11.2	3.0	2.34	20.9%

3.3 Project Storm Drain Calculations

The proposed on-site storm drain systems have been designed to convey runoff from the 100-year storm event. Assuming a pipe full condition and using Manning's Formula, Table 3-2 provides a summary of pipe capacities when designed at the minimum slope condition of 0.5 percent (i.e., conservative).

Table 3-2. Preliminary Pipe Design / Capacity Summary

Pipe Diameter (inches)	Flow Area (square inches)	Wetted Perimeter (Inches)	Flow Rate Capacity (cfs)[1]	Area[2] (acres)
4	12.6	12.6	0.16	0.04
6	28.3	18.8	0.47	0.12
8	50.3	25.1	1.01	0.25
10	78.5	31.4	1.83	0.46
12	113.1	37.7	2.99	0.75
15	176.7	47.1	5.41	1.36
18	254.5	56.5	7.45	1.87

[1] Slope of 0.5%, Manning's n value of 0.011 for Polyvinyl Chloride (PVC) with smooth inner walls except for the 18-inch, which utilized a Manning's n value of 0.013 for smooth concrete.
[2] Area is based on Runoff C value of 0.95 and Tc of 5 minutes.

4.0 SUMMARY AND CONCLUSION

This drainage report presents the hydrologic and hydraulic calculations in support of the Alvarado Creek Apartment Project. Peak flow rates for the 50-year and 100-year frequency storm events were determined using the Modified Rational Method analysis based on the hydrologic methodology outlined in the City Drainage Design Manual, dated January 2017. The results indicated the project will not result in an increase in flow in comparison to the pre-projection condition. Therefore, the project will not result in negative impacts to any adjacent properties or the downstream system. Hydrologic analysis were performed for the flow to the existing curb inlet west of the project in Mission Gorge Road in order to estimate the 50-year and 100-year frequency peak flow rates from the road into the existing 18-inch storm drain through the project. The analysis included on-grade inlet calculations, and the results indicate approximately 2.3 cfs are conveyed from the inlet into the storm drain during the 50-year storm event. During final engineering, detailed calculations will be performed in support the proposed re-routing of the existing 18-inch storm drain around the project to Alvarado Creek.

APPENDIX A

AES Printouts

Pre-Project, 50-Year Storm Event

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            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2014 Advanced Engineering Software (aes)
             Ver. 21.0 Release Date: 06/01/2014  License ID 1261

                           Analysis prepared by:

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                        San Diego, California 92110
                      619-291-0707   Fax 619-291-4165

 ************************** DESCRIPTION OF STUDY **************************
* PACIFIC WEST COMMUNITIES REDEVELOPMENT PROJECT                           *
* PRE-PROJECT 50-YEAR ANALYSIS                                             *
* RICK ENGINEERING COMPANY JOB NUMBER 19048                                *
 ***************************************************************************

  FILE NAME: GRANT50.DAT
  TIME/DATE OF STUDY: 17:09 08/17/2020
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =  50.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.01
  RAINFALL-INTENSITY ADJUSTMENT FACTOR = 1.000
  *USER SPECIFIED:
  NUMBER OF [TIME,INTENSITY] DATA PAIRS =  9
   1)   5.000;  4.200
   2)  10.000;  3.200
   3)  15.000;  2.700
   4)  20.000;  2.300
   5)  25.000;  2.050
   6)  30.000;  1.850
   7)  40.000;  1.600
   8)  50.000;  1.400
   9)  60.000;  1.250
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: ONLY PEAK CONFLUENCE VALUES CONSIDERED
  *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   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0180

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.50 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  5.0 (FT*FT/S)
```

```
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =  88
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    75.00
  UPSTREAM ELEVATION(FEET) =     77.00
  DOWNSTREAM ELEVATION(FEET) =     76.10
  ELEVATION DIFFERENCE(FEET) =      0.90
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.361
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    63.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.36
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     76.10  DOWNSTREAM(FEET) =     72.40
  CHANNEL LENGTH THRU SUBAREA(FEET) =   215.00   CHANNEL SLOPE =  0.0172
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.117
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.65
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.74
  AVERAGE FLOW DEPTH(FEET) =   0.07   TRAVEL TIME(MIN.) =   2.06
  Tc(MIN.) =    5.42
  SUBAREA AREA(ACRES) =     0.15       SUBAREA RUNOFF(CFS) =    0.59
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.910
  TOTAL AREA(ACRES) =        0.2         PEAK FLOW RATE(CFS) =       0.94

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.09   FLOW VELOCITY(FEET/SEC.) =   1.84
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    103.00 =     290.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 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.) =    5.42
  RAINFALL INTENSITY(INCH/HR) =   4.12
  TOTAL STREAM AREA(ACRES) =     0.25
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.94

******************************************************************************
  FLOW PROCESS FROM NODE    111.00 TO NODE    112.00 IS CODE =  21
------------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    80.00
  UPSTREAM ELEVATION(FEET) =     76.30
  DOWNSTREAM ELEVATION(FEET) =     75.10
  ELEVATION DIFFERENCE(FEET) =      1.20
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    1.902
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    65.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.40
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.40

******************************************************************************
  FLOW PROCESS FROM NODE    112.00 TO NODE    103.00 IS CODE =  51
------------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     75.10  DOWNSTREAM(FEET) =     72.40
  CHANNEL LENGTH THRU SUBAREA(FEET) =   160.00   CHANNEL SLOPE =  0.0169
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.56
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.55
  AVERAGE FLOW DEPTH(FEET) =   0.06   TRAVEL TIME(MIN.) =   1.72
  Tc(MIN.) =    3.62
  SUBAREA AREA(ACRES) =     0.08       SUBAREA RUNOFF(CFS) =    0.32
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        0.2         PEAK FLOW RATE(CFS) =       0.72

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.07   FLOW VELOCITY(FEET/SEC.) =   1.71
```

```
  LONGEST FLOWPATH FROM NODE    111.00 TO NODE    103.00 =     240.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 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.) =    3.62
  RAINFALL INTENSITY(INCH/HR) =   4.20
  TOTAL STREAM AREA(ACRES) =     0.18
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.72

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        0.94     5.42        4.117          0.25
      2        0.72     3.62        4.200          0.18

  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        1.34     3.62       4.200
      2        1.64     5.42       4.117

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       1.64   Tc(MIN.) =    5.42
  TOTAL AREA(ACRES) =        0.4
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    103.00 =     290.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.117
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.9328
  SUBAREA AREA(ACRES) =    0.15   SUBAREA RUNOFF(CFS) =    0.59
  TOTAL AREA(ACRES) =        0.6   TOTAL RUNOFF(CFS) =       2.23
  TC(MIN.) =    5.42

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    104.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
```

```
  ELEVATION DATA: UPSTREAM(FEET) =     72.40  DOWNSTREAM(FEET) =     71.70
  CHANNEL LENGTH THRU SUBAREA(FEET) =    55.00   CHANNEL SLOPE =  0.0127
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.038
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.38
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.34
  AVERAGE FLOW DEPTH(FEET) =   0.16   TRAVEL TIME(MIN.) =   0.39
  Tc(MIN.) =    5.81
  SUBAREA AREA(ACRES) =     0.08       SUBAREA RUNOFF(CFS) =    0.31
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.935
  TOTAL AREA(ACRES) =        0.7         PEAK FLOW RATE(CFS) =       2.49

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.16   FLOW VELOCITY(FEET/SEC.) =   2.41
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    104.00 =     345.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    104.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    121.00 TO NODE    122.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    80.00
  UPSTREAM ELEVATION(FEET) =     78.10
  DOWNSTREAM ELEVATION(FEET) =     77.10
  ELEVATION DIFFERENCE(FEET) =      1.00
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    1.982
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    62.50
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.40
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.40

****************************************************************************
  FLOW PROCESS FROM NODE    122.00 TO NODE    123.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     77.10  DOWNSTREAM(FEET) =     73.30
```

```
  CHANNEL LENGTH THRU SUBAREA(FEET) =   260.00   CHANNEL SLOPE =  0.0146
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.44
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.51
  AVERAGE FLOW DEPTH(FEET) =   0.13   TRAVEL TIME(MIN.) =   1.73
  Tc(MIN.) =    3.71
  SUBAREA AREA(ACRES) =     0.52       SUBAREA RUNOFF(CFS) =    2.07
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        0.6         PEAK FLOW RATE(CFS) =       2.47

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.17   FLOW VELOCITY(FEET/SEC.) =   3.03
  LONGEST FLOWPATH FROM NODE    121.00 TO NODE    123.00 =     340.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    123.00 TO NODE    123.00 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.) =    3.71
  RAINFALL INTENSITY(INCH/HR) =   4.20
  TOTAL STREAM AREA(ACRES) =     0.62
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.47

****************************************************************************
  FLOW PROCESS FROM NODE    131.00 TO NODE    132.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    60.00
  UPSTREAM ELEVATION(FEET) =     77.70
  DOWNSTREAM ELEVATION(FEET) =     77.10
  ELEVATION DIFFERENCE(FEET) =      0.60
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.091
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    60.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.48
  TOTAL AREA(ACRES) =      0.12   TOTAL RUNOFF(CFS) =      0.48

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```
  FLOW PROCESS FROM NODE    132.00 TO NODE    133.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   77.10  DOWNSTREAM ELEVATION(FEET) =   74.50
  STREET LENGTH(FEET) =   210.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0180
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.84
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.25
    HALFSTREET FLOOD WIDTH(FEET) =    6.18
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.67
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.42
  STREET FLOW TRAVEL TIME(MIN.) =   2.09   Tc(MIN.) =    4.18
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  SUBAREA AREA(ACRES) =    0.18      SUBAREA RUNOFF(CFS) =    0.72
  TOTAL AREA(ACRES) =        0.3        PEAK FLOW RATE(CFS) =       1.20

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.27   HALFSTREET FLOOD WIDTH(FEET) =   7.38
  FLOW VELOCITY(FEET/SEC.) =  1.81   DEPTH*VELOCITY(FT*FT/SEC.) =   0.49
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    133.00 =     270.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    133.00 TO NODE    133.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.9500
  SUBAREA AREA(ACRES) =    0.24   SUBAREA RUNOFF(CFS) =    0.96
  TOTAL AREA(ACRES) =        0.5   TOTAL RUNOFF(CFS) =       2.15
  TC(MIN.) =    4.18

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    133.00 TO NODE    123.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     74.60  DOWNSTREAM(FEET) =     73.30
  CHANNEL LENGTH THRU SUBAREA(FEET) =    80.00   CHANNEL SLOPE =  0.0162
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.43
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.69
  AVERAGE FLOW DEPTH(FEET) =   0.19   TRAVEL TIME(MIN.) =   0.50
  Tc(MIN.) =    4.68
  SUBAREA AREA(ACRES) =     0.14       SUBAREA RUNOFF(CFS) =    0.56
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        0.7         PEAK FLOW RATE(CFS) =       2.71

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.19   FLOW VELOCITY(FEET/SEC.) =   2.84
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    123.00 =     350.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    123.00 TO NODE    123.00 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.) =    4.68
  RAINFALL INTENSITY(INCH/HR) =   4.20
  TOTAL STREAM AREA(ACRES) =     0.68
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.71

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        2.47     3.71        4.200          0.62
      2        2.71     4.68        4.200          0.68

  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        4.63     3.71       4.200
      2        5.19     4.68       4.200

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
```

```
  PEAK FLOW RATE(CFS) =       5.19   Tc(MIN.) =    4.68
  TOTAL AREA(ACRES) =        1.3
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    123.00 =     350.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    123.00 TO NODE    104.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     73.30  DOWNSTREAM(FEET) =     71.70
  CHANNEL LENGTH THRU SUBAREA(FEET) =   205.00   CHANNEL SLOPE =  0.0078
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.016
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       6.20
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.75
  AVERAGE FLOW DEPTH(FEET) =   0.35   TRAVEL TIME(MIN.) =   1.24
  Tc(MIN.) =    5.92
  SUBAREA AREA(ACRES) =     0.53       SUBAREA RUNOFF(CFS) =    2.02
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        1.8         PEAK FLOW RATE(CFS) =       6.98

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.37   FLOW VELOCITY(FEET/SEC.) =   2.80
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    104.00 =     555.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    104.00 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        6.98     5.92       4.016        1.83
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    104.00 =     555.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1        2.49     5.81       4.038        0.66
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    104.00 =     345.00 FEET.

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
      1       9.34       5.81        4.038
      2       9.46       5.92        4.016

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
```

```
  PEAK FLOW RATE(CFS) =       9.46   Tc(MIN.) =    5.92
  TOTAL AREA(ACRES) =        2.5

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    105.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     71.70  DOWNSTREAM(FEET) =     71.20
  CHANNEL LENGTH THRU SUBAREA(FEET) =    55.00   CHANNEL SLOPE =  0.0091
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.959
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       9.52
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.21
  AVERAGE FLOW DEPTH(FEET) =   0.41   TRAVEL TIME(MIN.) =   0.29
  Tc(MIN.) =    6.21
  SUBAREA AREA(ACRES) =     0.03       SUBAREA RUNOFF(CFS) =    0.11
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.946
  TOTAL AREA(ACRES) =        2.5         PEAK FLOW RATE(CFS) =       9.46

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.41   FLOW VELOCITY(FEET/SEC.) =   3.19
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    105.00 =     610.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 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.) =    6.21
  RAINFALL INTENSITY(INCH/HR) =   3.96
  TOTAL STREAM AREA(ACRES) =     2.52
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      9.46

****************************************************************************
  FLOW PROCESS FROM NODE    141.00 TO NODE    142.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    80.00
  UPSTREAM ELEVATION(FEET) =     76.50
  DOWNSTREAM ELEVATION(FEET) =     74.40
  ELEVATION DIFFERENCE(FEET) =      2.10
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    1.709
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
```

```
          THE MAXIMUM OVERLAND FLOW LENGTH =    76.25
          (Reference: Table 3-1B of Hydrology Manual)
          THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.40
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.40

****************************************************************************
  FLOW PROCESS FROM NODE    142.00 TO NODE    105.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     74.40  DOWNSTREAM(FEET) =     71.20
  CHANNEL LENGTH THRU SUBAREA(FEET) =   115.00   CHANNEL SLOPE =  0.0278
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.80
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.38
  AVERAGE FLOW DEPTH(FEET) =   0.09   TRAVEL TIME(MIN.) =   0.81
  Tc(MIN.) =    2.52
  SUBAREA AREA(ACRES) =     0.20       SUBAREA RUNOFF(CFS) =    0.80
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        0.3         PEAK FLOW RATE(CFS) =       1.20

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.11   FLOW VELOCITY(FEET/SEC.) =   2.66
  LONGEST FLOWPATH FROM NODE    141.00 TO NODE    105.00 =     195.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 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.) =    2.52
  RAINFALL INTENSITY(INCH/HR) =   4.20
  TOTAL STREAM AREA(ACRES) =     0.30
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.20

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        9.46     6.21        3.959          2.52
      2        1.20     2.52        4.200          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        5.03     2.52       4.200
      2       10.59     6.21       3.959

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      10.59   Tc(MIN.) =    6.21
  TOTAL AREA(ACRES) =        2.8
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    105.00 =     610.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    106.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     71.20  DOWNSTREAM(FEET) =     66.60
  CHANNEL LENGTH THRU SUBAREA(FEET) =   130.00   CHANNEL SLOPE =  0.0354
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =   5.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.890
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      10.74
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   6.32
  AVERAGE FLOW DEPTH(FEET) =   0.36   TRAVEL TIME(MIN.) =   0.34
  Tc(MIN.) =    6.55
  SUBAREA AREA(ACRES) =     0.08       SUBAREA RUNOFF(CFS) =    0.30
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.947
  TOTAL AREA(ACRES) =        2.9         PEAK FLOW RATE(CFS) =      10.68

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.36   FLOW VELOCITY(FEET/SEC.) =   6.28
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    106.00 =     740.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    106.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.890
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.9469
  SUBAREA AREA(ACRES) =    0.37   SUBAREA RUNOFF(CFS) =    1.37
  TOTAL AREA(ACRES) =        3.3   TOTAL RUNOFF(CFS) =      12.05
  TC(MIN.) =    6.55

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    106.00 IS CODE =   1
```

```
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    6.55
  RAINFALL INTENSITY(INCH/HR) =   3.89
  TOTAL STREAM AREA(ACRES) =     3.27
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     12.05

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    80.00
  UPSTREAM ELEVATION(FEET) =     75.30
  DOWNSTREAM ELEVATION(FEET) =     74.10
  ELEVATION DIFFERENCE(FEET) =      1.20
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    1.902
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    65.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.48
  TOTAL AREA(ACRES) =      0.12   TOTAL RUNOFF(CFS) =      0.48

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    203.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     74.10  DOWNSTREAM(FEET) =     72.40
  CHANNEL LENGTH THRU SUBAREA(FEET) =   210.00   CHANNEL SLOPE =  0.0081
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.46
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.71
  AVERAGE FLOW DEPTH(FEET) =   0.13   TRAVEL TIME(MIN.) =   2.05
  Tc(MIN.) =    3.95
  SUBAREA AREA(ACRES) =     0.49       SUBAREA RUNOFF(CFS) =    1.96
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        0.6         PEAK FLOW RATE(CFS) =       2.43
```

```
  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.18   FLOW VELOCITY(FEET/SEC.) =   2.01
  LONGEST FLOWPATH FROM NODE    201.00 TO NODE    203.00 =     290.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    204.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   72.40  DOWNSTREAM ELEVATION(FEET) =   68.00
  STREET LENGTH(FEET) =    85.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0180
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.19
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.29
    HALFSTREET FLOOD WIDTH(FEET) =    8.37
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.90
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.14
  STREET FLOW TRAVEL TIME(MIN.) =   0.36   Tc(MIN.) =    4.32
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  SUBAREA AREA(ACRES) =    0.38      SUBAREA RUNOFF(CFS) =    1.52
  TOTAL AREA(ACRES) =        1.0        PEAK FLOW RATE(CFS) =       3.95

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.31   HALFSTREET FLOOD WIDTH(FEET) =   9.24
  FLOW VELOCITY(FEET/SEC.) =  4.07   DEPTH*VELOCITY(FT*FT/SEC.) =   1.26
  LONGEST FLOWPATH FROM NODE    201.00 TO NODE    204.00 =     375.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    204.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    4.32
  RAINFALL INTENSITY(INCH/HR) =   4.20
  TOTAL STREAM AREA(ACRES) =     0.99
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      3.95
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    302.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    80.00
  UPSTREAM ELEVATION(FEET) =     78.40
  DOWNSTREAM ELEVATION(FEET) =     76.80
  ELEVATION DIFFERENCE(FEET) =      1.60
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    1.793
  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!
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.72
  TOTAL AREA(ACRES) =      0.18   TOTAL RUNOFF(CFS) =      0.72

****************************************************************************
  FLOW PROCESS FROM NODE    302.00 TO NODE    303.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     76.80  DOWNSTREAM(FEET) =     74.90
  CHANNEL LENGTH THRU SUBAREA(FEET) =   200.00   CHANNEL SLOPE =  0.0095
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.58
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.96
  AVERAGE FLOW DEPTH(FEET) =   0.17   TRAVEL TIME(MIN.) =   1.70
  Tc(MIN.) =    3.49
  SUBAREA AREA(ACRES) =     0.43       SUBAREA RUNOFF(CFS) =    1.72
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        0.6         PEAK FLOW RATE(CFS) =       2.43

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.21   FLOW VELOCITY(FEET/SEC.) =   2.26
  LONGEST FLOWPATH FROM NODE    301.00 TO NODE    303.00 =     280.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    303.00 TO NODE    304.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
```

```
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     74.90  DOWNSTREAM(FEET) =     73.40
  CHANNEL LENGTH THRU SUBAREA(FEET) =   190.00   CHANNEL SLOPE =  0.0079
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.33
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.33
  AVERAGE FLOW DEPTH(FEET) =   0.26   TRAVEL TIME(MIN.) =   1.36
  Tc(MIN.) =    4.85
  SUBAREA AREA(ACRES) =     0.45       SUBAREA RUNOFF(CFS) =    1.80
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        1.1         PEAK FLOW RATE(CFS) =       4.23

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.29   FLOW VELOCITY(FEET/SEC.) =   2.44
  LONGEST FLOWPATH FROM NODE    301.00 TO NODE    304.00 =     470.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    304.00 TO NODE    305.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     73.40  DOWNSTREAM(FEET) =     71.40
  CHANNEL LENGTH THRU SUBAREA(FEET) =   200.00   CHANNEL SLOPE =  0.0100
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.017
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.82
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.13
  AVERAGE FLOW DEPTH(FEET) =   0.27   TRAVEL TIME(MIN.) =   1.06
  Tc(MIN.) =    5.91
  SUBAREA AREA(ACRES) =     0.31       SUBAREA RUNOFF(CFS) =    1.18
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        1.4         PEAK FLOW RATE(CFS) =       5.23

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.28   FLOW VELOCITY(FEET/SEC.) =   3.23
  LONGEST FLOWPATH FROM NODE    301.00 TO NODE    305.00 =     670.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    305.00 TO NODE    305.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
```

```
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
  TIME OF CONCENTRATION(MIN.) =    5.91
  RAINFALL INTENSITY(INCH/HR) =   4.02
  TOTAL STREAM AREA(ACRES) =     1.37
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      5.23

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1       12.05     6.55        3.890          3.27
      2        3.95     4.32        4.200          0.99
      3        5.23     5.91        4.017          1.37

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  3 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       18.92     4.32       4.200
      2       20.67     5.91       4.017
      3       20.77     6.55       3.890

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      20.77   Tc(MIN.) =    6.55
  TOTAL AREA(ACRES) =        5.6
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    305.00 =     740.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        5.6  TC(MIN.) =      6.55
  PEAK FLOW RATE(CFS)   =      20.77
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

