DANA POINT · CALIFORNIA
1989

# 11.5 Hydrology/WQMP

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FUSCOE
ENGINEERING

# VICTORIA BOULEVARD APARTMENTS

26126 VICTORIA BOULEVARD, DANA POINT,, CALIFORNIA

## PRELIMINARY HYDROLOGY ANALYSIS

PREPARED FOR
TOLL BROTHERS APARTMENT LIVING
23422 MILL CREEK DRIVE, SUITE 105,
LAGUNA HILLS, CA 92653

SHELBY L. SHIRLOCK
NO. C75912
06/16/2021

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PROJECT MANAGER
SHELBY SHIRLOCK, P.E.

DATE PREPARED: FEBRUARY, 2020
DATE REVISED: JUNE, 2021

PROJECT NUMBER: [1665.004.01]

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PRELIMINARY HYDROLOGY ANALYSIS

# VICTORIA BOULEVARD APARTMENTS

DANA POINT, CA – ORANGE COUNTY
JUNE, 2021

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PRELIMINARY HYDROLOGY ANALYSIS

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VICTORIA BOULEVARD APARTMENTS

DANA POINT, CA – ORANGE COUNTY
JUNE, 2021

# PRELIMINARY HYDROLOGY ANALYSIS

FOR

# VICTORIA APARTMENTS

26126 Victoria Boulevard,
Dana Point, CA,
County of Orange

Prepared By:

Shelby Shirlock, PE RCE C75912
Fuscoe Engineering, Irvine
16795 Von Karman #100
Irvine, CA 92606

For

TOLL BROTHERS APARTMENT LIVING
23422 Mill Creek Drive, Suite 105
Laguna Hills, CA 92653

## TABLE OF CONTENTS

# 1.0 INTRODUCTION

## 1.1 GEOGRAPHIC SETTING

The proposed project VICTORIA APARTMENTS consists of about 5.5 acres and is located in the City of Dana Point, Orange County, California. The project site is bounded by Victoria Boulevard to the northeast, Sepulveda Avenue to the northwest & the 5-freeway exit off-ramp transition to PCH 1-freeway to the south.

The majority of the project site is located within FEMA flood zone 'X' per FEMA Flood Insurance Rate Map (FIRM) No. 06059C0508K, map revised March 21, 2019. Flood Zone 'X' represents areas of minimum flood hazard (See Appendix 1). A portion of the site along Sepulveda Ave. is shown to be slightly within or adjacent to FEMA flood zone 'A' (no Base Flood Elevation determined). The City of Dana Point has provided a supplemental draft FEMA flood map and reference exhibits from a LOMR for the San Juan Creek area that is in the process of being adopted (See Appendix 5). Per this updated study and FIRM, the Flood Zone A is delineated to be retained almost completely within the public right of way of Sepulveda Avenue. The LOMR study determines the flooding depths within Sepulveda to be 1.5', which would be the best available data to determine the Base Flood Elevation within this zone. The proposed project takes this 1.5' flooding depth within Sepulveda into consideration.

## 1.2 PURPOSE OF THIS REPORT

The purpose of this report is to identify and analyze the existing and post-project drainage conditions in order to provide adequate drainage facilities for the proposed development and understand the impacts to the existing public infrastructures located in the City of Dana Point, California.

This drainage study will analyze and compare the 10-year, 25-year & 100-year storm events for the existing and proposed conditions. Outcomes of the analysis will facilitate the conceptual layout of a drainage system to adequately convey storm runoff through the site without adversely impacting surrounding areas.

This analysis will also demonstrate that the storm water and flood protection goals as outlined in the Orange County Design Manual have been met. See Section 4.0 for Design Criteria.

## 1.3 REFERENCES

The following references were used to evaluate hydrologic conditions and water quality requirements:

- Orange County Hydrology Manual (October 1986)
- Orange County Hydrology Manual Addendum No. 1 (1996)
- Orange County Local Drainage Manual (January 1996)
- City of Dana Point grading and drainage requirements
- Federal Emergency Management Agency; FEMA Service Center (Web based)

## 1.4 PROJECT SITE LOCATION MAP

The Project Site is identified in the location map shown below.

Soil Map Type D per figure C-1 of Orange County Hydrology Manual (see *Appendix 1*).

# 2.0 EXISTING TOPOGRAPHIC & HYDROLOGIC CONDITIONS

## 2.1 EXISTING TOPOGRAPHY

The approximate 5.5-acre project site area is an existing school maintenance facility and bus parking yard which is mostly impervious. Victoria Boulevard and Sepulveda that bounds the property to the northeast and northwest respectively, are traditional public streets with conventional gutter system, which is mostly impervious. The State Route 1 slope that bounds the property to south, is mostly pervious and vegetated. The existing site generally slopes from the northeasterly to southwesterly area of the property.

## 2.2 EXISTING DRAINAGE PATTERN AND STORM DRAIN FACILITIES

Existing site drainage flows from the southeast to northwest end as shown in subareas of the Existing Condition Hydrology Map (*Appendix 2* for reference).

Drainage Subarea A (0.57 Ac) is a portion of the site that flows into Victoria Boulevard's gutter system, which is drained by an existing 18-inch SD pipe. This 18-inch pipe connects to an existing 30-inch storm drain main that flows to the west towards Sepulveda Avenue.

Drainage Subarea B (3.29 Ac) is a portion of the site that flows into Sepulveda Avenue's gutter system, which is drained by an existing 18-inch storm drain pipe. This 18-inch pipe connects to the existing 36-inch RCP storm drain main that flows south towards an open transition structure at the southwestern end of Sepulveda Ave.

Drainage Subarea C (1.66 Ac) is a portion along the southerly edge of the project site of the that flows towards Sepulveda Avenue to the west and drains towards the same transition structure that Subareas A & B are draining into.

Drainage Subarea D (1.70 Ac) is an offsite portion of the 1 freeway to the south, that drains towards Sepulveda Avenue's street & gutter system. Flows from this area comingles with Subarea C flows that eventually drains towards the same open transition structure that Subareas A & B are draining into.

Flows from the open transition structure are conveyed by 2 existing 36" storm drain pipes downstream.

The existing 36" storm drain that the project site is tributary to was appropriately sized to accommodate the fully developed project site. The drainage conveyance downstream connects into San Juan Creek, which is a large river and exempted by the South Orange County Hydromodification Plan, then ultimately discharging into the Pacific Ocean.

# 3.0 PROPOSED PROJECT & HYDROLOGIC CONDITIONS

## 3.1 PROPOSED PROJECT

The Victoria Apartment project will consist of a 5-story, 400 dwelling unit wrap apartment buildings, a concrete parking structure, common amenity courtyard & landscaped amenities, common emergency drive aisles, and fire lane south of the apartment buildings.

## 3.2 PROPOSED DRAINAGE PATTERN AND STORM DRAIN FACILITIES

The proposed project area is divided into four drainage subareas (see Proposed Hydrology Map in *Appendix 2* for reference). The overall drainage strategy is to convey onsite stormwater runoff into a private onsite storm drain system that mitigates the proposed runoff's water quality, hydraulic and volumetric parameters per the regulating agencies (City of Dana Point and County of Orange) drainage codes. There will be several drainage management areas defined in the water quality analysis which the low flows will be treated by proprietary biofiltration structural BMP planters (Modular Wetlands) at the respective collection points. The site is deemed exempted to hydromodification requirements, therefore not requiring the storm drain system to mitigation for hydromodification.

The proposed Drainage Subarea A (1.89 Ac), which occupies majority of the northern portion of the project site, consists of the northerly portions of the apartment buildings, common amenity courtyard & landscaped amenities. The drainage in this area will flow to several onsite catch basins and biofiltration structural BMP planters, as required per the project -specific WQMP. The downstream onsite storm drain will be designed to convey the 25-yr (high) flows and tie into the existing 30-inch RCP storm drain pipe downstream via a new connection.

Drainage Subarea B (0.41Ac) consists of westerly portions of the apartment building. The drainage will flow to proposed onsite diversion structure and biofiltration structural BMP planter, as required per the project -specific WQMP. The downstream storm drain will be designed to convey the 25-yr (high) flows and tie into the existing 36-inch storm downstream.

Drainage Subareas C (3.22 Ac), located to the south of the property, consists of portions of garage structure, southerly portions of the apartment buildings common amenity courtyard & landscaped amenities. The drainage will flow to proposed onsite catch basins and biofiltration structural BMP planters, as required per the project -specific WQMP. The high flows designed to convey the 25-yr storm will drain into a new 24" storm drain pipe along the southerly fire lane. The 24" storm drain will tie into the proposed realignment of the existing 36" storm drain along Sepulveda. Runoff from this 36" storm drain will discharge into the existing open transition structure downstream of Sepulveda.

Drainage Subarea D (1.70 Ac) is the offsite portion of the 1 freeway adjacent to the south of the property consisting of mostly vegetation and pervious surface. The offsite runoff will be captured by a V-ditch gutter and discharge on the adjacent landscape surface towards Sepulveda Avenue's street & gutter system and onto the open headwall transition structure. The offsite surface runoff will eventually join with the onsite runoff downstream of the 36" inch storm drain at the existing open transition structure. From the transition structure, flows will continue southerly towards 2 existing 36" storm drains. Runoff will ultimately discharge to San Juan Creek, and then into the Pacific Ocean.

# 4.0 DESIGN CRITERIA

- The proposed storm drain systems will be designed to be consistent with the following goals and guidelines:
- Onsite design storm is based on a 25-year frequency in sump conditions for catch basins and the connecting storm drains also use a 25-year frequency.
- Velocity should not exceed 20 FPS in a standard wall R.C.P.
- Where velocity exceeds 20 FPS, a special wall R.C.P. with a minimum of 1½-inch steel clearance on the inside surface shall be used.
- Maximum velocity in special cover R.C.P. shall be 45 FPS.
- On local streets one lane shall be free of storm water in a 25-year storm event.
- Maximum W.S. in CB's for design conditions shall be 0.5' below inlet (FL.) elevation.
- Once water is picked up in a storm drain, it should remain in the system.
- Pipe size may not be decreased downstream without the City's approval.

# 5.0 RESULT SUMMARY AND CONCLUSIONS

A summary of the 10-year, 25-year & 100-year peak flow analysis for existing and proposed conditions are provided below.

The City of Dana Point Public Storm Drain along Victoria and Sepulveda appears to be designed to accommodate Peak 10-year flows.

The downstream existing 36-inch storm drain was designed to have the capacity assuming a fully developed project site parcel of a similar development type (existing Maintenance Yard vs. Apartments) and is properly sized to accommodate the proposed calculated 10-year peak flows.

Per Table 5.3, the proposed project storm drain design and hydrologic impacts result in a slight decrease in Q generated from the project site when comparing proposed to existing calculated Qs. Though slightly increasing the Q for a short portion of the existing storm drain within the Victoria ROW, it is anticipated that this should have no significant hydraulic impacts on the existing storm drain.

It is our opinion that the proposed storm drain system will not have an adverse effect on any of the existing or proposed improvements within the project or adjacent public streets. In addition, all design criteria outlined above will be met and provided in the final hydrology report.

*Hydrology Calculations for Tables below are provided in Appendices 2, 3, 4 and 5.*

### OVERALL SITE STORM RUNOFF (AREAS A, B, C)
### Table 5.1

| Peak Q Summary | | | | |
|---|---|---|---|---|
| **Storm Event** | Existing (CFS) | Proposed (CFS) | Δ (CFS) | Percentage Change |
| **10-Year** | 15.80 | 15.71 | -0.09 | -0.6 % |
| **25-Year** | 18.94 | 18.73 | -0.20 | -1.1 % |
| **100-Year** | 24.40 | 24.03 | -0.37 | -1.5 % |

### "OFF-SITE" STORM RUNOFF (AREA D)
### Table 5.2

| Peak Q Summary | | | | |
|---|---|---|---|---|
| **Storm Event** | Existing (CFS) | Proposed (CFS) | Δ (CFS) | Percentage Change |
| **10-Year** | 4.07 | 4.02 | -0.05 | -1.2 % |
| **25-Year** | 4.94 | 4.87 | -0.07 | -1.4 % |
| **100-Year** | 6.41 | 6.34 | -0.07 | -1.1 % |

## PUBLIC STORM DRAIN IMPACT
### Table 5.3

| Peak 10-year Storm Summary | | | | | |
|---|---|---|---|---|---|
| Remarks | Nodes | | Peak Flows | | |
| Notes | Existing | Proposed | Existing (CFS) | Proposed (CFS) | Design *(CFS) |
| Victoria SDMH @ 24" SD | 40 | 30 | **27.0 | 29.9 | 27.0 |
| Victoria JS Line A-5 to 30" SD | 60 | 40 | 31.3 | 32.6 | 39.0 |
| Victoria JS Line A-3 to 36" SD | 70 | 70 | 38.3 | 42.3 | 46.0 |
| Sepulveda JS Line A-2 to 36" SD | 80 | 80 | 38.8 | 42.8 | 60.0 |
| Sepulveda JS Line A-1 to 36" SD | 120 | 130 | 45.8 | 45.5 | 67.0 |
| Headwall Outlet | 450 | 450 | 59.1 | 58.5 | 67.0 |

* - Obtained from Sepulveda/Victoria Storm As-Built Records.

** - Assuming total capture of design Q10

# 6.0 APPENDICES

| | |
|---|---|
| *Appendix 1* | *Supporting Maps and Plans* |
| | *Soil Map, Fema Map & Existing Storm Drain Improvement Plans* |
| *Appendix 2* | *Hydrology Maps* |
| | *Existing and Proposed Conditions* |
| *Appendix 3* | *Existing Hydrology Calculations* |
| | *10 year, 25 year & 100 year storm frequencies* |
| *Appendix 4* | *Proposed Hydrology Calculations* |
| | *10 year, 25 year & 100 year storm frequencies* |
| *Appendix 5* | *Draft FIRM and LOMR Exhibits* |

# APPENDIX 1

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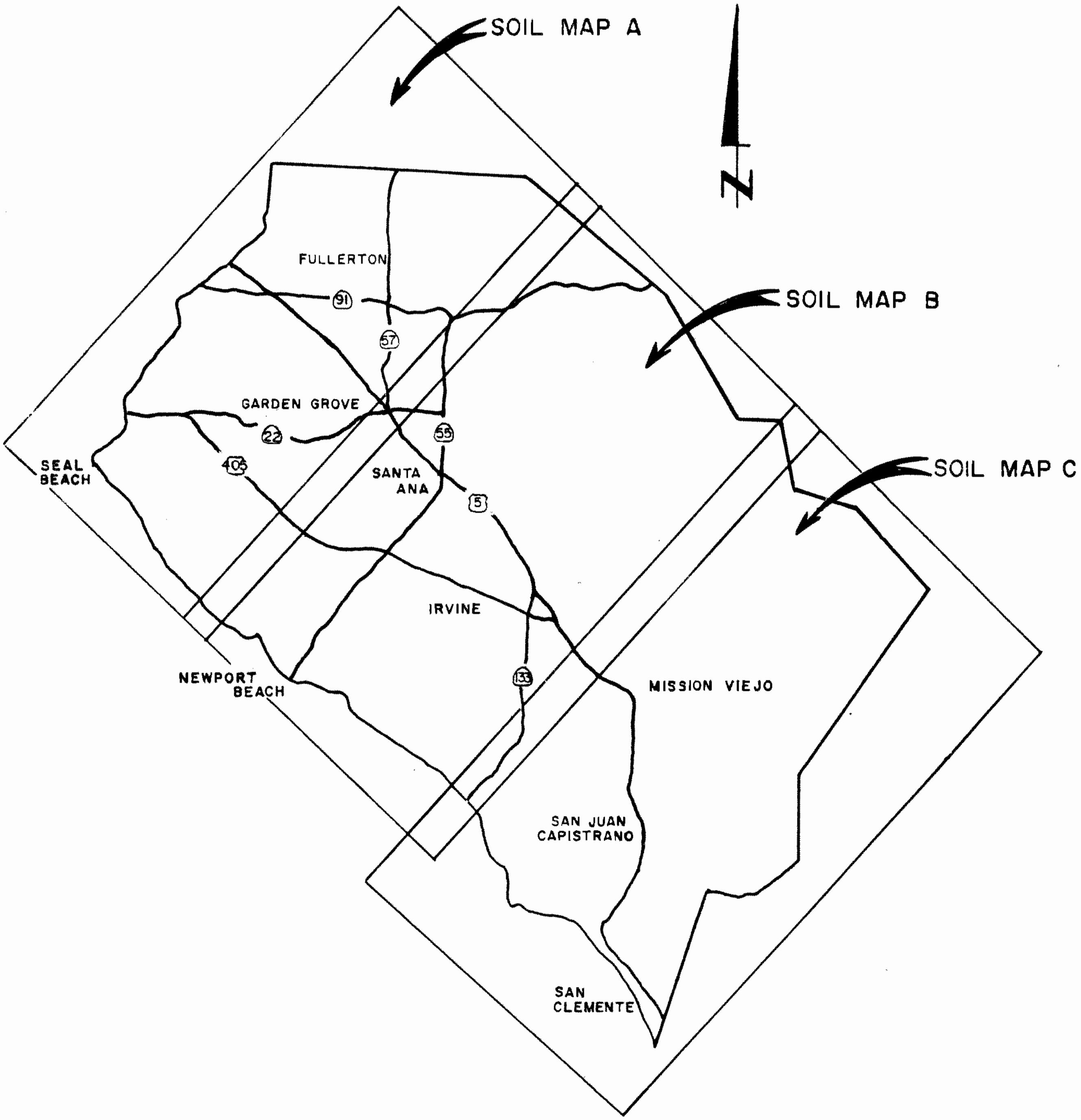
# SUPPORTING MAPS AND PLANS



(SEE SOIL MAPS IN POCKET)

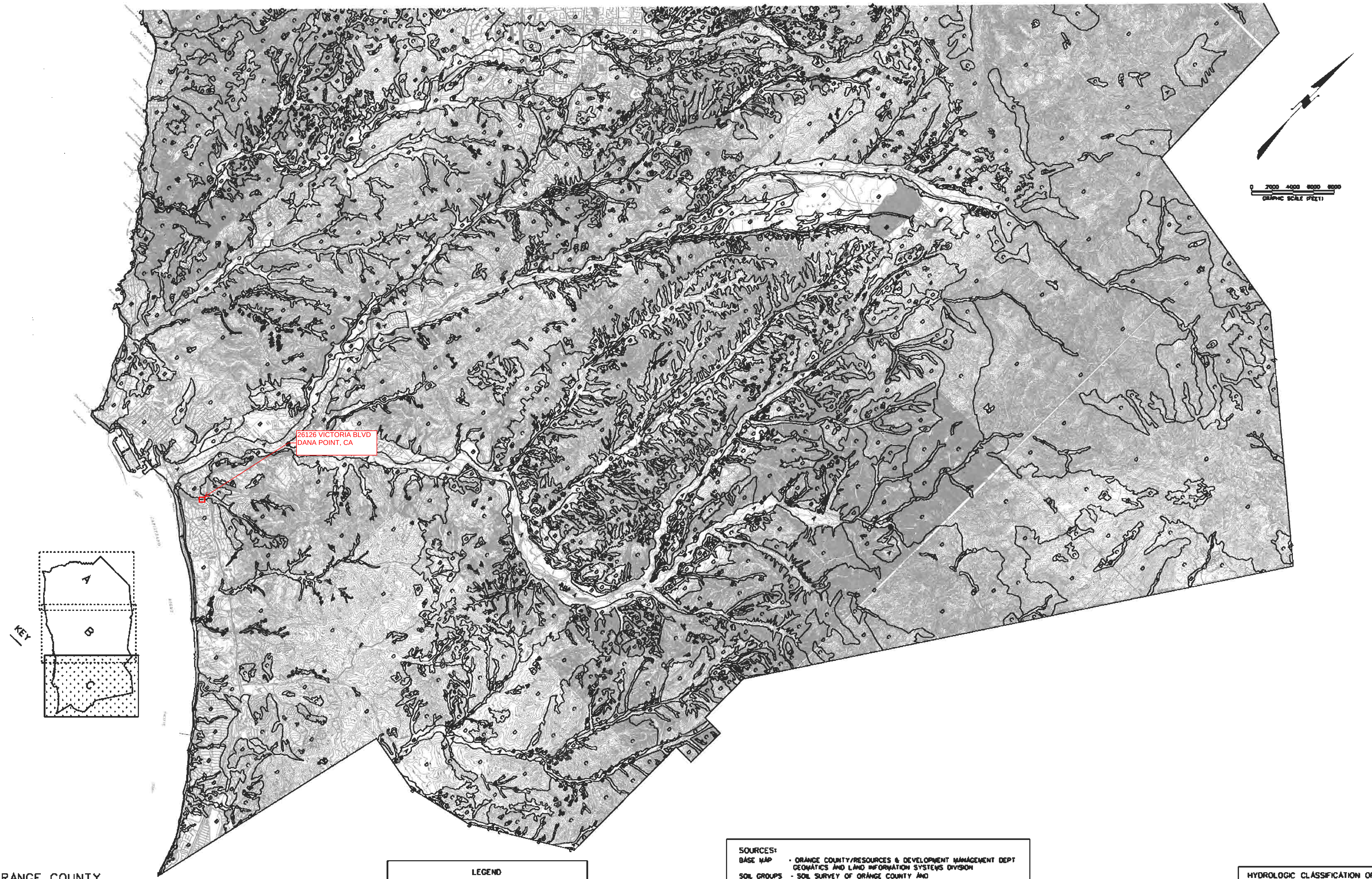
**ORANGE COUNTY**

**HYDROLOGY MANUAL**

ORANGE COUNTY

SOIL MAP INDEX

Figure C-1



ORANGE COUNTY
HYDROLOGY MANUAL

LEGEND

| | |
|---|---|
| A B C D | HYDROLOGIC SOIL GROUPS |
| ——— | HYDROLOGIC SOIL GROUP BOUNDARY |

SOURCES:

| | |
|---|---|
| BASE MAP | - ORANGE COUNTY/RESOURCES & DEVELOPMENT MANAGEMENT DEPT GEOMATICS AND LAND INFORMATION SYSTEMS DIVISION |
| SOIL GROUPS | - SOIL SURVEY OF ORANGE COUNTY AND WESTERN PART OF RIVERSIDE COUNTY, CALIFORNIA, USDA, SOIL CONSERVATION SERVICE, 1978. |

HYDROLOGIC CLASSIFICATION OF SOILS
ORANGE COUNTY, CALIFORNIA
PLATE C

# National Flood Hazard Layer FIRMette

**FEMA**

## Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

| | | |
|---|---|---|
| SPECIAL FLOOD HAZARD AREAS | 🟦 | Without Base Flood Elevation (BFE) *Zone A, V, A99* |
| | | With BFE or Depth *Zone AE, AO, AH, VE, AR* |
| | ▨ | Regulatory Floodway |
| OTHER AREAS OF FLOOD HAZARD | 🟧 | 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X* |
| | ▨ | Future Conditions 1% Annual Chance Flood Hazard *Zone X* |
| | ▨ | Area with Reduced Flood Risk due to Levee. See Notes. *Zone X* |
| | ▨ | Area with Flood Risk due to Levee *Zone D* |
| OTHER AREAS | NO SCREEN | Area of Minimal Flood Hazard *Zone X* |
| | ▭ | Effective LOMRs |
| | 🟧 | Area of Undetermined Flood Hazard *Zone D* |
| GENERAL STRUCTURES | — — — | Channel, Culvert, or Storm Sewer |
| | IIIIIII | Levee, Dike, or Floodwall |
| OTHER FEATURES | B 20.2<br>17.5 | Cross Sections with 1% Annual Chance Water Surface Elevation |
| | 8 — — | Coastal Transect |
| | 513 | Base Flood Elevation Line (BFE) |
| | — | Limit of Study |
| | — | Jurisdiction Boundary |
| | — - — | Coastal Transect Baseline |
| | — | Profile Baseline |
| | — | Hydrographic Feature |
| MAP PANELS | ☐ | Digital Data Available |
| | ☐ | No Digital Data Available |
| | ☒ | Unmapped |

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 10/1/2019 at 12:07:31 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

# CITY OF DANA POINT

## CALIFORNIA

# CONSTRUCTION PLAN

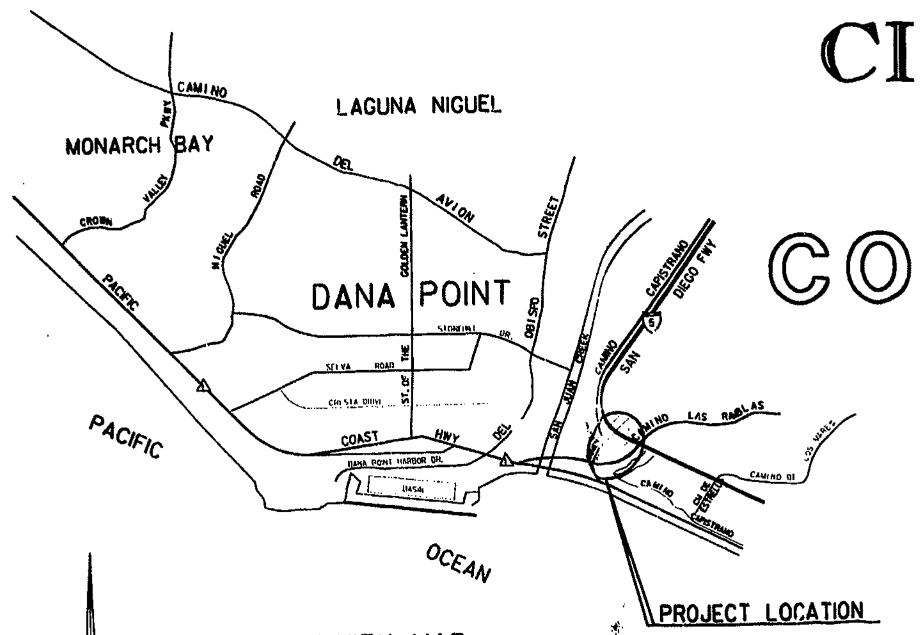
FOR

## STREET IMPROVEMENTS IN
## VICTORIA BOULEVARD
FROM SEPULVEDA AVENUE TO CAMINO CAPISTRANO

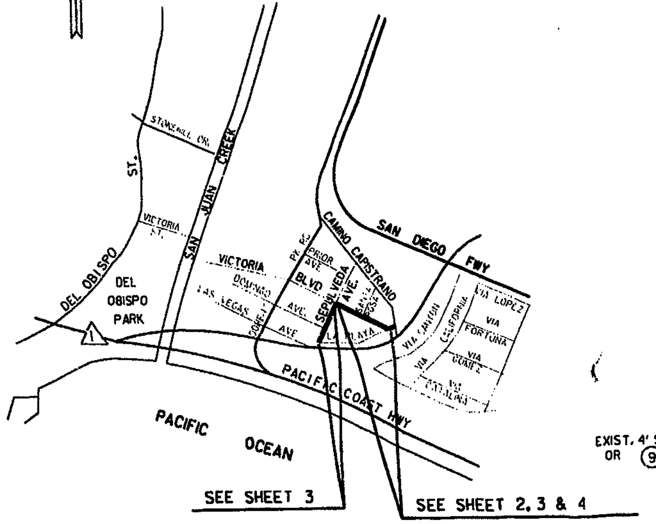
AND

## STORM DRAIN IMPROVEMENTS IN
## SEPULVEDA AVENUE
FROM 250 FT. SOUTH OF DOMINGO AVE. TO VICTORIA BLVD.

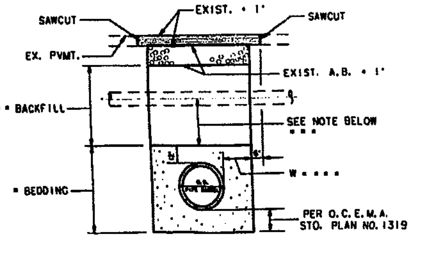
## AND VICTORIA BOULEVARD
FROM SEPULVEDA AVENUE TO CAMINO CAPISTRANO



VICINITY MAP
NOT TO SCALE



KEY MAP
NOT TO SCALE



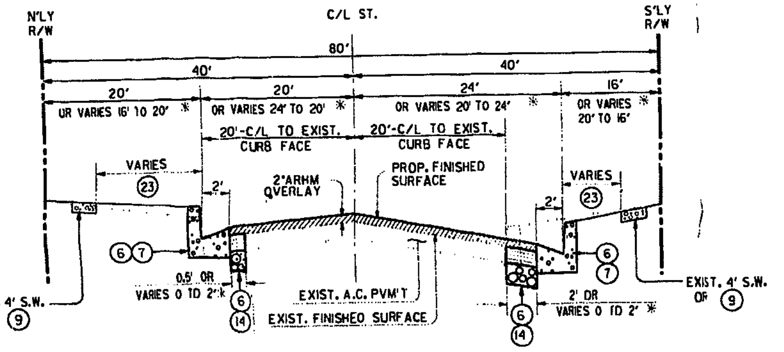
TYPICAL TRENCH DETAIL
N.T.S.

* PIPE BEDDING IN TRENCHES PER O.C.E.M.A. STD. PLAN NO. 1319

** BACKFILL PER SECTION 306-1.3 OF THE STANDARD SPECIFICATIONS.

*** WHERE STORM DRAIN MAIN OR LATERAL, WATER MAIN, OR SANITARY SEWER MA[illegible] CROSSING OCCURS, BACKFILL SHALL BE BY WATER DENSIFICATION M[illegible]ODS, HORIZONTAL DISTANCE EACH SIDE OF CROSSING FOR WATER DENSIFICATION, SHALL BE EQUAL TO THE VERTICAL DISTANCE BETWEEN THE CROSSING FACILITY AND THE STORM DRAIN.

**** WHERE THE COVER IS 8-FEET OR LESS, W MUST BE GREATER THAN OR EQUAL TO 6-INCHES.



TYPICAL SECTION FOR VICTORIA BOULEVARD
STA.20+55 TO STA.26+46.12
N.T.S.

## INDEX OF SHEETS

NOTE: THE CONTRACTOR SHALL COORDINATE WITH THE SAN DIEGO WATER COMPANY, AND NO ARHM OVERLAY IS DONE PRIOR TO THE INSTALLATION OF THE WATER LINE.

I. ROBERT BALL
EXP. 3-31-96
NO. 41744

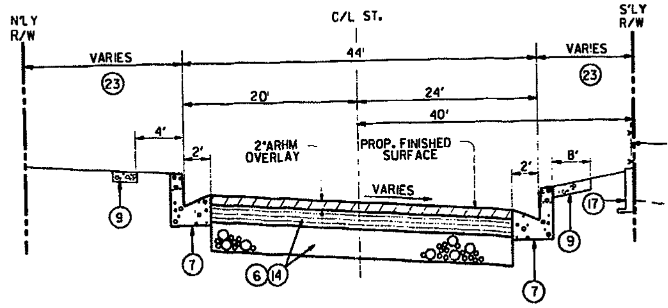
APPROVED: [illegible]
CITY ENGINEER
36672 — 5/7/92
R.C.E. NO. — DATE

CITY OF DANA POINT

PLANS PREPARED BY:
WILLDAN ASSOCIATES
12900 [illegible] PARKWAY SO., SUITE 200
INDUSTRY, [illegible] 46-3439
(213) 908-[illegible]
UNDER THE SUPERVISION OF:
I. R. Ball 5-7-92
I. ROBERT BALL R.C.E. 41744 DATE

### APWA STANDARD PLANS

| DRAWING NO. | DESCRIPTION |
|---|---|
| 300-0 | CURB OPENING CATCH BASIN |
| 308-0 | MONOLITHIC CATCH BASIN CONNECTION |
| 309-0 | CATCH BASIN REINFORCEMENT |
| 310-0 | C.B. FACE PLATE ASSEMBLY AND PROTECTION BAR |
| 312-0 | CATCH BASIN MANHOLE FRAME AND COVER |
| 313-0 | LOCAL DEPRESSION |
| 635-0 | STEEL STEP |



TYPICAL SECTION FOR VICTORIA BOULEVARD
STA.26+46.12 TO STA.27+85.25
N.T.S.

BENCH MARK:
NO. 78-E 785 ELEV. 20.105
DATE ADJ. ____ QUAD. ____
FD BR CAP IN CONC POST +/-29' E OF E RAIL OF MAINLINE +/-20.3' N OF NE COR CONC BOX CULVERT N C/L VICTORIA PROD.

### STREET IMPROVEMENTS - CONSTRUCTION NOTES

① PROTECT IN PLACE.
② RELOCATE.
③ RELOCATE BY OTHERS.
④ REMOVE.
⑤ REMOVE BY OTHERS.
(5A) REMOVE AND RECONSTRUCT.
⑥ REMOVE EXISTING A.C., A.B. OR P.C.C.
⑦ CONSTRUCT CURB AND GUTTER PER O.C.E.M.A. STD. PLAN NO.104-0-OC, TYPE A2-8.
⑧ CONSTRUCT CROSS GUTTER PER O.C.E.M.A. STD. PLAN NO.106-0-OC.
⑨ CONSTRUCT 4-INCH P.C.C. SIDEWALK PER O.C.E.M.A. STD. PLAN NO.1205-0.
⑩ REMOVE AND CONSTRUCT BRICK, STONE OR CONCRETE HOUSEWALK TO MATCH EXISTING.
⑪ CONSTRUCT DRIVEWAY APPROACH PER O.C.E.M.A. STD. PLAN NO.101-0-OC, TYPE A.
(11A) CONSTRUCT DRIVEWAY APPROACH PER O.C.E.M.A. STD. DWG. NO.1210.
⑫ CONSTRUCT ACCESS RAMP PER O.C.E.M.A. STD. PLAN NO.102-0-OC, TYPE A.
⑬ CONSTRUCT 2-INCH A.H.R.M. OVERLAY.
⑭ CONSTRUCT 4-INCH A.C. OVER 11-INCH A.B.
⑮ CONSTRUCT 4-INCH A.C. OVER 8-INCH A.B.
⑯ REMOVE AND RECONSTRUCT EXIST. 3-INCH CURB DRAIN.
⑰ ~~CONSTRUCT MASONRY RETAINING WALL PER O.C.E.M.A. STD. PLAN NO. 618-0-OC. (H=3'-4'),~~ TYPE A. ELIMINATED
⑱ ADJUST WATER VALVE BOX AND COVER TO GRADE.
⑲ ADJUST WATER METER BOX, FRAME AND LID TO GRADE.
⑳ ADJUST MANHOLE FRAME AND COVER TO GRADE.
㉑ SEE STORM DRAIN IMPROVEMENT PLANS (SHEETS 3&4)
㉒ REMOVE AND REINSTALL BUS BENCH INCLUDING 4-INCH THICK P.C.C. PAD.
㉓ GRADE ONLY.
㉔ INSTALL 3-INCH PVC SLEEVE SCHEDULE 40 AT 12-INCH COVER FROM THE SURFACE.
㉕ INSTALL 4-INCH PVC SLEEVE SCHEDULE 40 AT 24-INCH COVER FROM THE SURFACE.
㉖ ~~CONSTRUCT 5-FT. C.L.F. PER O.C.E.M.A. STD. PLAN NO. 600-0-OC.~~ ELIMINATED

### STORM DRAIN CONSTRUCTION NOTES

1 CONSTRUCT 18-INCH RCP (D-LOAD PER PLAN)
2 CONSTRUCT 21-INCH RCP (D-LOAD PER PLAN)
2A CONSTRUCT 24-INCH RCP (D-LOAD PER PLAN)
3 CONSTRUCT 30-INCH RCP (D-LOAD PER PLAN)
4 CONSTRUCT 33-INCH RCP (D-LOAD PER PLAN)
5 CONSTRUCT 36-INCH RCP (D-LOAD PER PLAN)
6 CONSTRUCT CATCH BASIN PER A.P.W.A. STD. PLAN NO.300-0 (WIDTH PER PLAN)
7 CONSTRUCT LOCAL DEPRESSION PER A.P.W.A. STD. PLAN NO.313-0 (CASE E)
8 CONSTRUCT J.S. TYPE I PER O.C.E.M.A. STD. PLAN NO.1310
9 CONSTRUCT J.S. TYPE IV PER O.C.E.M.A. STD. PLAN NO.1313
10 POT HOLE
11 CONSTRUCT SEWER ENCASESMENT PER ORANGE COUNTY STANDARD REQUIREMENTS FOR CONSTRUCTION OF SANITARY SEWERS PLAN NO. S-37-1.
12 CONSTRUCT CATCH BASIN PER A.P.W.A. STD. PLAN NO. 307-0 WIDTH PER PLAN (Y=18")
13 CONSTRUCT CHAIN LINK FENCE (H=5') PER O.C.E.M.A. STD. PLAN NO. 600-0-OC.
14 CONSTRUCT CONCERET COLLAR PER O.C.E.M.A. STD. PLAN NO. 1317
15 CONSTRUCT OPEN TRANSITION PER DETAIL ON SHT. NO. 4

12-31-12
SEE As built NOTES

### OCEMA STANDARD PLANS

| DRAWING NO. | DESCRIPTION |
|---|---|
| 1205 | SIDEWALK DETAILS |
| 1310 | JUNCTION STRUCTURE TYPE I |
| 1313 | JUNCTION STRUCTURE TYPE IV |
| 1317 | CONCERET COLLAR |
| 1319 | BEDDING DETAIL |
| 101-0-OC | DRIVEWAY APPROACHES |
| 102-0-OC | ACCESS RAMP |
| 104-0-OC | CURB AND GUTTER-BARRRIER |
| 106-0-OC | CROSS AND LONGITUDINAL GUTTERS |
| 618-0-OC | MASONRY RETAINING WALL |

As Builts
OK [illegible]
2/12/93

### GENERAL NOTES:

THE EXISTENCE AND LOCATION OF ANY UNDERGROUND UTILITY PIPES OR STRUCTURES SHOWN ON THESE PLANS WERE OBTAINED BY A SEARCH OF THE AVAILABLE RECORDS. NO CERTIFICATION IS MADE AS TO THE ACCURACY OR THOROUGHNESS OF THESE RECORDS. APPROVAL OF THIS PLAN BY THE CITY OF DANA POINT DOES NOT CONSTITUTE A REPRESENTATION AS TO THE ACCURACY OF LOCATION OR THE EXISTENCE OR NONEXISTENCE OF ANY UNDERGROUND UTILITY PIPE OR STRUCTURE WITHIN THE LIMITS OF THIS PROJECT. THE CONTRACTOR IS REQUIRED TO TAKE ALL DUE PRECAUTIONARY MEANS TO PROTECT THE UTILITY LINES NOT OF RECORD OR NOT SHOWN ON THESE PLANS.

REVISIONS

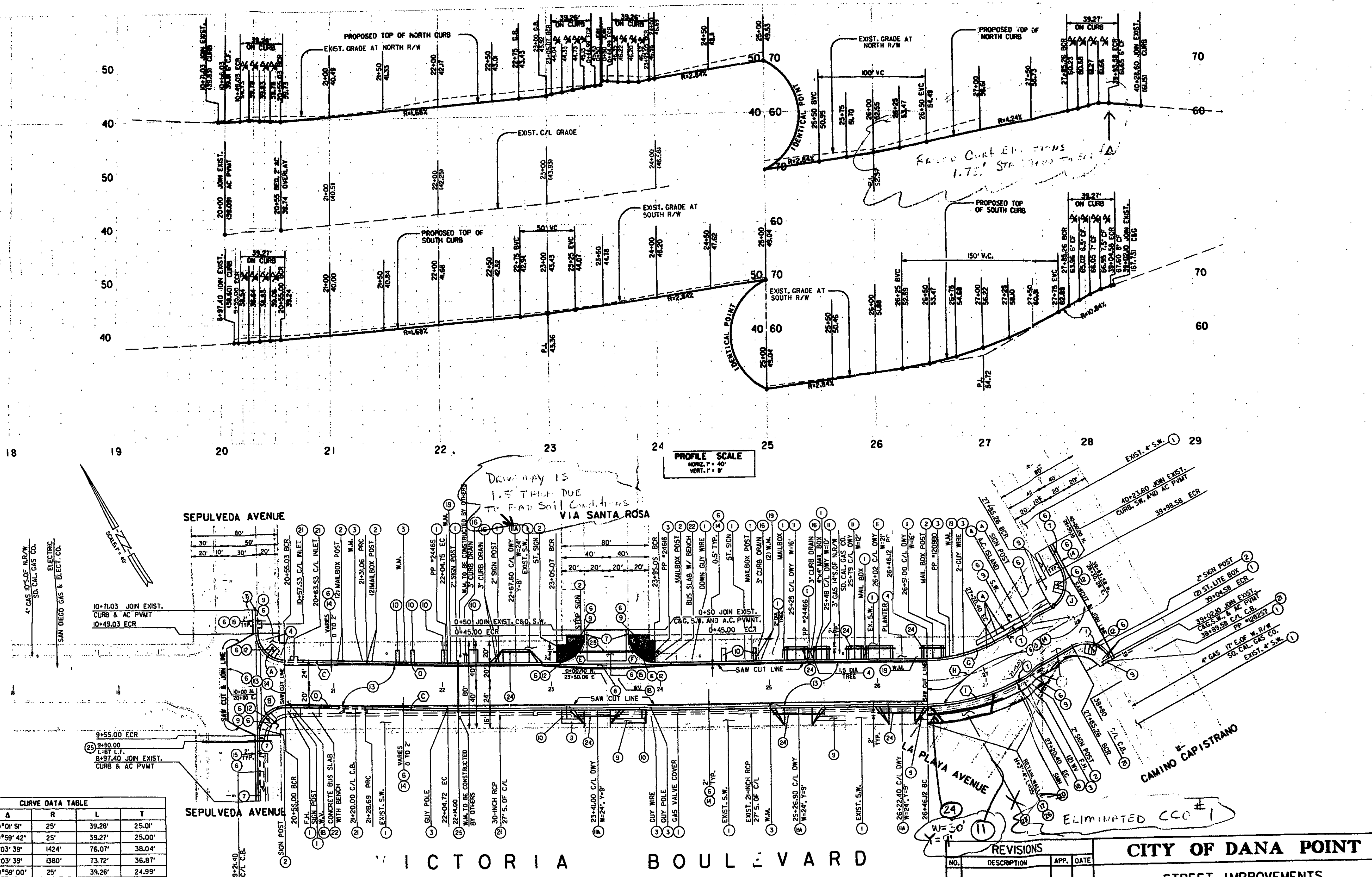
| NO. | DESCRIPTION | APP. | DATE |
|---|---|---|---|
| | | | |

CITY OF DANA POINT
STREET IMPROVEMENTS IN
VICTORIA BOULEVARD
AND
STORM DRAIN IMPROVEMENTS IN
SEPULVEDA AVENUE AND VICTORIA BOULEVARD

DESIGN BY: T.O.
DRAWN BY: G.C.
CHECK BY: M.G.

SHT. 1 OF 4 SHT.

PLAN NO.



| CURVE DATA TABLE | | | | |
|---|---|---|---|---|
| CURVE | Δ | R | L | T |
| A | 90°01' 51" | 25' | 39.28' | 25.01' |
| B | 59°59' 42" | 25' | 39.27' | 25.00' |
| C | 3°03' 39" | 1424' | 76.07' | 38.04' |
| O | 3°03' 39' | 1380' | 73.72' | 36.87' |
| E | 89°59' 00' | 25' | 39.26' | 24.99' |
| F | 89°59' 15" | 25' | 39.26' | 24.99' |
| G | 28°22' 32" | 130' | 64.38' | 32.87' |
| H | 28°22' 32" | 150' | 74.29' | 37.92' |
| I | 28°22' 32" | 174' | 86.17' | 43.99' |
| J | 90°00' 00" | 25' | 39.27' | 25.00' |

I. ROBERT BALL
EXP. 3-31-96
NO. 41744

APPROVED: 
CITY ENGINEER
36672 5/7/92
R.C.E. NO. DATE

CITY OF DANA POINT

PLANS PREPARED BY:
**WILLDAN ASSOCIATES**
12900 CROSSROADS PARKWAY SO., SUITE 200
INDUSTRY, CA 91746-3459
(213) 908-6200

UNDER THE SUPERVISION OF:
5-7-92
I. ROBERT BALL R.C.E. 41744 DATE

BENCH MARK:
NO. 78-E 785 ELEV. 20.105
DATE ADJ. QUAD.
FD BR CAP IN CONC POST +/-29' E OF E RAIL OF MAINLINE +/-20.3' N OF NE COR CONC BOX CULVERT N C/L VICTORIA PROD.

| REVISIONS | | | |
|---|---|---|---|
| NO. | DESCRIPTION | APP. | DATE |

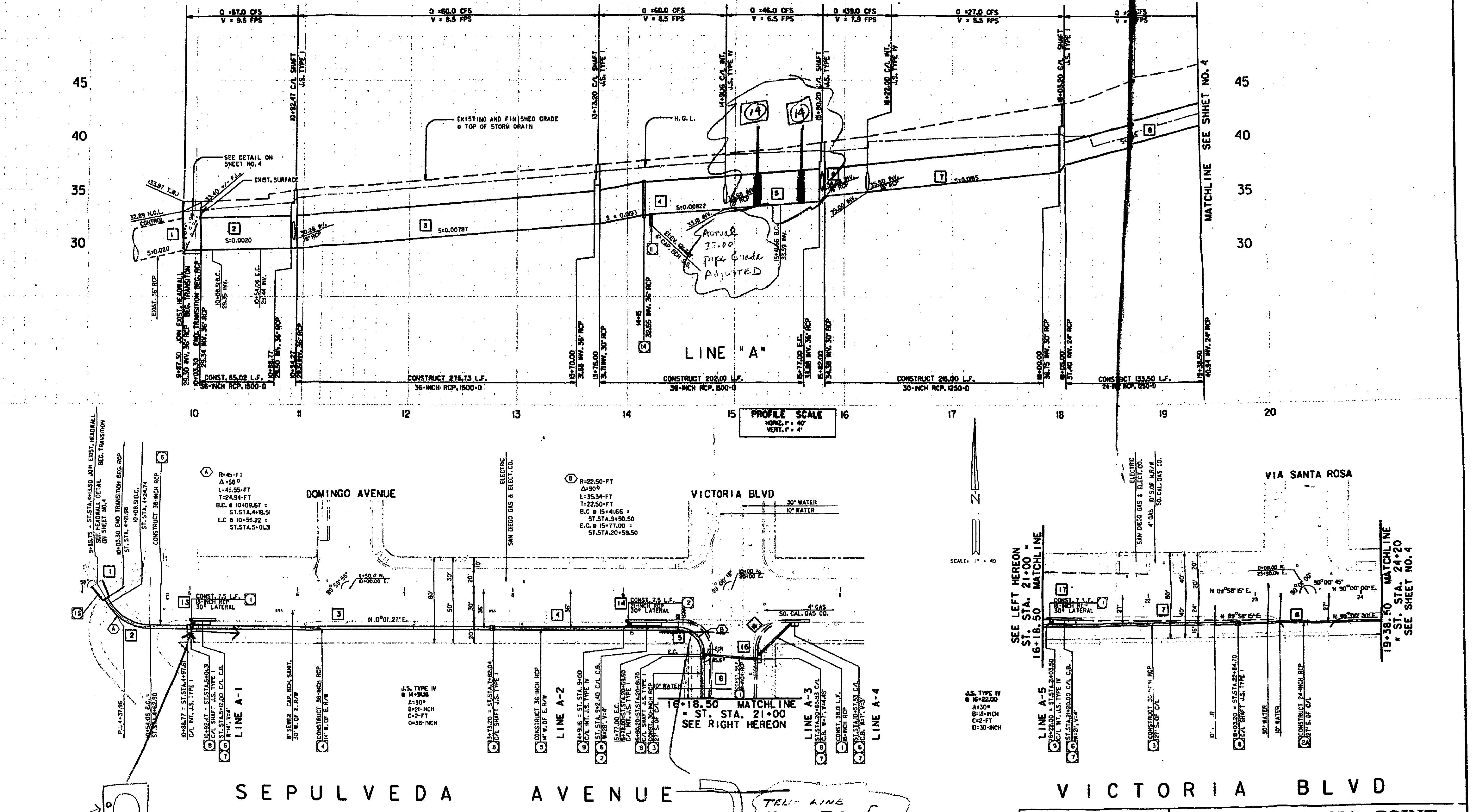
# CITY OF DANA POINT

## STREET IMPROVEMENTS
IN
## VICTORIA BOULEVARD
FROM SEPULVEDA AVENUE TO CAMINO CAPISTRANO

DESIGN BY: T.O.
DRAWN BY: G.C.
CHECK BY: M.G.

SHT. 2 OF 4 SHT.

PLAN NO.



2400 pair Telco line 10+88.77 TO 14+85 (Appkx)

SCALE: 1" = 40'

TELCO LINE CROSSES TOP of Pipe NO Clearance

NOTE: [NO.] INDICATES LINE NUMBER. SEE COMPUTER PRINTOUT.

EXP. 3-31-96 NO. 41744

APPROVED: Em H. [illegible]
CITY ENGINEER
36672 — R.C.E. NO.
5/7/92 — DATE
CITY OF DANA POINT

PLANS PREPARED BY:
WILLDAN ASSOCIATES
12900 CROSSROADS PARKWAY SO., SUITE 200
INDUSTRY, CA 91746-3499
(213) 908-6200
UNDER THE SUPERVISION OF: I R Ball 5-7-92
I. ROBERT BALL R.C.E.41744 CAT.

BENCH MARK:
NO. 78-E 785 ELEV. 20.105
DATE ADJ. ________ QUAD. ________
FD BR CAP IN CONC POST +/-29' E OF E RAIL OF MAINLINE +/-20.3' N OF NE COR CONC BOX CULVERT N C/L VICTORIA PROD.

| REVISIONS | | | |
|---|---|---|---|
| NO. | DESCRIPTION | APP. | DATE |
| | | | |

# CITY OF DANA POINT

## STORM DRAIN IMPROVEMENTS
IN
SEPULVEDA AVENUE
AND
VICTORIA BOULEVARD
FROM STA. 9+89.44 TO STA. 19+38.50

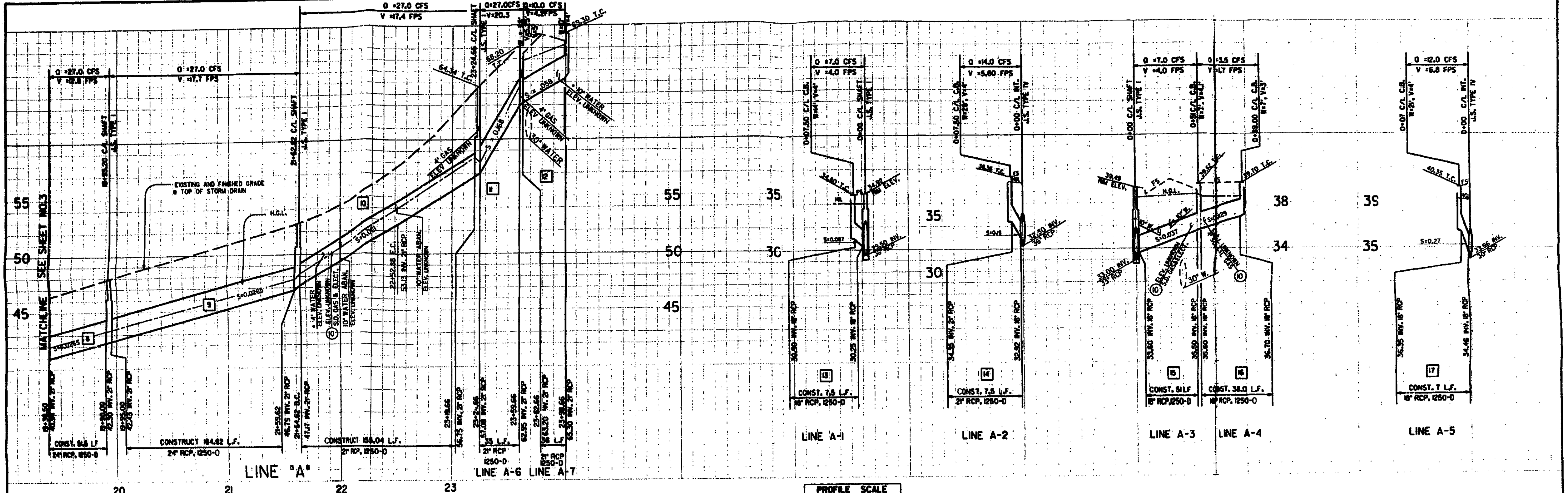
DESIGN BY: T.O.
DRAWN BY: G.C.
CHECK BY: M.G.

SHT. 3 OF 4 SHT.

PLAN NO.

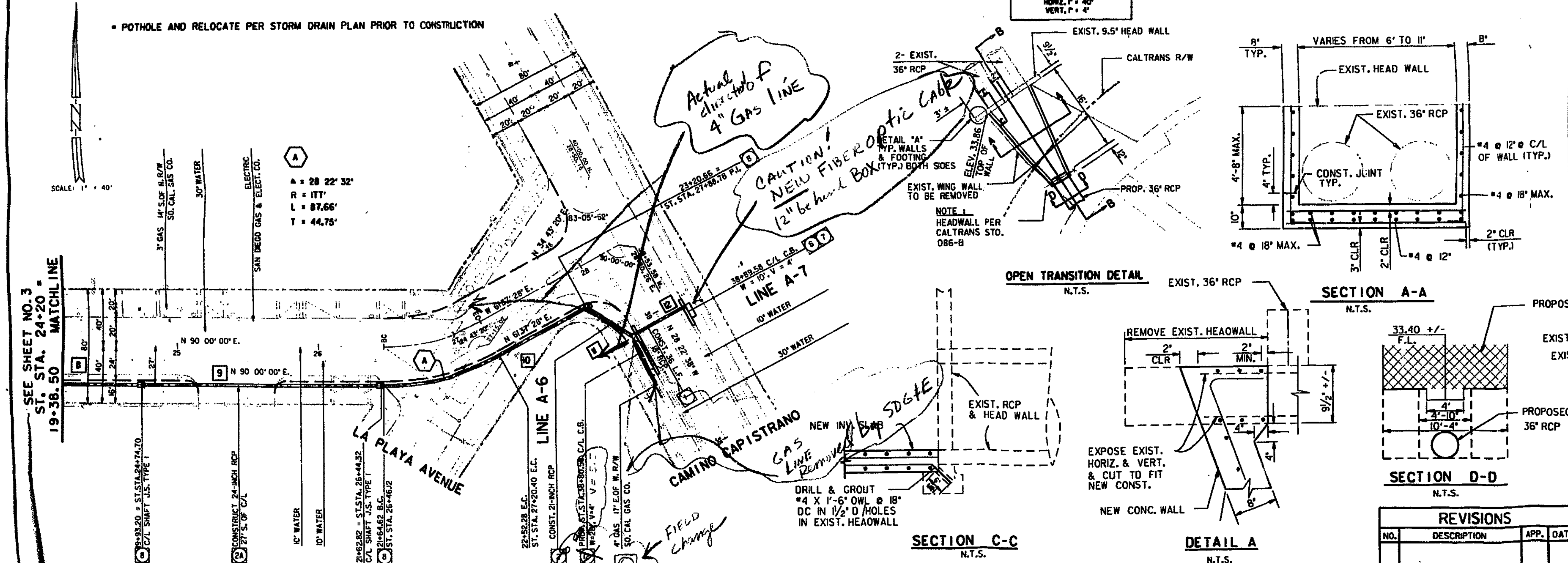
682/503/0207/064

8



PROFILE SCALE
HORIZ. 1" = 40'
VERT. 1" = 4'

* POTHOLE AND RELOCATE PER STORM DRAIN PLAN PRIOR TO CONSTRUCTION



OPEN TRANSITION DETAIL
N.T.S.

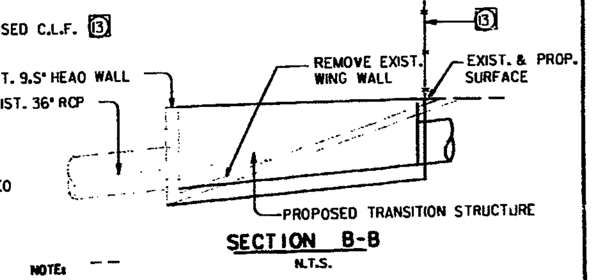
SECTION C-C
N.T.S.

DETAIL A
N.T.S.

SECTION A-A
N.T.S.

SECTION D-D
N.T.S.

| HYDRAULIC ELEMENT TABLE<br>10 - YEAR FREQUENCY | | | | | | |
|---|---|---|---|---|---|---|
| LOCATIONS | PIPE REACH | | Q (CFS) | PIPE SIZE (INCH) | VEL. (FPS) | REMARKS |
| | FROM STA. | TO STA. | | | | |
| LINE A | 9+87.75 | 10+03.75 | 67.0 | OPEN CHANNEL | | |
| LINE A | 10+03.75 | 10+88.77 | 67.0 | 36 | 8.5 | FULL FLOW |
| LINE A | 10+94.27 | 13+70.00 | 60.0 | 36 | 8.5 | FULL FLOW |
| LINE A | 13+75.00 | 14+9U6 | 60.0 | 30 | 8.5 | FULL FLOW |
| LINE A | 14+9U6 | 15+77.00 | 46.0 | 30 | 6.5 | FULL FLOW |
| LINE A | 15+82.00 | 16+22.00 | 39.0 | 30 | 7.9 | FULL FLOW |
| LINE A | 16+22.00 | 18+00.00 | 27.0 | 30 | 5.5 | FULL FLOW |
| LINE A | 18+05.00 | 19+90.00 | 27.0 | 21 | 12.8 | SEAL FLOW |
| LINE A | 19+95.00 | 21+59.62 | 27.0 | 21 | 17.7 | PARTIAL FLOW |
| LINE A | 21+59.62 | 23+19.66 | 27.0 | 21 | 17.4 | PARTIAL FLOW |
| LINE A-6 | 23+24.66 | 23+59.66 | 27.0 | 21 | 20.3 | PARTIAL FLOW |
| LINE A-7 | 23+62.66 | 23+98.66 | 10.0 | 18 | 4.2 | FULL FLOW |
| LINE A-1 | 0+00 | 0+07.50 | 7.0 | 18 | 4.0 | FULL FLOW |
| LINE A-2 | 0+00 | 0+07.50 | 14.0 | 18 | 5.8 | FULL FLOW |
| LINE A-3 | 0+00 | 0+51.00 | 7.0 | 18 | 4.0 | FULL FLOW |
| LINE A-4 | 0+51.00 | 0+89.00 | 3.5 | 18 | 1.7 | FULL FLOW |
| LINE A-5 | 0+00 | 0+07.00 | 12.0 | 18 | 6.8 | FULL FLOW |



SECTION B-B
N.T.S.

NOTE:
[NO.] - INDICATES LINE NUMBER. SEE COMPUTER PRINTOUT.

APPROVED: [signature]
CITY ENGINEER
36672 5/7/92
R.C.E. NO. DATE
CITY OF DANA POINT

T. ROBERT BALL
EXP. 3-31-96
NO. 41744

PLANS PREPARED BY:
WILLDAN ASSOCIATES
12900 CROSSROADS PARKWAY SO., SUITE 200
INDUSTRY, CA 91746-3499
(213) 908-6200
UNDER THE SUPERVISION OF:
T. R. Ball 5-7-92
T. ROBERT BALL R.C.E. 41744 DATE

BENCH MARK:
NO. 78-E 765 ELEV. 20.105
DATE ADJ. QUAD.
FD BR CAP IN CONC POST +/-29'
E OF E RAIL OF MAINLINE +/-20.3'
N OF NE COR CONC BOX CULVERT
N C/L VICTORIA PROD.

| REVISIONS | | | |
|---|---|---|---|
| NO. | DESCRIPTION | APP. | DATE |
| | | | |

# CITY OF DANA POINT

## STORM DRAIN IMPROVEMENTS IN VICTORIA BOULEVARD
FROM STA. 19+38.50 TO STA. 22+46.90

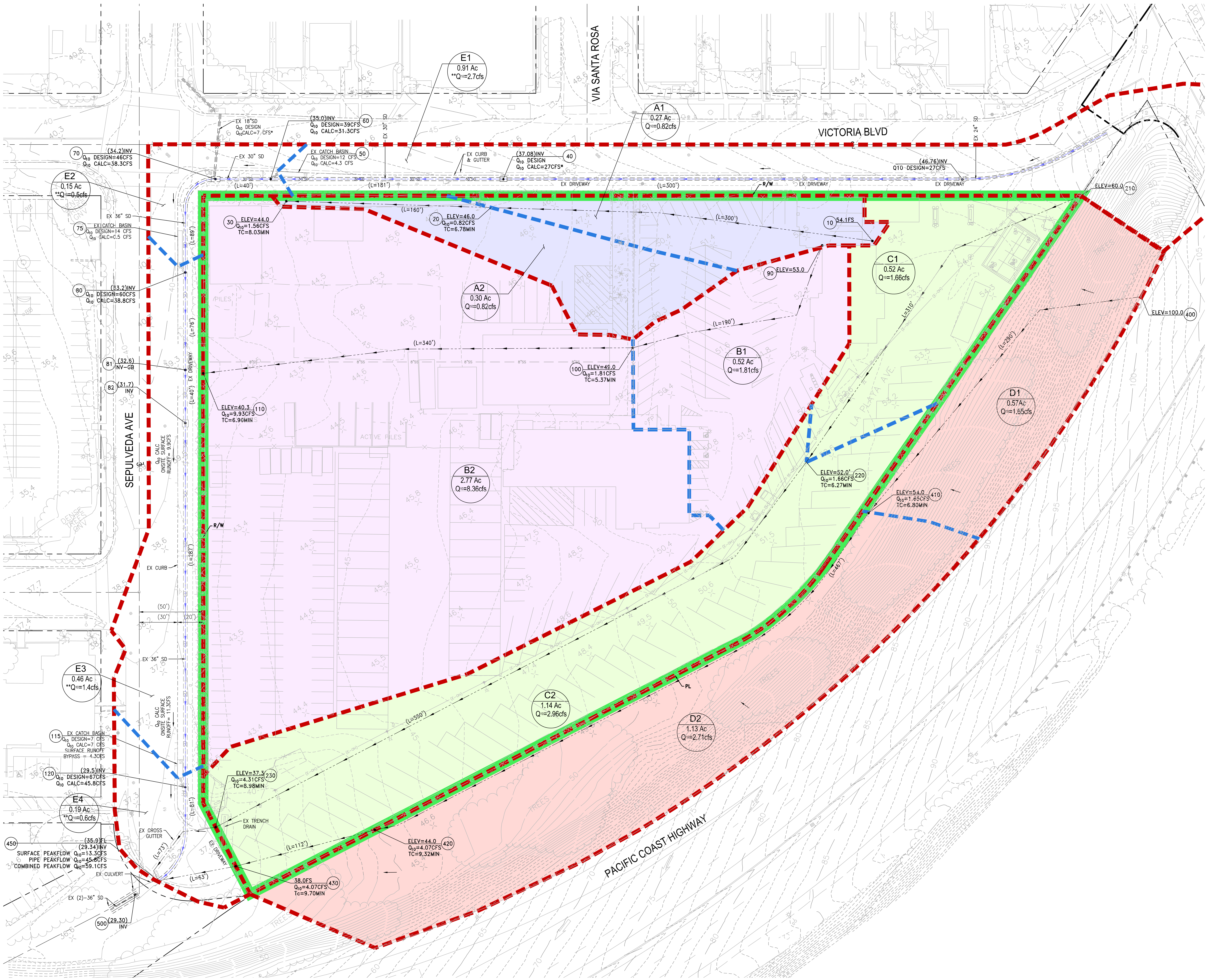
## CONNECTOR PIPE PROFILES AND HYDRAULIC ELEMENT TABLE

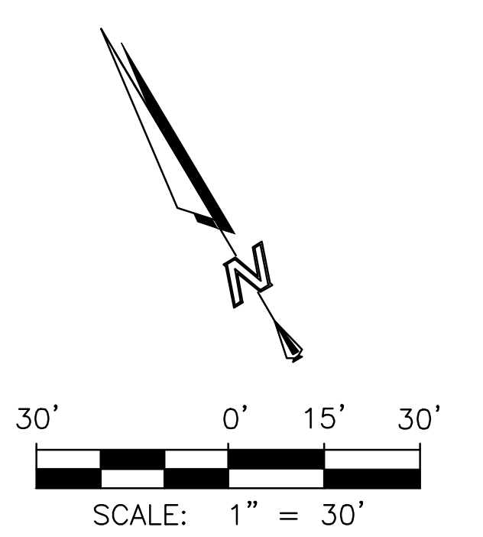
DESIGN BY: T.O.
DRAWN BY: G.C.
CHECK BY: M.G.
SHT. 4 OF 4 SHT.
PLAN NO.

# APPENDIX 2

---

# HYDROLOGY MAPS





## LEGEND

- PROPERTY LINE
- 🟩 ONSITE BOUNDARY (5.52 Ac)
- 🟥 DRAINAGE MAJOR SUB–BOUNDARY
- 🟦 DRAINAGE MINOR SUB–BOUNDARY
- — SD — EXISTING STORM DRAIN
- (10) HYDROLOGIC NODE
- A1 — DRAINAGE AREA DESIGNATION
- 3.2 ac — AREA
- $Q_{10}$=2.2 cfs — FLOWRATE
- --- — STREET WHICH AREA DRAINS TOWARD

- 🟦 SUB–AREA A (0.57 Ac/1.56 cfs @ NODE 30)
- 🟪 SUB–AREA B (3.29 Ac/9.93 cfs @ NODE 110)
- 🟩 SUB AREA C (1.66 Ac/4.31 cfs @ NODE 230)
- 🟥 SUB–AREA D – OFFSITE RUN–ON (1.70 Ac/4.07 cfs @ NODE 430)

## HYDROLOGIC PARAMETERS

STUDY AREA: 7.22 Ac = 5.52 Ac (ONSITE) + 1.70 Ac (OFFSITE)

SOIL GROUP: D

ZONE X PER FEMA FIRM MAP NO 06059C0508K

## ABBREVIATIONS

| | |
|---|---|
| AC | ACRE |
| CFS | CUBIC FEET PER SECOND |
| ℄ | CENTERLINE |
| ELEV | ELEVATION |
| EX | EXISTING |
| FG | FINISHED GRADE |
| FS | FINISHED SURFACE |
| GB | GRADE BREAK |
| INV | INVERT |
| L | LENGTH |
| MIN | MINUTES |
| ℙ | PROPERTY LINE |
| R/W | RIGHT OF WAY |
| SD | STORM DRAIN |
| TG | TOP OF GRATE |
| TYP | TYPICAL |

## EXISTING STORM DRAIN REFERENCE

CITY OF DANA POINT STORM DRAIN IMPROVEMENT IN VICTORIA BOULEVARD & SEPULVEDA AVENUE APPROVED ON 5/7/1992.

$Q_{10}$ DESIGN IN EXISTING STORM DRAIN USED FROM THIS REFERENCE PLAN.

## KEY ASSUMPTIONS

* – ASSUMES FULL CAPTURE OF 10–YEAR STORM DESIGN FROM REFERENCE AS–BUILT.