🡅

Pre-Project, 100-Year Storm Event

```
****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2014 Advanced Engineering Software (aes)
             Ver. 21.0 Release Date: 06/01/2014  License ID 1261

                           Analysis prepared by:

                          RICK ENGINEERING COMPANY
                              5620 Friars Road
                        San Diego, California 92110
                      619-291-0707   Fax 619-291-4165

 ************************** DESCRIPTION OF STUDY **************************
* PACIFIC WEST COMMUNITIES REDEVELOPMENT PROJECT                           *
* PRE-PROJECT 100-YEAR ANALYSIS                                            *
* RICK ENGINEERING COMPANY JOB NUMBER 19048                                *
 ***************************************************************************

  FILE NAME: GRNT100.DAT
  TIME/DATE OF STUDY: 16:13 01/18/2021
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.01
  RAINFALL-INTENSITY ADJUSTMENT FACTOR = 1.000
  *USER SPECIFIED:
  NUMBER OF [TIME,INTENSITY] DATA PAIRS =  9
   1)   5.000;  4.400
   2)  10.000;  3.450
   3)  15.000;  2.900
   4)  20.000;  2.500
   5)  25.000;  2.220
   6)  30.000;  2.000
   7)  40.000;  1.700
   8)  50.000;  1.500
   9)  60.000;  1.320
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: ONLY PEAK CONFLUENCE VALUES CONSIDERED
  *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   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0180

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.50 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  5.0 (FT*FT/S)
```

```
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    75.00
  UPSTREAM ELEVATION(FEET) =     77.00
  DOWNSTREAM ELEVATION(FEET) =     76.10
  ELEVATION DIFFERENCE(FEET) =      0.90
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.361
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    63.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.37
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.37

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     76.10  DOWNSTREAM(FEET) =     72.40
  CHANNEL LENGTH THRU SUBAREA(FEET) =   215.00   CHANNEL SLOPE =  0.0172
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.303
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.68
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.67
  AVERAGE FLOW DEPTH(FEET) =   0.07   TRAVEL TIME(MIN.) =   2.15
  Tc(MIN.) =    5.51
  SUBAREA AREA(ACRES) =     0.15       SUBAREA RUNOFF(CFS) =    0.61
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.910
  TOTAL AREA(ACRES) =        0.2         PEAK FLOW RATE(CFS) =       0.98

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.09   FLOW VELOCITY(FEET/SEC.) =   1.92
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    103.00 =     290.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 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.) =    5.51
  RAINFALL INTENSITY(INCH/HR) =   4.30
  TOTAL STREAM AREA(ACRES) =     0.25
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.98

****************************************************************************
  FLOW PROCESS FROM NODE    111.00 TO NODE    112.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    80.00
  UPSTREAM ELEVATION(FEET) =     76.30
  DOWNSTREAM ELEVATION(FEET) =     75.10
  ELEVATION DIFFERENCE(FEET) =      1.20
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    1.902
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    65.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.42
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.42

****************************************************************************
  FLOW PROCESS FROM NODE    112.00 TO NODE    103.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     75.10  DOWNSTREAM(FEET) =     72.40
  CHANNEL LENGTH THRU SUBAREA(FEET) =   160.00   CHANNEL SLOPE =  0.0169
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.59
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.62
  AVERAGE FLOW DEPTH(FEET) =   0.06   TRAVEL TIME(MIN.) =   1.64
  Tc(MIN.) =    3.54
  SUBAREA AREA(ACRES) =     0.08       SUBAREA RUNOFF(CFS) =    0.33
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        0.2         PEAK FLOW RATE(CFS) =       0.75

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.07   FLOW VELOCITY(FEET/SEC.) =   1.79
```

```
  LONGEST FLOWPATH FROM NODE    111.00 TO NODE    103.00 =     240.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 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.) =    3.54
  RAINFALL INTENSITY(INCH/HR) =   4.40
  TOTAL STREAM AREA(ACRES) =     0.18
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.75

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        0.98     5.51        4.303          0.25
      2        0.75     3.54        4.400          0.18

  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        1.38     3.54       4.400
      2        1.71     5.51       4.303

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       1.71   Tc(MIN.) =    5.51
  TOTAL AREA(ACRES) =        0.4
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    103.00 =     290.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.303
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.9328
  SUBAREA AREA(ACRES) =    0.15   SUBAREA RUNOFF(CFS) =    0.61
  TOTAL AREA(ACRES) =        0.6   TOTAL RUNOFF(CFS) =       2.33
  TC(MIN.) =    5.51

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    104.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
```

```
  ELEVATION DATA: UPSTREAM(FEET) =     72.40  DOWNSTREAM(FEET) =     71.70
  CHANNEL LENGTH THRU SUBAREA(FEET) =    55.00   CHANNEL SLOPE =  0.0127
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.231
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.49
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.41
  AVERAGE FLOW DEPTH(FEET) =   0.16   TRAVEL TIME(MIN.) =   0.38
  Tc(MIN.) =    5.89
  SUBAREA AREA(ACRES) =     0.08       SUBAREA RUNOFF(CFS) =    0.32
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.935
  TOTAL AREA(ACRES) =        0.7         PEAK FLOW RATE(CFS) =       2.61

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.16   FLOW VELOCITY(FEET/SEC.) =   2.41
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    104.00 =     345.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    104.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    121.00 TO NODE    122.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    80.00
  UPSTREAM ELEVATION(FEET) =     78.10
  DOWNSTREAM ELEVATION(FEET) =     77.10
  ELEVATION DIFFERENCE(FEET) =      1.00
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    1.982
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    62.50
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.42
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.42

****************************************************************************
  FLOW PROCESS FROM NODE    122.00 TO NODE    123.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     77.10  DOWNSTREAM(FEET) =     73.30
```

```
  CHANNEL LENGTH THRU SUBAREA(FEET) =   260.00   CHANNEL SLOPE =  0.0146
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.50
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.62
  AVERAGE FLOW DEPTH(FEET) =   0.13   TRAVEL TIME(MIN.) =   1.65
  Tc(MIN.) =    3.63
  SUBAREA AREA(ACRES) =     0.52       SUBAREA RUNOFF(CFS) =    2.17
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        0.6         PEAK FLOW RATE(CFS) =       2.59

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.18   FLOW VELOCITY(FEET/SEC.) =   3.04
  LONGEST FLOWPATH FROM NODE    121.00 TO NODE    123.00 =     340.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    123.00 TO NODE    123.00 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.) =    3.63
  RAINFALL INTENSITY(INCH/HR) =   4.40
  TOTAL STREAM AREA(ACRES) =     0.62
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.59

****************************************************************************
  FLOW PROCESS FROM NODE    131.00 TO NODE    132.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    60.00
  UPSTREAM ELEVATION(FEET) =     77.70
  DOWNSTREAM ELEVATION(FEET) =     77.10
  ELEVATION DIFFERENCE(FEET) =      0.60
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.091
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    60.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.50
  TOTAL AREA(ACRES) =      0.12   TOTAL RUNOFF(CFS) =      0.50

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    132.00 TO NODE    133.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   77.10  DOWNSTREAM ELEVATION(FEET) =   74.50
  STREET LENGTH(FEET) =   210.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0180
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.88
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.25
    HALFSTREET FLOOD WIDTH(FEET) =    6.38
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.67
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.42
  STREET FLOW TRAVEL TIME(MIN.) =   2.09   Tc(MIN.) =    4.19
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  SUBAREA AREA(ACRES) =    0.18      SUBAREA RUNOFF(CFS) =    0.75
  TOTAL AREA(ACRES) =        0.3        PEAK FLOW RATE(CFS) =       1.25

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.28   HALFSTREET FLOOD WIDTH(FEET) =   7.58
  FLOW VELOCITY(FEET/SEC.) =  1.81   DEPTH*VELOCITY(FT*FT/SEC.) =   0.50
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    133.00 =     270.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    133.00 TO NODE    133.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.9500
  SUBAREA AREA(ACRES) =    0.24   SUBAREA RUNOFF(CFS) =    1.00
  TOTAL AREA(ACRES) =        0.5   TOTAL RUNOFF(CFS) =       2.26
  TC(MIN.) =    4.19

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    133.00 TO NODE    123.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     74.60  DOWNSTREAM(FEET) =     73.30
  CHANNEL LENGTH THRU SUBAREA(FEET) =    80.00   CHANNEL SLOPE =  0.0162
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.55
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.78
  AVERAGE FLOW DEPTH(FEET) =   0.19   TRAVEL TIME(MIN.) =   0.48
  Tc(MIN.) =    4.67
  SUBAREA AREA(ACRES) =     0.14       SUBAREA RUNOFF(CFS) =    0.59
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        0.7         PEAK FLOW RATE(CFS) =       2.84

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.20   FLOW VELOCITY(FEET/SEC.) =   2.82
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    123.00 =     350.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    123.00 TO NODE    123.00 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.) =    4.67
  RAINFALL INTENSITY(INCH/HR) =   4.40
  TOTAL STREAM AREA(ACRES) =     0.68
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.84

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        2.59     3.63        4.400          0.62
      2        2.84     4.67        4.400          0.68

  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        4.80     3.63       4.400
      2        5.43     4.67       4.400

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
```

```
  PEAK FLOW RATE(CFS) =       5.43   Tc(MIN.) =    4.67
  TOTAL AREA(ACRES) =        1.3
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    123.00 =     350.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    123.00 TO NODE    104.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     73.30  DOWNSTREAM(FEET) =     71.70
  CHANNEL LENGTH THRU SUBAREA(FEET) =   205.00   CHANNEL SLOPE =  0.0078
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.225
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       6.50
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.72
  AVERAGE FLOW DEPTH(FEET) =   0.36   TRAVEL TIME(MIN.) =   1.26
  Tc(MIN.) =    5.92
  SUBAREA AREA(ACRES) =     0.53       SUBAREA RUNOFF(CFS) =    2.13
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        1.8         PEAK FLOW RATE(CFS) =       7.34

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.38   FLOW VELOCITY(FEET/SEC.) =   2.86
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    104.00 =     555.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    104.00 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        7.34     5.92       4.225        1.83
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    104.00 =     555.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1        2.61     5.89       4.231        0.66
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    104.00 =     345.00 FEET.

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
      1       9.91       5.89        4.231
      2       9.95       5.92        4.225

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
```

```
  PEAK FLOW RATE(CFS) =       9.95   Tc(MIN.) =    5.92
  TOTAL AREA(ACRES) =        2.5

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    105.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     71.70  DOWNSTREAM(FEET) =     71.20
  CHANNEL LENGTH THRU SUBAREA(FEET) =    55.00   CHANNEL SLOPE =  0.0091
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.171
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      10.01
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.26
  AVERAGE FLOW DEPTH(FEET) =   0.42   TRAVEL TIME(MIN.) =   0.28
  Tc(MIN.) =    6.20
  SUBAREA AREA(ACRES) =     0.03       SUBAREA RUNOFF(CFS) =    0.12
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.946
  TOTAL AREA(ACRES) =        2.5         PEAK FLOW RATE(CFS) =       9.95

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.42   FLOW VELOCITY(FEET/SEC.) =   3.26
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    105.00 =     610.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 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.) =    6.20
  RAINFALL INTENSITY(INCH/HR) =   4.17
  TOTAL STREAM AREA(ACRES) =     2.52
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      9.95

****************************************************************************
  FLOW PROCESS FROM NODE    141.00 TO NODE    142.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    80.00
  UPSTREAM ELEVATION(FEET) =     76.50
  DOWNSTREAM ELEVATION(FEET) =     74.40
  ELEVATION DIFFERENCE(FEET) =      2.10
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    1.709
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
```

```
          THE MAXIMUM OVERLAND FLOW LENGTH =    76.25
          (Reference: Table 3-1B of Hydrology Manual)
          THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.42
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.42

****************************************************************************
  FLOW PROCESS FROM NODE    142.00 TO NODE    105.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     74.40  DOWNSTREAM(FEET) =     71.20
  CHANNEL LENGTH THRU SUBAREA(FEET) =   115.00   CHANNEL SLOPE =  0.0278
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.84
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.43
  AVERAGE FLOW DEPTH(FEET) =   0.09   TRAVEL TIME(MIN.) =   0.79
  Tc(MIN.) =    2.50
  SUBAREA AREA(ACRES) =     0.20       SUBAREA RUNOFF(CFS) =    0.84
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        0.3         PEAK FLOW RATE(CFS) =       1.25

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.11   FLOW VELOCITY(FEET/SEC.) =   2.73
  LONGEST FLOWPATH FROM NODE    141.00 TO NODE    105.00 =     195.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 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.) =    2.50
  RAINFALL INTENSITY(INCH/HR) =   4.40
  TOTAL STREAM AREA(ACRES) =     0.30
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.25

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        9.95     6.20        4.171          2.52
      2        1.25     2.50        4.400          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        5.26     2.50       4.400
      2       11.14     6.20       4.171

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      11.14   Tc(MIN.) =    6.20
  TOTAL AREA(ACRES) =        2.8
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    105.00 =     610.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    106.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     71.20  DOWNSTREAM(FEET) =     66.60
  CHANNEL LENGTH THRU SUBAREA(FEET) =   130.00   CHANNEL SLOPE =  0.0354
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =   5.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.106
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      11.30
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   6.32
  AVERAGE FLOW DEPTH(FEET) =   0.37   TRAVEL TIME(MIN.) =   0.34
  Tc(MIN.) =    6.55
  SUBAREA AREA(ACRES) =     0.08       SUBAREA RUNOFF(CFS) =    0.31
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.947
  TOTAL AREA(ACRES) =        2.9         PEAK FLOW RATE(CFS) =      11.27

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.37   FLOW VELOCITY(FEET/SEC.) =   6.30
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    106.00 =     740.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    106.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.106
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.9469
  SUBAREA AREA(ACRES) =    0.37   SUBAREA RUNOFF(CFS) =    1.44
  TOTAL AREA(ACRES) =        3.3   TOTAL RUNOFF(CFS) =      12.71
  TC(MIN.) =    6.55

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    106.00 IS CODE =   1
```

```
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    6.55
  RAINFALL INTENSITY(INCH/HR) =   4.11
  TOTAL STREAM AREA(ACRES) =     3.27
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     12.71

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    80.00
  UPSTREAM ELEVATION(FEET) =     75.30
  DOWNSTREAM ELEVATION(FEET) =     74.10
  ELEVATION DIFFERENCE(FEET) =      1.20
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    1.902
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    65.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.50
  TOTAL AREA(ACRES) =      0.12   TOTAL RUNOFF(CFS) =      0.50

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    203.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     74.10  DOWNSTREAM(FEET) =     72.40
  CHANNEL LENGTH THRU SUBAREA(FEET) =   210.00   CHANNEL SLOPE =  0.0081
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.53
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.70
  AVERAGE FLOW DEPTH(FEET) =   0.14   TRAVEL TIME(MIN.) =   2.06
  Tc(MIN.) =    3.96
  SUBAREA AREA(ACRES) =     0.49       SUBAREA RUNOFF(CFS) =    2.05
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        0.6         PEAK FLOW RATE(CFS) =       2.55
```

```
  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.18   FLOW VELOCITY(FEET/SEC.) =   2.08
  LONGEST FLOWPATH FROM NODE    201.00 TO NODE    203.00 =     290.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    204.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   72.40  DOWNSTREAM ELEVATION(FEET) =   68.00
  STREET LENGTH(FEET) =    85.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0180
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.34
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.30
    HALFSTREET FLOOD WIDTH(FEET) =    8.57
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.92
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.17
  STREET FLOW TRAVEL TIME(MIN.) =   0.36   Tc(MIN.) =    4.32
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  SUBAREA AREA(ACRES) =    0.38      SUBAREA RUNOFF(CFS) =    1.59
  TOTAL AREA(ACRES) =        1.0        PEAK FLOW RATE(CFS) =       4.14

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.31   HALFSTREET FLOOD WIDTH(FEET) =   9.44
  FLOW VELOCITY(FEET/SEC.) =  4.10   DEPTH*VELOCITY(FT*FT/SEC.) =   1.29
  LONGEST FLOWPATH FROM NODE    201.00 TO NODE    204.00 =     375.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    204.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    4.32
  RAINFALL INTENSITY(INCH/HR) =   4.40
  TOTAL STREAM AREA(ACRES) =     0.99
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      4.14
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    302.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    80.00
  UPSTREAM ELEVATION(FEET) =     78.40
  DOWNSTREAM ELEVATION(FEET) =     76.80
  ELEVATION DIFFERENCE(FEET) =      1.60
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    1.793
  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) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.75
  TOTAL AREA(ACRES) =      0.18   TOTAL RUNOFF(CFS) =      0.75

****************************************************************************
  FLOW PROCESS FROM NODE    302.00 TO NODE    303.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     76.80  DOWNSTREAM(FEET) =     74.90
  CHANNEL LENGTH THRU SUBAREA(FEET) =   200.00   CHANNEL SLOPE =  0.0095
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.65
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.02
  AVERAGE FLOW DEPTH(FEET) =   0.17   TRAVEL TIME(MIN.) =   1.65
  Tc(MIN.) =    3.44
  SUBAREA AREA(ACRES) =     0.43       SUBAREA RUNOFF(CFS) =    1.80
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        0.6         PEAK FLOW RATE(CFS) =       2.55

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.22   FLOW VELOCITY(FEET/SEC.) =   2.28
  LONGEST FLOWPATH FROM NODE    301.00 TO NODE    303.00 =     280.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    303.00 TO NODE    304.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
```

```
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     74.90  DOWNSTREAM(FEET) =     73.40
  CHANNEL LENGTH THRU SUBAREA(FEET) =   190.00   CHANNEL SLOPE =  0.0079
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.49
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.34
  AVERAGE FLOW DEPTH(FEET) =   0.26   TRAVEL TIME(MIN.) =   1.35
  Tc(MIN.) =    4.79
  SUBAREA AREA(ACRES) =     0.45       SUBAREA RUNOFF(CFS) =    1.88
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        1.1         PEAK FLOW RATE(CFS) =       4.43

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.30   FLOW VELOCITY(FEET/SEC.) =   2.46
  LONGEST FLOWPATH FROM NODE    301.00 TO NODE    304.00 =     470.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    304.00 TO NODE    305.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     73.40  DOWNSTREAM(FEET) =     71.40
  CHANNEL LENGTH THRU SUBAREA(FEET) =   200.00   CHANNEL SLOPE =  0.0100
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.245
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.06
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.25
  AVERAGE FLOW DEPTH(FEET) =   0.27   TRAVEL TIME(MIN.) =   1.02
  Tc(MIN.) =    5.82
  SUBAREA AREA(ACRES) =     0.31       SUBAREA RUNOFF(CFS) =    1.25
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        1.4         PEAK FLOW RATE(CFS) =       5.52

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.29   FLOW VELOCITY(FEET/SEC.) =   3.28
  LONGEST FLOWPATH FROM NODE    301.00 TO NODE    305.00 =     670.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    305.00 TO NODE    305.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
==============================================================================
  TOTAL NUMBER OF STREAMS =  3
```

```
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
  TIME OF CONCENTRATION(MIN.) =    5.82
  RAINFALL INTENSITY(INCH/HR) =   4.24
  TOTAL STREAM AREA(ACRES) =     1.37
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      5.52

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1       12.71     6.55        4.106          3.27
      2        4.14     4.32        4.400          0.99
      3        5.52     5.82        4.245          1.37

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  3 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       20.11     4.32       4.400
      2       21.82     5.82       4.245
      3       21.92     6.55       4.106

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      21.92   Tc(MIN.) =    6.55
  TOTAL AREA(ACRES) =        5.6
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    305.00 =     740.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        5.6  TC(MIN.) =      6.55
  PEAK FLOW RATE(CFS)   =      21.92
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

🡅

Post-Project, 50-Year Storm Event

```
****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2014 Advanced Engineering Software (aes)
             Ver. 21.0 Release Date: 06/01/2014  License ID 1261

                           Analysis prepared by:

                          RICK ENGINEERING COMPANY
                              5620 Friars Road
                        San Diego, California 92110
                      619-291-0707   Fax 619-291-4165

 ************************** DESCRIPTION OF STUDY **************************
* PACIFIC WEST COMMUNITIES REDEVELOPMENT PROJECT                           *
* POST-PROJECT 50-YEAR ANALYSIS                                            *
* RICK ENGINEERING COMPANY JOB NUMBER 19048                                *
 ***************************************************************************

  FILE NAME: GRNT50P.DAT
  TIME/DATE OF STUDY: 18:38 02/02/2021
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =  50.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.01
  RAINFALL-INTENSITY ADJUSTMENT FACTOR = 1.000
  *USER SPECIFIED:
  NUMBER OF [TIME,INTENSITY] DATA PAIRS =  9
   1)   5.000;  4.200
   2)  10.000;  3.200
   3)  15.000;  2.700
   4)  20.000;  2.300
   5)  25.000;  2.050
   6)  30.000;  1.850
   7)  40.000;  1.600
   8)  50.000;  1.400
   9)  60.000;  1.250
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: ONLY PEAK CONFLUENCE VALUES CONSIDERED
  *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   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0180

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.50 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  5.0 (FT*FT/S)
```

```
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    75.00
  UPSTREAM ELEVATION(FEET) =     77.00
  DOWNSTREAM ELEVATION(FEET) =     76.10
  ELEVATION DIFFERENCE(FEET) =      0.90
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.361
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    63.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.36
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.36

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     76.10  DOWNSTREAM(FEET) =     72.40
  CHANNEL LENGTH THRU SUBAREA(FEET) =   215.00   CHANNEL SLOPE =  0.0172
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.113
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.73
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.73
  AVERAGE FLOW DEPTH(FEET) =   0.07   TRAVEL TIME(MIN.) =   2.07
  Tc(MIN.) =    5.43
  SUBAREA AREA(ACRES) =     0.19       SUBAREA RUNOFF(CFS) =    0.74
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.916
  TOTAL AREA(ACRES) =        0.3         PEAK FLOW RATE(CFS) =       1.09

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.09   FLOW VELOCITY(FEET/SEC.) =   1.95
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    103.00 =     290.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
```

```
==============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.113
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.9296
  SUBAREA AREA(ACRES) =    0.20   SUBAREA RUNOFF(CFS) =    0.78
  TOTAL AREA(ACRES) =        0.5   TOTAL RUNOFF(CFS) =       1.87
  TC(MIN.) =    5.43

******************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    104.00 IS CODE =  51
------------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     72.40  DOWNSTREAM(FEET) =     71.70
  CHANNEL LENGTH THRU SUBAREA(FEET) =    55.00   CHANNEL SLOPE =  0.0127
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.032
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.07
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.26
  AVERAGE FLOW DEPTH(FEET) =   0.14   TRAVEL TIME(MIN.) =   0.41
  Tc(MIN.) =    5.84
  SUBAREA AREA(ACRES) =     0.10       SUBAREA RUNOFF(CFS) =    0.38
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.933
  TOTAL AREA(ACRES) =        0.6         PEAK FLOW RATE(CFS) =       2.22

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.15   FLOW VELOCITY(FEET/SEC.) =   2.28
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    104.00 =     345.00 FEET.