** – STREET PEAK RUNOFF CALULATED FROM CONSERVATIVE FACTOR OF 3 CFS PER ACRE. NO ROUTING PERFORMED.

# VICTORIA APARTMENTS

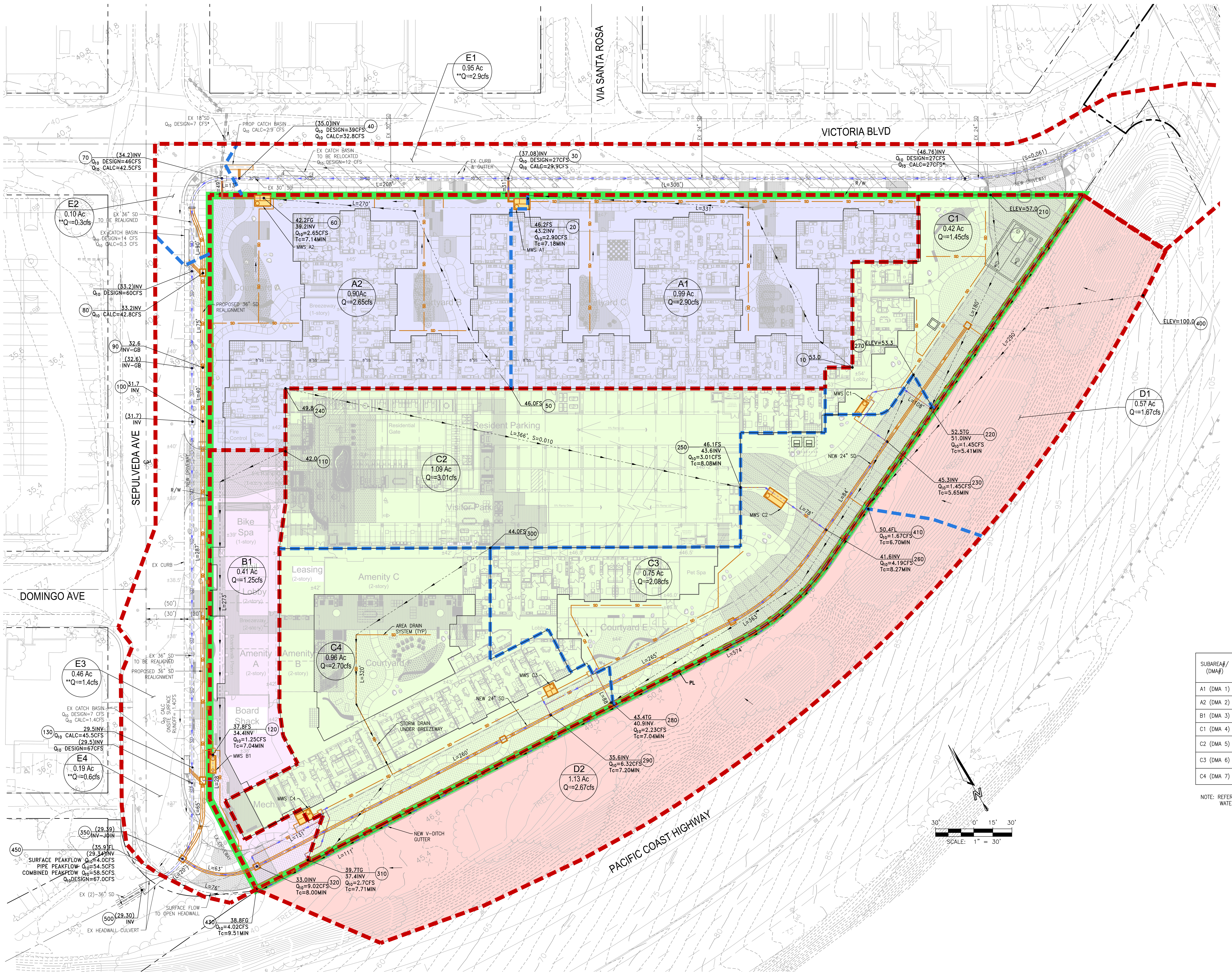
## 26126 VICTORIA BLVD, DANA POINT, CA

## EXISTING HYDROLOGY

May 27, 2020

FUSCOE
E N G I N E E R I N G
16795 Von Karman, Suite 100
Irvine, California 92606
tel 949.474.1960 ∘ fax 949.474.5315
www.fuscoe.com

F:\Projects\1665\004_Support Files\Reports\Hydrology\Supporting Docs\Hydrology Maps\1665-004ah - Existing Hydrology.dwg (5/27/2020 3:57 AM) Plotted by: Jason Castro



## LEGEND

| | |
|---|---|
| — — — | PROPERTY LINE/RIGHT OF WAY LINE |
| 🟩 | ONSITE BOUNDARY (5.52 Ac) |
| 🟥 🟥 🟥 | MAJOR DRAINAGE SUB-BOUNDARY |
| 🟦 🟦 🟦 | MINOR DRAINAGE SUB-BOUNDARY |
| ═ SD ═ | EXISTING STORM DRAIN |
| ═ SD ═ | NEW STORM DRAIN |
| (10) | HYDROLOGIC NODE |
| A1 | DRAINAGE AREA DESIGNATION |
| 3.2 ac | AREA |
| $Q_{10}$=2.2 cfs | FLOWRATE |
| | STORM EVENT FREQUENCY (IN YEARS) |
| ←- - - | SURFACE FLOW |
| ←- - - | PIPE FLOW |
| ▭ | PROPOSED MODULAR WETLANDS |

## TRIBUTARY AREAS

| | |
|---|---|
| 🟦 | SUB AREA A (1.89 Ac/5.44 cfs @ NODE 70) |
| 🟪 | SUB-AREA B (0.41 Ac/1.25 cfs @ NODE 120) |
| 🟩 | SUB-AREA C (3.22 Ac/9.02 cfs @ NODE 320) |
| 🟥 | SUB-AREA D – OFFSITE RUNOFF<br>(1.70 Ac/4.02 cfs @ NODE 430) |

## SITE PARAMETERS

STUDY AREA: 7.22 Ac = 5.52 Ac (ONSITE) + 1.70 Ac (OFFSITE)

SOIL GROUP: D

ZONE X PER FEMA FIRM MAP NO 06059C0508K

## ABBREVIATIONS

| | |
|---|---|
| AC | ACRE |
| CFS | CUBIC FEET PER SECOND |
| ℄ | CENTERLINE |
| DMA | DRAINAGE MANAGEMENT AREA |
| ELEV | ELEVATION |
| EX | EXISTING |
| FG | FINISHED GRADE |
| FS | FINISHED SURFACE |
| GB | GRADE BREAK |
| INV | INVERT |
| L | LENGTH |
| MIN | MINUTES |
| MWS | MODULAR WETLANDS SYSTEM |
| PL | PROPERTY LINE |
| POC | POINT OF CONNECTION |
| R/W | RIGHT OF WAY |
| SD | STORM DRAIN |
| TG | TOP OF GRATE |
| TYP | TYPICAL |

## ESTIMATED STORMWATER TREATMENT REQUIREMENTS

| SUBAREA#/ (DMA#) | AREA (AC) | IMPERVIOUSNESS | TREATMENT FLOW REQUIREMENT (CFS) PER OC STANDARDS | DESIGN FLOW RATE (80% x 1.5) (CFS) | MWS MODEL (FTxFT) STD HGL=3.4' | BMP TREATMENT CAPACITY (CFS) |
|---|---|---|---|---|---|---|
| A1 (DMA 1) | 0.99 | 85% | 0.203 | 0.304 | 8'x12' | 0.346 |
| A2 (DMA 2) | 0.90 | 85% | 0.184 | 0.277 | 8'x12' | 0.346 |
| B1 (DMA 3) | 0.41 | 85% | 0.084 | 0.126 | 4'x13' | 0.144 |
| C1 (DMA 4) | 0.42 | 85% | 0.086 | 0.129 | 4'x13' | 0.144 |
| C2 (DMA 5) | 1.09 | 85% | 0.223 | 0.335 | 8'x16' | 0.462 |
| C3 (DMA 6) | 0.75 | 85% | 0.154 | 0.230 | 8'x8' | 0.231 |
| C4 (DMA 7) | 0.96 | 85% | 0.197 | 0.295 | 8'x12' | 0.346 |

NOTE: REFER PRELIMINARY WQMP REPORT FOR WATER QUALITY CALCULATIONS
WATER QUALITY TREATMENT ASSUMES NO SITE INFILTRATION

## HYDROMODIFICATION SUSCEPTIBILITY

SITE DEEMED NOT TO BE SUBJECTED TO HYDROMODIFICATION MITIGATION MEASURES DUE TO EVENTUAL DISCHARGE TO SAN JUAN CREEK, WHICH IS AN ENGINEERED, LARGE RIVER & EXEMPTED BY THE SOUTH ORANGE COUNTY HYDROMODICATION PLAN (HMP).

## EXISTING STORM DRAIN REFERENCE

CITY OF DANA POINT STORM DRAIN IMPROVEMENT IN VICTORIA BOULEVARD & SEPULVEDA AVENUE APPROVED ON 5/7/1992.

$Q_{10}$ DESIGN IN EXISTING STORM DRAIN USED FROM THIS REFERENCE PLAN.

## KEY ASSUMPTIONS

* – ASSUMES FULL CAPTURE OF 10-YEAR STORM DESIGN FROM REFERENCE AS-BUILT.

** – STREET PEAK RUNOFF CALCULATED FROM CONSERVATIVE FACTOR OF 3 CFS PER ACRE. NO ROUTING PERFORMED.

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ENGINEERING
16795 Von Karman, Suite 100
Irvine, California 92606
tel 949.474.1960 ◦ fax 949.474.5315
www.fuscoe.com

# VICTORIA APARTMENTS
## 26126 VICTORIA BLVD, DANA POINT, CA
## PROPOSED HYDROLOGY

June 8, 2021

F:\Projects\1665\004_Support Files\Reports\Hydrology\Supporting Docs\Hydrology Maps\1665-004xh – Proposed Hydrology.dwg (6/8/2021 9:36 AM) Plotted by: Jason Castro

# APPENDIX 3

---

## EXISTING HYDROLOGY CALCULATIONS

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
         (c) Copyright 1983-2014 Advanced Engineering Software (aes)
             Ver. 21.0  Release Date: 06/01/2014  License ID 1355

                           Analysis prepared by:

                             Fuscoe Engineering
                              16795 Von Karman
                                 Suite 100
                              Irvine, CA 92606

 ************************** DESCRIPTION OF STUDY **************************
*                           VICTORIA APARTMENTS                            *
*                           EXISTING HYDROLOGY                             *
*                             10 YEAR STORM                                *
 **************************************************************************

  FILE NAME: VICTEX.DAT
  TIME/DATE OF STUDY: 10:04 02/05/2020
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   3.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)      (FT)   SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0      20.0   0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     20.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   300.00
  ELEVATION DATA: UPSTREAM(FEET) =     54.10  DOWNSTREAM(FEET) =     46.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.775
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.411
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
  MOBILE HOME PARK           D        0.27      0.20     0.250    75    6.78
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.250
  SUBAREA RUNOFF(CFS) =      0.82
  TOTAL AREA(ACRES) =      0.27   PEAK FLOW RATE(CFS) =      0.82

****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     30.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     46.00
  DOWNSTREAM NODE ELEVATION(FEET) =     44.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   160.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.080
  PAVEMENT LIP(FEET) =  0.020   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   1.00
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.094
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  MOBILE HOME PARK           D        0.30      0.20     0.250    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.250
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      1.23
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.12
  AVERAGE FLOW DEPTH(FEET) =   0.16   FLOOD WIDTH(FEET) =    9.42
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   1.26   Tc(MIN.) =    8.03
  SUBAREA AREA(ACRES) =    0.30       SUBAREA RUNOFF(CFS) =    0.82
  EFFECTIVE AREA(ACRES) =    0.57     AREA-AVERAGED Fm(INCH/HR) =   0.05
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.25
  TOTAL AREA(ACRES) =        0.6         PEAK FLOW RATE(CFS) =       1.56

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.18   FLOOD WIDTH(FEET) =   10.65
  FLOW VELOCITY(FEET/SEC.) =   2.23   DEPTH*VELOCITY(FT*FT/SEC) =   0.39
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     30.00 =     460.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     90.00 TO NODE    100.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   190.00
  ELEVATION DATA: UPSTREAM(FEET) =     53.00  DOWNSTREAM(FEET) =     49.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.367
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.898
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.52      0.20     0.100    75    5.37
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      1.81
  TOTAL AREA(ACRES) =      0.52   PEAK FLOW RATE(CFS) =      1.81

****************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    110.00 IS CODE =  91
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     49.00
  DOWNSTREAM NODE ELEVATION(FEET) =     40.30
  CHANNEL LENGTH THRU SUBAREA(FEET) =   340.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.080
  PAVEMENT LIP(FEET) =  0.020   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   1.00
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.375
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        2.77      0.20     0.100    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      5.92
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.69
  AVERAGE FLOW DEPTH(FEET) =   0.24   FLOOD WIDTH(FEET) =   17.15
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   1.54   Tc(MIN.) =    6.90
  SUBAREA AREA(ACRES) =    2.77       SUBAREA RUNOFF(CFS) =    8.36
  EFFECTIVE AREA(ACRES) =    3.29     AREA-AVERAGED Fm(INCH/HR) =   0.02
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        3.3         PEAK FLOW RATE(CFS) =       9.93

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.28   FLOOD WIDTH(FEET) =   21.37
  FLOW VELOCITY(FEET/SEC.) =   4.11   DEPTH*VELOCITY(FT*FT/SEC) =   1.17
  LONGEST FLOWPATH FROM NODE     90.00 TO NODE    110.00 =     530.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    210.00 TO NODE    220.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   310.00
  ELEVATION DATA: UPSTREAM(FEET) =     60.00  DOWNSTREAM(FEET) =     52.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.267
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.567
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.52      0.20     0.100    75    6.27
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      1.66
  TOTAL AREA(ACRES) =      0.52   PEAK FLOW RATE(CFS) =      1.66

****************************************************************************
  FLOW PROCESS FROM NODE    220.00 TO NODE    230.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     52.00
  DOWNSTREAM NODE ELEVATION(FEET) =     37.30
  CHANNEL LENGTH THRU SUBAREA(FEET) =   550.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.080
  PAVEMENT LIP(FEET) =  0.020   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   1.00
```

```
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.903
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        1.14      0.20     0.100    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      3.13
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.38
  AVERAGE FLOW DEPTH(FEET) =   0.20   FLOOD WIDTH(FEET) =   12.58
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   2.71   Tc(MIN.) =    8.98
  SUBAREA AREA(ACRES) =    1.14       SUBAREA RUNOFF(CFS) =    2.96
  EFFECTIVE AREA(ACRES) =    1.66     AREA-AVERAGED Fm(INCH/HR) =   0.02
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        1.7         PEAK FLOW RATE(CFS) =       4.31

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.22   FLOOD WIDTH(FEET) =   14.69
  FLOW VELOCITY(FEET/SEC.) =   3.55   DEPTH*VELOCITY(FT*FT/SEC) =   0.77
  LONGEST FLOWPATH FROM NODE    210.00 TO NODE    230.00 =     860.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    230.00 TO NODE    450.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     37.30  DOWNSTREAM(FEET) =     35.90
  CHANNEL LENGTH THRU SUBAREA(FEET) =    73.00   CHANNEL SLOPE =  0.0192
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  20.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  CHANNEL FLOW THRU SUBAREA(CFS) =       4.31
  FLOW VELOCITY(FEET/SEC.) =   3.39   FLOW DEPTH(FEET) =   0.19
  TRAVEL TIME(MIN.) =   0.36   Tc(MIN.) =    9.34
  LONGEST FLOWPATH FROM NODE    210.00 TO NODE    450.00 =     933.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    450.00 TO NODE    450.00 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.) =    9.34
  RAINFALL INTENSITY(INCH/HR) =   2.84
  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       1.66
  TOTAL STREAM AREA(ACRES) =       1.66
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       4.31

****************************************************************************
  FLOW PROCESS FROM NODE    400.00 TO NODE    410.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   290.00
  ELEVATION DATA: UPSTREAM(FEET) =    100.00  DOWNSTREAM(FEET) =     54.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.799
```

```
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.404
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  ".4 DWELLING/ACRE"          D        0.57      0.20     0.900    75    6.80
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.900
  SUBAREA RUNOFF(CFS) =      1.65
  TOTAL AREA(ACRES) =      0.57   PEAK FLOW RATE(CFS) =      1.65

****************************************************************************
  FLOW PROCESS FROM NODE    410.00 TO NODE    420.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     54.00
  DOWNSTREAM NODE ELEVATION(FEET) =     44.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   467.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.080
  PAVEMENT LIP(FEET) =  0.020   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   1.00
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.841
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  ".4 DWELLING/ACRE"          D        1.13      0.20     0.900    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.900
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      3.00
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.09
  AVERAGE FLOW DEPTH(FEET) =   0.20   FLOOD WIDTH(FEET) =   12.93
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   2.52   Tc(MIN.) =    9.32
  SUBAREA AREA(ACRES) =    1.13       SUBAREA RUNOFF(CFS) =    2.71
  EFFECTIVE AREA(ACRES) =    1.70     AREA-AVERAGED Fm(INCH/HR) =   0.18
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.90
  TOTAL AREA(ACRES) =        1.7         PEAK FLOW RATE(CFS) =       4.07

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.22   FLOOD WIDTH(FEET) =   15.04
  FLOW VELOCITY(FEET/SEC.) =   3.22   DEPTH*VELOCITY(FT*FT/SEC) =   0.71
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    420.00 =     757.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    420.00 TO NODE    430.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     44.00  DOWNSTREAM(FEET) =     38.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   112.00   CHANNEL SLOPE =  0.0536
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  20.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  CHANNEL FLOW THRU SUBAREA(CFS) =       4.07
  FLOW VELOCITY(FEET/SEC.) =   4.90   FLOW DEPTH(FEET) =   0.14
  TRAVEL TIME(MIN.) =   0.38   Tc(MIN.) =    9.70
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    430.00 =     869.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    430.00 TO NODE    450.00 IS CODE =  51
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     38.00  DOWNSTREAM(FEET) =     35.90
  CHANNEL LENGTH THRU SUBAREA(FEET) =    63.00   CHANNEL SLOPE =  0.0333
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  20.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  CHANNEL FLOW THRU SUBAREA(CFS) =       4.07
  FLOW VELOCITY(FEET/SEC.) =   3.99   FLOW DEPTH(FEET) =   0.16
  TRAVEL TIME(MIN.) =   0.26   Tc(MIN.) =    9.96
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    450.00 =     932.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    450.00 TO NODE    450.00 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.) =    9.96
  RAINFALL INTENSITY(INCH/HR) =   2.73
  AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.90
  EFFECTIVE STREAM AREA(ACRES) =       1.70
  TOTAL STREAM AREA(ACRES) =       1.70
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       4.07

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        4.31    9.34    2.838  0.20( 0.02) 0.10       1.7     210.00
      2        4.07    9.96    2.734  0.20( 0.18) 0.90       1.7     400.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        8.28    9.34    2.838  0.20( 0.10) 0.49       3.3     210.00
      2        8.22    9.96    2.734  0.20( 0.10) 0.50       3.4     400.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       8.28    Tc(MIN.) =     9.34
  EFFECTIVE AREA(ACRES) =       3.25   AREA-AVERAGED Fm(INCH/HR) =  0.10
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.49
  TOTAL AREA(ACRES) =       3.4
  LONGEST FLOWPATH FROM NODE    210.00 TO NODE    450.00 =     933.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        3.4  TC(MIN.) =      9.34
  EFFECTIVE AREA(ACRES) =      3.25  AREA-AVERAGED Fm(INCH/HR)=  0.10
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap = 0.492
  PEAK FLOW RATE(CFS)   =       8.28

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        8.28    9.34    2.838  0.20( 0.10) 0.49       3.3     210.00
      2        8.22    9.96    2.734  0.20( 0.10) 0.50       3.4     400.00
============================================================================
```

```
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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                           Analysis prepared by:

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 ************************** DESCRIPTION OF STUDY **************************
*                           VICTORIA APARTMENTS                            *
*                           EXISTING HYDROLOGY                             *
*                             25 YEAR STORM                                *
 **************************************************************************

  FILE NAME: VICTEX.DAT
  TIME/DATE OF STUDY: 16:54 02/25/2020
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   3.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)      (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0      20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     20.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   300.00
  ELEVATION DATA: UPSTREAM(FEET) =     54.10  DOWNSTREAM(FEET) =     46.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.775
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.062
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA       Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
  MOBILE HOME PARK           D        0.27      0.20     0.250    75    6.78
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.250
  SUBAREA RUNOFF(CFS) =      0.97
  TOTAL AREA(ACRES) =      0.27   PEAK FLOW RATE(CFS) =      0.97

****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     30.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     46.00
  DOWNSTREAM NODE ELEVATION(FEET) =     44.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   160.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.080
  PAVEMENT LIP(FEET) =  0.020   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   1.00
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.701
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  MOBILE HOME PARK           D        0.30      0.20     0.250    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.250
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      1.47
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.21
  AVERAGE FLOW DEPTH(FEET) =   0.17   FLOOD WIDTH(FEET) =   10.29
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   1.21   Tc(MIN.) =    7.98
  SUBAREA AREA(ACRES) =    0.30       SUBAREA RUNOFF(CFS) =    0.99
  EFFECTIVE AREA(ACRES) =    0.57     AREA-AVERAGED Fm(INCH/HR) =   0.05
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.25
  TOTAL AREA(ACRES) =        0.6         PEAK FLOW RATE(CFS) =       1.87

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.19   FLOOD WIDTH(FEET) =   11.70
  FLOW VELOCITY(FEET/SEC.) =   2.29   DEPTH*VELOCITY(FT*FT/SEC) =   0.43
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     30.00 =     460.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     90.00 TO NODE    100.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   190.00
  ELEVATION DATA: UPSTREAM(FEET) =     53.00  DOWNSTREAM(FEET) =     49.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.367
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.634
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.52      0.20     0.100    75    5.37
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      2.16
  TOTAL AREA(ACRES) =      0.52   PEAK FLOW RATE(CFS) =      2.16

****************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    110.00 IS CODE =  91
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     49.00
  DOWNSTREAM NODE ELEVATION(FEET) =     40.30
  CHANNEL LENGTH THRU SUBAREA(FEET) =   340.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.080
  PAVEMENT LIP(FEET) =  0.020   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   1.00
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.035
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        2.77      0.20     0.100    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      7.08
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.81
  AVERAGE FLOW DEPTH(FEET) =   0.26   FLOOD WIDTH(FEET) =   18.56
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   1.49   Tc(MIN.) =    6.85
  SUBAREA AREA(ACRES) =    2.77       SUBAREA RUNOFF(CFS) =   10.01
  EFFECTIVE AREA(ACRES) =    3.29     AREA-AVERAGED Fm(INCH/HR) =   0.02
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        3.3         PEAK FLOW RATE(CFS) =      11.89

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.30   FLOOD WIDTH(FEET) =   23.13
  FLOW VELOCITY(FEET/SEC.) =   4.23   DEPTH*VELOCITY(FT*FT/SEC) =   1.28
  LONGEST FLOWPATH FROM NODE     90.00 TO NODE    110.00 =     530.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    210.00 TO NODE    220.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   310.00
  ELEVATION DATA: UPSTREAM(FEET) =     60.00  DOWNSTREAM(FEET) =     52.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.267
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.245
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.52      0.20     0.100    75    6.27
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      1.98
  TOTAL AREA(ACRES) =      0.52   PEAK FLOW RATE(CFS) =      1.98

****************************************************************************
  FLOW PROCESS FROM NODE    220.00 TO NODE    230.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     52.00
  DOWNSTREAM NODE ELEVATION(FEET) =     37.30
  CHANNEL LENGTH THRU SUBAREA(FEET) =   550.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.080
  PAVEMENT LIP(FEET) =  0.020   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   1.00
```

```
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.486
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        1.14      0.20     0.100    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      3.74
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.51
  AVERAGE FLOW DEPTH(FEET) =   0.21   FLOOD WIDTH(FEET) =   13.63
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   2.61   Tc(MIN.) =    8.88
  SUBAREA AREA(ACRES) =    1.14       SUBAREA RUNOFF(CFS) =    3.56
  EFFECTIVE AREA(ACRES) =    1.66     AREA-AVERAGED Fm(INCH/HR) =   0.02
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        1.7         PEAK FLOW RATE(CFS) =       5.18

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.23   FLOOD WIDTH(FEET) =   15.92
  FLOW VELOCITY(FEET/SEC.) =   3.69   DEPTH*VELOCITY(FT*FT/SEC) =   0.85
  LONGEST FLOWPATH FROM NODE    210.00 TO NODE    230.00 =     860.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    230.00 TO NODE    450.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     37.30  DOWNSTREAM(FEET) =     35.90
  CHANNEL LENGTH THRU SUBAREA(FEET) =    73.00   CHANNEL SLOPE =  0.0192
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  20.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  CHANNEL FLOW THRU SUBAREA(CFS) =       5.18
  FLOW VELOCITY(FEET/SEC.) =   3.45   FLOW DEPTH(FEET) =   0.21
  TRAVEL TIME(MIN.) =   0.35   Tc(MIN.) =    9.23
  LONGEST FLOWPATH FROM NODE    210.00 TO NODE    450.00 =     933.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    450.00 TO NODE    450.00 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.) =    9.23
  RAINFALL INTENSITY(INCH/HR) =   3.41
  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       1.66
  TOTAL STREAM AREA(ACRES) =       1.66
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       5.18

****************************************************************************
  FLOW PROCESS FROM NODE    400.00 TO NODE    410.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   290.00
  ELEVATION DATA: UPSTREAM(FEET) =    100.00  DOWNSTREAM(FEET) =     54.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.799
```

```
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.054
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  ".4 DWELLING/ACRE"         D        0.57      0.20     0.900    75    6.80
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.900
  SUBAREA RUNOFF(CFS) =      1.99
  TOTAL AREA(ACRES) =      0.57   PEAK FLOW RATE(CFS) =      1.99

****************************************************************************
  FLOW PROCESS FROM NODE    410.00 TO NODE    420.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     54.00
  DOWNSTREAM NODE ELEVATION(FEET) =     44.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   467.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.080
  PAVEMENT LIP(FEET) =  0.020   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   1.00
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.406
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  ".4 DWELLING/ACRE"         D        1.13      0.20     0.900    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.900
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      3.62
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.18
  AVERAGE FLOW DEPTH(FEET) =   0.21   FLOOD WIDTH(FEET) =   14.16
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   2.45   Tc(MIN.) =    9.25
  SUBAREA AREA(ACRES) =    1.13       SUBAREA RUNOFF(CFS) =    3.28
  EFFECTIVE AREA(ACRES) =    1.70     AREA-AVERAGED Fm(INCH/HR) =   0.18
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.90
  TOTAL AREA(ACRES) =        1.7         PEAK FLOW RATE(CFS) =       4.94

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.23   FLOOD WIDTH(FEET) =   16.45
  FLOW VELOCITY(FEET/SEC.) =   3.32   DEPTH*VELOCITY(FT*FT/SEC) =   0.78
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    420.00 =     757.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    420.00 TO NODE    430.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     44.00  DOWNSTREAM(FEET) =     38.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   112.00   CHANNEL SLOPE =  0.0536
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  20.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  CHANNEL FLOW THRU SUBAREA(CFS) =       4.94
  FLOW VELOCITY(FEET/SEC.) =   5.10   FLOW DEPTH(FEET) =   0.16
  TRAVEL TIME(MIN.) =   0.37   Tc(MIN.) =    9.61
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    430.00 =     869.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    430.00 TO NODE    450.00 IS CODE =  51
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     38.00  DOWNSTREAM(FEET) =     35.90
  CHANNEL LENGTH THRU SUBAREA(FEET) =    63.00   CHANNEL SLOPE =  0.0333
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  20.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  CHANNEL FLOW THRU SUBAREA(CFS) =       4.94
  FLOW VELOCITY(FEET/SEC.) =   4.21   FLOW DEPTH(FEET) =   0.18
  TRAVEL TIME(MIN.) =   0.25   Tc(MIN.) =    9.86
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    450.00 =     932.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    450.00 TO NODE    450.00 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.) =    9.86
  RAINFALL INTENSITY(INCH/HR) =   3.28
  AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.90
  EFFECTIVE STREAM AREA(ACRES) =       1.70
  TOTAL STREAM AREA(ACRES) =       1.70
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       4.94

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        5.18    9.23    3.410  0.20( 0.02) 0.10       1.7     210.00
      2        4.94    9.86    3.284  0.20( 0.18) 0.90       1.7     400.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        9.98    9.23    3.410  0.20( 0.10) 0.49       3.3     210.00
      2        9.92    9.86    3.284  0.20( 0.10) 0.50       3.4     400.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       9.98    Tc(MIN.) =     9.23
  EFFECTIVE AREA(ACRES) =       3.25   AREA-AVERAGED Fm(INCH/HR) =  0.10
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.49
  TOTAL AREA(ACRES) =        3.4
  LONGEST FLOWPATH FROM NODE    210.00 TO NODE    450.00 =     933.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        3.4  TC(MIN.) =      9.23
  EFFECTIVE AREA(ACRES) =      3.25  AREA-AVERAGED Fm(INCH/HR)=  0.10
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap = 0.491
  PEAK FLOW RATE(CFS)   =       9.98

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        9.98    9.23    3.410  0.20( 0.10) 0.49       3.3     210.00
      2        9.92    9.86    3.284  0.20( 0.10) 0.50       3.4     400.00
============================================================================
```

```
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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                           Analysis prepared by:

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                              Irvine, CA 92606

 ************************* DESCRIPTION OF STUDY *************************
*                           VICTORIA APARTMENTS                            *
*                           EXISTING HYDROLOGY                             *
*                            100 YEAR STORM                                *
 **************************************************************************

  FILE NAME: VICTEX.DAT
  TIME/DATE OF STUDY: 16:56 02/25/2020
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   3.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)      (FT)   SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     20.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   300.00
  ELEVATION DATA: UPSTREAM(FEET) =     54.10  DOWNSTREAM(FEET) =     46.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.775
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.199
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN   (MIN.)
```

```
  MOBILE HOME PARK           D        0.27      0.20     0.250    91    6.78
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.250
  SUBAREA RUNOFF(CFS) =      1.25
  TOTAL AREA(ACRES) =      0.27   PEAK FLOW RATE(CFS) =      1.25

****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     30.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     46.00
  DOWNSTREAM NODE ELEVATION(FEET) =     44.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   160.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.080
  PAVEMENT LIP(FEET) =  0.020   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.749
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  MOBILE HOME PARK           D        0.30      0.20     0.250    91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.250
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      1.89
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.30
  AVERAGE FLOW DEPTH(FEET) =   0.19   FLOOD WIDTH(FEET) =   11.70
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   1.16   Tc(MIN.) =    7.93
  SUBAREA AREA(ACRES) =    0.30       SUBAREA RUNOFF(CFS) =    1.27
  EFFECTIVE AREA(ACRES) =    0.57     AREA-AVERAGED Fm(INCH/HR) =   0.05
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.25
  TOTAL AREA(ACRES) =        0.6         PEAK FLOW RATE(CFS) =       2.41

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.20   FLOOD WIDTH(FEET) =   13.28
  FLOW VELOCITY(FEET/SEC.) =   2.37   DEPTH*VELOCITY(FT*FT/SEC) =   0.48
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     30.00 =     460.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     90.00 TO NODE    100.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   190.00
  ELEVATION DATA: UPSTREAM(FEET) =     53.00  DOWNSTREAM(FEET) =     49.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.367
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.941
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.52      0.20     0.100    91    5.37
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      2.77
  TOTAL AREA(ACRES) =      0.52   PEAK FLOW RATE(CFS) =      2.77

****************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    110.00 IS CODE =  91
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
==============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     49.00
  DOWNSTREAM NODE ELEVATION(FEET) =     40.30
  CHANNEL LENGTH THRU SUBAREA(FEET) =   340.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.080
  PAVEMENT LIP(FEET) =  0.020   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.197
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        2.77      0.20     0.100    91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      9.11
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.01
  AVERAGE FLOW DEPTH(FEET) =   0.28   FLOOD WIDTH(FEET) =   20.67
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   1.41   Tc(MIN.) =    6.78
  SUBAREA AREA(ACRES) =    2.77       SUBAREA RUNOFF(CFS) =   12.91
  EFFECTIVE AREA(ACRES) =    3.29     AREA-AVERAGED Fm(INCH/HR) =   0.02
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        3.3         PEAK FLOW RATE(CFS) =      15.33

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.33   FLOOD WIDTH(FEET) =   25.59
  FLOW VELOCITY(FEET/SEC.) =   4.50   DEPTH*VELOCITY(FT*FT/SEC) =   1.47
  LONGEST FLOWPATH FROM NODE     90.00 TO NODE    110.00 =     530.00 FEET.

******************************************************************************
  FLOW PROCESS FROM NODE    210.00 TO NODE    220.00 IS CODE =  21
------------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   310.00
  ELEVATION DATA: UPSTREAM(FEET) =     60.00  DOWNSTREAM(FEET) =     52.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.267
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.436
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.52      0.20     0.100    91    6.27
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      2.53
  TOTAL AREA(ACRES) =      0.52   PEAK FLOW RATE(CFS) =      2.53

******************************************************************************
  FLOW PROCESS FROM NODE    220.00 TO NODE    230.00 IS CODE =  91
------------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
==============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     52.00
  DOWNSTREAM NODE ELEVATION(FEET) =     37.30
  CHANNEL LENGTH THRU SUBAREA(FEET) =   550.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.080
  PAVEMENT LIP(FEET) =  0.020   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   1.00
```

```
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.480
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        1.14      0.20     0.100    91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      4.81
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.64
  AVERAGE FLOW DEPTH(FEET) =   0.22   FLOOD WIDTH(FEET) =   15.39
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   2.52   Tc(MIN.) =    8.78
  SUBAREA AREA(ACRES) =    1.14       SUBAREA RUNOFF(CFS) =    4.58
  EFFECTIVE AREA(ACRES) =    1.66     AREA-AVERAGED Fm(INCH/HR) =   0.02
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        1.7         PEAK FLOW RATE(CFS) =       6.66

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.25   FLOOD WIDTH(FEET) =   17.85
  FLOW VELOCITY(FEET/SEC.) =   3.85   DEPTH*VELOCITY(FT*FT/SEC) =   0.96
  LONGEST FLOWPATH FROM NODE    210.00 TO NODE    230.00 =     860.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    230.00 TO NODE    450.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     37.30  DOWNSTREAM(FEET) =     35.90
  CHANNEL LENGTH THRU SUBAREA(FEET) =    73.00   CHANNEL SLOPE =  0.0192
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  20.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  CHANNEL FLOW THRU SUBAREA(CFS) =       6.66
  FLOW VELOCITY(FEET/SEC.) =   3.77   FLOW DEPTH(FEET) =   0.23
  TRAVEL TIME(MIN.) =   0.32   Tc(MIN.) =    9.11
  LONGEST FLOWPATH FROM NODE    210.00 TO NODE    450.00 =     933.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    450.00 TO NODE    450.00 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.) =    9.11
  RAINFALL INTENSITY(INCH/HR) =   4.39
  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       1.66
  TOTAL STREAM AREA(ACRES) =       1.66
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       6.66

****************************************************************************
  FLOW PROCESS FROM NODE    400.00 TO NODE    410.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   290.00
  ELEVATION DATA: UPSTREAM(FEET) =    100.00  DOWNSTREAM(FEET) =     54.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.799
```

```
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.188
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  ".4 DWELLING/ACRE"         D        0.57      0.20     0.900    91    6.80
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.900
  SUBAREA RUNOFF(CFS) =      2.57
  TOTAL AREA(ACRES) =      0.57   PEAK FLOW RATE(CFS) =      2.57

****************************************************************************
  FLOW PROCESS FROM NODE    410.00 TO NODE    420.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     54.00
  DOWNSTREAM NODE ELEVATION(FEET) =     44.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   467.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.080
  PAVEMENT LIP(FEET) =  0.020   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.370
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  ".4 DWELLING/ACRE"         D        1.13      0.20     0.900    91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.900
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      4.69
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.28
  AVERAGE FLOW DEPTH(FEET) =   0.23   FLOOD WIDTH(FEET) =   16.10
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   2.37   Tc(MIN.) =    9.17
  SUBAREA AREA(ACRES) =    1.13       SUBAREA RUNOFF(CFS) =    4.26
  EFFECTIVE AREA(ACRES) =    1.70     AREA-AVERAGED Fm(INCH/HR) =   0.18
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.90
  TOTAL AREA(ACRES) =        1.7         PEAK FLOW RATE(CFS) =       6.41

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.25   FLOOD WIDTH(FEET) =   18.38
  FLOW VELOCITY(FEET/SEC.) =   3.51   DEPTH*VELOCITY(FT*FT/SEC) =   0.89
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    420.00 =     757.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    420.00 TO NODE    430.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     44.00  DOWNSTREAM(FEET) =     38.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   112.00   CHANNEL SLOPE =  0.0536
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  20.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  CHANNEL FLOW THRU SUBAREA(CFS) =       6.41
  FLOW VELOCITY(FEET/SEC.) =   5.47   FLOW DEPTH(FEET) =   0.18
  TRAVEL TIME(MIN.) =   0.34   Tc(MIN.) =    9.51
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    430.00 =     869.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    430.00 TO NODE    450.00 IS CODE =  51
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     38.00  DOWNSTREAM(FEET) =     35.90
  CHANNEL LENGTH THRU SUBAREA(FEET) =    63.00   CHANNEL SLOPE =  0.0333
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  20.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  CHANNEL FLOW THRU SUBAREA(CFS) =       6.41
  FLOW VELOCITY(FEET/SEC.) =   4.54   FLOW DEPTH(FEET) =   0.20
  TRAVEL TIME(MIN.) =   0.23   Tc(MIN.) =    9.75
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    450.00 =     932.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    450.00 TO NODE    450.00 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.) =    9.75
  RAINFALL INTENSITY(INCH/HR) =   4.22
  AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.90
  EFFECTIVE STREAM AREA(ACRES) =       1.70
  TOTAL STREAM AREA(ACRES) =       1.70
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       6.41

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        6.66    9.11    4.388  0.20( 0.02) 0.10       1.7     210.00
      2        6.41    9.75    4.221  0.20( 0.18) 0.90       1.7     400.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       12.90    9.11    4.388  0.20( 0.10) 0.49       3.2     210.00
      2       12.82    9.75    4.221  0.20( 0.10) 0.50       3.4     400.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      12.90    Tc(MIN.) =     9.11
  EFFECTIVE AREA(ACRES) =       3.25   AREA-AVERAGED Fm(INCH/HR) =  0.10
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.49
  TOTAL AREA(ACRES) =        3.4
  LONGEST FLOWPATH FROM NODE    210.00 TO NODE    450.00 =     933.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        3.4  TC(MIN.) =      9.11
  EFFECTIVE AREA(ACRES) =      3.25  AREA-AVERAGED Fm(INCH/HR)=  0.10
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap = 0.491
  PEAK FLOW RATE(CFS)   =      12.90

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       12.90    9.11    4.388  0.20( 0.10) 0.49       3.2     210.00
      2       12.82    9.75    4.221  0.20( 0.10) 0.50       3.4     400.00
============================================================================
```

```
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

# APPENDIX 4

---

## PROPOSED HYDROLOGY CALCULATIONS

```
____________________________________________________________________________
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
         (c) Copyright 1983-2014 Advanced Engineering Software (aes)
             Ver. 21.0  Release Date: 06/01/2014  License ID 1355

                           Analysis prepared by:

                             Fuscoe Engineering
                              16795 Von Karman
                                 Suite 100
                              Irvine, CA 92606

 ************************** DESCRIPTION OF STUDY **************************
 *                         VICTORIA APARTMENTS                              *
 *                         PROPOSED HYDROLOGY                               *
 *                            10-YEAR STORM                                 *
 **************************************************************************

  FILE NAME: VICTPR.DAT
  TIME/DATE OF STUDY: 10:20 06/08/2021
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   3.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     20.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   331.00
  ELEVATION DATA: UPSTREAM(FEET) =     53.00  DOWNSTREAM(FEET) =     46.20

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.177
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.300
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
  APARTMENTS                 D        0.99      0.20     0.200    75    7.18
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      2.90
  TOTAL AREA(ACRES) =      0.99   PEAK FLOW RATE(CFS) =      2.90

****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     30.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    43.20  DOWNSTREAM(FEET) =    37.08
  FLOW LENGTH(FEET) =    31.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   3.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  14.17
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.90
  PIPE TRAVEL TIME(MIN.) =   0.04    Tc(MIN.) =    7.21
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     30.00 =     362.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     30.00 TO NODE     40.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    37.08  DOWNSTREAM(FEET) =    34.60
  FLOW LENGTH(FEET) =   208.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  30.0 INCH PIPE IS   5.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.94
  GIVEN PIPE DIAMETER(INCH) =  30.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.90
  PIPE TRAVEL TIME(MIN.) =   0.70    Tc(MIN.) =    7.91
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     40.00 =     570.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     40.00 TO NODE     70.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    34.60  DOWNSTREAM(FEET) =    34.20
  FLOW LENGTH(FEET) =    13.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  30.0 INCH PIPE IS   4.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.90
  GIVEN PIPE DIAMETER(INCH) =  30.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.90
  PIPE TRAVEL TIME(MIN.) =   0.03    Tc(MIN.) =    7.95
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     70.00 =     583.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     70.00 TO NODE     70.00 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.) =    7.95
  RAINFALL INTENSITY(INCH/HR) =   3.11
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.20
```

```
  EFFECTIVE STREAM AREA(ACRES) =       0.99
  TOTAL STREAM AREA(ACRES) =       0.99
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.90

****************************************************************************
  FLOW PROCESS FROM NODE     50.00 TO NODE     60.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   270.00
  ELEVATION DATA: UPSTREAM(FEET) =     46.00  DOWNSTREAM(FEET) =     42.20

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.135
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.311
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 D        0.90      0.20     0.200    75    7.14
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      2.65
  TOTAL AREA(ACRES) =      0.90   PEAK FLOW RATE(CFS) =      2.65

****************************************************************************
  FLOW PROCESS FROM NODE     60.00 TO NODE     70.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    39.20  DOWNSTREAM(FEET) =    34.20
  FLOW LENGTH(FEET) =    49.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   4.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  11.37
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.65
  PIPE TRAVEL TIME(MIN.) =   0.07    Tc(MIN.) =    7.21
  LONGEST FLOWPATH FROM NODE     50.00 TO NODE     70.00 =     319.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     70.00 TO NODE     70.00 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.) =    7.21
  RAINFALL INTENSITY(INCH/HR) =   3.29
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       0.90
  TOTAL STREAM AREA(ACRES) =       0.90
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.65

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.90    7.95    3.113  0.20( 0.04) 0.20       1.0      10.00
      2        2.65    7.21    3.292  0.20( 0.04) 0.20       0.9      50.00
```

```
  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        5.44    7.21    3.292  0.20( 0.04) 0.20       1.8      50.00
      2        5.41    7.95    3.113  0.20( 0.04) 0.20       1.9      10.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       5.44    Tc(MIN.) =     7.21
  EFFECTIVE AREA(ACRES) =       1.80   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        1.9
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     70.00 =     583.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     70.00 TO NODE     80.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    34.20  DOWNSTREAM(FEET) =    33.20
  FLOW LENGTH(FEET) =    90.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS   7.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.68
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.44
  PIPE TRAVEL TIME(MIN.) =   0.26    Tc(MIN.) =    7.47
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     80.00 =     673.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     80.00 TO NODE     90.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    33.20  DOWNSTREAM(FEET) =    32.60
  FLOW LENGTH(FEET) =    75.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS   7.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.06
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.44
  PIPE TRAVEL TIME(MIN.) =   0.25    Tc(MIN.) =    7.72
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     90.00 =     748.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     90.00 TO NODE    100.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    32.60  DOWNSTREAM(FEET) =    31.70
  FLOW LENGTH(FEET) =    40.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS   5.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.28
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.44
  PIPE TRAVEL TIME(MIN.) =   0.09    Tc(MIN.) =    7.81
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    100.00 =     788.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    130.00 IS CODE =  41
```

```
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    31.70  DOWNSTREAM(FEET) =    29.50
  FLOW LENGTH(FEET) =   287.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS   7.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.99
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.44
  PIPE TRAVEL TIME(MIN.) =   0.96    Tc(MIN.) =    8.77
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    130.00 =    1075.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    130.00 TO NODE    130.00 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.) =    8.77
  RAINFALL INTENSITY(INCH/HR) =   2.94
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       1.80
  TOTAL STREAM AREA(ACRES) =       1.89
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       5.44

****************************************************************************
  FLOW PROCESS FROM NODE    110.00 TO NODE    120.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   273.00
  ELEVATION DATA: UPSTREAM(FEET) =     42.00  DOWNSTREAM(FEET) =     37.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.040
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.337
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 D        0.42      0.20     0.200    75    7.04
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      1.25
  TOTAL AREA(ACRES) =      0.42   PEAK FLOW RATE(CFS) =      1.25

****************************************************************************
  FLOW PROCESS FROM NODE    120.00 TO NODE    130.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    34.40  DOWNSTREAM(FEET) =    29.50
  FLOW LENGTH(FEET) =    36.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   2.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.18
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.25
  PIPE TRAVEL TIME(MIN.) =   0.06    Tc(MIN.) =    7.10
```

```
  LONGEST FLOWPATH FROM NODE    110.00 TO NODE    130.00 =     309.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    130.00 TO NODE    130.00 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.) =    7.10
  RAINFALL INTENSITY(INCH/HR) =   3.32
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       0.42
  TOTAL STREAM AREA(ACRES) =       0.42
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.25

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        5.44    8.77    2.942  0.20( 0.04) 0.20       1.8      50.00
      1        5.41    9.51    2.808  0.20( 0.04) 0.20       1.9      10.00
      2        1.25    7.10    3.321  0.20( 0.04) 0.20       0.4     110.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        6.22    7.10    3.321  0.20( 0.04) 0.20       1.9     110.00
      2        6.54    8.77    2.942  0.20( 0.04) 0.20       2.2      50.00
      3        6.46    9.51    2.808  0.20( 0.04) 0.20       2.3      10.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       6.54    Tc(MIN.) =     8.77
  EFFECTIVE AREA(ACRES) =       2.22   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        2.3
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    130.00 =    1075.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    130.00 TO NODE    350.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    29.50  DOWNSTREAM(FEET) =    29.39
  FLOW LENGTH(FEET) =    65.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS  12.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.06
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.54
  PIPE TRAVEL TIME(MIN.) =   0.35    Tc(MIN.) =    9.12
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    350.00 =    1140.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    350.00 TO NODE    350.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    210.00 TO NODE    220.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   180.00
  ELEVATION DATA: UPSTREAM(FEET) =     57.00  DOWNSTREAM(FEET) =     52.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.408
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.881
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 D        0.42      0.20     0.200    75    5.41
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      1.45
  TOTAL AREA(ACRES) =      0.42   PEAK FLOW RATE(CFS) =      1.45

****************************************************************************
  FLOW PROCESS FROM NODE    220.00 TO NODE    230.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    51.00  DOWNSTREAM(FEET) =    45.30
  FLOW LENGTH(FEET) =   108.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   3.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.58
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.45
  PIPE TRAVEL TIME(MIN.) =   0.24    Tc(MIN.) =    5.65
  LONGEST FLOWPATH FROM NODE    210.00 TO NODE    230.00 =     288.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    230.00 TO NODE    260.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    45.30  DOWNSTREAM(FEET) =    41.60
  FLOW LENGTH(FEET) =    84.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS   3.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.56
  GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.45
  PIPE TRAVEL TIME(MIN.) =   0.21    Tc(MIN.) =    5.86
  LONGEST FLOWPATH FROM NODE    210.00 TO NODE    260.00 =     372.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    260.00 TO NODE    260.00 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.) =    5.86
  RAINFALL INTENSITY(INCH/HR) =   3.71
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20
```

```
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       0.42
  TOTAL STREAM AREA(ACRES) =       0.42
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.45

****************************************************************************
  FLOW PROCESS FROM NODE    240.00 TO NODE    250.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   366.00
  ELEVATION DATA: UPSTREAM(FEET) =     49.80  DOWNSTREAM(FEET) =     46.10

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.078
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.084
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        1.09      0.20     0.100    75    8.08
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      3.01
  TOTAL AREA(ACRES) =      1.09   PEAK FLOW RATE(CFS) =      3.01

****************************************************************************
  FLOW PROCESS FROM NODE    250.00 TO NODE    260.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    43.60  DOWNSTREAM(FEET) =    41.60
  FLOW LENGTH(FEET) =    78.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   5.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.93
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.01
  PIPE TRAVEL TIME(MIN.) =   0.19    Tc(MIN.) =    8.27
  LONGEST FLOWPATH FROM NODE    240.00 TO NODE    260.00 =     444.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    260.00 TO NODE    260.00 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.) =    8.27
  RAINFALL INTENSITY(INCH/HR) =   3.04
  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       1.09
  TOTAL STREAM AREA(ACRES) =       1.09
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.01

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        1.45    5.86    3.707  0.20( 0.04) 0.20       0.4     210.00
      2        3.01    8.27    3.043  0.20( 0.02) 0.10       1.1     240.00
```

```
  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        4.05    5.86    3.707  0.20( 0.03) 0.14       1.2     210.00
      2        4.19    8.27    3.043  0.20( 0.03) 0.13       1.5     240.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       4.19    Tc(MIN.) =     8.27
  EFFECTIVE AREA(ACRES) =       1.51   AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.13
  TOTAL AREA(ACRES) =        1.5
  LONGEST FLOWPATH FROM NODE    240.00 TO NODE    260.00 =     444.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    260.00 TO NODE    290.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    41.60  DOWNSTREAM(FEET) =    35.60
  FLOW LENGTH(FEET) =   265.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS   5.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.10
  GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       4.19
  PIPE TRAVEL TIME(MIN.) =   0.62    Tc(MIN.) =    8.89
  LONGEST FLOWPATH FROM NODE    240.00 TO NODE    290.00 =     709.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    290.00 TO NODE    290.00 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.) =    8.89
  RAINFALL INTENSITY(INCH/HR) =   2.92
  AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.13
  EFFECTIVE STREAM AREA(ACRES) =       1.51
  TOTAL STREAM AREA(ACRES) =       1.51
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       4.19

****************************************************************************
  FLOW PROCESS FROM NODE    270.00 TO NODE    280.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   363.00
  ELEVATION DATA: UPSTREAM(FEET) =     53.30  DOWNSTREAM(FEET) =     43.40

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.037
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.338
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
  APARTMENTS                 D        0.75      0.20     0.200    75    7.04
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      2.23
  TOTAL AREA(ACRES) =      0.75   PEAK FLOW RATE(CFS) =      2.23

****************************************************************************
  FLOW PROCESS FROM NODE    280.00 TO NODE    290.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    40.90  DOWNSTREAM(FEET) =    35.60
  FLOW LENGTH(FEET) =    88.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   4.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.96
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.23
  PIPE TRAVEL TIME(MIN.) =   0.16    Tc(MIN.) =    7.20
  LONGEST FLOWPATH FROM NODE    270.00 TO NODE    290.00 =     451.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    290.00 TO NODE    290.00 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.) =    7.20
  RAINFALL INTENSITY(INCH/HR) =   3.29
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       0.75
  TOTAL STREAM AREA(ACRES) =       0.75
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.23

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        4.05    6.49    3.497  0.20( 0.03) 0.14       1.2     210.00
      1        4.19    8.89    2.920  0.20( 0.03) 0.13       1.5     240.00
      2        2.23    7.20    3.294  0.20( 0.04) 0.20       0.8     270.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        6.18    6.49    3.497  0.20( 0.03) 0.16       1.9     210.00
      2        6.32    7.20    3.294  0.20( 0.03) 0.16       2.0     270.00
      3        6.16    8.89    2.920  0.20( 0.03) 0.15       2.3     240.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       6.32    Tc(MIN.) =     7.20
  EFFECTIVE AREA(ACRES) =       2.04   AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.16
  TOTAL AREA(ACRES) =        2.3
  LONGEST FLOWPATH FROM NODE    240.00 TO NODE    290.00 =     709.00 FEET.

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

```
  FLOW PROCESS FROM NODE    290.00 TO NODE    320.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    35.60  DOWNSTREAM(FEET) =    33.30
  FLOW LENGTH(FEET) =   260.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS   9.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.68
  GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.32
  PIPE TRAVEL TIME(MIN.) =   0.76    Tc(MIN.) =    7.96
  LONGEST FLOWPATH FROM NODE    240.00 TO NODE    320.00 =     969.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    320.00 TO NODE    320.00 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.) =    7.96
  RAINFALL INTENSITY(INCH/HR) =   3.11
  AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.16
  EFFECTIVE STREAM AREA(ACRES) =       2.04
  TOTAL STREAM AREA(ACRES) =       2.26
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       6.32

****************************************************************************
  FLOW PROCESS FROM NODE    300.00 TO NODE    310.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   320.00
  ELEVATION DATA: UPSTREAM(FEET) =     44.00  DOWNSTREAM(FEET) =     39.70

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.708
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.168
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 D        0.96      0.20     0.200    75    7.71
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      2.70
  TOTAL AREA(ACRES) =      0.96   PEAK FLOW RATE(CFS) =      2.70

****************************************************************************
  FLOW PROCESS FROM NODE    310.00 TO NODE    320.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    37.40  DOWNSTREAM(FEET) =    33.00
  FLOW LENGTH(FEET) =   131.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   4.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.40
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.70
```

```
  PIPE TRAVEL TIME(MIN.) =   0.30    Tc(MIN.) =    8.00
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    320.00 =     451.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    320.00 TO NODE    320.00 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.) =    8.00
  RAINFALL INTENSITY(INCH/HR) =   3.10
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       0.96
  TOTAL STREAM AREA(ACRES) =       0.96
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.70

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        6.18    7.26    3.280  0.20( 0.03) 0.16       1.9     210.00
      1        6.32    7.96    3.109  0.20( 0.03) 0.16       2.0     270.00
      1        6.16    9.66    2.784  0.20( 0.03) 0.15       2.3     240.00
      2        2.70    8.00    3.100  0.20( 0.04) 0.20       1.0     300.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        8.77    7.26    3.280  0.20( 0.03) 0.17       2.7     210.00
      2        9.02    7.96    3.109  0.20( 0.03) 0.17       3.0     270.00
      3        9.02    8.00    3.100  0.20( 0.03) 0.17       3.0     300.00
      4        8.59    9.66    2.784  0.20( 0.03) 0.17       3.2     240.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       9.02    Tc(MIN.) =     8.00
  EFFECTIVE AREA(ACRES) =       3.00   AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.17
  TOTAL AREA(ACRES) =        3.2
  LONGEST FLOWPATH FROM NODE    240.00 TO NODE    320.00 =     969.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    320.00 TO NODE    350.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    33.00  DOWNSTREAM(FEET) =    29.39
  FLOW LENGTH(FEET) =    63.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS   6.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  12.31
  GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       9.02
  PIPE TRAVEL TIME(MIN.) =   0.09    Tc(MIN.) =    8.09
  LONGEST FLOWPATH FROM NODE    240.00 TO NODE    350.00 =    1032.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    350.00 TO NODE    350.00 IS CODE =  11
```

```
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        8.77    7.34    3.258  0.20( 0.03) 0.17       2.7     210.00
      2        9.02    8.05    3.090  0.20( 0.03) 0.17       3.0     270.00
      3        9.02    8.09    3.082  0.20( 0.03) 0.17       3.0     300.00
      4        8.59    9.74    2.770  0.20( 0.03) 0.17       3.2     240.00
  LONGEST FLOWPATH FROM NODE    240.00 TO NODE    350.00 =    1032.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        6.22    7.46    3.228  0.20( 0.04) 0.20       1.9     110.00
      2        6.54    9.12    2.876  0.20( 0.04) 0.20       2.2      50.00
      3        6.46    9.87    2.750  0.20( 0.04) 0.20       2.3      10.00
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    350.00 =    1140.00 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       14.96    7.34    3.258  0.20( 0.04) 0.18       4.6     210.00
      2       15.04    7.46    3.228  0.20( 0.04) 0.18       4.7     110.00
      3       15.35    8.05    3.090  0.20( 0.04) 0.18       5.0     270.00
      4       15.36    8.09    3.082  0.20( 0.04) 0.18       5.0     300.00
      5       15.29    9.12    2.876  0.20( 0.04) 0.18       5.4      50.00
      6       15.06    9.74    2.770  0.20( 0.04) 0.18       5.5     240.00
      7       14.99    9.87    2.750  0.20( 0.04) 0.18       5.5      10.00
    TOTAL AREA(ACRES) =         5.5

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       15.36  Tc(MIN.) =    8.088
  EFFECTIVE AREA(ACRES) =      5.01  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.18
  TOTAL AREA(ACRES) =        5.5
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    350.00 =    1140.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    350.00 TO NODE    450.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    29.39  DOWNSTREAM(FEET) =    29.34
  FLOW LENGTH(FEET) =    20.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS  17.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.44
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      15.36
  PIPE TRAVEL TIME(MIN.) =   0.08    Tc(MIN.) =    8.16
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    450.00 =    1160.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    450.00 TO NODE    450.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    400.00 TO NODE    410.00 IS CODE =  21
```

```
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   290.00
  ELEVATION DATA: UPSTREAM(FEET) =    100.00  DOWNSTREAM(FEET) =     50.40

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.697
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.434
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  ".4 DWELLING/ACRE"          D        0.57      0.20     0.900    75    6.70
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.900
  SUBAREA RUNOFF(CFS) =      1.67
  TOTAL AREA(ACRES) =      0.57   PEAK FLOW RATE(CFS) =      1.67

****************************************************************************
  FLOW PROCESS FROM NODE    410.00 TO NODE    430.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     50.40
  DOWNSTREAM NODE ELEVATION(FEET) =     38.80
  CHANNEL LENGTH THRU SUBAREA(FEET) =   574.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.080
  PAVEMENT LIP(FEET) =  0.020   MANNING'S N = .0130
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   1.50
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.808
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  ".4 DWELLING/ACRE"          D        1.13      0.20     0.900    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.900
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      3.00
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.40
  AVERAGE FLOW DEPTH(FEET) =   0.19   FLOOD WIDTH(FEET) =   12.23
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   2.82   Tc(MIN.) =    9.51
  SUBAREA AREA(ACRES) =    1.13       SUBAREA RUNOFF(CFS) =    2.67
  EFFECTIVE AREA(ACRES) =    1.70     AREA-AVERAGED Fm(INCH/HR) =   0.18
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.90
  TOTAL AREA(ACRES) =        1.7         PEAK FLOW RATE(CFS) =       4.02

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.21   FLOOD WIDTH(FEET) =   14.14
  FLOW VELOCITY(FEET/SEC.) =   3.54   DEPTH*VELOCITY(FT*FT/SEC) =   0.75
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    430.00 =     864.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    430.00 TO NODE    450.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     38.80  DOWNSTREAM(FEET) =     35.90
  CHANNEL LENGTH THRU SUBAREA(FEET) =    76.00   CHANNEL SLOPE =  0.0382
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   0.500
```

```
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  CHANNEL FLOW THRU SUBAREA(CFS) =       4.02
  FLOW VELOCITY(FEET/SEC.) =   6.98   FLOW DEPTH(FEET) =   0.27
  TRAVEL TIME(MIN.) =   0.18   Tc(MIN.) =    9.69
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    450.00 =     940.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    450.00 TO NODE    450.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 2 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        4.02    9.69    2.778  0.20( 0.18) 0.90       1.7     400.00
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    450.00 =     940.00 FEET.

  ** MEMORY BANK #  2 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       14.96    7.42    3.239  0.20( 0.04) 0.18       4.6     210.00
      2       15.04    7.53    3.210  0.20( 0.04) 0.18       4.7     110.00
      3       15.35    8.12    3.074  0.20( 0.04) 0.18       5.0     270.00
      4       15.36    8.16    3.065  0.20( 0.04) 0.18       5.0     300.00
      5       15.29    9.20    2.863  0.20( 0.04) 0.18       5.4      50.00
      6       15.06    9.82    2.758  0.20( 0.04) 0.18       5.5     240.00
      7       14.99    9.94    2.738  0.20( 0.04) 0.18       5.5      10.00
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    450.00 =    1160.00 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       18.58    7.42    3.239  0.20( 0.07) 0.34       5.9     210.00
      2       18.68    7.53    3.210  0.20( 0.07) 0.34       6.0     110.00
      3       19.10    8.12    3.074  0.20( 0.07) 0.34       6.4     270.00
      4       19.12    8.16    3.065  0.20( 0.07) 0.34       6.4     300.00
      5       19.23    9.20    2.863  0.20( 0.07) 0.35       7.0      50.00
      6       19.13    9.69    2.778  0.20( 0.07) 0.35       7.2     400.00
      7       19.05    9.82    2.758  0.20( 0.07) 0.35       7.2     240.00
      8       18.95    9.94    2.738  0.20( 0.07) 0.35       7.2      10.00
    TOTAL AREA(ACRES) =         7.2

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       19.23  Tc(MIN.) =    9.197
  EFFECTIVE AREA(ACRES) =      6.97  AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        7.2
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    450.00 =    1160.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        7.2  TC(MIN.) =      9.20
  EFFECTIVE AREA(ACRES) =      6.97  AREA-AVERAGED Fm(INCH/HR)=  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap = 0.348
  PEAK FLOW RATE(CFS)   =      19.23

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       18.58    7.42    3.239  0.20( 0.07) 0.34       5.9     210.00
      2       18.68    7.53    3.210  0.20( 0.07) 0.34       6.0     110.00
      3       19.10    8.12    3.074  0.20( 0.07) 0.34       6.4     270.00
      4       19.12    8.16    3.065  0.20( 0.07) 0.34       6.4     300.00
```

```
     5       19.23    9.20    2.863  0.20( 0.07) 0.35       7.0      50.00
     6       19.13    9.69    2.778  0.20( 0.07) 0.35       7.2     400.00
     7       19.05    9.82    2.758  0.20( 0.07) 0.35       7.2     240.00
     8       18.95    9.94    2.738  0.20( 0.07) 0.35       7.2      10.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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                           Analysis prepared by:

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                              Irvine, CA 92606

 ************************** DESCRIPTION OF STUDY **************************
*                         VICTORIA APARTMENTS                              *
*                         PROPOSED HYDROLOGY                               *
*                            25-YEAR STORM                                 *
 **************************************************************************

  FILE NAME: VICTPR.DAT
  TIME/DATE OF STUDY: 10:21 06/08/2021
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   3.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)     (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     20.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   331.00
  ELEVATION DATA: UPSTREAM(FEET) =     53.00  DOWNSTREAM(FEET) =     46.20

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.177
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.931
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
  APARTMENTS                  D        0.99      0.20     0.200    75    7.18
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      3.47
  TOTAL AREA(ACRES) =      0.99   PEAK FLOW RATE(CFS) =      3.47

****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     30.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    43.20  DOWNSTREAM(FEET) =    37.08
  FLOW LENGTH(FEET) =    31.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   3.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  14.92
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.47
  PIPE TRAVEL TIME(MIN.) =   0.03    Tc(MIN.) =    7.21
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     30.00 =     362.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     30.00 TO NODE     40.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    37.08  DOWNSTREAM(FEET) =    34.60
  FLOW LENGTH(FEET) =   208.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  30.0 INCH PIPE IS   5.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.22
  GIVEN PIPE DIAMETER(INCH) =  30.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.47
  PIPE TRAVEL TIME(MIN.) =   0.66    Tc(MIN.) =    7.88
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     40.00 =     570.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     40.00 TO NODE     70.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    34.60  DOWNSTREAM(FEET) =    34.20
  FLOW LENGTH(FEET) =    13.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  30.0 INCH PIPE IS   4.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.28
  GIVEN PIPE DIAMETER(INCH) =  30.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.47
  PIPE TRAVEL TIME(MIN.) =   0.03    Tc(MIN.) =    7.91
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     70.00 =     583.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     70.00 TO NODE     70.00 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.) =    7.91
  RAINFALL INTENSITY(INCH/HR) =   3.72
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.20
```

```
  EFFECTIVE STREAM AREA(ACRES) =       0.99
  TOTAL STREAM AREA(ACRES) =       0.99
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.47

****************************************************************************
  FLOW PROCESS FROM NODE     50.00 TO NODE     60.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   270.00
  ELEVATION DATA: UPSTREAM(FEET) =     46.00  DOWNSTREAM(FEET) =     42.20

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.135
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.944
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 D        0.90      0.20     0.200    75    7.14
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      3.16
  TOTAL AREA(ACRES) =      0.90   PEAK FLOW RATE(CFS) =      3.16

****************************************************************************
  FLOW PROCESS FROM NODE     60.00 TO NODE     70.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    39.20  DOWNSTREAM(FEET) =    34.20
  FLOW LENGTH(FEET) =    49.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   4.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  11.94
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.16
  PIPE TRAVEL TIME(MIN.) =   0.07    Tc(MIN.) =    7.20
  LONGEST FLOWPATH FROM NODE     50.00 TO NODE     70.00 =     319.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     70.00 TO NODE     70.00 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.) =    7.20
  RAINFALL INTENSITY(INCH/HR) =   3.92
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       0.90
  TOTAL STREAM AREA(ACRES) =       0.90
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.16

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        3.47    7.91    3.722  0.20( 0.04) 0.20       1.0      10.00
      2        3.16    7.20    3.923  0.20( 0.04) 0.20       0.9      50.00
```

```
  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        6.49    7.20    3.923  0.20( 0.04) 0.20       1.8      50.00
      2        6.47    7.91    3.722  0.20( 0.04) 0.20       1.9      10.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       6.49    Tc(MIN.) =     7.20
  EFFECTIVE AREA(ACRES) =       1.80   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        1.9
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     70.00 =     583.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     70.00 TO NODE     80.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    34.20  DOWNSTREAM(FEET) =    33.20
  FLOW LENGTH(FEET) =    90.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS   7.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.98
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.49
  PIPE TRAVEL TIME(MIN.) =   0.25    Tc(MIN.) =    7.45
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     80.00 =     673.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     80.00 TO NODE     90.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    33.20  DOWNSTREAM(FEET) =    32.60
  FLOW LENGTH(FEET) =    75.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS   8.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.33
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.49
  PIPE TRAVEL TIME(MIN.) =   0.23    Tc(MIN.) =    7.69
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     90.00 =     748.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     90.00 TO NODE    100.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    32.60  DOWNSTREAM(FEET) =    31.70
  FLOW LENGTH(FEET) =    40.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS   6.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.68
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.49
  PIPE TRAVEL TIME(MIN.) =   0.09    Tc(MIN.) =    7.78
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    100.00 =     788.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    130.00 IS CODE =  41
```

```
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    31.70  DOWNSTREAM(FEET) =    29.50
  FLOW LENGTH(FEET) =   287.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS   8.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.25
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.49
  PIPE TRAVEL TIME(MIN.) =   0.91    Tc(MIN.) =    8.69
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    130.00 =    1075.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    130.00 TO NODE    130.00 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.) =    8.69
  RAINFALL INTENSITY(INCH/HR) =   3.53
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       1.80
  TOTAL STREAM AREA(ACRES) =       1.89
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       6.49

****************************************************************************
  FLOW PROCESS FROM NODE    110.00 TO NODE    120.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   273.00
  ELEVATION DATA: UPSTREAM(FEET) =     42.00  DOWNSTREAM(FEET) =     37.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.040
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.974
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 D        0.42      0.20     0.200    75    7.04
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      1.49
  TOTAL AREA(ACRES) =      0.42   PEAK FLOW RATE(CFS) =      1.49

****************************************************************************
  FLOW PROCESS FROM NODE    120.00 TO NODE    130.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    34.40  DOWNSTREAM(FEET) =    29.50
  FLOW LENGTH(FEET) =    36.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   2.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.68
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.49
  PIPE TRAVEL TIME(MIN.) =   0.06    Tc(MIN.) =    7.10
```

```
  LONGEST FLOWPATH FROM NODE    110.00 TO NODE    130.00 =     309.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    130.00 TO NODE    130.00 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.) =    7.10
  RAINFALL INTENSITY(INCH/HR) =   3.96
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       0.42
  TOTAL STREAM AREA(ACRES) =       0.42
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.49

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        6.49    8.69    3.528  0.20( 0.04) 0.20       1.8      50.00
      1        6.47    9.39    3.376  0.20( 0.04) 0.20       1.9      10.00
      2        1.49    7.10    3.956  0.20( 0.04) 0.20       0.4     110.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        7.44    7.10    3.956  0.20( 0.04) 0.20       1.9     110.00
      2        7.82    8.69    3.528  0.20( 0.04) 0.20       2.2      50.00
      3        7.73    9.39    3.376  0.20( 0.04) 0.20       2.3      10.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       7.82    Tc(MIN.) =     8.69
  EFFECTIVE AREA(ACRES) =       2.22   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        2.3
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    130.00 =    1075.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    130.00 TO NODE    350.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    29.50  DOWNSTREAM(FEET) =    29.39
  FLOW LENGTH(FEET) =    65.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS  13.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.22
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       7.82
  PIPE TRAVEL TIME(MIN.) =   0.34    Tc(MIN.) =    9.02
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    350.00 =    1140.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    350.00 TO NODE    350.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    210.00 TO NODE    220.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   180.00
  ELEVATION DATA: UPSTREAM(FEET) =     57.00  DOWNSTREAM(FEET) =     52.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.408
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.614
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 D        0.42      0.20     0.200    75    5.41
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      1.73
  TOTAL AREA(ACRES) =      0.42   PEAK FLOW RATE(CFS) =      1.73

****************************************************************************
  FLOW PROCESS FROM NODE    220.00 TO NODE    230.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    51.00  DOWNSTREAM(FEET) =    45.30
  FLOW LENGTH(FEET) =   108.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   3.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.96
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.73
  PIPE TRAVEL TIME(MIN.) =   0.23    Tc(MIN.) =    5.63
  LONGEST FLOWPATH FROM NODE    210.00 TO NODE    230.00 =     288.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    230.00 TO NODE    260.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    45.30  DOWNSTREAM(FEET) =    41.60
  FLOW LENGTH(FEET) =    84.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS   3.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.92
  GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.73
  PIPE TRAVEL TIME(MIN.) =   0.20    Tc(MIN.) =    5.84
  LONGEST FLOWPATH FROM NODE    210.00 TO NODE    260.00 =     372.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    260.00 TO NODE    260.00 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.) =    5.84
  RAINFALL INTENSITY(INCH/HR) =   4.42
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20
```

```
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       0.42
  TOTAL STREAM AREA(ACRES) =       0.42
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.73

****************************************************************************
  FLOW PROCESS FROM NODE    240.00 TO NODE    250.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   366.00
  ELEVATION DATA: UPSTREAM(FEET) =     49.80  DOWNSTREAM(FEET) =     46.10

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.078
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.677
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        1.09      0.20     0.100    75    8.08
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      3.59
  TOTAL AREA(ACRES) =      1.09   PEAK FLOW RATE(CFS) =      3.59

****************************************************************************
  FLOW PROCESS FROM NODE    250.00 TO NODE    260.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    43.60  DOWNSTREAM(FEET) =    41.60
  FLOW LENGTH(FEET) =    78.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   5.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.29
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.59
  PIPE TRAVEL TIME(MIN.) =   0.18    Tc(MIN.) =    8.26
  LONGEST FLOWPATH FROM NODE    240.00 TO NODE    260.00 =     444.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    260.00 TO NODE    260.00 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.) =    8.26
  RAINFALL INTENSITY(INCH/HR) =   3.63
  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       1.09
  TOTAL STREAM AREA(ACRES) =       1.09
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.59

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        1.73    5.84    4.419  0.20( 0.04) 0.20       0.4     210.00
      2        3.59    8.26    3.632  0.20( 0.02) 0.10       1.1     240.00
```

```
  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        4.82    5.84    4.419  0.20( 0.03) 0.14       1.2     210.00
      2        5.01    8.26    3.632  0.20( 0.03) 0.13       1.5     240.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       5.01    Tc(MIN.) =     8.26
  EFFECTIVE AREA(ACRES) =       1.51   AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.13
  TOTAL AREA(ACRES) =        1.5
  LONGEST FLOWPATH FROM NODE    240.00 TO NODE    260.00 =     444.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    260.00 TO NODE    290.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    41.60  DOWNSTREAM(FEET) =    35.60
  FLOW LENGTH(FEET) =   265.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS   6.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.46
  GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.01
  PIPE TRAVEL TIME(MIN.) =   0.59    Tc(MIN.) =    8.85
  LONGEST FLOWPATH FROM NODE    240.00 TO NODE    290.00 =     709.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    290.00 TO NODE    290.00 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.) =    8.85
  RAINFALL INTENSITY(INCH/HR) =   3.49
  AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.13
  EFFECTIVE STREAM AREA(ACRES) =       1.51
  TOTAL STREAM AREA(ACRES) =       1.51
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       5.01

****************************************************************************
  FLOW PROCESS FROM NODE    270.00 TO NODE    280.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   363.00
  ELEVATION DATA: UPSTREAM(FEET) =     53.30  DOWNSTREAM(FEET) =     43.40

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.037
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.976
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
 APARTMENTS                 D        0.75      0.20     0.200    75    7.04
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
 SUBAREA RUNOFF(CFS) =      2.66
 TOTAL AREA(ACRES) =      0.75   PEAK FLOW RATE(CFS) =      2.66

****************************************************************************
 FLOW PROCESS FROM NODE    280.00 TO NODE    290.00 IS CODE =  41
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    40.90  DOWNSTREAM(FEET) =    35.60
 FLOW LENGTH(FEET) =    88.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  12.0 INCH PIPE IS   4.7 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   9.40
 GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       2.66
 PIPE TRAVEL TIME(MIN.) =   0.16    Tc(MIN.) =    7.19
 LONGEST FLOWPATH FROM NODE    270.00 TO NODE    290.00 =     451.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    290.00 TO NODE    290.00 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.) =    7.19
 RAINFALL INTENSITY(INCH/HR) =   3.93
 AREA-AVERAGED Fm(INCH/HR) =  0.04
 AREA-AVERAGED Fp(INCH/HR) =  0.20
 AREA-AVERAGED Ap =  0.20
 EFFECTIVE STREAM AREA(ACRES) =       0.75
 TOTAL STREAM AREA(ACRES) =       0.75
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.66

 ** CONFLUENCE DATA **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1        4.82    6.44    4.182  0.20( 0.03) 0.14       1.2     210.00
     1        5.01    8.85    3.492  0.20( 0.03) 0.13       1.5     240.00
     2        2.66    7.19    3.926  0.20( 0.04) 0.20       0.8     270.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1        7.35    6.44    4.182  0.20( 0.03) 0.16       1.9     210.00
     2        7.53    7.19    3.926  0.20( 0.03) 0.16       2.0     270.00
     3        7.36    8.85    3.492  0.20( 0.03) 0.15       2.3     240.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =       7.53    Tc(MIN.) =     7.19
 EFFECTIVE AREA(ACRES) =       2.04   AREA-AVERAGED Fm(INCH/HR) =  0.03
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.16
 TOTAL AREA(ACRES) =        2.3
 LONGEST FLOWPATH FROM NODE    240.00 TO NODE    290.00 =     709.00 FEET.