******************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    104.00 IS CODE =  10
------------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
==============================================================================

******************************************************************************
  FLOW PROCESS FROM NODE    121.00 TO NODE    122.00 IS CODE =  21
------------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    80.00
  UPSTREAM ELEVATION(FEET) =     78.10
  DOWNSTREAM ELEVATION(FEET) =     77.10
  ELEVATION DIFFERENCE(FEET) =      1.00
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    1.982
```

```
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    62.50
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.40
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.40

****************************************************************************
  FLOW PROCESS FROM NODE    122.00 TO NODE    123.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     77.10  DOWNSTREAM(FEET) =     73.30
  CHANNEL LENGTH THRU SUBAREA(FEET) =   260.00   CHANNEL SLOPE =  0.0146
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.44
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.51
  AVERAGE FLOW DEPTH(FEET) =   0.13   TRAVEL TIME(MIN.) =   1.73
  Tc(MIN.) =    3.71
  SUBAREA AREA(ACRES) =     0.52       SUBAREA RUNOFF(CFS) =    2.07
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        0.6         PEAK FLOW RATE(CFS) =       2.47

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.17   FLOW VELOCITY(FEET/SEC.) =   3.03
  LONGEST FLOWPATH FROM NODE    121.00 TO NODE    123.00 =     340.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    123.00 TO NODE    123.00 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.) =    3.71
  RAINFALL INTENSITY(INCH/HR) =   4.20
  TOTAL STREAM AREA(ACRES) =     0.62
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.47

****************************************************************************
  FLOW PROCESS FROM NODE    131.00 TO NODE    132.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
```

```
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    60.00
  UPSTREAM ELEVATION(FEET) =     77.70
  DOWNSTREAM ELEVATION(FEET) =     77.10
  ELEVATION DIFFERENCE(FEET) =      0.60
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.091
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    60.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.48
  TOTAL AREA(ACRES) =      0.12   TOTAL RUNOFF(CFS) =      0.48

****************************************************************************
  FLOW PROCESS FROM NODE    132.00 TO NODE    133.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   77.10  DOWNSTREAM ELEVATION(FEET) =   74.50
  STREET LENGTH(FEET) =   210.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0180
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.84
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.25
    HALFSTREET FLOOD WIDTH(FEET) =    6.18
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.67
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.42
  STREET FLOW TRAVEL TIME(MIN.) =   2.09   Tc(MIN.) =    4.18
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  SUBAREA AREA(ACRES) =    0.18      SUBAREA RUNOFF(CFS) =    0.72
  TOTAL AREA(ACRES) =        0.3        PEAK FLOW RATE(CFS) =       1.20

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.27   HALFSTREET FLOOD WIDTH(FEET) =   7.38
  FLOW VELOCITY(FEET/SEC.) =  1.81   DEPTH*VELOCITY(FT*FT/SEC.) =   0.49
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    133.00 =     270.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    133.00 TO NODE    133.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.9500
  SUBAREA AREA(ACRES) =    0.24   SUBAREA RUNOFF(CFS) =    0.96
  TOTAL AREA(ACRES) =        0.5   TOTAL RUNOFF(CFS) =       2.15
  TC(MIN.) =    4.18

****************************************************************************
  FLOW PROCESS FROM NODE    133.00 TO NODE    123.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     74.50  DOWNSTREAM(FEET) =     73.30
  CHANNEL LENGTH THRU SUBAREA(FEET) =    80.00   CHANNEL SLOPE =  0.0150
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.43
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.66
  AVERAGE FLOW DEPTH(FEET) =   0.19   TRAVEL TIME(MIN.) =   0.50
  Tc(MIN.) =    4.68
  SUBAREA AREA(ACRES) =     0.14       SUBAREA RUNOFF(CFS) =    0.56
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        0.7         PEAK FLOW RATE(CFS) =       2.71

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.20   FLOW VELOCITY(FEET/SEC.) =   2.80
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    123.00 =     350.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    123.00 TO NODE    123.00 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.) =    4.68
  RAINFALL INTENSITY(INCH/HR) =   4.20
  TOTAL STREAM AREA(ACRES) =     0.68
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.71
```

```
  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        2.47     3.71        4.200          0.62
      2        2.71     4.68        4.200          0.68

  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        4.62     3.71       4.200
      2        5.19     4.68       4.200

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       5.19   Tc(MIN.) =    4.68
  TOTAL AREA(ACRES) =        1.3
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    123.00 =     350.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    123.00 TO NODE    104.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     73.30  DOWNSTREAM(FEET) =     71.70
  CHANNEL LENGTH THRU SUBAREA(FEET) =   205.00   CHANNEL SLOPE =  0.0078
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.015
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       6.20
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.75
  AVERAGE FLOW DEPTH(FEET) =   0.35   TRAVEL TIME(MIN.) =   1.24
  Tc(MIN.) =    5.93
  SUBAREA AREA(ACRES) =     0.53       SUBAREA RUNOFF(CFS) =    2.02
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        1.8         PEAK FLOW RATE(CFS) =       6.98

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.37   FLOW VELOCITY(FEET/SEC.) =   2.80
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    104.00 =     555.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    104.00 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        6.98     5.93       4.015        1.83
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    104.00 =     555.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1        2.22     5.84       4.032        0.59
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    104.00 =     345.00 FEET.

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
      1       9.10       5.84        4.032
      2       9.19       5.93        4.015

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       9.19   Tc(MIN.) =    5.93
  TOTAL AREA(ACRES) =        2.4

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    105.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    65.95  DOWNSTREAM(FEET) =    65.59
  FLOW LENGTH(FEET) =   120.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.20
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       9.19
  PIPE TRAVEL TIME(MIN.) =   0.38    Tc(MIN.) =    6.31
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    105.00 =     675.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.938
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (24. DU/AC OR LESS) RUNOFF COEFFICIENT = .6900
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.9367
  SUBAREA AREA(ACRES) =    0.09   SUBAREA RUNOFF(CFS) =    0.24
  TOTAL AREA(ACRES) =        2.5   TOTAL RUNOFF(CFS) =       9.26
  TC(MIN.) =    6.31

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    106.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
```

```
  ELEVATION DATA: UPSTREAM(FEET) =    65.59  DOWNSTREAM(FEET) =    64.50
  FLOW LENGTH(FEET) =   330.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.24
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       9.26
  PIPE TRAVEL TIME(MIN.) =   1.05    Tc(MIN.) =    7.36
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    106.00 =    1005.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    106.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.728
  *USER SPECIFIED(SUBAREA):
  NATURAL DESERT LANDSCAPING RUNOFF COEFFICIENT = .5000
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8901
  SUBAREA AREA(ACRES) =    0.30   SUBAREA RUNOFF(CFS) =    0.56
  TOTAL AREA(ACRES) =        2.8   TOTAL RUNOFF(CFS) =       9.32
  TC(MIN.) =    7.36

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    106.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    7.36
  RAINFALL INTENSITY(INCH/HR) =   3.73
  TOTAL STREAM AREA(ACRES) =     2.81
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      9.32

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  22
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  USER SPECIFIED Tc(MIN.) =    5.000
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  SUBAREA RUNOFF(CFS) =      6.14
  TOTAL AREA(ACRES) =      1.54   TOTAL RUNOFF(CFS) =      6.14

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    204.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
```

```
  ELEVATION DATA: UPSTREAM(FEET) =    69.50  DOWNSTREAM(FEET) =    64.50
  FLOW LENGTH(FEET) =   100.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.48
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.14
  PIPE TRAVEL TIME(MIN.) =   0.48    Tc(MIN.) =    5.48
  LONGEST FLOWPATH FROM NODE    201.00 TO NODE    204.00 =     130.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    204.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    5.48
  RAINFALL INTENSITY(INCH/HR) =   4.10
  TOTAL STREAM AREA(ACRES) =     1.54
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      6.14

****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    302.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    80.00
  UPSTREAM ELEVATION(FEET) =     78.40
  DOWNSTREAM ELEVATION(FEET) =     76.80
  ELEVATION DIFFERENCE(FEET) =      1.60
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    1.793
  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!
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.72
  TOTAL AREA(ACRES) =      0.18   TOTAL RUNOFF(CFS) =      0.72

****************************************************************************
  FLOW PROCESS FROM NODE    302.00 TO NODE    303.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     76.80  DOWNSTREAM(FEET) =     74.90
  CHANNEL LENGTH THRU SUBAREA(FEET) =   200.00   CHANNEL SLOPE =  0.0095
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
```

```
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.58
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.96
  AVERAGE FLOW DEPTH(FEET) =   0.17   TRAVEL TIME(MIN.) =   1.70
  Tc(MIN.) =    3.49
  SUBAREA AREA(ACRES) =     0.43       SUBAREA RUNOFF(CFS) =    1.72
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        0.6         PEAK FLOW RATE(CFS) =       2.43

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.21   FLOW VELOCITY(FEET/SEC.) =   2.26
  LONGEST FLOWPATH FROM NODE    301.00 TO NODE    303.00 =     280.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    303.00 TO NODE    304.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     74.90  DOWNSTREAM(FEET) =     73.40
  CHANNEL LENGTH THRU SUBAREA(FEET) =   190.00   CHANNEL SLOPE =  0.0079
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.33
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.33
  AVERAGE FLOW DEPTH(FEET) =   0.26   TRAVEL TIME(MIN.) =   1.36
  Tc(MIN.) =    4.85
  SUBAREA AREA(ACRES) =     0.45       SUBAREA RUNOFF(CFS) =    1.80
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        1.1         PEAK FLOW RATE(CFS) =       4.23

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.29   FLOW VELOCITY(FEET/SEC.) =   2.44
  LONGEST FLOWPATH FROM NODE    301.00 TO NODE    304.00 =     470.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    304.00 TO NODE    304.50 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     73.40  DOWNSTREAM(FEET) =     72.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   130.00   CHANNEL SLOPE =  0.0108
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.096
  *USER SPECIFIED(SUBAREA):
```

```
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.60
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.22
  AVERAGE FLOW DEPTH(FEET) =   0.26   TRAVEL TIME(MIN.) =   0.67
  Tc(MIN.) =    5.52
  SUBAREA AREA(ACRES) =     0.19       SUBAREA RUNOFF(CFS) =    0.74
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        1.2         PEAK FLOW RATE(CFS) =       4.86

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.26   FLOW VELOCITY(FEET/SEC.) =   3.26
  LONGEST FLOWPATH FROM NODE    301.00 TO NODE    304.50 =     600.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    304.50 TO NODE    305.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     72.00  DOWNSTREAM(FEET) =     71.40
  CHANNEL LENGTH THRU SUBAREA(FEET) =    30.00   CHANNEL SLOPE =  0.0200
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   2.00
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.074
  *USER SPECIFIED(SUBAREA):
  NATURAL DESERT LANDSCAPING RUNOFF COEFFICIENT = .5000
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.97
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.59
  AVERAGE FLOW DEPTH(FEET) =   0.30   TRAVEL TIME(MIN.) =   0.11
  Tc(MIN.) =    5.63
  SUBAREA AREA(ACRES) =     0.10       SUBAREA RUNOFF(CFS) =    0.20
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.917
  TOTAL AREA(ACRES) =        1.4         PEAK FLOW RATE(CFS) =       5.04

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.30   FLOW VELOCITY(FEET/SEC.) =   4.63
  LONGEST FLOWPATH FROM NODE    301.00 TO NODE    305.00 =     630.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    305.00 TO NODE    305.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
  TIME OF CONCENTRATION(MIN.) =    5.63
  RAINFALL INTENSITY(INCH/HR) =   4.07
  TOTAL STREAM AREA(ACRES) =     1.35
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      5.04

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
```

```
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        9.32     7.36        3.728          2.81
      2        6.14     5.48        4.104          1.54
      3        5.04     5.63        4.074          1.35

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  3 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       17.99     5.48       4.104
      2       18.27     5.63       4.074
      3       19.52     7.36       3.728

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      19.52   Tc(MIN.) =    7.36
  TOTAL AREA(ACRES) =        5.7
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    305.00 =    1005.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        5.7  TC(MIN.) =      7.36
  PEAK FLOW RATE(CFS)   =      19.52
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