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

```
  FLOW PROCESS FROM NODE    290.00 TO NODE    320.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    35.60  DOWNSTREAM(FEET) =    33.30
  FLOW LENGTH(FEET) =   260.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  10.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.96
  GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       7.53
  PIPE TRAVEL TIME(MIN.) =   0.73    Tc(MIN.) =    7.92
  LONGEST FLOWPATH FROM NODE    240.00 TO NODE    320.00 =     969.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    320.00 TO NODE    320.00 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.) =    7.92
  RAINFALL INTENSITY(INCH/HR) =   3.72
  AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.16
  EFFECTIVE STREAM AREA(ACRES) =       2.04
  TOTAL STREAM AREA(ACRES) =       2.26
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       7.53

****************************************************************************
  FLOW PROCESS FROM NODE    300.00 TO NODE    310.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   320.00
  ELEVATION DATA: UPSTREAM(FEET) =     44.00  DOWNSTREAM(FEET) =     39.70

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.708
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.776
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 D        0.96      0.20     0.200    75    7.71
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      3.23
  TOTAL AREA(ACRES) =      0.96   PEAK FLOW RATE(CFS) =      3.23

****************************************************************************
  FLOW PROCESS FROM NODE    310.00 TO NODE    320.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    37.40  DOWNSTREAM(FEET) =    33.00
  FLOW LENGTH(FEET) =   131.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   5.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.79
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.23
```

```
  PIPE TRAVEL TIME(MIN.) =   0.28    Tc(MIN.) =    7.99
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    320.00 =     451.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    320.00 TO NODE    320.00 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.) =    7.99
  RAINFALL INTENSITY(INCH/HR) =   3.70
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       0.96
  TOTAL STREAM AREA(ACRES) =       0.96
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.23

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        7.35    7.17    3.934  0.20( 0.03) 0.16       1.9     210.00
      1        7.53    7.92    3.718  0.20( 0.03) 0.16       2.0     270.00
      1        7.36    9.58    3.338  0.20( 0.03) 0.15       2.3     240.00
      2        3.23    7.99    3.700  0.20( 0.04) 0.20       1.0     300.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       10.43    7.17    3.934  0.20( 0.03) 0.17       2.7     210.00
      2       10.75    7.92    3.718  0.20( 0.03) 0.17       3.0     270.00
      3       10.75    7.99    3.700  0.20( 0.03) 0.17       3.0     300.00
      4       10.27    9.58    3.338  0.20( 0.03) 0.17       3.2     240.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      10.75    Tc(MIN.) =     7.99
  EFFECTIVE AREA(ACRES) =       3.01   AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.17
  TOTAL AREA(ACRES) =        3.2
  LONGEST FLOWPATH FROM NODE    240.00 TO NODE    320.00 =     969.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    320.00 TO NODE    350.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    33.00  DOWNSTREAM(FEET) =    29.39
  FLOW LENGTH(FEET) =    63.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS   7.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  12.93
  GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      10.75
  PIPE TRAVEL TIME(MIN.) =   0.08    Tc(MIN.) =    8.07
  LONGEST FLOWPATH FROM NODE    240.00 TO NODE    350.00 =    1032.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    350.00 TO NODE    350.00 IS CODE =  11
```

```
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1       10.43    7.25    3.909  0.20( 0.03) 0.17       2.7     210.00
      2       10.75    8.00    3.697  0.20( 0.03) 0.17       3.0     270.00
      3       10.75    8.07    3.679  0.20( 0.03) 0.17       3.0     300.00
      4       10.27    9.66    3.322  0.20( 0.03) 0.17       3.2     240.00
  LONGEST FLOWPATH FROM NODE    240.00 TO NODE    350.00 =    1032.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1        7.44    7.44    3.853  0.20( 0.04) 0.20       1.9     110.00
      2        7.82    9.02    3.453  0.20( 0.04) 0.20       2.2      50.00
      3        7.73    9.73    3.310  0.20( 0.04) 0.20       2.3      10.00
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    350.00 =    1140.00 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1       17.79    7.25    3.909  0.20( 0.04) 0.18       4.6     210.00
      2       17.95    7.44    3.853  0.20( 0.04) 0.18       4.7     110.00
      3       18.33    8.00    3.697  0.20( 0.04) 0.18       5.0     270.00
      4       18.35    8.07    3.679  0.20( 0.04) 0.18       5.0     300.00
      5       18.29    9.02    3.453  0.20( 0.04) 0.18       5.4      50.00
      6       18.01    9.66    3.322  0.20( 0.04) 0.18       5.5     240.00
      7       17.97    9.73    3.310  0.20( 0.04) 0.18       5.5      10.00
    TOTAL AREA(ACRES) =         5.5

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       18.35  Tc(MIN.) =    8.070
  EFFECTIVE AREA(ACRES) =      5.03  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.18
  TOTAL AREA(ACRES) =        5.5
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    350.00 =    1140.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    350.00 TO NODE    450.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    29.39  DOWNSTREAM(FEET) =    29.34
  FLOW LENGTH(FEET) =    20.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS  19.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.64
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      18.35
  PIPE TRAVEL TIME(MIN.) =   0.07    Tc(MIN.) =    8.14
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    450.00 =    1160.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    450.00 TO NODE    450.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    400.00 TO NODE    410.00 IS CODE =  21
```

```
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   290.00
  ELEVATION DATA: UPSTREAM(FEET) =    100.00  DOWNSTREAM(FEET) =     50.40

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.697
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.088
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  ".4 DWELLING/ACRE"          D        0.57      0.20     0.900    75    6.70
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.900
  SUBAREA RUNOFF(CFS) =      2.01
  TOTAL AREA(ACRES) =      0.57   PEAK FLOW RATE(CFS) =      2.01

****************************************************************************
  FLOW PROCESS FROM NODE    410.00 TO NODE    430.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     50.40
  DOWNSTREAM NODE ELEVATION(FEET) =     38.80
  CHANNEL LENGTH THRU SUBAREA(FEET) =   574.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.080
  PAVEMENT LIP(FEET) =  0.020   MANNING'S N = .0130
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   1.50
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.365
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  ".4 DWELLING/ACRE"          D        1.13      0.20     0.900    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.900
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      3.62
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.48
  AVERAGE FLOW DEPTH(FEET) =   0.20   FLOOD WIDTH(FEET) =   13.46
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   2.75   Tc(MIN.) =    9.45
  SUBAREA AREA(ACRES) =    1.13       SUBAREA RUNOFF(CFS) =    3.24
  EFFECTIVE AREA(ACRES) =    1.70     AREA-AVERAGED Fm(INCH/HR) =   0.18
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.90
  TOTAL AREA(ACRES) =        1.7         PEAK FLOW RATE(CFS) =       4.87

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.23   FLOOD WIDTH(FEET) =   15.51
  FLOW VELOCITY(FEET/SEC.) =   3.64   DEPTH*VELOCITY(FT*FT/SEC) =   0.82
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    430.00 =     864.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    430.00 TO NODE    450.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     38.80  DOWNSTREAM(FEET) =     35.90
  CHANNEL LENGTH THRU SUBAREA(FEET) =    76.00   CHANNEL SLOPE =  0.0382
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   0.500
```

```
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  CHANNEL FLOW THRU SUBAREA(CFS) =       4.87
  FLOW VELOCITY(FEET/SEC.) =   7.54   FLOW DEPTH(FEET) =   0.30
  TRAVEL TIME(MIN.) =   0.17   Tc(MIN.) =    9.62
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    450.00 =     940.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    450.00 TO NODE    450.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 2 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        4.87    9.62    3.331  0.20( 0.18) 0.90       1.7     400.00
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    450.00 =     940.00 FEET.

  ** MEMORY BANK #  2 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       17.79    7.32    3.887  0.20( 0.04) 0.18       4.6     210.00
      2       17.95    7.51    3.832  0.20( 0.04) 0.18       4.7     110.00
      3       18.33    8.07    3.678  0.20( 0.04) 0.18       5.0     270.00
      4       18.35    8.14    3.661  0.20( 0.04) 0.18       5.0     300.00
      5       18.29    9.10    3.438  0.20( 0.04) 0.18       5.4      50.00
      6       18.01    9.73    3.308  0.20( 0.04) 0.18       5.5     240.00
      7       17.97    9.80    3.296  0.20( 0.04) 0.18       5.5      10.00
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    450.00 =    1160.00 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       22.16    7.32    3.887  0.20( 0.07) 0.34       5.9     210.00
      2       22.36    7.51    3.832  0.20( 0.07) 0.34       6.0     110.00
      3       22.87    8.07    3.678  0.20( 0.07) 0.34       6.4     270.00
      4       22.90    8.14    3.661  0.20( 0.07) 0.34       6.5     300.00
      5       23.05    9.10    3.438  0.20( 0.07) 0.35       7.0      50.00
      6       22.94    9.62    3.331  0.20( 0.07) 0.35       7.2     400.00
      7       22.85    9.73    3.308  0.20( 0.07) 0.35       7.2     240.00
      8       22.78    9.80    3.296  0.20( 0.07) 0.35       7.2      10.00
    TOTAL AREA(ACRES) =         7.2

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       23.05  Tc(MIN.) =    9.096
  EFFECTIVE AREA(ACRES) =      6.97  AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        7.2
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    450.00 =    1160.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        7.2  TC(MIN.) =      9.10
  EFFECTIVE AREA(ACRES) =      6.97  AREA-AVERAGED Fm(INCH/HR)=  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap = 0.347
  PEAK FLOW RATE(CFS)   =      23.05

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       22.16    7.32    3.887  0.20( 0.07) 0.34       5.9     210.00
      2       22.36    7.51    3.832  0.20( 0.07) 0.34       6.0     110.00
      3       22.87    8.07    3.678  0.20( 0.07) 0.34       6.4     270.00
      4       22.90    8.14    3.661  0.20( 0.07) 0.34       6.5     300.00
```

```
     5       23.05    9.10    3.438  0.20( 0.07) 0.35       7.0      50.00
     6       22.94    9.62    3.331  0.20( 0.07) 0.35       7.2     400.00
     7       22.85    9.73    3.308  0.20( 0.07) 0.35       7.2     240.00
     8       22.78    9.80    3.296  0.20( 0.07) 0.35       7.2      10.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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                           Analysis prepared by:

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 ************************* DESCRIPTION OF STUDY *************************
*                         VICTORIA APARTMENTS                              *
*                         PROPOSED HYDROLOGY                               *
*                           100-YEAR STORM                                 *
 ***************************************************************************

  FILE NAME: VICTPR.DAT
  TIME/DATE OF STUDY: 10:21 06/08/2021
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   3.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     20.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   331.00
  ELEVATION DATA: UPSTREAM(FEET) =     53.00  DOWNSTREAM(FEET) =     46.20

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.177
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.030
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
  APARTMENTS                 D        0.99      0.20     0.200    91    7.18
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      4.45
  TOTAL AREA(ACRES) =      0.99   PEAK FLOW RATE(CFS) =      4.45

****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     30.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    43.20  DOWNSTREAM(FEET) =    37.08
  FLOW LENGTH(FEET) =    31.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   3.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  16.04
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       4.45
  PIPE TRAVEL TIME(MIN.) =   0.03    Tc(MIN.) =    7.21
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     30.00 =     362.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     30.00 TO NODE     40.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    37.08  DOWNSTREAM(FEET) =    34.60
  FLOW LENGTH(FEET) =   208.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  30.0 INCH PIPE IS   6.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.61
  GIVEN PIPE DIAMETER(INCH) =  30.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       4.45
  PIPE TRAVEL TIME(MIN.) =   0.62    Tc(MIN.) =    7.83
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     40.00 =     570.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     40.00 TO NODE     70.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    34.60  DOWNSTREAM(FEET) =    34.20
  FLOW LENGTH(FEET) =    13.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  30.0 INCH PIPE IS   5.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.83
  GIVEN PIPE DIAMETER(INCH) =  30.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       4.45
  PIPE TRAVEL TIME(MIN.) =   0.03    Tc(MIN.) =    7.85
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     70.00 =     583.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     70.00 TO NODE     70.00 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.) =    7.85
  RAINFALL INTENSITY(INCH/HR) =   4.78
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.20
```

```
  EFFECTIVE STREAM AREA(ACRES) =       0.99
  TOTAL STREAM AREA(ACRES) =       0.99
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       4.45

****************************************************************************
  FLOW PROCESS FROM NODE     50.00 TO NODE     60.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   270.00
  ELEVATION DATA: UPSTREAM(FEET) =     46.00  DOWNSTREAM(FEET) =     42.20

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.135
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.047
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 D        0.90      0.20     0.200    91    7.14
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      4.06
  TOTAL AREA(ACRES) =      0.90   PEAK FLOW RATE(CFS) =      4.06

****************************************************************************
  FLOW PROCESS FROM NODE     60.00 TO NODE     70.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    39.20  DOWNSTREAM(FEET) =    34.20
  FLOW LENGTH(FEET) =    49.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   5.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  12.76
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       4.06
  PIPE TRAVEL TIME(MIN.) =   0.06    Tc(MIN.) =    7.20
  LONGEST FLOWPATH FROM NODE     50.00 TO NODE     70.00 =     319.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     70.00 TO NODE     70.00 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.) =    7.20
  RAINFALL INTENSITY(INCH/HR) =   5.02
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       0.90
  TOTAL STREAM AREA(ACRES) =       0.90
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       4.06

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        4.45    7.85    4.776  0.20( 0.04) 0.20       1.0      10.00
      2        4.06    7.20    5.021  0.20( 0.04) 0.20       0.9      50.00
```

```
  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        8.34    7.20    5.021  0.20( 0.04) 0.20       1.8      50.00
      2        8.30    7.85    4.776  0.20( 0.04) 0.20       1.9      10.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       8.34    Tc(MIN.) =     7.20
  EFFECTIVE AREA(ACRES) =       1.81   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        1.9
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     70.00 =     583.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     70.00 TO NODE     80.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    34.20  DOWNSTREAM(FEET) =    33.20
  FLOW LENGTH(FEET) =    90.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS   8.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.44
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       8.34
  PIPE TRAVEL TIME(MIN.) =   0.23    Tc(MIN.) =    7.43
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     80.00 =     673.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     80.00 TO NODE     90.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    33.20  DOWNSTREAM(FEET) =    32.60
  FLOW LENGTH(FEET) =    75.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS   9.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.73
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       8.34
  PIPE TRAVEL TIME(MIN.) =   0.22    Tc(MIN.) =    7.65
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     90.00 =     748.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     90.00 TO NODE    100.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    32.60  DOWNSTREAM(FEET) =    31.70
  FLOW LENGTH(FEET) =    40.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS   7.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.27
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       8.34
  PIPE TRAVEL TIME(MIN.) =   0.08    Tc(MIN.) =    7.73
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    100.00 =     788.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    130.00 IS CODE =  41
```

```
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    31.70  DOWNSTREAM(FEET) =    29.50
  FLOW LENGTH(FEET) =   287.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS   9.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.64
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       8.34
  PIPE TRAVEL TIME(MIN.) =   0.85    Tc(MIN.) =    8.58
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    130.00 =    1075.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    130.00 TO NODE    130.00 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.) =    8.58
  RAINFALL INTENSITY(INCH/HR) =   4.54
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       1.81
  TOTAL STREAM AREA(ACRES) =       1.89
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       8.34

****************************************************************************
  FLOW PROCESS FROM NODE    110.00 TO NODE    120.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   273.00
  ELEVATION DATA: UPSTREAM(FEET) =     42.00  DOWNSTREAM(FEET) =     37.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.040
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.086
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 D        0.42      0.20     0.200    91    7.04
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      1.91
  TOTAL AREA(ACRES) =      0.42   PEAK FLOW RATE(CFS) =      1.91

****************************************************************************
  FLOW PROCESS FROM NODE    120.00 TO NODE    130.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    34.40  DOWNSTREAM(FEET) =    29.50
  FLOW LENGTH(FEET) =    36.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   3.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  11.48
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.91
  PIPE TRAVEL TIME(MIN.) =   0.05    Tc(MIN.) =    7.09
```

```
  LONGEST FLOWPATH FROM NODE    110.00 TO NODE    130.00 =     309.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    130.00 TO NODE    130.00 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.) =    7.09
  RAINFALL INTENSITY(INCH/HR) =   5.06
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       0.42
  TOTAL STREAM AREA(ACRES) =       0.42
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.91

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        8.34    8.58    4.541  0.20( 0.04) 0.20       1.8      50.00
      1        8.30    9.24    4.353  0.20( 0.04) 0.20       1.9      10.00
      2        1.91    7.09    5.064  0.20( 0.04) 0.20       0.4     110.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        9.60    7.09    5.064  0.20( 0.04) 0.20       1.9     110.00
      2       10.05    8.58    4.541  0.20( 0.04) 0.20       2.2      50.00
      3        9.94    9.24    4.353  0.20( 0.04) 0.20       2.3      10.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      10.05    Tc(MIN.) =     8.58
  EFFECTIVE AREA(ACRES) =       2.23   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        2.3
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    130.00 =    1075.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    130.00 TO NODE    350.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    29.50  DOWNSTREAM(FEET) =    29.39
  FLOW LENGTH(FEET) =    65.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS  15.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.44
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      10.05
  PIPE TRAVEL TIME(MIN.) =   0.31    Tc(MIN.) =    8.89
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    350.00 =    1140.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    350.00 TO NODE    350.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    210.00 TO NODE    220.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   180.00
  ELEVATION DATA: UPSTREAM(FEET) =     57.00  DOWNSTREAM(FEET) =     52.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.408
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.915
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 D        0.42      0.20     0.200    91    5.41
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      2.22
  TOTAL AREA(ACRES) =      0.42   PEAK FLOW RATE(CFS) =      2.22

****************************************************************************
  FLOW PROCESS FROM NODE    220.00 TO NODE    230.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    51.00  DOWNSTREAM(FEET) =    45.30
  FLOW LENGTH(FEET) =   108.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   4.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.52
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.22
  PIPE TRAVEL TIME(MIN.) =   0.21    Tc(MIN.) =    5.62
  LONGEST FLOWPATH FROM NODE    210.00 TO NODE    230.00 =     288.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    230.00 TO NODE    260.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    45.30  DOWNSTREAM(FEET) =    41.60
  FLOW LENGTH(FEET) =    84.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS   3.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.44
  GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.22
  PIPE TRAVEL TIME(MIN.) =   0.19    Tc(MIN.) =    5.81
  LONGEST FLOWPATH FROM NODE    210.00 TO NODE    260.00 =     372.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    260.00 TO NODE    260.00 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.) =    5.81
  RAINFALL INTENSITY(INCH/HR) =   5.68
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20
```

```
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       0.42
  TOTAL STREAM AREA(ACRES) =       0.42
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.22

****************************************************************************
  FLOW PROCESS FROM NODE    240.00 TO NODE    250.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   366.00
  ELEVATION DATA: UPSTREAM(FEET) =     49.80  DOWNSTREAM(FEET) =     46.10

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.078
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.700
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        1.09      0.20     0.100    91    8.08
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      4.59
  TOTAL AREA(ACRES) =      1.09   PEAK FLOW RATE(CFS) =      4.59

****************************************************************************
  FLOW PROCESS FROM NODE    250.00 TO NODE    260.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    43.60  DOWNSTREAM(FEET) =    41.60
  FLOW LENGTH(FEET) =    78.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   6.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.80
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       4.59
  PIPE TRAVEL TIME(MIN.) =   0.17    Tc(MIN.) =    8.25
  LONGEST FLOWPATH FROM NODE    240.00 TO NODE    260.00 =     444.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    260.00 TO NODE    260.00 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.) =    8.25
  RAINFALL INTENSITY(INCH/HR) =   4.65
  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       1.09
  TOTAL STREAM AREA(ACRES) =       1.09
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       4.59

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1        2.22    5.81    5.678  0.20( 0.04) 0.20       0.4     210.00
      2        4.59    8.25    4.645  0.20( 0.02) 0.10       1.1     240.00
```

```
  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        6.18    5.81    5.678  0.20( 0.03) 0.14       1.2     210.00
      2        6.41    8.25    4.645  0.20( 0.03) 0.13       1.5     240.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       6.41    Tc(MIN.) =     8.25
  EFFECTIVE AREA(ACRES) =       1.51   AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.13
  TOTAL AREA(ACRES) =        1.5
  LONGEST FLOWPATH FROM NODE    240.00 TO NODE    260.00 =     444.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    260.00 TO NODE    290.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    41.60  DOWNSTREAM(FEET) =    35.60
  FLOW LENGTH(FEET) =   265.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS   7.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.01
  GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.41
  PIPE TRAVEL TIME(MIN.) =   0.55    Tc(MIN.) =    8.80
  LONGEST FLOWPATH FROM NODE    240.00 TO NODE    290.00 =     709.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    290.00 TO NODE    290.00 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.) =    8.80
  RAINFALL INTENSITY(INCH/HR) =   4.48
  AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.13
  EFFECTIVE STREAM AREA(ACRES) =       1.51
  TOTAL STREAM AREA(ACRES) =       1.51
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       6.41

****************************************************************************
  FLOW PROCESS FROM NODE    270.00 TO NODE    280.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   363.00
  ELEVATION DATA: UPSTREAM(FEET) =     53.30  DOWNSTREAM(FEET) =     43.40

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.037
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.087
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
  APARTMENTS                 D        0.75      0.20     0.200    91    7.04
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      3.41
  TOTAL AREA(ACRES) =      0.75   PEAK FLOW RATE(CFS) =      3.41

****************************************************************************
  FLOW PROCESS FROM NODE    280.00 TO NODE    290.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    40.90  DOWNSTREAM(FEET) =    35.60
  FLOW LENGTH(FEET) =    88.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   5.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.04
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.41
  PIPE TRAVEL TIME(MIN.) =   0.15    Tc(MIN.) =    7.18
  LONGEST FLOWPATH FROM NODE    270.00 TO NODE    290.00 =     451.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    290.00 TO NODE    290.00 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.) =    7.18
  RAINFALL INTENSITY(INCH/HR) =   5.03
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       0.75
  TOTAL STREAM AREA(ACRES) =       0.75
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.41

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        6.18    6.37    5.388  0.20( 0.03) 0.14       1.2     210.00
      1        6.41    8.80    4.476  0.20( 0.03) 0.13       1.5     240.00
      2        3.41    7.18    5.028  0.20( 0.04) 0.20       0.8     270.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        9.41    6.37    5.388  0.20( 0.03) 0.16       1.9     210.00
      2        9.66    7.18    5.028  0.20( 0.03) 0.16       2.0     270.00
      3        9.44    8.80    4.476  0.20( 0.03) 0.15       2.3     240.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       9.66    Tc(MIN.) =     7.18
  EFFECTIVE AREA(ACRES) =       2.05   AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.16
  TOTAL AREA(ACRES) =        2.3
  LONGEST FLOWPATH FROM NODE    240.00 TO NODE    290.00 =     709.00 FEET.

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

```
  FLOW PROCESS FROM NODE    290.00 TO NODE    320.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    35.60  DOWNSTREAM(FEET) =    33.30
  FLOW LENGTH(FEET) =   260.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  11.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.35
  GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       9.66
  PIPE TRAVEL TIME(MIN.) =   0.68    Tc(MIN.) =    7.86
  LONGEST FLOWPATH FROM NODE    240.00 TO NODE    320.00 =     969.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    320.00 TO NODE    320.00 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.) =    7.86
  RAINFALL INTENSITY(INCH/HR) =   4.77
  AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.16
  EFFECTIVE STREAM AREA(ACRES) =       2.05
  TOTAL STREAM AREA(ACRES) =       2.26
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       9.66

****************************************************************************
  FLOW PROCESS FROM NODE    300.00 TO NODE    310.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   320.00
  ELEVATION DATA: UPSTREAM(FEET) =     44.00  DOWNSTREAM(FEET) =     39.70

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.708
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.828
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 D        0.96      0.20     0.200    91    7.71
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      4.14
  TOTAL AREA(ACRES) =      0.96   PEAK FLOW RATE(CFS) =      4.14

****************************************************************************
  FLOW PROCESS FROM NODE    310.00 TO NODE    320.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    37.40  DOWNSTREAM(FEET) =    33.00
  FLOW LENGTH(FEET) =   131.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   5.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.36
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      4.14
```

```
  PIPE TRAVEL TIME(MIN.) =   0.26    Tc(MIN.) =    7.97
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    320.00 =     451.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    320.00 TO NODE    320.00 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.) =    7.97
  RAINFALL INTENSITY(INCH/HR) =   4.74
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       0.96
  TOTAL STREAM AREA(ACRES) =       0.96
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       4.14

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        9.41    7.05    5.081  0.20( 0.03) 0.16       1.9     210.00
      1        9.66    7.86    4.773  0.20( 0.03) 0.16       2.0     270.00
      1        9.44    9.48    4.288  0.20( 0.03) 0.15       2.3     240.00
      2        4.14    7.97    4.737  0.20( 0.04) 0.20       1.0     300.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       13.34    7.05    5.081  0.20( 0.03) 0.17       2.7     210.00
      2       13.77    7.86    4.773  0.20( 0.03) 0.17       3.0     270.00
      3       13.78    7.97    4.737  0.20( 0.03) 0.17       3.0     300.00
      4       13.18    9.48    4.288  0.20( 0.03) 0.17       3.2     240.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      13.78    Tc(MIN.) =     7.97
  EFFECTIVE AREA(ACRES) =       3.02   AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.17
  TOTAL AREA(ACRES) =        3.2
  LONGEST FLOWPATH FROM NODE    240.00 TO NODE    320.00 =     969.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    320.00 TO NODE    350.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    33.00  DOWNSTREAM(FEET) =    29.39
  FLOW LENGTH(FEET) =    63.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS   8.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  13.86
  GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      13.78
  PIPE TRAVEL TIME(MIN.) =   0.08    Tc(MIN.) =    8.04
  LONGEST FLOWPATH FROM NODE    240.00 TO NODE    350.00 =    1032.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    350.00 TO NODE    350.00 IS CODE =  11
```

```
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       13.34    7.13    5.050  0.20( 0.03) 0.17       2.7     210.00
      2       13.77    7.94    4.747  0.20( 0.03) 0.17       3.0     270.00
      3       13.78    8.04    4.711  0.20( 0.03) 0.17       3.0     300.00
      4       13.18    9.56    4.268  0.20( 0.03) 0.17       3.2     240.00
  LONGEST FLOWPATH FROM NODE    240.00 TO NODE    350.00 =    1032.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        9.60    7.41    4.938  0.20( 0.04) 0.20       1.9     110.00
      2       10.05    8.89    4.448  0.20( 0.04) 0.20       2.2      50.00
      3        9.94    9.55    4.270  0.20( 0.04) 0.20       2.3      10.00
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    350.00 =    1140.00 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       22.79    7.13    5.050  0.20( 0.04) 0.18       4.5     210.00
      2       23.10    7.41    4.938  0.20( 0.04) 0.18       4.7     110.00
      3       23.54    7.94    4.747  0.20( 0.04) 0.18       5.0     270.00
      4       23.58    8.04    4.711  0.20( 0.04) 0.18       5.1     300.00
      5       23.49    8.89    4.448  0.20( 0.04) 0.18       5.4      50.00
      6       23.12    9.55    4.270  0.20( 0.04) 0.18       5.5      10.00
      7       23.11    9.56    4.268  0.20( 0.04) 0.18       5.5     240.00
    TOTAL AREA(ACRES) =         5.5

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       23.58  Tc(MIN.) =    8.045
  EFFECTIVE AREA(ACRES) =      5.07  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.18
  TOTAL AREA(ACRES) =        5.5
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    350.00 =    1140.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    350.00 TO NODE    450.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    29.39  DOWNSTREAM(FEET) =    29.34
  FLOW LENGTH(FEET) =    20.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS  23.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.91
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      23.58
  PIPE TRAVEL TIME(MIN.) =   0.07    Tc(MIN.) =    8.11
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    450.00 =    1160.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    450.00 TO NODE    450.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    400.00 TO NODE    410.00 IS CODE =  21
```

```
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   290.00
  ELEVATION DATA: UPSTREAM(FEET) =    100.00  DOWNSTREAM(FEET) =     50.40

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.697
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.233
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  ".4 DWELLING/ACRE"          D        0.57      0.20     0.900    91    6.70
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.900
  SUBAREA RUNOFF(CFS) =      2.59
  TOTAL AREA(ACRES) =      0.57   PEAK FLOW RATE(CFS) =      2.59

****************************************************************************
  FLOW PROCESS FROM NODE    410.00 TO NODE    430.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     50.40
  DOWNSTREAM NODE ELEVATION(FEET) =     38.80
  CHANNEL LENGTH THRU SUBAREA(FEET) =   574.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.080
  PAVEMENT LIP(FEET) =  0.020   MANNING'S N = .0130
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   1.50
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.326
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  ".4 DWELLING/ACRE"          D        1.13      0.20     0.900    91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.900
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      4.69
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.62
  AVERAGE FLOW DEPTH(FEET) =   0.22   FLOOD WIDTH(FEET) =   15.24
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   2.64   Tc(MIN.) =    9.34
  SUBAREA AREA(ACRES) =    1.13       SUBAREA RUNOFF(CFS) =    4.22
  EFFECTIVE AREA(ACRES) =    1.70     AREA-AVERAGED Fm(INCH/HR) =   0.18
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.90
  TOTAL AREA(ACRES) =        1.7         PEAK FLOW RATE(CFS) =       6.34

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.24   FLOOD WIDTH(FEET) =   17.42
  FLOW VELOCITY(FEET/SEC.) =   3.84   DEPTH*VELOCITY(FT*FT/SEC) =   0.94
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    430.00 =     864.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    430.00 TO NODE    450.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     38.80  DOWNSTREAM(FEET) =     35.90
  CHANNEL LENGTH THRU SUBAREA(FEET) =    76.00   CHANNEL SLOPE =  0.0382
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   0.500
```

```
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  CHANNEL FLOW THRU SUBAREA(CFS) =       6.34
  FLOW VELOCITY(FEET/SEC.) =   8.24   FLOW DEPTH(FEET) =   0.35
  TRAVEL TIME(MIN.) =   0.15   Tc(MIN.) =    9.49
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    450.00 =     940.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    450.00 TO NODE    450.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 2 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1        6.34    9.49    4.285  0.20( 0.18) 0.90       1.7     400.00
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    450.00 =     940.00 FEET.

  ** MEMORY BANK #  2 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1       22.79    7.20    5.022  0.20( 0.04) 0.18       4.5     210.00
      2       23.10    7.48    4.912  0.20( 0.04) 0.18       4.7     110.00
      3       23.54    8.01    4.724  0.20( 0.04) 0.18       5.0     270.00
      4       23.58    8.11    4.689  0.20( 0.04) 0.18       5.1     300.00
      5       23.49    8.96    4.429  0.20( 0.04) 0.18       5.4      50.00
      6       23.12    9.62    4.253  0.20( 0.04) 0.18       5.5      10.00
      7       23.11    9.63    4.251  0.20( 0.04) 0.18       5.5     240.00
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    450.00 =    1160.00 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1       28.46    7.20    5.022  0.20( 0.07) 0.34       5.8     210.00
      2       28.86    7.48    4.912  0.20( 0.07) 0.34       6.1     110.00
      3       29.46    8.01    4.724  0.20( 0.07) 0.34       6.5     270.00
      4       29.53    8.11    4.689  0.20( 0.07) 0.34       6.5     300.00
      5       29.69    8.96    4.429  0.20( 0.07) 0.35       7.0      50.00
      6       29.53    9.49    4.285  0.20( 0.07) 0.35       7.2     400.00
      7       29.41    9.62    4.253  0.20( 0.07) 0.35       7.2      10.00
      8       29.40    9.63    4.251  0.20( 0.07) 0.35       7.2     240.00
    TOTAL AREA(ACRES) =         7.2

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       29.69  Tc(MIN.) =    8.961
  EFFECTIVE AREA(ACRES) =      6.96  AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        7.2
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE    450.00 =    1160.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        7.2  TC(MIN.) =      8.96
  EFFECTIVE AREA(ACRES) =      6.96  AREA-AVERAGED Fm(INCH/HR)=  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap = 0.347
  PEAK FLOW RATE(CFS)   =      29.69

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1       28.46    7.20    5.022  0.20( 0.07) 0.34       5.8     210.00
      2       28.86    7.48    4.912  0.20( 0.07) 0.34       6.1     110.00
      3       29.46    8.01    4.724  0.20( 0.07) 0.34       6.5     270.00
      4       29.53    8.11    4.689  0.20( 0.07) 0.34       6.5     300.00
```

```
     5       29.69    8.96    4.429  0.20( 0.07) 0.35       7.0      50.00
     6       29.53    9.49    4.285  0.20( 0.07) 0.35       7.2     400.00
     7       29.41    9.62    4.253  0.20( 0.07) 0.35       7.2      10.00
     8       29.40    9.63    4.251  0.20( 0.07) 0.35       7.2     240.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

# APPENDIX 5

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## DRAFT FIRM AND LOMR EXHIBITS

# NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

**Coastal Base Flood Elevations** shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations tables in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations tables should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) Zone 11. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov.

**Base map** information shown on this FIRM was derived from the National Agriculture Imagery Program, dated 2005.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

**Corporate limits** shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://msc.fema.gov.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov.

# LEGEND

▨ SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

| | |
|---|---|
| **ZONE A** | No Base Flood Elevations determined. |
| **ZONE AE** | Base Flood Elevations determined. |
| **ZONE AH** | Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined. |
| **ZONE AO** | Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined. |
| **ZONE AR** | Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood. |
| **ZONE A99** | Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined. |
| **ZONE V** | Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined. |
| **ZONE VE** | Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined. |

▨ FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

▨ OTHER FLOOD AREAS

| | |
|---|---|
| **ZONE X** | Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood. |

☐ OTHER AREAS

| | |
|---|---|
| **ZONE X** | Areas determined to be outside the 0.2% annual chance floodplain. |
| **ZONE D** | Areas in which flood hazards are undetermined, but possible. |

▨ COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

▨ OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

| | |
|---|---|
| ——— | 1% annual chance floodplain boundary |
| ——— | 0.2% annual chance floodplain boundary |
| — — — | Floodway boundary |
| — —— —— — | Zone D boundary |
| ••••••••••••••• | CBRS and OPA boundary |
| ▨ ← | Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities. |
| ~~~ 513 ~~~ | Base Flood Elevation line and value; elevation in feet* |
| (EL 987) | Base Flood Elevation value where uniform within zone; elevation in feet* |

* Referenced to the North American Vertical Datum of 1988

| | |
|---|---|
| Ⓐ———Ⓐ | Cross section line |
| ㉓- - - - - -㉓ | Transect line |
| 87°07'45", 32°22'30" | Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere |
| $^{24}76^{000m}$N | 1000-meter Universal Transverse Mercator grid values, zone NAD 1983 UTM Zone 11N |
| 600000 FT | 5000-foot grid ticks: California State Plane coordinate system, zone VI (FIPSZONE 0406), Lambert Conformal Conic projection |
| DX5510 × | Bench mark (see explanation in Notes to Users section of this FIRM panel) |
| ●M1.5 | River Mile |

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
September 15, 1989

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
February 5, 1992 - November 3, 1993 - January 3, 1997 - February 18, 2004 - December 3, 2009 : for description of revisions, see Notice to Users page in the Flood Insurance Study report.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

N

**MAP SCALE 1" = 500'**

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

**PANEL 0508J**

# FIRM
## FLOOD INSURANCE RATE MAP

## ORANGE COUNTY, CALIFORNIA
### AND INCORPORATED AREAS

## PANEL 508 OF 539

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|---|---|---|---|
| DANA POINT, CITY OF | 060736 | 0508 | J |
| SAN CLEMENTE, CITY OF | 060230 | 0508 | J |
| SAN JUAN CAPISTRANO, CITY OF | 060231 | 0508 | J |

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

**MAP NUMBER
06059C0508J**

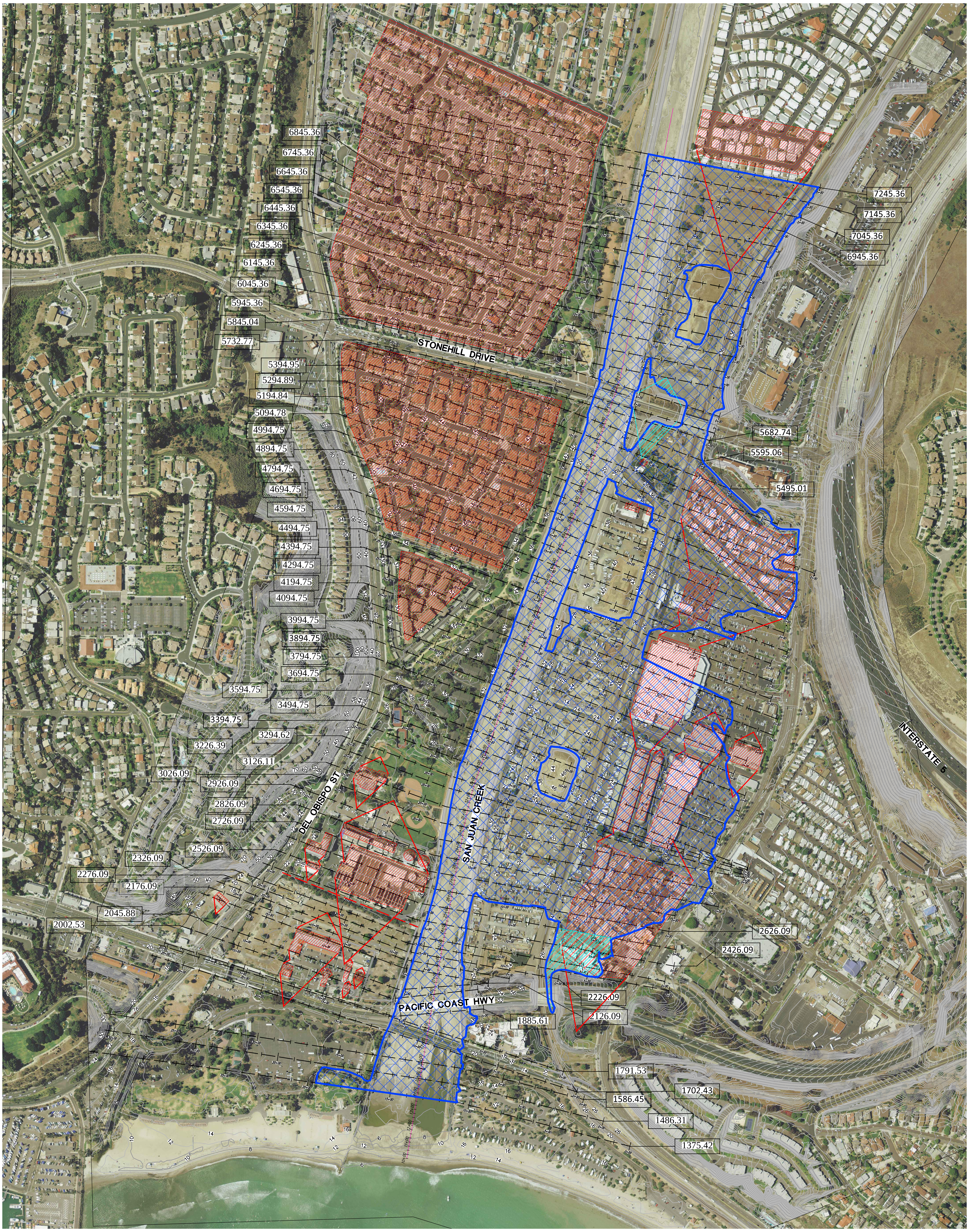
**MAP REVISED
DECEMBER 3, 2009**

**Federal Emergency Management Agency**

# Exhibits

## Exhibit A: Existing Condition San Juan Creek Work Map for HEC-RAS Analysis – Easterly Levee Failure

# EXHIBIT A
# SAN JUAN CREEK
# HIGH CONFIDENCE FLOW RATE
# EASTERLY LEVEE FAILURE FLOOD PLAIN



LEGEND

| | |
|---|---|
| ▨ | HEC-RAS FLOOD PLAIN |
| ▨ | INEFFECTIVE FLOW AREAS<br>(FLOW WITH NEAR ZERO VELOCITY) |
| ▨ | OBSTRUCTIONS |
| ─── | OBSTRUCTION INEFFECTIVE FLOW |
| — — — | EXISTING WALL |

GRAPHIC SCALE
200 0 100 200 400
1" = 200'

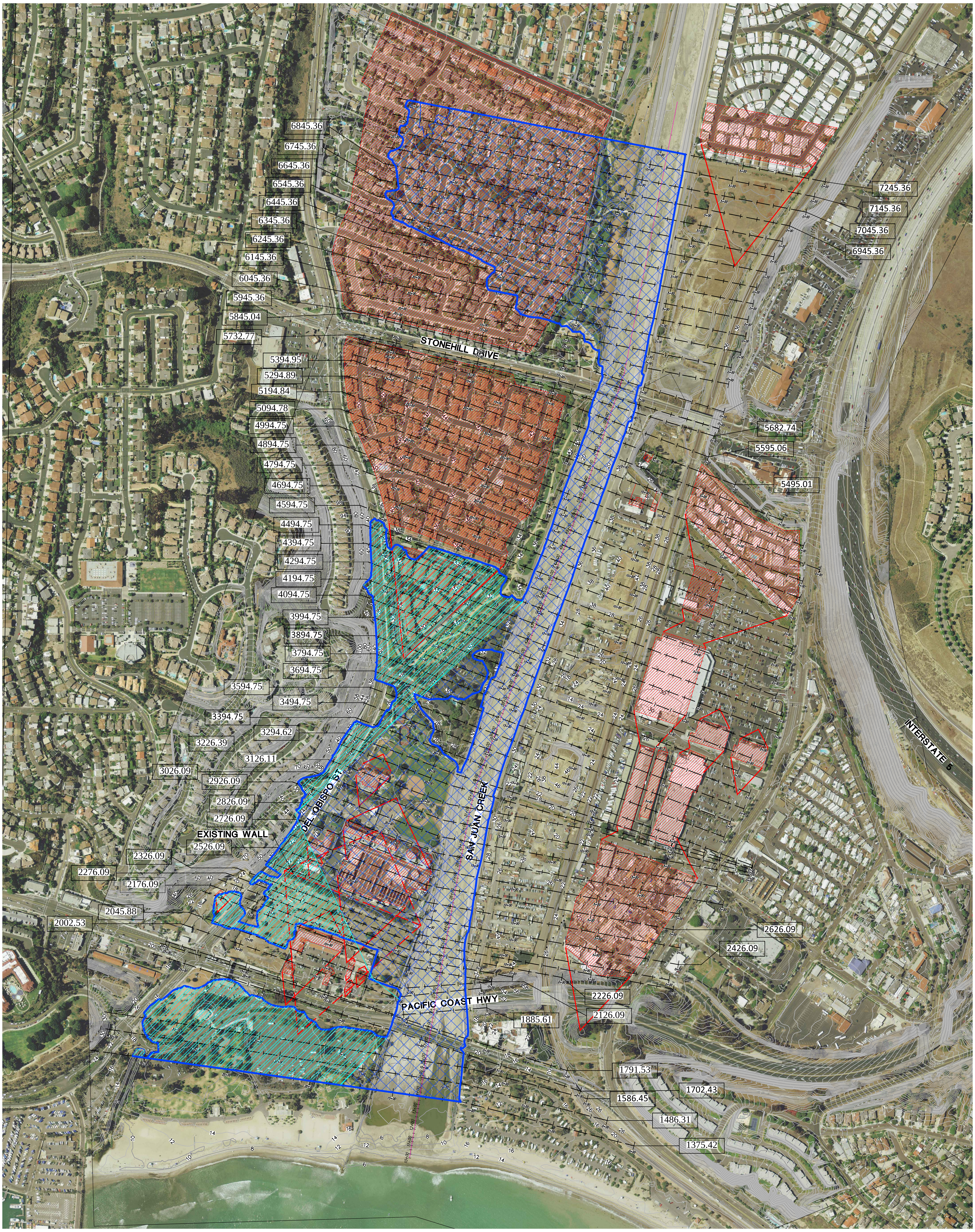
**EXHIBIT A**

JLC Engineering & Consulting, Inc.

36263 CALLE DE LOBO
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

## **Exhibit B:** Existing Condition San Juan Creek Work Map for HEC-RAS Analysis – Westerly Levee Failure

# EXHIBIT B
# SAN JUAN CREEK
# HIGH CONFIDENCE FLOW RATE
# WESTERLY LEVEE FAILURE FLOOD PLAIN



LEGEND

▨ HEC-RAS FLOOD PLAIN

▨ INEFFECTIVE FLOW AREAS (FLOW WITH NEAR ZERO VELOCITY)

▨ OBSTRUCTIONS

— OBSTRUCTION INEFFECTIVE FLOW

– – – EXISTING WALL

N

GRAPHIC SCALE
200 0 100 200 400
1" = 200'

## EXHIBIT B

JLC Engineering & Consulting, Inc.

36263 CALLE DE LOBO
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

## Exhibit C: Base Flood Elevation Delineation

# EXHIBIT C
# SAN JUAN CREEK
# HIGH CONFIDENCE FLOW RATE
# BASE FLOOD ELEVATION DELINEATION

LEGEND

- ▨ HEC-RAS FLOOD PLAIN
- ▨ INEFFECTIVE FLOW AREAS (FLOW WITH NEAR ZERO VELOCITY)
- ▨ OBSTRUCTIONS
- ━ OBSTRUCTION INEFFECTIVE FLOW
- ╍ EXISTING WALL

N

GRAPHIC SCALE
200 0 100 200 400
1" = 200'

**EXHIBIT C**

JLC Engineering & Consulting, Inc.

36263 CALLE DE LOBO
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

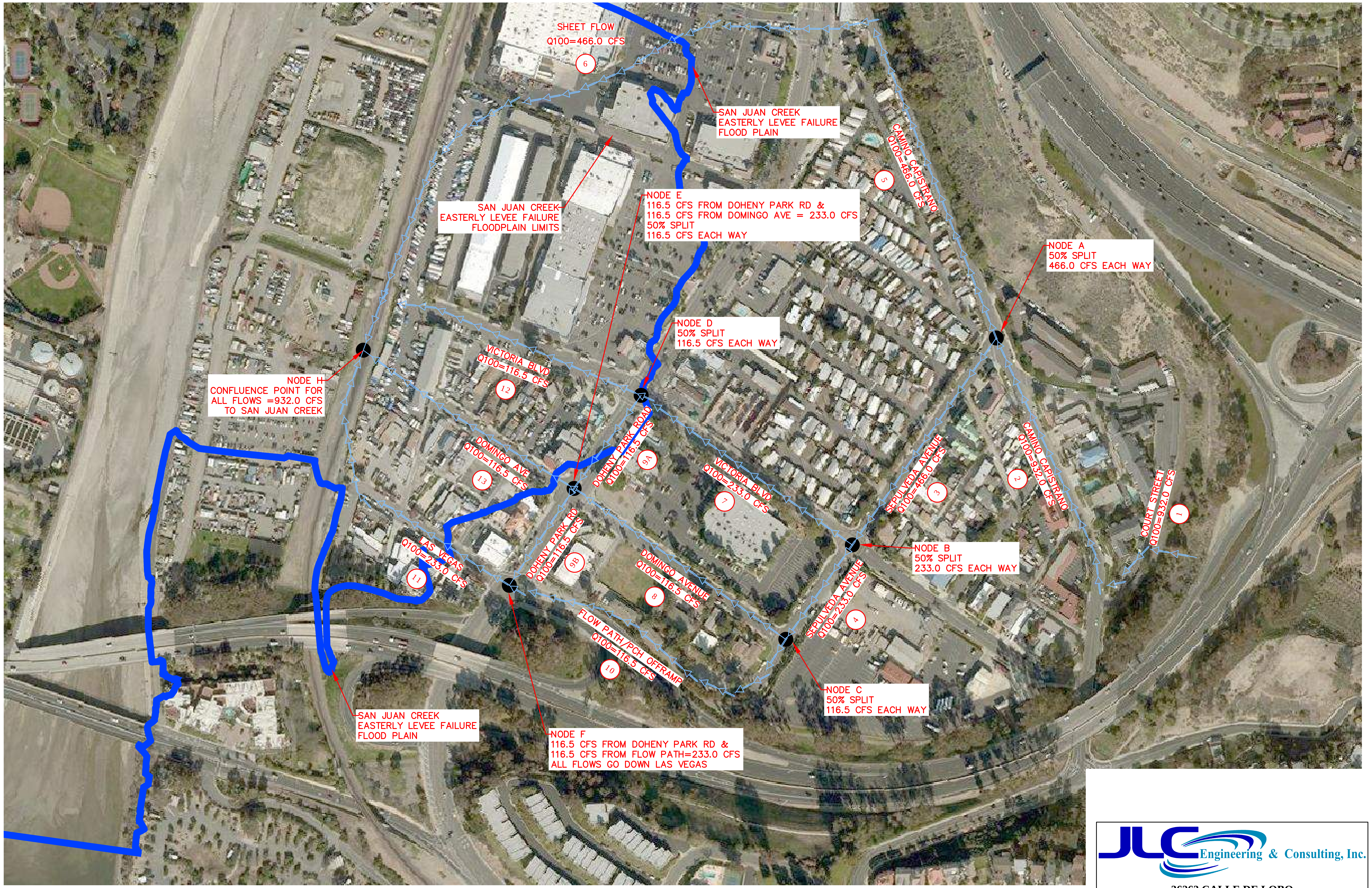
## **Exhibit D: Map of Street Sections from San Juan Creek to Interstate 5**

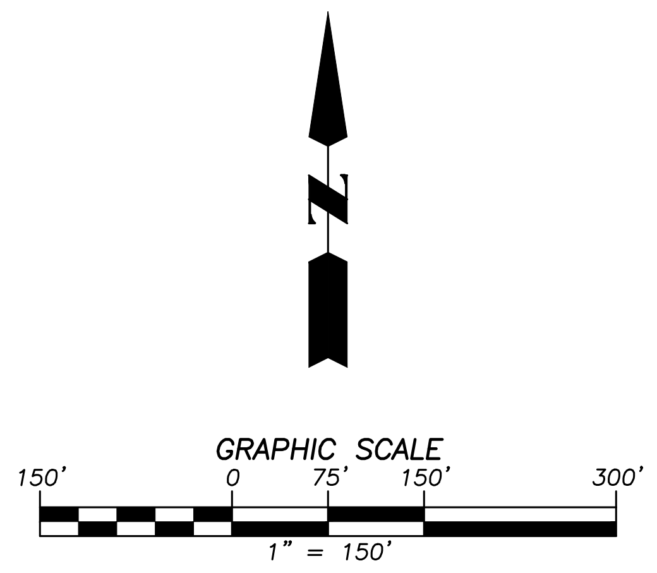
SHEET 1 OF 1

# SAN JUAN CREEK

IN THE CITY OF DANA POINT, COUNTY OF ORANGE, STATE OF CALIFORNIA

# MAP OF STREETS BETWEEN SAN JUAN CREEK AND INTERSTATE 5





JLC Engineering & Consulting, Inc.

36263 CALLE DE LOBO
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

## EXHIBIT D

SAN JUAN CREEK

MAP OF STREETS FROM SJC TO INTERSTATE 5

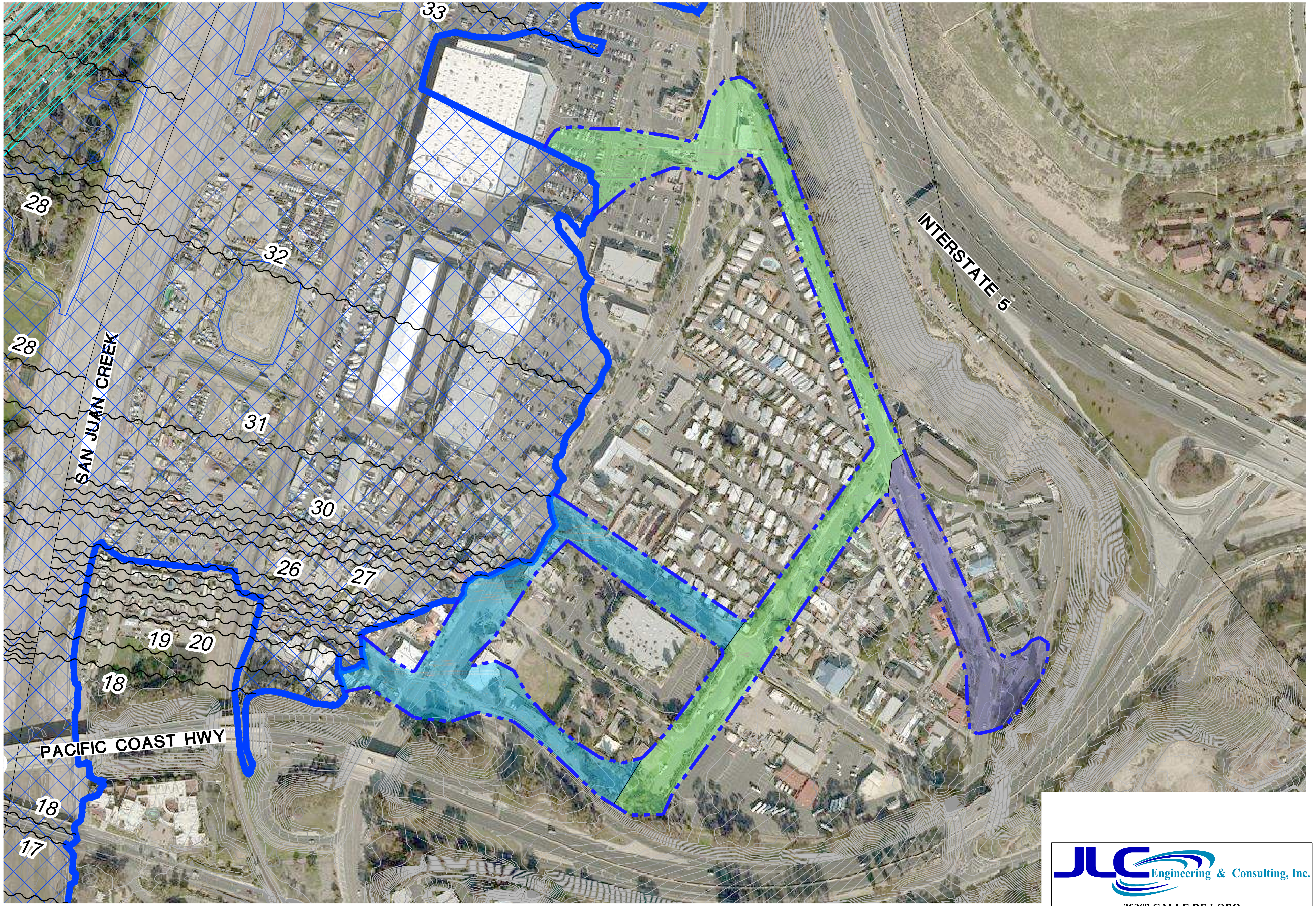
## Exhibit E: L01S02 Street Flooding Depths

SHEET 1 OF 1

# SAN JUAN CREEK

IN THE CITY OF DANA POINT, COUNTY OF ORANGE, STATE OF CALIFORNIA

# L01S02 STREET FLOODING DEPTHS



LEGEND

🟦 1.0' FLOODING DEPTH

🟩 1.5' FLOODING DEPTH

🟪 2.0' FLOODING DEPTH

▨ HEC-RAS FLOOD PLAIN

N

GRAPHIC SCALE
150' 0 75' 150' 300'
1" = 150'

EXHIBIT E

JLC Engineering & Consulting, Inc.
36263 CALLE DE LOBO
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

SAN JUAN CREEK

L01S02 STREET
FLOODING DEPTHS

FUSCOE
ENGINEERING

PRELIMINARY WATER QUALITY MANAGEMENT PLAN (PWQMP)

# VICTORIA APARTMENTS

CITY OF DANA POINT, CA

PREPARED FOR
TOLL BROTHERS APARTMENT LIVING
23422 Mill Creek Drive, Suite 105
Laguna Hills, CA 92653
949.573.7300

FUSCOE ENGINEERING, INC.
16795 Von Karman, Suite 100
Irvine, California 92606
949.474.1960
www.fuscoe.com

SHELBY L. SHIRLOCK
NO. C75912
06/30/22

PROJECT MANAGER
Shelby Shirlock, PE

DATE PREPARED: February 28, 2020
DATE REVISED: May 28, 2020
DATE REVISED: JUNE 16, 2021

PROJECT NUMBER: 1665-004-01

full circle thinking®

FUSCOE
ENGINEERING

PRELIMINARY WATER QUALITY MANAGEMENT PLAN (PWQMP)

# VICTORIA APARTMENTS

June 16, 2021

FUSCOE
ENGINEERING

PRELIMINARY WATER QUALITY MANAGEMENT PLAN (PWQMP)

VICTORIA APARTMENTS

June 16, 2021

FUSCOE
ENGINEERING

PRELIMINARY WATER QUALITY MANAGEMENT PLAN (PWQMP)

VICTORIA APARTMENTS

June 16, 2021

# PRELIMINARY
# Water Quality Management Plan (WQMP)

## Project Name:

## VICTORIA APARTMENTS

**CITY OF DANA POINT**
**Tract No. 735**
**26126 Victoria Boulevard, Dana Point, CA 92624**
**APN 668-361-01**

**Prepared for:**

TOLL BROTHERS APARTMENT LIVING
23422 Mill Creek Drive, Suite 105
Laguna Hills, CA 92653
949.573.7300

**Prepared by:**

FUSCOE ENGINEERING, INC.

**Engineer's Seal**

REGISTERED PROFESSIONAL ENGINEER
SHELBY L. SHIRLOCK
NO. C75912
06/30/22
CIVIL
STATE OF CALIFORNIA

**Engineer:** Shelby Shirlock, PE
**Registration No:** 75912
16795 Von Karman Suite 100
Irvine, CA 92606
949.474.0960

**Prepared on:**

February 28, 2020

**Revised On:**

May 28, 2020
May 7, 2021
June 16, 2021

## PROJECT OWNER'S CERTIFICATION

| | | | |
|---|---|---|---|
| **Permit/Application No.** | Pending | **Grading Permit No.** | Pending |
| **Tract/Parcel Map No.** | Tract No. 735 | **Building Permit No.** | Pending |
| **Address of Project Site and/or APN (Specify Lot Numbers if Portions of Tract)** | | 26126 Victoria Boulevard, Dana Point, CA 92624<br>APN: 668-361-01 | |

This Water Quality Management Plan (WQMP) has been prepared for Toll Brothers Apartment Living by Fuscoe Engineering, Inc. The WQMP is intended to comply with the requirements of the local NPDES Stormwater Program requiring the preparation of the plan.

The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with the current Orange County Drainage Area Management Plan (DAMP) and the intent of the non-point source NPDES Permit for Waste Discharge Requirements for the County of Orange, Orange County Flood Control District and the incorporated Cities of Orange County within the San Diego Region (South Orange County).. Once the undersigned transfers its interest in the property, its successors-in-interest shall bear the aforementioned responsibility to implement and amend the WQMP. An appropriate number of approved and signed copies of this document shall be available on the subject site in perpetuity.

| **OWNER: John Hyde** | | | |
|---|---|---|---|
| **Title:** | Senior Project Manager | | |
| **Company:** | Toll Brothers Apartment Living | | |
| **Address:** | 23422 Mill Creek Drive, Suite 105, Laguna Hills, CA 92653 | | |
| **Email:** | jhyde@tollbrothers.com | | |
| **Telephone #** | 949.573.7300 | | |
| **Owner Signature:** | | **Date:** | |

# CONTENTS

## LIST OF ATTACHMENTS

## LIST OF EXHIBITS (INCLUDED IN ATTACHMENT C)

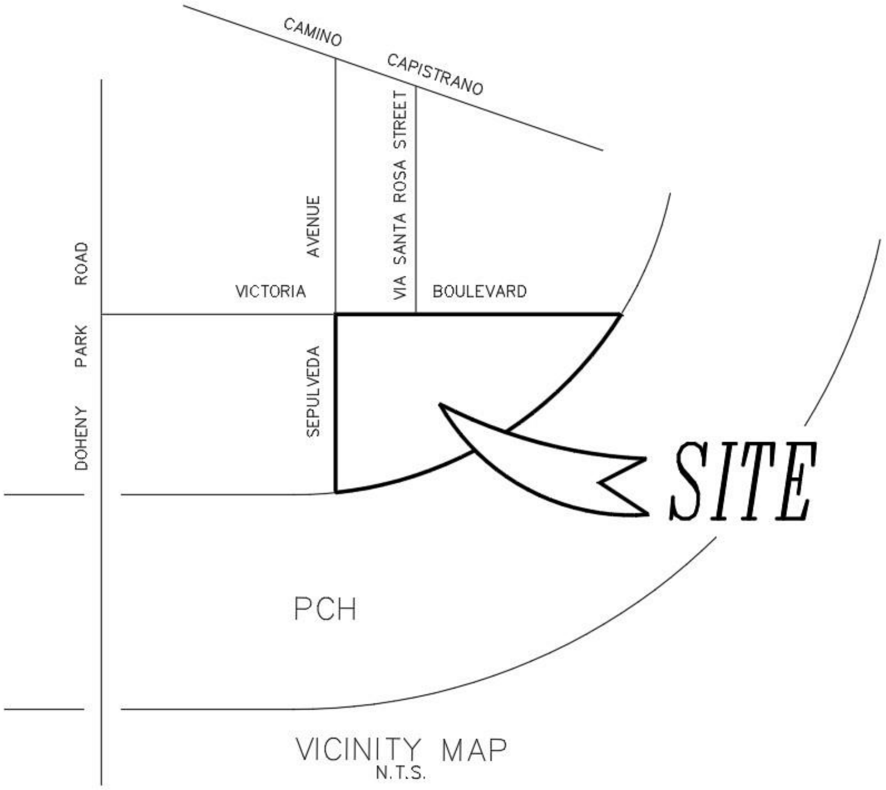
- Vicinity Map
- Site Plan
- WQMP Exhibit
- Existing Hydrology Map
- Proposed Hydrology Map
- Dana Point Exemption Map (from South OC TGD)
- Infiltration Constraint – D Soils (Low Permeability)
- Potential Course Sediment San Juan Creek (from South OC TGD)
- Rainfall Zone (Figure XVI-1 from OC TGD)

# SECTION 1 DISCRETIONARY PERMIT(S) AND WATER QUALITY CONDITIONS

| PROJECT INFORMATION | | | |
|---|---|---|---|
| **Permit/Application No.** | ENG19-0462 | **Site Address Tract/Parcel Map No.** | 26126 Victoria Boulevard<br>Dana Point, CA 92624<br>Tract No. 735 |
| **Additional Information/ Comments** | The project is located on the southeast corner of Victoria Blvd and Sepulveda Ave in the City of Dana Point. | | |
| **WATER QUALITY CONDITIONS OF APPROVAL OR ISSUANCE** | | | |
| **Water Quality Conditions from prior approvals or applicable watershed-based plans** | *Pending – To be provided in Final WQMP*<br>*City of Dana Point Water Quality Requirements for Development Projects*<br>*All **priority** projects shall meet Water Quality Management Plan (WQMP) and Hydromodification Management Plan (HMP) requirements as described in the documents and tools below. The project's WQMP is a plan for minimizing the adverse effects of urbanization on site hydrology, runoff flow rates and pollutant loads. Hydromodification management measures address the changes in the magnitude and frequency of stream flows and associated sediment load due to urbanization or other changes in the watershed land use and hydrology and the resulting impacts on receiving channels, such as erosion, sedimentation and potentially degradation of in-stream habitat.*<br>*Note: The Preliminary WQMP (pWQMP) is required as part of the Project Application. An application will not be deemed complete without a pWQMP. It should be noted that the pWQMP is not a "conceptual" document in the normal sense of the word and requires detailed engineering sizing calculations and location details for selected BMPs.* | | |

# SECTION 2 PROJECT DESCRIPTION

## 2.1 PROJECT DESCRIPTION

| DESCRIPTION OF PROPOSED PROJECT | | |
|---|---|---|
| **Site Location:** | The project is located at 26126 Victoria Boulevard, Dana Point, CA 92624. The project is bounded by Victoria Blvd to the northeast, Sepulveda Ave to the northwest and La Playa Ave and Pacific Coast Highway (PCH) to the south.<br><br> | |
| **Project Area (ft²):**<br>240,263 ft² | **Number of Dwelling Units:** 400 | **SIC Code:** N/A |
| **Narrative Project Description:** | The project site is currently developed and being utilized as a storage facility. Existing buildings and parking lots will be demolished and replaced with a 5-story on-grade wrap-style luxury apartment community which will wrap around a 6.5-level parking structure. The structure will provide 673 residential spaces and 80 visitor spaces for a total of 753 parking spaces. The apartment complex will consist of 17 studios, 241 one-bedroom units, 122 two-bedroom units, and 20 three-bedroom units for a total of 400 dwelling units. | |

## DESCRIPTION OF PROPOSED PROJECT

The proposed residential building will include a leasing office, lobby, bike spa, and boardwalk storage room in the western/southwestern portion of the building. Six outdoor courtyards are proposed surrounding the proposed amenities. In addition, roof deck amenities that will include a pool & spa are proposed. All details are subject to change and will be finalized in the Final WQMP.