🡅

Post-Project, 100-Year Storm Event

```
****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2014 Advanced Engineering Software (aes)
             Ver. 21.0 Release Date: 06/01/2014  License ID 1261

                           Analysis prepared by:

                          RICK ENGINEERING COMPANY
                              5620 Friars Road
                        San Diego, California 92110
                      619-291-0707   Fax 619-291-4165

 ************************** DESCRIPTION OF STUDY **************************
* PACIFIC WEST COMMUNITIES REDEVELOPMENT PROJECT                           *
* POST-PROJECT 100-YEAR ANALYSIS                                           *
* RICK ENGINEERING COMPANY JOB NUMBER 19048                                *
 ***************************************************************************

  FILE NAME: GRNT100P.DAT
  TIME/DATE OF STUDY: 18:38 02/02/2021
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.01
  RAINFALL-INTENSITY ADJUSTMENT FACTOR = 1.000
  *USER SPECIFIED:
  NUMBER OF [TIME,INTENSITY] DATA PAIRS =  9
   1)   5.000;  4.400
   2)  10.000;  3.450
   3)  15.000;  2.900
   4)  20.000;  2.500
   5)  25.000;  2.220
   6)  30.000;  2.000
   7)  40.000;  1.700
   8)  50.000;  1.500
   9)  60.000;  1.320
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: ONLY PEAK CONFLUENCE VALUES CONSIDERED
  *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   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0180

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.50 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  5.0 (FT*FT/S)
```

```
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL COMMERCIAL RUNOFF COEFFICIENT = .8500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    75.00
  UPSTREAM ELEVATION(FEET) =     77.00
  DOWNSTREAM ELEVATION(FEET) =     76.10
  ELEVATION DIFFERENCE(FEET) =      0.90
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.361
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    63.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.37
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.37

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     76.10  DOWNSTREAM(FEET) =     72.40
  CHANNEL LENGTH THRU SUBAREA(FEET) =   215.00   CHANNEL SLOPE =  0.0172
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.336
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.76
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.81
  AVERAGE FLOW DEPTH(FEET) =   0.07   TRAVEL TIME(MIN.) =   1.98
  Tc(MIN.) =    5.34
  SUBAREA AREA(ACRES) =     0.19       SUBAREA RUNOFF(CFS) =    0.78
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.916
  TOTAL AREA(ACRES) =        0.3         PEAK FLOW RATE(CFS) =       1.15

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.09   FLOW VELOCITY(FEET/SEC.) =   2.05
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    103.00 =     290.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
```

```
==============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.336
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.9296
  SUBAREA AREA(ACRES) =    0.20   SUBAREA RUNOFF(CFS) =    0.82
  TOTAL AREA(ACRES) =        0.5   TOTAL RUNOFF(CFS) =       1.98
  TC(MIN.) =    5.34

******************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    104.00 IS CODE =  51
------------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     72.40  DOWNSTREAM(FEET) =     71.70
  CHANNEL LENGTH THRU SUBAREA(FEET) =    55.00   CHANNEL SLOPE =  0.0127
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.259
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.18
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.27
  AVERAGE FLOW DEPTH(FEET) =   0.15   TRAVEL TIME(MIN.) =   0.40
  Tc(MIN.) =    5.74
  SUBAREA AREA(ACRES) =     0.10       SUBAREA RUNOFF(CFS) =    0.40
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.933
  TOTAL AREA(ACRES) =        0.6         PEAK FLOW RATE(CFS) =       2.34

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.16   FLOW VELOCITY(FEET/SEC.) =   2.30
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    104.00 =     345.00 FEET.

******************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    104.00 IS CODE =  10
------------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
==============================================================================

******************************************************************************
  FLOW PROCESS FROM NODE    121.00 TO NODE    122.00 IS CODE =  21
------------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    80.00
  UPSTREAM ELEVATION(FEET) =     78.10
  DOWNSTREAM ELEVATION(FEET) =     77.10
  ELEVATION DIFFERENCE(FEET) =      1.00
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    1.982
```

```
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    62.50
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.42
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.42

****************************************************************************
  FLOW PROCESS FROM NODE    122.00 TO NODE    123.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     77.10  DOWNSTREAM(FEET) =     73.30
  CHANNEL LENGTH THRU SUBAREA(FEET) =   260.00   CHANNEL SLOPE =  0.0146
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.50
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.62
  AVERAGE FLOW DEPTH(FEET) =   0.13   TRAVEL TIME(MIN.) =   1.65
  Tc(MIN.) =    3.63
  SUBAREA AREA(ACRES) =     0.52       SUBAREA RUNOFF(CFS) =    2.17
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        0.6         PEAK FLOW RATE(CFS) =       2.59

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.18   FLOW VELOCITY(FEET/SEC.) =   3.04
  LONGEST FLOWPATH FROM NODE    121.00 TO NODE    123.00 =     340.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    123.00 TO NODE    123.00 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.) =    3.63
  RAINFALL INTENSITY(INCH/HR) =   4.40
  TOTAL STREAM AREA(ACRES) =     0.62
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.59

****************************************************************************
  FLOW PROCESS FROM NODE    131.00 TO NODE    132.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
```

```
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    60.00
  UPSTREAM ELEVATION(FEET) =     77.70
  DOWNSTREAM ELEVATION(FEET) =     77.10
  ELEVATION DIFFERENCE(FEET) =      0.60
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.091
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    60.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.50
  TOTAL AREA(ACRES) =      0.12   TOTAL RUNOFF(CFS) =      0.50

****************************************************************************
  FLOW PROCESS FROM NODE    132.00 TO NODE    133.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   77.10  DOWNSTREAM ELEVATION(FEET) =   74.50
  STREET LENGTH(FEET) =   210.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0180
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.88
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.25
    HALFSTREET FLOOD WIDTH(FEET) =    6.38
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.67
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.42
  STREET FLOW TRAVEL TIME(MIN.) =   2.09   Tc(MIN.) =    4.19
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  SUBAREA AREA(ACRES) =    0.18      SUBAREA RUNOFF(CFS) =    0.75
  TOTAL AREA(ACRES) =        0.3        PEAK FLOW RATE(CFS) =       1.25

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.28   HALFSTREET FLOOD WIDTH(FEET) =   7.58
  FLOW VELOCITY(FEET/SEC.) =  1.81   DEPTH*VELOCITY(FT*FT/SEC.) =   0.50
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    133.00 =     270.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    133.00 TO NODE    133.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.9500
  SUBAREA AREA(ACRES) =    0.24   SUBAREA RUNOFF(CFS) =    1.00
  TOTAL AREA(ACRES) =        0.5   TOTAL RUNOFF(CFS) =       2.26
  TC(MIN.) =    4.19

****************************************************************************
  FLOW PROCESS FROM NODE    133.00 TO NODE    123.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     74.50  DOWNSTREAM(FEET) =     73.30
  CHANNEL LENGTH THRU SUBAREA(FEET) =    80.00   CHANNEL SLOPE =  0.0150
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.55
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.67
  AVERAGE FLOW DEPTH(FEET) =   0.19   TRAVEL TIME(MIN.) =   0.50
  Tc(MIN.) =    4.69
  SUBAREA AREA(ACRES) =     0.14       SUBAREA RUNOFF(CFS) =    0.59
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        0.7         PEAK FLOW RATE(CFS) =       2.84

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.20   FLOW VELOCITY(FEET/SEC.) =   2.78
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    123.00 =     350.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    123.00 TO NODE    123.00 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.) =    4.69
  RAINFALL INTENSITY(INCH/HR) =   4.40
  TOTAL STREAM AREA(ACRES) =     0.68
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.84
```

```
  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        2.59     3.63        4.400          0.62
      2        2.84     4.69        4.400          0.68

  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        4.80     3.63       4.400
      2        5.43     4.69       4.400

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       5.43   Tc(MIN.) =    4.69
  TOTAL AREA(ACRES) =        1.3
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    123.00 =     350.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    123.00 TO NODE    104.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     73.30  DOWNSTREAM(FEET) =     71.70
  CHANNEL LENGTH THRU SUBAREA(FEET) =   205.00   CHANNEL SLOPE =  0.0078
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.221
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       6.50
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.72
  AVERAGE FLOW DEPTH(FEET) =   0.36   TRAVEL TIME(MIN.) =   1.26
  Tc(MIN.) =    5.94
  SUBAREA AREA(ACRES) =     0.53       SUBAREA RUNOFF(CFS) =    2.13
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        1.8         PEAK FLOW RATE(CFS) =       7.34

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.38   FLOW VELOCITY(FEET/SEC.) =   2.86
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    104.00 =     555.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    104.00 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        7.34     5.94       4.221        1.83
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    104.00 =     555.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1        2.34     5.74       4.259        0.59
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    104.00 =     345.00 FEET.

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
      1       9.43       5.74        4.259
      2       9.66       5.94        4.221

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       9.66   Tc(MIN.) =    5.94
  TOTAL AREA(ACRES) =        2.4

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    105.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    65.95  DOWNSTREAM(FEET) =    65.59
  FLOW LENGTH(FEET) =   120.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.47
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       9.66
  PIPE TRAVEL TIME(MIN.) =   0.37    Tc(MIN.) =    6.31
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    105.00 =     675.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.151
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (24. DU/AC OR LESS) RUNOFF COEFFICIENT = .6900
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.9367
  SUBAREA AREA(ACRES) =    0.09   SUBAREA RUNOFF(CFS) =    0.26
  TOTAL AREA(ACRES) =        2.5   TOTAL RUNOFF(CFS) =       9.76
  TC(MIN.) =    6.31

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    106.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
```

```
  ELEVATION DATA: UPSTREAM(FEET) =    65.59  DOWNSTREAM(FEET) =    64.50
  FLOW LENGTH(FEET) =   330.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.52
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       9.76
  PIPE TRAVEL TIME(MIN.) =   1.00    Tc(MIN.) =    7.30
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    106.00 =    1005.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    106.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.962
  *USER SPECIFIED(SUBAREA):
  NATURAL DESERT LANDSCAPING RUNOFF COEFFICIENT = .5000
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.8901
  SUBAREA AREA(ACRES) =    0.30   SUBAREA RUNOFF(CFS) =    0.59
  TOTAL AREA(ACRES) =        2.8   TOTAL RUNOFF(CFS) =       9.91
  TC(MIN.) =    7.30

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    106.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    7.30
  RAINFALL INTENSITY(INCH/HR) =   3.96
  TOTAL STREAM AREA(ACRES) =     2.81
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      9.91

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  22
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  USER SPECIFIED Tc(MIN.) =    5.000
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  SUBAREA RUNOFF(CFS) =      6.44
  TOTAL AREA(ACRES) =      1.54   TOTAL RUNOFF(CFS) =      6.44

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    204.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
```

```
  ELEVATION DATA: UPSTREAM(FEET) =    69.50  DOWNSTREAM(FEET) =    64.50
  FLOW LENGTH(FEET) =   100.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.64
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.44
  PIPE TRAVEL TIME(MIN.) =   0.46    Tc(MIN.) =    5.46
  LONGEST FLOWPATH FROM NODE    201.00 TO NODE    204.00 =     130.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    204.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    5.46
  RAINFALL INTENSITY(INCH/HR) =   4.31
  TOTAL STREAM AREA(ACRES) =     1.54
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      6.44

****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    302.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    80.00
  UPSTREAM ELEVATION(FEET) =     78.40
  DOWNSTREAM ELEVATION(FEET) =     76.80
  ELEVATION DIFFERENCE(FEET) =      1.60
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    1.793
  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) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.75
  TOTAL AREA(ACRES) =      0.18   TOTAL RUNOFF(CFS) =      0.75

****************************************************************************
  FLOW PROCESS FROM NODE    302.00 TO NODE    303.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     76.80  DOWNSTREAM(FEET) =     74.90
  CHANNEL LENGTH THRU SUBAREA(FEET) =   200.00   CHANNEL SLOPE =  0.0095
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
```

```
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.65
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.02
  AVERAGE FLOW DEPTH(FEET) =   0.17   TRAVEL TIME(MIN.) =   1.65
  Tc(MIN.) =    3.44
  SUBAREA AREA(ACRES) =     0.43       SUBAREA RUNOFF(CFS) =    1.80
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        0.6         PEAK FLOW RATE(CFS) =       2.55

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.22   FLOW VELOCITY(FEET/SEC.) =   2.28
  LONGEST FLOWPATH FROM NODE    301.00 TO NODE    303.00 =     280.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    303.00 TO NODE    304.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     74.90  DOWNSTREAM(FEET) =     73.40
  CHANNEL LENGTH THRU SUBAREA(FEET) =   190.00   CHANNEL SLOPE =  0.0079
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.49
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.34
  AVERAGE FLOW DEPTH(FEET) =   0.26   TRAVEL TIME(MIN.) =   1.35
  Tc(MIN.) =    4.79
  SUBAREA AREA(ACRES) =     0.45       SUBAREA RUNOFF(CFS) =    1.88
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        1.1         PEAK FLOW RATE(CFS) =       4.43

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.30   FLOW VELOCITY(FEET/SEC.) =   2.46
  LONGEST FLOWPATH FROM NODE    301.00 TO NODE    304.00 =     470.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    304.00 TO NODE    304.50 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     73.40  DOWNSTREAM(FEET) =     72.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   130.00   CHANNEL SLOPE =  0.0108
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.314
  *USER SPECIFIED(SUBAREA):
```

```
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.82
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.27
  AVERAGE FLOW DEPTH(FEET) =   0.26   TRAVEL TIME(MIN.) =   0.66
  Tc(MIN.) =    5.45
  SUBAREA AREA(ACRES) =     0.19       SUBAREA RUNOFF(CFS) =    0.78
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  TOTAL AREA(ACRES) =        1.2         PEAK FLOW RATE(CFS) =       5.12

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.27   FLOW VELOCITY(FEET/SEC.) =   3.33
  LONGEST FLOWPATH FROM NODE    301.00 TO NODE    304.50 =     600.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    304.50 TO NODE    305.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     72.00  DOWNSTREAM(FEET) =     71.40
  CHANNEL LENGTH THRU SUBAREA(FEET) =    30.00   CHANNEL SLOPE =  0.0200
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.018   MAXIMUM DEPTH(FEET) =   2.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.293
  *USER SPECIFIED(SUBAREA):
  NATURAL DESERT LANDSCAPING RUNOFF COEFFICIENT = .5000
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.23
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.69
  AVERAGE FLOW DEPTH(FEET) =   0.31   TRAVEL TIME(MIN.) =   0.11
  Tc(MIN.) =    5.56
  SUBAREA AREA(ACRES) =     0.10       SUBAREA RUNOFF(CFS) =    0.21
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.917
  TOTAL AREA(ACRES) =        1.4         PEAK FLOW RATE(CFS) =       5.31

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.31   FLOW VELOCITY(FEET/SEC.) =   4.74
  LONGEST FLOWPATH FROM NODE    301.00 TO NODE    305.00 =     630.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    305.00 TO NODE    305.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
  TIME OF CONCENTRATION(MIN.) =    5.56
  RAINFALL INTENSITY(INCH/HR) =   4.29
  TOTAL STREAM AREA(ACRES) =     1.35
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      5.31

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
```

```
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        9.91     7.30        3.962          2.81
      2        6.44     5.46        4.313          1.54
      3        5.31     5.56        4.293          1.35

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  3 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       19.06     5.46       4.313
      2       19.27     5.56       4.293
      3       20.73     7.30       3.962

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      20.73   Tc(MIN.) =    7.30
  TOTAL AREA(ACRES) =        5.7
  LONGEST FLOWPATH FROM NODE    131.00 TO NODE    305.00 =    1005.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        5.7  TC(MIN.) =      7.30
  PEAK FLOW RATE(CFS)   =      20.73
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

🡅

Mission Gorge Road Existing Inlet, 50-Year Storm Event

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****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2014 Advanced Engineering Software (aes)
             Ver. 21.0 Release Date: 06/01/2014  License ID 1261

                           Analysis prepared by:

                          RICK ENGINEERING COMPANY
                              5620 Friars Road
                        San Diego, California 92110
                      619-291-0707   Fax 619-291-4165

 ************************** DESCRIPTION OF STUDY **************************
* PACIFIC WEST COMMUNITIES REDEVELOPMENT PROJECT                           *
* PRE-PROJECT 50-YEAR ANALYSIS, MISSION GORGE ROAD                         *
* RICK ENGINEERING COMPANY JOB NUMBER 19048                                *
 ***************************************************************************

  FILE NAME: MISGOR50.DAT
  TIME/DATE OF STUDY: 12:01 03/17/2020
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =  50.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.01
  RAINFALL-INTENSITY ADJUSTMENT FACTOR = 1.000
  *USER SPECIFIED:
  NUMBER OF [TIME,INTENSITY] DATA PAIRS =  9
   1)   5.000;  4.200
   2)  10.000;  3.200
   3)  15.000;  2.700
   4)  20.000;  2.300
   5)  25.000;  2.050
   6)  30.000;  1.850
   7)  40.000;  1.600
   8)  50.000;  1.400
   9)  60.000;  1.250
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: ONLY PEAK CONFLUENCE VALUES CONSIDERED
  *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   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0180

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.50 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  5.0 (FT*FT/S)
```

```
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    401.00 TO NODE    402.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  95
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    80.00
  UPSTREAM ELEVATION(FEET) =     80.20
  DOWNSTREAM ELEVATION(FEET) =     79.80
  ELEVATION DIFFERENCE(FEET) =      0.40
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.405
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.40
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.40

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    403.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   79.80  DOWNSTREAM ELEVATION(FEET) =   77.70
  STREET LENGTH(FEET) =   225.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0180
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.15
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.33
    HALFSTREET FLOOD WIDTH(FEET) =   10.27
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.84
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.61
  STREET FLOW TRAVEL TIME(MIN.) =   2.04   Tc(MIN.) =    4.45
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.200
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
```

```
  S.C.S. CURVE NUMBER (AMC II) =  95
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  SUBAREA AREA(ACRES) =    0.88      SUBAREA RUNOFF(CFS) =    3.51
  TOTAL AREA(ACRES) =        1.0        PEAK FLOW RATE(CFS) =       3.91

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.39   HALFSTREET FLOOD WIDTH(FEET) =  13.16
  FLOW VELOCITY(FEET/SEC.) =  2.11   DEPTH*VELOCITY(FT*FT/SEC.) =   0.82
  LONGEST FLOWPATH FROM NODE    401.00 TO NODE    403.00 =     305.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    403.00 TO NODE    404.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   77.70  DOWNSTREAM ELEVATION(FEET) =   75.60
  STREET LENGTH(FEET) =   350.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0180
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       6.99
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.49
    HALFSTREET FLOOD WIDTH(FEET) =   18.09
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.06
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.01
  STREET FLOW TRAVEL TIME(MIN.) =   2.83   Tc(MIN.) =    7.28
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.745
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  95
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  SUBAREA AREA(ACRES) =    1.73      SUBAREA RUNOFF(CFS) =    6.15
  TOTAL AREA(ACRES) =        2.7        PEAK FLOW RATE(CFS) =       9.64

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.53   HALFSTREET FLOOD WIDTH(FEET) =  21.31
  FLOW VELOCITY(FEET/SEC.) =  2.18   DEPTH*VELOCITY(FT*FT/SEC.) =   1.15
  LONGEST FLOWPATH FROM NODE    401.00 TO NODE    404.00 =     655.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    404.00 TO NODE    405.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
```

```
  UPSTREAM ELEVATION(FEET) =   75.60  DOWNSTREAM ELEVATION(FEET) =   74.30
  STREET LENGTH(FEET) =   400.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0180
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      10.90
    ***STREET FLOW SPLITS OVER STREET-CROWN***
    FULL DEPTH(FEET) =    0.53   FLOOD WIDTH(FEET) =   21.31
    FULL HALF-STREET VELOCITY(FEET/SEC.) =    1.61
    SPLIT DEPTH(FEET) =    0.46   SPLIT FLOOD WIDTH(FEET) =   16.84
    SPLIT FLOW(CFS) =    4.26   SPLIT VELOCITY(FEET/SEC.) =    1.44
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.53
    HALFSTREET FLOOD WIDTH(FEET) =   21.31
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.61
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.85
  STREET FLOW TRAVEL TIME(MIN.) =   4.15   Tc(MIN.) =   11.43
    50 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.057
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  95
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  SUBAREA AREA(ACRES) =    0.87      SUBAREA RUNOFF(CFS) =    2.53
  TOTAL AREA(ACRES) =        3.6        PEAK FLOW RATE(CFS) =      10.40

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.53   HALFSTREET FLOOD WIDTH(FEET) =  21.31
  FLOW VELOCITY(FEET/SEC.) =  1.61   DEPTH*VELOCITY(FT*FT/SEC.) =   0.85
  LONGEST FLOWPATH FROM NODE    401.00 TO NODE    405.00 =    1055.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        3.6  TC(MIN.) =     11.43
  PEAK FLOW RATE(CFS)   =      10.40
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
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🡅

Mission Gorge Road Existing Inlet, 100-Year Storm Event

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            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2014 Advanced Engineering Software (aes)
             Ver. 21.0 Release Date: 06/01/2014  License ID 1261

                           Analysis prepared by:

                          RICK ENGINEERING COMPANY
                              5620 Friars Road
                        San Diego, California 92110
                      619-291-0707   Fax 619-291-4165

 ************************** DESCRIPTION OF STUDY **************************
* PACIFIC WEST COMMUNITIES REDEVELOPMENT PROJECT                           *
* PRE-PROJECT 100-YEAR ANALYSIS, MISSION GORGE ROAD                        *
* RICK ENGINEERING COMPANY JOB NUMBER 19048                                *