Outdoor activities are anticipated with passive uses in the common landscaped areas surrounding the building, within the proposed courtyard/amenity areas, for recreational and open space purposes. All vehicular parking will be located in the proposed parking structure. No outdoor storage of materials is anticipated. All other outdoor areas will be used for walkways, common areas and landscaping, and other passive recreational purposes.

No outdoor storage of materials is anticipated (materials will be stored indoors). Materials anticipated to be stored on-site include those associated with residential developments (i.e. cleaning products, storage, etc.); however, no hazardous wastes will be stored on-site. Trash will be managed indoors by one trash room in the ground-level parking structure. An at-grade trash staging area will be located next to the parking structure entrance on the southerly portion of the parking structure.

Outdoor trash receptacles will be provided throughout the common areas of the site for the tenants to dispose of their refuse in a proper manner, and property maintenance will provide trash and waste material removal to maintain a trash-free property. All wastes shall be collected and properly disposed of off-site.

The site is not anticipated to have any loading docks, outdoor storage areas, community car wash racks, equipment wash areas, or food preparation areas associated with food service establishments. A pet spa/wash area will be provided indoors in the southern portion of the proposed residential building and will be plumbed to sewer. The proposed rooftop pool & spa will also drain to sewer. Additional details on these proposed features will be provided in the Final WQMP).

| **Project Area** | **Pervious** | | **Impervious** | |
|---|---|---|---|---|
| | **Area (acres or sq ft)** | **Percentage** | **Area (acres or sq ft)** | **Percentage** |
| **Pre-Project Conditions** | 0.55 | 10% | 4.97 | 90% |
| **Post-Project Conditions** | 0.83 | 15% | 4.69 | 85% |

## 2.2 POST-DEVELOPMENT DRAINAGE CHARACTERISTICS

Under proposed conditions, runoff will follow existing drainage patterns. A proposed storm drain system will route low flows to one of seven Modular Wetland Systems (MWS) for water quality treatment while high flows by-pass the system. Both treated and high flows will tie into an existing 30" or 36" storm drain system, exiting the site along Sepulveda Ave and Victoria Blvd. The drainage is then conveyed by a public storm drain system to the San Juan Creek, an Orange County Flood Control District (OCFCD) Channel, and ultimately out to the Pacific Ocean. Runoff from the adjacent 1 Freeway slope in the southern portion of the project site will be diverted around the site via new gutter and will continue to drain to Sepulveda Ave similar to existing conditions.

## 2.3 PROPERTY OWNERSHIP/MANAGEMENT

| PROPERTY OWNERSHIP/MANAGEMENT | |
|---|---|
| **Public Streets** | City of Dana Point |
| **Private Streets** | Toll Brothers Apartment Living |
| **Landscaped Areas** | Toll Brothers Apartment Living |
| **Buildings** | Toll Brothers Apartment Living |
| **Storm Drain** | Toll Brothers Apartment Living |
| **Structural BMPs** | Toll Brothers Apartment Living |

The Owner, Toll Brothers Apartment Living, shall assume all BMP maintenance and inspection responsibilities for the proposed project. Inspection and maintenance responsibilities are outlined in Attachment B of this report.

# SECTION 3 SITE & WATERSHED CHARACTERIZATION

## 3.1 SITE CONDITIONS

### 3.1.1 Existing Site Conditions

The project site is currently developed and being utilized as a storage facility. It is also being used as bus parking for the Capistrano Unified School District and consists of surface parking lots, along with various school district maintenance and facility buildings. The address is 26126 Victoria Boulevard Dana Point, CA 92624 (APN 668-361-01). The surrounding development includes churches to the west, a fire station to the east, an existing mobile home park to the north as well as commercial development to the northeast. Per the City of Dana Point General Plan, the site's land use is Community Facility and is zoned CF (Community Facility).

The existing site has varying elevations with the highest point located at the easterly corner and lowest point near the westerly corner of the site. The site drainage mostly flows in a south westerly direction. Runoff sheet flows across the site in that southerly direction and discharges onto Sepulveda Ave. This portion of Sepulveda Ave. also receives runoff from an offsite portion of the 1 freeway slope. From there, drainage flows along Sepulveda Ave until it is intercepted by a catch basin and culvert near the southwest corner of the property. The drainage is then conveyed by a public storm drain system to the San Juan Creek, an Orange County Flood Control District (OCFCD) Channel, and ultimately out to the Pacific Ocean.

The existing storm drain system begins as a 21" RCP at the upstream reach, near the intersection of Victoria Boulevard and Camino Capistrano. The storm drain continues as a 24" RCP westerly on Victoria Boulevard, toward Sepulveda Avenue, where it becomes a 30" RCP. The storm drain then turns southerly on Sepulveda Avenue, where it becomes a 36" RCP before discharging into a headwall at the south end of Sepulveda Avenue. Based on the topography of the site, it appears that the property is tributary to this storm drain system.

| EXISTING LAND USES | | | | |
|---|---|---|---|---|
| **Land Use Description** | **Total Area (acres)** | **Impervious Area (acres)** | **Pervious Area (acres)** | **Imperviousness (%)** |
| Commercial | 5.52 | 4.97 | 0.55 | 90 |
| **Total** | 5.52 | 4.97 | 0.55 | 90 |

### 3.1.2 Infiltration-Related Characteristics

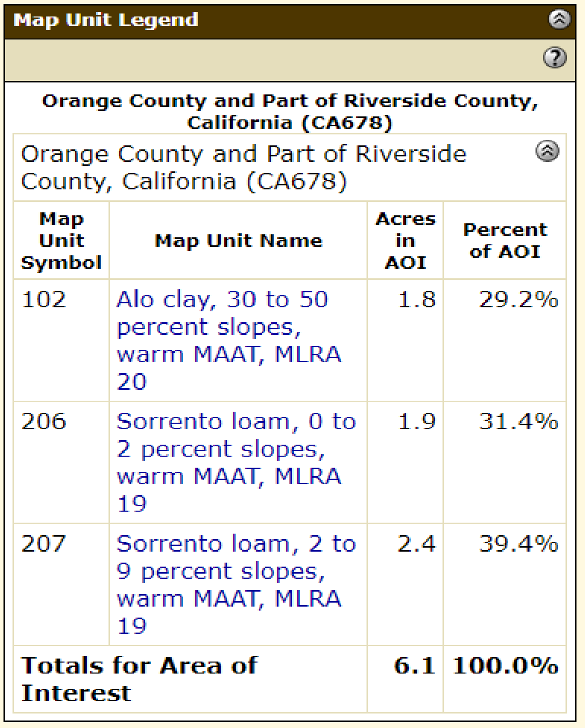
#### *3.1.2.1 Hydrogeologic Conditions*

Groundwater was encountered approximately 16 to 20 feet below the existing ground surface during a field investigation conducted by Geocon West, Inc. in March 2019. Review of the Seismic Hazard Zone Report for the Dana Point 7.5 Minute Quadrangle (California Division of Mines and Geology [CDMG], 2001) indicates the historically highest groundwater level in the area is approximately 5 feet beneath the ground surface. The Geotech report advises, "Considering the historic high groundwater level and the depth to groundwater observed in the borings, groundwater may be encountered during construction. It is not uncommon for groundwater levels to vary seasonally or for groundwater seepage conditions to develop where none previously existed, especially in impermeable fine-grained soils which are heavily irrigated or after seasonal rainfall."

### *3.1.2.2 Soil and Geologic Infiltration Characteristics*

The geotechnical investigation, performed by Geocon West, Inc. in March 2019, found the site is underlain with artificial fill, Holocene age stream alluvial deposits, and by late Miocene to early Pliocene Capistrano Formation. The artificial fill was encountered to a maximum depth of 5 feet below ground surface (bgs) and consist of brown, gray brown, and reddish brown, sandy silty clay, clayey silt, and clayey silty sand. It is noted that there was previously abandoned underground storage tanks onsite that were removed from the northeast corner of the site. The backfill material for these excavations is classified as undocumented artificial fill. Alluvial deposits were found underneath the fill and consist of brown to dark brown to gray to olive brown, interbedded sandy clayey silt, silty clay, and clayey sand. Capistrano Formation was encountered at depths of approximately 40, 25, and 35 feet bgs. Where encountered, the bedrock consists of clayey and sandy siltstone and silty sandstone. In general, the unit generally consists of a stiff to hard siltstone to claystone that is highly expansive.

According to Figure 9.9a of the TGD, the project site is partially located in Hydrologic Soil Group (HSG) D soils (see Attachment C). The figure below from the Web Soil Survey shows the estimated boundary of the HSG D soils (Map Unit Symbol 102).



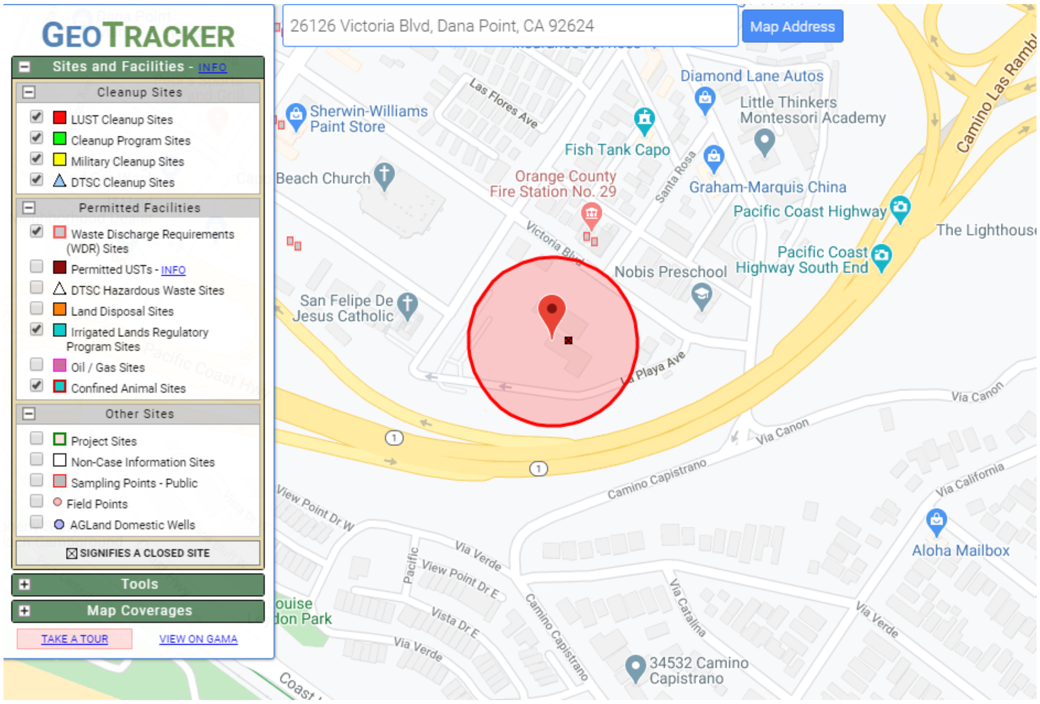
**Map Unit Legend**

**Orange County and Part of Riverside County, California (CA678)**

Orange County and Part of Riverside County, California (CA678)

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| 102 | Alo clay, 30 to 50 percent slopes, warm MAAT, MLRA 20 | 1.8 | 29.2% |
| 206 | Sorrento loam, 0 to 2 percent slopes, warm MAAT, MLRA 19 | 1.9 | 31.4% |
| 207 | Sorrento loam, 2 to 9 percent slopes, warm MAAT, MLRA 19 | 2.4 | 39.4% |
| **Totals for Area of Interest** | | **6.1** | **100.0%** |

There is a LUST Cleanup Site within 250 feet of the project site. CUSD Transportation Yard (T0605902398) was discovered to have leaking underground storage tanks and was reported in December of 1989. The main contaminant of concern was gasoline and it posed a threat to other groundwater (uses other than drinking water such as municipal, agricultural, and industrial). The petroleum release was remediated and the case was closed as of July 26, 2000.



26126 Victoria Blvd, Dana Point, CA 92624

Sites and Facilities

Cleanup Sites
- ☑ 🟥 LUST Cleanup Sites
- ☑ 🟩 Cleanup Program Sites
- ☑ 🟨 Military Cleanup Sites
- ☑ △ DTSC Cleanup Sites

Permitted Facilities
- ☑ Waste Discharge Requirements (WDR) Sites
- ☐ Permitted USTs
- ☐ △ DTSC Hazardous Waste Sites
- ☐ 🟧 Land Disposal Sites
- ☑ Irrigated Lands Regulatory Program Sites
- ☐ Oil / Gas Sites
- ☑ Confined Animal Sites

Other Sites
- ☐ Project Sites
- ☐ ☐ Non-Case Information Sites
- ☐ Sampling Points - Public
- ☐ ○ Field Points
- ☐ ● AGLand Domestic Wells

☒ SIGNIFIES A CLOSED SITE

#### *3.1.2.3 Geotechnical Conditions*

Overall, the geotechnical conditions of the project site are not favorable to infiltration. In addition to poor infiltrating soils, the State of California Seismic Hazard Zone Map for the Dana Point Quadrangle (CDMG, 2001) indicates that the site is located within an area designated as having a potential for liquefaction, mostly likely due to shallow groundwater levels, a primary factor controlling liquefaction. Liquefaction is a phenomenon in which loose, saturated, relatively cohesionless soil deposits lose shear strength during strong ground motions.

The topography at the site is relatively flat with no pronounced highs or lows. Offsite slopes bounding the southwestern portion of the property range from 12 feet on the southwest to 45 feet at the northeast corner. This offsite drainage will be diverted around the project via concrete v-gutter.

The site is not located within an area identified as having a potential for seismic slope instability (CDMG, 2001). There are no known landslides near the site, nor is the site in the path of any known or potential landslides. Therefore, the potential for slope stability hazards to adversely affect the proposed development is considered low.

The site is located within a coastal area and therefore, tsunamis, seiches, and flooding are considered possible geologic hazards in the site vicinity. The site is not located within the tsunami inundation area (CEMA, 2009), therefore, the risk of tsunami inundation is considered unlikely.

#### *3.1.2.4 Summary of Infiltration Opportunities and Constraints of Existing Site*

Full and partial infiltration is considered infeasible on the project site due to several limiting site conditions. According to Section 4.2.2.3 of the TGD, full and partial infiltration of the DCV is prohibited if seasonally high groundwater or mounded groundwater is less than 5 feet below the designed bottom of the infiltration facility. As stated in Section 3.1.2.1, seasonally high groundwater is 5 feet below ground surface making infiltration infeasible.

In addition to shallow groundwater and clayey soils, the site is also subject to liquefaction. Section 4.2.2.4 notes that full infiltration in locations less than 50 feet away from slopes steeper than 15 percent poses a significant risk. Variable slopes are present offsite and border the project site to the south east.

Lastly, Geotracker found past contamination onsite. Although the case has been closed, past contamination and shallow groundwater are major concerns for implementing infiltration BMPs and potentially contaminating groundwater. Full and partial infiltration has been deemed infeasible. BMPs will be designed as biotreatment with no infiltration.

## 3.2 PROPOSED SITE DEVELOPMENT ACTIVITIES

The Development Area – that is the area to be disturbed within project grading limits – encompasses approximately 5.52 acres that is currently existing commercial buildings and parking lots to be demolished and replaced with the proposed residential building, landscaped areas and walkways. The proposed building will consist of five stories of dwelling units above ground wrapped around a six and half story parking garage. The building includes approximately 400 proposed residential units with roughly 753 parking stalls for tenants and guests. A total of approximately 4.69 acres of the property will end up as impervious surface, resulting in a proposed imperviousness of 85%. Refer to Attachment C for the project site plan. Additional details will be provided in the Final WQMP.

### 3.2.1 Overview of Site Development Activities

The proposed development of the project site involves the demolition of the existing buildings and parking lots and the construction of a new residential building that includes residential units and an enclosed parking garage. The construction of the proposed residential building will result in slightly less impervious surface than the in the existing condition (85% impervious proposed versus 90% impervious existing). The stormwater runoff from the proposed development will end up in the same existing storm sewer system on Sepulveda Ave. as the runoff under existing conditions and will continue to enter San Juan Creek.

### 3.2.2. Project Attributes Influencing Stormwater Management

There are no outdoor trash enclosures on the project site as the site's trash enclosure will be located indoors within the proposed building's parking levels. No loading docks, outdoor storage areas, vehicle wash areas, or hazardous materials storage are proposed on the project site. Parking will be provided for the proposed residential building via garage parking structure. Native vegetation will be provided on the project site to minimize the amount of imperviousness proposed and minimize the potable water demands for irrigation.

| PROPOSED LAND USES | | | | |
|---|---|---|---|---|
| **Land Use Description** | **Total Area (acres)** | **Impervious Area (acres)** | **Pervious Area (acres)** | **Imperviousness (%)** |
| Residential | 5.52 | 4.69 | 0.83 | 85% |
| **Total** | 5.52 | 4.69 | 0.83 | 85% |

### 3.2.3 Effects on Infiltration and Harvest and Use Feasibility

Harvest and reuse (a.k.a. Rainwater Harvesting) BMPs are LID BMPs that capture and store storm water runoff for later se. Per Section 4.2.3 of the South OC TGD, projects are required to consider harvest and use if the reliable wet season demand for harvest water is adequate to use the DCV (Design Capture Volume) within 48 hours.

In order to quantify harvested water demand for the common area of the project, the Modified Estimate Applied Water Use (EAWU) method was used, consistent with Appendix F of the South OC TGD (dated September 28, 2017).

The Modified EAWU method is modified from the OC Irrigation Code (County Ordinance No. 09-010) to account for the wet season demand and storm events (assuming that no irrigation would be applied for approximately 30% of the days in the wet season).

The equation used to calculate the Modified EAWU is:

$$Modified\ EAWU = \frac{(ETo_{wet} \times K_L \times LA \times 0.015)}{IE}$$

Where:

$Modified\ EAWU$ = estimated daily average water use during wet season
$ETo_{wet}$ = average reference ET from November through April (inches per month) per Table F-2 of the TGD
$K_L$ = landscape coefficient (Table F-4 of the TGD)
$LA$ = landscape area irrigated with harvested water (square feet)
$IE$ = irrigation efficiency (assumed at 90%)

*Note: in the equation, the coefficient (0.015) accounts for unit conversions and shut down of irrigation during and for three days following a significant precipitation event.*

For a system to be considered "feasible", the reliable wet season demand for harvested water must be adequate to use the DCV within 48 hours.

The overall project site was evaluated using the impervious/pervious land area ratios and planting types to estimate the feasibility for harvest and reuse systems on-site. The following table summarizes the estimated applied water use for the project site.

| ESTIMATED APPLIED WATER USE (EAWU) FOR COMMON AREA LANDSCAPING | | | | | | | |
|---|---|---|---|---|---|---|---|
| Drainage Area & Landscape Type | Total Area (ac) | % Imp | Imp Tributary (ac) | Irrigated LS Area (ac) | $ETo_{wet}$[1] (in/mo) | $K_L$[2] | Modified EAWU (gpd) |
| Blended | 5.52 | 0.85 | 4.69 | 0.83 | 2.75 | 0.55 | 909 |
| Design Capture Volume (gal) | | 94,485 | Drawdown (days) | 103.9 | Is Drawdown of DCV <48 hours? | | No |

*Notes:*
1 Per Table F-2 for Laguna Beach (similar climate type), South OC Technical Guidance Document, September 28, 2017.
2 Per Table F-4 of the South OC Technical Guidance Document, September 28, 2017

As shown above, the project does not have sufficient water demand during the wet season to support harvest and reuse. There is insufficient irrigation demand to drawdown the DCV in 48 hours.

## 3.3 RECEIVING WATERBODIES

Known 303(d) Listed pollutants for the receiving water bodies include:

- **San Juan Creek**: Benthic Community Effects, DDE, Indicator Bacteria, Phosphorus, Selenium, Nitrogen, Dissolved Oxygen, Toxicity
- **San Juan Creek (mouth)**: Cadmium, Copper, Indicator Bacteria, Nickel, Ammonia

TMDLs (Total Maximum Daily Load) for the receiving water bodies include:

- **San Juan Creek**: Benthic Community Effects (est. 2005), DDE (est. 2005), Indicator Bacteria (est. 2005), Phosphorus (est. 2005), Selenium (est. 2005), Nitrogen (est. 2005), Dissolved Oxygen (est. 2005), Toxicity (est. 2005)
- **San Juan Creek (mouth)**: Cadmium (est. 2005), Copper (est. 2005), Indicator Bacteria (est. 2011), Nickel (est. 2005), Nitrogen Ammonia (est. 2005)

There are no Environmentally Sensitive Areas (ESAs) or Areas of Special Biological Significance (ASBS) within the project site or within the project site's vicinity.

## 3.4 STORMWATER POLLUTANTS OR CONDITIONS OF CONCERN

POLLUTANTS OR CONDITIONS OF CONCERN

| Pollutant | Expected from Proposed Land Uses/ Activities (Yes or No) | Receiving Waterbody Impaired? (Yes or No) | Priority Pollutant from WQIP or other Water Quality Condition? (Yes or No) | Pollutant of Concern (Primary, Other or No) |
|---|---|---|---|---|
| Suspended Solids | Yes | No | No | Other |
| Nutrients | Yes | Yes | No | Primary |
| Heavy Metals | No | Yes | No | No |
| Bacteria/Virus/Pathogens | Yes | Yes | Yes | Primary |
| Pesticides | Yes | Yes | No | Primary |
| Oil and Grease | Yes | No | No | Other |
| Toxic Organic Compounds | No | Yes | No | No |
| Trash and Debris | Yes | No | No | Other |
| Dry Weather Runoff | Yes | No | Yes | Primary |

## 3.5 HYDROLOGIC CONDITIONS OF CONCERN

Does a hydrologic condition of concern exist for this project?

☒ No – An HCOC does not exist for this receiving water because (select one):

☐ Project discharges directly to a protected conveyance (bed and bank are concrete lined the entire way from the point(s) of discharge to a receiving lake, reservoir, embayment, or the Ocean

☒ Project discharges directly to storm drains which discharge directly to a reservoir, lake, embayment, ocean or protected conveyance (as described above)

☐ The project discharges to an area identified in the WMAA as exempt from hydromodification concerns

☐ Yes – An HCOC does exist for this receiving water because none of the above are applicable.

The project will not be subject to hydromodification mitigation measures, as it discharges to San Juan Creek, which is an engineered, large river, and is exempted by the South Orange County Dana Point Exemption Map (see Attachment C).

## 3.6 CRITICAL COURSE SEDIMENT YIELD AREAS

Not Applicable. The project is not located in an area of high course sediment yield. Refer to the South Orange County Potential Course Sediment San Juan Creek Exhibit in Attachment C.

# SECTION 4 SITE PLAN AND DRAINAGE PLAN

## 4.1 DRAINAGE MANAGEMENT AREA DELINEATION

In accordance with the South Orange County Model WQMP and Technical Guidance Document (TGD), the project site has been divided into Drainage Management Areas (DMAs) to be utilized for defining drainage areas and sizing LID and other treatment control BMPs. The DMAs were primarily delineated based on the building's roof drainage, as most of the project site is comprised of the building footprint. As full and partial infiltration is considered to be infeasible for the project site, seven proprietary biotreatment units are proposed throughout the site to address water quality treatment.

Runoff from DMAs 1-7 will be directed to Modular Wetland System units for water quality treatment. A diversion structure will divert low flows to the MWS unit while high flows will by-pass the system and exit onto Sepulveda Ave.

The DCVs for each DMA are summarized in the table below. These have been derived utilizing the "Simple Method" in accordance with the TG Section E.3.1. Actual BMP sizing requirements, including 80 percent capture flowrates, and other design details for the specific BMPs proposed are provided in Section 4.3 below. Locations of DMAs and associated LID and treatment BMPs are identified on the exhibits in Attachment C. Additional calculations and TGD Worksheets are provided in Attachment D.

DRAINAGE MANAGEMENT AREAS (DMAs)

| DMA | BMP | Drainage Area (ac) | % Imp. | Design Storm Depth (in) | Simple Method DCV (ft$^3$) |
|---|---|---|---|---|---|
| DMA 1 | BIO-7: Proprietary Biotreatment | 0.99 | 85% | 0.8 | 2,265 |
| DMA 2 | BIO-7: Proprietary Biotreatment | 0.90 | 85% | 0.8 | 2,060 |
| DMA 3 | BIO-7: Proprietary Biotreatment | 0.41 | 85% | 0.8 | 938 |
| DMA 4 | BIO-7: Proprietary Biotreatment | 0.42 | 85% | 0.8 | 961 |
| DMA 5 | BIO-7: Proprietary Biotreatment | 1.09 | 85% | 0.8 | 2,494 |
| DMA 6 | BIO-7: Proprietary Biotreatment | 0.75 | 85% | 0.8 | 1,716 |
| DMA 7 | BIO-7: Proprietary Biotreatment | 0.96 | 85% | 0.8 | 2,197 |
| Total | -- | 5.52 | 85% | 0.8 | 12,632 |

## 4.2 OVERALL SITE DESIGN BMPS

*Minimize Impervious Area*

Impervious surfaces have been minimized by incorporating landscaped areas throughout the site surrounding the proposed building. Landscaping will be provided throughout the site within the common areas as well as around the perimeter of the building.

*Maximize Natural Infiltration Capacity*

This BMP is not applicable as the project site is not suitable for infiltration.

*Preserve Existing Drainage Patterns and Time of Concentration*

Runoff from the site will continue to flow similar to existing conditions. Low-flows and first-flush runoff will drain to modular wetland systems for water quality treatment via biofiltration.

*Disconnect Impervious Areas*

Landscaping will be provided around the perimeter of the building and in the courtyard areas. Runoff from the site will flow through proprietary biofiltration systems for water quality treatment.

*Protect Existing Vegetation and Sensitive Areas*

Under the existing conditions, the majority of the site has been developed and there are not existing vegetation or sensitive areas to protect.

*Revegetate Disturbed Areas*

All disturbed areas on the project site will either be paved or landscaped.

*Soil Stockpiling and Site Generated Organics*

As part of the grading and stockpiling activities on the site, organic materials that are suitable for assisting with the re-vegetation of the site will be collected, stored and then reused during planting of the site, where feasible.

*Firescaping*

The proposed project is designed to meet the Orange County Fire Authority's fuel modification standards.

*Water Efficient Landscaping*

Xeriscape landscaping is not proposed for the project. However, native and/or tolerant landscaping will be incorporated into the site design consistent with City guidelines.

*Slopes and Channel Buffers*

This BMP does not apply to the project site as the site is relatively flat and there are no slopes to be protected.

## 4.3 DMA CHARACTERISTICS AND SITE DESIGN BMPS

Following is a detailed description of each Drainage Management Area as delineated on HMP Proposed Condition and the WQMP Exhibits in Attachment C.

### 4.3.1 DMA 1

DMA 1 is located in the northern portion of the project site and has a total area of 0.99 acres with an assumed imperviousness of 85%. Calculations are based on this conservative impervious ratio for residential land use. This ratio is subject to change in final design with updated landscape architect plans. This drainage area will consist of walkways and seating areas in Courtyard C and D along with ornamental landscaping and building roof runoff. Runoff from this drainage area will be piped to a Modular Wetland System on the north side of the site along Victoria Blvd. Low flows will be treated via biotreatment while high flows will bypass treatment via a diversion structure. All flows will connect to the existing storm line along Victoria Blvd before draining into San Juan Creek.

### 4.3.2 DMA 2

DMA 2 is located in the northern portion of the project site and has a total area of 0.90 acres with an assumed imperviousness of 85%. Calculations are based on this conservative impervious ratio for residential land use. This ratio is subject to change in final design with updated landscape architect plans. This drainage area will consist of walkways and seating areas in Courtyard A and B along with ornamental landscaping and building roof runoff. Runoff from this drainage area will be piped to a Modular Wetland System on the north corner of the site along Victoria Blvd. Low flows will be treated via biotreatment while high flows will bypass treatment via a diversion structure. All flows will connect to the existing storm line along Victoria Blvd before draining into San Juan Creek.

### 4.3.3 DMA 3

DMA 3 is located in the south west portion of the project site and has a total area of 0.41 acres with an assumed imperviousness of 85%. Calculations are based on this conservative impervious ratio for residential land use. This ratio is subject to change in final design with updated landscape architect plans. This drainage area will consist of walkways, ornamental landscaping and building roof runoff. Runoff from this drainage area will be piped to a Modular Wetland System on the southwest side of the site along Sepulveda Ave. Low flows will be treated via biotreatment while high flows will bypass treatment via a diversion structure. All flows will connect to the existing storm line along Sepulveda Ave before draining into San Juan Creek.

### 4.3.4 DMA 4

DMA 4 is located in the north east portion of the project site and has a total area of 0.42 acres with an assumed imperviousness of 85%. Calculations are based on this conservative impervious ratio for residential land use. This ratio is subject to change in final design with updated landscape architect plans. This drainage area will consist of walkways, ornamental landscaping and building roof runoff.

Runoff from this drainage area will be piped to a Modular Wetland System on the east side of the site along PCH. Low flows will be treated via biotreatment while high flows will bypass treatment via a diversion structure. All flows will connect to the existing storm line along Sepulveda Ave before draining into San Juan Creek.

### 4.3.5 DMA 5

DMA 5 is located in the center portion of the project site and has a total area of 1.09 acres with an assumed imperviousness of 85%. Calculations are based on this conservative impervious ratio for residential land use. This ratio is subject to change in final design with updated landscape architect plans. This drainage area will consist of mostly building roof runoff. Runoff from this drainage area will be piped to a Modular Wetland System on the southeast side of the site along PCH. Low flows will be treated via biotreatment while high flows will bypass treatment via a diversion structure. All flows will connect to the existing storm line along Sepulveda Ave before draining into San Juan Creek.

### 4.3.6 DMA 6

DMA 6 is located in the south portion of the project site and has a total area of 0.75 acres with an assumed imperviousness of 85%. Calculations are based on this conservative impervious ratio for residential land use. This ratio is subject to change in final design with updated landscape architect plans. This drainage area will consist of walkways and seating areas in Courtyard E along with ornamental landscaping and building roof runoff. Runoff from this drainage area will be piped to a Modular Wetland System on the southwest side of the site along PCH. Low flows will be treated via biotreatment while high flows will bypass treatment via a diversion structure. All flows will connect to the existing storm line along Sepulveda Ave before draining into San Juan Creek.

### 4.3.7 DMA 7

DMA 7 is located in the southwest portion of the project site and has a total area of 0.96 acres with an assumed imperviousness of 85%. Calculations are based on this conservative impervious ratio for residential land use. This ratio is subject to change in final design with updated landscape architect plans. This drainage area will consist of walkways and seating areas in Courtyard F along with ornamental landscaping and building roof runoff. Runoff from this drainage area will be piped to a Modular Wetland System on the southwest side of the site along PCH. Low flows will be treated via biotreatment while high flows will bypass treatment via a diversion structure. All flows will connect to the existing storm line along Sepulveda Ave before draining into San Juan Creek.

### 4.3.8 DMA Summary

| DRAINAGE MANAGEMENT AREAS | | | | |
|---|---|---|---|---|
| **DMA (Number/Description)** | **Total Area (acres)** | **Imperviousness (%)** | **Infiltration Feasibility Category (Full, Partial or No Infiltration)** | **Hydrologic Source Controls Used** |
| DMA 1 | 0.99 | 85% | No Infiltration | None |
| DMA 2 | 0.90 | 85% | No Infiltration | None |
| DMA 3 | 0.41 | 85% | No Infiltration | None |
| DMA 4 | 0.42 | 85% | No Infiltration | None |
| DMA 5 | 1.09 | 85% | No Infiltration | None |
| DMA 6 | 0.75 | 85% | No Infiltration | None |
| DMA 7 | 0.96 | 85% | No Infiltration | None |

## 4.4 SOURCE CONTROL BMPS

The table below indicates all BMPs to be incorporated in the project. For those designated as not applicable (N/A), a brief explanation why is provided.

**NON-STRUCTURAL SOURCE CONTROL BMPs**

| ID | Name | Check One | | Reason Source Control is Not Applicable |
|---|---|---|---|---|
| | | Included | Not Applicable | |
| N1 | Education for Property Owners, Tenants & Occupants | ☒ | ☐ | |
| N2 | Activity Restrictions | ☒ | ☐ | |
| N3 | Common Area Landscape Management | ☒ | ☐ | |
| N4 | BMP Maintenance | ☒ | ☐ | |
| N5 | Title 22 CCR Compliance (How development will comply) | ☐ | ☒ | Not applicable. No hazardous materials will be stored on-site. |
| N6 | Local Water Quality Permit Compliance | ☐ | ☒ | Not applicable. The City of Dana Point does not issue water quality permits. |
| N7 | Spill Contingency Plan | ☐ | ☒ | No fueling or liquid storage facilities. |
| N8 | Underground Storage Tank Compliance | ☐ | ☒ | No underground tanks. |
| N9 | Hazardous Materials Disclosure Compliance | ☐ | ☒ | No hazardous materials will be stored on-site. |
| N10 | Uniform Fire Code Implementation | ☐ | ☒ | Not applicable. No hazardous materials will be stored on-site. |
| N11 | Common Area Litter Control | ☒ | ☐ | |
| N12 | Employee Training | ☒ | ☐ | |
| N13 | Housekeeping of Loading Docks | ☐ | ☒ | No loading docks proposed. |
| N14 | Common Area Catch Basin Inspection | ☒ | ☐ | |
| N15 | Street Sweeping Private Streets and Parking Lots | ☒ | ☐ | |
| N16 | Retail Gasoline Outlets | ☐ | ☒ | No retail gasoline outlets proposed. |

### *N1, Education for Property Owners, Tenants and Occupants*

Educational materials will be provided to tenants, including brochures and restrictions to reduce pollutants from reaching the storm drain system. Examples include tips for pet care, household tips, and proper household hazardous waste disposal. Tenants will be provided with these materials by the property management prior to occupancy, and periodically thereafter. Refer to Section 7 for a list of materials available and attached to this WQMP. Additional materials are available through the County of Orange Stormwater Program website (http://ocwatersheds.com/PublicEd/) and the California Stormwater Quality Association's (CASQA) BMP Handbooks (http://www.casqa.org/resources/bmp-handbooks).

### *N2, Activity Restrictions*

The Owner shall develop ongoing activity restrictions that include those that have the potential to create adverse impacts on water quality. Activities include, but are not limited to: handling and disposal of contaminants, fertilizer and pesticide application restrictions, litter control and pick-up, and vehicle or equipment repair and maintenance in non-designated areas, as well as any other activities that may potentially contribute to water pollution.

### *N3, Common Area Landscape Management*

Management programs will be designed and implemented by the Owner to maintain all the common areas within the project site. These programs will cover how to reduce the potential pollutant sources of fertilizer and pesticide uses, utilization of water-efficient landscaping practices and proper disposal of landscape wastes by the owner/developer and/or contractors.

### *N4, BMP Maintenance*

The Owner will be responsible for the implementation and maintenance of each applicable non-structural BMP, as well as scheduling inspections and maintenance of all applicable structural BMP facilities through its staff, landscape contractor, and/or any other necessary maintenance contractors. Details on BMP maintenance can be found in the O&M Plan, Attachment B of this WQMP.

### *N11, Common Area Litter Control*

The Owner will be responsible for performing trash pickup and sweeping of littered common areas on a weekly basis or whenever necessary. Responsibilities will also include noting improper disposal materials by the public and reporting such violations for investigation.

### *N12, Employee Training*

All employees of the Owner and any contractors will require training to ensure that employees are aware of maintenance activities that may result in pollutants reaching the storm drain. Training will include, but not be limited to, spill cleanup procedures, proper waste disposal, housekeeping practices, etc.

### *N14, Common Area Catch Basin Inspection*

All on-site catch basin inlets and drainage facilities shall be inspected and maintained by the Owner at least once a year, prior to the rainy season, no later than October 1st of each year.

*N15, Street Sweeping Private Streets and Parking Lots*

The Owner shall be responsible for sweeping all on-site drive aisles within the project on a quarterly basis.

The table below indicates all structural source control BMPs to be incorporated in the project. For those designated as not applicable (N/A), a brief explanation why is provided.

**STRUCTURAL SOURCE CONTROL BMPs**

| ID | Name | Check One | | Reason Source Control is Not Applicable |
|---|---|---|---|---|
| | | Included | Not Applicable | |
| S1 | Provide storm drain system stenciling and signage | ☒ | ☐ | |
| S2 | Design and construct outdoor material storage areas to reduce pollution introduction | ☐ | ☒ | No outdoor material storage areas proposed. |
| S3 | Design and construct trash and waste storage areas to reduce pollution introduction | ☐ | ☒ | Trash enclosure will be located indoors within the parking levels. |
| S4 | Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control | ☒ | ☐ | |
| S5 | Protect slopes and channels and provide energy dissipation | ☐ | ☒ | No slopes on site. |
| Incorporate requirements applicable to individual priority project categories (from SDRWQCB NPDES Permit) | | | | |
| S6 | Dock areas | ☐ | ☒ | No loading docks are proposed. |
| S7 | Maintenance bays | ☐ | ☒ | No maintenance bays are proposed. |
| S8 | Vehicle wash areas | ☐ | ☒ | No vehicle wash areas are proposed. |
| S9 | Outdoor processing areas | ☐ | ☒ | No outdoor material storage areas are proposed. |
| S10 | Equipment wash areas | ☐ | ☒ | No equipment wash areas are proposed. |
| S11 | Fueling areas | ☐ | ☒ | No fueling areas are proposed. |
| S12 | Hillside landscaping | ☐ | ☒ | Project is not located on a hillside. |
| S13 | Wash water control for food preparation areas | ☐ | ☒ | No food preparation areas are proposed. |

| STRUCTURAL SOURCE CONTROL BMPs | | | | |
|---|---|---|---|---|
| ID | Name | Check One | | Reason Source Control is Not Applicable |
| | | Included | Not Applicable | |
| S14 | Community car wash racks | ☐ | ☒ | No community car wash racks are proposed. |

*S1, Provide storm drain system stenciling and signage*

The phrase "NO DUMPING! DRAINS TO OCEAN", or an equally effective phrase approved by the City, will be stenciled on all major storm drain inlets within the project site to alert the public to the destination of pollutants discharged into storm water. Stencils shall be in place prior to release of certificate of occupancy. Stencils shall be inspected for legibility on an annual basis and re-stenciled as necessary.

*S4, Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control*

The Owner will be responsible for the installation and maintenance of all common landscape areas utilizing similar planting materials with similar water requirements to reduce excess irrigation runoff. The Owner will be responsible for implementing all efficient irrigation systems for common area landscaping including, but not limited to, provisions for water sensors and programmable irrigation cycles. This includes smart timers, rain sensors, and moisture shut-off valves. The irrigation systems shall be in conformance with water efficiency guidelines. Systems shall be tested twice per year, and water used during testing/flushing shall not be discharged to the storm drain system.

# SECTION 5 LOW IMPACT DEVELOPMENT BMPS

## 5.1 LID BMPS IN DMA 1

### 5.1.1 Hydrologic Source Controls for DMA 1

Hydrologic Source Controls (HSC) are not proposed for DMA 1. The DCV for DMA 1 is addressed through a structural LID BMP (BIO-7: Proprietary Biotreatment).

### 5.1.2 Structural LID BMP for DMA 1

| STRUCTURAL LID BMP FOR DMA 1 | |
|---|---|
| Infiltration Feasibility | *Not feasible. See Section 3.1.2* |
| Harvest and Use Feasibility | *Not feasible. See Section 3.2.3* |
| Selected BMP | BIO-7: Proprietary Biotreatment |
| Selected BMP Sizing Method | Stormwater Quality Design Flow (SQDF, $Q_{DESIGN}$) |
| DCV | DCV = C x d x A x 43560 sf/ac x 1/12 ft/in<br>Where:<br>DCV = design storm capture volume, cu-ft<br>C = runoff coefficient = (0.75 x imp + 0.15)<br>Imp = impervious fraction of drainage area (ranges from 0 to 1)<br>d = storm depth (inches)<br>A = tributary area (acres)<br>Imp = 0.85<br>d = 0.80 inches<br>A = 0.99<br>DCV = *(0.75 x 0.85 +0.15) x 0.80 inches x 0.99 ac x 43560 sf/ac x 1/12 ft/in*<br>= 2,265 cu-ft |
| $Q_{80\%}$ | $Q_{80\%}$= C x I x A<br>Where: |

| | |
|---|---|
| | $Q_{80\%}$ = flow rate to achieve 80% capture, cfs<br>C = runoff coefficient = (0.75 x imp + 0.15)<br>I = Rainfall Intensity (in/hr)<br>A = tributary area (acres)<br>I = 0.26 (a conservative Tc of 5 min was used)<br>A = 0.99<br>**$Q_{80\%}$ =** *(0.75 x 0.85 +0.15) x 0.26 inches/hr x 0.99 ac*<br>**= 0.203 cfs**<br>*Refer to Attachment D for detailed calculations (Worksheet 9)* |
| $Q_{DESIGN}$ | $Q_{DESIGN}$= $Q_{80\%}$ x 150%<br>$Q_{DESIGN}$ =0.203 cfs x 1.5<br>**= 0.304 cfs** |
| **MWS Size/Model** | MWS-L-8-12 |
| **Treatment Capacity** | 0.346 cfs |

Since full/partial infiltration and harvest and reuse are considered infeasible in DMA 1, biotreatment BMPs (third priority structural LID BMPs) will be utilized on-site for water quality treatment. The project will implement a series of Modular Wetland System units for water quality treatment to treat all pollutants of concern to a medium to high level of effectiveness. The systems will include the Modular Wetlands Systems developed by Bio Clean Environmental Services, Inc. There are several advantages of the Modular Wetland System over traditional bioretention planters including the following reasons:

- Modular Wetlands are the only proprietary biotreatment device approved through the Washington State University TAPE (Technology Assessment Protocol – Ecology) program for basic storm water treatment and enhanced treatment including sediment, nutrients and heavy metals (all proposed pollutants of concern for the Upper Newport Bay). TAPE approval is based on a series of independent field studies using strict sampling criteria to validate vendor's claims. TAPE approval is considered one of the most stringent and most reliable in the country.
- Modular Wetlands have a pre-treatment chamber that is specifically designed to capture fine sediments and particulates through a series of BioMediaGREEN sponges which prohibit the fines and particulates from entering the bioretention chamber and accelerating potential clogging of the bioretention soil.

- Modular Wetland Systems are specifically designed for higher flow through treatment rates which reduce the potential for nutrient and copper leaching under more stagnant conditions (a common occurrence with planters that are left unmaintained).

Modular Wetlands by Modular Wetlands Systems, Inc. are proprietary biotreatment systems that utilize multi-stage treatment processes including screening media filtration, settling, and biofiltration. The pre-treatment chamber contains the first three stages of treatment, and includes a catch basin inlet filter to capture trash, debris, gross solids and sediments, a settling chamber for separating out larger solids, and a media filter cartridge for capturing fine TSS, metals, nutrients, and bacteria. Runoff then flows through the wetland chamber where treatment is achieved through a variety of physical, chemical, and biological processes. As storm water passes down through the planting soil, pollutants are filtered, adsorbed, biodegraded and sequestered by the soil and plants, functioning similar to bioretention systems. The discharge chamber at the end of the unit collects treated flows and discharges back into the storm drain system.

This system was selected based on its ability to treat the project's pollutants of concerns to a medium or high effectiveness, in accordance with the Model WQMP and TGD requirements. The table below summarizes the overall treatment effectiveness for Modular Wetlands, derived from the Technical Guidance Document and testing data provided by the manufacturer. Additional details for the Modular Wetland System are included in Attachment C of this WQMP.

| POLLUTANTS OF CONCERN AND PERFORMANCE RATINGS | | |
|---|---|---|
| **Pollutant of Concern** (1) | **Treatment Effectiveness** | |
| | **Bioretention System** (2) | **Modular Wetlands Proprietary Bioretention Units** (3) |
| Oil & Grease | High | High |
| Trash & Debris | High | High |
| Oxygen Demanding Substances | N/A | N/A |
| Toxic Organic Compounds | Medium | N/A(4) |
| **Primary Pollutant of Concern (303d listed impairments & TMDLs)** | | |
| Suspended Solids/Sediments | High | High |
| Nutrients | Low | Medium-High |
| Metals | High | High |
| Pathogens/Bacteria | Medium | Medium-High |
| Pesticides | N/A | N/A |

*Notes:*

1 See Section II.2.

2 Per Table 4.2 of the Model WQMP's companion Technical Guidance Document dated December 20, 2013.

3 Based on Washington State University Technology Assessment Protocol – Ecology (TAPE) third-party independent field tests for a high-flow biotreatment system with raised under drain (Modular Wetland System-Linear). Refer to manufacturer documentation (attached) for specific removal efficiencies and source references.

4 Field and Lab Testing demonstrates 75-83% removal rates of Chemical Oxygen Demand (COD), a measure of the amount of organic pollutants commonly found in surface water. COD removals of this range would fall within the Medium-High effectiveness category.

The MWS unit for DMA 1 has been sized with Worksheet 9 of the TGD for treatment of 1.5 times the 80% capture flowrate not retained onsite by LID BMPs, per guidelines from the 2017 TGD. Refer to Worksheet 9 in Attachment D for further calculation details.

## 5.2 LID BMPS IN DMA 2

### 5.2.1 Hydrologic Source Controls for DMA 2

Hydrologic Source Controls (HSC) are not proposed for DMA 2. The DCV for DMA 2 is addressed through a structural LID BMP (BIO-7: Proprietary Biotreatment).

### 5.2.2 Structural LID BMP for DMA 2

| STRUCTURAL LID BMP FOR DMA 2 | |
|---|---|
| **Infiltration Feasibility** | *Not feasible. See Section 3.1.2* |
| **Harvest and Use Feasibility** | *Not feasible. See Section 3.2.3* |
| **Selected BMP** | BIO-7: Proprietary Biotreatment |
| **Selected BMP Sizing Method** | Flow-Based Compact Biofiltration |
| **DCV** | DCV = C x d x A x 43560 sf/ac x 1/12 ft/in<br>Where:<br>DCV = design storm capture volume, cu-ft<br>C = runoff coefficient = (0.75 x imp + 0.15)<br>Imp = impervious fraction of drainage area (ranges from 0 to 1)<br>d = storm depth (inches)<br>A = tributary area (acres)<br>Imp = 0.85<br>d = 0.80 inches<br>A = 0.90<br>**DCV =** *(0.75 x 0.85 +0.15) x 0.80 inches x 0.90 ac x 43560 sf/ac x 1/12 ft/in*<br>**= 2,060 cu-ft** |

| | |
|---|---|
| $Q_{80\%}$ | $Q_{80\%}$= C x I x A<br>Where:<br>$Q_{80\%}$ = flow rate to achieve 80% capture, cfs<br>C = runoff coefficient = (0.75 x imp + 0.15)<br>I = Rainfall Intensity (in/hr)<br>A = tributary area (acres)<br>I = 0.26 (a conservative Tc of 5 min was used)<br>A = 0.90<br>**$Q_{80\%}$ =** *(0.75 x 0.85 +0.15) x 0.26 inches/hr x 0.90 ac*<br>**= 0.184 cfs**<br>*Refer to Attachment D for detailed calculations (Worksheet 9)* |
| $Q_{DESIGN}$ | $Q_{DESIGN}$= $Q_{80\%}$ x 150%<br>**$Q_{DESIGN}$** =0.184 cfs x 1.5<br>**= 0.277 cfs** |
| **MWS Size/Model** | MWS-L-8-12 |
| **Treatment Capacity** | 0.346 cfs |

Since full/partial infiltration and harvest and reuse are considered infeasible in DMA 2, biotreatment BMPs (third priority structural LID BMPs) will be utilized on-site for water quality treatment. The project will implement a series of Modular Wetland System units for water quality treatment to treat all pollutants of concern to a medium to high level of effectiveness. The systems will include the Modular Wetlands Systems developed by Bio Clean Environmental Services, Inc. There are several advantages of the Modular Wetland System over traditional bioretention planters including the following reasons:

- Modular Wetlands are the only proprietary biotreatment device approved through the Washington State University TAPE (Technology Assessment Protocol – Ecology) program for basic storm water treatment and enhanced treatment including sediment, nutrients and heavy metals (all proposed pollutants of concern for the Upper Newport Bay). TAPE approval is based on a series of independent field studies using strict sampling criteria to validate vendor's claims. TAPE approval is considered one of the most stringent and most reliable in the country.
- Modular Wetlands have a pre-treatment chamber that is specifically designed to capture fine sediments and particulates through a series of BioMediaGREEN sponges which prohibit the

fines and particulates from entering the bioretention chamber and accelerating potential clogging of the bioretention soil.

- Modular Wetland Systems are specifically designed for higher flow through treatment rates which reduce the potential for nutrient and copper leaching under more stagnant conditions (a common occurrence with planters that are left unmaintained).

Modular Wetlands by Modular Wetlands Systems, Inc. are proprietary biotreatment systems that utilize multi-stage treatment processes including screening media filtration, settling, and biofiltration. The pre-treatment chamber contains the first three stages of treatment, and includes a catch basin inlet filter to capture trash, debris, gross solids and sediments, a settling chamber for separating out larger solids, and a media filter cartridge for capturing fine TSS, metals, nutrients, and bacteria. Runoff then flows through the wetland chamber where treatment is achieved through a variety of physical, chemical, and biological processes. As storm water passes down through the planting soil, pollutants are filtered, adsorbed, biodegraded and sequestered by the soil and plants, functioning similar to bioretention systems. The discharge chamber at the end of the unit collects treated flows and discharges back into the storm drain system.

This system was selected based on its ability to treat the project's pollutants of concerns to a medium or high effectiveness, in accordance with the Model WQMP and TGD requirements. The table below summarizes the overall treatment effectiveness for Modular Wetlands, derived from the Technical Guidance Document and testing data provided by the manufacturer. Additional details for the Modular Wetland System are included in Attachment C of this WQMP.

| **POLLUTANTS OF CONCERN AND PERFORMANCE RATINGS** | | |
|---|---|---|
| **Pollutant of Concern** (1) | **Treatment Effectiveness** | |
| | **Bioretention System** (2) | **Modular Wetlands Proprietary Bioretention Units** (3) |
| Oil & Grease | High | High |
| Trash & Debris | High | High |
| Oxygen Demanding Substances | N/A | N/A |
| Toxic Organic Compounds | Medium | N/A(4) |
| **Primary Pollutant of Concern (303d listed impairments & TMDLs)** | | |
| Suspended Solids/Sediments | High | High |
| Nutrients | Low | Medium-High |
| Metals | High | High |
| Pathogens/Bacteria | Medium | Medium-High |
| Pesticides | N/A | N/A |

| POLLUTANTS OF CONCERN AND PERFORMANCE RATINGS | | |
|---|---|---|
| **Pollutant of Concern (1)** | **Treatment Effectiveness** | |
| | **Bioretention System (2)** | **Modular Wetlands Proprietary Bioretention Units (3)** |

*Notes:*

5 See Section II.2.

6 Per Table 4.2 of the Model WQMP's companion Technical Guidance Document dated December 20, 2013.

7 Based on Washington State University Technology Assessment Protocol – Ecology (TAPE) third-party independent field tests for a high-flow biotreatment system with raised under drain (Modular Wetland System-Linear). Refer to manufacturer documentation (attached) for specific removal efficiencies and source references.

8 Field and Lab Testing demonstrates 75-83% removal rates of Chemical Oxygen Demand (COD), a measure of the amount of organic pollutants commonly found in surface water. COD removals of this range would fall within the Medium-High effectiveness category.

The MWS unit for DMA 2 has been sized with Worksheet 9 of the TGD for treatment of 1.5 times the 80% capture flowrate not retained onsite by LID BMPs, per guidelines from the 2017 TGD. Refer to Worksheet 9 in Attachment D for further calculation details.

## 5.3 LID BMPS IN DMA 3

### 5.3.1 Hydrologic Source Controls for DMA 3

Hydrologic Source Controls (HSC) are not proposed for DMA 3. The DCV for DMA 3 is addressed through a structural LID BMP (BIO-7: Proprietary Biotreatment).

### 5.3.2 Structural LID BMP for DMA 3

| STRUCTURAL LID BMP FOR DMA 3 | |
|---|---|
| Infiltration Feasibility | *Not feasible. See Section 3.1.2* |
| Harvest and Use Feasibility | *Not feasible. See Section 3.2.3* |
| Selected BMP | BIO-7: Proprietary Biotreatment |
| Selected BMP Sizing Method | Flow-Based Compact Biofiltration |
| DCV | DCV = C x d x A x 43560 sf/ac x 1/12 ft/in<br>Where:<br>DCV = design storm capture volume, cu-ft<br>C = runoff coefficient = (0.75 x imp + 0.15)<br>Imp = impervious fraction of drainage area (ranges from 0 to 1)<br>d = storm depth (inches)<br>A = tributary area (acres) |

| | |
|---|---|
| | Imp = 0.85<br>d = 0.80 inches<br>A = 0.41<br>**DCV =** *(0.75 x 0.85 +0.15) x 0.80 inches x 0.41 ac x 43560 sf/ac x 1/12 ft/in*<br>**= 938 cu-ft** |
| $Q_{80\%}$ | $Q_{80\%}$= C x I x A<br>Where:<br>$Q_{80\%}$ = flow rate to achieve 80% capture, cfs<br>C = runoff coefficient = (0.75 x imp + 0.15)<br>I = Rainfall Intensity (in/hr)<br>A = tributary area (acres)<br>I = 0.26 (a conservative Tc of 5 min was used)<br>A = 0.41<br>**$Q_{80\%}$ =** *(0.75 x 0.85 +0.15) x 0.26 inches/hr x 0.41 ac*<br>**= 0.084 cfs**<br>*Refer to Attachment D for detailed calculations (Worksheet 9)* |
| $Q_{DESIGN}$ | $Q_{DESIGN}$= $Q_{80\%}$ x 150%<br>**$Q_{DESIGN}$** =0.084 cfs x 1.5<br>**= 0.126 cfs** |
| **MWS Size/Model** | MWS-L-4-13 |
| **Treatment Capacity** | 0.144 cfs |

Since full/partial infiltration and harvest and reuse are considered infeasible in DMA 3, biotreatment BMPs (third priority structural LID BMPs) will be utilized on-site for water quality treatment. The project will implement a series of Modular Wetland System units for water quality treatment to treat all pollutants of concern to a medium to high level of effectiveness. The systems will include the Modular

Wetlands Systems developed by Bio Clean Environmental Services, Inc. There are several advantages of the Modular Wetland System over traditional bioretention planters including the following reasons:

- Modular Wetlands are the only proprietary biotreatment device approved through the Washington State University TAPE (Technology Assessment Protocol – Ecology) program for basic storm water treatment and enhanced treatment including sediment, nutrients and heavy metals (all proposed pollutants of concern for the Upper Newport Bay). TAPE approval is based on a series of independent field studies using strict sampling criteria to validate vendor's claims. TAPE approval is considered one of the most stringent and most reliable in the country.
- Modular Wetlands have a pre-treatment chamber that is specifically designed to capture fine sediments and particulates through a series of BioMediaGREEN sponges which prohibit the fines and particulates from entering the bioretention chamber and accelerating potential clogging of the bioretention soil.
- Modular Wetland Systems are specifically designed for higher flow through treatment rates which reduce the potential for nutrient and copper leaching under more stagnant conditions (a common occurrence with planters that are left unmaintained).

Modular Wetlands by Modular Wetlands Systems, Inc. are proprietary biotreatment systems that utilize multi-stage treatment processes including screening media filtration, settling, and biofiltration. The pre-treatment chamber contains the first three stages of treatment, and includes a catch basin inlet filter to capture trash, debris, gross solids and sediments, a settling chamber for separating out larger solids, and a media filter cartridge for capturing fine TSS, metals, nutrients, and bacteria. Runoff then flows through the wetland chamber where treatment is achieved through a variety of physical, chemical, and biological processes. As storm water passes down through the planting soil, pollutants are filtered, adsorbed, biodegraded and sequestered by the soil and plants, functioning similar to bioretention systems. The discharge chamber at the end of the unit collects treated flows and discharges back into the storm drain system.

This system was selected based on its ability to treat the project's pollutants of concerns to a medium or high effectiveness, in accordance with the Model WQMP and TGD requirements. The table below summarizes the overall treatment effectiveness for Modular Wetlands, derived from the Technical Guidance Document and testing data provided by the manufacturer. Additional details for the Modular Wetland System are included in Attachment C of this WQMP.

| POLLUTANTS OF CONCERN AND PERFORMANCE RATINGS | | |
|---|---|---|
| **Pollutant of Concern** (1) | **Treatment Effectiveness** | |
| | **Bioretention System** (2) | **Modular Wetlands Proprietary Bioretention Units** (3) |
| Oil & Grease | High | High |
| Trash & Debris | High | High |
| Oxygen Demanding Substances | N/A | N/A |
| Toxic Organic Compounds | Medium | N/A(4) |
| **Primary Pollutant of Concern (303d listed impairments & TMDLs)** | | |

| POLLUTANTS OF CONCERN AND PERFORMANCE RATINGS | | |
|---|---|---|
| **Pollutant of Concern (1)** | **Treatment Effectiveness** | |
| | **Bioretention System (2)** | **Modular Wetlands Proprietary Bioretention Units (3)** |
| Suspended Solids/Sediments | High | High |
| Nutrients | Low | Medium-High |
| Metals | High | High |
| Pathogens/Bacteria | Medium | Medium-High |
| Pesticides | N/A | N/A |

*Notes:*

9 See Section II.2.

10 Per Table 4.2 of the Model WQMP's companion Technical Guidance Document dated December 20, 2013.

11 Based on Washington State University Technology Assessment Protocol – Ecology (TAPE) third-party independent field tests for a high-flow biotreatment system with raised under drain (Modular Wetland System-Linear). Refer to manufacturer documentation (attached) for specific removal efficiencies and source references.

12 Field and Lab Testing demonstrates 75-83% removal rates of Chemical Oxygen Demand (COD), a measure of the amount of organic pollutants commonly found in surface water. COD removals of this range would fall within the Medium-High effectiveness category.

The MWS unit for DMA 3 has been sized with Worksheet 9 of the TGD for treatment of 1.5 times the 80% capture flowrate not retained onsite by LID BMPs, per guidelines from the 2017 TGD. Refer to Worksheet 9 in Attachment D for further calculation details.

## 5.4 LID BMPS IN DMA 4

### 5.4.1 Hydrologic Source Controls for DMA 4

Hydrologic Source Controls (HSC) are not proposed for DMA 4. The DCV for DMA 4 is addressed through a structural LID BMP (BIO-7: Proprietary Biotreatment).

### 5.4.2 Structural LID BMP for DMA 4

| STRUCTURAL LID BMP FOR DMA 4 | |
|---|---|
| **Infiltration Feasibility** | *Not feasible. See Section 3.1.2* |
| **Harvest and Use Feasibility** | *Not feasible. See Section 3.2.3* |
| **Selected BMP** | BIO-7: Proprietary Biotreatment |
| **Selected BMP Sizing Method** | Flow-Based Compact Biofiltration |
| **DCV** | DCV = C x d x A x 43560 sf/ac x 1/12 ft/in<br>Where: |

| | |
|---|---|
| | DCV = design storm capture volume, cu-ft<br>C = runoff coefficient = (0.75 x imp + 0.15)<br>Imp = impervious fraction of drainage area (ranges from 0 to 1)<br>d = storm depth (inches)<br>A = tributary area (acres)<br><br>Imp = 0.85<br>d = 0.80 inches<br>A = 0.42<br><br>**DCV =** *(0.75 x 0.85 +0.15) x 0.80 inches x 0.42 ac x 43560 sf/ac x 1/12 ft/in*<br>**= 961 cu-ft** |
| **$Q_{80\%}$** | $Q_{80\%}$= C x I x A<br>Where:<br><br>$Q_{80\%}$ = flow rate to achieve 80% capture, cfs<br>C = runoff coefficient = (0.75 x imp + 0.15)<br>I = Rainfall Intensity (in/hr)<br>A = tributary area (acres)<br><br>I = 0.26 (a conservative Tc of 5 min was used)<br>A = 0.42<br><br>**$Q_{80\%}$ =** *(0.75 x 0.85 +0.15) x 0.26 inches/hr x 0.42 ac*<br>**= 0.086 cfs**<br><br>*Refer to Attachment D for detailed calculations (Worksheet 9)* |
| **$Q_{DESIGN}$** | $Q_{DESIGN}$= $Q_{80\%}$ x 150%<br><br>**$Q_{DESIGN}$** =0.086 cfs x 1.5<br>**= 0.129 cfs** |
| **MWS Size/Model** | MWS-L-4-13 |

| | |
|---|---|
| **Treatment Capacity** | 0.144 cfs |

Since full/partial infiltration and harvest and reuse are considered infeasible in DMA 4, biotreatment BMPs (third priority structural LID BMPs) will be utilized on-site for water quality treatment. The project will implement a series of Modular Wetland System units for water quality treatment to treat all pollutants of concern to a medium to high level of effectiveness. The systems will include the Modular Wetlands Systems developed by Bio Clean Environmental Services, Inc. There are several advantages of the Modular Wetland System over traditional bioretention planters including the following reasons:

- Modular Wetlands are the only proprietary biotreatment device approved through the Washington State University TAPE (Technology Assessment Protocol – Ecology) program for basic storm water treatment and enhanced treatment including sediment, nutrients and heavy metals (all proposed pollutants of concern for the Upper Newport Bay). TAPE approval is based on a series of independent field studies using strict sampling criteria to validate vendor's claims. TAPE approval is considered one of the most stringent and most reliable in the country.
- Modular Wetlands have a pre-treatment chamber that is specifically designed to capture fine sediments and particulates through a series of BioMediaGREEN sponges which prohibit the fines and particulates from entering the bioretention chamber and accelerating potential clogging of the bioretention soil.
- Modular Wetland Systems are specifically designed for higher flow through treatment rates which reduce the potential for nutrient and copper leaching under more stagnant conditions (a common occurrence with planters that are left unmaintained).

Modular Wetlands by Modular Wetlands Systems, Inc. are proprietary biotreatment systems that utilize multi-stage treatment processes including screening media filtration, settling, and biofiltration. The pre-treatment chamber contains the first three stages of treatment, and includes a catch basin inlet filter to capture trash, debris, gross solids and sediments, a settling chamber for separating out larger solids, and a media filter cartridge for capturing fine TSS, metals, nutrients, and bacteria. Runoff then flows through the wetland chamber where treatment is achieved through a variety of physical, chemical, and biological processes. As storm water passes down through the planting soil, pollutants are filtered, adsorbed, biodegraded and sequestered by the soil and plants, functioning similar to bioretention systems. The discharge chamber at the end of the unit collects treated flows and discharges back into the storm drain system.

This system was selected based on its ability to treat the project's pollutants of concerns to a medium or high effectiveness, in accordance with the Model WQMP and TGD requirements. The table below summarizes the overall treatment effectiveness for Modular Wetlands, derived from the Technical Guidance Document and testing data provided by the manufacturer. Additional details for the Modular Wetland System are included in Attachment C of this WQMP.

| POLLUTANTS OF CONCERN AND PERFORMANCE RATINGS | | |
|---|---|---|
| **Pollutant of Concern** (1) | **Treatment Effectiveness** | |
| | **Bioretention System** (2) | **Modular Wetlands Proprietary Bioretention Units** (3) |
| Oil & Grease | High | High |
| Trash & Debris | High | High |
| Oxygen Demanding Substances | N/A | N/A |
| Toxic Organic Compounds | Medium | N/A(4) |
| **Primary Pollutant of Concern (303d listed impairments & TMDLs)** | | |
| Suspended Solids/Sediments | High | High |
| Nutrients | Low | Medium-High |
| Metals | High | High |
| Pathogens/Bacteria | Medium | Medium-High |
| Pesticides | N/A | N/A |

*Notes:*

13 See Section II.2.

14 Per Table 4.2 of the Model WQMP's companion Technical Guidance Document dated December 20, 2013.

15 Based on Washington State University Technology Assessment Protocol – Ecology (TAPE) third-party independent field tests for a high-flow biotreatment system with raised under drain (Modular Wetland System-Linear). Refer to manufacturer documentation (attached) for specific removal efficiencies and source references.

16 Field and Lab Testing demonstrates 75-83% removal rates of Chemical Oxygen Demand (COD), a measure of the amount of organic pollutants commonly found in surface water. COD removals of this range would fall within the Medium-High effectiveness category.

The MWS unit for DMA 4 has been sized with Worksheet 9 of the TGD for treatment of 1.5 times the 80% capture flowrate not retained onsite by LID BMPs, per guidelines from the 2017 TGD. Refer to Worksheet 9 in Attachment D for further calculation details.

## 5.5 LID BMPS IN DMA 5

### 5.5.1 Hydrologic Source Controls for DMA 5

Hydrologic Source Controls (HSC) are not proposed for DMA 5. The DCV for DMA 5 is addressed through a structural LID BMP (BIO-7: Proprietary Biotreatment).

### 5.5.2 Structural LID BMP for DMA 5

| STRUCTURAL LID BMP FOR DMA 5 | |
|---|---|
| **Infiltration Feasibility** | *Not feasible. See Section 3.1.2* |
| **Harvest and Use Feasibility** | *Not feasible. See Section 3.2.3* |

| | |
|---|---|
| **Selected BMP** | BIO-7: Proprietary Biotreatment |
| **Selected BMP Sizing Method** | Flow-Based Compact Biofiltration |
| **DCV** | DCV = C x d x A x 43560 sf/ac x 1/12 ft/in<br>Where:<br>DCV = design storm capture volume, cu-ft<br>C = runoff coefficient = (0.75 x imp + 0.15)<br>Imp = impervious fraction of drainage area (ranges from 0 to 1)<br>d = storm depth (inches)<br>A = tributary area (acres)<br>Imp = 0.85<br>d = 0.80 inches<br>A = 1.09<br>**DCV =** *(0.75 x 0.85 +0.15) x 0.80 inches x 1.09 ac x 43560 sf/ac x 1/12 ft/in*<br>**= 2,494 cu-ft** |
| **$Q_{80\%}$** | $Q_{80\%}$= C x I x A<br>Where:<br>$Q_{80\%}$ = flow rate to achieve 80% capture, cfs<br>C = runoff coefficient = (0.75 x imp + 0.15)<br>I = Rainfall Intensity (in/hr)<br>A = tributary area (acres)<br>I = 0.26 (a conservative Tc of 5 min was used)<br>A = 1.09<br>**$Q_{80\%}$ =** *(0.75 x 0.85 +0.15) x 0.26 inches/hr x 1.09 ac*<br>**= 0.223 cfs**<br>*Refer to Attachment D for detailed calculations (Worksheet 9)* |

| | |
|---|---|
| $Q_{DESIGN}$ | $Q_{DESIGN} = Q_{80\%}$ x 150%<br>$Q_{DESIGN}$ =0.223 cfs x 1.5<br>**= 0.335 cfs** |
| **MWS Size/Model** | MWS-L-8-16 |
| **Treatment Capacity** | 0.462 cfs |

Since full/partial infiltration and harvest and reuse are considered infeasible in DMA 5, biotreatment BMPs (third priority structural LID BMPs) will be utilized on-site for water quality treatment. The project will implement a series of Modular Wetland System units for water quality treatment to treat all pollutants of concern to a medium to high level of effectiveness. The systems will include the Modular Wetlands Systems developed by Bio Clean Environmental Services, Inc. There are several advantages of the Modular Wetland System over traditional bioretention planters including the following reasons:

- Modular Wetlands are the only proprietary biotreatment device approved through the Washington State University TAPE (Technology Assessment Protocol – Ecology) program for basic storm water treatment and enhanced treatment including sediment, nutrients and heavy metals (all proposed pollutants of concern for the Upper Newport Bay). TAPE approval is based on a series of independent field studies using strict sampling criteria to validate vendor's claims. TAPE approval is considered one of the most stringent and most reliable in the country.
- Modular Wetlands have a pre-treatment chamber that is specifically designed to capture fine sediments and particulates through a series of BioMediaGREEN sponges which prohibit the fines and particulates from entering the bioretention chamber and accelerating potential clogging of the bioretention soil.
- Modular Wetland Systems are specifically designed for higher flow through treatment rates which reduce the potential for nutrient and copper leaching under more stagnant conditions (a common occurrence with planters that are left unmaintained).

Modular Wetlands by Modular Wetlands Systems, Inc. are proprietary biotreatment systems that utilize multi-stage treatment processes including screening media filtration, settling, and biofiltration. The pre-treatment chamber contains the first three stages of treatment, and includes a catch basin inlet filter to capture trash, debris, gross solids and sediments, a settling chamber for separating out larger solids, and a media filter cartridge for capturing fine TSS, metals, nutrients, and bacteria. Runoff then flows through the wetland chamber where treatment is achieved through a variety of physical, chemical, and biological processes. As storm water passes down through the planting soil, pollutants are filtered, adsorbed, biodegraded and sequestered by the soil and plants, functioning similar to bioretention systems. The discharge chamber at the end of the unit collects treated flows and discharges back into the storm drain system.

This system was selected based on its ability to treat the project's pollutants of concerns to a medium or high effectiveness, in accordance with the Model WQMP and TGD requirements. The table below summarizes the overall treatment effectiveness for Modular Wetlands, derived from the Technical

Guidance Document and testing data provided by the manufacturer. Additional details for the Modular Wetland System are included in Attachment C of this WQMP.

**POLLUTANTS OF CONCERN AND PERFORMANCE RATINGS**

| **Pollutant of Concern** (1) | **Treatment Effectiveness** | |
|---|---|---|
| | **Bioretention System** (2) | **Modular Wetlands Proprietary Bioretention Units** (3) |
| Oil & Grease | High | High |
| Trash & Debris | High | High |
| Oxygen Demanding Substances | N/A | N/A |
| Toxic Organic Compounds | Medium | N/A(4) |
| **Primary Pollutant of Concern (303d listed impairments & TMDLs)** | | |
| Suspended Solids/Sediments | High | High |
| Nutrients | Low | Medium-High |
| Metals | High | High |
| Pathogens/Bacteria | Medium | Medium-High |
| Pesticides | N/A | N/A |

*Notes:*

17 See Section II.2.

18 Per Table 4.2 of the Model WQMP's companion Technical Guidance Document dated December 20, 2013.

19 Based on Washington State University Technology Assessment Protocol – Ecology (TAPE) third-party independent field tests for a high-flow biotreatment system with raised under drain (Modular Wetland System-Linear). Refer to manufacturer documentation (attached) for specific removal efficiencies and source references.

20 Field and Lab Testing demonstrates 75-83% removal rates of Chemical Oxygen Demand (COD), a measure of the amount of organic pollutants commonly found in surface water. COD removals of this range would fall within the Medium-High effectiveness category.

The MWS unit for DMA 5 has been sized with Worksheet 9 of the TGD for treatment of 1.5 times the 80% capture flowrate not retained onsite by LID BMPs, per guidelines from the 2017 TGD. Refer to Worksheet 9 in Attachment D for further calculation details.

## 5.1 LID BMPS IN DMA 6

### 5.6.1 Hydrologic Source Controls for DMA 6

Hydrologic Source Controls (HSC) are not proposed for DMA 6. The DCV for DMA 6 is addressed through a structural LID BMP (BIO-7: Proprietary Biotreatment).

## 5.6.2 Structural LID BMP for DMA 6

| STRUCTURAL LID BMP FOR DMA 6 | |
|---|---|
| **Infiltration Feasibility** | *Not feasible. See Section 3.1.2* |
| **Harvest and Use Feasibility** | *Not feasible. See Section 3.2.3* |
| **Selected BMP** | BIO-7: Proprietary Biotreatment |
| **Selected BMP Sizing Method** | Flow-Based Compact Biofiltration |
| DCV | DCV = C x d x A x 43560 sf/ac x 1/12 ft/in<br>Where:<br>DCV = design storm capture volume, cu-ft<br>C = runoff coefficient = (0.75 x imp + 0.15)<br>Imp = impervious fraction of drainage area (ranges from 0 to 1)<br>d = storm depth (inches)<br>A = tributary area (acres)<br>Imp = 0.85<br>d = 0.80 inches<br>A = 0.75<br>**DCV =** *(0.75 x 0.85 +0.15) x 0.80 inches x 0.75 ac x 43560 sf/ac x 1/12 ft/in*<br>**= 1,716 cu-ft** |
| $Q_{80\%}$ | $Q_{80\%}$= C x I x A<br>Where:<br>$Q_{80\%}$ = flow rate to achieve 80% capture, cfs<br>C = runoff coefficient = (0.75 x imp + 0.15)<br>I = Rainfall Intensity (in/hr)<br>A = tributary area (acres)<br>I = 0.26 (a conservative Tc of 5 min was used)<br>A = 0.75 |

| | |
|---|---|
| | $Q_{80\%}$ = *(0.75 x 0.85 +0.15) x 0.26 inches/hr x 0.75 ac*<br>**= 0.154 cfs**<br>*Refer to Attachment D for detailed calculations (Worksheet 9)* |
| $Q_{DESIGN}$ | $Q_{DESIGN}$= $Q_{80\%}$ x 150%<br>$Q_{DESIGN}$ =0.154 cfs x 1.5<br>**= 0.230 cfs** |
| **MWS Size/Model** | MWS-L-8-8 |
| **Treatment Capacity** | 0.231 cfs |

Since full/partial infiltration and harvest and reuse are considered infeasible in DMA 6, biotreatment BMPs (third priority structural LID BMPs) will be utilized on-site for water quality treatment. The project will implement a series of Modular Wetland System units for water quality treatment to treat all pollutants of concern to a medium to high level of effectiveness. The systems will include the Modular Wetlands Systems developed by Bio Clean Environmental Services, Inc. There are several advantages of the Modular Wetland System over traditional bioretention planters including the following reasons:

- Modular Wetlands are the only proprietary biotreatment device approved through the Washington State University TAPE (Technology Assessment Protocol – Ecology) program for basic storm water treatment and enhanced treatment including sediment, nutrients and heavy metals (all proposed pollutants of concern for the Upper Newport Bay). TAPE approval is based on a series of independent field studies using strict sampling criteria to validate vendor's claims. TAPE approval is considered one of the most stringent and most reliable in the country.
- Modular Wetlands have a pre-treatment chamber that is specifically designed to capture fine sediments and particulates through a series of BioMediaGREEN sponges which prohibit the fines and particulates from entering the bioretention chamber and accelerating potential clogging of the bioretention soil.
- Modular Wetland Systems are specifically designed for higher flow through treatment rates which reduce the potential for nutrient and copper leaching under more stagnant conditions (a common occurrence with planters that are left unmaintained).

Modular Wetlands by Modular Wetlands Systems, Inc. are proprietary biotreatment systems that utilize multi-stage treatment processes including screening media filtration, settling, and biofiltration. The pre-treatment chamber contains the first three stages of treatment, and includes a catch basin inlet filter to capture trash, debris, gross solids and sediments, a settling chamber for separating out larger solids, and a media filter cartridge for capturing fine TSS, metals, nutrients, and bacteria. Runoff then flows through the wetland chamber where treatment is achieved through a variety of physical, chemical, and biological processes. As storm water passes down through the planting soil, pollutants are filtered, adsorbed, biodegraded and sequestered by the soil and plants, functioning similar to bioretention systems. The discharge chamber at the end of the unit collects treated flows and discharges back into the storm drain system.

This system was selected based on its ability to treat the project's pollutants of concerns to a medium or high effectiveness, in accordance with the Model WQMP and TGD requirements. The table below summarizes the overall treatment effectiveness for Modular Wetlands, derived from the Technical Guidance Document and testing data provided by the manufacturer. Additional details for the Modular Wetland System are included in Attachment C of this WQMP.

| **POLLUTANTS OF CONCERN AND PERFORMANCE RATINGS** | | |
|---|---|---|
| **Pollutant of Concern (1)** | **Treatment Effectiveness** | |
| | **Bioretention System (2)** | **Modular Wetlands Proprietary Bioretention Units (3)** |
| Oil & Grease | High | High |
| Trash & Debris | High | High |
| Oxygen Demanding Substances | N/A | N/A |
| Toxic Organic Compounds | Medium | N/A(4) |
| **Primary Pollutant of Concern (303d listed impairments & TMDLs)** | | |
| Suspended Solids/Sediments | High | High |
| Nutrients | Low | Medium-High |
| Metals | High | High |
| Pathogens/Bacteria | Medium | Medium-High |
| Pesticides | N/A | N/A |

*Notes:*

21 See Section II.2.

22 Per Table 4.2 of the Model WQMP's companion Technical Guidance Document dated December 20, 2013.

23 Based on Washington State University Technology Assessment Protocol – Ecology (TAPE) third-party independent field tests for a high-flow biotreatment system with raised under drain (Modular Wetland System-Linear). Refer to manufacturer documentation (attached) for specific removal efficiencies and source references.

24 Field and Lab Testing demonstrates 75-83% removal rates of Chemical Oxygen Demand (COD), a measure of the amount of organic pollutants commonly found in surface water. COD removals of this range would fall within the Medium-High effectiveness category.

The MWS unit for DMA 6 has been sized with Worksheet 9 of the TGD for treatment of 1.5 times the 80% capture flowrate not retained onsite by LID BMPs, per guidelines from the 2017 TGD. Refer to Worksheet 9 in Attachment D for further calculation details.

## 5.7 LID BMPS IN DMA 7

### 5.7.1 Hydrologic Source Controls for DMA 7

Hydrologic Source Controls (HSC) are not proposed for DMA 7. The DCV for DMA 7 is addressed through a structural LID BMP (BIO-7: Proprietary Biotreatment).

## 5.7.2 Structural LID BMP for DMA 7

| STRUCTURAL LID BMP FOR DMA 7 | |
|---|---|
| **Infiltration Feasibility** | *Not feasible. See Section 3.1.2* |
| **Harvest and Use Feasibility** | *Not feasible. See Section 3.2.3* |
| **Selected BMP** | BIO-7: Proprietary Biotreatment |
| **Selected BMP Sizing Method** | Flow-Based Compact Biofiltration |
| DCV | DCV = C x d x A x 43560 sf/ac x 1/12 ft/in<br>Where:<br>DCV = design storm capture volume, cu-ft<br>C = runoff coefficient = (0.75 x imp + 0.15)<br>Imp = impervious fraction of drainage area (ranges from 0 to 1)<br>d = storm depth (inches)<br>A = tributary area (acres)<br>Imp = 0.85<br>d = 0.80 inches<br>A = 0.96<br>DCV = *(0.75 x 0.85 +0.15) x 0.80 inches x 0.96 ac x 43560 sf/ac x 1/12 ft/in*<br>= 2,197 cu-ft |
| $Q_{80\%}$ | $Q_{80\%}$= C x I x A<br>Where:<br>$Q_{80\%}$ = flow rate to achieve 80% capture, cfs<br>C = runoff coefficient = (0.75 x imp + 0.15)<br>I = Rainfall Intensity (in/hr)<br>A = tributary area (acres)<br>I = 0.26 (a conservative Tc of 5 min was used) |

| | |
|---|---|
| | A = 0.96<br>$Q_{80\%}$ = *(0.75 x 0.85 +0.15) x 0.26 inches/hr x 0.96 ac*<br>**= 0.197 cfs**<br>*Refer to Attachment D for detailed calculations (Worksheet 9)* |
| $Q_{DESIGN}$ | $Q_{DESIGN}$= $Q_{80\%}$ x 150%<br>$Q_{DESIGN}$ =0.197 cfs x 1.5<br>**= 0.295 cfs** |
| **MWS Size/Model** | MWS-L-8-12 |
| **Treatment Capacity** | 0.346 cfs |

Since full/partial infiltration and harvest and reuse are considered infeasible in DMA 7, biotreatment BMPs (third priority structural LID BMPs) will be utilized on-site for water quality treatment. The project will implement a series of Modular Wetland System units for water quality treatment to treat all pollutants of concern to a medium to high level of effectiveness. The systems will include the Modular Wetlands Systems developed by Bio Clean Environmental Services, Inc. There are several advantages of the Modular Wetland System over traditional bioretention planters including the following reasons:

- Modular Wetlands are the only proprietary biotreatment device approved through the Washington State University TAPE (Technology Assessment Protocol – Ecology) program for basic storm water treatment and enhanced treatment including sediment, nutrients and heavy metals (all proposed pollutants of concern for the Upper Newport Bay). TAPE approval is based on a series of independent field studies using strict sampling criteria to validate vendor's claims. TAPE approval is considered one of the most stringent and most reliable in the country.
- Modular Wetlands have a pre-treatment chamber that is specifically designed to capture fine sediments and particulates through a series of BioMediaGREEN sponges which prohibit the fines and particulates from entering the bioretention chamber and accelerating potential clogging of the bioretention soil.
- Modular Wetland Systems are specifically designed for higher flow through treatment rates which reduce the potential for nutrient and copper leaching under more stagnant conditions (a common occurrence with planters that are left unmaintained).

Modular Wetlands by Modular Wetlands Systems, Inc. are proprietary biotreatment systems that utilize multi-stage treatment processes including screening media filtration, settling, and biofiltration. The pre-treatment chamber contains the first three stages of treatment, and includes a catch basin inlet filter to capture trash, debris, gross solids and sediments, a settling chamber for separating out larger solids, and a media filter cartridge for capturing fine TSS, metals, nutrients, and bacteria. Runoff then flows through the wetland chamber where treatment is achieved through a variety of physical, chemical, and biological processes. As storm water passes down through the planting soil, pollutants are filtered, adsorbed, biodegraded and sequestered by the soil and plants, functioning similar to bioretention systems. The discharge chamber at the end of the unit collects treated flows and discharges back into the storm drain system.

This system was selected based on its ability to treat the project's pollutants of concerns to a medium or high effectiveness, in accordance with the Model WQMP and TGD requirements. The table below summarizes the overall treatment effectiveness for Modular Wetlands, derived from the Technical Guidance Document and testing data provided by the manufacturer. Additional details for the Modular Wetland System are included in Attachment C of this WQMP.

**POLLUTANTS OF CONCERN AND PERFORMANCE RATINGS**

| **Pollutant of Concern** (1) | **Treatment Effectiveness** | |
|---|---|---|
| | **Bioretention System** (2) | **Modular Wetlands Proprietary Bioretention Units** (3) |
| Oil & Grease | High | High |
| Trash & Debris | High | High |
| Oxygen Demanding Substances | N/A | N/A |
| Toxic Organic Compounds | Medium | N/A(4) |
| **Primary Pollutant of Concern (303d listed impairments & TMDLs)** | | |
| Suspended Solids/Sediments | High | High |
| Nutrients | Low | Medium-High |
| Metals | High | High |
| Pathogens/Bacteria | Medium | Medium-High |
| Pesticides | N/A | N/A |

*Notes:*

25 See Section II.2.

26 Per Table 4.2 of the Model WQMP's companion Technical Guidance Document dated December 20, 2013.

27 Based on Washington State University Technology Assessment Protocol – Ecology (TAPE) third-party independent field tests for a high-flow biotreatment system with raised under drain (Modular Wetland System-Linear). Refer to manufacturer documentation (attached) for specific removal efficiencies and source references.

28 Field and Lab Testing demonstrates 75-83% removal rates of Chemical Oxygen Demand (COD), a measure of the amount of organic pollutants commonly found in surface water. COD removals of this range would fall within the Medium-High effectiveness category.

The MWS unit for DMA 7 has been sized with Worksheet 9 of the TGD for treatment of 1.5 times the 80% capture flowrate not retained onsite by LID BMPs, per guidelines from the 2017 TGD. Refer to Worksheet 9 in Attachment D for further calculation details.

## 5.8 SUMMARY OF LID BMPS

| MODULAR WETLAND SYSTEM UNIT DESIGN SUMMARY | | | | | | |
|---|---|---|---|---|---|---|
| DMA | Total Drainage Area (ac) | % Imp. | $Q_{80\%}$ | $Q_{DESIGN}$ | Size/Model | Total Treatment Capacity |
| DMA 1 | 0.99 | 85% | 0.203 | 0.304 | MWS-L-8-12 | 0.346 |
| DMA 2 | 0.90 | 85% | 0.184 | 0.277 | MWS-L-8-12 | 0.346 |
| DMA 3 | 0.41 | 85% | 0.084 | 0.126 | MWS-L-4-13 | 0.144 |
| DMA 4 | 0.42 | 85% | 0.086 | 0.129 | MWS-L-4-13 | 0.144 |
| DMA 5 | 1.09 | 85% | 0.223 | 0.335 | MWS-L-8-16 | 0.462 |
| DMA 6 | 0.75 | 85% | 0.154 | 0.230 | MWS-L-8-8 | 0.231 |
| DMA 7 | 0.96 | 85% | 0.197 | 0.295 | MWS-L-8-12 | 0.346 |

# SECTION 6 HYDROMODIFICATION BMPS

## 6.1 POINTS OF COMPLIANCE

Not Applicable. Refer to Section 3.5.

## 6.2 PRE-DEVELOPMENT (NATURAL) CONDITIONS

Not Applicable. Refer to Section 3.5.

## 6.3 POST-DEVELOPMENT CONDITIONS AND HYDROMODIFICATION BMPS

Not Applicable. Refer to Section 3.5.

## 6.4 MEASURES FOR AVOIDANCE OF CRITICAL COARSE SEDIMENT YIELD AREAS

Not Applicable. Refer to Section 3.5.

## 6.5 HYDROLOGIC MODELING AND HYDROMODIFICATION COMPLIANCE

Not Applicable. Refer to Section 3.5.

# SECTION 7 EDUCATIONAL MATERIALS INDEX

| EDUCATION MATERIALS | | | |
|---|---|---|---|
| **Residential Materials (http://www.ocwatersheds.com)** | **Check if Applicable** | **Business Materials (http://www.ocwatersheds.com)** | **Check if Applicable** |
| The Ocean Begins at Your Front Door | ☒ | Tips for the Automotive Industry | ☐ |
| Tips for Car Wash Fund-raisers | ☐ | Tips for Using Concrete and Mortar | ☐ |
| Tips for the Home Mechanic | ☐ | Tips for the Food Service Industry | ☐ |
| Household Tips | ☒ | Proper Maintenance Practices for Your Business | ☐ |
| Homeowners Guide for Sustainable Water Use | ☒ | Compliance BMPs for Mobile Businesses | ☐ |
| Proper Disposal of Household Hazardous Waste | ☒ | **Other Materials** | **Check if Attached** |
| Recycle at Your Local Used Oil Collection Center (North County) | ☐ | DF-1 Drainage System Operation & Maintenance | ☒ |
| Recycle at Your Local Used Oil Collection Center (Central County) | ☐ | R-1 Automobile Repair & Maintenance | ☐ |
| Recycle at Your Local Used Oil Collection Center (South County) | ☒ | R-2 Automobile Washing | ☐ |
| Tips for Maintaining a Septic Tank System | ☐ | R-3 Automobile Parking | ☒ |
| Responsible Pest Control | ☒ | R-4 Home & Garden Care Activities | ☒ |
| Sewer Spill | ☐ | R-5 Disposal of Pet Waste | ☒ |
| Tips for the Home Improvement Projects | ☐ | R-6 Disposal of Green Waste | ☒ |
| Tips for Horse Care | ☐ | R-7 Household Hazardous Waste | ☒ |
| Tips for Landscaping and Gardening | ☒ | R-8 Water Conservation | ☒ |
| Tips for Pet Care | ☒ | SD-10 Site Design & Landscape Planning | ☒ |
| Tips for Pool Maintenance | ☒ | SD-11 Roof Runoff Controls | ☐ |
| Tips for Residential Pool, Landscape and Hardscape Drains | ☒ | SD-12 Efficient Irrigation | ☒ |
| Tips for Projects Using Paint | ☐ | SD-13 Storm Drain Signage | ☒ |
| Other: | ☐ | SD-31 Maintenance Bays & Docks | ☐ |

# ATTACHMENTS

# ATTACHMENT A

## EDUCATION MATERIALS

## Did You Know?

- Most people believe that the largest source of water pollution in urban areas comes from specific sources such as factories and sewage treatment plants. In fact, the largest source of water pollution comes from city streets, neighborhoods, construction sites and parking lots. This type of pollution is sometimes called "non-point source" pollution.
- There are two types of non-point source pollution: stormwater and urban runoff pollution.
- Stormwater runoff results from rainfall. When rainstorms cause large volumes of water to rinse the urban landscape, picking up pollutants along the way.
- Urban runoff can happen any time of the year when excessive water use from irrigation, vehicle washing and other sources carries trash, lawn clippings and other urban pollutants into storm drains.

## Where Does It Go?

- Anything we use outside homes, vehicles and businesses – like motor oil, paint, pesticides, fertilizers and cleaners – can be blown or washed into storm drains.
- A little water from a garden hose or rain can also send materials into storm drains.
- Storm drains are separate from our sanitary sewer systems; unlike water in sanitary sewers (from sinks or toilets), water in storm drains is not treated before entering our waterways.

## Sources of Non-Point Source Pollution

- Automotive leaks and spills.
- Improper disposal of used oil and other engine fluids.
- Metals found in vehicle exhaust, weathered paint, rust, metal plating and tires.
- Pesticides and fertilizers from lawns, gardens and farms.
- Improper disposal of cleaners, paint and paint removers.
- Soil erosion and dust debris from landscape and construction activities.
- Litter, lawn clippings, animal waste, and other organic matter.
- Oil stains on parking lots and paved surfaces.

## The Effect on the Ocean

Non-point source pollution can have a serious impact on water quality in Orange County. Pollutants from the storm drain system can harm marine life as well as coastal and wetland habitats. They can also degrade recreation areas such as beaches, harbors and bays.

Stormwater quality management programs have been developed throughout Orange County to educate and encourage the public to protect water quality, monitor runoff in the storm drain system, investigate illegal dumping and maintain storm drains.

Support from Orange County residents and businesses is needed to improve water quality and reduce urban runoff pollution. Proper use and disposal of materials will help stop pollution before it reaches the storm drain and the ocean.

*Even if you live miles from the Pacific Ocean, you may be unknowingly polluting it.*

*Dumping one quart of motor oil into a storm drain can contaminate 250,000 gallons of water.*

## For More Information

**California Environmental Protection Agency**
www.calepa.ca.gov

- **Air Resources Board**
  www.arb.ca.gov
- **Department of Pesticide Regulation**
  www.cdpr.ca.gov
- **Department of Toxic Substances Control**
  www.dtsc.ca.gov
- **Integrated Waste Management Board**
  www.ciwmb.ca.gov
- **Office of Environmental Health Hazard Assessment**
  www.oehha.ca.gov
- **State Water Resources Control Board**
  www.waterboards.ca.gov

**Earth 911** - Community-Specific Environmental Information 1-800-cleanup or visit www.1800cleanup.org

**Health Care Agency's Ocean and Bay Water Closure and Posting Hotline**
(714) 433-6400 or visit www.ocbeachinfo.com

**Integrated Waste Management Dept. of Orange County** (714) 834-6752 or visit www.oclandfills.com for information on household hazardous waste collection centers, recycling centers and solid waste collection

**O.C. Agriculture Commissioner**
(714) 447-7100 or visit www.ocagcomm.com

**Stormwater Best Management Practice Handbook**
Visit www.cabmphandbooks.com

**UC Master Gardener Hotline**
(714) 708-1646 or visit www.uccemg.com

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The Orange County Stormwater Program has created and moderates an electronic mailing list to facilitate communications, take questions and exchange ideas among its users about issues and topics related to stormwater and urban runoff and the implementation of program elements. To join the list, please send an email to ocstormwaterinfo-join@list.ocwatersheds.com

**Orange County Stormwater Program**

| | | |
|---|---|---|
| Aliso Viejo | (949) | 425-2535 |
| Anaheim Public Works Operations | (714) | 765-6860 |
| Brea Engineering | (714) | 990-7666 |
| Buena Park Public Works | (714) | 562-3655 |
| Costa Mesa Public Services | (714) | 754-5323 |
| Cypress Public Works | (714) | 229-6740 |
| Dana Point Public Works | (949) | 248-3584 |
| Fountain Valley Public Works | (714) | 593-4441 |
| Fullerton Engineering Dept. | (714) | 738-6853 |
| Garden Grove Public Works | (714) | 741-5956 |
| Huntington Beach Public Works | (714) | 536-5431 |
| Irvine Public Works | (949) | 724-6315 |
| La Habra Public Services | (562) | 905-9792 |
| La Palma Public Works | (714) | 690-3310 |
| Laguna Beach Water Quality | (949) | 497-0378 |
| Laguna Hills Public Services | (949) | 707-2650 |
| Laguna Niguel Public Works | (949) | 362-4337 |
| Laguna Woods Public Works | (949) | 639-0500 |
| Lake Forest Public Works | (949) | 461-3480 |
| Los Alamitos Community Dev. | (562) | 431-3538 |
| Mission Viejo Public Works | (949) | 470-3056 |
| Newport Beach, Code & Water Quality Enforcement | (949) | 644-3215 |
| Orange Public Works | (714) | 532-6480 |
| Placentia Public Works | (714) | 993-8245 |
| Rancho Santa Margarita | (949) | 635-1800 |
| San Clemente Environmental Programs | (949) | 361-6143 |
| San Juan Capistrano Engineering | (949) | 234-4413 |
| Santa Ana Public Works | (714) | 647-3380 |
| Seal Beach Engineering | (562) | 431-2527 x317 |
| Stanton Public Works | (714) | 379-9222 x204 |
| Tustin Public Works/Engineering | (714) | 573-3150 |
| Villa Park Engineering | (714) | 998-1500 |
| Westminster Public Works/Engineering | (714) | 898-3311 x446 |
| Yorba Linda Engineering | (714) | 961-7138 |
| Orange County Stormwater Program | (877) | 897-7455 |

Orange County 24-Hour
Water Pollution Problem Reporting Hotline
1-877-89-SPILL (1-877-897-7455)

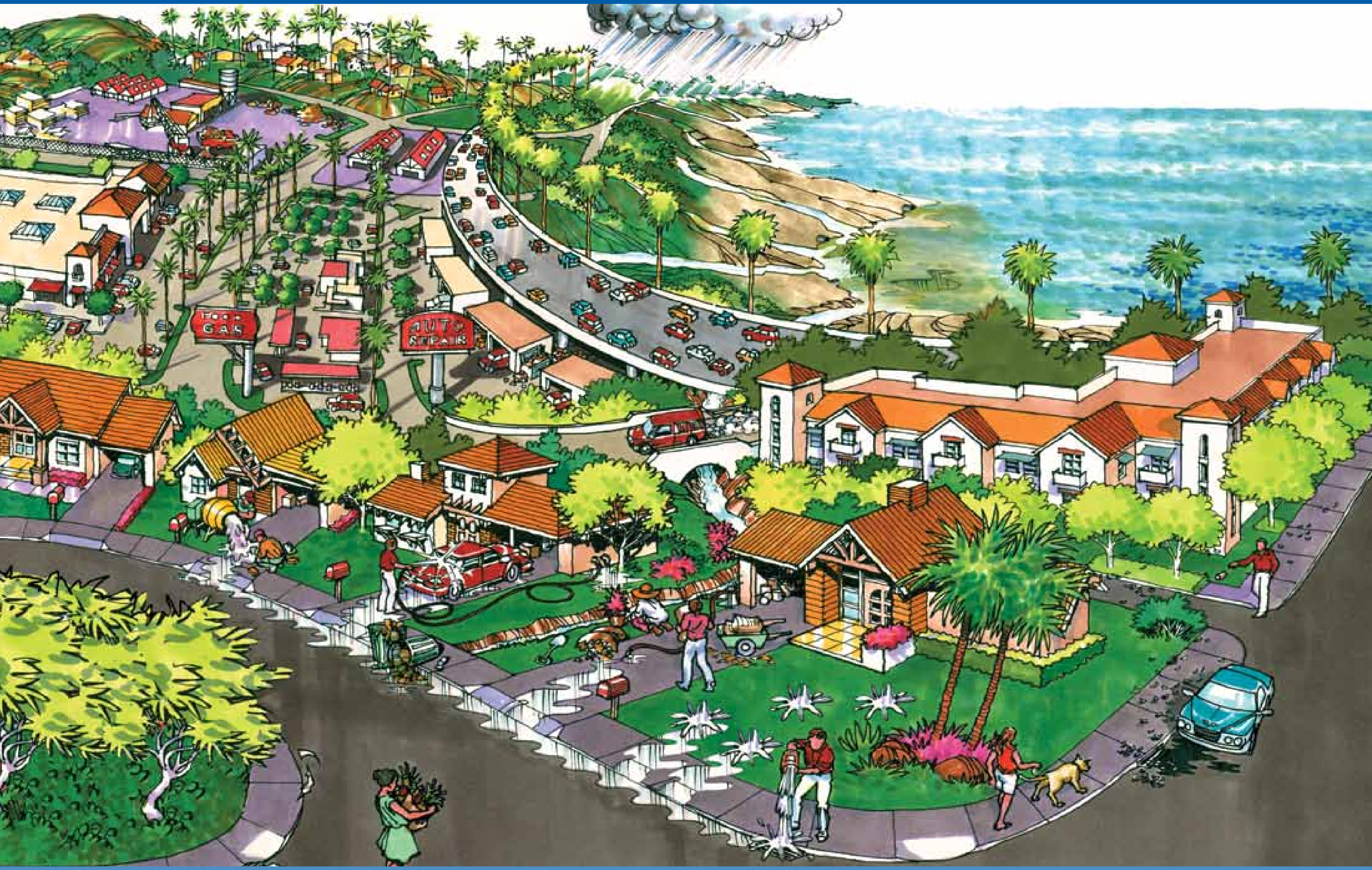
On-line Water Pollution Problem Reporting Form
www.ocwatersheds.com

Printed on Recycled Paper

# The Ocean Begins at Your Front Door

PROJECT POLLUTION PREVENTION

# The Ocean Begins at Your Front Door



*Never allow pollutants to enter the street, gutter or storm drain!*

Follow these simple steps to help reduce water pollution:

## *Household Activities*

- Do not rinse spills with water. Use dry cleanup methods such as applying cat litter or another absorbent material, sweep and dispose of in the trash. Take items such as used or excess batteries, oven cleaners, automotive fluids, painting products and cathode ray tubes, like TVs and computer monitors, to a Household Hazardous Waste Collection Center (HHWCC).
- For a HHWCC near you call (714) 834-6752 or visit www.oclandfills.com.
- Do not hose down your driveway, sidewalk or patio to the street, gutter or storm drain. Sweep up debris and dispose of it in the trash.

## *Automotive*

- Take your vehicle to a commercial car wash whenever possible. If you wash your vehicle at home, choose soaps, cleaners, or detergents labeled non-toxic, phosphate- free or biodegradable. Vegetable and citrus-based products are typically safest for the environment.
- Do not allow washwater from vehicle washing to drain into the street, gutter or storm drain. Excess washwater should be disposed of in the sanitary sewer (through a sink or toilet) or onto an absorbent surface like your lawn.
- Monitor your vehicles for leaks and place a pan under leaks. Keep your vehicles well maintained to stop and prevent leaks.
- Never pour oil or antifreeze in the street, gutter or storm drain. Recycle these substances at a service station, a waste oil collection center or used oil recycling center. For the nearest Used Oil Collection Center call 1-800-CLEANUP or visit www.1800cleanup.org.

## *Pool Maintenance*

- Pool and spa water must be dechlorinated and free of excess acid, alkali or color to be allowed in the street, gutter or storm drain.
- When it is not raining, drain dechlorinated pool and spa water directly into the sanitary sewer.
- Some cities may have ordinances that do not allow pool water to be disposed of in the storm drain. Check with your city.

## *Landscape and Gardening*

- Do not over-water. Water your lawn and garden by hand to control the amount of water you use or set irrigation systems to reflect seasonal water needs. If water flows off your yard onto your driveway or sidewalk, your system is over-watering. Periodically inspect and fix leaks and misdirected sprinklers.
- Do not rake or blow leaves, clippings or pruning waste into the street, gutter or storm drain. Instead, dispose of waste by composting, hauling it to a permitted landfill, or as green waste through your city's recycling program.
- Follow directions on pesticides and fertilizer, (measure, do not estimate amounts) and do not use if rain is predicted within 48 hours.
- Take unwanted pesticides to a HHWCC to be recycled. For locations and hours of HHWCC, call (714) 834-6752 or visit www.oclandfills.com.

## *Trash*

- Place trash and litter that cannot be recycled in securely covered trash cans.
- Whenever possible, buy recycled products.
- Remember: Reduce, Reuse, Recycle.

## *Pet Care*

- Always pick up after your pet. Flush waste down the toilet or dispose of it in the trash. Pet waste, if left outdoors, can wash into the street, gutter or storm drain.
- If possible, bathe your pets indoors. If you must bathe your pet outside, wash it on your lawn or another absorbent/permeable surface to keep the washwater from entering the street, gutter or storm drain.
- Follow directions for use of pet care products and dispose of any unused products at a HHWCC.

## *Common Pollutants*

### *Home Maintenance*

- Detergents, cleaners and solvents
- Oil and latex paint
- Swimming pool chemicals
- Outdoor trash and litter

### *Lawn and Garden*

- Pet and animal waste
- Pesticides
- Clippings, leaves and soil
- Fertilizer

### *Automobile*

- Oil and grease
- Radiator fluids and antifreeze
- Cleaning chemicals
- Brake pad dust

***Do your part to prevent water pollution in our creeks, rivers, bays and ocean.***

Clean beaches and healthy creeks, rivers, bays, and ocean are important to Orange County. However, many common household activities can lead to water pollution if you're not careful.

Litter, oil, chemicals and other substances that are left on your yard or driveway can be blown or washed into storm drains that flow to the ocean. Over-watering your lawn and washing your car can also flush materials into the storm drains. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated.

*REMEMBER THE WATER IN YOUR STORM DRAIN IS NOT TREATED BEFORE IT ENTERS OUR WATERWAYS*

You would never pour soap, fertilizers or oil into the ocean, so don't let them enter streets, gutters or storm drains. Follow the easy tips in this brochure to help prevent water pollution.

For more information,
please call the
**Orange County Stormwater Program**
at **1-877-89-SPILL** (1-877-897-7455)
or visit
**www.ocwatersheds.com**

To report a spill,
call the
**Orange County 24-Hour Water Pollution Problem Reporting Hotline**
**1-877-89-SPILL** (1-877-897-7455).

**For emergencies, dial 911.**

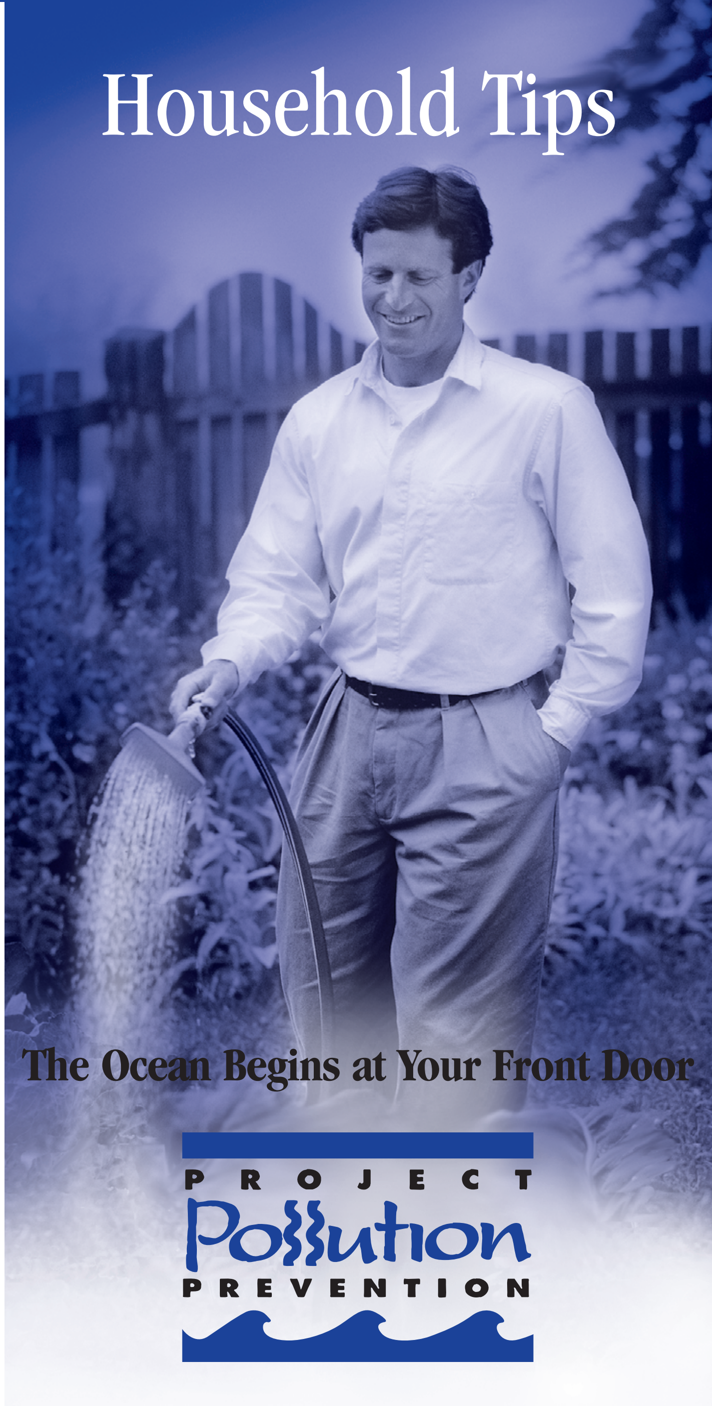
The tips contained in this brochure provide useful information to help prevent water pollution while performing everyday household activities. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

GENUINE RECYCLED PAPER
50% PRE-CONSUMER AND 15% POST-CONSUMER

RECYCLE USED OIL

# Help Prevent Ocean Pollution:

# Household Tips



**The Ocean Begins at Your Front Door**

PROJECT
Pollution
PREVENTION

# Pollution Prevention

## *Household Activities*

- **Do not rinse spills with water!** Sweep outdoor spills and dispose of in the trash. For wet spills like oil, apply cat litter or another absorbent material, then sweep and bring to a household hazardous waste collection center (HHWCC).
- Securely cover trash cans.
- Take household hazardous waste to a household hazardous waste collection center.
- Store household hazardous waste in closed, labeled containers inside or under a cover.
- Do not hose down your driveway, sidewalk or patio. Sweep up debris and dispose of in trash.
- Always pick up after your pet. Flush waste down the toilet or dispose of in the trash.
- Bathe pets indoors or have them professionally groomed.

## *Household Hazardous Wastes include:*

- ▲ **Batteries**
- ▲ **Paint thinners, paint strippers and removers**
- ▲ **Adhesives**
- ▲ **Drain openers**
- ▲ **Oven cleaners**
- ▲ **Wood and metal cleaners and polishes**
- ▲ **Herbicides and pesticides**
- ▲ **Fungicides/wood preservatives**
- ▲ **Automotive fluids and products**
- ▲ **Grease and rust solvents**
- ▲ **Thermometers and other products containing mercury**
- ▲ **Fluorescent lamps**
- ▲ **Cathode ray tubes, e.g. TVs, computer monitors**
- ▲ **Pool and spa chemicals**

## *Gardening Activities*

- Follow directions on pesticides and fertilizers, (measure, do not estimate amounts) and do not use if rain is predicted within 48 hours.
- Water your lawn and garden by hand to control the amount of water you use. Set irrigation systems to reflect seasonal water needs. If water flows off your yard and onto your driveway or sidewalk, your system is over-watering.
- Mulch clippings or leave them on the lawn. If necessary, dispose in a green waste container.
- Cultivate your garden often to control weeds.

## *Washing and Maintaining Your Car*

- Take your car to a commercial car wash whenever possible.
- Choose soaps, cleaners, or detergents labeled "non-toxic," "phosphate free" or "biodegradable." Vegetable and citrus-based products are typically safest for the environment, **but even these should not be allowed into the storm drain.**
- Shake floor mats into a trash can or vacuum to clean.
- Do not use acid-based wheel cleaners and "hose off" engine degreasers at home. They can be used at a commercial facility, which can properly process the washwater.
- **Do not dump washwater onto your driveway, sidewalk, street, gutter or storm drain.** Excess washwater should be disposed of in the sanitary sewers (through a sink, or toilet) or onto an absorbent surface like your lawn.
- Use a nozzle to turn off water when not actively washing down automobile.
- Monitor vehicles for leaks and place pans under leaks. Keep your car well maintained to stop and prevent leaks.
- Use cat litter or other absorbents and sweep to remove any materials deposited by vehicles. Contain sweepings and dispose of at a HHWCC.
- Perform automobile repair and maintenance under a covered area and use drip pans or plastic sheeting to keep spills and waste material from reaching storm drains.
- **Never pour oil or antifreeze in the street, gutter or storm drains.** Recycle these substances at a service station, HHWCC, or used oil recycling center. For the nearest Used Oil Collection Center call 1-800-CLEANUP or visit www.ciwmb.ca.gov/UsedOil.

*For locations and hours of Household Hazardous Waste Collection Centers in Anaheim, Huntington Beach, Irvine and San Juan Capistrano, call (714)834-6752 or visit www.oclandfills.com.*

## The Pollution Solution

Several residential activities can result in water pollution. Among these activities are car washing and hosing off driveways and sidewalks. Both activities can waste water and result in excess runoff. Water conservation methods described in this pamphlet can prevent considerable amounts of runoff and conserve water. By taking your car to a commercial car wash and by sweeping driveways and sidewalks, you can further prevent the transport of pollutants to Orange County waterways. Here are some of the common pollutants for which you can be part of the solution:

### 1 Pesticides and Fertilizer

- **Pollution:** The same pesticides that are designed to be toxic to pests can have an equally lethal impact on our marine life. The same fertilizer that promotes plant growth in lawns and gardens can also create nuisance algae blooms, which remove oxygen from the water and clog waterways when it decomposes.
- **Solution:** Never use pesticides or fertilizer within 48 hours of an anticipated rainstorm. Use only as much as is directed on the label and keep it off driveways and sidewalks.

### 2 Dirt and Sediment

- **Pollution:** Dirt or sediment can impede the flow of the stormwater and negatively impact stream habitat as it travels through waterways and deposits downstream. Pollutants can attach to sediment, which can then be transported through our waterways.
- **Solution:** Protect dirt stockpiles by covering them with tarps or secure plastic sheets to prevent wind or rain from allowing dirt or sediment to enter the storm drain system.

### 3 Metals

- **Pollution:** Metals and other toxins present in car wash water can harm important plankton, which forms the base of the aquatic food chain.
- **Solution:** Take your car to a commercial car wash where the wash water is captured and treated at a local wastewater treatment plant.

**DID YOU KNOW?**

***Did you know that most of the pollution found in our waterways is not from a single source, but from a "non-point" source meaning the accumulation of pollution from residents and businesses throughout the community***

### 4 Pet Waste

- **Pollution:** Pet waste carries bacteria through our watersheds and eventually will be washed out to the ocean. This can pose a health risk to swimmers and surfers.
- **Solution:** Pick up after your pets!

### 5 Trash and Debris

- **Pollution:** Trash and debris can enter waterways by wind, littering and careless maintenance of trash receptacles. Street sweeping collects some of this trash; however, much of what isn't captured ends up in our storm drain system where it flows untreated out to the ocean.
- **Solution:** Don't litter and make sure trash containers are properly covered. It is far more expensive to clean up the litter and trash that ends up in our waterways than it is to prevent it in the first place. Come out to one of Orange County's many locations for Coastal and Inner-Coastal Cleanup Day, which is held in September.

### 6 Motor Oil / Vehicle Fluids

- **Pollution:** Oil and petroleum products from our vehicles are toxic to people, wildlife and plants.
- **Solution:** Fix any leaks from your vehicle and keep the maintenance up on your car. Use absorbent material such as cat litter on oil spills, then sweep it up and dispose of it in the trash. Recycle used motor oil at a local Household Hazardous Waste Collection Center.

## A TEAM EFFORT

The Orange County Stormwater Program has teamed with the Municipal Water District of Orange County (MWDOC) and the University of California Cooperative Extension Program (UCCE) to develop this pamphlet.

Low Impact Development (LID) and sustainable water use prevents water pollution and conserves water for drinking and reuse. Reducing your water use and the amount of water flowing from your home protects the environment and saves you money.

## Thank you for making water protection a priority!

For more information, please visit www.ocwatersheds.com/publiced/

www.mwdoc.com

www.uccemg.com

ORANGE COUNTY PublicWorks
Our Community. Our Commitment.
Jess A. Carbajal, Executive Director
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The Ocean Begins at Your Front Door
www.ocwatersheds.com | Report a spill 1.877.89.SPILL

Stormwater 101 | Residents | Kid's Corner | Business | Schools | News/Events | Resources | STORMWATER IQ QUIZ | USED OIL LOCATIONS | CONTACTS

The Public Education section of the Orange County Stormwater Program website is filled with information, interactive games, video and radio public service announcements and issue-specific brochures for you to learn more about water pollution prevention.

Click here to find out about Earth Day events in your community.

It's easy to protect our waterways from pollution. Click here to learn how!

OC WATERSHEDS CLICK HERE FOR MORE INFORMATION | KID'S CORNER Click. Play. Learn. | ESPAÑOL/NGUOI VIET Multi-Cultural Resources Click Here | STAY INFORMED Fill out our form to get news and events | Jump To Our Contact Form

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To report a spill, call the Orange County 24-Hour Water Pollution Prevention Reporting Hotline
at 1-877-89-SPILL \ (1-877-897-7455)

**Special Thanks to**
The City of Los Angeles Stormwater Program for the use of its artwork

The Metropolitan Water District of Southern California for the use of the California-Friendly Plant and Native Habitat photos

PROJECT Pollution PREVENTION | UCCE University of California | MUNICIPAL WATER DISTRICT OF ORANGE COUNTY

# Homeowners Guide for Sustainable Water Use

## Low Impact Development, Water Conservation & Pollution Prevention

The Ocean Begins at Your Front Door

PROJECT Pollution PREVENTION | UCCE University of California | MUNICIPAL WATER DISTRICT OF ORANGE COUNTY

# RUNOFF, RAINWATER AND REUSE

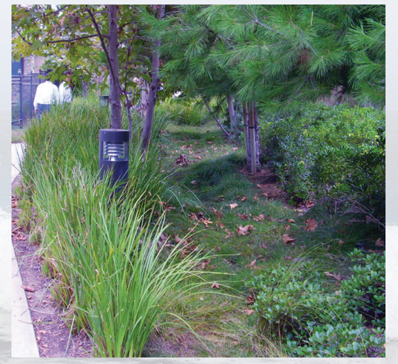
## Where Does Water Runoff Go?

Stormwater, or water from rainfall events, and runoff from outdoor water use such as sprinklers and hoses flows from homes directly into catch basins and the storm drain system. After entering the storm drain, the water flows untreated into streams, rivers, bays and ultimately the Pacific Ocean. Runoff can come from lawns, gardens, driveways, sidewalks and roofs. As it flows over hard, impervious surfaces, it picks up pollutants. Some pollutants carried by the water runoff include trash, pet waste, pesticides, fertilizer, motor oil and more.

## Water Conservation

Pollution not only impairs the water quality for habitat and recreation, it can also reduce the water available for reuse. Runoff allowed to soak into the ground is cleaned as it percolates through the soil, replenishing depleted groundwater supplies. Groundwater provides at least 50% of the total water for drinking and other indoor household activities in north and central Orange County. When land is covered with roads, parking lots, homes, etc., there is less land to take in the water and more hard surfaces over which the water can flow.

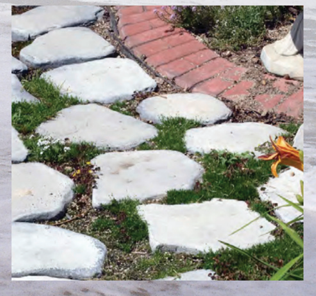
In Orange County, 60-70% of water used by residents and businesses goes to irrigation and other outdoor uses. Reusing rainwater to irrigate our lawn not only reduces the impact of water pollution from runoff, but it also is a great way to conserve our precious water resources and replenish our groundwater basin.



### What is Low Impact Development (LID)?

Low Impact Development (LID) is a method of development that seeks to maintain the natural hydrologic character of an area. LID provides a more sustainable and pollution-preventative approach to water management.

New water quality regulations require implementation of LID in larger new developments and encourage implementation of LID and other sustainable practices in existing residential areas. Implementing modifications to your lawn or garden can reduce pollution in our environment, conserve water and reduce your water bill.



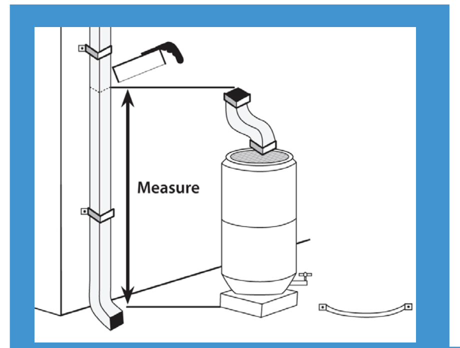
Permeable pavement allows water runoff to infiltrate through the soil and prevents most pollutants from reaching the storm drain system.

# OPTIONS FOR RAINWATER HARVESTING AND REUSE

Rainwater harvesting is a great way to save money, prevent pollution and reduce potable water use. To harvest your rainwater, simply redirect the runoff from roofs and downspouts to rain barrels. Rain gardens are another option; these reduce runoff as well as encourage infiltration.

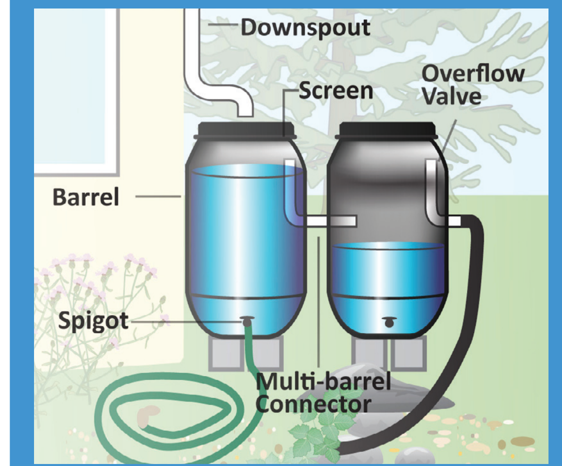
## Downspout Disconnection/Redirection

Disconnecting downspouts from pipes running to the gutter prevents runoff from transporting pollutants to the storm drain. Once disconnected, downspouts can be redirected to rain gardens or other vegetated areas, or be connected to a rain barrel.



## Rain Barrels

Rain barrels capture rainwater flow from roofs for reuse in landscape irrigation. Capacity of rain barrels needed for your home will depend on the amount of roof area and rainfall received. When purchasing your rain barrel, make sure it includes a screen, a spigot to siphon water for use, an overflow tube to allow for excess water to run out and a connector if you wish to connect multiple barrels to add capacity of water storage.

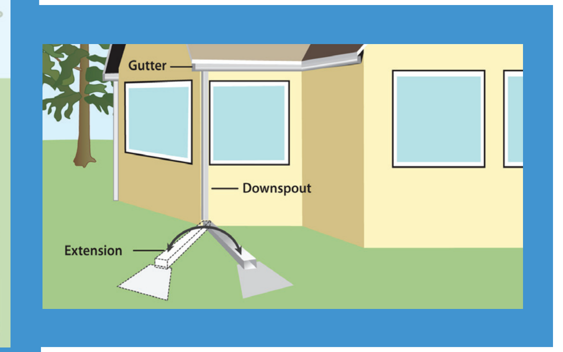


Mosquito growth prevention is very important when installing a rain barrel. The best way to prevent mosquito breeding is to eliminate entry points by ensuring all openings are sealed tightly. If these methods are unsuccessful, products are available to kill mosquito larvae, but that are harmless to animals and humans. Regular application of these products is essential. Please visit the Orange County Vector Control website for more information at www.ocvcd.org/mosquitoes3.php.

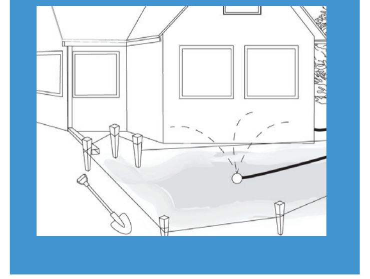
## Rain Gardens

Rain gardens allow runoff to be directed from your roof downspout into a landscaped area. Vegetation and rocks in the garden will slow the flow of water to allow for infiltration into the soil. Plants and soil particles will absorb pollutants from the roof runoff. By utilizing a native plant palate, rain gardens can be maintained all year with minimal additional irrigation. These plants are adapted to the semi-arid climate of Southern California, require less water and can reduce your water bill.

Before modifying your yard to install a rain garden, please consult your local building and/or planning departments to ensure your garden plan follows pertinent building codes and ordinances. Besides codes and ordinances, some home owner associations also have guidelines for yard modifications. If your property is in hill areas or includes engineered slopes, please seek professional advice before proceeding with changes.



For information on how to disconnect a downspout or to install and maintain a rain barrel or rain garden at your home, please see the Los Angeles Rainwater Harvesting Program, A Homeowner's "How-To" Guide, November 2009 at www.larainwaterharvesting.org/



# OTHER WATER CONSERVATION AND POLLUTION PREVENTION TECHNIQUES

## Native Vegetation and Maintenance

"California Friendly" plants or native vegetation can significantly reduce water use. These plants often require far less fertilizers and pesticides, which are two significant pollutants found in Orange County waterways. Replacing water "thirsty" plants and grass types with water efficient natives is a great way to save water and reduce the need for potentially harmful pesticides and fertilizer.

Please see the California Friendly Garden Guide produced by the Metropolitan Water District of Southern California and associated Southern California Water Agencies for a catalog of California friendly plants and other garden resources at www.bewaterwise.com/Gardensoft.

## Weed Free Yards

Weeds are water thieves. They often reproduce quickly and rob your yard of both water and nutrients. Weed your yard by hand if possible. If you use herbicides to control the weeds, use only the amount recommended on the label and never use it if rain is forecast within the next 48 hours.

## Soil Amendments

Soil amendments such as green waste (e.g. grass clippings, compost, etc.) can be a significant source of nutrients and can help keep the soil near the roots of plants moist. However, they can cause algal booms if they get into our waterways, which reduces the amount of oxygen in the water and impacts most aquatic organisms. It is important to apply soil amendments more than 48 hours prior to predicted rainfall.

# IRRIGATE EFFICIENTLY

Water runoff from sprinklers left on too long will carry pollutants into our waterways.

## Smart Irrigation Controllers

Smart Irrigation Controllers have internal clocks as well as sensors that will turn off the sprinklers in response to environmental changes. If it is raining, too windy or too cold, the smart irrigation control sprinklers will automatically shut off.

Check with your local water agency for available rebates on irrigation controllers and smart timers.

- Aim your sprinklers at your lawn, not the sidewalk – By simply adjusting the direction of your sprinklers you can save water, prevent water pollution from runoff, keep your lawn healthy and save money.
- **Set a timer for your sprinklers** – lawns absorb the water they need to stay healthy within a few minutes of turning on the sprinklers. Time your sprinklers; when water begins running off your lawn, you can turn them off. Your timer can be set to water your lawn for this duration every time.
- **Water at Sunrise** – Watering early in the morning will reduce water loss due to evaporation. Additionally, winds tend to die down in the early morning so the water will get to the lawn as intended.
- **Water by hand** – Instead of using sprinklers, consider watering your yard by hand. Hand-watering ensures that all plants get the proper amount of water and you will prevent any water runoff, which wastes water and carries pollutants into our waterways.
- **Fix leaks** - Nationwide, households waste one trillion gallons of water a year to leaks – that is enough water to serve the entire state of Texas for a year. If your garden hose is leaking, replace the nylon or rubber hose washer and ensure a tight connection. Fix broken sprinklers immediately.

*Do your part to prevent water pollution in our creeks, rivers, bays and ocean.*

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, not properly disposing of household hazardous waste can lead to water pollution. Batteries, electronics, paint, oil, gardening chemicals, cleaners and other hazardous materials cannot be thrown in the trash. They also must never be poured or thrown into yards, sidewalks, driveways, gutters or streets. Rain or other water could wash the materials into the storm drain and eventually into our waterways and the ocean. In addition, hazardous waste must not be poured in the sanitary sewers (sinks and toilets).

***NEVER DISPOSE OF HOUSEHOLD HAZARDOUS WASTE IN THE TRASH, STREET, GUTTER, STORM DRAIN OR SEWER.***

For more information,
please call the
**Orange County Stormwater Program**
at **1-877-89-SPILL** (1-877-897-7455)
or visit
**www.ocwatersheds.com**

**To Report Illegal Dumping of Household Hazardous Waste call 1-800-69-TOXIC**

To report a spill,
call the
**Orange County 24-Hour Water Pollution Problem Reporting Hotline**
**1-877-89-SPILL** (1-877-897-7455).

**For emergencies, dial 911.**

RECYCLE
USED OIL

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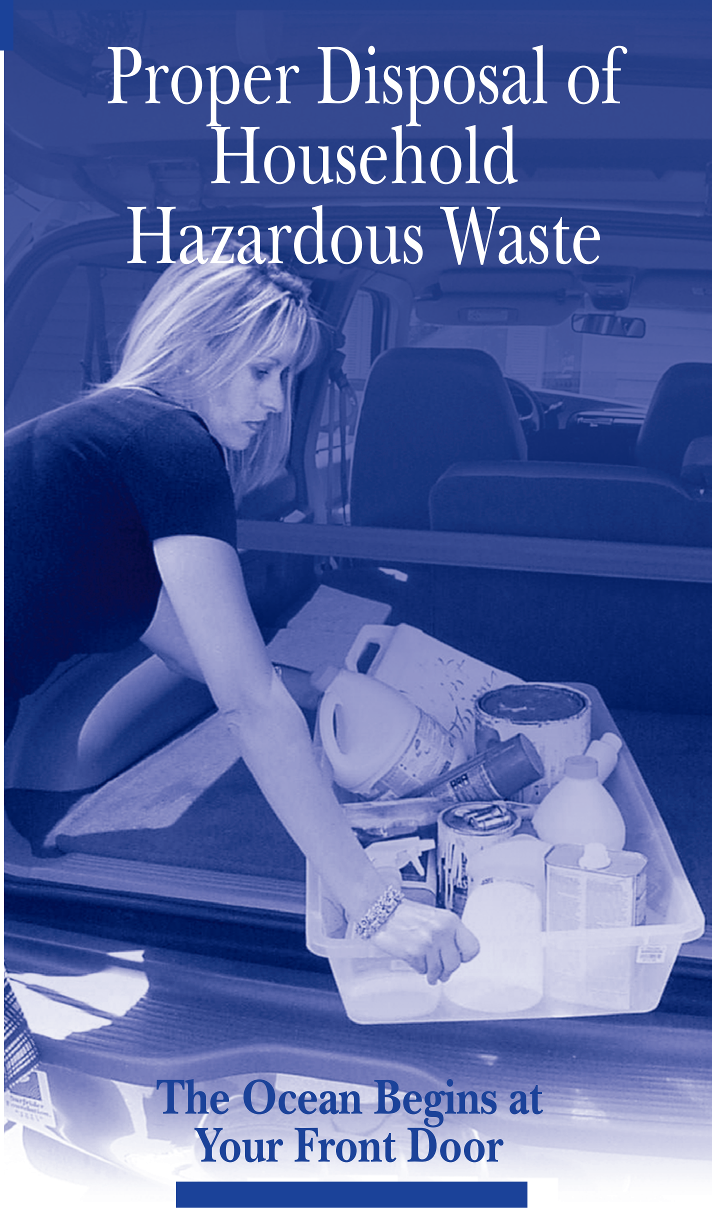
Help Prevent Ocean Pollution:

# Proper Disposal of Household Hazardous Waste



**The Ocean Begins at Your Front Door**

PROJECT
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PREVENTION

**ORANGE COUNTY**

# Pollution Prevention

Leftover household products that contain corrosive, toxic, ignitable, or reactive ingredients are considered to be "household hazardous waste" or "HHW." HHW can be found throughout your home, including the bathroom, kitchen, laundry room and garage.

*WHEN POSSIBLE, USE NON-HAZARDOUS OR LESS-HAZARDOUS PRODUCTS.*

Disposal of HHW down the drain, on the ground, into storm drains, or in the trash is illegal and unsafe.

Proper disposal of HHW is actually easy. Simply drop them off at a Household Hazardous Waste Collection Center (HHWCC) for free disposal and recycling. Many materials including anti-freeze, latex-based paint, motor oil and batteries can be recycled. Some centers have a "Stop & Swap" program that lets you take partially used home, garden, and automobile products free of charge. There are four HHWCCs in Orange County:

**Anaheim**:..................1071 N. Blue Gum St
**Huntington Beach**:.........17121 Nichols St
**Irvine**:........................... 6411 Oak Canyon
**San Juan Capistrano**:... 32250 La Pata Ave

Centers are open Tuesday-Saturday, 9 a.m.-3 p.m. Centers are closed on rainy days and major holidays. For more information, call **(714) 834-6752** or visit **www.oclandfills.com.**

## Common household hazardous wastes

- Batteries
- Paint and paint products
- Adhesives
- Drain openers
- Household cleaning products
- Wood and metal cleaners and polishes
- Pesticides
- Fungicides/wood preservatives
- Automotive products (antifreeze, motor oil, fluids)
- Grease and rust solvents
- Fluorescent lamps
- Mercury (thermometers & thermostats)
- All forms of electronic waste including computers and microwaves
- Pool & spa chemicals
- Cleaners
- Medications
- Propane (camping & BBQ)
- Mercury-containing lamps
- Television & monitors (CRTs, flatscreens)

## Tips for household hazardous waste

- Never dispose of HHW in the trash, street, gutter, storm drain or sewer.
- Keep these materials in closed, labeled containers and store materials indoors or under a cover.
- When possible, use non-hazardous products.
- Reuse products whenever possible or share with family and friends.
- Purchase only as much of a product as you'll need. Empty containers may be disposed of in the trash.
- HHW can be harmful to humans, pets and the environment. Report emergencies to 911.

### *Did you know that just one quart of oil can pollute 250,000 gallons of water?*

A clean ocean and healthy creeks, rivers, bays and beaches are important to Orange County. However, not properly disposing of used oil can lead to water pollution. If you pour or drain oil onto driveways, sidewalks or streets, it can be washed into the storm drain. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering the ocean. Help prevent water pollution by taking your used oil to a used oil collection center.

Included in this brochure is a list of locations that will accept up to five gallons of used motor oil at no cost. Many also accept used oil filters. Please contact the facility before delivering your used oil. This listing of companies is for your reference and does not constitute a recommendation or endorsement of the company.

Please note that used oil filters may not be disposed of with regular household trash. They must be taken to a household hazardous waste collection or recycling center in Anaheim, Huntington Beach, Irvine or San Juan Capistrano. For information about these centers, visit www.oclandfills.com.

Please do not mix your oil with other substances!

For more information, please call the Orange County Stormwater Program at 1-877-89-SPILL (1-877-897-7455) or visit www.watersheds.com.

For information about the proper disposal of household hazardous waste, call the Household Waste Hotline at (714) 834-6752 or visit www.oclandfills.com.

RECYCLE
USED OIL

For additional information about the nearest oil recycling center, call the Used Oil Program at 1-800-CLEANUP or visit www.cleanup.org.

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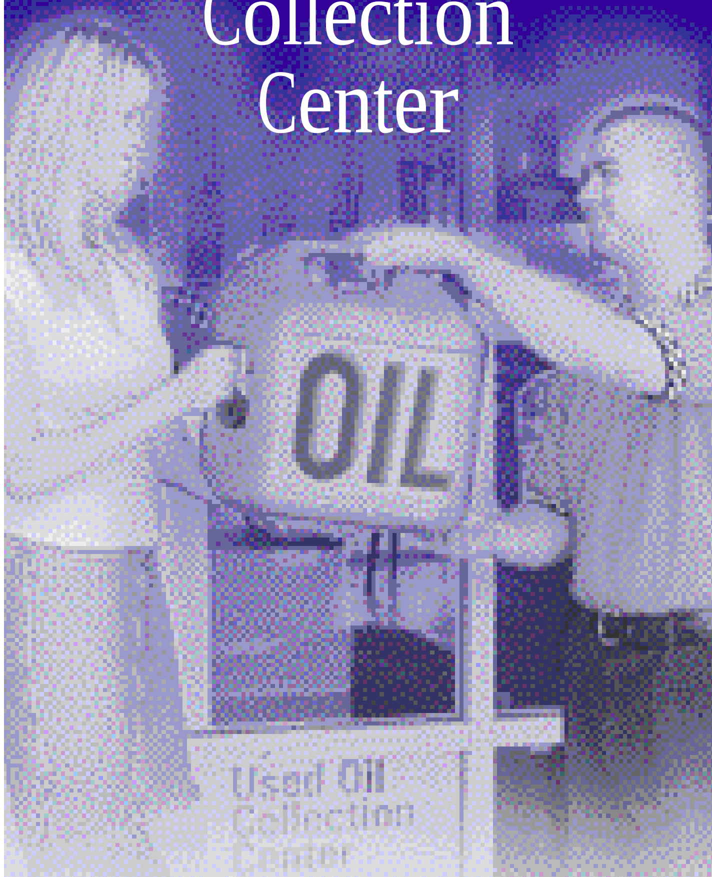
## Help Prevent Ocean Pollution:

# Recycle at Your Local Used Oil Collection Center



**The Ocean Begins at Your Front Door**

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PREVENTION

SOUTH COUNTY

# Used Oil Collection Centers

### ALISO VIEJO

Big O Tires
27812 Aliso Creek Rd, Suite E-100
(949) 362-4225

Econo Lube N' Tune
22932 Glenwood Dr.
(949) 643-9667

Jiffy Lube
27832 Aliso Creek Road
(949) 362-0005

Pep Boys
26881 Aliso Creek Road
(949) 362-9254

### DANA POINT

Dana Point Fuel Dock
34661 Puerto Pl. (949) 496-6113

EZ Lube Inc.
34242 Doheny Park Rd.
(949) 477-1223

### FOOTHILL RANCH

USA Express Tire & Service
26492 Town Center Dr.
(714) 826-1001

### LAGUNA BEACH

USA Express Tire & Service Inc.
350 Broadway (949) 494-7111

### LAKE FOREST

Big O Tires
20742 Lake Forest Dr.
(949) 443-4155

EZ Lube
26731 Rancho Parkway
(949) 465-9912

Firestone Store
24421 Rockfield Blvd.
(949) 581-2660

Jiffy Lube
20781 Lake Forest Dr.
(949) 583-0470

Kragen Auto Parts
24601 Raymond Way
(949) 829-8292

Pep Boys
22671 Lake Forest Dr.
(949) 855-9593

Ryan's Foothill Ranch Transmission
20622 Pascal Way (949) 770-6888

USA Express Tire & Service
24561 Trabuco Rd (949) 454-8001

### LAGUNA NIGUEL

Econo Lube N Tune
27912 Forbes Rd. (949) 364-5833

Laguna Niguel Auto Center
26042 Cape Dr. #12
(949) 582-2191

### LAGUNA HILLS

David J Phillips Buick
24888 Alicia Pkwy.
(949) 831-0434

EZ Lube
24281 Moulton Pkwy.
(949) 830-9840

EZ Lube
26921 Moulton Pkwy.
(949) 751-3436

Kragen Auto Parts
26562 Moulton Ave.
(949) 831-0434

Firestone Store
24196 Laguna Hills Mall
(949) 581-4700

### MISSION VIEJO

AAA Complete Auto Care & Tire
27913 Center Street
(949) 347-8200

Autobahn West
25800 Jeronimo Rd. Suite 401
(949) 770-2312

Auto Zone
22942 Los Alisos (949) 830-8181

Econo Lube & Tune
25902 El Paseo (949) 582-5483

Jiffy Lube
27240 La Paz Rd. (949) 455-0470

Kragen Auto Parts
24510 Alicia Pkwy. (949) 951-9175

Mission Viejo Chevron
27742 Crown Vly. Pkwy.
(949) 364-0137

Oilmax 10 Minute Lube
25800 Jeronimo Rd. #300
(949) 859-9271

Ramona Auto Service
27210 La Paz Rd. (949) 583-1233

### RANCHO SANTA MARGARITA

Jiffy Lube
23401 Antonio Parkway
(949) 589-7447

### SAN CLEMENTE

EZ Lube
525 Avenida Pico (949) 940-1850

Kragen Auto Parts
1113 S. El Camino Real
(949) 492-9850

Kragen Auto Parts
400 Camino de Estrella
(949) 240-9195

San Clemente Car Wash & Oil
1731 N. El Camino Real
(949) 847-4924

### SAN JUAN CAPISTRANO

Saturn of San Juan Capistrano
33033 Camino Capistrano
(949) 248-5411

Texaco Xpress Lube
27201 Ortega Hwy.
(949) 489-8008

*This information was provided by the County of Orange Integrated Waste Management Department and the California Integrated Waste Management Board (CIWMB).*

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many common activities such as pest control can lead to water pollution if you're not careful. Pesticide treatments must be planned and applied properly to ensure that pesticides do not enter the street, gutter or storm drain. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never dump pesticides into the ocean, so don't let it enter the storm drains. Pesticides can cause significant damage to our environment if used improperly. If you are thinking of using a pesticide to control a pest, there are some important things to consider.