 ***************************************************************************

  FILE NAME: MSGOR100.DAT
  TIME/DATE OF STUDY: 16:16 01/18/2021
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.01
  RAINFALL-INTENSITY ADJUSTMENT FACTOR = 1.000
  *USER SPECIFIED:
  NUMBER OF [TIME,INTENSITY] DATA PAIRS =  9
   1)   5.000;  4.400
   2)  10.000;  3.450
   3)  15.000;  2.900
   4)  20.000;  2.500
   5)  25.000;  2.220
   6)  30.000;  2.000
   7)  40.000;  1.700
   8)  50.000;  1.500
   9)  60.000;  1.320
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: ONLY PEAK CONFLUENCE VALUES CONSIDERED
  *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   20.0     10.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0180

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.50 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  5.0 (FT*FT/S)
```

```
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    401.00 TO NODE    402.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    80.00
  UPSTREAM ELEVATION(FEET) =     80.20
  DOWNSTREAM ELEVATION(FEET) =     79.80
  ELEVATION DIFFERENCE(FEET) =      0.40
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.405
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.42
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.42

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    403.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   79.80  DOWNSTREAM ELEVATION(FEET) =   77.70
  STREET LENGTH(FEET) =   225.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0180
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.26
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.34
    HALFSTREET FLOOD WIDTH(FEET) =   10.51
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.85
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.62
  STREET FLOW TRAVEL TIME(MIN.) =   2.03   Tc(MIN.) =    4.44
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
```

```
  S.C.S. CURVE NUMBER (AMC II) =  88
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  SUBAREA AREA(ACRES) =    0.88      SUBAREA RUNOFF(CFS) =    3.68
  TOTAL AREA(ACRES) =        1.0        PEAK FLOW RATE(CFS) =       4.10

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.39   HALFSTREET FLOOD WIDTH(FEET) =  13.40
  FLOW VELOCITY(FEET/SEC.) =  2.14   DEPTH*VELOCITY(FT*FT/SEC.) =   0.84
  LONGEST FLOWPATH FROM NODE    401.00 TO NODE    403.00 =     305.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    403.00 TO NODE    404.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   77.70  DOWNSTREAM ELEVATION(FEET) =   75.60
  STREET LENGTH(FEET) =   350.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0180
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       7.37
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.50
    HALFSTREET FLOOD WIDTH(FEET) =   18.48
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.09
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.03
  STREET FLOW TRAVEL TIME(MIN.) =   2.80   Tc(MIN.) =    7.23
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.976
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  SUBAREA AREA(ACRES) =    1.73      SUBAREA RUNOFF(CFS) =    6.53
  TOTAL AREA(ACRES) =        2.7        PEAK FLOW RATE(CFS) =      10.24

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.53   HALFSTREET FLOOD WIDTH(FEET) =  21.31
  FLOW VELOCITY(FEET/SEC.) =  2.18   DEPTH*VELOCITY(FT*FT/SEC.) =   1.15
  LONGEST FLOWPATH FROM NODE    401.00 TO NODE    404.00 =     655.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    404.00 TO NODE    405.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
```

```
  UPSTREAM ELEVATION(FEET) =   75.60  DOWNSTREAM ELEVATION(FEET) =   74.30
  STREET LENGTH(FEET) =   400.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0180
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      11.60
    ***STREET FLOW SPLITS OVER STREET-CROWN***
    FULL DEPTH(FEET) =    0.53   FLOOD WIDTH(FEET) =   21.31
    FULL HALF-STREET VELOCITY(FEET/SEC.) =    1.61
    SPLIT DEPTH(FEET) =    0.48   SPLIT FLOOD WIDTH(FEET) =   17.85
    SPLIT FLOW(CFS) =    4.96   SPLIT VELOCITY(FEET/SEC.) =    1.50
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.53
    HALFSTREET FLOOD WIDTH(FEET) =   21.31
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.61
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.85
  STREET FLOW TRAVEL TIME(MIN.) =   4.15   Tc(MIN.) =   11.38
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.298
  *USER SPECIFIED(SUBAREA):
  GENERAL INDUSTRIAL RUNOFF COEFFICIENT = .9500
  S.C.S. CURVE NUMBER (AMC II) =  88
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.950
  SUBAREA AREA(ACRES) =    0.87      SUBAREA RUNOFF(CFS) =    2.73
  TOTAL AREA(ACRES) =        3.6        PEAK FLOW RATE(CFS) =      11.22

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.53   HALFSTREET FLOOD WIDTH(FEET) =  21.31
  FLOW VELOCITY(FEET/SEC.) =  1.61   DEPTH*VELOCITY(FT*FT/SEC.) =   0.85
  LONGEST FLOWPATH FROM NODE    401.00 TO NODE    405.00 =    1055.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        3.6  TC(MIN.) =     11.38
  PEAK FLOW RATE(CFS)   =      11.22
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

🡅

APPENDIX B

On-Grade Inlet Intercept Calculations

Street Flow Depth and Inlet Calculations Calculations (50- and 100-Year Event)

Manning Formula Used

Q=1.486/n*A*R^(2/3)*s^(1/2)
(Chow, 1959)

	C&G Width (ft)	C&G Slope (12 For 8.3%)	C&G Mannings n Value	Asphalt Width (ft)	Asphalt Lip at C&G (ft)	Asphalt Slope (50 for 2%)	Asphalt Mannings n Value	Road & Gutter Slope (s=vert./hor.)
INPUT:	1.5	12	0.015	14.5	0.03125	10	0.018	0.003

DEPTH (IN)	**DEPTH** (FT)	**C&G Area** (FT^2)	**C&G P** (FT)	**Asphalt Area** (FT^2)	**Asphalt P** (FT)	**R=A/P R** (FT)	**Q** (CFS)	**V** (FS)
9	0.750	1.031	2.286	1.763	5.967	0.0000	6.83	2.44
9.1	0.758	1.044	2.295	1.813	6.051	0.3422	7.02	2.46
9.2	0.767	1.056	2.303	1.863	6.135	0.3460	7.21	2.47
9.3	0.775	1.069	2.311	1.914	6.218	0.3497	7.41	2.49
9.4	0.783	1.081	2.320	1.966	6.302	0.3535	7.62	2.50
9.5	0.792	1.094	2.328	2.019	6.386	0.3572	7.82	2.51
9.6	0.800	1.106	2.336	2.072	6.470	0.3609	8.03	2.53
9.7	0.808	1.119	2.345	2.126	6.553	0.3647	8.25	2.54
9.8	0.817	1.131	2.353	2.181	6.637	0.3684	8.46	2.55
9.9	0.825	1.144	2.361	2.236	6.721	0.3721	8.68	2.57
10	0.833	1.156	2.370	2.292	6.805	0.3759	8.91	2.58
10.1	0.842	1.169	2.378	2.349	6.888	0.3796	9.13	2.60
10.2	0.850	1.181	2.386	2.406	6.972	0.3834	9.36	2.61
10.3	0.858	1.194	2.395	2.465	7.056	0.3871	9.60	2.62
10.4	0.867	1.206	2.403	2.523	7.140	0.3908	9.84	2.64
10.5	0.875	1.219	2.411	2.583	7.223	0.3946	10.08	2.65
10.6	0.883	1.231	2.420	2.643	7.307	0.3983	10.33	2.66
10.7	0.892	1.244	2.428	2.704	7.391	0.4021	10.57	2.68
10.8	0.900	1.256	2.436	2.766	7.475	0.4058	10.83	2.69
10.9	0.908	1.269	2.445	2.828	7.558	0.4096	11.09	2.71
11	0.917	1.281	2.453	2.891	7.642	0.4133	11.35	2.72
11.1	0.925	1.294	2.461	2.955	7.726	0.4171	11.61	2.73
11.2	0.933	1.306	2.470	3.019	7.810	0.4208	11.88	2.75
11.3	0.942	1.319	2.478	3.084	7.893	0.4245	12.15	2.76
11.4	0.950	1.331	2.486	3.150	7.977	0.4283	12.43	2.77
11.5	0.958	1.344	2.495	3.217	8.061	0.4320	12.71	2.79
11.6	0.967	1.356	2.503	3.284	8.145	0.4358	12.99	2.80
11.7	0.975	1.369	2.511	3.352	8.228	0.4395	13.28	2.81

Inlet Calculations for Mission Gorge Existing Inlet - Node 403 (50- and 100-Year Frequency Storm Event)

Location (Node)	**Drainage (Acres)**	**Runoff "C"**	**Tc**	**I (in/hr)**	**Q (cfs)**	**depth y (feet)**	**a (feet)**	**L_T (feet)**	**$Q_{CAPACITY}$ (cfs)**	**Q Bypass (cfs)**	**Efficiency**
50-Year Storm Event	3.60	0.95	12.9	3.06	10.40	0.883	0.17	3.0	2.26	8.14	21.7%
100-Year Storm Event	3.60	0.95	11.4	3.30	11.20	0.908	0.17	3.0	2.34	8.86	20.9%

APPENDIX C

Detention Analysis

Alvarado Creek Apartment Project Hydrograph Calculations

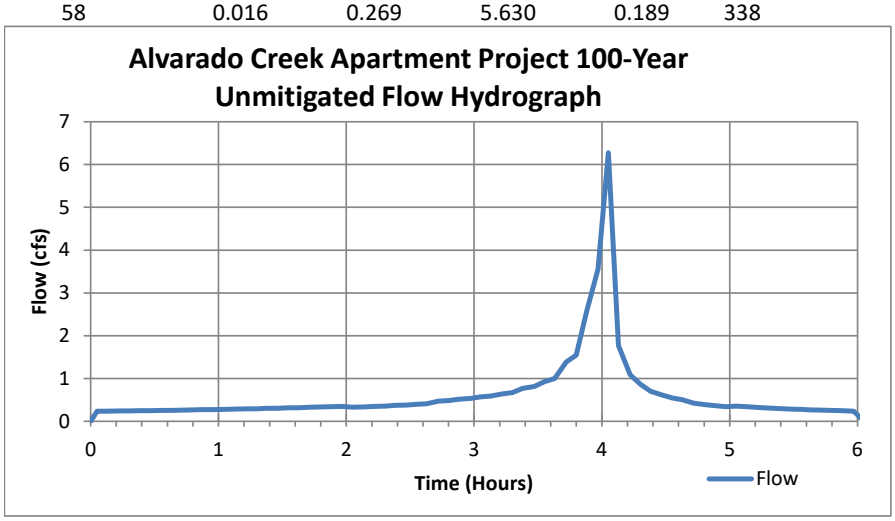
Tc =	**5**	**min**	Ref. 1:	City of San Diego Drainage Design Manual (Jan. 2017)
C =	**0.95**		Ref. 2:	Chapter 6, San Diego County Hydrology Manual (June 2003)
Area =	**1.5**	**ac**		
Qp =	**6.3**	**cfs**		

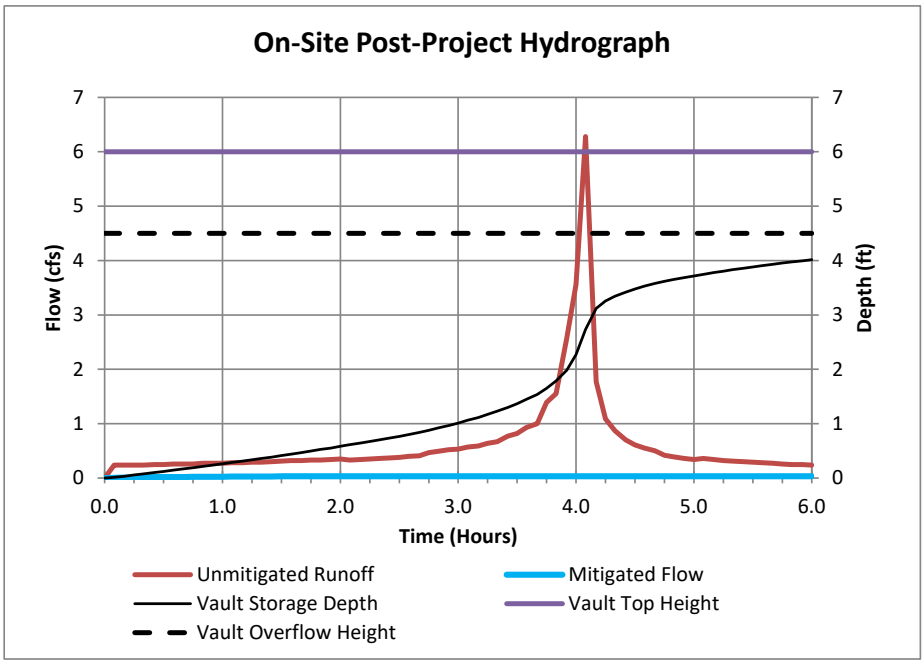
N	PN (inches)	QN (cfs)	Time (hrs)	I (in/hr)	Time (min)
-	0.000	0.0	0	0	0
72	0.014	0.2	0.050	0.165	3.0
71	0.014	0.2	0.130	0.166	8.0
69	0.014	0.2	0.220	0.169	13.0
68	0.014	0.2	0.300	0.171	18.0
66	0.015	0.2	0.380	0.174	23.0
65	0.015	0.3	0.470	0.176	28.0
63	0.015	0.3	0.550	0.179	33.0
62	0.015	0.3	0.630	0.181	38.0
60	0.015	0.3	0.720	0.185	43.0
59	0.016	0.3	0.800	0.187	48.0
57	0.016	0.3	0.880	0.191	53.0
56	0.016	0.3	0.970	0.193	58.0
54	0.016	0.3	1.050	0.197	63.0
53	0.017	0.3	1.130	0.200	68.0
51	0.017	0.3	1.220	0.204	73.0
50	0.017	0.3	1.300	0.207	78.0
48	0.018	0.3	1.380	0.212	83.0
47	0.018	0.3	1.470	0.215	88.0
45	0.018	0.3	1.550	0.221	93.0
44	0.019	0.320	1.630	0.224	98.0
42	0.019	0.329	1.720	0.231	103.0
41	0.020	0.334	1.800	0.234	108.0
39	0.020	0.345	1.880	0.242	113.0
38	0.020	0.350	1.970	0.246	118.0
36	0.019	0.330	2.050	0.231	123.0
35	0.020	0.336	2.130	0.236	128.0
33	0.020	0.349	2.220	0.245	133.0
32	0.021	0.356	2.300	0.250	138.0
30	0.022	0.372	2.380	0.261	143.0
29	0.022	0.380	2.470	0.267	148.0
27	0.023	0.399	2.550	0.280	153.0
26	0.024	0.409	2.630	0.287	158.0
24	0.028	0.474	2.720	0.333	163.0
23	0.028	0.487	2.800	0.342	168.0
21	0.030	0.516	2.880	0.362	173.0
20	0.031	0.532	2.970	0.373	178.0
18	0.033	0.569	3.050	0.399	183.0
17	0.035	0.590	3.130	0.414	188.0
15	0.037	0.639	3.220	0.449	193.0
14	0.039	0.668	3.300	0.469	198.0
12	0.045	0.773	3.380	0.543	203.0
11	0.048	0.816	3.470	0.573	208.0
9	0.054	0.927	3.550	0.650	213.0
8	0.058	0.999	3.630	0.701	218
6	0.081	1.387	3.720	0.973	223
5	0.090	1.545	3.800	1.084	228

Alvarado Creek Apartment Project Hydrograph Calculations

Tc =	**5**	**min**	Ref. 1:	City of San Diego Drainage Design Manual (Jan. 2017)
C =	**0.95**		Ref. 2:	Chapter 6, San Diego County Hydrology Manual (June 2003)
Area =	**1.5**	**ac**		
Qp =	**6.3**	**cfs**		

N	PN (inches)	QN (cfs)	Time (hrs)	I (in/hr)	Time (min)
3	0.150	2.565	3.880	1.800	233
2	0.208	3.557	3.970	2.496	238
1	0.367	6.276	4.050	4.404	243
4	0.104	1.770	4.130	1.242	248
7	0.064	1.089	4.220	0.764	253
10	0.051	0.867	4.300	0.608	258
13	0.041	0.701	4.380	0.492	263
16	0.036	0.613	4.470	0.430	268
19	0.032	0.550	4.550	0.386	273
22	0.029	0.501	4.630	0.352	278
25	0.025	0.420	4.720	0.295	283
28	0.023	0.389	4.800	0.273	288
31	0.021	0.364	4.880	0.255	293
34	0.020	0.342	4.970	0.240	298
37	0.021	0.356	5.050	0.250	303
40	0.020	0.339	5.130	0.238	308
43	0.019	0.324	5.220	0.227	313
46	0.018	0.311	5.300	0.218	318
49	0.017	0.299	5.380	0.210	323
52	0.017	0.288	5.470	0.202	328
55	0.016	0.278	5.550	0.195	333
58	0.016	0.269	5.630	0.189	338

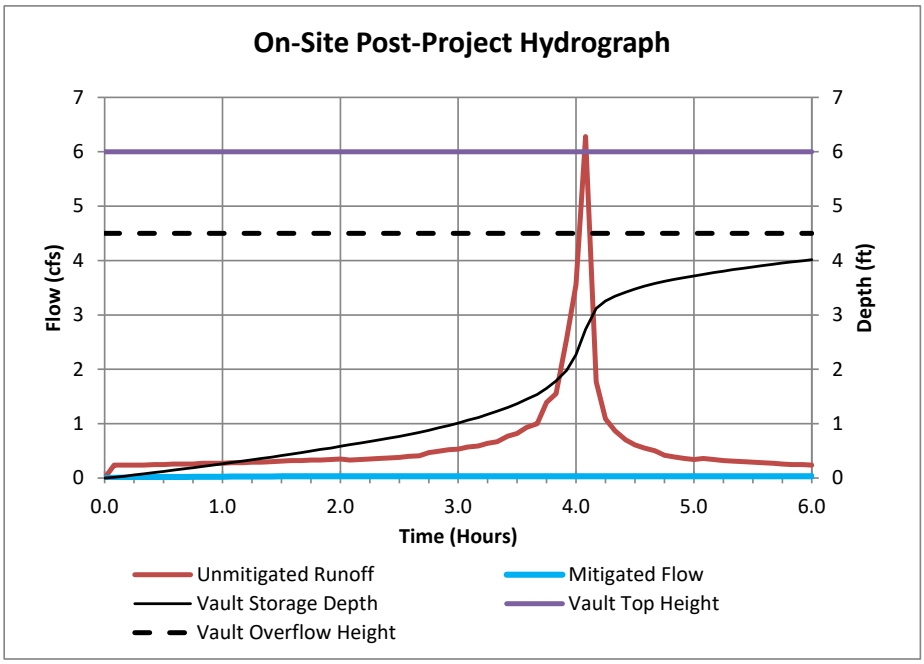




Post-Project Results

Peaks	**6.3**	**0.033**	**4.0**
Units	**cfs**	**cfs**	**ft**

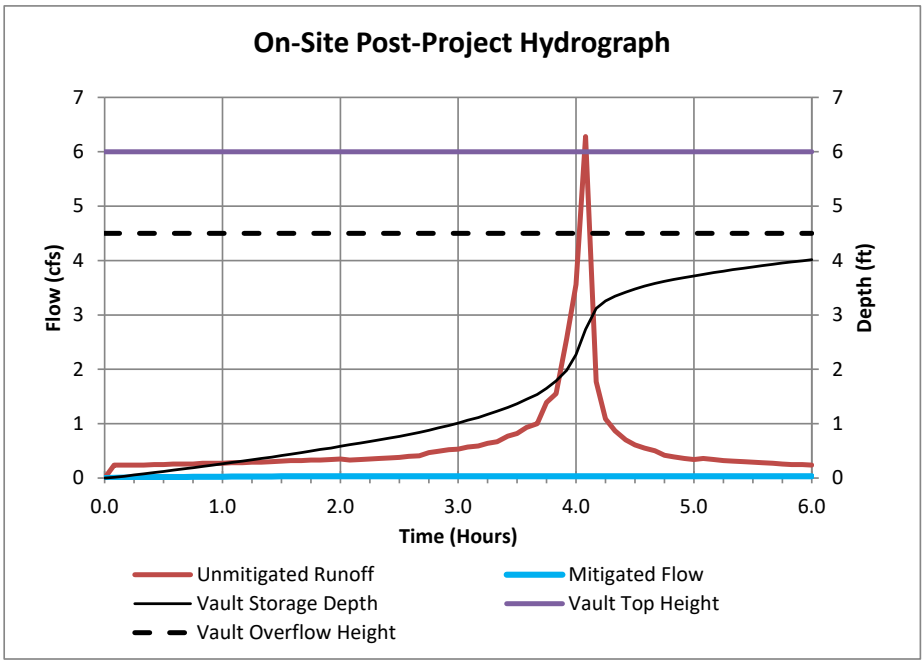
Time (hrs)	**$Q_{unmit.}$ (cfs)**	**From SWMM $Q_{mit.}$ (cfs)**	**From SWMM Vault Depth (ft)**
0.00	**0.00**	**0.00**	**0.00**
0.08	**0.24**	**0.01**	0.0
0.17	**0.24**	**0.01**	0.0
0.25	**0.24**	**0.01**	0.1
0.33	**0.24**	**0.01**	0.1
0.42	**0.25**	**0.02**	0.1
0.50	**0.25**	**0.02**	0.1
0.58	**0.26**	**0.02**	0.1
0.67	**0.26**	**0.02**	0.2
0.75	**0.26**	**0.02**	0.2
0.83	**0.27**	**0.02**	0.2
0.92	**0.27**	**0.02**	0.2
1.00	**0.27**	**0.03**	0.3
1.08	**0.28**	**0.03**	0.3
1.17	**0.28**	**0.03**	0.3
1.25	**0.29**	**0.03**	0.3
1.33	**0.29**	**0.03**	0.4
1.42	**0.30**	**0.03**	0.4
1.50	**0.31**	**0.03**	0.4
1.58	**0.32**	**0.03**	0.4
1.67	**0.32**	**0.03**	0.5
1.75	**0.33**	**0.03**	0.5
1.83	**0.33**	**0.03**	0.5
1.92	**0.34**	**0.03**	0.6
2.00	**0.35**	**0.03**	0.6
2.08	**0.33**	**0.03**	0.6



Post-Project Results

Peaks	**6.3**	**0.033**	**4.0**
Units	**cfs**	**cfs**	**ft**

Time (hrs)	**$Q_{unmit.}$ (cfs)**	**From SWMM $Q_{mit.}$ (cfs)**	**From SWMM Vault Depth (ft)**
2.17	**0.34**	**0.03**	0.6
2.25	**0.35**	**0.03**	0.7
2.33	**0.36**	**0.03**	0.7
2.42	**0.37**	**0.03**	0.7
2.50	**0.38**	**0.03**	0.8
2.58	**0.40**	**0.03**	0.8
2.67	**0.41**	**0.03**	0.8
2.75	**0.47**	**0.03**	0.9
2.83	**0.49**	**0.03**	0.9
2.92	**0.52**	**0.03**	1.0
3.00	**0.53**	**0.03**	1.0
3.08	**0.57**	**0.03**	1.1
3.17	**0.59**	**0.03**	1.1
3.25	**0.64**	**0.03**	1.2
3.33	**0.67**	**0.03**	1.2
3.42	**0.77**	**0.03**	1.3
3.50	**0.82**	**0.03**	1.4
3.58	**0.93**	**0.03**	1.4
3.67	**1.00**	**0.03**	1.5
3.75	**1.39**	**0.03**	1.6
3.83	**1.55**	**0.03**	1.8
3.92	**2.57**	**0.03**	2.0
4.00	**3.56**	**0.03**	2.3
4.08	**6.28**	**0.03**	2.7
4.17	**1.77**	**0.03**	3.1
4.25	**1.09**	**0.03**	3.3



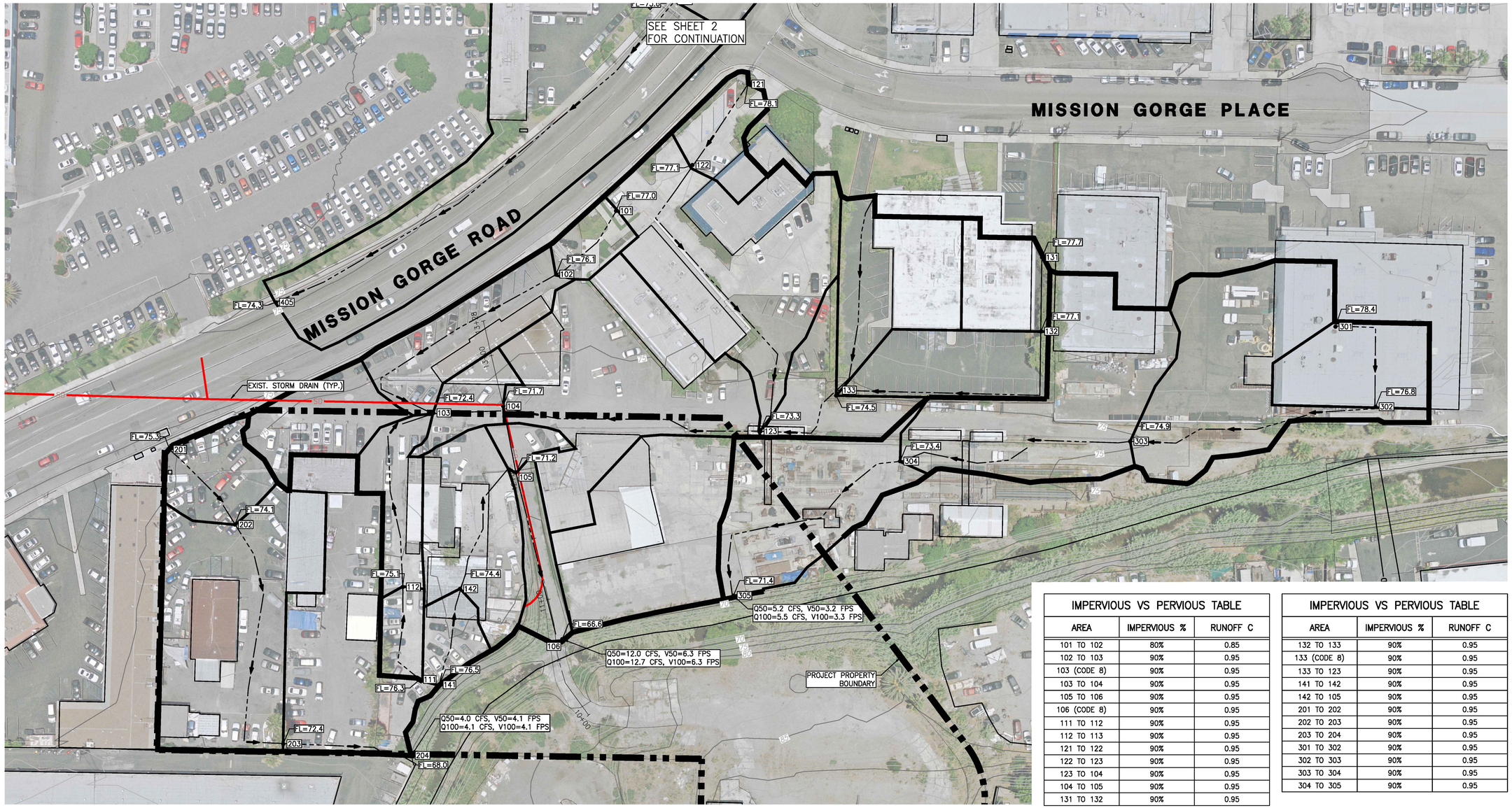
Post-Project Results

Peaks	**6.3**	**0.033**	**4.0**
Units	**cfs**	**cfs**	**ft**

Time (hrs)	**$Q_{unmit.}$ (cfs)**	**From SWMM $Q_{mit.}$ (cfs)**	**From SWMM Vault Depth (ft)**
4.33	**0.87**	**0.03**	3.3
4.42	**0.70**	**0.03**	3.4
4.50	**0.61**	**0.03**	3.5
4.58	**0.55**	**0.03**	3.5
4.67	**0.50**	**0.03**	3.6
4.75	**0.42**	**0.03**	3.6
4.83	**0.39**	**0.03**	3.7
4.92	**0.36**	**0.03**	3.7
5.00	**0.34**	**0.03**	3.7
5.08	**0.36**	**0.03**	3.7
5.17	**0.34**	**0.03**	3.8
5.25	**0.32**	**0.03**	3.8
5.33	**0.31**	**0.03**	3.8
5.42	**0.30**	**0.03**	3.9
5.50	**0.29**	**0.03**	3.9
5.58	**0.28**	**0.03**	3.9
5.67	**0.27**	**0.03**	3.9
5.75	**0.26**	**0.03**	4.0
5.83	**0.25**	**0.03**	4.0
5.92	**0.25**	**0.03**	4.0
6.00	**0.24**	**0.03**	4.0

Map Pocket 1

Drainage Study Map, Pre-Project Condition



IMPERVIOUS VS PERVIOUS TABLE		
AREA	IMPERVIOUS %	RUNOFF C
101 TO 102	80%	0.85
102 TO 103	90%	0.95
103 (CODE 8)	90%	0.95
103 TO 104	90%	0.95
105 TO 106	90%	0.95
106 (CODE 8)	90%	0.95
111 TO 112	90%	0.95
112 TO 113	90%	0.95
121 TO 122	90%	0.95
122 TO 123	90%	0.95
123 TO 104	90%	0.95
104 TO 105	90%	0.95
131 TO 132	90%	0.95

IMPERVIOUS VS PERVIOUS TABLE		
AREA	IMPERVIOUS %	RUNOFF C
132 TO 133	90%	0.95
133 (CODE 8)	90%	0.95
133 TO 123	90%	0.95
141 TO 142	90%	0.95
142 TO 105	90%	0.95
201 TO 202	90%	0.95
202 TO 203	90%	0.95
203 TO 204	90%	0.95
301 TO 302	90%	0.95
302 TO 303	90%	0.95
303 TO 304	90%	0.95
304 TO 305	90%	0.95

LEGEND

- DRAINAGE BOUNDARY (MAJOR)
- DRAINAGE BOUNDARY (MINOR)
- FLOW PATH
- EXISTING STORM DRAIN
- 101 DRAINAGE NODE
- 0.25 AC DRAINAGE AREA
- 75 EXIST. MAJOR ELEV. CONTOUR
- 74 EXIST. MINOR ELEV. CONTOUR

N

40 20 0 40 80 120

GRAPHIC SCALE: 1"=40'

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(FAX)619.291.4165

DRAINAGE MAP, PRE-PROJECT
ALVARADO CREEK APARTMENT PROEJCT
SAN DIEGO, CA

DATE: MAY 2021

J-19048

SHEET 1 OF 2

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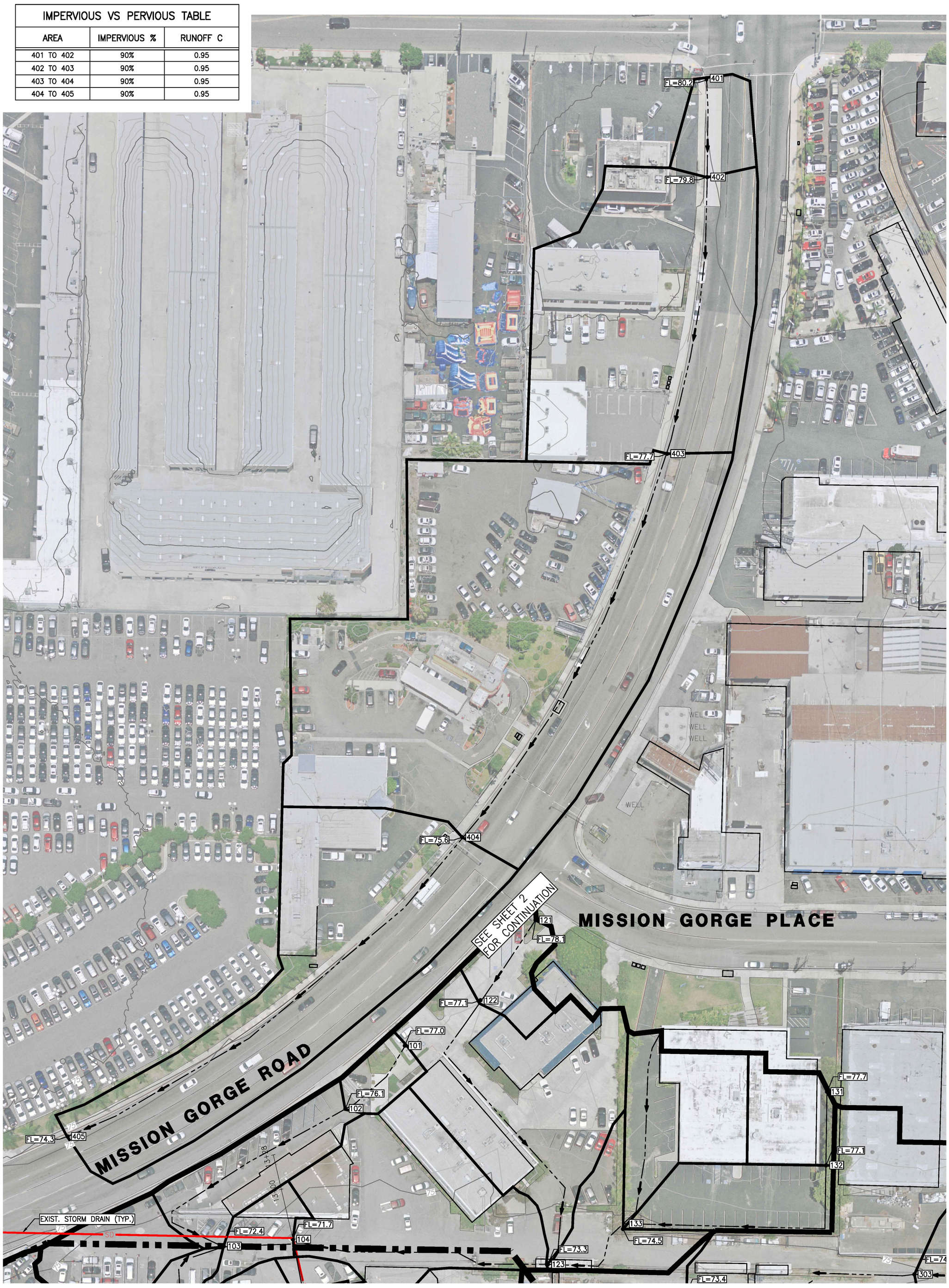
NOT FOR CONSTRUCTION – EXHIBIT FOR DRAINAGE STUDY ONLY

IMPERVIOUS VS PERVIOUS TABLE		
AREA	IMPERVIOUS %	RUNOFF C
401 TO 402	90%	0.95
402 TO 403	90%	0.95
403 TO 404	90%	0.95
404 TO 405	90%	0.95



LEGEND

- DRAINAGE BOUNDARY (MAJOR)
- DRAINAGE BOUNDARY (MINOR)
- FLOW PATH
- EXISTING STORM DRAIN
- 101 DRAINAGE NODE
- 0.25 AC DRAINAGE AREA
- 75 EXIST. MAJOR ELEV. CONTOUR
- 74 EXIST. MINOR ELEV. CONTOUR

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SAN DIEGO, CA 92110
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N

40 20 0 40 80 120

GRAPHIC SCALE: 1"=40'

DRAINAGE MAP, PRE-PROJECT
ALVARADO CREEK APARTMENT PROEJCT
SAN DIEGO, CA

DATE: MAY 2021

J-19048

SHEET 2 OF 2

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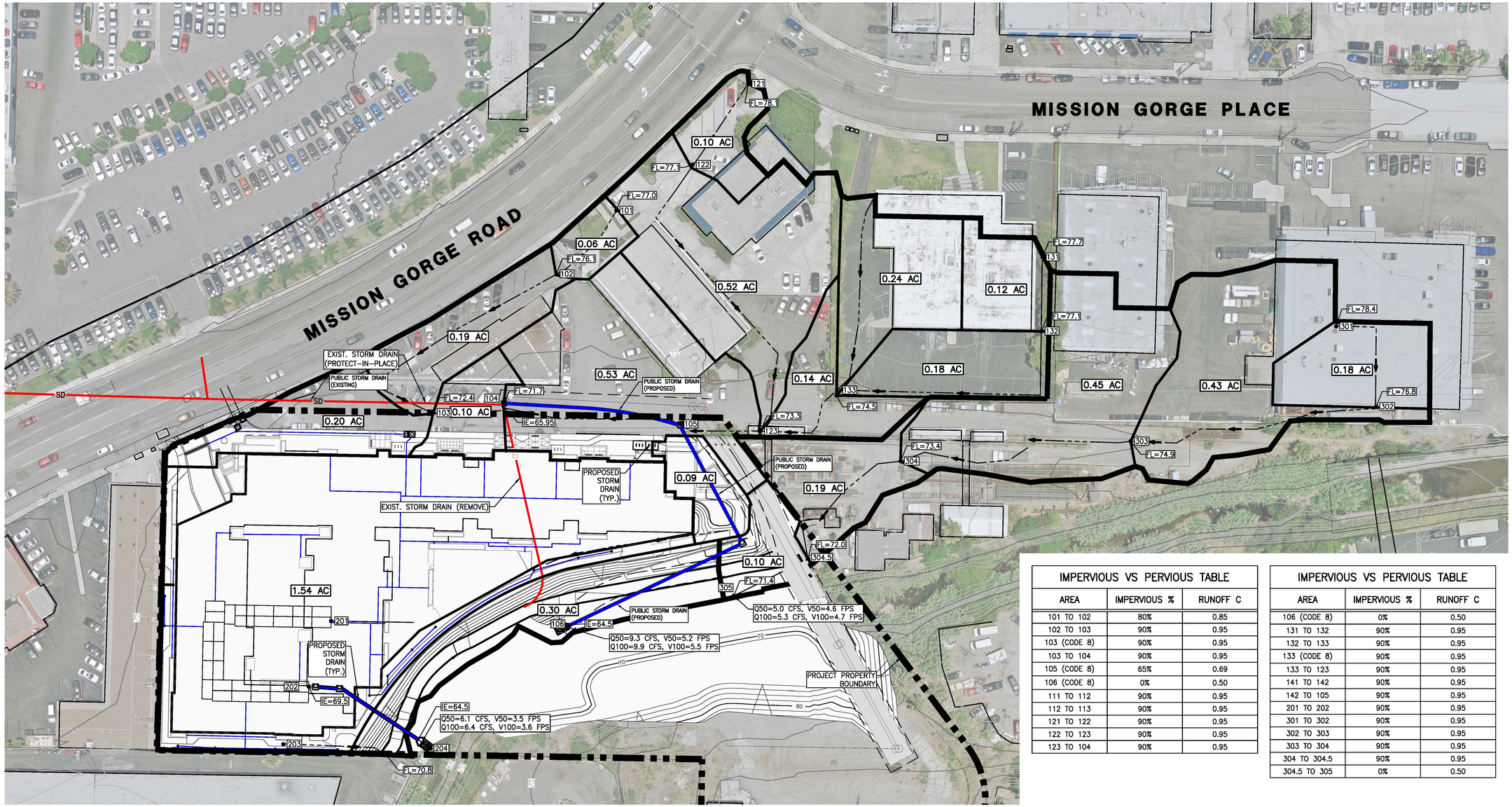
Map Pocket 2

Drainage Study Map, Post-Project Condition



IMPERVIOUS VS PERVIOUS TABLE		
AREA	IMPERVIOUS %	RUNOFF C
101 TO 102	80%	0.85
102 TO 103	90%	0.95
103 (CODE 8)	90%	0.95
103 TO 104	90%	0.95
105 (CODE 8)	65%	0.69
106 (CODE 8)	0%	0.50
111 TO 112	90%	0.95
112 TO 113	90%	0.95
121 TO 122	90%	0.95
122 TO 123	90%	0.95
123 TO 104	90%	0.95

IMPERVIOUS VS PERVIOUS TABLE		
AREA	IMPERVIOUS %	RUNOFF C
106 (CODE 8)	0%	0.50
131 TO 132	90%	0.95
132 TO 133	90%	0.95
133 (CODE 8)	90%	0.95
133 TO 123	90%	0.95
141 TO 142	90%	0.95
142 TO 105	90%	0.95
201 TO 202	90%	0.95
301 TO 302	90%	0.95
302 TO 303	90%	0.95
303 TO 304	90%	0.95
304 TO 304.5	90%	0.95
304.5 TO 305	0%	0.50

LEGEND

- DRAINAGE BOUNDARY (MAJOR)
- DRAINAGE BOUNDARY (MINOR)
- FLOW PATH
- EXISTING STORM DRAIN
- PROPOSED STORM DRAIN
- 101 DRAINAGE NODE
- 0.25 AC DRAINAGE AREA
- 75 EXIST. MAJOR ELEV. CONTOUR
- 74 EXIST. MINOR ELEV. CONTOUR

NOTE:
1. UNLESS NOTED AS PUBLIC, STORM DRAIN LINES SHOWN ARE PRIVATE.

N

40 20 0 40 80 120
GRAPHIC SCALE: 1"=40'

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DRAINAGE MAP, POST-PROJECT
ALVARADO CREEK APARTMENT PROJECT
SAN DIEGO, CA

DATE: SEPT. 2021

J-19048

SHEET 1 OF 1

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Attachment 6
Geotechnical and Groundwater Investigation Report

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

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April 5, 2021 KA Project No. 112-19097

Mr. Darren Berberian
The Pacific Companies
(949) 599-6069
darrenb@tpchousing.com

RE: GEOTECHNICAL ENGINEERING INVESTIGATION UPDATED REPORT
Proposed Grantville Development
5901 – 5927 Mission Gorge Road
San Diego, California

Dear Mr. Berberian:

In accordance with your request and authorization, we have updated the Geotechnical Engineering Investigation report issued on November 27, 2019 for the above-referenced site to address comments received by the City of San Diego's Development Services Department during Review Cycles 5 and 6. This report summarizes the results of our field investigation, laboratory testing and engineering analyses. Based on the data obtained, our understanding of the proposed project and our engineering analyses, it is our opinion that it is feasible to develop the site as planned.

A summary of changes included in this updated Geotechnical Engineering Investigation report is included below.

Issue Number	
2	An updated Geotechnical Engineering Investigation report dated April 5, 2021 has been issued.
3	The report has been revised accordingly. All DRAFT markings have been removed and boring logs have been included.
4	A site specific geological map and geologic site plan have been included as Figures 4 and 5.
5	Site specific geotechnical cross-sections have been included in Figure 6.
6	The site description has been updated (page 3).
7	Text stating the site is considered suitable for the proposed development is included in the Administrative Summary (page 8).
8	Text stating the proposed development is not anticipated to impact, destabilize, or result in settlement of the adjacent properties or right of ways is included in the Administrative Summary (page 8).

As noted in our report, Krazan & Associates should be retained to review project plans and specifications prior to the start of construction, and to observe and test earthwork and foundation construction. Observation and testing services should also be performed by our field staff during construction activities will allow us to compare conditions exposed during construction with those encountered during our investigation and to present supplemental recommendations if warranted by different site conditions.

If you have any questions regarding the information or recommendations presented in our report, or if we may be of further assistance, please contact our office at (951) 273-1011.

Respectfully submitted,
KRAZAN & ASSOCIATES, INC.

Dave R. Jarosz, II
Managing Engineer
RGE No. 2698/RCE No. 60185

Madison K. Weber
Project Engineer
RCE No. 81935

cc: Addressee

GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED GRANTVILLE DEVELOPMENT
5901 – 5927 MISSION GORGE ROAD
SAN DIEGO, CALIFORNIA

PROJECT NO. 112-19097
NOVEMBER 27, 2019
REVISED APRIL 5, 2021

PREPARED FOR:

THE PACIFIC COMPANIES

ATTENTION: MR. DARREN BERBERIAN

PREPARED BY:

KRAZAN & ASSOCIATES, INC.
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GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED GRANTVILLE DEVELOPMENT
5901 – 5927 MISSION GORGE ROAD
SAN DIEGO, CALIFORNIA

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November 27, 2019
Revised April 5, 2021

KA Project No. 112-19097

UPDATED REPORT
GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED GRANTVILLE DEVELOPMENT
5901 – 5927 MISSION GORGE ROAD
SAN DIEGO, CALIFORNIA

INTRODUCTION

Krazan & Associates previously submitted a Geotechnical Engineering Investigation Report for this site dated November 27, 2019. This updated report addresses comments received by the City of San Diego's Development Services Department.

This report presents the results of our Geotechnical Engineering Investigation for the proposed development that is understood to include construction of a new mixed use retail and multi-family residential development. The proposed development is understood to include two (2) five-story structures above one level of at grade parking. It is anticipated that the proposed construction will include trash enclosures, associated parking and drive areas, and localized landscaped areas. Discussions regarding site conditions are presented herein, together with conclusions and recommendations pertaining to site preparation, grading, utility trench backfill, drainage and landscaping, foundations, concrete floor slabs and exterior concrete flatwork, retaining walls, soil corrosivity, and pavement design.

A Vicinity Map showing the location of the site is presented on Figure 1. A Site Plan showing the approximate boring locations is presented on Figure 2. Descriptions of the field and laboratory investigations, boring log legend and boring logs are presented in Appendix A. Appendix A contains a description of the laboratory-testing phase of this study, along with the laboratory test results. Appendices B and C contain general guide specifications for earthwork and flexible pavements, respectively. If conflicts in the text of the report occur with the general specifications in the appendices, the recommendations in the text of the report have precedence.

PURPOSE AND SCOPE OF SERVICES

This preliminary geotechnical investigation was conducted to evaluate subsurface soil and groundwater conditions at the project site. Engineering analysis of the field and laboratory data was performed for the purpose of developing and providing geotechnical recommendations for use in the design and construction of the earthwork, foundation and pavement aspects of the project.

Our scope of services was outlined in our proposal dated September 30, 2019 (KA Proposal No. G19118CAC) and included the following:

- A site reconnaissance by a member of our engineering staff to evaluate the surface conditions at the project site.
- Review of selected published geologic maps, reports and literature pertinent to the site and surrounding area.
- A field investigation consisting of drilling a total of eleven (11) borings to depths ranging from approximately twenty (20) to fifty (50) feet below the existing ground surface or auger refusal for evaluation of the subsurface conditions at the project site.
- Performance of laboratory tests on representative soil samples obtained from the borings to evaluate the physical and index properties of the subsurface soils.
- Evaluation of the data obtained from the investigation and engineering analyses of the data with respect to the geotechnical aspects of structural design, site grading and paving.
- Preparation of this report summarizing the findings, results, conclusions and recommendations of our investigation.

Environmental services, such as a chemical analysis of soil and groundwater for possible environmental contaminates, were not in our scope of services.

PROPOSED CONSTRUCTION

Based on our review of the preliminary site plan and our discussions with the project representatives, we understand that the proposed development will include construction of a new mixed use retail and multi-family residential development. The proposed development is understood to include two (2) five-story structures above one level of at grade parking. It is anticipated that the proposed structures will be supported on shallow foundation systems and/or drilled pier foundation system with a slab-on-grade construction for the lowest floor. Foundation loads are anticipated to be moderate. Concrete slabs, buried utility lines, localized landscaped areas, and asphalt and Portland cement concrete pavements areas are anticipated to be associated with the development.

In the event these structural or grading details are inconsistent with the final design criteria, we should be notified so that we can evaluate the potential impacts of the changes on the recommendations presented in this report and provide an updated report as necessary.

SITE LOCATION AND SITE DESCRIPTION

Currently, there are several businesses located at the subject site. These businesses include auto sales, auto body shops, and company equipment and material yards. Portions of the site include vacant land. The subject site is located south of the intersection of Mission Gorge Road and Mission Gorge Place, in the city of San Diego, California. The subject site is located at the physical address of 5901 – 5927 Mission Gorge Road, San Diego, California. Presently, the site is occupied by approximately seven (7)

existing one and two-story buildings. Most buildings are occupied by tenants with the previously noted business types. Driveways, drive aisles, and automobile parking is provided across the subject site. Ground surface in the parking and drive areas are composed of asphalt and Portland cement pavements. The southeast portion of the site is understood to be planned as open space and as such no subsurface exploration was conducted for that area. The site is bound to the north and west by Mission Gorge Road and auto dealerships beyond, and to the south by light commercial developments and the San Diego Metropolitan Transit System beyond, to the east by light commercial developments. The site is relatively flat and level, with no major changes in elevation.

GEOLOGIC SETTING

The subject site is situated at in an area at the western margin of the Peninsular Ranges Geomorphic Province of southern California. This geomorphic province encompasses an area that extends for approximately 790 miles, from the Transverse Ranges and the Los Angeles Basin to the tip of Baja California, and varies in width from 30 to 100 miles. In general, the Peninsular Ranges consist of rugged mountains underlain by Mesozoic era (67 to 245 million years old) metamorphic and crystalline rocks to the east and a dissected coastal plain underlain by Cenozoic era (up to 67 million years old) sediments. The mountain ranges of this geomorphic province are generally northwest-trending and separated by subparallel fault zones, and are largely composed of granitic and related rocks and smaller amounts of metamorphic rocks. The coastal portions of this geomorphic province in the San Diego region are typically comprised of marine and non-marine sedimentary rocks that have been deposited within a northwest-trending basin known as the San Diego Embayment. The Peninsular Ranges are bounded on the east by the Salton Trough and on the north by the Los Angeles Basin, and extends westward into the Pacific Ocean where its highest peaks are exposed at Catalina, Santa Barbara, San Clemente, and San Nicholas Islands.