For more information,
please call
University of California Cooperative Extension Master Gardeners at
(714) 708-1646
or visit these Web sites:
www.uccemg.org
www.ipm.ucdavis.edu

For instructions on collecting a specimen sample visit the Orange County Agriculture Commissioner's website at:
http://www.ocagcomm.com/ser_lab.asp

To report a spill, call the
**Orange County 24-Hour Water Pollution Problem Reporting Hotline at 1-877-89-SPILL (1-877-897-7455).**

**For emergencies, dial 911.**

Information From:
Cheryl Wilen, Area IPM Advisor; Darren Haver, Watershed Management Advisor; Mary Louise Flint, IPM Education and Publication Director; Pamela M. Geisel, Environmental Horticulture Advisor; Carolyn L. Unruh, University of California Cooperative Extension staff writer. Photos courtesy of the UC Statewide IPM Program and Darren Haver.

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## Help Prevent Ocean Pollution:

# Responsible Pest Control

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# Tips for Pest Control

## *Key Steps to Follow:*

### *Step 1:* Correctly identify the pest (insect, weed, rodent, or disease) and verify that it is actually causing the problem.


Three life stages of the common lady beetle, a beneficial insect.

This is important because beneficial insects are often mistaken for pests and sprayed with pesticides needlessly.

Consult with a Certified Nursery Professional at a local nursery or garden center or send a sample of the pest to the Orange County Agricultural Commissioner's Office.

Determine if the pest is still present – even though you see damage, the pest may have left.

### *Step 2:* Determine how many pests are present and causing damage.

Small pest populations may be controlled more safely using non-pesticide techniques. These include removing food sources, washing off leaves with a strong stream of water, blocking entry into the home using caulking and replacing problem plants with ones less susceptible to pests.

Integrated Pest Management (IPM) usually combines several least toxic pest control methods for long-term prevention and management of pest problems without harming you, your family, or the environment.

UC CE
University of California
Cooperative Extension

### *Step 3:* If a pesticide must be used, choose the least toxic chemical.

Obtain information on the least toxic pesticides that are effective at controlling the target pest from the UC Statewide Integrated Pest Management (IPM) Program's Web site at www.ipm.ucdavis.edu.

Seek out the assistance of a Certified Nursery Professional at a local nursery or garden center when selecting a pesticide. Purchase the smallest amount of pesticide available.

Apply the pesticide to the pest during its most vulnerable life stage. This information can be found on the pesticide label.

### *Step 4:* Wear appropriate protective clothing.

Follow pesticide labels regarding specific types of protective equipment you should wear. Protective clothing should always be washed separately from other clothing.

### *Step 5:* Continuously monitor external conditions when applying pesticides such as weather, irrigation, and the presence of children and animals.

Never apply pesticides when rain is predicted within the next 48 hours. Also, do not water after applying pesticides unless the directions say it is necessary.

Apply pesticides when the air is still; breezy conditions may cause the spray or dust to drift away from your targeted area.

In case of an emergency call 911 and/or the regional poison control number at (714) 634-5988 or (800) 544-4404 (CA only).

For general questions you may also visit www.calpoison.org.

### *Step 6:* In the event of accidental spills, sweep up or use an absorbent agent to remove any excess pesticides. Avoid the use of water.

Be prepared. Have a broom, dust pan, or dry absorbent material, such as cat litter, newspapers or paper towels, ready to assist in cleaning up spills.

Contain and clean up the spill right away. Place contaminated materials in a doubled plastic bag. All materials used to clean up the spill should be properly disposed of according to your local Household Hazardous Waste Disposal site.

### *Step 7:* Properly store and dispose of unused pesticides.

Purchase Ready-To-Use (RTU) products to avoid storing large concentrated quantities of pesticides.

Store unused chemicals in a locked cabinet.

Unused pesticide chemicals may be disposed of at a Household Hazardous Waste Collection Center.

Empty pesticide containers should be triple rinsed prior to disposing of them in the trash.

**Household Hazardous Waste**
**Collection Center**
**(714) 834-6752**
**www.oclandfills.com**

PROJECT Pollution PREVENTION

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many common activities can lead to water pollution if you're not careful. Fertilizers, pesticides and other chemicals that are left on yards or driveways can be blown or washed into storm drains that flow to the ocean. Overwatering lawns can also send materials into storm drains. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never pour gardening products into the ocean, so don't let them enter the storm drains. Follow these easy tips to help prevent water pollution.

For more information,
please call the
**Orange County Stormwater Program**
at **1-877-89-SPILL** (1-877-897-7455)
or visit
**www.ocwatersheds.com**

**UCCE Master Gardener Hotline:**
**(714) 708-1646**

To report a spill,
call the
**Orange County 24-Hour**
**Water Pollution Problem**
**Reporting Hotline**
**1-877-89-SPILL** (1-877-897-7455).

**For emergencies, dial 911.**

The tips contained in this brochure provide useful information to help prevent water pollution while landscaping or gardening. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

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## Help Prevent Ocean Pollution:

# Tips for Landscape & Gardening

The Ocean Begins
at Your Front Door

PROJECT
Pollution
PREVENTION

# Tips for Landscape & Gardening

Never allow gardening products or polluted water to enter the street, gutter or storm drain.

## *General Landscaping Tips*

- Protect stockpiles and materials from wind and rain by storing them under tarps or secured plastic sheeting.
- Prevent erosion of slopes by planting fast-growing, dense ground covering plants. These will shield and bind the soil.

- Plant native vegetation to reduce the amount of water, fertilizers, and pesticide applied to the landscape.
- Never apply pesticides or fertilizers when rain is predicted within the next 48 hours.

## *Garden & Lawn Maintenance*

- Do not overwater. Use irrigation practices such as drip irrigation, soaker hoses or micro spray systems. Periodically inspect and fix leaks and misdirected sprinklers.

- Do not rake or blow leaves, clippings or pruning waste into the street, gutter or storm drain. Instead, dispose of green waste by composting, hauling it to a permitted landfill, or recycling it through your city's program.
- Use slow-release fertilizers to minimize leaching, and use organic fertilizers.
- Read labels and use only as directed. Do not over-apply pesticides or fertilizers. Apply to spots as needed, rather than blanketing an entire area.
- Store pesticides, fertilizers and other chemicals in a dry covered area to prevent exposure that may result in the deterioration of containers and packaging.

- Rinse empty pesticide containers and re-use rinse water as you would use the product. Do not dump rinse water down storm drains. Dispose of empty containers in the trash.
- When available, use non-toxic alternatives to traditional pesticides, and use pesticides specifically designed to control the pest you are targeting. For more information, visit **www.ipm.ucdavis.edu**.
- If fertilizer is spilled, sweep up the spill before irrigating. If the spill is liquid, apply an absorbent material such as cat litter, and then sweep it up and dispose of it in the trash.
- Take unwanted pesticides to a Household Hazardous Waste Collection Center to be recycled. Locations are provided below.

### Household Hazardous Waste Collection Centers

**Anaheim:** 1071 N. Blue Gum St.
**Huntington Beach:** 17121 Nichols St.
**Irvine:** 6411 Oak Canyon
**San Juan Capistrano:** 32250 La Pata Ave.

**For more information, call (714) 834-6752 or visit www.oclandfills.com**

**Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many common activities can lead to water pollution if you're not careful. Pet waste and pet care products can be washed into the storm drains that flow to the ocean. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.**

**You would never put pet waste or pet care products into the ocean, so don't let them enter the storm drains. Follow these easy tips to help prevent water pollution.**

For more information,
please call the
**Orange County Stormwater Program**
at **1-877-89-SPILL** (1-877-897-7455)
or visit
**www.ocwatersheds.com**

To report a spill,
call the
**Orange County 24-Hour**
**Water Pollution Problem**
**Reporting Hotline**
**1-877-89-SPILL** (1-877-897-7455).

**For emergencies, dial 911.**

The tips contained in this brochure provide useful information to help prevent water pollution while caring for your pet. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

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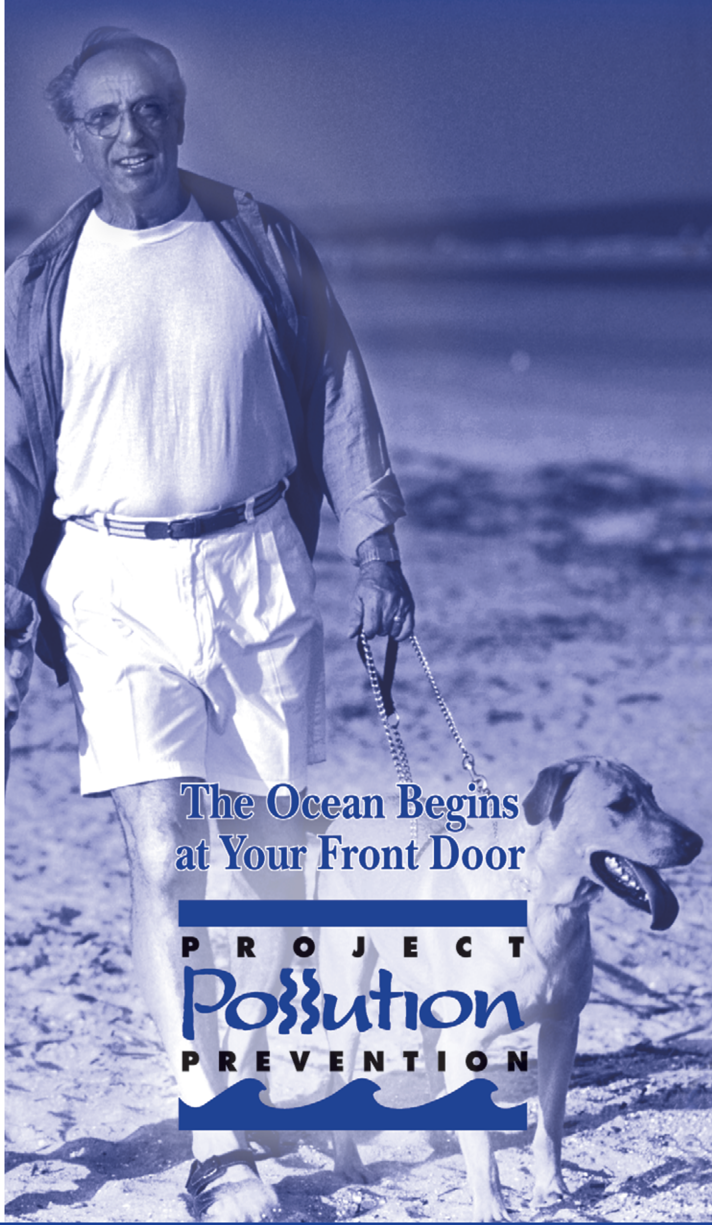
# Help Prevent Ocean Pollution:

# Tips for Pet Care



The Ocean Begins at Your Front Door

PROJECT
Pollution
PREVENTION

# Tips for Pet Care

Never let any pet care products or washwater run off your yard and into the street, gutter or storm drain.

## *Washing Your Pets*

Even biodegradable soaps and shampoos can be harmful to marine life and the environment.

- If possible, bathe your pets indoors using less-toxic shampoos or have your pet professionally groomed. Follow instructions on the products and clean up spills.
- If you bathe your pet outside, wash it on your lawn or another absorbent/ permeable surface to keep the washwater from running into the street, gutter or storm drain.

## *Flea Control*

- Consider using oral or topical flea control products.
- If you use flea control products such as shampoos, sprays or collars, make sure to dispose of any unused products at a Household Hazardous Waste Collection Center. For location information, call **(714) 834-6752**.

## *Why You Should Pick Up After Your Pet*

It's the law! Every city has an ordinance requiring you to pick up after your pet. Besides being a nuisance, pet waste can lead to water pollution, even if you live inland. During rainfall, pet waste left outdoors can wash into storm drains. This waste flows directly into our waterways and the ocean where it can harm human health, marine life and the environment.

As it decomposes, pet waste demands a high level of oxygen from water. This decomposition can contribute to killing marine life by reducing the amount of dissolved oxygen available to them.

Have fun with your pets, but please be a responsible pet owner by taking care of them and the environment.

- Take a bag with you on walks to pick up after your pet.
- Dispose of the waste in the trash or in a toilet.

PROJECT POLLUTION PREVENTION

Clean beaches and healthy creeks, rivers, bays, and ocean are important to Orange County. However, many common activities can lead to water pollution if you're not careful. Swimming pools and spas are common in Orange County, but they must be maintained properly to guarantee that chemicals aren't allowed to enter the street, where they can flow into the storm drains and then into the waterways. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never dump pool chemicals into the ocean, so don't let it enter the storm drains. Follow these easy tips to help prevent water pollution.

For more information,
please call the
**Orange County Stormwater Program**
at **1-877-89-SPILL** (1-877-897-7455)
or visit
**www.ocwatersheds.com**

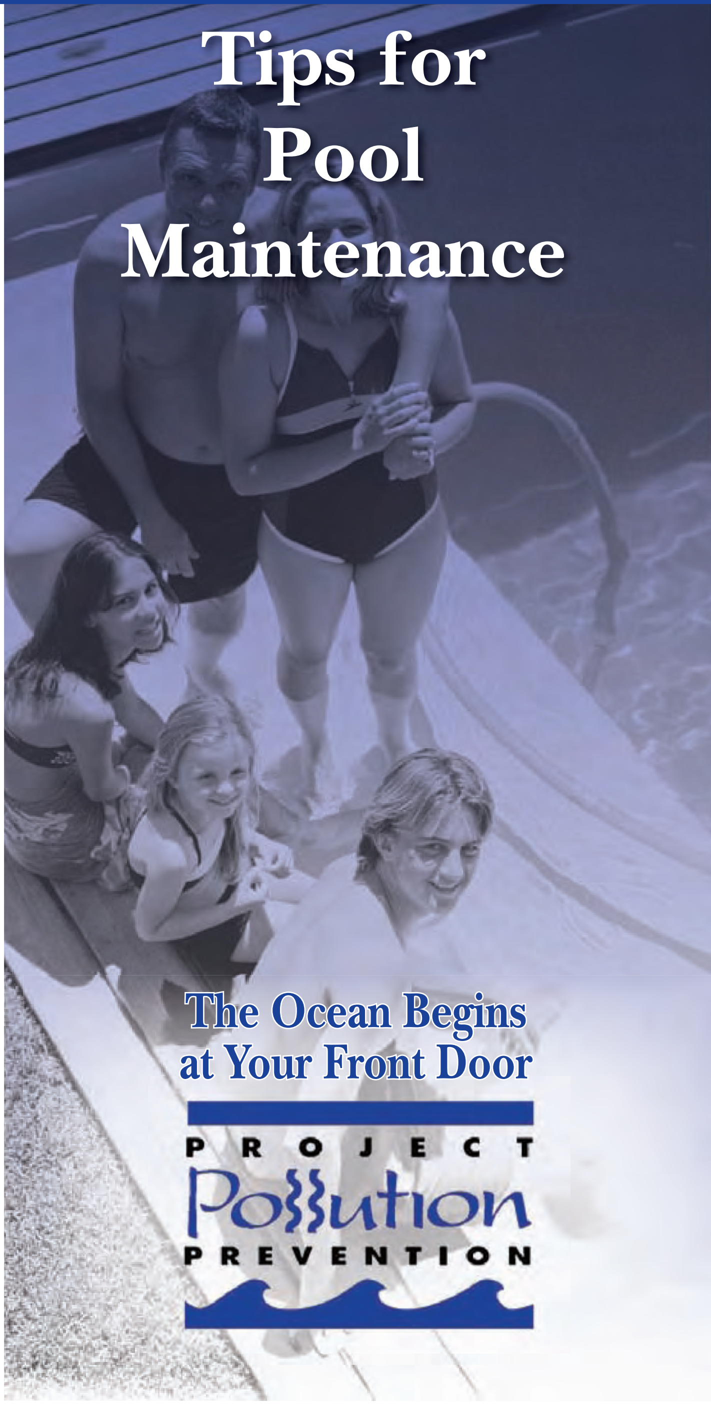
To report a spill,
call the
**Orange County 24-Hour**
**Water Pollution Reporting Hotline**
**1-877-89-SPILL** (1-877-897-7455).

**For emergencies, dial 911.**

The tips contained in this brochure provide useful information to help prevent water pollution while maintaining your pool. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

Help Prevent Ocean Pollution:

# Tips for Pool Maintenance



**The Ocean Begins at Your Front Door**

PROJECT
Pollution
PREVENTION

# Tips for Pool Maintenance

Many pools are plumbed to allow the pool to drain directly to the sanitary sewer. If yours is not, follow these instructions for disposing of pool and spa water.

## *Acceptable and Preferred Method of Disposal*

When you cannot dispose of pool water in the sanitary sewer, the release of dechlorinated swimming pool water is allowed if all of these tips are followed:

- The residual chlorine does not exceed 0.1 mg/l (parts per million).
- The pH is between 6.5 and 8.5.
- The water is free of any unusual coloration, dirt or algae.
- There is no discharge of filter media.
- There is no discharge of acid cleaning wastes.
- Some cities may have ordinances that do not allow pool water to be disposed into a storm drain. Check with your city.

## *How to Know if You're Following the Standards*

You can find out how much chlorine is in your water by using a pool testing kit. Excess chlorine can be removed by discontinuing the use of chlorine for a few days prior to discharge or by purchasing dechlorinating chemicals from a local pool supply company. Always make sure to follow the instructions that come with any products you use.

## *Doing Your Part*

By complying with these guidelines, you will make a significant contribution toward keeping pollutants out of Orange County's creeks, streams, rivers, bays and the ocean. This helps to protect organisms that are sensitive to pool chemicals, and helps to maintain the health of our environment.

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For more information,
please call the
**Orange County Stormwater Program**
at **1-877-89-SPILL** (1-877-897-7455)
or visit
**www.ocwatersheds.com**

To report a spill,
call the
**Orange County 24-Hour**
**Water Pollution Problem**
**Reporting Hotline**
at **1-877-89-SPILL** (1-877-897-7455).

**For emergencies, dial 911.**

The tips contained in this brochure provide useful information to help prevent water pollution. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

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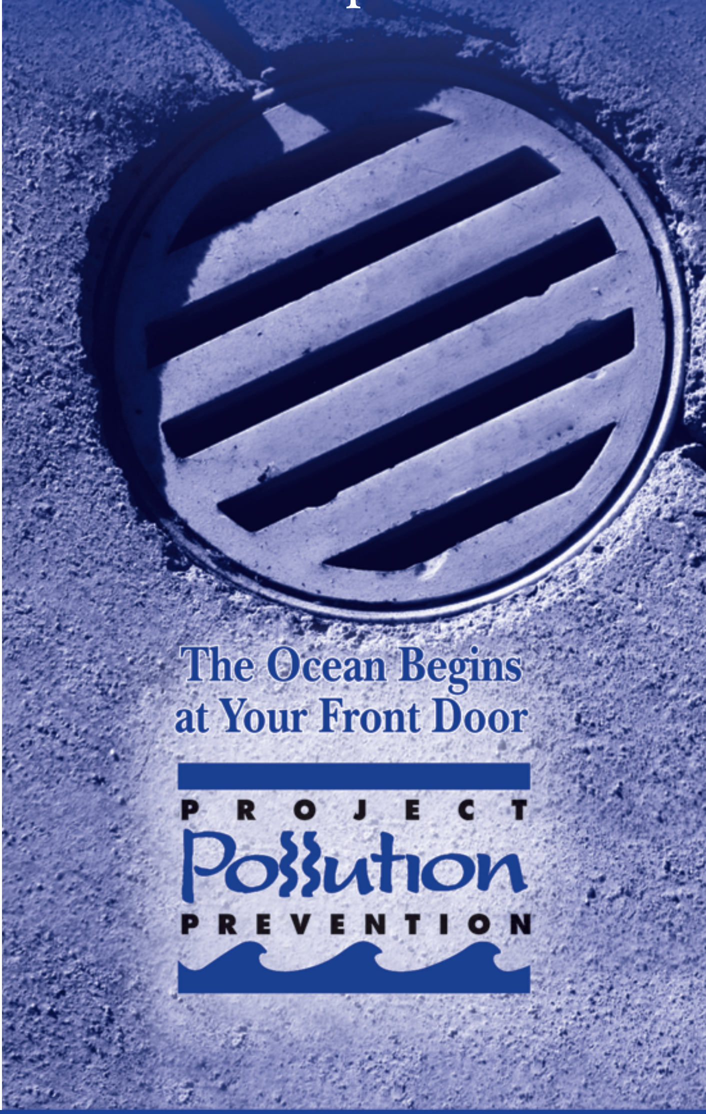
## Help Prevent Ocean Pollution:

# Tips for Residential Pool, Landscape and Hardscape Drains



**The Ocean Begins**
**at Your Front Door**

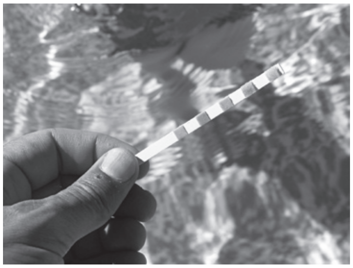
PROJECT
**Pollution**
PREVENTION

# Tips for Residential Pool, Landscape and Hardscape Drains

## Pool Maintenance

All pool water discharged to the curb, gutter or permitted pool drain from your property must meet the following water quality criteria:

- The residual chlorine does not exceed 0.1 mg/L (parts per million).
- The pH is between 6.5 and 8.5.
- The water is free of any unusual coloration.
- There is no discharge of filter media or acid cleaning wastes.



Some cities have ordinances that do not allow pool water to be discharged to the storm drain. Check with your city.

## Landscape and Hardscape Drains

The following recommendations will help reduce or prevent pollutants from your landscape and hardscape drains from entering the street, gutter or storm drain. Unlike water that enters the sewer (from sinks and toilets), water that enters a landscape or hardscape drain is not treated before entering our creeks, rivers, bays and ocean.

## Household Activities

- Do not rinse spills of materials or chemicals to any drain.
- Use dry cleanup methods such as applying cat litter or another absorbent material, then sweep it up and dispose of it in the trash. If the material is hazardous, dispose of it at a Household Hazardous Waste Collection Center (HHWCC). For locations, call **(714) 834-6752** or visit **www.oclandfills.com**.
- Do not hose down your driveways, sidewalks or patios to your landscape or hardscape drain. Sweep up debris and dispose of it in the trash.
- Always pick up after your pet. Flush waste down the toilet or dispose of it in the trash.
- Do not store items such as cleaners, batteries, automotive fluids, paint products, TVs, or computer monitors uncovered outdoors. Take them to a HHWCC for disposal.

## Yard Maintenance

- Do not overwater. Water by hand or set automated irrigation systems to reflect seasonal water needs.
- Follow directions on pesticides and fertilizers (measure, do not estimate amounts) and do not use if rain is predicted within 48 hours.
- Cultivate your garden often to control weeds and reduce the need to use chemicals.

## Vehicle Maintenance

- Never pour oil or antifreeze down your landscape or hardscape drain. Recycle these substances at a service station, a waste collection center or used oil recycling center. For locations, contact the Used Oil Program at **1-800-CLEANUP** or visit **www.CLEANUP.org**.
- Whenever possible, take your vehicle to a commercial car wash.
- If you do wash your vehicle at home, do not allow the washwater to go down your landscape or hardscape drain. Instead, dispose of it in the sanitary sewer (a sink or toilet) or onto an absorbent surface such as your lawn.
- Use a spray nozzle that will shut off the water when not in use.

# DF-1

# DRAINAGE FACILITY OPERATION AND MAINTENANCE

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff and storm water that may contain certain pollutants. Consequently these pollutants may accumulate in the system and must be removed periodically. In addition, the systems must also be maintained to function properly hydraulically to avoid flooding. Maintaining the system may involve the following activities:

1. Inspection and Cleaning of Stormwater Conveyance Structures
2. Controlling Illicit Connections and Discharges
3. Controlling Illegal Dumping

This list of Model Maintenance Procedures can be utilized as an inspection checklist to determine where better compliance with Designated Minimum Best Management Practices (notated with checkmarks and capital letters) is needed, and to recommend Additional Best Management Practices (notated with bullet points and lower case letters) that may be applicable under certain circumstances, especially where there are certain Pollutant Constituents of Concern. BMPs applicable to certain constituents are notated as:

*Bacteria (BACT)* *Sediment (SED)* *Nutrients (NUT)* *Oil and Grease (O&G)* *Pesticides (PEST)*
*OtherToxic Compounds (TOX)* *Trash (TRASH)* *Hydrological Impacts (HYD)* *Any/All or General (ANY)*

Program/Facility Being Inspected: ______________________________

Date: ____________________ Inspector Name: ______________________________

When completed, the checklist should be attached to the General Inspection Form Cover Sheet and copies should be provided to the Supervisor of the Facility/Program being inspected.

## MAINTENANCE PROCEDURES:

## 1. Inspection and Cleaning of Drainage Facilities

| **Unsatisfactory** OK | **General Guidelines** |
|---|---|
| ☐ ____________ ☐ | T 1A. Annually inspect and clean drainage structures as needed. |
| ☐ ____________ ☐ | T 1B. Maintain appropriate records of cleaning and inspections. |
| ☐ ____________ ☐ | T 1C. Properly dispose of removed materials at a landfill or recycling facility. |
| ☐ ____________ ☐ | T 1D. Conduct intermittent supplemental visual inspections during the wet season to determine if there are problem inlets where sediment/trash or other pollutants accumulate, and provide for additional cleanouts as appropriate. |
| ☐ ____________ ☐ | T 1E. Prevent or clean up any discharges that may occur during the course of maintenance and cleaning procedures. |
| ☐ ____________ ☐ | T 1F. Verify that appropriate employees or subcontractors are trained in proper conductance of maintenance activities, including record keeping and disposal. |
| ☐ ____________ ☐ | T 1G. Annually inspect and clean v-ditches as needed, prior to the wet season. On shrub-covered slopes, vegetative debris may be placed on the downhill side of the ditch. Trash should be bagged and disposed at a landfill. |

**Unsatisfactory** **OK**

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**General Guidelines (cont.)**

- 1a. Remove trash or debris as needed from open channels. It should be noted that major vegetative debris removal may require other regulatory permits prior to completing the work. (TRASH)
- 1b. Consider retrofitting energy dissipaters (e.g. riprap) below culvert outfalls to minimize potential for erosion. (SED)
- 1c. Repair any v-ditches that have cracked or displaced in a manner that accelerates erosion. (SED)
- 1d. If suspicious conditions appear to exist, test selected samples of the removed wastes for compliance with hazardous waste regulations prior to disposal. (TOX)
- 1e. Consider more frequent regular cleaning of selected drainage structures to help address ongoing specific impairments. (SED, BACT, NUT, TRASH)
- 1f. Consider structural retrofits to the MS4 to help address ongoing specific impairments (SED, BACT, NUT, TRASH, O&G)
- 1g. Consider cleaning out pipes at gradient breaks or other in-pipe debris accumulation points as identified/needed. (ANY, BACT, NUT, TRASH)

**Storm Drain Flushing**

- 1h. Flushing of storm drains or storm drain inlets should only be done when critically necessary and no other solution is practical. (SED, BACT, TRASH).
- 1i. If flushed, to the extent practical the material should be collected (vacuumed), treated with an appropriate filtering device to remove sand and debris and disposed of properly. (SED)

**Waste Management**

T 1H. Store wastes collected from cleaning activities of the drainage facilities in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.

- 1j. Dewater the wastes if necessary with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device to remove the sand and debris prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not permitted, water should be pumped or vacuumed to a tank and properly disposed of. Do not dewater near a storm drain or stream. (SED, TRASH)
- 1k. Provide for laboratory analysis of at least one randomly collected sediment (less the debris) sample per year from the storm drain inlet leaning program to ensure that it does not meet the EPA criteria for hazardous waste. If the sample is determined to be hazardous, the sediment must be disposed of as hazardous waste and the source should be investigated. (TOX).

## 2. Controlling Illicit Connections and Discharges

| Unsatisfactory | OK | General Guidelines |
|---|---|---|
| ☐ | ☐ | T 2A. Report prohibited discharges such as dumping, paint spills, abandoned oil containers, etc. observed during the course of normal daily activities so they can be investigated, contained, and cleaned up. |
| ☐ | ☐ | T 2B. Where field observations and/or monitoring data indicate significant problems, conduct field investigations to detect and eliminate existing illicit connections and improper disposal of pollutants into the storm drain (i.e. identify problem areas where discharges or illegal connections may occur and follow up stream to determine the source(s)). (Refer to Appendices A-10 and A-11.) |
| ☐ | ☐ | T 2C. Report all observed illicit connections and discharges to the 24-hour water pollution problem reporting hotline (714) 567-6363. |
| ☐ | ☐ | T 2D. Encourage public reporting of improper waste disposal by distributing public education materials and advertising the 24-hour water pollution problem reporting hotline. |
| | | **Storm Drain Stenciling ("No Dumping—Drains to Ocean")** |
| ☐ | ☐ | T 2E. Implement and maintain a storm drain stenciling program. |
| ☐ | ☐ | • 2a. Consider adding the hotline number to the storm drain stencils (BACT, TOX, TRASH). |

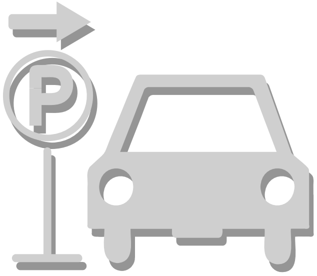
## 3. Controlling Illegal Dumping

| | | |
|---|---|---|
| | | **Field Investigation** |
| ☐ | ☐ | T 3A. Report prohibited discharges such as dumpings observed during the course of normal daily activities so they can be investigated, contained and cleaned up. |
| ☐ | ☐ | T 3B. Conduct field investigations to detect and eliminate improper disposal of pollutants into the storm drain (i.e. identify problem areas where discharges or illegal connections may occur and follow up stream to determine the source(s)). |
| ☐ | ☐ | T 3C. Report all observed illegal dumping to the 24-hour water pollution problem reporting hotline (714) 567-6363. |
| ☐ | ☐ | T 3D. Encourage public reporting of improper waste disposal by distributing public education materials and advertising the 24-hour water pollution problem reporting hotline. |
| ☐ | ☐ | T 3E. If perpetrator can be identified, take appropriate enforcement action. |
| ☐ | ☐ | • 3a. Consider posting "No Dumping" signs in problem areas with a phone number for reporting dumping and disposal. Signs could also indicate fines and penalties for illegal dumping. (ANY) |

| | |
|---|---|
| **Unsatisfactory** **OK**<br>☐ ☐<br>☐ ☐<br>☐ ☐ | **Training/Education/Outreach**<br>T 3F. Verify that appropriate employees and subcontractors are trained to recognize and report illegal dumping.<br>T 3G. Encourage public reporting of illegal dumping by advertising the 24-hour water pollution problem reporting hotline (714) 567-6363.<br>• 3b. Take extra steps to educate the public in neighborhoods where illegal dumping has occurred to inform them why illegal dumping is a problem, and that illegal dumping carries a significant financial penalty. (ANY) |

## LIMITATIONS:

Clean-up activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.



# R-3
# AUTOMOBILE PARKING

Parked automobiles may contribute pollutants to the storm drain because poorly maintained vehicles may leak fluids containing hydrocarbons, metals, and other pollutants. In addition, heavily soiled automobiles may drop clods of dirt onto the parking surface, contributing to the sediment load when runoff is present. During rain events, or wash-down activities, the pollutants may be carried into the storm drain system. The pollution prevention activities outlined in this fact sheets are used to prevent the discharge of pollutants to the storm drain system.

| The activities outlined in this fact sheet target the following pollutants: | |
|---|---|
| Sediment | x |
| Nutrients | |
| Bacteria | |
| Foaming Agents | |
| Metals | X |
| Hydrocarbons | X |
| Hazardous Materials | x |
| Pesticides and Herbicides | |
| Other | |

Think before parking your car. Remember - The ocean starts at your front door.

## Required Activities

- If required, vehicles have to be removed from the street during designated street sweeping/cleaning times.
- If the automobile is leaking, place a pan or similar collection device under the automobile, until such time as the leak may be repaired.
- Use dry cleaning methods to remove any materials deposited by vehicles (e.g. adsorbents for fluid leaks, sweeping for soil clod deposits).

## Recommended Activities

- Park automobiles over permeable surfaces (e.g. gravel, or porous cement).
- Limit vehicle parking to covered areas.
- Perform routine maintenance to minimize fluid leaks, and maximize fuel efficiency.

For additional information contact:
County of Orange, OC Watershed
Main: (714) 955-0600/ 24hr Water Pollution Discharge Hotline 1-877-89-SPILL
or visit our website at: www.ocwatersheds.com

# R-4

# HOME AND GARDEN CARE ACTIVITIES

| The activities outlined in this fact sheet target the following pollutants: | |
|---|---|
| Sediment | x |
| Nutrients | |
| Bacteria | x |
| Foaming Agents | x |
| Metals | x |
| Hydrocarbons | x |
| Hazardous Materials | x |
| Pesticides and Herbicides | |
| Other | x |

## HOME CARE

Many hazardous materials may be used in and around residences during routine maintenance activities (such as: oils, paints, cleaners, bleaches, pesticides, glues, solvents, and other products). Improper or excessive use of these products can increase the potential for pollutants to be transported to the storm drain by runoff. The pollution prevention activities outlined in this fact sheets are used to prevent the discharge of pollutants to the storm drain system.

Think before conducting home care activities. Remember - The ocean starts at your front door.

### Required Activities

- Clean out painting equipment in an area where the waste can be contained and properly disposed of (latex – sewer, oil based – household hazardous waste center).

- Rinse off cement mixers and cement laden tools in a contained washout area. Dispose of dried concrete waste in household trash.

- If safe, contain, clean up, and properly dispose all household hazardous waste spills. If an unsafe condition exists, call 911 to activate the proper response team.

- Household hazardous materials must be stored indoors or under cover, and in closed and labeled containers. Dispose of them at a household hazardous waste center.

- Household wash waters (e.g. washer machine effluent, mop water, etc.) must be disposed of in the sanitary sewer.

- Pool and spa water may be discharged to the storm drain if residual chlorine is less than 0.1 mg/L, the pH is between 6.5 and 8.5, and the water is free from any unusual coloration. (Call 714-834-6107 to obtain information on a pool drain permit). Pool filter media must be contained and disposed of properly.

### Recommended Activities

- Only purchase the types and amounts of materials needed.
- Share unused portions of products with neighbors or community programs (latex paint)

For additional information contact:
County of Orange, OC **Watershed**
Main: (714) 955-0600/ 24hr Water Pollution Discharge Hotline 1-877-89-SPILL
or visit our website at: www.ocwatersheds.com

## GARDEN CARE

| The activities outlined in this fact sheet target the following pollutants: | |
|---|---|
| Sediment | x |
| Nutrients | x |
| Bacteria | x |
| Foaming Agents | |
| Metals | |
| Hydrocarbons | |
| Hazardous Materials | |
| Pesticides and Herbicides | x |
| Other | x |

Garden activities may contribute pollutants via soil erosion, green waste, fertilizer and pesticide use. Plant and garden care activities such as landscape maintenance, fertilization, and pesticide application have the potential to discharge significant quantities of pollutants to the storm drain system. Nonvegetated surfaces may allow for significant erosion leading to high sediment loads. Other pollutants such as pesticides may adsorb onto the soil particles and be transported off site. Excess fertilizer and pesticide pollutants from over application may be carried to the storm drain by dissolving in irrigation runoff or rainwater. Green wastes may also contain organic matter and may have adsorbed fertilizers and pesticides.

Excessive irrigation is often the most significant factor in home and garden care activities. Pollutants may dissolve in irrigation water and then be transported to the storm drain, or particles and materials coated with fertilizers and pesticides may be suspended in the irrigation flow and carried to the storm drain. The pollution prevention activities outlined in this fact sheets are used to prevent the discharge of pollutants to the storm drain system.

Think before conducting garden care activities. Remember - The ocean starts at your front door.

### Required Activities

- Irrigation systems must be properly adjusted to reflect seasonal water needs.
- Minimize the use of pesticides and fertilizers. Read the labels and follow directions to avoid improper use. Do not apply chemicals if it is windy or about to rain.
- Properly clean up and dispose of spills of gardening chemicals, fertilizes, or soils. If possible, return the spilled material to the container for future use.
- Lawn and garden care products must be stored in closed labeled containers, in covered areas, or off-ground and under protective tarps.
- Household hazardous waste must be properly disposed at a household hazardous waste center.
- Cover nonvegetated surfaces to prevent erosion.

### Recommended Activities

- Utilize xeroscaping and use of drought and insect resistant landscaping.
- Cultivate garden often to control weeds
- Use integrated pest management (IPM). Planting pest repelling plants (e.g. Marigolds) or using pest eating insects (e.g. ladybugs) may reduce the need for pesticides.
- Do not leave food (human or pet) outside overnight
- Remove fruit and garden waste

For additional information contact:
County of Orange, OC **Watershed**
Main: (714) 955-0600/ 24hr Water Pollution Discharge Hotline 1-877-89-SPILL
or visit our website at: www.ocwatersheds.com

# R-5

# DISPOSAL OF PET WASTES

| The activities outlined in this fact sheet target the following pollutants: | |
|---|---|
| Sediment | x |
| Nutrients | x |
| Bacteria | x |
| Foaming Agents | |
| Metals | |
| Hydrocarbons | |
| Hazardous Materials | |
| Pesticides and Herbicides | |
| Other | |

Pet wastes left in the environment may introduce solids, bacteria, and nutrients to the storm drain. The type and quantity of waste will dictate the proper disposal method. Small quantities of waste are best disposed with regular trash or flushed down a toilet. Large quantities of wastes from herbivore animals may be composted for subsequent use or disposal to landfill.

Pick up after your pet! It's as easy as 1-2-3. 1) Bring a bag. 2) Clean it up. 3) Dispose of it properly (toilet or trash). The pollution prevention activities outlined in this fact sheets are used to prevent the discharge of pollutants to the storm drain system.

Think before you dispose of any pet wastes. Remember - The ocean starts at your front door.

## Required Activities

- All pet wastes must be picked up and properly disposed of. Pet waste should be disposed of in the regular trash, flushed down a toilet, or composted as type and quantities dictate.

- Properly dispose of unused flea control products (shampoo, sprays, or collars).

- Manure produced by livestock in uncovered areas should be removed at least daily for composting, or storage in water-tight container prior to disposal. Never hose down to stream or storm drain. Composting or storage areas should be configured and maintained so as not to allow contact with runoff. Compost may be donated to greenhouses, nurseries, and botanical parks. Topsoil companies and composting centers may also accept composted manure.

- Line waste pits or trenches with an impermeable layer, such as thick plastic sheeting.

- When possible, allow wash water to infiltrate into the ground, or collect in an area that is routed to the sanitary sewer.

- Confine livestock in fenced in areas except during exercise and grazing times. Restrict animal access to creeks and streams, preferably by fencing.

- Install gutters that will divert roof runoff away from livestock areas.

## Recommended Activities

- In order to properly dispose of pet waste, carry bags, pooper-scooper, or equivalent to safely pick up pet wastes while walking with pets.
- Bathe pets indoors and use less toxic shampoos. When possible, have pets professionally groomed.
- Properly inoculate your pet in order to maintain their health and reduce the possibility of pathogens in pet wastes.
- Maintain healthy and vigorous pastures with at least three inches of leafy material.
- Consider indoor feeding of livestock during heavy rainfall, to minimize manure exposed to potential runoff.
- Locate barns, corrals, and other high use areas on portions of property that either drain away from or are located distant form nearby creeks or storm drains.

# R-6

# DISPOSAL OF GREEN WASTES

| The activities outlined in this fact sheet target the following pollutants: | |
|---|---|
| Sediment | x |
| Nutrients | x |
| Bacteria | x |
| Foaming Agents | |
| Metals | |
| Hydrocarbons | |
| Hazardous Materials | x |
| Pesticides and Herbicides | x |
| Other | |

Green wastes entering the storm drain may clog the system creating flooding problems. Green wastes washed into receiving waters create an oxygen demand as they are decomposed, reducing the available oxygen for aquatic life. Pesticide and nutrient residues may be carried to the receiving water with the green wastes. The pollution prevention activities outlined in this fact sheets are used to prevent the discharge of pollutants to the storm drain system.

Think before disposing of any green wastes – Remember - The ocean starts at your front door.

## Required Activities

- Green wastes can not be disposed of in the street, gutter, public right-of-way, storm drain, or receiving water. Dispose of green wastes as a part of the household trash. If the quantities are too large, arrange a pick up with the local waste hauler.

- After conducting yard or garden activities sweep the area and properly dispose of the clippings and waste. Do not sweep or blow out into the street or gutter.

## Recommended Activities

- Utilize a commercial landscape company to conduct the landscape activities and waste disposal.

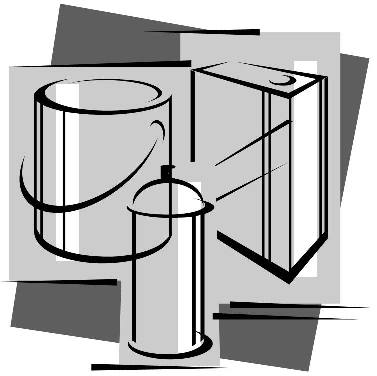
- Utilize native plants and drought tolerant species to reduce the water use and green waste produced.

- Use a lawn mower that has a mulcher so that the grass clippings remain on the lawn and do not have to be collected and disposed of.

- Compost materials in a designated area within the yard.

- Recycle lawn clippings and greenery waste through local programs if available.

For additional information contact:
County of Orange, OC Watershed
Main: (714) 955-0600/ 24hr Water Pollution Discharge Hotline 1-877-89-SPILL
or visit our website at: www.ocwatersheds.com



# R-7
# HOUSEHOLD HAZARDOUS WASTE

Household hazardous wastes (HHW) are defined as waste materials which are typically found in homes or similar sources, which exhibit characteristics such as: corrosivity, ignitability, reactivity, and/or toxicity, or are listed as hazardous materials by EPA.

| The activities outlined in this fact sheet target the following pollutants: | |
|---|---|
| Sediment | |
| Nutrients | |
| Bacteria | |
| Foaming Agents | x |
| Metals | x |
| Hydrocarbons | x |
| Hazardous Materials | x |
| Pesticides and Herbicides | x |
| Other | x |

List of most common HHW products:

- Drain openers
- Oven cleaners
- Wood and metal cleaners and polishes
- Automotive oil and fuel additives
- Grease and rust solvents
- Carburetor and fuel injection cleaners
- Starter fluids
- Batteries
- Paint Thinners
- Paint strippers and removers
- Adhesives
- Herbicides
- Pesticides
- Fungicides/wood preservatives

Many types of waste can be recycled, however options for each waste type are limited. Recycling is always preferable to disposal of unwanted materials. All gasoline, antifreeze, waste oil, and lead-acid batteries can be recycled. Latex and oil-based paint can be reused, as well as recycled. Materials that cannot be reused or recycled should be disposed of at a properly permitted landfill.

Think before disposing of any household hazardous waste. Remember - The ocean starts at your front door.

RECYCLE
USED OIL

## Required Activities

- Dispose of HHW at a local collection facility. Call (714) 834-6752 for the household hazardous waste center closest to your area.

- Household hazardous materials must be stored indoors or under cover, and in closed and labeled containers.

- If safe, contain, clean up, and properly dispose all household hazardous waste spills. If an unsafe condition exists, call 911 to activate the proper response team.

## Recommended Activities

- Use non-hazardous or less-hazardous products.
- Participate in HHW reuse and recycling. Call (714) 834-6752 for the participating household hazardous waste centers.

*The California Integrated Waste Management Board has a Recycling Hotline (800) 553-2962, that provides information and recycling locations for used oil.*

For additional information contact:
County of Orange, OC Watershed
Main: (714) 955-0600/ 24hr Water Pollution Discharge Hotline 1-877-89-SPILL
or visit our website at: www.ocwatersheds.com

# R-8
# WATER CONSERVATION

| The activities outlined in this fact sheet target the following pollutants: | |
|---|---|
| Sediment | x |
| Nutrients | x |
| Bacteria | x |
| Foaming Agents | x |
| Metals | x |
| Hydrocarbons | x |
| Hazardous Materials | x |
| Pesticides and Herbicides | x |
| Other | x |

Excessive irrigation and/or the overuse of water is often the most significant factor in transporting pollutants to the storm drain system. Pollutants from a wide variety of sources including automobile repair and maintenance, automobile washing, automobile parking, home and garden care activities and pet care may dissolve in the water and be transported to the storm drain. In addition, particles and materials coated with fertilizers and pesticides may be suspended in the flow and be transported to the storm drain.

Hosing off outside areas to wash them down not only consumes large quantities of water, but also transports any pollutants, sediments, and waste to the storm drain system. The pollution prevention activities outlined in this fact sheets are used to prevent the discharge of pollutants to the storm drain system.

Think before using water. Remember - The ocean starts at your front door.

## Required Activities

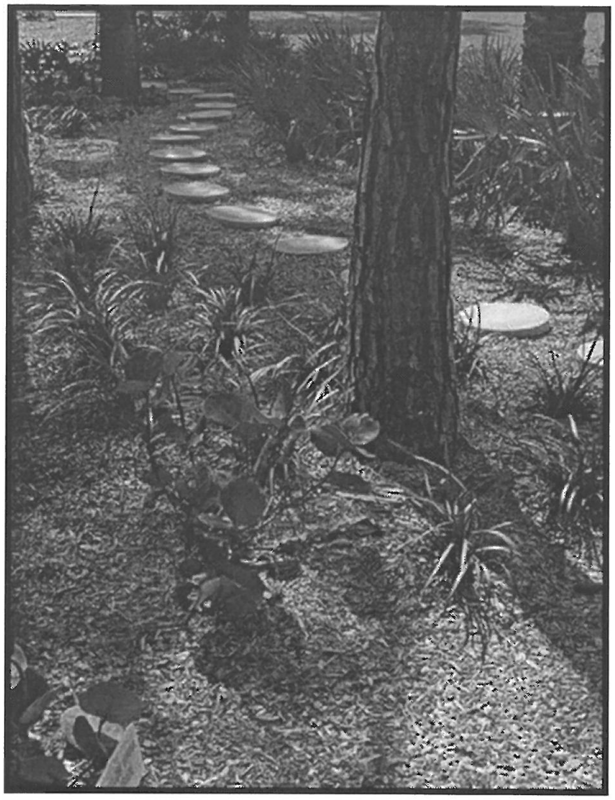
- Irrigation systems must be properly adjusted to reflect seasonal water needs.
- Do not hose off outside surfaces to clean, sweep with a broom instead.

## Recommended Activities

- Fix any leaking faucets and eliminate unnecessary water sources.
- Use xeroscaping and drought tolerant landscaping to reduce the watering needs.
- Do not over watering lawns or gardens. Over watering wastes water and promotes diseases.
- Use a bucket to re-soak sponges/rags while washing automobiles and other items outdoors. Use hose only for rinsing.
- Wash automobiles at a commercial car wash employing water recycling.

For additional information contact:
County of Orange, OC Watershed
Main: (714) 955-0600/ 24hr Water Pollution Discharge Hotline 1-877-89-SPILL
or visit our website at: www.ocwatersheds.com

# Site Design & Landscape Planning SD-10



### Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- ☑ Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

## Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from stormwater.

## Approach

Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

## Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

## Design Considerations

Design requirements for site design and landscapes planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.

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### *Designing New Installations*

Begin the development of a plan for the landscape unit with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.

- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open unwooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (e.g., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

#### *Conserve Natural Areas during Landscape Planning*

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.

- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.

- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.

- Promote natural vegetation by using parking lot islands and other landscaped areas.

- Preserve riparian areas and wetlands.

#### *Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit*

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.

- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

- Evaluating infiltration opportunities by referring to the stormwater management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydrogeological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

*Protection of Slopes and Channels during Landscape Design*

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Vegetate slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

### *Redeveloping Existing Installations*

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, disconnect directly connected impervious areas.

### Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

# Efficient Irrigation

# SD-12

**Design Objectives**

☑ Maximize Infiltration

☑ Provide Retention

☑ Slow Runoff

Minimize Impervious Land Coverage

Prohibit Dumping of Improper Materials

Contain Pollutants

Collect and Convey

## Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into stormwater drainage systems.

## Approach

Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the stormwater conveyance system.

## Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

## Design Considerations

### *Designing New Installations*

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where determined applicable and feasible by the Permittee:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.

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- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:
  - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff
  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect
  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible
  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth
- Employ other comparable, equally effective methods to reduce irrigation water runoff.

### *Redeveloping Existing Installations*

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

## Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

# Storm Drain Signage SD-13

### Design Objectives

Maximize Infiltration
Provide Retention
Slow Runoff
Minimize Impervious Land Coverage
☑ Prohibit Dumping of Improper Materials
Contain Pollutants
Collect and Convey

## Description

Waste materials dumped into storm drain inlets can have severe impacts on receiving and ground waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets.

## Approach

The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Storm drain messages have become a popular method of alerting the public about the effects of and the prohibitions against waste disposal.

## Suitable Applications

Stencils and signs alert the public to the destination of pollutants discharged to the storm drain. Signs are appropriate in residential, commercial, and industrial areas, as well as any other area where contributions or dumping to storm drains is likely.

## Design Considerations

Storm drain message markers or placards are recommended at all storm drain inlets within the boundary of a development project. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side. All storm drain inlet locations should be identified on the development site map.

### *Designing New Installations*

The following methods should be considered for inclusion in the project design and show on project plans:

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include "NO DUMPING

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– DRAINS TO OCEAN" and/or other graphical icons to discourage illegal dumping.

- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Note - Some local agencies have approved specific signage and/or storm drain message placards for use. Consult local agency stormwater staff to determine specific requirements for placard types and methods of application.

### *Redeveloping Existing Installations*

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. If the project meets the definition of "redevelopment", then the requirements stated under " designing new installations" above should be included in all project design plans.

## Additional Information

### *Maintenance Considerations*

- Legibility of markers and signs should be maintained. If required by the agency with jurisdiction over the project, the owner/operator or homeowner's association should enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards or signs.

### *Placement*

- Signage on top of curbs tends to weather and fade.

- Signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.

## Supplemental Information

### *Examples*

- Most MS4 programs have storm drain signage programs. Some MS4 programs will provide stencils, or arrange for volunteers to stencil storm drains as part of their outreach program.

## Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

# ATTACHMENT B

# OPERATIONS AND MAINTENANCE (O&M) PLAN

# OPERATION & MAINTENANCE (O&M) PLAN FOR WQMP

## Project Name:

## VICTORIA APARTMENTS

## Tract No. 735

## APN 668-361-01

**Prepared for:**

TOLL BROTHERS APARTMENT LIVING
23422 Mill Creek Drive, Suite 105
Launa Hills, CA 92653
949.573.7300

**Prepared on:**

February 28, 2020

**Revised on:**

May 28, 2020

**Engineer's Seal**

REGISTERED PROFESSIONAL ENGINEER
SHELBY L. SHIRLOCK
C 75912
EXP. 06/30/20
CIVIL
STATE OF CALIFORNIA

**Engineer:** Shelby Shirlock, PE
**Registration No:** 75912
16795 Von Karman Suite 100
Irvine, CA 92606
949.474.0960

# CONTENTS

# SECTION 1 PROJECT DESCRIPTION AND BMP OVERVIEW

| GENERAL PROJECT ATTRIBUTES AND STORMWATER CONTROL MEASURES | | |
|---|---|---|
| **Site Location:** | 26126 Victoria Boulevard, Dana Point, CA 92624<br>The project is located on the southeast corner of Victoria Blvd and Sepulveda Ave in the City of Dana Point. | |
| **Project Area:** | **Number of Dwelling Units:** 400 | **SIC Code:** N/A |
| **Narrative Project Description:** | The project site is currently developed and being utilized as a storage facility. Existing buildings and parking lots will be demolished and replaced with a 5-story on-grade wrap-style luxury apartment community which will wrap around a 6.5-level parking structure. The structure will provide 673 residential spaces and 80 visitor spaces for a total of 753 parking spaces. The apartment complex will consist of 17 studios, 241 one-bedroom units, 122 two-bedroom units, and 20 three-bedroom units for a total of 400 dwelling units.<br>The proposed residential building will include a leasing office, lobby, bike spa, and boardwalk storage room in the western/southwestern portion of the building. Six outdoor courtyards are proposed surrounding the proposed amenities. In addition, roof deck amenities that will include a pool & spa are proposed. All details are subject to change and will be finalized in the Final WQMP. | |
| **Project-Specific Source Control BMPs:** | N1 Education for Property Owners, Tenants & Occupants<br>N2 Activity Restrictions<br>N3 Common Area Landscape Management<br>N4 BMP Maintenance<br>N11 Common Area Litter Control<br>N12 Employee Training<br>N14 Common Area Catch Basin Inspection<br>N15 Street Sweeping Private Streets and Parking Lots<br>S1 Provide storm drain system stenciling and signage<br>S4 Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control | |
| **Summary of Drainage Patterns:** | Under proposed conditions, runoff will follow existing drainage patterns. A proposed storm drain system will route low flows to one of seven Modular Wetland Systems (MWS) for water quality treatment while high flows by-pass the system. Both treated and high flows will tie into an existing 30” or 36” storm drain system, exiting the site along Sepulveda Ave and Victoria Blvd. The drainage is then conveyed by a public storm drain system to the San Juan Creek, an Orange County Flood Control District (OCFCD) Channel, and ultimately out to the Pacific Ocean. Runoff from the adjacent 1 Freeway slope in the southern portion of the project site will be diverted around the site via | |

| GENERAL PROJECT ATTRIBUTES AND STORMWATER CONTROL MEASURES | |
|---|---|
| | new gutter and will continue to drain to Sepulveda Ave similar to existing conditions. |
| **Summary of Hydrologic Source Controls:** | Hydrologic Source Controls (HSC) are not proposed. The DCV for the site is addressed through structural LID BMPs (BIO-7: Proprietary Biotreatment). |
| **Structural Treatment and Hydromodification BMPs:** | BIO-7: Proprietary Biotreatment (Bio Clean Modular Wetland System). |

Modular Wetlands by Modular Wetlands Systems, Inc. are proprietary biotreatment systems that utilize multi-stage treatment processes including screening media filtration, settling, and biofiltration. The pre-treatment chamber contains the first three stages of treatment, and includes a catch basin inlet filter to capture trash, debris, gross solids and sediments, a settling chamber for separating out larger solids, and a media filter cartridge for capturing fine TSS, metals, nutrients, and bacteria. Runoff then flows through the wetland chamber where treatment is achieved through a variety of physical, chemical, and biological processes. As storm water passes down through the planting soil, pollutants are filtered, adsorbed, biodegraded and sequestered by the soil and plants, functioning similar to bioretention systems. The discharge chamber at the end of the unit collects treated flows and discharges back into the storm drain system.

| BMP ID | BMP Type | Narrative Description | Location | Other Considerations |
|---|---|---|---|---|
| MWS #1 | BIO-7 | Proprietary biotreatment that receives Flow from DMA 1. | North side of property in between Courtyard B and C. | |
| MWS #2 | BIO-7 | Proprietary biotreatment that receives Flow from DMA 2. | Northwest corner of property near Courtyard A. | |
| MWS #3 | BIO-7 | Proprietary biotreatment that receives Flow from DMA 3. | Southwest corner of property along Sepulveda Ave. | |
| MWS #4 | BIO-7 | Proprietary biotreatment that receives Flow from DMA 4. | Northeast side of property along PCH. | |
| MWS #5 | BIO-7 | Proprietary biotreatment that receives Flow from DMA 5. | Southeast side of property along PCH. | |
| MWS #6 | BIO-7 | Proprietary biotreatment that receives Flow from DMA 6. | Southwest side of property along PCH. | |
| MWS #7 | BIO-7 | Proprietary biotreatment that receives Flow from DMA 7. | Southwest corner of property along PCH. | |

# SECTION 2 PERSONNEL, DOCUMENTATION, AND REPORTING

## 2.1 MAINTENANCE ROLES AND RESPONSIBILITIES

The roles related to O&M of the BMPs are defined as follows:

- *Facility Owner* – The Facility Owner is the party who is ultimately responsible for the functionality of all BMPs. The maintenance agreement (Attachment 2) identifies the facility owner for each BMP, including the timing of any ownership transitions.
- *Responsible Party* – The Responsible Party is the party that shall have direct responsibility for the O&M of the BMPs. This party shall be the designated contact with inspectors and lead maintenance personnel. The Responsible Party shall sign self-inspection reports and any correspondence regarding the verification of inspections and required maintenance. The Responsible Party will establish a system to delegate general inquiries to the appropriate maintenance personnel concerning the operation and maintenance of the BMPs. The Responsible Party reports directly to the Facility Owner and operates and manages the BMPs on the Facility Owner's behalf.
- *Designated Emergency Respondent* – The Designated Emergency Respondent is the party responsible for directing activities and communications during emergencies such as broken irrigation pipes, landslides, hazardous spill responses etc., that would require immediate response should they occur during off-hours. It is the responsibility of the Designated Emergency Respondent to communicate the emergent situation with the Responsible Party as soon as possible.
- *Key Maintenance Personnel* – Key Maintenance Personnel are the designated lead field manager(s) or supervisor(s) who directly oversee and delegate the maintenance activities, maintain the scheduling, and coordinate activities between all personnel. These tend to change more often than other personnel over time, so their names do not necessarily need to be included in the O&M Plan. However, they must be properly trained as recorded in the training logs (Section 2.2).

The table below lists the roles for this project. This table must be updated whenever changes occur.

| Role | Name (Title and Affiliation) | Phone Number | Address | Email Address |
|---|---|---|---|---|
| **Facility Owner** | Toll Bros., Inc. | 855.897.8655 | 250 Gibraltar Road, Horsham, PA 19044 | N/A |
| **Responsible Party** | John Hyde<br>Senior Project Manager | 949.573.7300 | 23422 Mill Creek Drive, Suite 105, Laguna Hills, CA 92653 | jhyde@tollbrothers.com |

| Role | Name (Title and Affiliation) | Phone Number | Address | Email Address |
|---|---|---|---|---|
| Designated Emergency Respondent | Pending – to be provided in Final WQMP | | | |

## 2.2 QUALIFICATION AND TRAINING REQUIREMENTS FOR PERSONNEL

Many of the activities presented in this O&M plan can be completed by personnel with basic landscaping and yard maintenance skills and project-specific orientation. However, there are activities that require a more experienced skillset to identify and remediate potential issues that could compromise the functionality of each BMP. The Responsible Party shall exercise discretion in determining the skillset required to complete each task.

Activities that can typically be completed by maintenance personnel with basic training and/or qualifications include:

- General landscaping activities (pruning, weeding, and raking)
- Routine sediment, trash and debris removal;
- Filling in minor scour or erosion areas, or replacing rip rap that has become displaced; and
- Watering or irrigation, as necessary.

Activities that typically require maintenance personnel with specialized qualifications, training, and/or engineering oversight include:

- Inspection and/or repair of inflow and outflow structures;
- Inspection and/or repair of underground elements;
- Large-volume sediment or media removal requiring specialized equipment;
- Inspection, diagnosis, and remediation of significant erosion issues potentially compromising function and/or structural stability; and
- Spill response and remediation.

Maintenance personnel who have identified a potential major issue with any facility should contact the designated key maintenance personnel for the facility immediately.

Training must be provided for all personnel performing maintenance tasks on or providing maintenance oversight of structural BMPs. The table below provides the personnel and relevant training topics.

Training Logs contained in Attachment 3 should be used to document training of maintenance personnel.

| Training Topic | Responsible Party | Designated Emergency Respondent | Key Maintenance Personnel |
|---|---|---|---|
| Proper Maintenance of all BMP components | X | | X |
| Identification and clean-up procedures for spills and overflows | X | X | X |
| Safety concerns when maintaining devices and responding to emergency situations | X | X | X |

## 2.3 MAINTENANCE AGREEMENTS AND FUNDING MECHANISMS

The Owner, Toll Brothers Apartment Living, shall assume all BMP maintenance and inspection responsibilities for the proposed project. Should the maintenance responsibility be transferred at any time during the operational life of Victoria Apartments, such as when an HOA or POA is formed for a project, a formal notice of transfer shall be submitted to the City of Dana Point at the time responsibility of the property subject to this WQMP is transferred. The transfer of responsibility shall be incorporated into this O&M Plan. Copies of the forms will be included in Attachment 2 of the Final WQMP.

Long-term-funding for BMP maintenance will be provided by Toll Brothers Apartments through the standard operating budget.

## 2.4 RECORD KEEPING REQUIREMENTS

Documentation of site conditions, maintenance activities performed, and any other remaining maintenance required is necessary during each inspection/maintenance visit. Inspection and maintenance records shall be retained in an accessible, secure location for the life of the facility, and not less than 10 years.

The following documentation mechanisms and procedures have been established for this O&M Plan:

- Training Logs: Personnel must document training activities as part of implementing this O&M Plan. Attachment 3 contains a sample training log.
- Inspection and Routine Maintenance Logs: Maintenance personnel are required to maintain logs of inspection and maintenance activities. Attachment 4 contain inspection and maintenance logs.
- Rehabilitative and Corrective Maintenance Log and Reporting: Rehabilitation and corrective maintenance activities should be documented at a degree of detail that is commensurate to the complexity/significance of the activity. Any significant changes to the BMP designs that arise from rehabilitation/corrective maintenance will be documented via an update to the Project WQMP and as-built drawings. Corrective maintenance that does not result in design changes

will be documented as a special entry in the maintenance logs to provide pertinent details of that rehabilitative or corrective maintenance activity.

The Project is not subject to any monitoring requirements.

## 2.5 REQUIRED PERMITS ASSOCIATED WITH MAINTENANCE ACTIVITIES

The Project is not subject to any permits.

## 2.6 SELF-REPORTING REQUIREMENTS

The **WQMP Verification Form** (Attachment 4) shall be completed accurately and submitted with associated documentation to the City of Dana Point by September 30 of each year, or as requested by the City. **Failure to complete and submit the verification form will result in a noncompliance and enforcement actions may be taken.**

## 2.7 CITY INSPECTIONS

The City of Dana Point may conduct a site inspection to evaluate compliance with the Project WQMP, at any time, in accordance with the Dana Point Municipal Code Chapter 15.10, Storm Water/Surface Runoff Water Quality (water quality ordinance).

## 2.8 ELECTRONIC DATA SUBMITTAL

This document, along with the attachments, shall be provided to the City or County in PDF format. AutoCAD files and/or GIS coordinates of BMPs shall also be submitted to the City/County, upon request.

# SECTION 3 INSPECTION AND MAINTENANCE ACTIVITIES

This section identifies the inspection and O&M activities for each BMP incorporated into the project. Section 3.1 and 3.2 contain common maintenance activities and frequencies associated with Source Control BMPs and HSCs, respectively. Section 3.3 contains individual tables for each structural LID or hydromodification BMP with an explanation of the various types of maintenance activities associated with these BMPs.

## 3.1 INSPECTION AND MAINTENANCE OF SOURCE CONTROL BMPS

| Source Control BMP | Activity | Frequency |
|---|---|---|
| Dry Weather Flow Source Control<br>**Note: this is a South Orange County High Priority Water Quality Condition for All Projects** | Check for dry weather flows such as street washing, irrigation overspray, air conditioner condensate in areas of the project that do not drain to LID BMPs, the sanitary sewer, or landscaped pervious areas. Notify residents of any dry weather flows and follow up to correct. | Twice per year during dry season |
| | Inspect project outfall or most-downstream project manhole for presence of dry weather flow. If present, conduct reconnaissance to determine source and implement actions to eliminate source. | Twice per year during dry season |
| N1. Education for Property Owner's Tenants and Occupants | Distribute appropriate materials to owners, tenants, and/or occupants via contract language, mailings, website, or meetings. | Information provided to owners and tenants upon sale or lease. Reminders sent or posted as needed. |
| | Check www.ocwatersheds.com and/or City website for updated educational materials. | Annually |
| N2. Activity Restrictions | Within the CC&R's or lease agreement, restrict the following activities: handling and disposal of contaminants, fertilizer and pesticide application restrictions, litter control and pick-up, and vehicle or equipment repair and maintenance in non- designated areas, as well as any other activities that may potentially contribute to water pollution. | Information provided to owners and tenants upon sale or lease. Reminders sent or posted as needed. |
| N3/S4. Common Area Landscape Management, Efficient Landscape | Check that fertilizer and pesticide usage is in accordance with the Integrated Pest Management Program. Adjust, if needed. | Annually |

| Source Control BMP | Activity | Frequency |
|---|---|---|
| Design, and Efficient Irrigation | Check the irrigation system water budget to ensure efficiency targets are being met and the system is in good condition. Adjust/repair irrigation system and controllers, if needed. | Annually prior to irrigation system activation |
| | Check landscaping for presence of invasive species and remove, if needed. | Annually |
| N11. Common Area Litter Control | Remove trash from around trash enclosure, inspect to ensure lids closed, structurally sound, and not overflowing. Repair or replace, as needed. | Monthly |
| | Inspect common area for litter and trash disposal violations by homeowners and reporting to the HOA or responsible party for investigation. Remove litter, as needed. | Weekly |
| N14. Common Area Catch Basin Inspection | Remove trash and debris from catch basins and grates. Check for damage, clogging, and standing water. Repair or mitigate clogging/standing water, as needed. | Four times per year during wet season, including inspection just before the wet season and within 24 hours after at least two storm events >0.5 inches |
| N15. Street Sweeping Private Streets and Parking Lots | Sweep curb and gutter areas using a vacuum street sweeper. Report any significant or illicit debris in curb/gutter to HOA or responsible party, as needed. | Weekly |
| S1. Provide Storm Drain System Stenciling and Signage | Check that all catch basins in paved areas marked or stenciled with “No dumping-Drains to Ocean; No Descargue Basura” language. Replace/repaint markings if faded, damaged, removed, or otherwise illegible. | Annually |

## 3.2 INSPECTION AND MAINTENANCE OF HYDROLOGIC SOURCE CONTROLS

Hydrologic Source Controls (HSC) are not proposed. The DCV for the site is addressed through structural LID BMPs (BIO-7: Proprietary Biotreatment).

| HSCs | Activity | Frequency |
|---|---|---|
| N/A | N/A | N/A |

## 3.3 INSPECTION AND MAINTENANCE OF STRUCTURAL LID AND HYDROMODIFICATION BMPS

The section is organized by type of structural LID or hydromodification BMP with separate tables for each BMP type included in the project. The section identifies four categories of activities related to O&M of the BMPs:

**General Inspections** – Evaluations conducted at regularly scheduled intervals to indicate the need for maintenance of structural BMPs.