The Peninsular Ranges are traversed by several major active faults. Right-lateral, strike-slip movement is the major tectonic activity associated with faults in the regional tectonic framework. Earthquakes along these faults have the potential for generating strong seismic ground motions in the region. The seismic event most likely to affect the site would be a major earthquake on the Rose Canyon Fault. The Rose Canyon Fault is a complex zone of strike-slip, oblique, reverse, and normal faults that extend onshore from La Jolla Cove south to San Diego Bay.

SEISMICITY AND LIQUEFACTION POTENTIAL

Seismicity is a general term relating to the abrupt release of accumulated strain energy in the rock materials of the earth's crust in a given geographical area. The recurrence of accumulation and subsequent release of strain have resulted in faults and fault systems. Fault patterns and density reflect relative degrees of regional stress through time, but do not necessarily indicate recent seismic activity; therefore, the degree of seismic risk must be determined or estimated by the seismic record in any given region. The Newport-Inglewood and Rose Canyon Fault Zones are the nearest active fault zones to the site and are each located approximately 5.6 miles from the site.

Soil liquefaction is a state of soil particle suspension caused by a complete loss of strength when the effective stress drops to zero. Liquefaction normally occurs under saturated conditions in soils such as

sand in which the strength is purely frictional. However, liquefaction has occurred in soils other than clean sand. Liquefaction usually occurs under vibratory conditions such as those induced by seismic events. To evaluate the liquefaction potential of the site, the following items were evaluated:

1) Soil type
2) Groundwater depth
3) Relative density
4) Initial confining pressure
5) Intensity and duration of ground shaking

A Seismic Hazard Map has not been published by the State of California at the time of this publication for the vicinity of the subject site. The subject site is located on the San Diego Seismic Safety Study Map. Based on a review of the map, the subject site is located in an area designated as a Liquefaction Hazard Zone by the City of San Diego. The subsurface soil conditions encountered at the site consist of relatively medium dense to very dense and very stiff to hard soils. In addition, groundwater was encountered at a depth of approximately ten (10) feet below site grades.

The potential for soil liquefaction during a seismic event was evaluated using the LiquefyPro computer program (version 5.8h) developed by CivilTech Software. For the analysis, a maximum earthquake magnitude of 6.5 M_w and a peak horizontal ground surface acceleration of 0.432g were considered appropriate for the liquefaction analysis. A groundwater depth of 10 feet was used for the analysis. The computer analysis indicates that the subsurface soil conditions encountered at the subject site are not conducive to liquefaction induced settlement.

Based on our findings, it is our opinion that the potential for seismic-induced soil liquefaction within the project site is low. Therefore, measures to mitigate liquefaction potential are not considered necessary.

FAULT RUPTURE HAZARD ZONES

The Alquist-Priolo Geologic Hazards Zones Act went into affect in March, 1973. Since that time, the Act has been amended 11 times (Hart, 2007). The purpose of the Act, as provided in California Geologic Survey (CGS) Special Publication 42 (SP 42), is to prohibit the location of most structures for human occupancy across the traces of active faults and to mitigate thereby the hazard of fault-rupture". The Act was renamed the Alquist-Priolo Earthquake Fault Zoning Act in 1994, and at that time, the originally designated "Special Studies Zones" was renamed the "Earthquake Fault Zones."

The area of the subject site is not included on an Earthquake Fault Zones Map prepared by the CGS. The subject site is included in the San Diego Seismic Safety Study Map. The subject site is not located within a Fault-Rupture Hazard Zone. The Newport-Inglewood, Rose Canyon, and Coronado Bank Fault Zones are the nearest active fault zones to the site and are located approximately 5.6, 5.6, and 18.0 miles away from the site, respectively.

SEISMIC HAZARDS ZONES

In 1990, the California State Legislature passed the Seismic Hazard Mapping Act to protect public safety from the effects of strong shaking, liquefaction, landslides, or other ground failure, and other hazards

caused by earthquakes. The Act requires that the State Geologist delineate various seismic hazards zones on Seismic Hazards Zones Maps. Specifically, the maps identify areas where soil liquefaction and earthquake-induced landslides are most likely to occur. A site-specific geotechnical evaluation is required prior to permitting most urban developments within the mapped zones. The Act also requires sellers of real property within the zones to disclose this fact to potential buyers. A Liquefaction Hazard Map has not been prepared for the subject site. The subject site is included in the San Diego Seismic Safety Study Map. The subject site is located in an area designated as a Liquefaction Hazard Zone by the San Diego Seismic Hazard Map.

OTHER HAZARDS

Rockfall, Landslide, Slope Instability, Debris Flow: The subject site is relatively flat and level. It is our understanding that there are no significant slopes proposed as part of the proposed development. Provided the recommendations presented in this report are implemented into the design and construction of the anticipated development, rockfalls, landslides, slope instability, and debris flows are not anticipated to pose a hazard to the subject site.

Seiches: Seiches are large waves generated within enclosed bodies of water. The site is not located in close proximity to any lakes or reservoirs. As such, seiches are not anticipated to pose a hazard to the subject site.

Hydroconsolidation: The near surface soils encountered at the subject site were found to be medium dense to very dense. Provided remedial grading recommendations presented in this report are incorporated in the design and construction, hydroconsolidation is not anticipated to be a significant concern for the subject site.

SITE COEFFICIENT

The site class, per Table 1613.5.2, 2016 CBC, is based upon the site soil conditions. It is our opinion that a Site Class D is appropriate for building design at this site. For seismic design of the structures, in accordance with the seismic provisions of the 2016 CBC, we recommend the following parameters:

2016 CALIFORNIA BUILDING CODE		
Seismic Item	**Value**	**CBC Reference**
Site Class	D	Table 1613.5.2
Fa	1.118	Table 1613.5.3 (1)
Ss	0.956	Figure 1613.5 (3)
SMS	1.068	Section 1613.5.3
SDS	0.712	Section 1613.5.4
Fv	1.668	Table 1613.5.3 (2)
S1	0.366	Figure 1613.5 (4)
SM1	0.611	Section 1613.5.3
SD1	0.407	Section 1613.5.4

The seismic hazard most likely to impact the site is ground shaking due to a large earthquake on one of the major active regional faults. The Rose Canyon Fault and Newport-Inglewood Zones are located approximately 5.6 miles from the subject site. Because of the proximity to the subject site and the maximum probable events for these faults, it appears that a maximum probable event along these fault zones could produce a peak horizontal acceleration of approximately 0.432g when uncertainty is used. With respect to this hazard, the site is comparable to others in this general area within similar geologic settings.

FIELD AND LABORATORY INVESTIGATIONS

Subsurface soil conditions were explored by drilling a total of eleven (11) borings using a truck-mounted drill rig to depths ranging from approximately twenty (20) to fifty (50) feet below existing site grades or auger refusal. Bulk subgrade soil samples were also obtained for laboratory testing. The approximate boring and bulk sample locations are shown on the Site Plan, Figure 2. These approximate boring and sample locations were estimated in the field based on pacing and measuring from the limits of existing site features. During drilling operations, penetration tests were performed at regular intervals to evaluate the soil consistency and to obtain information regarding the engineering properties of the subsurface soils. Soil samples were retained for laboratory testing. The soils encountered were continuously examined and visually classified in accordance with the Unified Soil Classification System. A more detailed description of the field investigation is presented in Appendix A.

Laboratory tests were performed on selected soil samples to evaluate their physical characteristics and engineering properties. The laboratory-testing program was formulated with emphasis on the evaluation of natural in situ moisture and density, gradation, R-Value, maximum dry density, resistivity, pH value, sulfate and chloride-contents of the materials encountered. Details of the laboratory-testing program are discussed in Appendix A. The results of the laboratory tests are presented on the boring logs or on the test reports, which are also included in Appendix A. This information, along with the field observations, was used to prepare the final boring logs in Appendix A.

SOIL PROFILE AND SUBSURFACE CONDITIONS

Based on our findings, the subsurface conditions encountered appear typical of those found in the geologic region of the site. Generally, groundcover throughout the majority of the subject site consisted of approximately four (4) to six (6) inches of asphalt underlain by approximately three (3) to six (6) inches of discernable aggregate base material. In general, the subsurface soils encountered at the eastern portion of the site consisted of interbeded layers of medium dense to very dense clayey sand, silty sand, and poorly-graded sand with varying amounts of clay and silt content and very stiff to hard sandy clay up to the maximum depth explored, 50 feet below site grades. The western portion of the site had similar soils encountered with the exception of the upper three to six feet of fill material found at those locations. The fill material appears to be consistent and uniform across the western portion of the site. The fill material encountered consisted of dense silty sand with trace cobble and gravel content.

Field and laboratory tests suggest that these soils are moderately strong and slightly compressible. Penetration resistance, measured by the number of blows required to drive a Modified California sampler or a Standard Penetration Test (SPT) sampler, ranged from 7 blows per foot to over 50 blows per six inches. Dry densities ranged from approximately 101 to 125 pcf. Representative samples of the near surface soils consolidated approximately 0.8 to 1.9 percent under a 2 ksf load when saturated. Representative samples of the near surface soils were tested and found to have angles of internal friction of 28 and 29 degrees with cohesion values of 300 and 100 psf, respectively.

The above is a general description of soil conditions encountered at the site in the borings drilled for this investigation. For a more detailed description of the soil conditions encountered, please refer to the boring logs in Appendix A.

GROUNDWATER

Test boring locations were checked for the presence of groundwater during and immediately following the drilling operations. Groundwater was encountered at a depth as shallow as approximately ten (10) feet below current site grades during drilling operations. Based on conditions encountered at the boring locations, groundwater is anticipated to be present at depths on the order of ten (10) feet below ground surface.

It should be recognized that water table elevation might fluctuate with time. The depth to groundwater can be expected to fluctuate both seasonally and from year to year. Fluctuations in the groundwater level may occur due to variations in precipitation, irrigation practices at the site and in the surrounding areas, climatic conditions, flow in adjacent or nearby canals, pumping from wells and possibly as the result of other factors that were not evident at the time of our investigation. Therefore, water level observations at the time of our field investigation may vary from those encountered during the construction phase of the project. The evaluation of such factors is beyond the scope of this report. Long-term monitoring in observation wells, sealed from the influence of surface water, is often required to more accurately define the potential range of groundwater conditions on a site.

SOIL CORROSIVITY

Corrosion tests were performed to evaluate the soil corrosivity to the buried structures. The tests consisted of minimum resistivity, sulfate content and chloride content, and the results of the tests are included as follows:

Parameter	Results	Test Method
pH Value	7.5	EPA 9045C
Resistivity	1,350 ohm-cm	CA. 643
Sulfate	231 ppm	CA. 417
Chloride	111 ppm	CA. 422

CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of our field and laboratory investigations, along with previous geotechnical experience in the project area, the following is a summary of our evaluations, conclusions, and recommendations.

ADMINISTRATIVE SUMMARY

In brief, the subject site and soil conditions, with the exception of the existing development and the disturbed upper soils, appear to be conducive to the development of the project. The subject site is considered suitable for the proposed development. Based on the data collected during this investigation and from a geotechnical engineering standpoint, it is our opinion that the proposed improvements may be made as anticipated provided that the recommendations presented in this report are considered in the design and construction of the project.

The proposed development is not anticipated to extend into or impact the adjacent right of ways. The proposed development in not anticipated to destabilize or result in settlement of adjacent properties or right of ways.

Existing structures are located within the project site vicinity. Any surface or buried structures encountered during construction should be properly removed and/or relocated. It is suspected that demolition activities of the existing structures will disturb the near surface soils. Areas disturbed by demolition activities should be excavated to firm native ground. The resulting excavations should be backfilled with Engineered Fill. Excavations, depressions, or soft and pliant areas extending below planned, finished subgrade levels should be cleaned to firm, undisturbed soil and backfilled with Engineered Fill. In general, any septic tanks, debris pits, cesspools, or similar structures should be entirely removed. Concrete footings should be removed to an equivalent depth of at least 3 feet below proposed footing elevations or as recommended by the Soils Engineer. Any other buried structures

should be removed in accordance with the recommendations of the Soils Engineer. The resulting excavations should be backfilled with Engineered Fill.

To reduce post-construction soil movement and provide uniform support for the proposed structure, overexcavation and recompaction within the proposed building footprint area should be performed to a minimum depth of five (5) feet below existing grades or three (3) feet below bottom of the proposed footings, whichever is deeper. The actual depth of the overexcavation and recompaction should be determined by our field representative during construction. The overexcavation and recompaction should also extend laterally a minimum of five (5) feet beyond edges of the proposed footings and building appurtenances. Any undocumented fill encountered during grading should be removed and replaced with Engineered Fill.

Within the proposed exterior flatwork and pavement areas, the overexcavation and recompaction should be performed to a depth of at least one (1) foot below existing grade or finish subgrade, whichever is deeper. This compaction effort should stabilize the surface soils and locate any unsuitable or pliant areas not found during our field investigation.

It is recommended that interior slabs-on-grade be designed at least five inches (5") in thickness. It is recommended that the slabs should be reinforced with a minimum of number three (#3) bars, eighteen inches (18") on center in both directions. It is recommended that exterior slabs-on-grade be designed at least five inches (5") in thickness. It is recommended that the slabs should be reinforced with a minimum of number three (#3) bars, eighteen inches (18") on center in both directions.

The proposed structures, including walls and other foundation elements may be supported on a shallow foundation system after the bottom of the footings have been moisture-conditioned to at least 2 percent above optimum moisture-content, and recompacted to a minimum of 95 percent of the maximum dry density based on ASTM Test Method D1557. Spread and continuous footings can be designed for a maximum allowable soil bearing pressure, dead plus live load, of 2,600 psf.

Cast-in-place piles may be used as part of the deep foundation system to support heavier foundation loads. Thus, cast-in-place foundation piles should be designed as friction piles. It is recommended that all piles should be founded a minimum of twelve feet (12') into competent native soils. The actual depth of the piles should be determined by the foundation designer. An allowable friction between the concrete and native alluvium of 400 pounds per square foot may be used below the depth of one foot. The upper foot should be neglected when calculated pile foundation support. A lateral bearing of 400 pounds per square foot per foot of depth to a maximum of 4,000 psf may be used to resist lateral loading in approved native alluvium materials. It is recommended that piles have a minimum shaft diameter of eighteen (18) inches. Pile foundations should be no closer together than three (3) pile shaft diameters.

For preliminary purposes, an allowable bearing pressure of 1,000 pounds per square foot may be used for design of the slab. For preliminary modeling purposes a vertical modulus of subgrade reaction (Kv1), also referred to as a soil spring, of 30 pounds per square inch per inch may be used for long term conditions. An increased modulus of 40 pounds per square inch per inch may be used for short term loading to evaluate punching shear at columns and walls. The slab design should ultimately limit slab bending or arching in the lightly loaded mid-slab areas between load bearing columns and walls. Based

on the preliminary nature of the project design and a lack of formal design documents, these values should be considered preliminary and should be reevaluated during final design. The values should be reevaluated in order to determine soil support values appropriate for the actual design conditions.

The site is predominately surrounded by existing developments. Associated with these developments are buried structures, such as utility lines. Any surface or buried structures encountered during construction should be properly removed and/or relocated. It is suspected that demolition activities of the existing structures will disturb the upper soils. Areas disturbed by demolition activities should be excavated to firm native ground. The resulting excavations should be backfilled with Engineered Fill, compacted to a minimum of 95 percent of maximum dry density based on ASTM Test Method D1557.

GROUNDWATER INFLUENCE ON STRUCTURES/CONSTRUCTION

Based on our findings and historical records, it is not anticipated that groundwater will rise within the zone of structural influence or affect the construction of foundations and pavements for the project. Groundwater may be encountered in utility trenches or deep excavations. The contractor should be prepared to address dewatering or saturated soil in the event excavations extend to depths on the order of ten (10) feet below site grades. If earthwork is performed at depths greater than ten (10) feet below site grades, groundwater may be encountered, also during or soon after periods of precipitation, the subgrade soils may become saturated, "pump," or not respond to densification techniques. Typical remedial measures include: discing and aerating the soil during dry weather; mixing the soil with dryer materials; removing and replacing the soil with an approved fill material; or mixing the soil with an approved lime or cement product. Our firm should be consulted prior to implementing remedial measures to observe the unstable subgrade conditions and provide appropriate recommendations.

SEISMIC CONSIDERATIONS

Ground Shaking

Although ground rupture is not considered to be a major concern at the subject site, the site will likely be subject to at least one moderate to severe earthquake and associated seismic shaking during its lifetime, as well as periodic slight to moderate earthquakes. Some degree of structural damage due to stronger seismic shaking should be expected at the site, but the risk can be reduced through adherence to seismic design codes.

Seismic Induced Settlement

One of the most common phenomena during seismic shaking accompanying any earthquake is the induced settlement of loose unconsolidated soils. Based on site subsurface conditions and the moderate to high seismicity of the region, any loose fill materials at the site could be vulnerable to this potential hazard. However, this hazard can be mitigated by following the design and construction recommendations of our Geotechnical Engineering Investigation (over-excavation and rework of the loose soils and/or fill). Based on the moderate penetration resistance measured, the native deposits underlying the surface materials do not appear to be subject to significant seismic settlement.

EARTHWORK

Site Preparation

General site clearing should include removal of vegetation; existing utilities; structures including foundations; basement walls and floors; existing stockpiled soil; trees and associated root systems; rubble; rubbish; and any loose and/or saturated materials. With the construction of a subterranean structure throughout the majority of the site and with the required excavation estimated to extend to a depth of approximately 10 to 15 feet below grade, we expect the remnants of any prior development, will be removed during the excavation of the site. The same is true for the root structures of any existing trees and any near-surface organic-laden soils. In the event that previously unidentified debris pits or underground utilities are encountered, those objects should be removed in their entirety. Any abandoned underground utilities that are exposed and found to extend into adjacent properties should be capped.

To reduce post-construction soil movement and provide uniform support for the proposed structure, overexcavation and recompaction within the proposed building footprint area should be performed to a minimum depth of five (5) feet below existing grades or three (3) feet below bottom of the proposed footings, whichever is deeper. The actual depth of the overexcavation and recompaction should be determined by our field representative during construction. The overexcavation and recompaction should also extend laterally a minimum of five (5) feet beyond edges of the proposed footings and building appurtenances. Any undocumented fill encountered during grading should be removed and replaced with Engineered Fill.

The site is presently occupied by several one and two story buildings, and asphalt and concrete parking lots. Fill may be present at the site. Any fill soil encountered should be excavated and stockpiled so that the native soils can be properly prepared. Any clayey soils encountered at the site will not be suitable for reuse as Non-Expansive Engineered Fill. However, clayey soils will be suitable for reuse as General Engineered Fill, provided they are cleansed of excessive organics and debris, and are moisture-conditioned to a minimum of 2 percent above optimum moisture-content. Prior to fill placement Krazan & Associates, Inc. should inspect the bottom of the excavation to verify no additional removal will be required.

Existing structures are located immediately adjacent to the site. Associated with these structures are buried structures such as utilities. Demolition activities should include proper removal of any buried structures. Any surface or buried structures, such as utilities or loosely backfilled excavations, encountered during construction should be properly removed and the resulting excavations backfilled. After demolition activities, it is recommended that these disturbed soils be removed and/or recompacted. Excavations, depressions, or soft and pliant areas extending below planned, finished subgrade levels should be cleaned to firm, undisturbed soil and backfilled with Engineered Fill. In general, any septic tanks, debris pits, cesspools, or similar structures should be entirely removed.

Whenever excavation is made adjacent to existing streets, utilities and structures, there is the potential for movement. The adjacent structures and improvements should be inspected and documented to preclude claims for damage or settlement that are not associated with the construction of the planned development. A monitoring program should be established so excessive movement is detected early. The monitoring

program should include optical surveying of the shoring and adjacent streets and buildings to detect any horizontal or vertical movement.

Any concrete footings encountered should be removed to an equivalent depth of at least 3 feet below proposed footing elevations or as recommended by the Soils Engineer. Any other buried structures should be removed in accordance with the recommendations of the Soils Engineer. The resulting excavations should be backfilled with Engineered Fill.

Following stripping, fill removal, and demolition activities, it is recommended that at a minimum, the upper five (5) feet of exposed subgrade soils beneath the building pad areas be excavated, worked until uniform and free from large clods, moisture-conditioned to at least optimum moisture-content, and recompacted to a minimum of 95 percent of the maximum dry density based on ASTM Test Method D1557. Within the pavement and exterior flatwork areas, the exposed subgrade should be excavated to a depth of twelve (12) inches, worked until uniform and free from large clods and moisture-conditioned to at least optimum moisture-content and recompacted to a minimum of 95 percent of the maximum dry density based on ASTM Test Method D1557. Prior to backfilling, the bottom of the excavation should be proof-rolled and observed by Krazan & Associates, Inc. to verify stability. This compaction effort should stabilize the upper soils and locate any unsuitable or pliant areas not found during our field investigation.

In areas where slab-on-grade construction will be utilized, it is recommended that the soil within proposed slab-on-grade and exterior flatwork areas consist of Non-Expansive Engineered Fill. The non-expansive fill material should be a well-graded silty sand or sandy silt soil. Imported Fill should be approved by the Soils Engineer prior to placement. The fill should be placed as specified as Engineered Fill.

The upper soils, during wet winter months, become very moist due to the absorptive characteristics of the soil. Earthwork operations performed during winter months may encounter very moist unstable soils, which may require removal to grade a stable building foundation. Project site winterization consisting of placement of aggregate base and protecting exposed soils during the construction phase should be performed.

A representative of our firm should be present during all site clearing and grading operations to test and observe earthwork construction. This testing and observation is an integral part of our service, as acceptance of earthwork construction is dependent upon compaction and stability of the material. The Soils Engineer may reject any material that does not meet compaction and stability requirements. Further recommendations of this report are predicated upon the assumption that earthwork construction will conform to recommendations set forth in this section and the Engineered Fill section.

Fill Placement

Prior to placement of fill soils, the upper 12 inches of native subgrade soils should be scarified, moisture-conditioned to near optimum moisture-content, and recompacted to a minimum of 95 percent of the maximum dry density based on ASTM Test Method D1557. Fill material should be compacted to a minimum of 95 percent of the maximum dry density based on ASTM Test Method D1557.

The upper soils, during wet winter months, may become very moist due to the absorptive characteristics of the soil. Earthwork operations performed during winter months may encounter very moist unstable soils, which may require removal to grade a stable building foundation. Project site winterization consisting of placement of aggregate base and protecting exposed soils during the construction phase should be performed.

ENGINEERED FILL

The organic-free, on-site, soils are predominately clayey sand, poorly-graded sand, and silty sand. These soils will be suitable for reuse as Engineered Fill, provided they are cleansed of excessive organics and debris.

The preferred materials specified for Engineered Fill are suitable for most applications with the exception of exposure to erosion. Project site winterization and protection of exposed soils during the construction phase should be the sole responsibility of the contractor, since they have complete control of the project site at that time.

Imported Fill material should be predominately non-expansive granular material. This material should be approved by the Geotechnical Engineer prior to use and should typically possess the following characteristics:

NON-EXPANSIVE FILL PROPERTIES	
Percent Passing No. 200 Sieve	10 to 50
Plasticity Index (PI)	12 maximum
Liquid Limit	35 maximum
UBC Standard 29-2 Expansion Index	20 maximum

Imported Fill should be free from rocks and clods greater than 4 inches in diameter. All Imported Fill material should be submitted to the Soils Engineer for approval at least 48 hours prior to delivery to the site. Fill soils should be placed in lifts approximately 6 inches thick, moisture-conditioned to near optimum moisture-content, and compacted to achieve at least 95 percent of maximum dry density as determined by ASTM Test Method D1557. Additional lifts should not be placed if the previous lift did not meet the required dry density or if soil conditions are not stable.

FOUNDATIONS – CONVENTIONAL

The proposed structures, including walls and other foundation elements may be supported on a shallow foundation system bearing on a minimum of three (3) feet of compacted Engineered Fill. Spread and continuous footings can be designed for the following maximum allowable soil bearing pressures:

Load	Allowable Loading
Dead Load Only	2,000 psf
Dead-Plus-Live Load	2,600 psf
Total Load, including wind or seismic loads	3,500 psf

The footings should have a minimum embedment depth of 24 inches below pad subgrade (soil grade) or adjacent exterior grade, whichever is lower. Footings should have a minimum width of 18 inches, regardless of load. Shallow foundation systems should be designed to tolerate the anticipated static and seismic settlement. The actual foundation design should be performed by the project structural engineer.

It is recommended that the foundation for the proposed structure be placed entirely within compacted fill materials or entirely within alluvium or bedrock. Footings shall not transition from one bearing material to another. It is recommended that all foundations contain steel reinforcement of at least two (2) number four (#4) bars, one (1) top and one (1) bottom.

It is recommended that all foundations be set back a minimum of five (5) feet from the top of all adjacent slopes or deepened to maintain at least five (5) feet between the bottom of the footing and the slope face. Additionally, all footing set back criteria, should conform to 2010 CBC Section 1805.3.2 and Figure 1805.3.1. It is recommended that all footings be cleared of all loose soil and construction debris prior to pouring concrete.

Resistance to lateral footing displacement can be computed using an allowable friction factor of 0.25 acting between the base of foundations and the supporting subgrade. Lateral resistance for footings can alternatively be developed using an allowable equivalent fluid passive pressure of 200 pounds per cubic foot acting against the appropriate vertical footing faces. The frictional and passive resistance of the soil may be combined without reduction in determining the total lateral resistance. A 1/3 increase in the value above may be used for short duration, wind, or seismic loads. All of the above earth pressures are unfactored and are, therefore, not inclusive of factors of safety.

Foundations – Cast-In-Place Piers

It is understood that drilled and cast-in-place piers could be used to support the heavier foundation loads for the proposed buildings. Thus, cast-in-place foundation piles should be designed as friction piles. It is recommended that all piles should be founded a minimum of twelve feet (12') into competent native soils. The actual depth of the piles should be determined by the foundation designer. An allowable friction between the concrete and native alluvium of 400 pounds per square foot may be used below the depth of one foot. The upper foot should be neglected when calculated pile foundation support. A lateral bearing of 400 pounds per square foot per foot of depth to a maximum of 4,000 psf may be used to resist lateral loading in approved native alluvium materials. It is recommended that piles have a minimum shaft diameter of eighteen (18) inches. Pile foundations should be no closer together than three (3) pile shaft diameters.

SETTLEMENT

Seismic Induced Settlement

One of the most common phenomena during seismic shaking accompanying any earthquake is the induced settlement of loose unconsolidated soils. Based on site subsurface conditions and the moderate to high seismicity of the region, any loose or soft materials at the site could be vulnerable to this potential hazard. Although the soil conditions encountered are not considered subject to liquefaction induced

settlement, seismic settlement due to seismic shaking is not expected to exceed 0.22 inch. The differential seismic settlement is anticipated to be less than 0.15 inch in 100 feet.

Static Settlement

Provided the site is prepared as recommended and that the foundations are designed and constructed in accordance with our recommendations, the static settlement due to foundation loads is not expected to exceed 1 inch. The differential settlement is anticipated to be less than ½ inch in 20 feet. Most of the settlement is expected to occur during construction as the loads are applied. However, additional post-construction settlement may occur if the foundation soils are flooded or saturated.

Lateral Load Resistance

Resistance to lateral footing displacement can be computed using an allowable friction factor of 0.25 acting between the base of foundations and the supporting subgrade. Where a vapor barrier material is used below concrete slabs-on-grade, a coefficient of friction should be provided by the vapor barrier manufacturer. Lateral resistance for footings can alternatively be developed using an allowable equivalent fluid passive pressure of 200 pounds per cubic foot acting against the appropriate vertical footing faces. Where equivalent fluid pressure against the sides of the footings or embedded slab edge are to be used, the footing or slab edge must be cast directly against undisturbed soils or the soils surrounding the structure must be recompacted to the requirements for Engineered Fill presented above. The frictional and passive resistance of the soil may be combined without reduction in determining the total lateral resistance. A one-third increase in the value above may be used for short duration, wind, or seismic loads.

Floor Slabs and Exterior Flatwork

To reduce post-construction soil movement beneath floor slabs and exterior flatwork, it is recommended that mitigation measures be performed. For conventional slab-on-grade, it is recommended that the upper 24 inches of soil consist of Non-Expansive Engineered Fill.

Concrete slab-on-grade floors should be underlain by a water vapor retarder. The water vapor retarder should be installed in accordance with ASTM Specification E 1643-98. According to ASTM Guidelines, the water vapor retarder should consist of a vapor retarder sheeting underlain by a minimum of 3 inches of compacted, clean, gravel of ¾-inch maximum size. To aid in concrete curing an optional 2 to 4 inches of granular fill may be placed on top of the vapor retarder. The granular fill should consist of damp clean sand with at least 10 to 30 percent of the sand passing the 100 sieve. The sand should be free of clay, silt, or organic material. Rock dust which is manufactured sand from rock crushing operations is typically suitable for the granular fill. This granular fill material should be compacted.

It is recommended that the concrete slabs be reinforced with at least No. 3 reinforcing bars, placed at 18 inches on center in each direction within the slabs middle third, to reduce crack separation and possible vertical offset at the cracks. Thicker floor slabs with increased concrete strength and reinforcement should be designed wherever heavy concentrated loads, heavy equipment, or machinery is anticipated.

The exterior floors should be poured separately in order to act independently of the walls and foundation system. Exterior finish grades should be sloped a minimum of 2 percent away from all interior slab areas to preclude ponding of water adjacent to the structures. All fills required to bring the building pads to grade should be Engineered Fills.

Moisture within the structure may be derived from water vapors, which were transformed from the moisture within the soils. This moisture vapor can travel through the vapor membrane and penetrate the slab-on-grade. This moisture vapor penetration can affect floor coverings and produce mold and mildew in the structure. To reduce moisture vapor intrusion, it is recommended that a vapor retarder be installed in accordance with ASTM guidelines. It is recommended that the utility trenches within the structure be compacted, as specified in our report, to reduce the transmission of moisture through the utility trench backfill. Special attention to the immediate drainage and irrigation around the building is recommended. Positive drainage should be established away from the structure and should be maintained throughout the life of the structure. Ponding of water should not be allowed adjacent to the structure. Over-irrigation within landscaped areas adjacent to the structure should not be performed. In addition, ventilation of the structure (i.e. ventilation fans) is recommended to reduce the accumulation of interior moisture.

RETAINING WALLS

Walls retaining horizontal backfill and capable of deflecting a minimum of 0.1 percent of its height at the top may be designed using an equivalent fluid active pressure of 44 pounds per square foot per foot of depth. Walls that are incapable of this deflection or walls that are fully constrained against deflection may be designed for an equivalent fluid at-rest pressure of 64 pounds per square foot per foot of depth. Expansive soils should not be used for backfill against walls. The wedge of non-expansive backfill material should extend from the bottom of each retaining wall outward and upward at a slope of 2:1 (horizontal to vertical) or flatter. The stated lateral earth pressures do not include the effects of hydrostatic water pressures generated by infiltrating surface water that may accumulate behind the retaining walls; or loads imposed by construction equipment, foundations, or roadways. All of the above earth pressures are unfactored and are, therefore, not inclusive of factors of safety.

During grading and backfilling operations adjacent to any walls, heavy equipment should not be allowed to operate within a lateral distance of 5 feet from the wall, or within a lateral distance equal to the wall height, whichever is greater, to avoid developing excessive lateral pressures. Within this zone, only hand operated equipment ("whackers," vibratory plates, or pneumatic compactors) should be used to compact the backfill soils.

Retaining and/or below grade walls should be drained with either perforated pipe encased in free-draining gravel or a prefabricated drainage system. The gravel zone should have a minimum width of 12 inches wide and should extend upward to within 12 inches of the top of the wall. The upper 12 inches of backfill should consist of native soils, concrete pavement, asphaltic concrete pavement or other suitable backfill to minimize surface drainage into the wall drain system. The aggregate should conform to Class II permeable materials graded in accordance with the CalTrans Standard Specifications (May 2006). Prefabricated drainage systems, such as Miradrain®, Enkadrain®, or an equivalent substitute, are acceptable alternatives in lieu of gravel provided they are installed in accordance with the manufacturer's

recommendations. If a prefabricated drainage system is proposed, Krazan & Associates, Inc. should review the system for final acceptance prior to installation.

Drainage pipes should be placed with perforations down and should discharge in a non-erosive manner away from foundations and other improvements. The pipes should be placed no higher than 6 inches above the heel of the wall in the center line of the drainage blanket and should have a minimum diameter of 4 inches. Collector pipes may be either slotted or perforated. Slots should be no wider than 1/8 inch in width, while perforations should be no more than ¼ inch in diameter. If retaining walls are less than 6 feet in height, the perforated pipe may be omitted in lieu of weep holes on 4 feet maximum spacing. The weep holes should consist of 4-inch diameter holes (concrete walls) or unmortared head joints (masonry walls) and not be higher than 18 inches above the lowest adjacent grade. Two 8-inch square overlapping patches of geotextile fabric (conforming to the CalTrans Standard Specifications for "edge drains") should be affixed to the rear wall opening of each weep hole to retard soil piping.

It is recommended that any uncertified fill material encountered within pavement areas, be removed and/or recompacted. The fill material should be moisture-conditioned to near optimum moisture-content and recompacted to a minimum of 95 percent of the maximum dry density based on ASTM Test Method D1557. As an alternative, the Owner may elect not to recompact the existing fill within paved areas. However, the Owner should be aware that the paved areas may settle which may require annual maintenance. At a minimum, it is recommended that the upper 12 inches of subgrade soil be moisture-conditioned as necessary and recompacted to a minimum of 95 percent of the maximum dry density based on ASTM Test Method D1557.

To simulate the effect of earthquake loading on retaining walls, the walls may be evaluated based on an active lateral soil pressure calculated using an equivalent fluid weight of 45 pounds per cubic foot plus a horizontal seismic surcharge line force of 35H pounds per square foot of wall. The resultant of the lateral soil pressure should be applied at H/3 above the wall base and the resultant of the seismic surcharge force should be applied at a height of 0.6H above the wall base. For the purpose of this report, "H" is defined as the vertical height from the base of the wall to the ground surface above.

SHORING AND EXCAVATION STABILITY

The locations of the planned structures relative to existing developments, including houses, apartment buildings, commercial structures, and roadways, that surround the subject site will need to be evaluated for possible impacts of the excavations on these structures. Due to the close proximity of several of these structures to the property lines, the relatively small setback of the structure from the property lines, as well as the expected depth of the excavation, sloping back of the excavation walls is not feasible and shoring will be required.

The design of the shoring system is normally the responsibility of the contractor or shoring designer, and therefore, is outside the scope of this report. However, the logs of borings presented with this report may be used for factual data such as soil types encountered at the location of each particular boring and at the indicated depths for a preliminary assessment of shoring requirements. Interpolation between the exploratory borings is at the user's own risk. Design work for shoring system should be performed by an engineer with expertise in shoring systems. The design of the temporary shoring should take into account

lateral pressures exerted by the adjacent soil, and, where present, surcharge loads due to adjacent embankments, buildings and any construction equipment or traffic expected to operate alongside the excavation.

Shoring on the sides of the excavation can be provided by means of a cantilever or restrained soldier beam or soldier pile and lagging wall. Lateral load resistance can be mobilized through the use of passive pressures on members that extend below the bottom of the excavation or interior bracing. Shoring must be designed with sufficient rigidity or must be supported by struts (bracing) to prevent deflection where in close proximity to structures. If the shoring is allowed to deflect, as occurs where designed as a cantilevered wall, settlement of the area behind the shoring will occur.

Whenever excavation is made adjacent to existing streets, utilities and structures, there is the potential for movement. The existing structures should be inspected and documented to preclude claims for damage or settlement that are not associated with the construction of the planned development. A monitoring program should be established so excessive movement is detected early. The monitoring program should include optical surveying of the shoring and adjacent streets and buildings to detect any horizontal or vertical movement.

UTILITY TRENCH LOCATION, CONSTRUCTION AND BACKFILL

To maintain the desired support for existing or new foundations, new utility trenches should be located such that the base of the trench excavation is located above an imaginary plane having an inclination of 1.0 horizontal to 1.0 vertical, extending downward from the bottom edge of the adjacent footing.

Utility trenches should be excavated according to accepted engineering practices following OSHA standards by a contractor experienced in such work. The responsibility for the safety of open trenches should be borne by the contractor. Traffic and vibration adjacent to trench walls should be kept to a minimum; cyclic wetting and drying of excavation side slopes should be avoided. Depending upon the location and depth of some utility trenches, groundwater flow into open excavations could be experienced, especially during or shortly following periods of precipitation. For purposes of this section of the report, backfill is defined as material placed in a trench starting one foot above the pipe; bedding and shading (also referred to as initial backfill) is all material placed in a trench below the backfill. With the exception of specific requirements of the local utility companies or building department, pipe bedding and shading should consist of clean medium-grained sand. The sand should be placed in a damp state and should be compacted by mechanical means prior to the placement of backfill soils. Above the pipe zone, underground utility trenches may be backfilled with either free-draining sand, on-site soil or imported soil. The trench backfill should be compacted to at least 95 percent relative compaction.

COMPACTED MATERIAL ACCEPTANCE

Compaction specifications are not the only criteria for acceptance of the site grading or other such activities. However, the compaction test is the most universally recognized test method for assessing the performance of the Grading Contractor. The numerical test results from the compaction test cannot be solely used to predict the engineering performance of the compacted material. Therefore, the acceptance of compacted materials will also be dependent upon the moisture-content and the stability of that material.

The Geotechnical Engineer has the option of rejecting any compacted material regardless of the degree of compaction if that material is considered to be too dry or excessively wet, unstable or if future instability is suspected. A specific example of rejection of fill material passing the required percent compaction is a fill which has been compacted with in situ moisture-content significantly less than optimum moisture. Where expansive soils are present, heaving of the soils may occur with the introduction of water. Where the material is a lean clay or silt, this type of dry fill (brittle fill) is susceptible to future settlement if it becomes saturated or flooded.

SURFACE DRAINAGE AND LANDSCAPING

The ground surface should slope away from building and pavement areas toward appropriate drop inlets or other surface drainage devices. We recommended that adjacent paved exterior grades be sloped a minimum of 2 percent for a minimum distance of 10 feet away from structures. These grades should be maintained for the life of the project. Roof drains should be designed to avoid discharging into landscape areas adjacent to the building. Downspouts should be directed to discharge directly onto paved surfaces to allow for surface drainage into the storm systems or should be connected directly to the on-site storm drain.

R-VALUE TEST RESULTS AND PAVEMENT DESIGN

Two R-Value samples were obtained from the project site at the location shown on the attached site plan. The samples were tested in accordance with the State of California Materials Manual Test Designation 301. Results of the test are as follows:

Sample	Depth	Description	R-Value at Equilibrium
1	0-36"	Silty Sand (SM)	30
2	0-36"	Clayey Sand (SC)	25

These test results are moderate and indicate good subgrade support characteristics under dynamic traffic loads. The following table shows the recommended pavement sections for various traffic indices.

Traffic Index	Asphaltic Concrete	Class II Aggregate Base*	Compacted Subgrade*
4.5	2.5"	6.0"	12.0"
5.0	2.5"	8.0"	12.0"
5.5	3.0"	8.0"	12.0"
6.0	3.0"	10.0"	12.0"
6.5	3.5"	10.0"	12.0"
7.0	4.0"	11.0"	12.0"

**** 95% compaction based on ASTM Test Method D1557 or CAL 216***
***** 95% compaction based on ASTM Test Method D1557 or CAL 216***

If traffic indices are not available, an estimated (typical value) index of 4.5 may be used for light automobile traffic, and an index of 7.0 may be used for light truck traffic.

PORTLAND CEMENT CONCRETE (RIGID) PAVEMENT

A minimum six-inch layer of compacted Class 2 Aggregate Base should be placed over the prepared subgrade prior to placement of the concrete pavements. With the addition of the aggregate base material, we recommend that a combined modulus of subgrade/base reaction value of 150 pounds per cubic inch be used in design where the rigid pavement is to be designed by a Structural Engineer.

Rigid pavement design procedures have been developed by various agencies, including AASHTO and the Portland Cement Association (PCA). We have evaluated the required pavement sections based on the procedure presented in "AASHTO Guide for Design of Pavement Structures 1993" traffic volumes.

RIGID PAVEMENT			
Traffic Index	**Portland Cement Concrete (inches)**	**Class 2 Aggregate Base (inches)**	**Compacted Subgrade (inches)**
5.0	5.0	6.0	12
7.0	6.5	6.0	12

Please note that the concrete modulus of rupture is based on *flexural strength*, not compressive strength, and should be specified accordingly. A *flexural strength* of 550 psi should be specified accordingly. Our experience is that the compressive strength will have to be on the order of 3,800 to 4,500 psi in order to achieve the required flexural strength. Prior to the construction of any rigid pavement, we recommend that concrete mix histories with flexural strength data be obtained from the proposed supplier. In the absence of flexural strength history, we recommend that laboratory trial batching and testing be performed to allow for confirmation that the proposed concrete mix is capable of producing the required flexural strength.