**Routine Maintenance Activities** – Activities conducted at regularly scheduled intervals to sustain long-term performance of each BMP, including inspections and normal upkeep.

**Corrective (Major) Maintenance Activities** – Includes activities conducted to replace or rehabilitate system components at the end of their usable life as well as activities conducted to resolve major issues that are not anticipated.

**Emergency Response Activities** – Activities related to emergencies, primarily concerning spills, which may require immediate action and notifications (Section 3.4).

| BMP ID | BMP Type | Reference Maintenance Table |
|---|---|---|
| MWS (Quantity: 7) | BIO-7 | BIO-7 (page 12) |

<table>
<tr><th colspan="2">BIO-5/7 PROPRIETARY BIOTREATMENT</th></tr>
<tr><th>Activity</th><th>Frequency</th></tr>
<tr><td colspan="2">GENERAL INSPECTIONS</td></tr>
<tr><td>Remove trash and debris</td><td rowspan="6">Four times per year during wet season, including inspection just before the wet season and within 24 hours after at least two storm events ≥ 0.5 inches.</td></tr>
<tr><td>Identify excess erosion or scour</td></tr>
<tr><td>Identify sediment accumulation that requires maintenance</td></tr>
<tr><td>Inspect during storm event, when possible, to estimate treatment capacity and determine if premature bypass is occurring</td></tr>
<tr><td>Evaluate plant health and need for corrective action</td></tr>
<tr><td>Identify any needed corrective maintenance that will require site-specific planning or design</td></tr>
<tr><td colspan="2">OPERATION AND MAINTENANCE</td></tr>
<tr><td colspan="2">• O&M of proprietary BMPs must follow established manufacturer guidelines<br>• O&M of accompanying retention BMPs should follow the guidelines established in the associated fact sheet for that BMP.</td></tr>
</table>

## 3.4 EMERGENCY RESPONSE PLAN

In some cases, adverse conditions may occur which could be an imminent threat to human or environmental health or severe damage to infrastructure or property. For example, a spill of hazardous substances in the contributing area to a BMP could cause harmful substances to enter the BMP and be released downstream, affecting environmental and public health. Other emergencies could arise related to the stormwater features or water quality protection, such as landsliding, major erosion, or burst pipes in the tributary area.

In the event of an actual or suspected hazardous material release, the following plan shall take effect. The primary importance of initial response to an actual or suspected spill will be public safety, control of the source of pollution, and containment of spills that have occurred, as applicable. The table below provides the emergency contact information for hazardous materials spills affecting BMPs.

| Name | Phone | When to Report |
|---|---|---|
| Local Emergency Response (Fire Department) | 911 | Immediately |
| Orange County 24-Hour Water Pollution Problem Reporting Hotline | 1-877-897-7455 | Immediately |
| CalOES State Warning Center | 1-800-852-7550 | Immediately |

The first number to call is emergency response (9-1-1), followed by the California Governor's Office of Emergency Services (CalOES), formerly the California Emergency Management Agency (CalEMA). (CalOES) maintains guidance and instructions of what to do in the event of a spill of hazardous substances (http://www.caloes.ca.gov/cal-oes-divisions/fire-rescue/hazardous-materials/spill-release-reporting). This plan is based on the guidance provided by CalOES (CalOES, 2014).

1. If an actual or suspected hazardous material incident exists, maintenance personnel will immediately call 911 and the CalOES State Warning Center (Table 6).
2. The Designated Emergency Respondent and Responsible Party assigned to the facility (from Section 2.1) must also be notified of any actual or potential spill.
3. Remediation of contamination in the water quality facility should be handled as a corrective maintenance issue per Section 3.2 of this O&M plan.

In the event that a potential spill is identified prior to it reaching the BMPs, the Designated Emergency Respondent will implement an isolation protocol to prevent the spill from entering the BMP. An inflatable plug, Hazmat Plug, or equivalent device as approved by the Designated Emergency Respondent will be installed within the storm drains or catch basins to block upstream flow from reaching and contaminating the BMP. The temporary plug will be an interim measure until the spill is properly maintained and remediated and the Designated Emergency Respondent has determined the risk to the BMP of contamination no longer exists.

Similar measures should be taken in the event of a landslide, mudslide, or major erosion within the tributary area of the BMP to prevent sediment from damaging the BMP to the extent possible.

## 3.5 VECTOR CONTROL

In addition to the inspection and maintenance activities listed in Section 3, all BMPs shall be inspected for standing water on a regular basis. Standing water which exists for longer than 72 hours may contribute to mosquito breeding areas. Standing water may indicate that the BMP is not functioning properly and proper action to remedy the situation shall be taken in a timely manner.

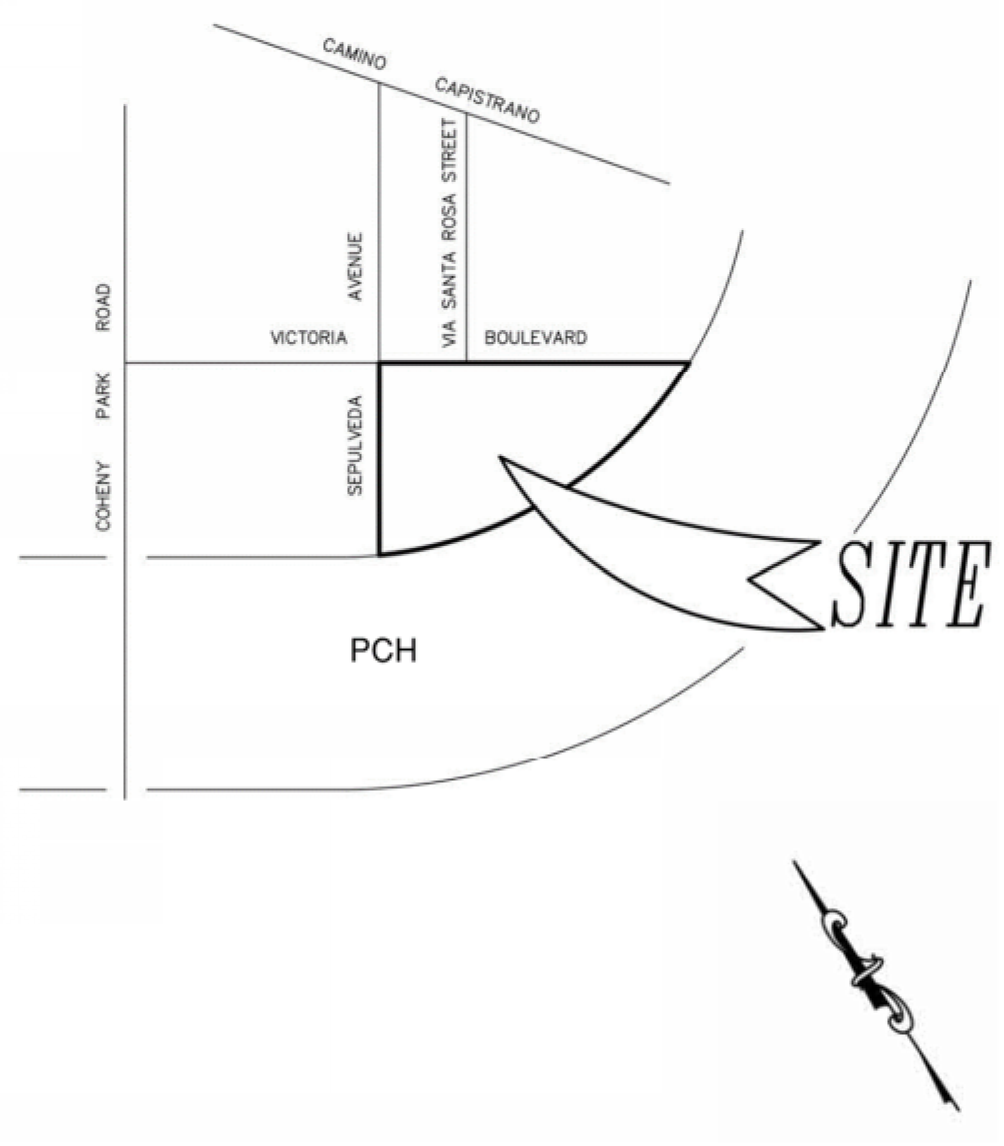
Elimination of standing water and managing garbage, lawn clippings, and pet droppings can help decrease the present of mosquitoes and flies in the area.

The Orange County Vector Control District may be contacted for more information and support at 714-971-2421 or 949-654-2421 or www.ocvcd.org.

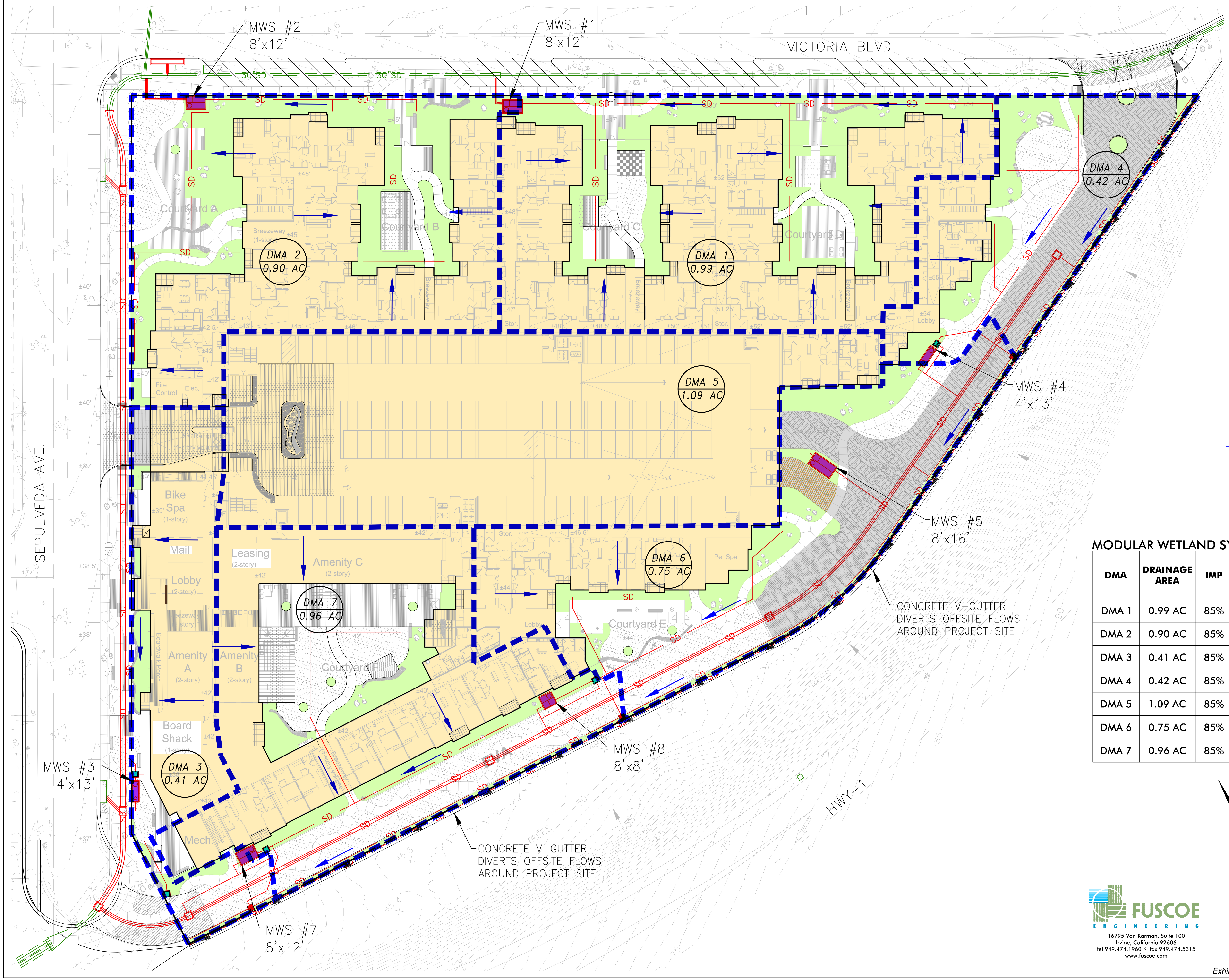
# ATTACHMENT 1 PHOTOS AND EXHIBITS

- Vicinity Map
- WQMP Exhibit
- MWS Cross Section Details

# VICINITY MAP



Not to Scale



## LEGEND

| | |
|---|---|
| ‐ ‐ ‐ | PROPERTY LINE |
| ═ | EXISTING STORM DRAIN TO BE DEMOLISHED |
| ═ | EXISTING STORM DRAIN TO REMAIN |
| ═ | PROPOSED STORM DRAIN |
| ▬ ▬ | BMP DRAINAGE AREA BOUNDARY |
| 🟩 | PROPOSED LANDSCAPE |
| 🟨 | PROPOSED BUILDING |
| ▨ | STREET SWEEPING PRIVATE STREETS & DRIVE AISLES |
| 🟥 | CATCH BASIN STENCILING & MAINTENANCE |
| 🟦 | LOW FLOW DIVERSION STRUCTURE |
| 🟪 | MODULAR WETLAND SYSTEM UNIT |
| ▨ | TRASH STAGING AREA / LOADING ZONE |
| → | DIRECTION OF FLOW |
| DMA_1 X.XX_AC | DRAINAGE MANAGEMENT AREA AND ACREAGE |

### MODULAR WETLAND SYSTEM DESIGN SUMMARY

| DMA | DRAINAGE AREA | IMP | Q FLOW RATE 80% CAPTURE | Q DESIGN (80% X 1.5) | SIZE / MODEL | TOTAL TREATMENT CAPACITY |
|---|---|---|---|---|---|---|
| DMA 1 | 0.99 AC | 85% | 0.203 CFS | 0.304 CFS | MWS-L-8-12 | 0.346 CFS |
| DMA 2 | 0.90 AC | 85% | 0.184 CFS | 0.277 CFS | MWS-L-8-12 | 0.346 CFS |
| DMA 3 | 0.41 AC | 85% | 0.084 CFS | 0.126 CFS | MWS-L-4-13 | 0.144 CFS |
| DMA 4 | 0.42 AC | 85% | 0.086 CFS | 0.129 CFS | MWS-L-4-13 | 0.144 CFS |
| DMA 5 | 1.09 AC | 85% | 0.223 CFS | 0.335 CFS | MWS-L-8-16 | 0.462 CFS |
| DMA 6 | 0.75 AC | 85% | 0.154 CFS | 0.230 CFS | MWS-L-8-8 | 0.231 CFS |
| DMA 7 | 0.96 AC | 85% | 0.197 CFS | 0.295 CFS | MWS-L-8-12 | 0.346 CFS |

80' 0' 40' 80'
SCALE: 1" = 80'

FUSCOE
ENGINEERING
16795 Von Karman, Suite 100
Irvine, California 92606
tel 949.474.1960 ∘ fax 949.474.5315
www.fuscoe.com

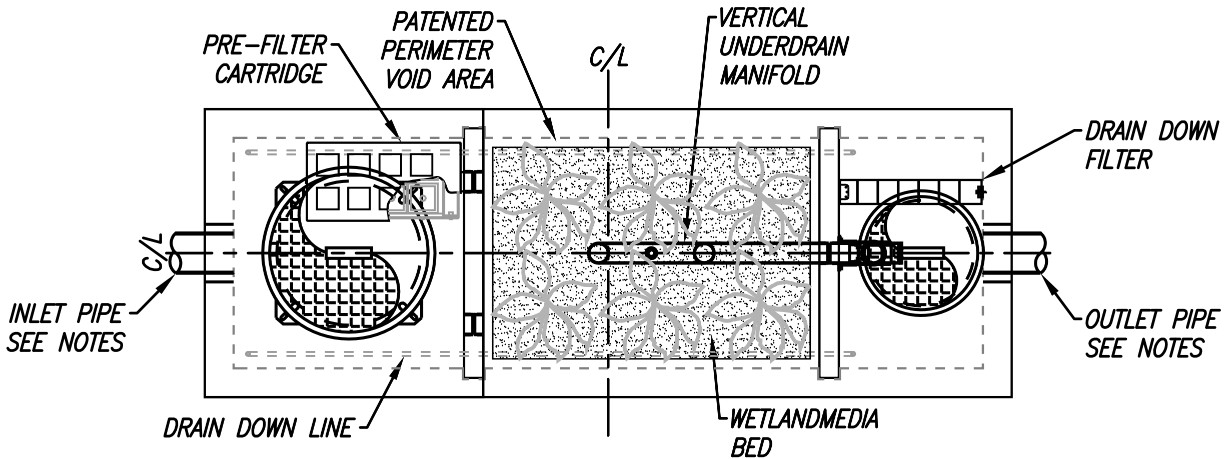
Exhibit Date: 06/16/2021

# PRELIMINARY WQMP EXHIBIT
## VICTORIA APARTMENTS
## DANA POINT, CA

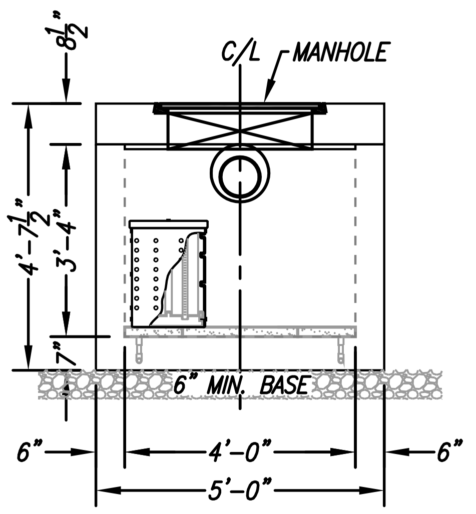
F:\PROJECTS\1665\004_SUPPORT FILES\REPORTS\WQMP\PRELIMINARY WQMP\ATTACHMENTS\ATTACHMENT C – EXHIBITS\1665-004XH_PWQMP VICTORIAAPARTMENTS_2021-04-30.DWG (06-16-21 2:29:59PM) Plotted by: Suleen Lao

## SITE SPECIFIC DATA

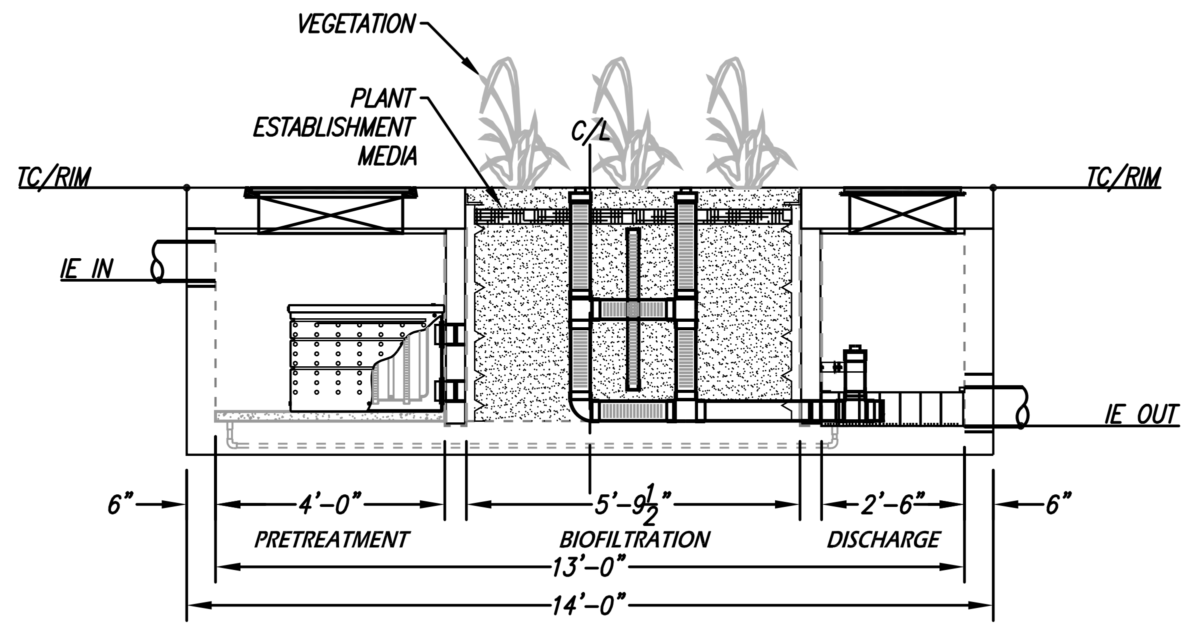
| | | | |
|---|---|---|---|
| PROJECT NAME | | | |
| PROJECT LOCATION | | | |
| STRUCTURE ID | | | |
| TREATMENT REQUIRED | | | |
| VOLUME BASED (CF) | | FLOW BASED (CFS) | |
| | | | |
| TREATMENT HGL AVAILABLE (FT) | | | |
| PEAK BYPASS REQUIRED (CFS) - IF APPLICABLE | | | |
| PIPE DATA | I.E. | MATERIAL | DIAMETER |
| INLET PIPE 1 | | | |
| INLET PIPE 2 | | | |
| OUTLET PIPE | | | |
| | PRETREATMENT | BIOFILTRATION | DISCHARGE |
| RIM ELEVATION | | | |
| SURFACE LOAD | PARKWAY | OPEN PLANTER | PARKWAY |
| FRAME & COVER | ø30" | N/A | ø24" |
| WETLANDMEDIA VOLUME (CY) | | | 3.05 |
| WETLANDMEDIA DELIVERY METHOD | | | TBD |
| ORIFICE SIZE (DIA. INCHES) | | | ø1.71" |
| MAXIMUM PICK WEIGHT (LBS) | | | 27000 |
| NOTES: | | | |



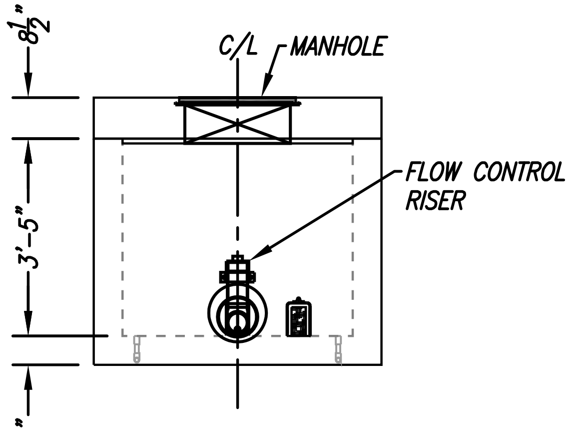
PLAN VIEW



LEFT END VIEW



ELEVATION VIEW



RIGHT 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.
3. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE. (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL GAPS AROUND PIPES SHALL BE SEALED WATER TIGHT WITH A NON-SHRINK GROUT PER MANUFACTURERS STANDARD CONNECTION DETAIL AND SHALL MEET OR EXCEED REGIONAL PIPE CONNECTION STANDARDS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. DRIP OR SPRAY IRRIGATION REQUIRED ON ALL UNITS WITH VEGETATION.

## GENERAL NOTES

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

| | |
|---|---|
| TREATMENT FLOW (CFS) | 0.144 |
| OPERATING HEAD (FT) | 3.4 |
| PRETREATMENT LOADING RATE (GPM/SF) | TBD |
| WETLAND MEDIA LOADING RATE (GPM/SF) | 1.0 |

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

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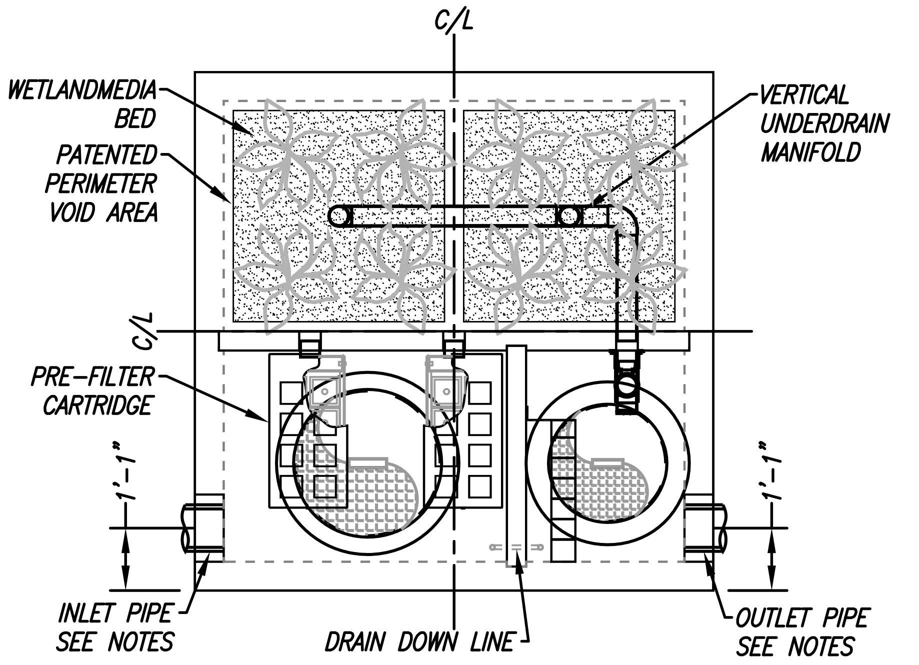
# MWS-L-4-13-V
# STORMWATER BIOFILTRATION SYSTEM
# STANDARD DETAIL

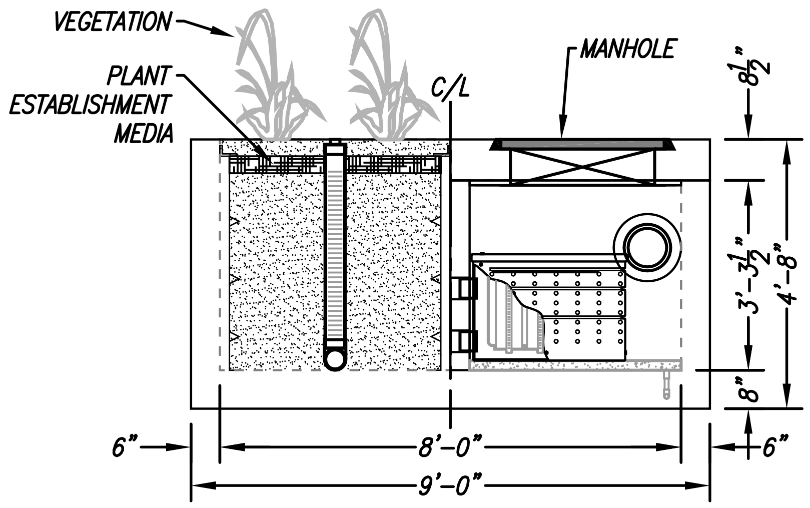
## SITE SPECIFIC DATA

| | | | |
|---|---|---|---|
| PROJECT NUMBER | | | |
| ORDER NUMBER | | | |
| PROJECT NAME | | | |
| PROJECT LOCATION | | | |
| STRUCTURE ID | | | |
| TREATMENT REQUIRED | | | |
| VOLUME BASED (CF) | | FLOW BASED (CFS) | |
| | | | |
| TREATMENT HGL AVAILABLE (FT) | | | |
| PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE | | | |
| PIPE DATA | I.E. | MATERIAL | DIAMETER |
| INLET PIPE 1 | | | |
| INLET PIPE 2 | | | |
| OUTLET PIPE | | | |
| | PRETREATMENT | BIOFILTRATION | DISCHARGE |
| RIM ELEVATION | | | |
| SURFACE LOAD | PEDESTRIAN | OPEN PLANTER | PEDESTRIAN |
| FRAME & COVER | ø30" | N/A | ø24" |
| WETLANDMEDIA VOLUME (CY) | | | TBD |
| ORIFICE SIZE (DIA. INCHES) | | | TBD |

NOTES: PRELIMINARY NOT FOR CONSTRUCTION.



**PLAN VIEW**



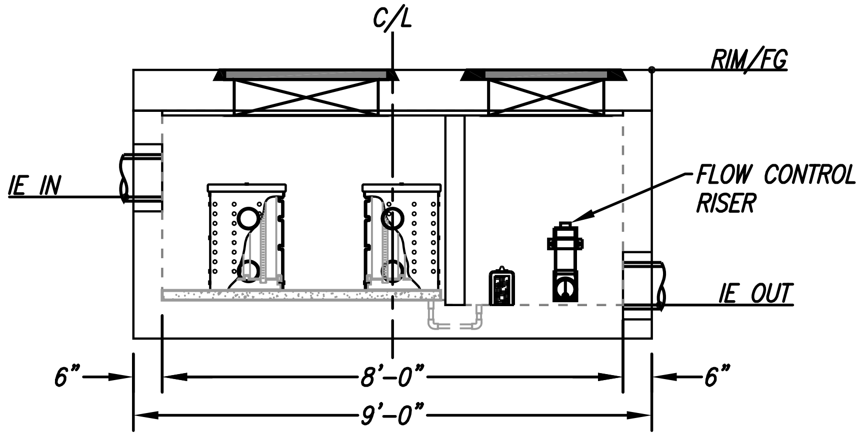
**LEFT END VIEW**

## INSTALLATION NOTES

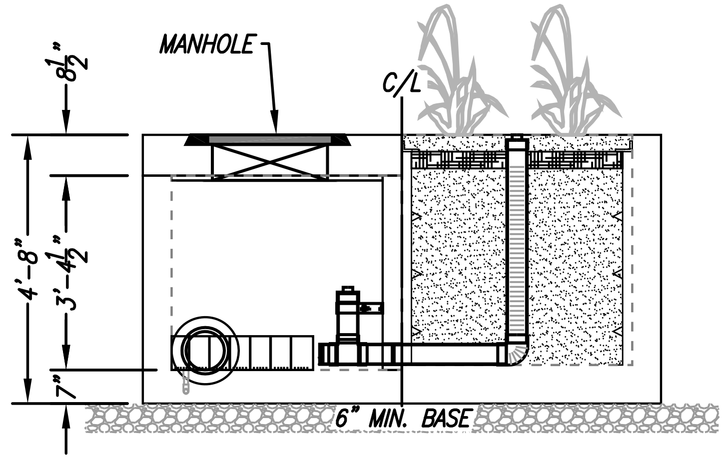
1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURERS CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER 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.



**ELEVATION VIEW**



**RIGHT END VIEW**

| | |
|---|---|
| TREATMENT FLOW (CFS) | 0.231 |
| OPERATING HEAD (FT) | 3.4 |
| PRETREATMENT LOADING RATE (GPM/SF) | 2.0 |
| WETLAND MEDIA LOADING RATE (GPM/SF) | 1.0 |

MODULAR WETLANDS

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Bio Clean
A Forterra Company

# MWS-L-8-8-V
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

MODULAR WETLANDS™

# MODULAR WETLAND SYSTEMS LINEAR 2.0
# VAULT TYPE

*FLOW RATES*

PEAK TREATMENT FLOW RATE
= 0.35 CFS OR 155.49 GPM

PEAK BYPASS FLOW RATE
= N/A

*SPECIFICATIONS*

INSTALL AT SURFACE

O.D. DIMENSIONS
= 13' X 9' X 4.63'

RIM ELEVATION TO IE OUT:
= 4.13'

**BIOFILTRATION CHAMBER SURFACE AREA CALCS**

SIDES = 4
3.7' L x 3.4' H = 12.58 SF
12.58 SF X 4 SIDES = 50.32
CELLS = 3
50.32 X 3 CELLS = 150.96

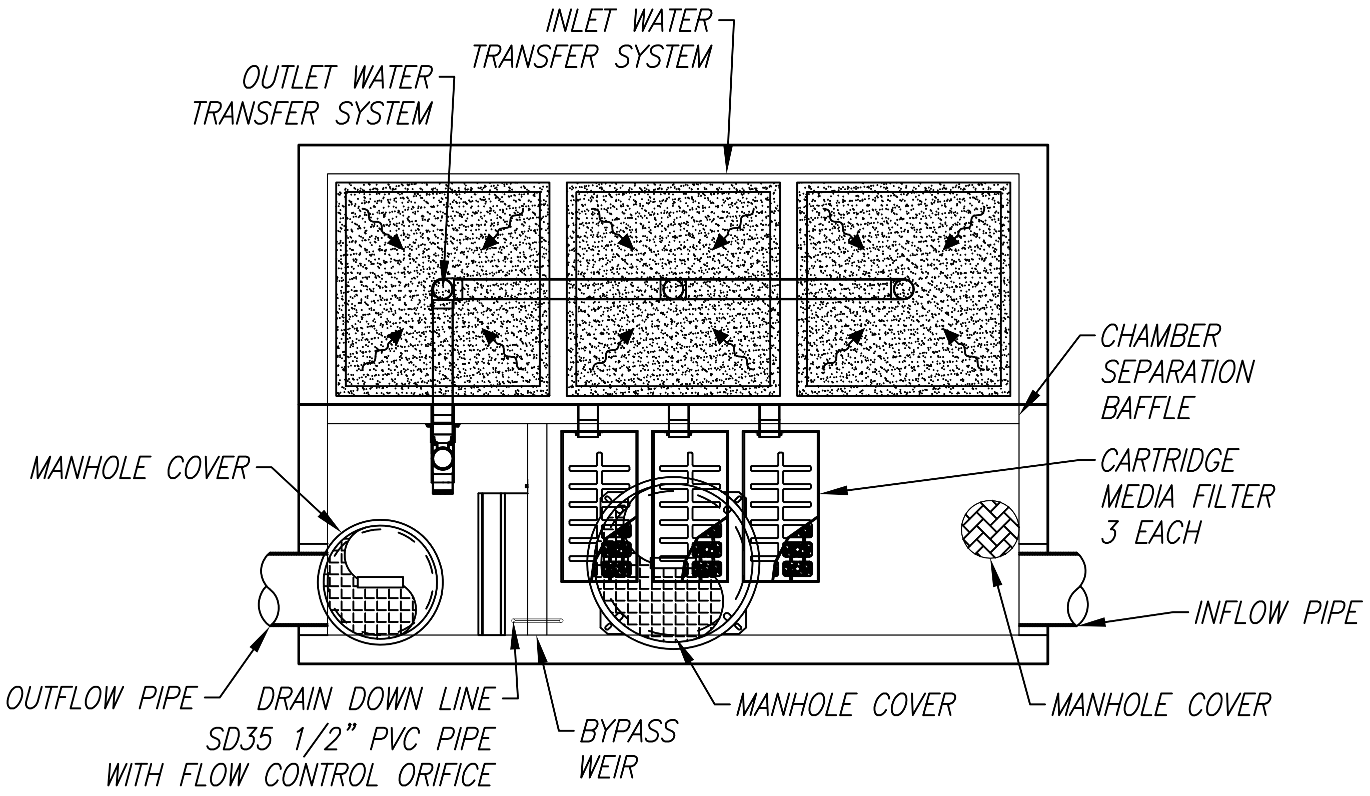
TOTAL WETLAND MEDIA SURFACE AREA
**= 150.96 SF**

WETLAND MEDIA LOADING RATE
155.49 GPM / 150.96 SF
**= 1.03 GPM/SF**

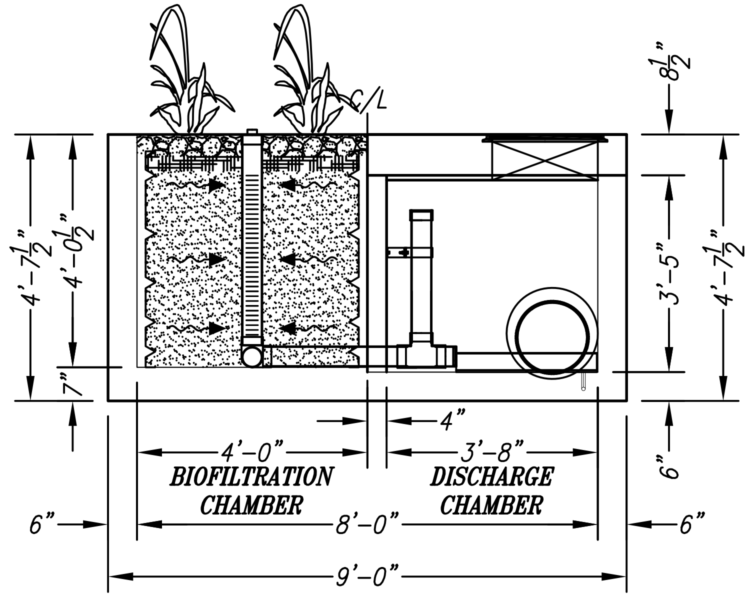
**PRETREATMENT FILTER SURFACE AREA CALCS**

TOTAL PRETREATMENT SURFACE AREA
**= 75 SF**

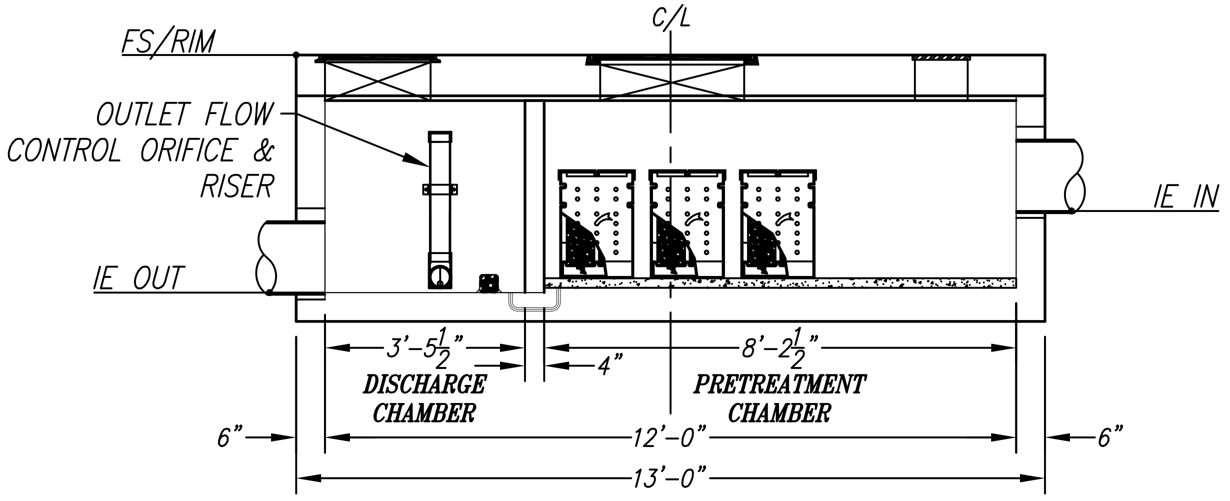
PRETREATMENT FILTER LOADING RATE
155.49 GPM / 75 SF
**= 2.07 GPM/SF**



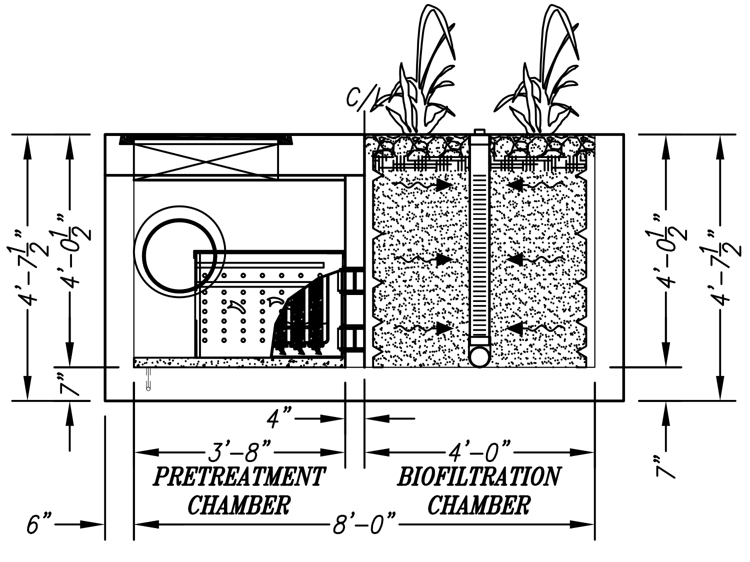
**PLAN VIEW**



**LEFT END VIEW**



**ELEVATION VIEW**



**RIGHT END VIEW**

## LEGEND

| | |
|---|---|
| ▨ | WETLAND MEDIA |
| ▦ | PLANT/ROOT MOISTURE RETENTION LAYER |
| ▩ | MANHOLE / ACCESS HATCH |

INSTALLATION NOTES:

1. INSTALL UNIT ON LEVEL BED OF GRAVEL OF AT LEAST 6" IN DEPTH WITH 1' MINIMUM OVER EXCAVATION AROUND ENTIRE UNIT.
2. CONCRETE 28 DAY COMPRESSIVE STRENGTH fc=5,000 PSI.
3. REINFORCING: ASTM A-615, GRADE 60.
4. RATED FOR PARKWAY LOADING 300 PSF.
5. JOINT SEALANT: BUTYL RUBBER SS-S-00210

MODULAR WETLAND SYSTEMS INC.
P.O. BOX 869
OCEANSIDE, CA 92049
www.ModularWetlands.com

PROPRIETARY AND CONFIDENTIAL

| | NAME | DATE |
|---|---|---|
| DRAWN | | |
| REVIEWED | | |
| APPROVED | | |
| COMMENTS: | | |

TITLE: MWS LINEAR 2.0
VAULT TYPE

SIZE
DWG. NO. MWS-L-8-12-UG-V
REV

SCALE NTS
UNITS = INCHES
SHEET 1 OF 2

MODULAR WETLANDS™

FLOW RATES

PEAK TREATMENT FLOW RATE = 0.35 CFS OR 155.49 GPM

PEAK BYPASS FLOW RATE = DEPENDENT ON PIPE SIZE

SPECIFICATIONS

INSTALL AT SURFACE

O.D. DIMENSIONS = 13' X 9' X 5.33'

RIM ELEVATION TO IE OUT: = 4.83'

# MODULAR WETLAND SYSTEMS LINEAR 2.0
# VAULT TYPE

**BIOFILTRATION CHAMBER SURFACE AREA CALCS**

SIDES = 4

3.7' L x 3.4' H = 12.58 SF

12.58 SF X 4 SIDES = 50.32

CELLS = 3

50.32 X 3 CELLS = 150.96

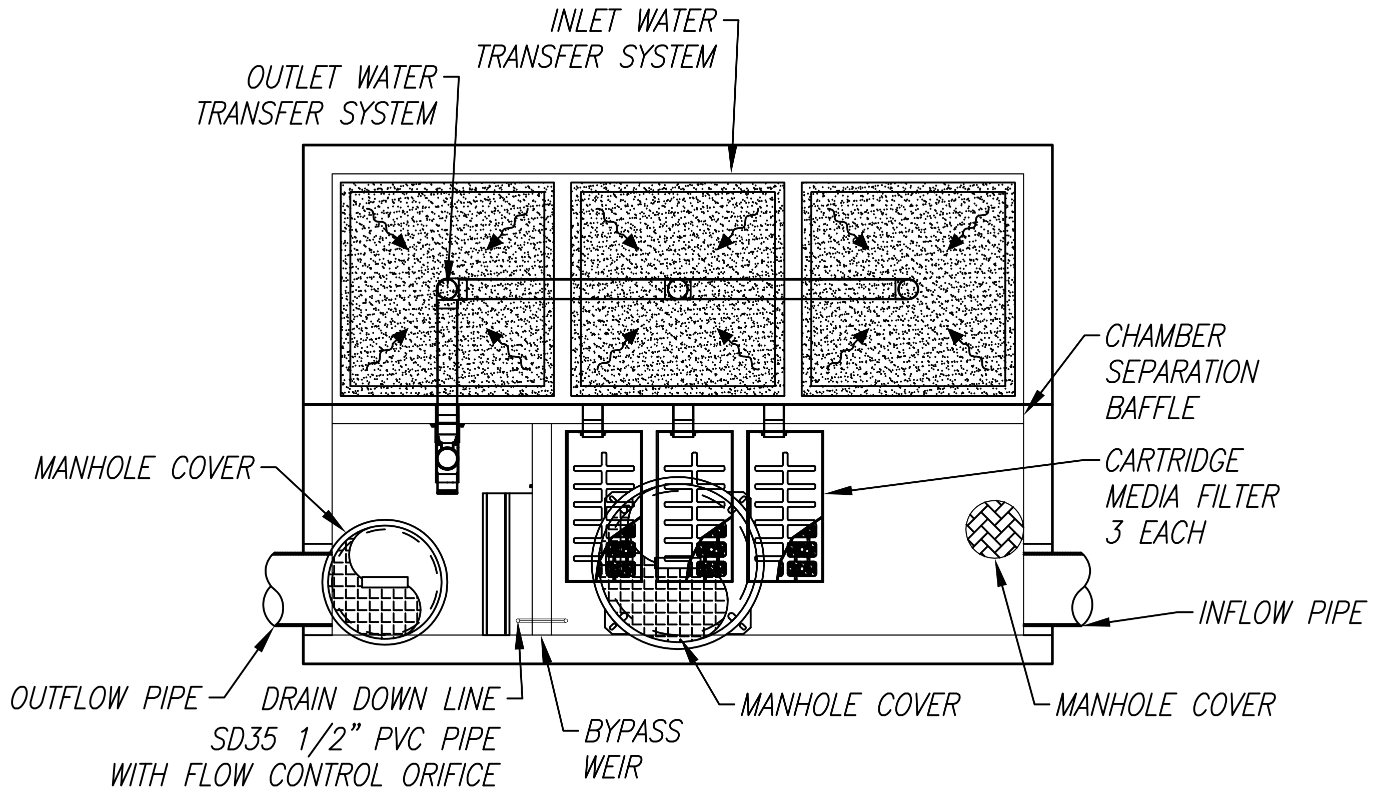
TOTAL WETLAND MEDIA SURFACE AREA **= 150.96 SF**

WETLAND MEDIA LOADING RATE
155.49 GPM / 150.96 SF
**= 1.03 GPM/SF**

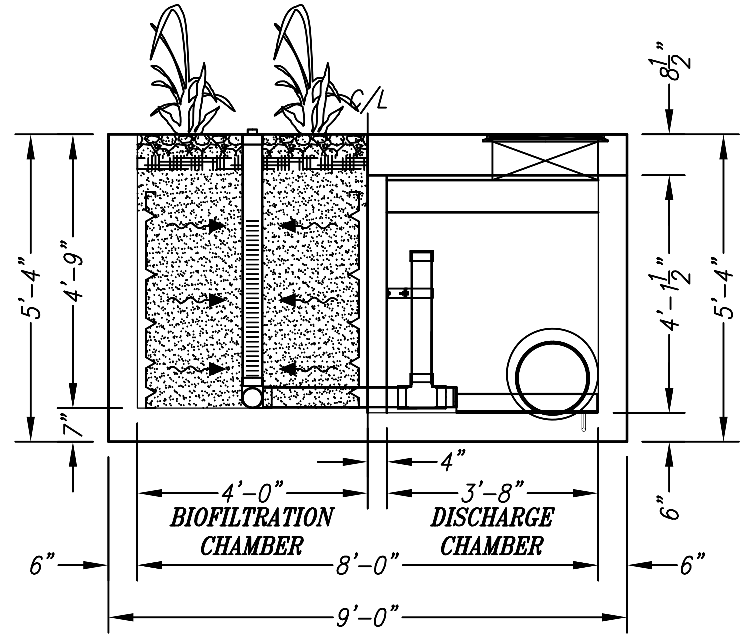
**PRETREATMENT FILTER SURFACE AREA CALCS**

TOTAL PRETREATMENT SURFACE AREA **= 75 SF**

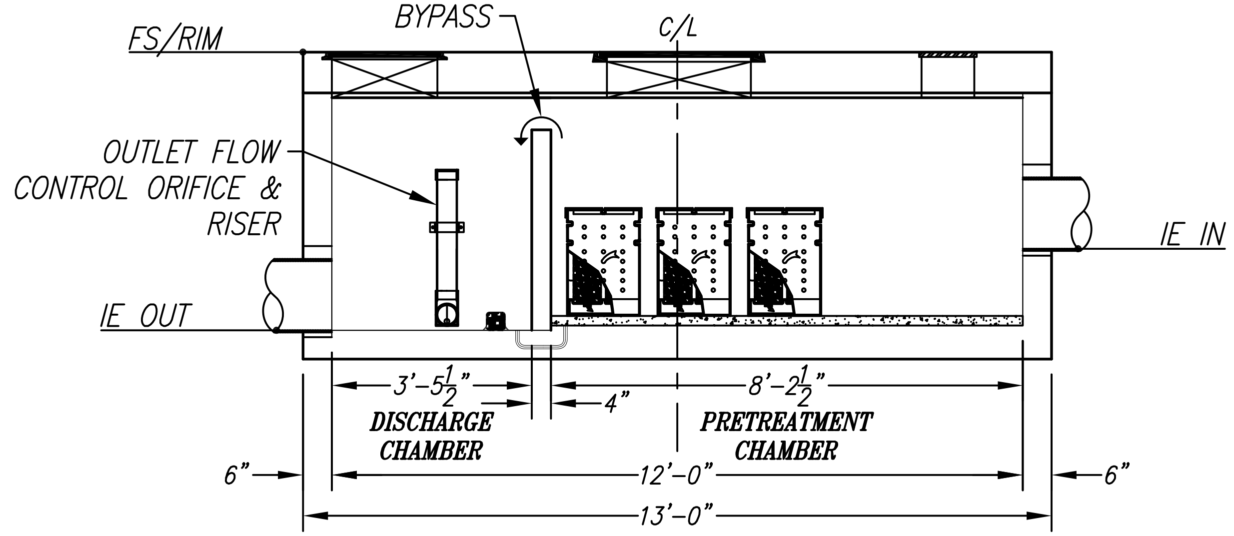
PRETREATMENT FILTER LOADING RATE
155.49 GPM / 75 SF
**= 2.07 GPM/SF**



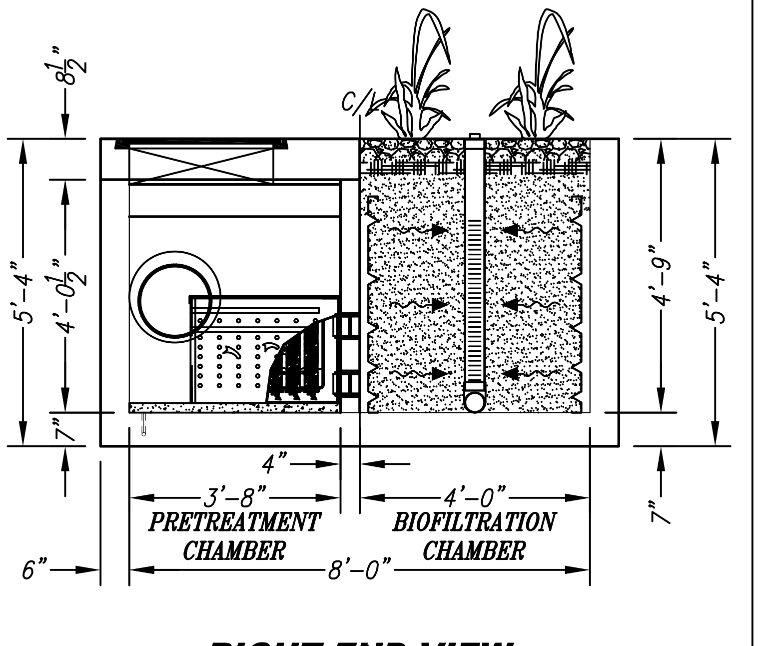
**PLAN VIEW**



**LEFT END VIEW**



**ELEVATION VIEW**



**RIGHT END VIEW**

## LEGEND

| | |
|---|---|
| ▨ | WETLAND MEDIA |
| ▦ | PLANT/ROOT MOISTURE RETENTION LAYER |
| ▩ | MANHOLE / ACCESS HATCH |

INSTALLATION NOTES:

1. INSTALL UNIT ON LEVEL BED OF GRAVEL OF AT LEAST 6" IN DEPTH WITH 1' MINIMUM OVER EXCAVATION AROUND ENTIRE UNIT.
2. CONCRETE 28 DAY COMPRESSIVE STRENGTH fc=5,000 PSI.
3. REINFORCING: ASTM A-615, GRADE 60.
4. RATED FOR PARKWAY LOADING 300 PSF.
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| | NAME | DATE |
|---|---|---|
| DRAWN | | |
| REVIEWED | | |
| APPROVED | | |

COMMENTS:

TITLE: MWS LINEAR 2.0
VAULT TYPE

SIZE
DWG. NO. MWS-L-8-12-UG-V
REV

SCALE NTS
UNITS = INCHES
SHEET 1 OF 2

MODULAR WETLANDS™

**FLOW RATES**

PEAK TREATMENT FLOW RATE = 0.35 CFS OR 155.49 GPM

PEAK BYPASS FLOW RATE = DEPENDENT ON PIPE SIZE

**SPECIFICATIONS**

INSTALL AT SURFACE

O.D. DIMENSIONS = 13' X 9' X 7.5'

RIM ELEVATION TO IE OUT: = 7.00'

# MODULAR WETLAND SYSTEMS LINEAR 2.0
# VAULT TYPE

**BIOFILTRATION CHAMBER SURFACE AREA CALCS**

SIDES = 4

3.7' L x 3.4' H = 12.58 SF

12.58 SF X 4 SIDES = 50.32

CELLS = 3

50.32 X 3 CELLS = 150.96

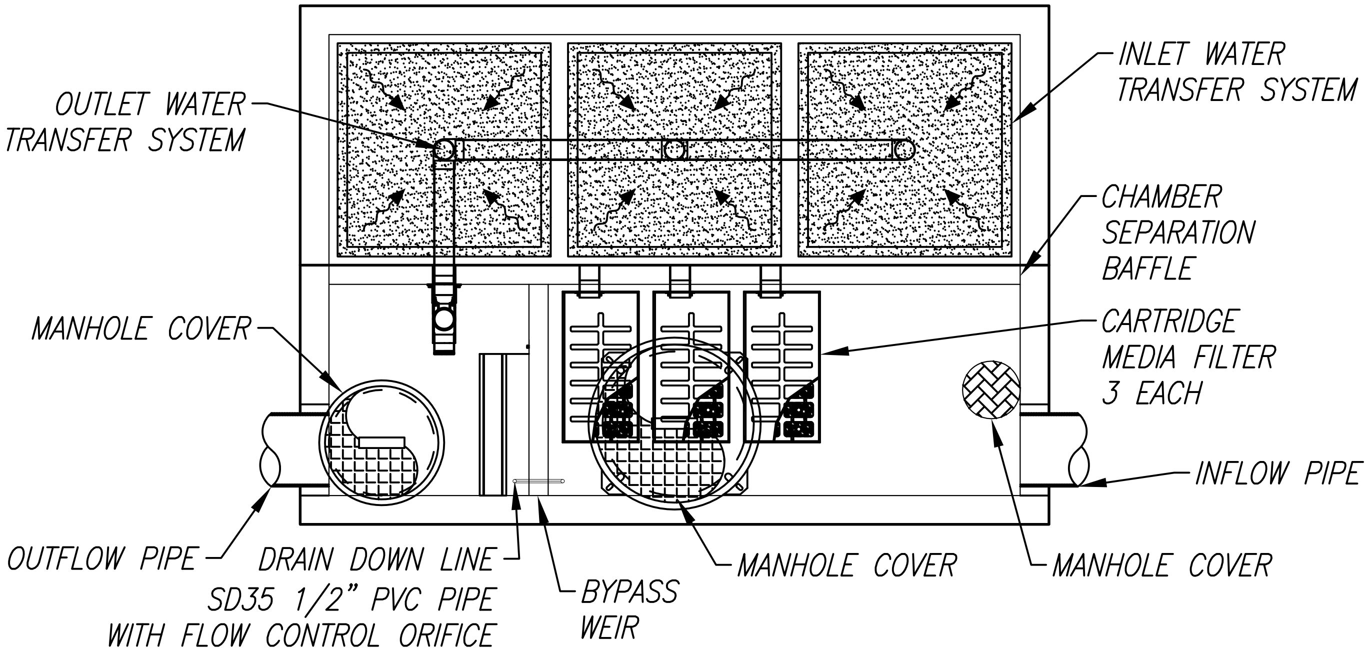
TOTAL WETLAND MEDIA SURFACE AREA **= 150.96 SF**

WETLAND MEDIA LOADING RATE 155.49 GPM / 150.96 SF **= 1.03 GPM/SF**

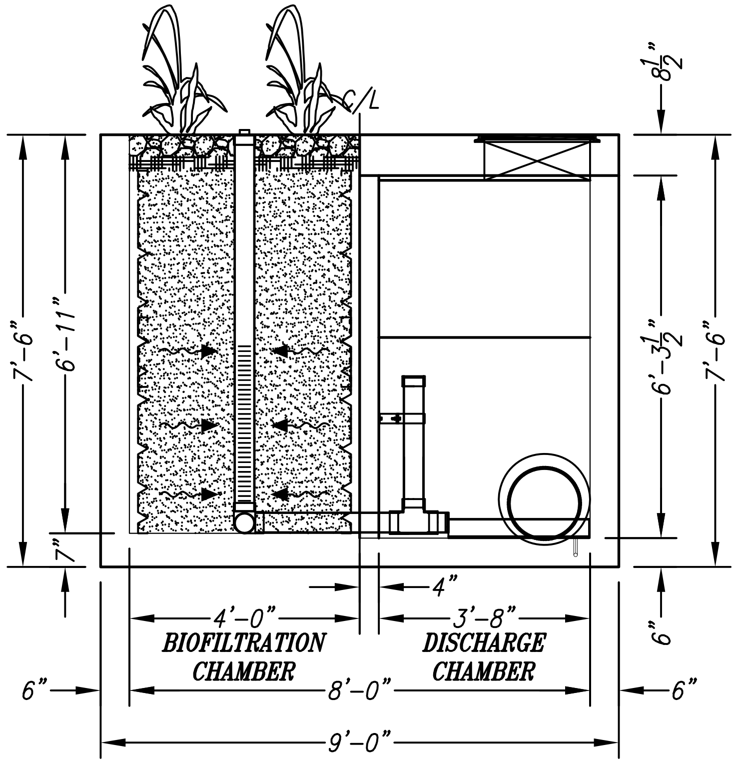
**PRETREATMENT FILTER SURFACE AREA CALCS**

TOTAL PRETREATMENT SURFACE AREA **= 75 SF**

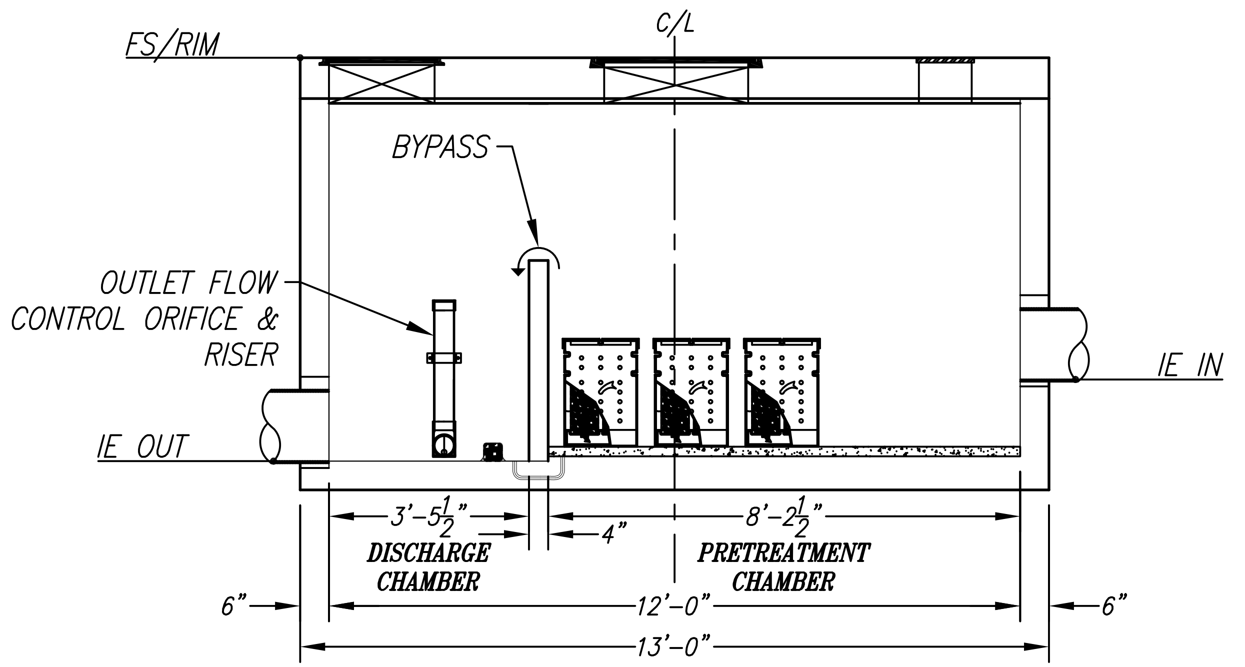
PRETREATMENT FILTER LOADING RATE 155.49 GPM / 75 SF **= 2.07 GPM/SF**



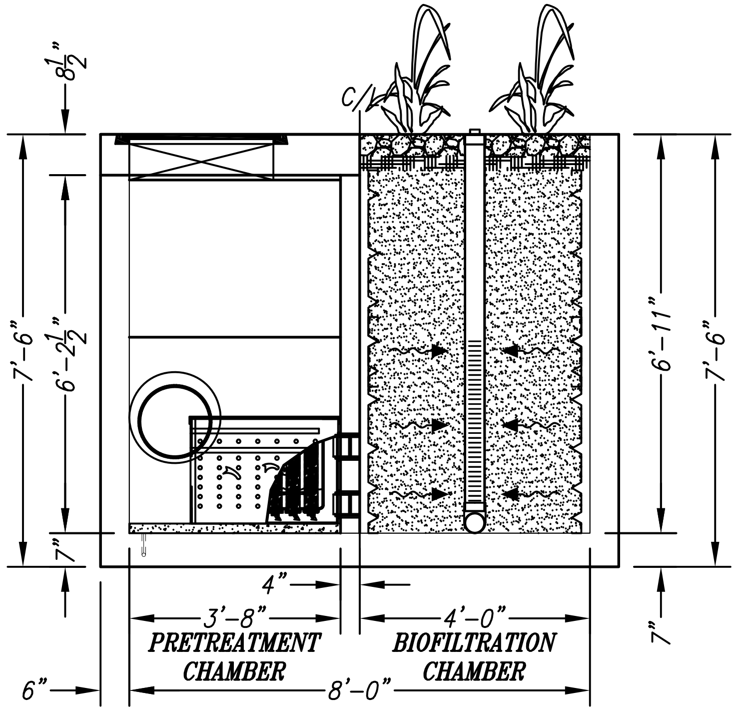
**PLAN VIEW**



**LEFT END VIEW**



**ELEVATION VIEW**



**RIGHT END VIEW**

## LEGEND

▒ WETLAND MEDIA

▦ PLANT/ROOT MOISTURE RETENTION LAYER

▩ MANHOLE / ACCESS HATCH

INSTALLATION NOTES:

1. INSTALL UNIT ON LEVEL BED OF GRAVEL OF AT LEAST 6" IN DEPTH WITH 1' MINIMUM OVER EXCAVATION AROUND ENTIRE UNIT.
2. CONCRETE 28 DAY COMPRESSIVE STRENGTH fc=5,000 PSI.
3. REINFORCING: ASTM A-615, GRADE 60.
4. RATED FOR PARKWAY LOADING 300 PSF.
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| | NAME | DATE |
|---|---|---|
| DRAWN | | |
| REVIEWED | | |
| APPROVED | | |

COMMENTS:

TITLE: MWS LINEAR 2.0 VAULT TYPE

SIZE
DWG. NO. MWS-L-8-12-UG-V
REV

SCALE NTS
UNITS = INCHES
SHEET 1 OF 2

MODULAR WETLANDS™

FLOW RATES

PEAK TREATMENT FLOW RATE = 0.35 CFS OR 155.49 GPM

PEAK BYPASS FLOW RATE = DEPENDENT ON PIPE SIZE

SPECIFICATIONS

INSTALL AT SURFACE

O.D. DIMENSIONS = 13' X 9' X 7.5'

RIM ELEVATION TO IE OUT: = 7.00'

# MODULAR WETLAND SYSTEMS LINEAR 2.0
# VAULT TYPE

**BIOFILTRATION CHAMBER SURFACE AREA CALCS**

SIDES = 4

3.7' L x 3.4' H = 12.58 SF

12.58 SF X 4 SIDES = 50.32

CELLS = 3

50.32 X 3 CELLS = 150.96

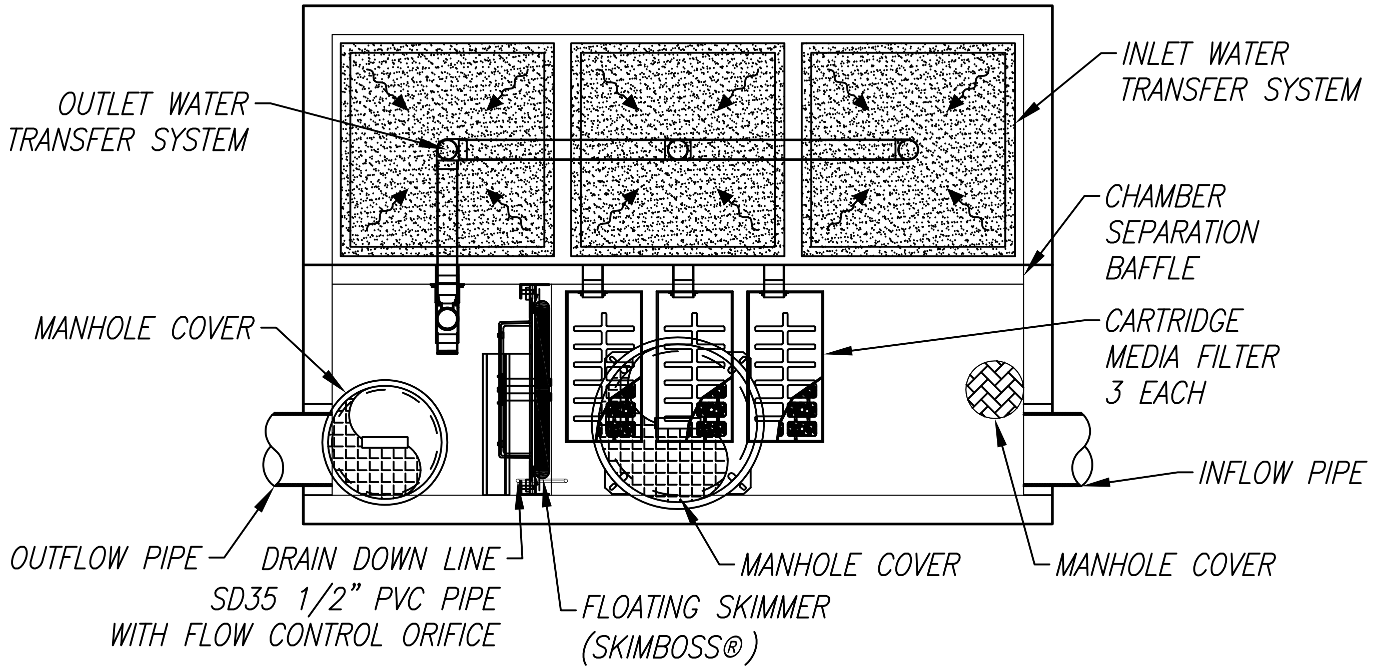
TOTAL WETLAND MEDIA SURFACE AREA **= 150.96 SF**