The concrete pavements should be designed with both longitudinal and transverse joints. The saw-cut or formed joints should extend to a minimum depth of one-fourth of the pavement thickness plus ¼ inch. Joint spacing should not exceed 15 feet. Steel reinforcement of all rigid pavements is recommended to keep the joints tight and to control temperature cracking.

Keyed joints are recommended at all construction joints to transfer loads across the joints. Joints should be reinforced with a minimum of ½ inch diameter by 48-inch long deformed reinforcing steel dowel bars placed at mid-slab depth on 18-inch center-to-center spacing to keep the joints tight for load transfer. The joints should be filled with a flexible sealer. Expansion joints should be constructed only where the pavements abut structures or fixed objects.

Smooth bar dowels, with a diameter of d/8, where d equals the thickness of the concrete, at least 14 inches in length, placed at a spacing of 12 inches on center, may also be considered for construction joints to transfer loads across the joints. The dowels should be centered across the joints with one side of the dowel lubricated to reduce the bond strength between the dowel and the concrete and fitted with a plastic cap to allow for bar expansion.

SOIL CORROSIVITY

Excessive sulfate in either the soil or native water may result in an adverse reaction between the cement in concrete (or stucco) and the soil. HUD/FHA and CBC have developed criteria for evaluation of sulfate levels and how they relate to cement reactivity with soil and/or water.

One soil sample was obtained from the site and tested in accordance with State of California Materials Manual Test Designation 417. The sulfate concentration detected from the soil sample indicated moderate sulfate exposure value as established by HUD/FHA and CBC. Therefore, it is recommended that concrete in contact with soil utilize Type II Cement and have a minimum compressive strength of 4,000 psi and a water to cement ratio of 0.50.

Electrical resistivity testing of the soil indicates that the onsite soils may have a severe potential for metal loss from electrochemical corrosion process. A qualified corrosion engineer should be consulted regarding the corrosion effects of the onsite soils on underground metal utilities.

ADDITIONAL SERVICES

Krazan & Associates should be retained to review your final foundation and grading plans, and specifications. It has been our experience that this review provides an opportunity to detect misinterpretation or misunderstandings with respect to the recommendations presented in this report prior to the start of construction.

Variations in soil types and conditions are possible and may be encountered during construction. In order to permit correlation between the soil data obtained during this investigation and the actual soil conditions encountered during construction, a representative of Krazan & Associates, Inc. should be present at the site during the earthwork and foundation construction activities to confirm that actual subsurface conditions are consistent with those contemplated in our development of this report. This will allow us the opportunity to compare actual conditions exposed during construction with those encountered in our investigation and to expedite supplemental recommendations if warranted by the exposed conditions. This activity is an integral part of our service, as acceptance of earthwork construction is dependent upon compaction testing and stability of the material. Krazan & Associates, Inc. will not be responsible for grades or staking, since this is the responsibility of the Prime Contractor.

All earthworks should be performed in accordance with the recommendations presented in this report, or as recommended by Krazan & Associates during construction. Krazan & Associates should be notified at least five working days prior to the start of construction and at least two days prior to when observation and testing services are needed. Krazan & Associates, Inc. will not be responsible for grades or staking, since this is the responsibility of the Prime Contractor.

The review of plans and specifications, and the observation and testing of earthwork related construction activities by Krazan & Associates are important elements of our services if we are to remain in the role of Geotechnical Engineer-Of-Record. If Krazan & Associates is not retained for these services, the client and the consultants providing these services will be assuming our responsibility for any potential claims that may arise during or after construction.

LIMITATIONS

Geotechnical Engineering is one of the newest divisions of Civil Engineering. This branch of Civil Engineering is constantly improving as new technologies and understanding of earth sciences advance. Although your site was analyzed using appropriate and current techniques and methods, undoubtedly there will be substantial future improvements in this branch of engineering. In addition to advancements in the field of Geotechnical Engineering, physical changes in the site due to site clearing or grading activities, new agency regulations, or possible changes in the proposed structure or development after issuance of this report will result in the need for professional review of this report. Updates or revisions to the recommendations report, and possibly additional study of the site may be required at that time. In light of this, the Owner should be aware that there is a practical limit to the usefulness of this report without critical review. Although the time limit for this review is strictly arbitrary, it is suggested that two years be considered a reasonable time for the usefulness of this report.

Foundation and earthwork construction is characterized by the presence of a calculated risk that soil and groundwater conditions have been fully revealed by the original foundation investigation. This risk is derived from the practical necessity of basing interpretations and design conclusions on limited sampling of the earth. The recommendations made in this report are based on the assumption that soil conditions do not vary significantly from those disclosed during our field investigation. The logs of the exploratory borings do not provide a warranty as to the conditions that may exist beneath the entire site. The extent and nature of subsurface soil and groundwater variations may not become evident until construction begins. It is possible that variations in soil conditions and depth to groundwater could exist beyond the points of exploration that may require additional studies, consultation, and possible design revisions. If conditions are encountered in the field during construction, which differ from those described in this report, our firm should be contacted immediately to provide any necessary revisions to these recommendations.

This report presents the results of our Geotechnical Engineering Investigation, which was conducted for the purpose of evaluating the soil conditions in terms of foundation and retaining wall design, and grading and paving of the site. This report does not include reporting of any services related to environmental studies conducted to assessment the presence or absence of hazardous and/or toxic materials in the soil, groundwater, or atmosphere, or the presence of wetlands. Any statements in this report or on any boring log regarding odors, unusual or suspicious items, or conditions observed, are strictly for descriptive purposes and are not intended to convey professional judgment regarding the presence of potentially hazardous or toxic substances. Conversely, the absence of statements in this report or on any boring log regarding odors, unusual or suspicious items, or conditions observed, does not constitute our rendering professional judgment regarding the absence of potentially hazardous or toxic substances.

The conclusions of this report are based on the information provided regarding the proposed construction. We emphasize that this report is valid for the project as described in the text of this report and it should not be used for any other sites or projects. The geotechnical engineering information presented herein is based upon our understanding of the proposed project and professional interpretation of the data obtained in our studies of the site. It is not warranted that such information and interpretation cannot be superseded by future geotechnical engineering developments. The Geotechnical Engineer should be notified of any changes to the proposed project so the recommendations may be reviewed and re-

evaluated. The work conducted through the course of this investigation, including the preparation of this report, has been performed in accordance with the generally accepted standards of geotechnical engineering practice, which existed in geographic area of the project at the time the report was written. No other warranty, express or implied, is made. This report is issued with the understanding that the owner chooses the risk they wish to bear by the expenditures involved with the construction alternatives and scheduling that are chosen.

If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (951) 273-1011.

Respectfully submitted,
KRAZAN & ASSOCIATES, INC.

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APPENDIX A

FIELD AND LABORATORY INVESTIGATIONS

Field Investigation

Our field investigation consisted of a surface reconnaissance and a subsurface exploration program consisted of drilling, logging and sampling a total of eleven (11) borings. The depth of exploration was approximately 20 to 50 feet below the existing site surface.

A member of our staff visually classified the soils in the field as the drilling progressed and recorded a continuous log of each boring. Visual classification of the soils encountered in our exploratory borings was made in general accordance with the Unified Soil Classification System (ASTM D2487). A key for the classification of the soil and the boring logs are presented in this Appendix.

During drilling operations, penetration tests were performed at regular intervals to evaluate the soil consistency and to obtain information regarding the engineering properties of the subsoils. Samples were obtained from the borings by driving either a 2.5-inch inside diameter Modified California tube sampler fitted with brass sleeves or a 2-inch outside diameter, 1-3/8-inch inside diameter Standard Penetration ("split-spoon") test (SPT) sampler without sleeves. Soil samples were retained for possible laboratory testing. The samplers were driven up to a depth of 18 inches into the underlying soil using a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler was recorded for each 6-inch penetration interval and the number of blows required to drive the sampler the last 12 inches are shown as blows per foot on the boring logs.

The approximate locations of our borings and bulk samples are shown on the Site Plan, Figure 2. These approximate locations were estimated in the field based on pacing and measuring from the limits of existing site features.

Laboratory Investigation

The laboratory investigation was programmed to determine the physical and mechanical properties of the soil underlying the site. The laboratory-testing program was formulated with emphasis on the evaluation of in-situ moisture, density, gradation, shear strength, consolidation potential, and R-value of the materials encountered. In addition, chemical tests were performed to evaluate the soil/cement reactivity and corrosivity. Test results were used in our engineering analysis with respect to site and building pad preparation through mass grading activities, foundation and retaining wall design recommendations, pavement section design, evaluation of the materials as possible fill materials and for possible exclusion of some soils from use at the structures as fill or backfill.

Select laboratory test results are presented on the boring logs, with graphic or tabulated results of selected tests included in this Appendix. The laboratory test data, along with the field observations, was used to prepare the final boring logs presented in the Appendix.

APPENDIX B

EARTHWORK SPECIFICATIONS

GENERAL

When the text of the report conflicts with the general specifications in this appendix, the recommendations in the report have precedence.

SCOPE OF WORK: These specifications and applicable plans pertain to and include all earthwork associated with the site rough grading, including, but not limited to, the furnishing of all labor, tools and equipment necessary for site clearing and grubbing, stripping, preparation of foundation materials for receiving fill, excavation, processing, placement and compaction of fill and backfill materials to the lines and grades shown on the project grading plans and disposal of excess materials.

PERFORMANCE: The Contractor shall be responsible for the satisfactory completion of all earthworks in accordance with the project plans and specifications. This work shall be inspected and tested by a representative of Krazan and Associates, Incorporated, hereinafter referred to as the Geotechnical Engineer and/or Testing Agency. Attainment of design grades, when achieved, shall be certified by the project Civil Engineer. Both the Geotechnical Engineer and the Civil Engineer are the Owner's representatives. If the Contractor should fail to meet the technical or design requirements embodied in this document and on the applicable plans, he shall make the necessary adjustments until all work is deemed satisfactory as determined by both the Geotechnical Engineer and the Civil Engineer. No deviation from these specifications shall be made except upon written approval of the Geotechnical Engineer, Civil Engineer, or project Architect.

No earthwork shall be performed without the physical presence or approval of the Geotechnical Engineer. The Contractor shall notify the Geotechnical Engineer at least 2 working days prior to the commencement of any aspect of the site earthwork.

The Contractor agrees that he shall assume sole and complete responsibility for job site conditions during the course of construction of this project, including safety of all persons and property; that this requirement shall apply continuously and not be limited to normal working hours; and that the Contractor shall defend, indemnify and hold the Owner and the Engineers harmless from any and all liability, real or alleged, in connection with the performance of work on this project, except for liability arising from the sole negligence of the Owner or the Engineers.

TECHNICAL REQUIREMENTS: All compacted materials shall be densified to the minimum relative compaction of 95 percent. Soil moisture content requirements presented in the Geotechnical Engineer's report shall also be complied with. The maximum laboratory compacted dry unit weight of each soil placed as fill shall be determined in accordance with ASTM Test Method D1557-00 (Modified Proctor). The optimum moisture content shall also be determined in accordance with this test method. The terms "relative compaction" and "compaction" are defined as the in-place dry density of the compacted soil divided by the laboratory compacted maximum dry density as determined by ASTM Test Method D1557-00, expressed as a percentage as specified in the technical portion of the Geotechnical Engineer's report. The location and frequency of field density tests shall be as determined by the Geotechnical Engineer. The results of these tests and compliance with these specifications shall be the basis upon which the Geotechnical Engineer will judge satisfactory completion of work.

SOILS AND FOUNDATION CONDITIONS: The Contractor is presumed to have visited the site and to have familiarized himself with existing site conditions and the contents of the data presented in the Geotechnical Engineering Investigation report.

The Contractor shall make his own interpretation of the data contained in the Geotechnical Engineering Investigation report and the Contractor shall not be relieved of liability under the Contract for any loss sustained as a result of any variance between conditions indicated by or deduced from said report and the actual conditions encountered during the progress of the work.

DUST CONTROL: The work includes dust control as required for the alleviation or prevention of any dust nuisance on or about the site or the borrow area, or off-site if caused by the Contractor's operation either during the performance of the earthwork or resulting from the conditions in which the Contractor leaves the site. The Contractor shall assume all liability, including court costs of codefendants, for all claims related to dust or wind-blown materials attributable to his work.

SITE PREPARATION

Site preparation shall consist of site clearing and grubbing, over-excavation of the proposed building pad areas, preparation of foundation materials for receiving fill, construction of Engineered Fill including the placement of non-expansive fill where recommended by the Geotechnical Engineer.

CLEARING AND GRUBBING: The Contractor shall accept the site in this present condition and shall demolish and/or remove from the area of designated project earthwork all structures, both surface and subsurface, trees, brush, roots, debris, organic matter and all other matter determined by the Geotechnical Engineer to be deleterious. Site stripping to remove organic materials and organic-laden soils in landscaped areas shall extend to a minimum depth of 2 inches or until all organic-laden soil with organic matter in excess of 3 percent of the soils by volume are removed. Such materials shall become the property of the Contractor and shall be removed from the site.

Tree root systems in proposed building areas should be removed to a minimum depth of 3 feet and to such an extent that would permit removal of all roots greater than 1 inch in diameter. Tree roots removed in parking areas may be limited to the upper 1½ feet of the ground surface. Backfill of tree root excavation should not be permitted until all exposed surfaces have been inspected and the Geotechnical Engineer is present for the proper control of backfill placement and compaction. Burning in areas that are to receive fill materials shall not be permitted.

Excavations required to achieve design grades, depressions, soft or pliant areas, or areas disturbed by demolition activities extending below planned finished subgrade levels should be excavated down to firm, undisturbed soil and backfilled with Engineered Fill. The resulting excavations should be backfilled with Engineered Fill.

EXCAVATION: Following clearing and grubbing operations, the proposed building pad area shall be over-excavated to a depth of at least two feet below existing grades or one foot below the planned foundation bottom levels, whichever is deeper, and the remaining areas of the building and adjoining exterior concrete flatwork or pavements at the building perimeter shall be over-excavated to a depth of at least one foot below existing grade. The areas of over-excavation and recompaction beneath footings and slabs shall extend out laterally a minimum of five feet beyond the perimeter of these elements.

All excavation shall be accomplished to the tolerance normally defined by the Civil Engineer as shown on the project grading plans. All over-excavation below the grades specified shall be backfilled at the

Contractor's expense and shall be compacted in accordance with the applicable **TECHNICAL REQUIREMENTS**.

SUBGRADE PREPARATION: Surfaces to receive Engineered Fill or to support structures directly, shall be scarified to a depth of 8 inches, moisture conditioned as necessary and compacted in accordance with the **TECHNICAL REQUIREMENTS**, above.

Loose soil areas and/or areas of disturbed soil shall be should be excavated down to firm, undisturbed soil, moisture-conditioned as necessary and backfilled with Engineered Fill. All ruts, hummocks, or other uneven surface features shall be removed by surface grading prior to placement of any fill materials. All areas that are to receive fill materials shall be approved by the Geotechnical Engineer prior to the placement of any of the fill material.

FILL AND BACKFILL MATERIAL: No material shall be moved or compacted without the presence of the Geotechnical Engineer. Material from the required site excavation may be utilized for construction of site fills, with the limitations of their use presented in the Geotechnical Engineer's report, provided the Geotechnical Engineer gives prior approval. All materials utilized for constructing site fills shall be free from vegetation or other deleterious matter as determined by the Geotechnical Engineer, and shall comply with the requirements for non-expansive fill, aggregate base or aggregate subbase as applicable for its proposed used on the site as presented in the Geotechnical Engineer's report.

PLACEMENT, SPREADING AND COMPACTION: The placement and spreading of approved fill materials and the processing and compaction of approved fill and native materials shall be the responsibility of the Contractor. Fill materials should be placed and compacted in horizontal lifts, each not exceeding 8 inches in uncompacted thickness. Due to equipment limitations, thinner lifts may be necessary to achieve the recommended level of compaction. Compaction of fill materials by flooding, ponding, or jetting shall not be permitted unless specifically approved by local code, as well as the Geotechnical Engineer. Additional lifts should not be placed if the previous lift did not meet the required dry density (relative compaction) or if soil conditions are not stable. The compacted subgrade in pavement areas should be non-yielding when proof-rolled with a loaded ten-wheel truck, such as a water truck or dump truck, prior to pavement construction.

Both cut and fill shall be surface-compacted to the satisfaction of the Geotechnical Engineer prior to final acceptance.

SEASONAL LIMITS: No fill material shall be placed, spread, or rolled while it is frozen or thawing, or during unfavorable wet weather conditions. When the work is interrupted by heavy rains, fill operations shall not be resumed until the Geotechnical Engineer indicates that the moisture content and density of previously placed fill is as specified.

APPENDIX C

PAVEMENT SPECIFICATIONS

1. DEFINITIONS - The term "pavement" shall include asphalt concrete surfacing, untreated aggregate base, and aggregate subbase. The term "subgrade" is that portion of the area on which surfacing, base, or subbase is to be placed.

The term "Standard Specifications": hereinafter referred to is the January 1999 Standard Specifications of the State of California, Department of Transportation, and the "Materials Manual" is the Materials Manual of Testing and Control Procedures, State of California, Department of Public Works, Division of Highways. The term "relative compaction" refers to the field density expressed as a percentage of the maximum laboratory density as defined in the ASTM D1557-00.

2. SCOPE OF WORK - This portion of the work shall include all labor, materials, tools, and equipment necessary for, and reasonably incidental to the completion of the pavement shown on the plans and as herein specified, except work specifically notes as "Work Not Included."

3. PREPARATION OF THE SUBGRADE - The Contractor shall prepare the surface of the various subgrades receiving subsequent pavement courses to the lines, grades, and dimensions given on the plans. The upper 12 inches of the soil subgrade beneath the pavement section shall be compacted to a minimum relative compaction of 95 percent. The finished subgrades shall be tested and approved by the Geotechnical Engineer prior to the placement of additional pavement courses.

4. UNTREATED AGGREGATE BASE - The aggregate base material shall be spread and compacted on the prepared subgrade in conformity with the lines, grades, and dimensions shown on the plans. The aggregate base material shall conform to the requirements of Section 26 of the Standard Specifications for Class 2 material, ¾-inches maximum size. The aggregate base material shall be compacted to a minimum relative compaction of 95 percent. The aggregate base material shall be spread and compacted in accordance with Section 26 of the Standard Specifications. The aggregate base material shall be spread in layers not exceeding 6 inches and each layer of aggregate material course shall be tested and approved by the Geotechnical Engineer prior to the placement of successive layers.

5. AGGREGATE SUBBASE - The aggregate subbase shall be spread and compacted on the prepared subgrade in conformity with the lines, grades, and dimensions shown on the plans. The aggregate subbase material shall conform to the requirements of Section 25 of the Standard Specifications for Class II material. The aggregate subbase material shall be compacted to a minimum relative compaction of 95 percent, and it shall be spread and compacted in accordance with Section 25 of the Standard Specifications. Each layer of aggregate subbase shall be tested and approved by the Geotechnical Engineer prior to the placement of successive layers.

6. ASPHALT CONCRETE SURFACING - Asphalt concrete surfacing shall consist of a mixture of mineral aggregate and paving grade asphalt, mixed at a central mixing plant and spread and compacted on a prepared base in conformity with the lines, grades, and dimensions shown on the plans. The viscosity grade of the asphalt shall be AR-8000. The mineral aggregate shall be Type B, ½-inch or ¾-inch maximum, medium grading, for the wearing course and ¾-inch maximum, medium grading for the base course, and shall conform to the requirements set forth in Section 39 of the Standard Specifications. The drying, proportioning, and mixing of the materials shall conform to Section 39.

The prime coat, spreading and compacting equipment, and spreading and compacting the mixture shall conform to the applicable chapters of Section 39, with the exception that no surface course shall be placed when the atmospheric temperature is below 50 degrees F. The surfacing shall be rolled with a combination steel-wheel and pneumatic rollers, as described in Section 39-6. The surface course shall be placed with an approved self-propelled mechanical spreading and finishing machine.

7. FOG SEAL COAT - The fog seal (mixing type asphalt emulsion) shall conform to and be applied in accordance with the requirements of Section 37.