WETLAND MEDIA LOADING RATE 155.49 GPM / 150.96 SF **= 1.03 GPM/SF**

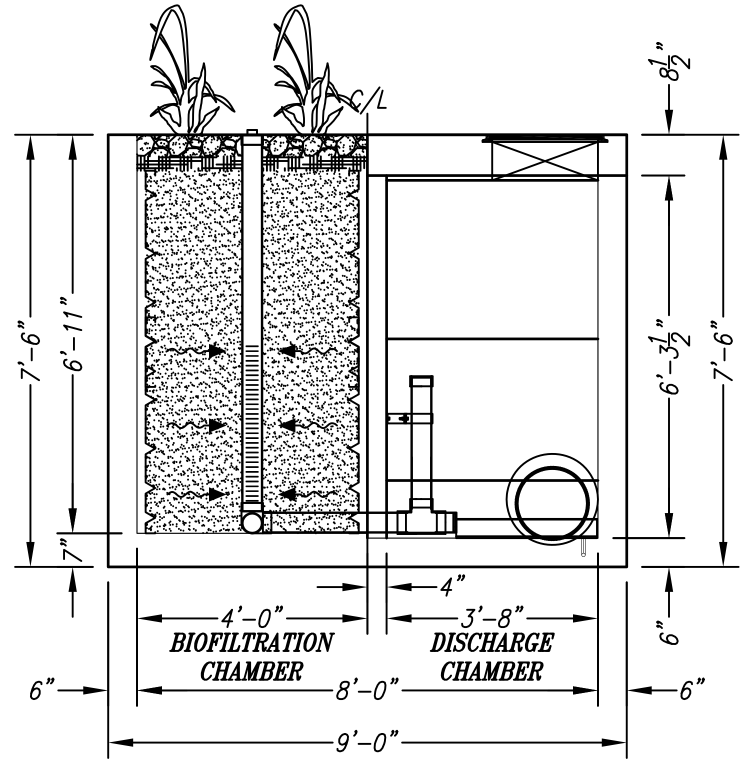
**PRETREATMENT FILTER SURFACE AREA CALCS**

TOTAL PRETREATMENT SURFACE AREA **= 75 SF**

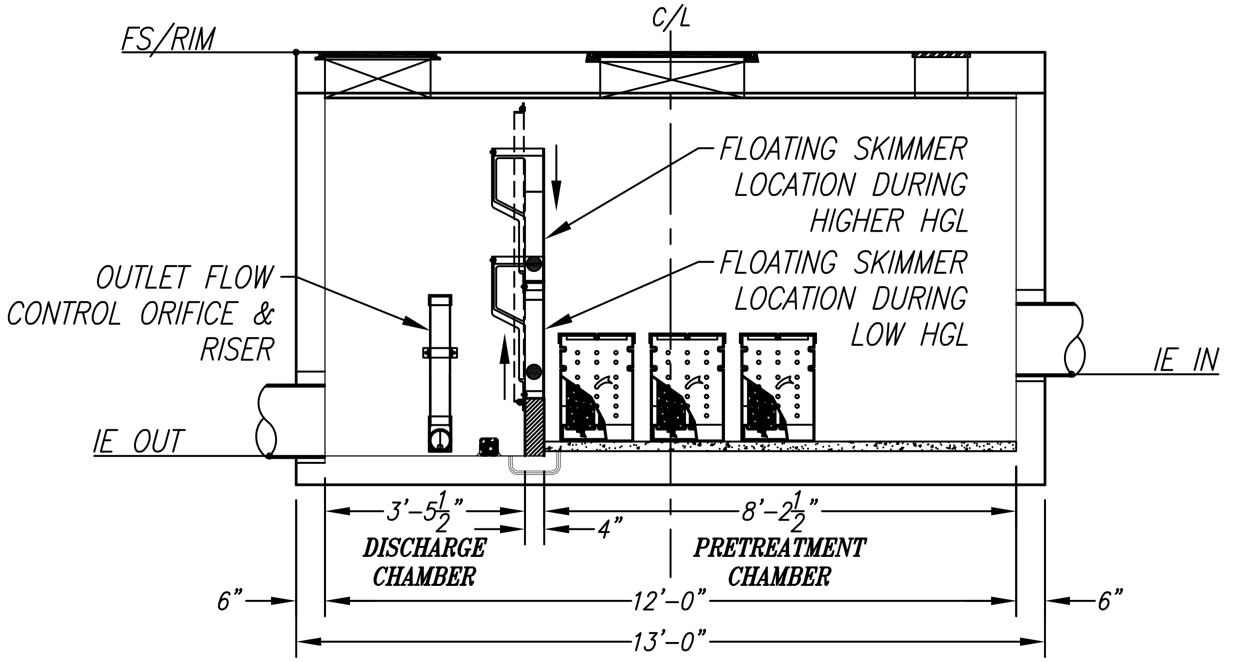
PRETREATMENT FILTER LOADING RATE 155.49 GPM / 75 SF **= 2.07 GPM/SF**



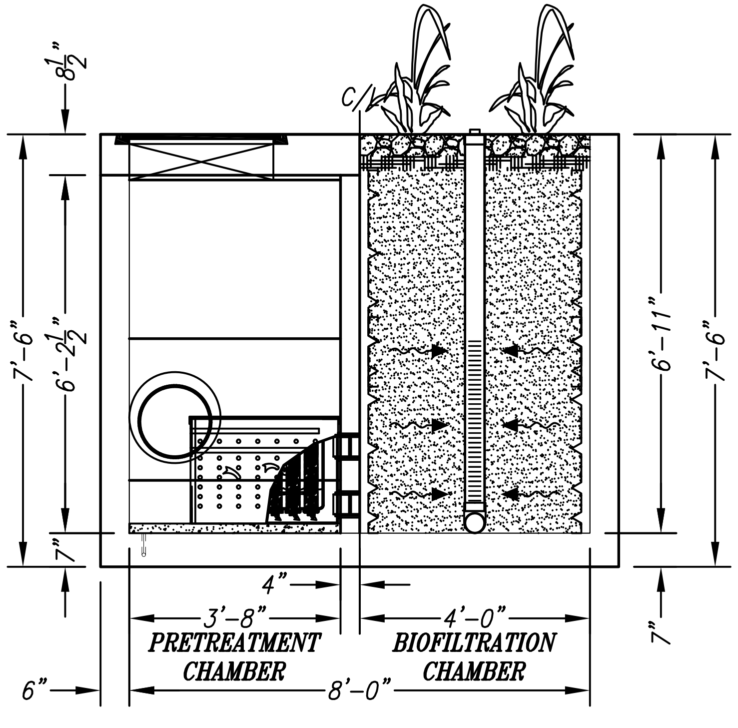
**PLAN VIEW**



**LEFT END VIEW**



**ELEVATION VIEW**



**RIGHT END VIEW**

*LEGEND*

▨ WETLAND MEDIA

▦ PLANT/ROOT MOISTURE RETENTION LAYER

▩ MANHOLE / ACCESS HATCH

INSTALLATION NOTES:

1. INSTALL UNIT ON LEVEL BED OF GRAVEL OF AT LEAST 6" IN DEPTH WITH 1' MINIMUM OVER EXCAVATION AROUND ENTIRE UNIT.
2. CONCRETE 28 DAY COMPRESSIVE STRENGTH fc=5,000 PSI.
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| | NAME | DATE |
|---|---|---|
| DRAWN | | |
| REVIEWED | | |
| APPROVED | | |

COMMENTS:

TITLE: MWS LINEAR 2.0 VAULT TYPE

SIZE | DWG. NO. MWS-L-8-12-UG-V | REV

SCALE NTS | UNITS = INCHES | SHEET 1 OF 2

# MODULAR WETLAND SYSTEMS LINEAR 2.0 VAULT TYPE

MODULAR WETLANDS™

*FLOW RATES*

PEAK TREATMENT FLOW RATE = 0.462 CFS OR 207.31 GPM

PEAK BYPASS FLOW RATE = N/A

*SPECIFICATIONS*

INSTALL AT SURFACE

O.D. DIMENSIONS = 17' X 9' X 4.7'

**BIOFILTRATION CHAMBER SURFACE AREA CALCS**

SIDES = 4

3.7' L x 3.4' H = 12.58 SF

12.58 SF X 4 SIDES = 50.32

CELLS = 4

50.32 X 4 CELLS = 201.28

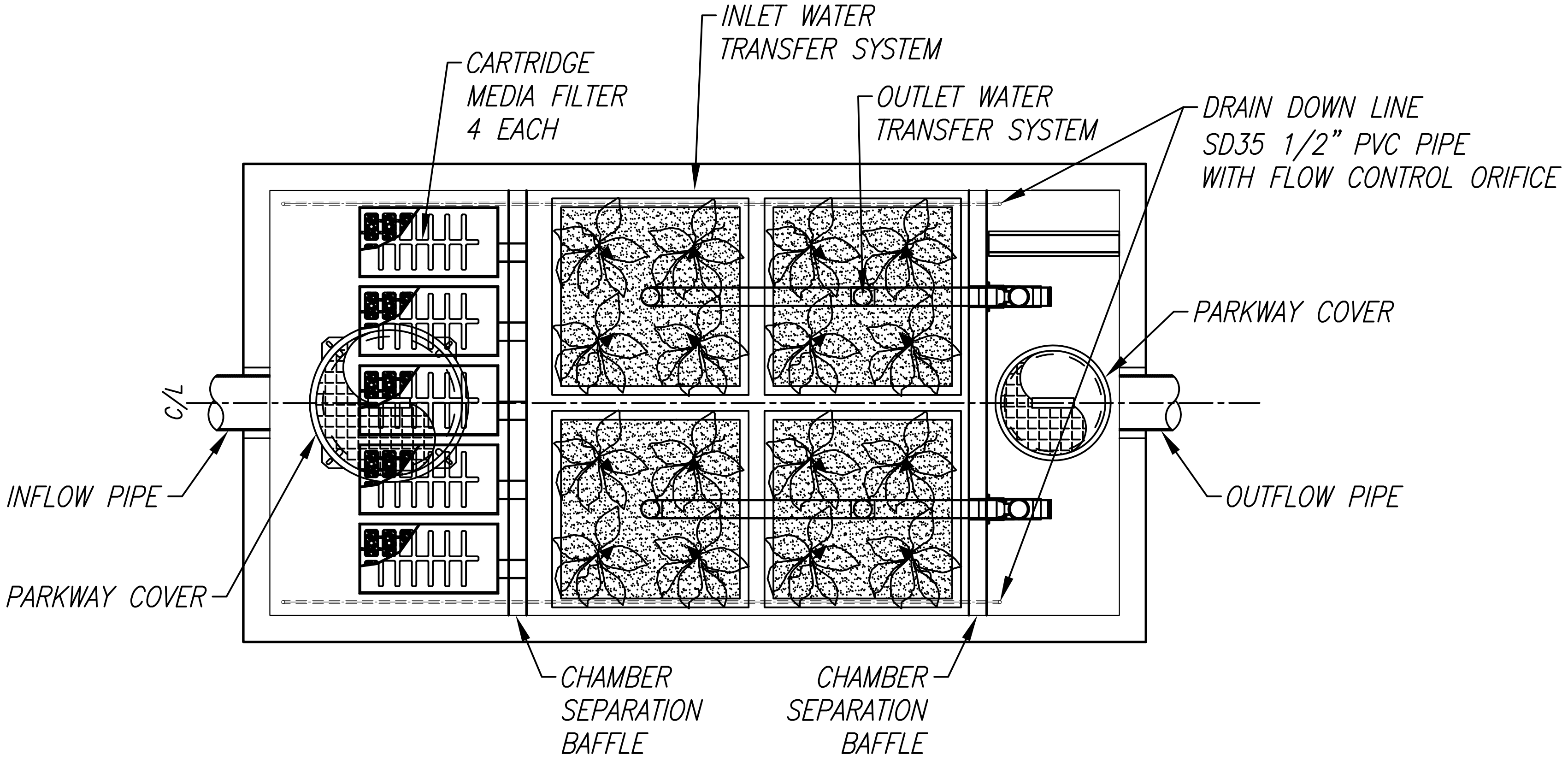
TOTAL WETLAND MEDIA SURFACE AREA **= 201.28 SF**

WETLAND MEDIA LOADING RATE 207.31 GPM / 201.28 SF **= 1.03 GPM/SF**

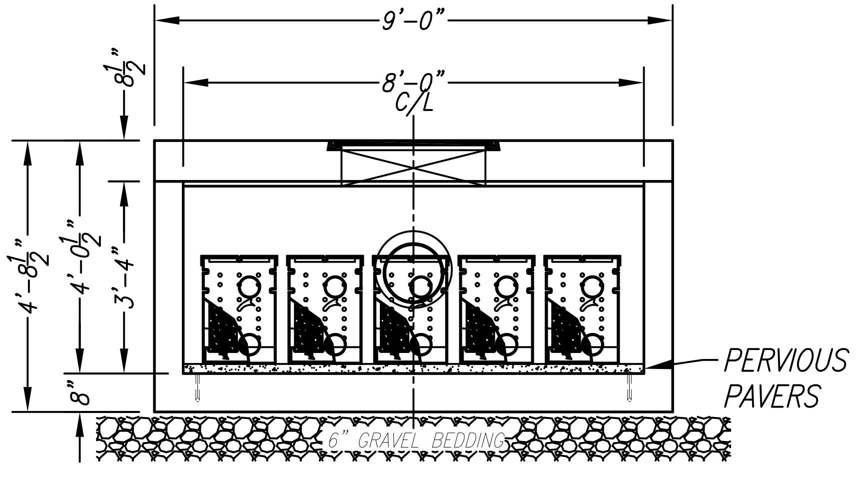
**PRETREATMENT FILTER SURFACE AREA CALCS**

TOTAL PRETREATMENT SURFACE AREA 25 SF x 5 FILTERS **= 125.00 SF**

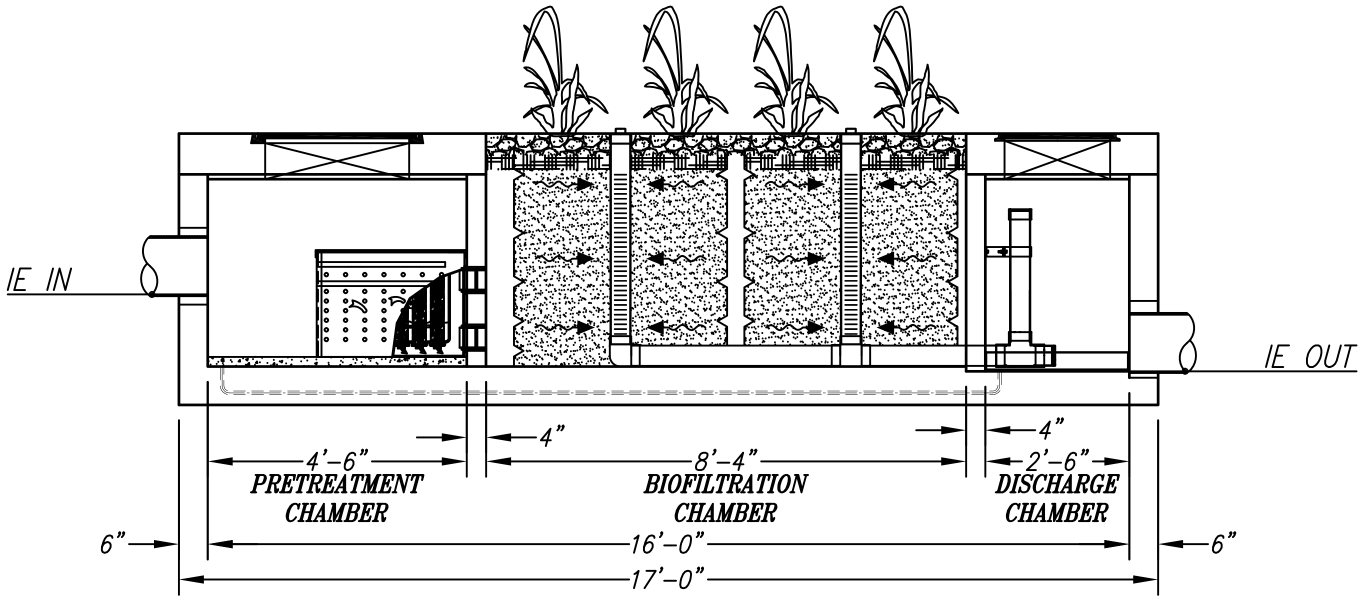
PRETREATMENT FILTER LOADING RATE 207.31 GPM / 125.00 SF **= 1.66 GPM/SF**



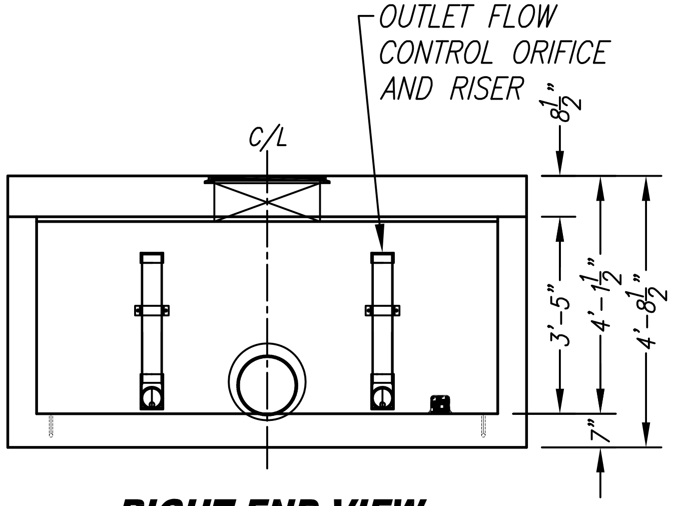
## PLAN VIEW



## LEFT END VIEW



## ELEVATION VIEW



## RIGHT END VIEW

## LEGEND

| | |
|---|---|
| ▨ | WETLAND MEDIA |
| ▦ | PLANT/ROOT MOISTURE RETENTION LAYER |
| ▩ | MANHOLE / ACCESS HATCH |

INSTALLATION NOTES:

1. INSTALL UNIT ON LEVEL BED OF GRAVEL OF AT LEAST 6" IN DEPTH WITH 1' MINIMUM OVER EXCAVATION AROUND ENTIRE UNIT.
2. CONCRETE 28 DAY COMPRESSIVE STRENGTH fc=5,000 PSI.
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| | NAME | DATE |
|---|---|---|
| DRAWN | | |
| REVIEWED | | |
| APPROVED | | |

COMMENTS:

TITLE: MWS LINEAR 2.0 CURB TYPE

SIZE

DWG. NO. MWS-L-8-16-V

REV

SCALE NTS

UNITS = INCHES

SHEET 1 OF 1

# ATTACHMENT 2 MAINTENANCE AGREEMENT & FUNDING MECHANISM DOCUMENTATION

The Owner, Toll Brothers Apartment Living, shall assume all BMP maintenance and inspection responsibilities for the proposed project. Should the maintenance responsibility be transferred at any time during the operational life of Victoria Apartments, such as when an HOA or POA is formed for a project, a formal notice of transfer shall be submitted to the City of Dana Point at the time responsibility of the property subject to this WQMP is transferred. The transfer of responsibility shall be incorporated into this O&M Plan.

Long-term-funding for BMP maintenance will be provided by Toll Brothers Apartments through the standard operating budget.

Copies of the forms and additional details will be included in the Final WQMP.

# NOTICE OF TRANSFER OF RESPONSIBILITY

---

# WATER QUALITY MANAGEMENT PLAN

Victoria Apartments
APN 668-361-01

Submission of this Notice Of Transfer of Responsibility constitutes notice to the City of Dana Point that responsibility for the Water Quality Management Plan ("WQMP") for the subject property identified below, and implementation of that plan, is being transferred from the Previous Owner (and his/her agent) of the site (or a portion thereof) to the New Owner, as further described below.

## I. Previous Owner/ Previous Responsible Party Information

| | | | |
|---|---|---|---|
| Company/ Individual Name: | | Contact Person: | |
| Street Address: | | Title: | |
| City: | State: | ZIP: | Phone: |

## II. Information about Site Transferred

| | |
|---|---|
| Name of Project (if applicable): | |
| Title of WQMP Applicable to site: | |
| Street Address of Site (if applicable): | |
| Planning Area (PA) and/ or Tract Number(s) for Site: | Lot Numbers (if Site is a portion of a tract): |
| Date WQMP Prepared (and revised if applicable): | |

## III. New Owner/ New Responsible Party Information

| | | | |
|---|---|---|---|
| Company/ Individual Name: | | Contact Person: | |
| Street Address: | | Title: | |
| City: | State: | ZIP: | Phone: |

## IV. Ownership Transfer Information

| | |
|---|---|
| General Description of Site Transferred to New Owner: | General Description of Portion of Project/ Parcel Subject to WQMP Retained by Owner (if any): |

| |
|---|
| Lot/ Tract Numbers of Site Transferred to New Owner: |
| Remaining Lot/ Tract Numbers Subject to WQMP Still Held by Owner (if any): |
| Date of Ownership Transfer: |

Note: When the Previous Owner is transferring a Site that is a portion of a larger project/ parcel addressed by the WQMP, as opposed to the entire project/parcel addressed by the WQMP, the General Description of the Site transferred and the remainder of the project/ parcel no transferred shall be set forth as maps attached to this notice. These maps shall show those portions of a project/ parcel addressed by the WQMP that are transferred to the New Owner (the Transferred Site), those portions retained by the Previous Owner, and those portions previously transferred by Previous Owner. Those portions retained by Previous Owner shall be labeled as "Previously Transferred".

## V. Purpose of Notice of Transfer

The purposes of this Notice of Transfer of Responsibility are: 1) to track transfer of responsibility for implementation and amendment of the WQMP when property to which the WQMP is transferred from the Previous Owner to the New Owner, and 2) to facilitate notification to a transferee of property subject to a WQMP that such New Order is now the Responsible Party of record for the WQMP for those portions of the site that it owns.

## VI. Certifications

### A. Previous Owner

I certify under penalty of law that I am no longer the owner of the Transferred Site as described in Section II above. I have provided the New Owner with a copy of the WQMP applicable to the Transferred Site that the New Owner is acquiring from the Previous Owner.

| | |
|---|---|
| Printed Name of Previous Owner Representative: | Title: |
| Signature of Previous Owner Representative: | Date: |

### B. New Owner

I certify under penalty of law that I am the owner of the Transferred Site, as described in Section II above, that I have been provided a copy of the WQMP, and that I have informed myself and understand the New Owner's responsibilities related to the WQMP, its implementation, and Best Management Practices associated with it. I understand that by signing this notice, the New Owner is accepting all ongoing responsibilities for implementation and amendment of the WQMP for the Transferred Site, which the New Owner has acquired from the Previous Owner.

| | |
|---|---|
| Printed Name of New Owner Representative: | Title: |
| Signature: | Date: |

# FORM FOR WQMP CONSTRUCTION CERTIFICATION

CIVIL ENGINEER'S LETTERHEAD

City of Dana Point
Department of Public Works/Engineering
33282 Golden Lantern
Dana Point, CA 92629

Attention: Lisa Zawaski, Senior Water Quality Engineer

Subject: **WQMP Construction Certification**

Reference Project: Grading Permit No. _____

Address: _____

Project Name: _____

I hereby certify that the above referenced project has been field inspected to confirm that the structural best management practices (BMPs) have been installed per the project's approved Water Quality Management Plan (WQMP) and associated grading plans and in accordance with my responsibilities as a Civil Engineer in the State of California.

By way of this certification, I hereby declare that the BMPs are operational and functioning properly for intended use and that any debris that may have been accumulated during construction has been removed.

______________________________
Signature

(R.C.E. #________________)

*Engineer's Wet Stamp Here*

# ATTACHMENT 3 TRAINING LOG FORM

# TRAINING / EDUCATIONAL LOG

Date of Training/Educational Activity: ____________________

Name of Person Performing Activity (Printed): ____________________

Signature: ____________________

Topic of Training/Educational Activity

____________________

____________________

| Name of Participant | Signature of Participant |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

For newsletter or mailer educational activities, please include the following information:

- Date of mailing:
- Number distributed:
- Method of distribution:
- Topics addressed:

If a newsletter article was distributed, please include a copy of it.

# ATTACHMENT 4 INSPECTION AND MAINTENANCE LOG FORM

# TRAINING / EDUCATIONAL LOG

Date of Training/Educational Activity: ______________________________

Name of Person Performing Activity (Printed): ______________________________

Signature: ______________________________

| BMP Name or Type (As Shown in O&M Plan) | Brief Description of Operation, Maintenance or Inspection Activity Performed | Summary of Notable Observations or Outcomes from Activity |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

[add additional pages, photographs, drawings, notes as needed]

# CITY OF DANA POINT
# WATER QUALITY MANAGEMENT PLAN (WQMP) VERIFICATION SURVEY

Project Name/Site Address: ____________________________________________

Responsible Party: ____________________________________________

Contact Phone: ______________________ Contact Email: ______________________

**1.** Have your contractors (landscape, maintenance, etc.) been educated regarding the applicable requirements to prevent pollution as outlined in the WQMP?

☐ Yes ☐ No Name of Landscape/Maintenance Contractor: ______________________

Method of education (contract language, Copy of O&M, educational brochures, etc.): ______________

**2.** Have the storm drains and inlets been inspected and maintained, at a minimum, annually prior to Oct 1?

☐ Yes ☐ No Date of Last Inspection/Maintenance: __________________________

Maintenance conducted by: ________________________________

3. Have you observed any runoff from the irrigation system?

☐ Yes ☐ No If yes, how was the problem resolved?: ______________________

______________________________________________________

4. What type of Integrated Pest Management (IPM) practices are used on site?

______________________________________________________

5. Are native and/or drought tolerant plants established and considered for any new landscaping?

☐ Yes ☐ No

6. Have the storm drain stencils been inspected annually for legibility prior to Oct. 1?

☐ Yes ☐ No Total number of stencils on site: _______

How many inlets required restenciling / date of restenciling? ________ /_________

7. Have education materials been distributed to the residents/tenants/contractors within the past year?

☐ Yes ☐ No Topic / Date of Distribution: _____________ / ________________

Method of Distribution: newsletter, billing insert, etc.: ________________

8. Is street sweeping conducted weekly?

   ☐ Yes ☐ No Contractor: ____________________________________________

9. Are trash areas in common area inspected daily?

   ☐ Yes ☐ No

10. Have any vector concerns been observed (standing water, mosquito larvae, etc.). if yes, please contact Orange County Vector Control District at www.ocvcd.org.

    ☐ Yes ☐ No

11. Have the Modular Wetland System units (7) been inspected and maintained per Manufacturer instructions? (attach invoices and inspection/maintenance forms).

    ☐ Yes ☐ No

12. Have there been any issues with operation and maintenance of the Modular Wetland System units (7)?

    ____________________________________________________________________________

I certify that the above information is correct and that the BMPs for this project have been implemented and operated and maintained in accordance with the Operation and Maintenance (O&M) Plan on site and on file at the City.

______________________________________________
Print Name of Responsible Party

______________________________________________ ____________________
Signature (required) Date

*This form must be completed and submitted to the City by June 30 each year.*

City of Dana Point • 33282 Golden Lantern • Dana Point • 92629
Attn: Water Quality Engineer

Email: lzawaski@danapoint.org
Fax: 949-234-2826

# ATTACHMENT 5 INSPECTION AND O&M CHECKLIST (OPTIONAL)

*Guidance: Based on the BMPs present at the site, this checklist is intended to summarize the activities necessary at each frequency. Include more details if desired.*

| **Weekly Activities** | Check Box |
|---|---|
| Selected source control/housekeeping activities (See Section 3.1) | |
| | |
| **Monthly Activities** | |
| Selected source control/housekeeping activities (See Section 3.1) | |
| | |
| **Quarterly Activities**<br>**(before wet season, after wet season, plus twice after rain > 0.5 inches)** | |
| Inspections of selected source control BMPs (See Section 3.1) | |
| Inspections and as-needed minor maintenance of all structural treatment and hydromodification BMPs (See Section 3.3) | |
| | |
| **Twice Yearly Activities**<br>**(during dry weather)** | |
| Dry weather flow inspections (non-structural source control) (See Section 3.1) | |
| Inspection and as-needed maintenance of other selected source control BMPs (See Section 3.1) | |
| | |
| **Annual Activities** | |
| Self-certification (See Section 2.6) | |
| Various source control BMP and housekeeping activities (See Section 3.1) | |
| Inspection and maintenance of HSCs (See Section 3.2) | |
| Various planned maintenance activities of treatment and hydromodification BMPs, such as vegetation maintenance, minor sediment maintenance, etc. (See Section 3.3) | |

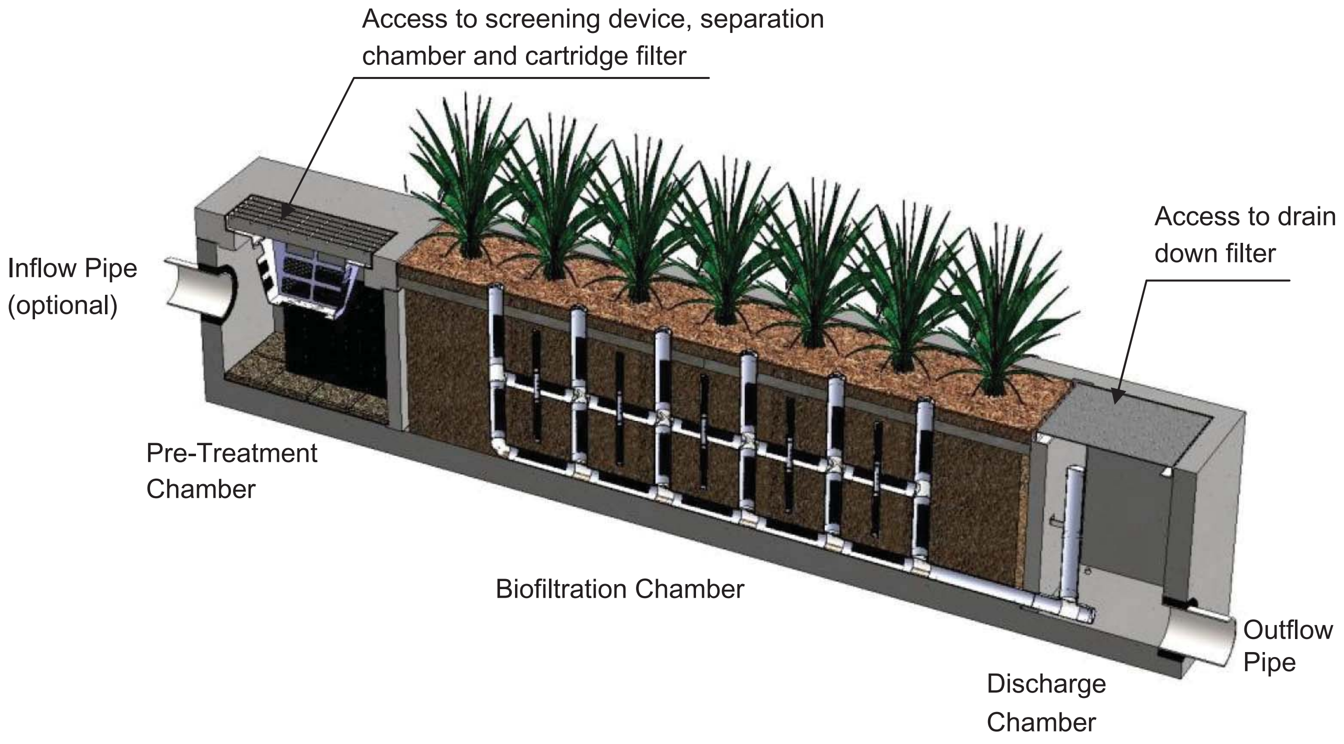
# ATTACHMENT 6 VENDOR O&M INFORMATION

# Maintenance Guidelines for Modular Wetland System - Linear

## Maintenance Summary

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

## System Diagram



# Maintenance Procedures

## Screening Device

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

## Separation Chamber

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

## Cartridge Filters

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

## Drain Down Filter

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

# Maintenance Notes

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

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

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

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

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

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

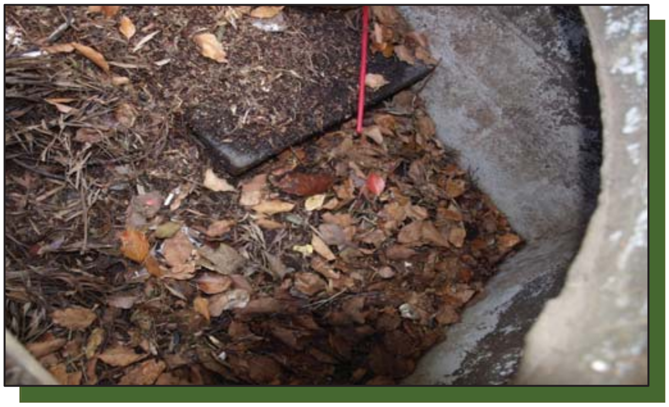
# Maintenance Procedure Illustration

## Screening Device

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

## Separation Chamber

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



## Cartridge Filters

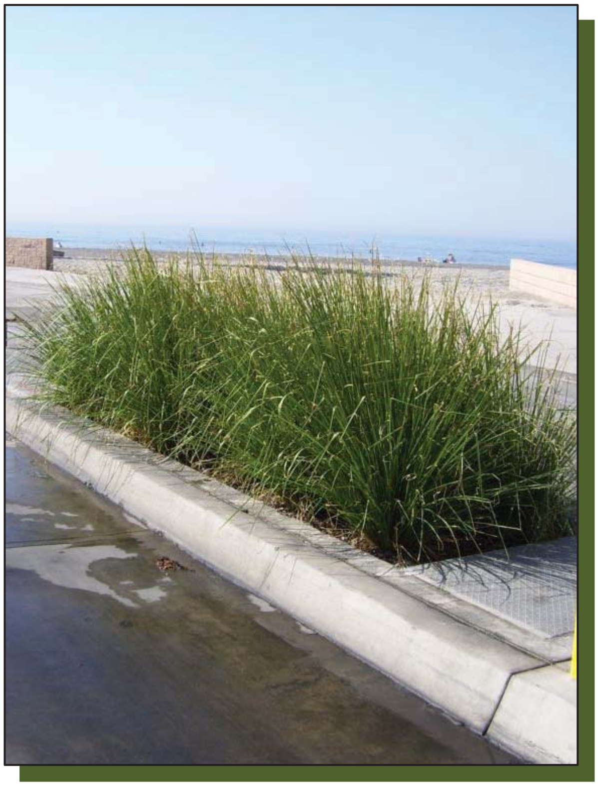
The cartridge filters are located in the Pre-Treatment chamber connected to the wall adjacent to the biofiltration chamber. The cartridges have removable tops to access the individual media filters. Once the cartridge is open media can be easily removed and replaced by hand or a vacuum truck.

## Drain Down Filter

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

## Trim Vegetation

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



# Inspection Form

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

www.modularwetlands.com

BIO CLEAN ENVIRONMENTAL SERVICES, INC.

# Inspection Report
# Modular Wetlands System

MODULAR WETLANDS

Project Name ______________________________

Project Address ______________________________ (city) (Zip Code)

Owner / Management Company ______________________________

Contact ______________________ Phone ( ) –

Inspector Name ______________________ Date ____/____/______ Time ____________ AM / PM

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

Weather Condition ______________________ Additional Notes ______________________

For Office Use Only

(Reviewed By)

(Date)

Office personnel to complete section to the left.

## Inspection Checklist

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

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

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

| **Recommended Maintenance** | |
|---|---|
| No Cleaning Needed | |
| Schedule Maintenance as Planned | |
| Needs Immediate Maintenance | |

| **Plant Information** | |
|---|---|
| Damage to Plants | |
| Plant Replacement | |
| Plant Trimming | |

Additional Notes: ______________________________

______________________________

______________________________

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

# Maintenance Report

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

www.modularwetlands.com

# Cleaning and Maintenance Report
# Modular Wetlands System

For Office Use Only

(Reviewed By)

(Date)

Office personnel to complete section to the left.

Project Name

Project Address (city) (Zip Code)

Owner / Management Company

Contact

Phone ( ) –

Inspector Name

Date / /

Time AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm

Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition

Additional Notes

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

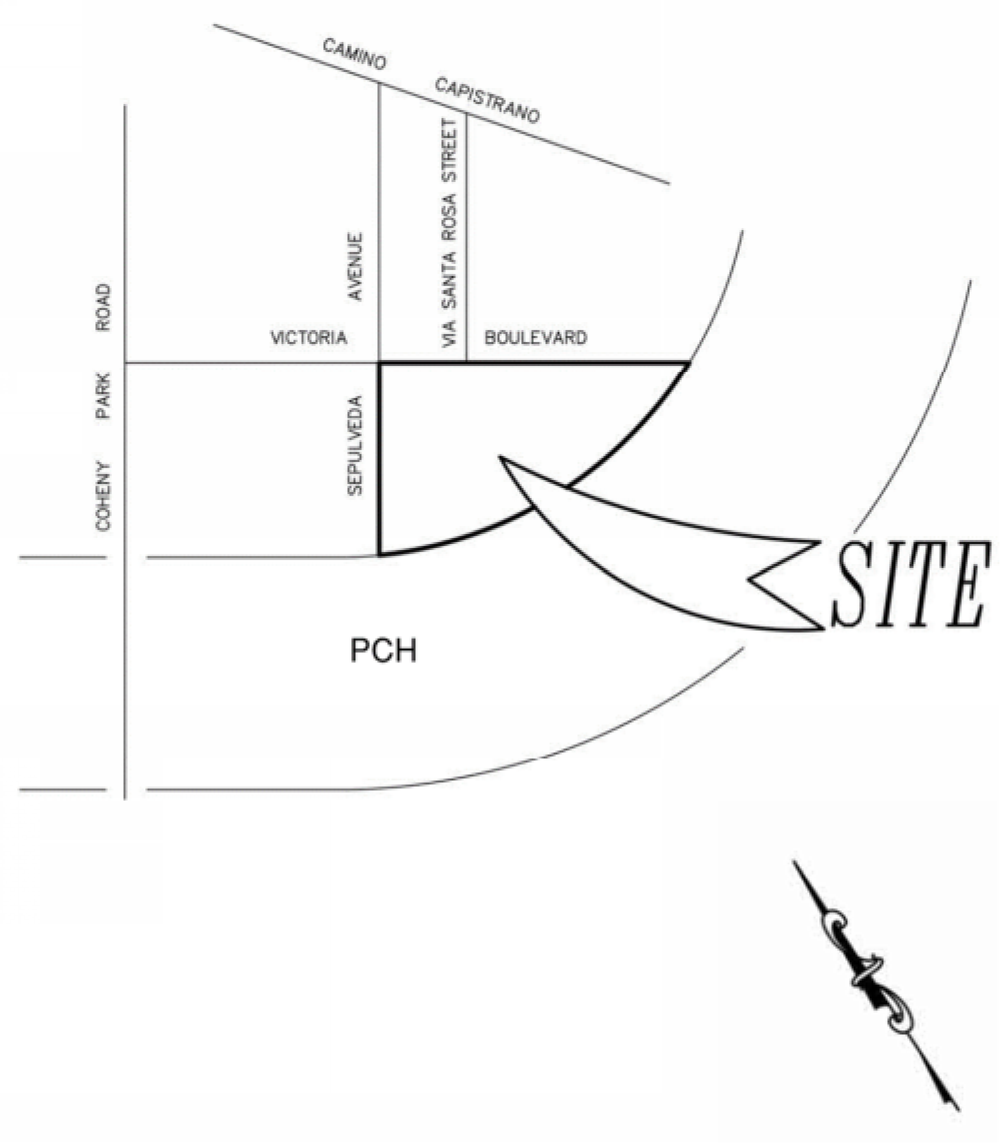
Comments:

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

# ATTACHMENT C

## EXHIBITS

# VICINITY MAP



Not to Scale

## Project Summary

| | |
|---|---|
| Total Site Area: | 5.5 AC<br>240,262.6 SF |
| Total Units: | 365 DU |
| Total Density: | 66.2 DU/AC |

## Unit Summary

| Unit Type | # DU | % |
|---|---|---|
| Studio/1-Bath | 43 | 11.8% |
| 1-Bed/1-Bath | 182 | 49.9% |
| 2-Bed/2-Bath | 121 | 33.2% |
| 3-Bed/2-Bath | 19 | 5.2% |
| **Total** | **365 DU** | **100%** |

### Resident Services Tabulation

| | |
|---|---|
| Leasing | 1,519 SF |
| Grand Lobby/Mail | 1,689 SF |
| Board Shack | 2,290 SF |
| Bike Spa | 1,224 SF |
| Total Amenities | 6,722 SF |

### Common Open Space Tabulation

| | |
|---|---|
| Amenity A | 1,557 SF |
| Amenity B | 1,342 SF |
| Amenity C | 3,055 SF |
| Fitness (Roof) | 2,831 SF |
| Club (Roof) | 2,362 SF |
| Pet Spa | 747 SF |
| Total Amenities | 11,894 SF |

## Parking Summary

Parking Required:

| Unit Type | Req'd. Ratio | Required Parking |
|---|---|---|
| Studio | 1.5 Sp./DU | 65 Sp. |
| 1-Bd | 1.5 Sp./DU | 273 Sp. |
| 2-Bd | 2.0 Sp./DU | 242 Sp. |
| 3-Bd | 2.5 Sp./DU | 48 Sp. |
| Visitor | 0.2 Sp./DU | 73 Sp. |
| **Total** | **1.9 Sp./DU** | **701 Spaces Required** |

Parking Provided:

| | |
|---|---|
| Residential: | 630 spaces |
| Visitor: | 73 spaces |
| Total Parking Provided: | 703 spaces *(1.9 sp/du)* |

## Open Space Summary*

Required:

100 SF/DU x 365 DU = 36,500 SF Required

Provided:

| | | |
|---|---|---|
| Open Space Active: | 81,187 SF | 1.86 AC |
| Public Street ROW Area: | 19,049 SF | |
| Public Paseo: | 18,273 SF | |
| Public EVA Area: | 10,512 SF | |
| Public Park Areas: | 16,299 SF | |
| Public Street Frontage Areas: | 17,054 SF | |
| | | |
| Open Space Common: | 44,201 SF | 1.01 AC |
| Private Common Court Areas: | 25,271 SF | |
| Private Commons Rooftop Area: | 18,930 SF | |
| | | |
| Open Space Private: | 18,970 SF | 0.43 AC |
| Private Balconies: | 18,970 SF | |
| | | |
| Total: | 144,358 SF | 3.31 AC |

*See Sheet L-14 for Additional Landscape Area Tabulations

ktgy
**Architecture + Planning**
888.456.5849
ktgy.com

Toll Brothers Apartment Living
200 Spectrum Center Drive, Suite 300
Irvine, CA 92618

**VICTORIA BLVD APARTMENTS**
DANA POINT, CA # 2019-0151

CONCEPTUAL DESIGN
JUNE 16, 2021

0 20 40 80

CONCEPTUAL SITE PLAN

A1.0

## LEGEND

- - - - PROPERTY LINE
- ═ EXISTING STORM DRAIN TO BE DEMOLISHED
- ═ EXISTING STORM DRAIN TO REMAIN
- ═ PROPOSED STORM DRAIN
- ▬ ▬ BMP DRAINAGE AREA BOUNDARY
- 🟩 PROPOSED LANDSCAPE
- 🟨 PROPOSED BUILDING
- ▒ STREET SWEEPING PRIVATE STREETS & DRIVE AISLES
- 🟥 CATCH BASIN STENCILING & MAINTENANCE
- ■ LOW FLOW DIVERSION STRUCTURE
- 🟪 MODULAR WETLAND SYSTEM UNIT
- ▨ TRASH STAGING AREA / LOADING ZONE
- → DIRECTION OF FLOW
- DMA_1 X.XX_AC DRAINAGE MANAGEMENT AREA AND ACREAGE

### MODULAR WETLAND SYSTEM DESIGN SUMMARY

| DMA | DRAINAGE AREA | IMP | Q FLOW RATE 80% CAPTURE | Q DESIGN (80% X 1.5) | SIZE / MODEL | TOTAL TREATMENT CAPACITY |
|---|---|---|---|---|---|---|
| DMA 1 | 0.99 AC | 85% | 0.203 CFS | 0.304 CFS | MWS-L-8-12 | 0.346 CFS |
| DMA 2 | 0.90 AC | 85% | 0.184 CFS | 0.277 CFS | MWS-L-8-12 | 0.346 CFS |
| DMA 3 | 0.41 AC | 85% | 0.084 CFS | 0.126 CFS | MWS-L-4-13 | 0.144 CFS |
| DMA 4 | 0.42 AC | 85% | 0.086 CFS | 0.129 CFS | MWS-L-4-13 | 0.144 CFS |
| DMA 5 | 1.09 AC | 85% | 0.223 CFS | 0.335 CFS | MWS-L-8-16 | 0.462 CFS |
| DMA 6 | 0.75 AC | 85% | 0.154 CFS | 0.230 CFS | MWS-L-8-8 | 0.231 CFS |
| DMA 7 | 0.96 AC | 85% | 0.197 CFS | 0.295 CFS | MWS-L-8-12 | 0.346 CFS |

80' 0' 40' 80'

SCALE: 1" = 80'

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tel 949.474.1960 ◦ fax 949.474.5315
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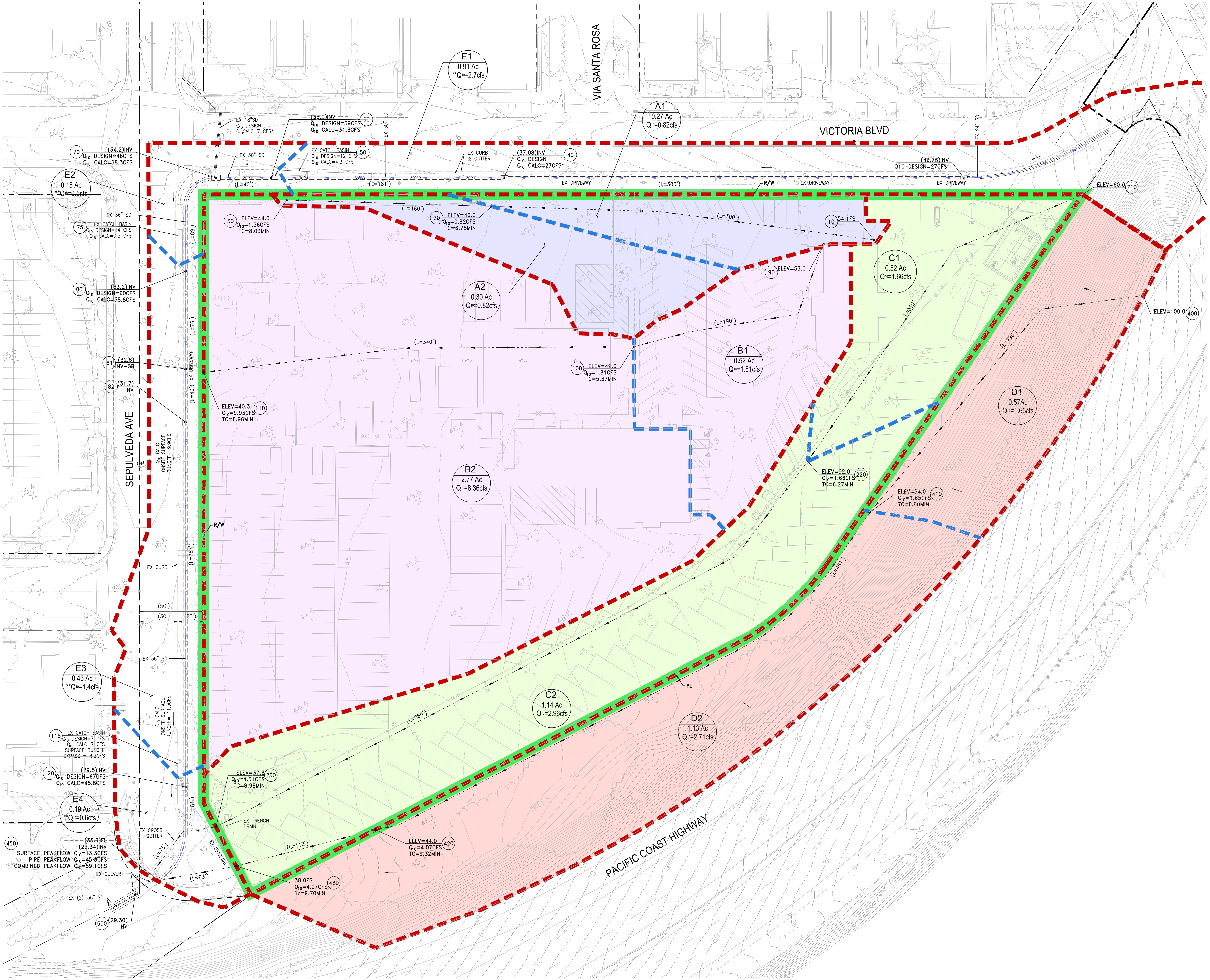
Exhibit Date: 06/16/2021

# PRELIMINARY WQMP EXHIBIT
## VICTORIA APARTMENTS
## DANA POINT, CA

F:\PROJECTS\1665\004_SUPPORT FILES\REPORTS\WQMP\PRELIMINARY WQMP\ATTACHMENTS\ATTACHMENT C – EXHIBITS\1665-004XH_PWQMP VICTORIAAPARTMENTS_2021-04-30.DWG (06-16-21 2:29:59PM) Plotted by: Suleen Loo



## LEGEND

| | |
|---|---|
| — — — | PROPERTY LINE |
| 🟩 | ONSITE BOUNDARY (5.52 Ac) |
| 🟥 🟥 🟥 | DRAINAGE MAJOR SUB-BOUNDARY |
| 🟦 🟦 🟦 | DRAINAGE MINOR SUB-BOUNDARY |
| — SD — | EXISTING STORM DRAIN |
| (10) | HYDROLOGIC NODE |

A1 — DRAINAGE AREA DESIGNATION
3.2 ac — AREA
$Q_{10}$=2.2 cfs — FLOWRATE
--- — STREET WHICH AREA DRAINS TOWARD

| | |
|---|---|
| ▨ | SUB-AREA A (0.57 Ac/1.56 cfs @ NODE 30) |
| ▨ | SUB-AREA B (3.29 Ac/9.93 cfs @ NODE 110) |
| 🟩 | SUB AREA C (1.66 Ac/4.31 cfs @ NODE 230) |
| 🟥 | SUB-AREA D – OFFSITE RUN-ON<br>(1.70 Ac/4.07 cfs @ NODE 430) |

## HYDROLOGIC PARAMETERS

STUDY AREA: 7.22 Ac = 5.52 Ac (ONSITE) + 1.70 Ac (OFFSITE)

SOIL GROUP: D

ZONE X PER FEMA FIRM MAP NO 06059C0508K

## ABBREVIATIONS

| | |
|---|---|
| AC | ACRE |
| CFS | CUBIC FEET PER SECOND |
| ℄ | CENTERLINE |
| ELEV | ELEVATION |
| EX | EXISTING |
| FG | FINISHED GRADE |
| FS | FINISHED SURFACE |
| GB | GRADE BREAK |
| INV | INVERT |
| L | LENGTH |
| MIN | MINUTES |
| ⅊ | PROPERTY LINE |
| R/W | RIGHT OF WAY |
| SD | STORM DRAIN |
| TG | TOP OF GRATE |
| TYP | TYPICAL |

## EXISTING STORM DRAIN REFERENCE

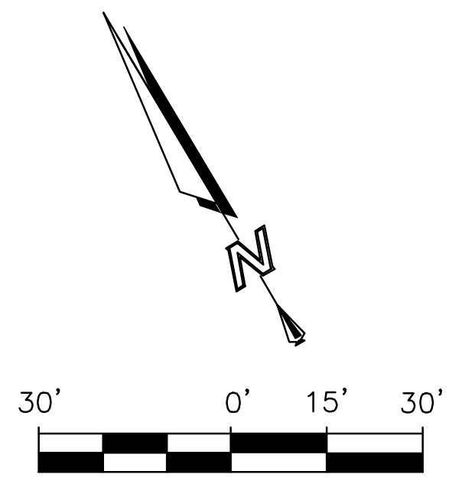
CITY OF DANA POINT STORM DRAIN IMPROVEMENT IN VICTORIA BOULEVARD & SEPULVEDA AVENUE APPROVED ON 5/7/1992.

$Q_{10}$ DESIGN IN EXISTING STORM DRAIN USED FROM THIS REFERENCE PLAN.

## KEY ASSUMPTIONS

* – ASSUMES FULL CAPTURE OF 10-YEAR STORM DESIGN FROM REFERENCE AS-BUILT.

** – STREET PEAK RUNOFF CALULATED FROM CONSERVATIVE FACTOR OF 3 CFS PER ACRE. NO ROUTING PERFORMED.



SCALE: 1" = 30'

# VICTORIA APARTMENTS

## 26126 VICTORIA BLVD, DANA POINT, CA

## EXISTING HYDROLOGY

May 27, 2020

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ENGINEERING
16795 Von Karman, Suite 100
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www.fuscoe.com

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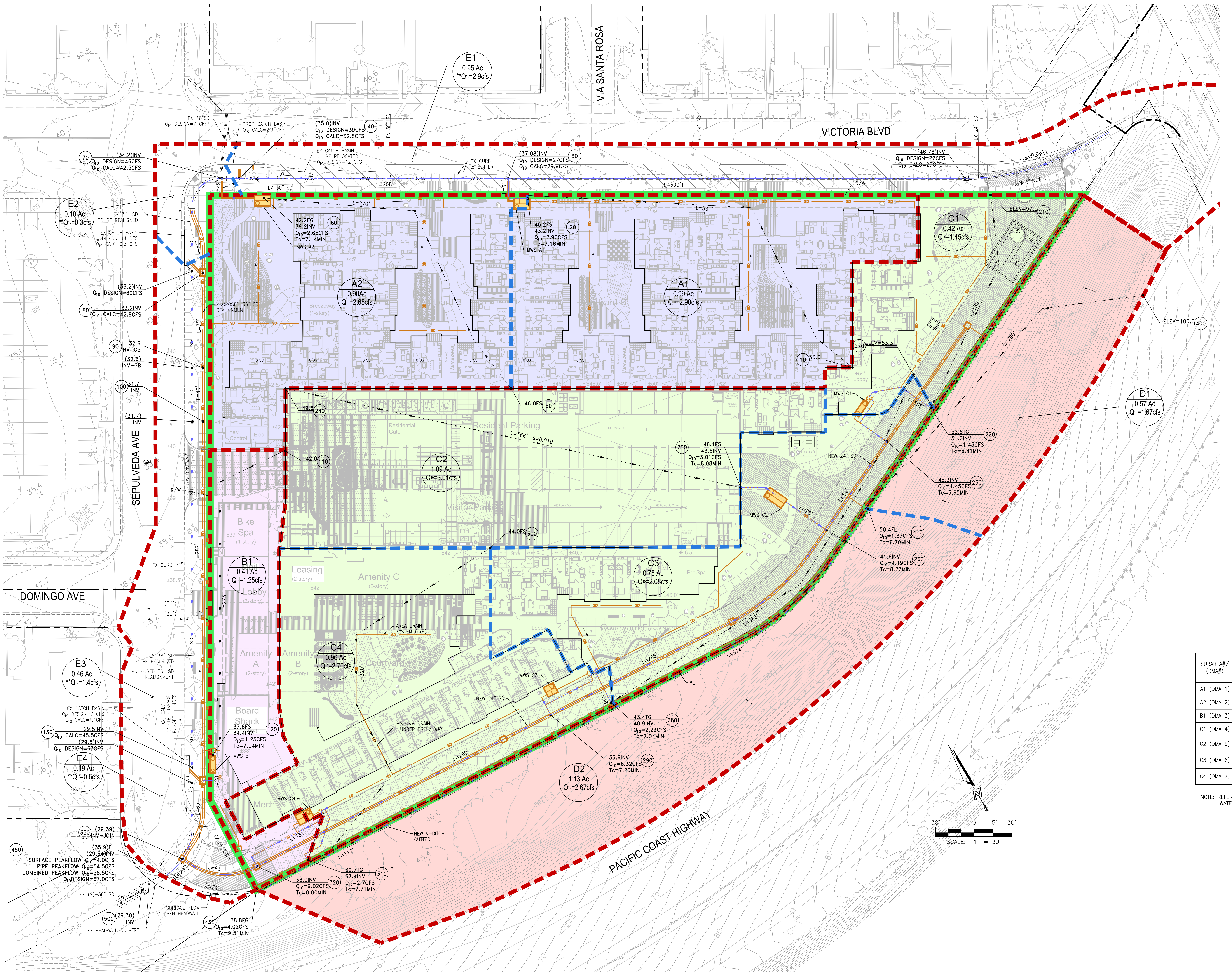

## LEGEND

- PROPERTY LINE/RIGHT OF WAY LINE
- 🟩 ONSITE BOUNDARY (5.52 Ac)
- MAJOR DRAINAGE SUB–BOUNDARY
- MINOR DRAINAGE SUB–BOUNDARY
- SD EXISTING STORM DRAIN
- SD NEW STORM DRAIN
- (10) HYDROLOGIC NODE
- A1 DRAINAGE AREA DESIGNATION
- 3.2 ac AREA
- $Q_{10}$=2.2 cfs FLOWRATE
- STORM EVENT FREQUENCY (IN YEARS)
- SURFACE FLOW
- PIPE FLOW
- PROPOSED MODULAR WETLANDS

## TRIBUTARY AREAS

- ▨ SUB AREA A (1.89 Ac/5.44 cfs @ NODE 70)
- ▨ SUB–AREA B (0.41 Ac/1.25 cfs @ NODE 120)
- 🟩 SUB–AREA C (3.22 Ac/9.02 cfs @ NODE 320)
- 🟥 SUB–AREA D – OFFSITE RUNOFF (1.70 Ac/4.02 cfs @ NODE 430)

## SITE PARAMETERS

STUDY AREA: 7.22 Ac = 5.52 Ac (ONSITE) + 1.70 Ac (OFFSITE)
SOIL GROUP: D
ZONE X PER FEMA FIRM MAP NO 06059C0508K

## ABBREVIATIONS

| | |
|---|---|
| AC | ACRE |
| CFS | CUBIC FEET PER SECOND |
| ℄ | CENTERLINE |
| DMA | DRAINAGE MANAGEMENT AREA |
| ELEV | ELEVATION |
| EX | EXISTING |
| FG | FINISHED GRADE |
| FS | FINISHED SURFACE |
| GB | GRADE BREAK |
| INV | INVERT |
| L | LENGTH |
| MIN | MINUTES |
| MWS | MODULAR WETLANDS SYSTEM |
| ⅊ | PROPERTY LINE |
| POC | POINT OF CONNECTION |
| R/W | RIGHT OF WAY |
| SD | STORM DRAIN |
| TG | TOP OF GRATE |
| TYP | TYPICAL |

## ESTIMATED STORMWATER TREATMENT REQUIREMENTS

| SUBAREA#/ (DMA#) | AREA (AC) | IMPERVIOUSNESS | TREATMENT FLOW REQUIREMENT (CFS) PER OC STANDARDS | DESIGN FLOW RATE (80% x 1.5) (CFS) | MWS MODEL (FTxFT) STD HGL=3.4' | BMP TREATMENT CAPACITY (CFS) |
|---|---|---|---|---|---|---|
| A1 (DMA 1) | 0.99 | 85% | 0.203 | 0.304 | 8'x12' | 0.346 |
| A2 (DMA 2) | 0.90 | 85% | 0.184 | 0.277 | 8'x12' | 0.346 |
| B1 (DMA 3) | 0.41 | 85% | 0.084 | 0.126 | 4'x13' | 0.144 |
| C1 (DMA 4) | 0.42 | 85% | 0.086 | 0.129 | 4'x13' | 0.144 |
| C2 (DMA 5) | 1.09 | 85% | 0.223 | 0.335 | 8'x16' | 0.462 |
| C3 (DMA 6) | 0.75 | 85% | 0.154 | 0.230 | 8'x8' | 0.231 |
| C4 (DMA 7) | 0.96 | 85% | 0.197 | 0.295 | 8'x12' | 0.346 |

NOTE: REFER PRELIMINARY WQMP REPORT FOR WATER QUALITY CALCULATIONS
WATER QUALITY TREATMENT ASSUMES NO SITE INFILTRATION

## HYDROMODIFICATION SUSCEPTIBILITY

SITE DEEMED NOT TO BE SUBJECTED TO HYDROMODIFICATION MITIGATION MEASURES DUE TO EVENTUAL DISCHARGE TO SAN JUAN CREEK, WHICH IS AN ENGINEERED, LARGE RIVER & EXEMPTED BY THE SOUTH ORANGE COUNTY HYDROMODICATION PLAN (HMP).

## EXISTING STORM DRAIN REFERENCE

CITY OF DANA POINT STORM DRAIN IMPROVEMENT IN VICTORIA BOULEVARD & SEPULVEDA AVENUE APPROVED ON 5/7/1992.

$Q_{10}$ DESIGN IN EXISTING STORM DRAIN USED FROM THIS REFERENCE PLAN.

## KEY ASSUMPTIONS

* – ASSUMES FULL CAPTURE OF 10–YEAR STORM DESIGN FROM REFERENCE AS–BUILT.

** – STREET PEAK RUNOFF CALCULATED FROM CONSERVATIVE FACTOR OF 3 CFS PER ACRE. NO ROUTING PERFORMED.

# VICTORIA APARTMENTS

26126 VICTORIA BLVD, DANA POINT, CA
PROPOSED HYDROLOGY
June 8, 2021

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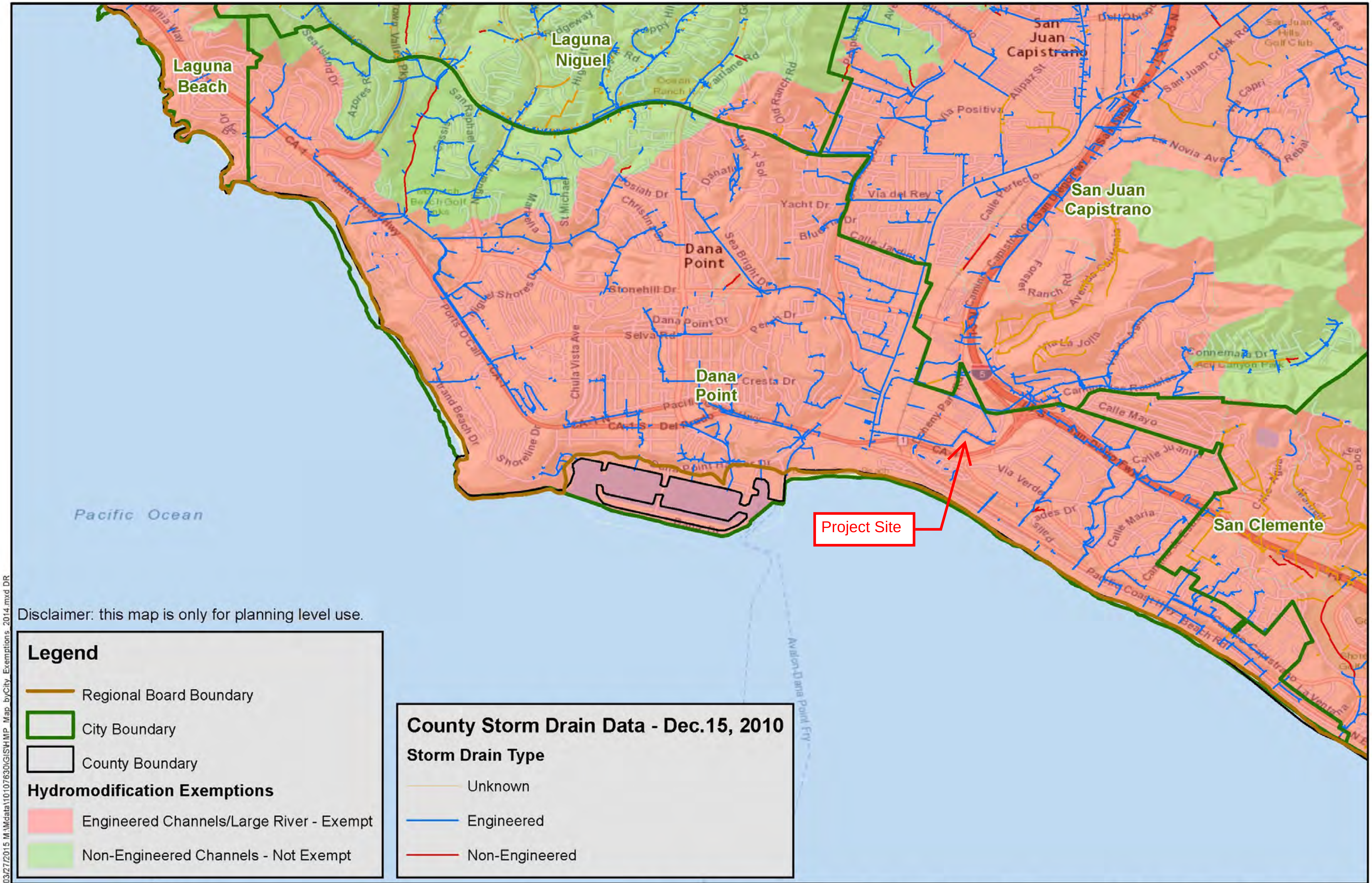
ENGINEERING
16795 Von Karman, Suite 100
Irvine, California 92606
tel 949.474.1960 ◦ fax 949.474.5315
www.fuscoe.com

Projects\1665\004_Support Files\Reports\Hydrology\Supporting Docs\Hydrology Maps\1665–004xh – Proposed Hydrology.dwg (6/8/2021 9:36 AM) Plotted by: Jason Castro

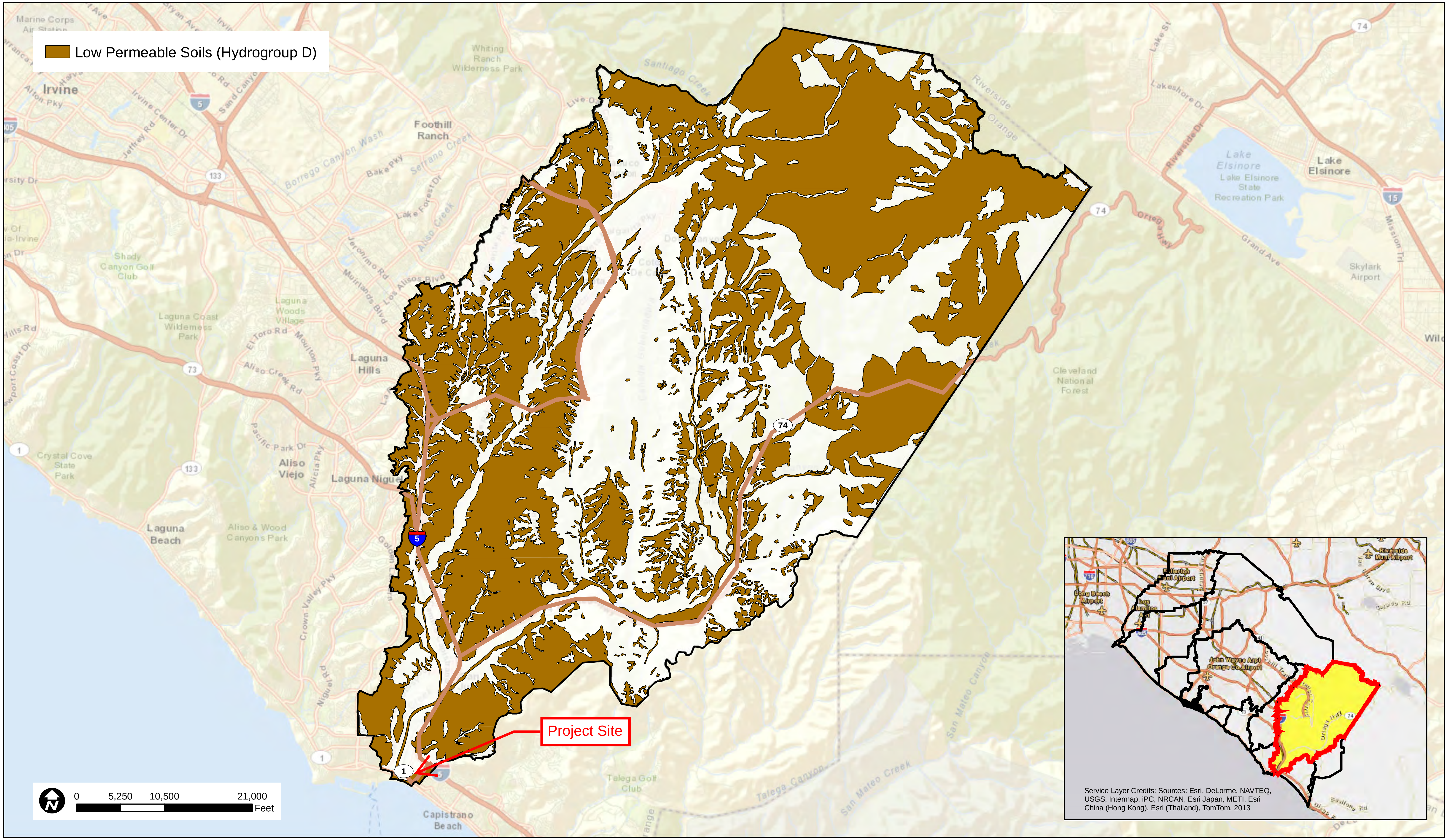


Disclaimer: this map is only for planning level use.

03/27/2015 M:\Mdata\10107630\GIS\HMP_Map_byCity_Exemptions_2014.mxd DR

# South Orange County Engineered Channel Exemption Areas
## Dana Point Exemption Map

Sources: County of Orange; Caltrans; ESRI; RBF Consulting; San Diego RWQCB; SWRCB



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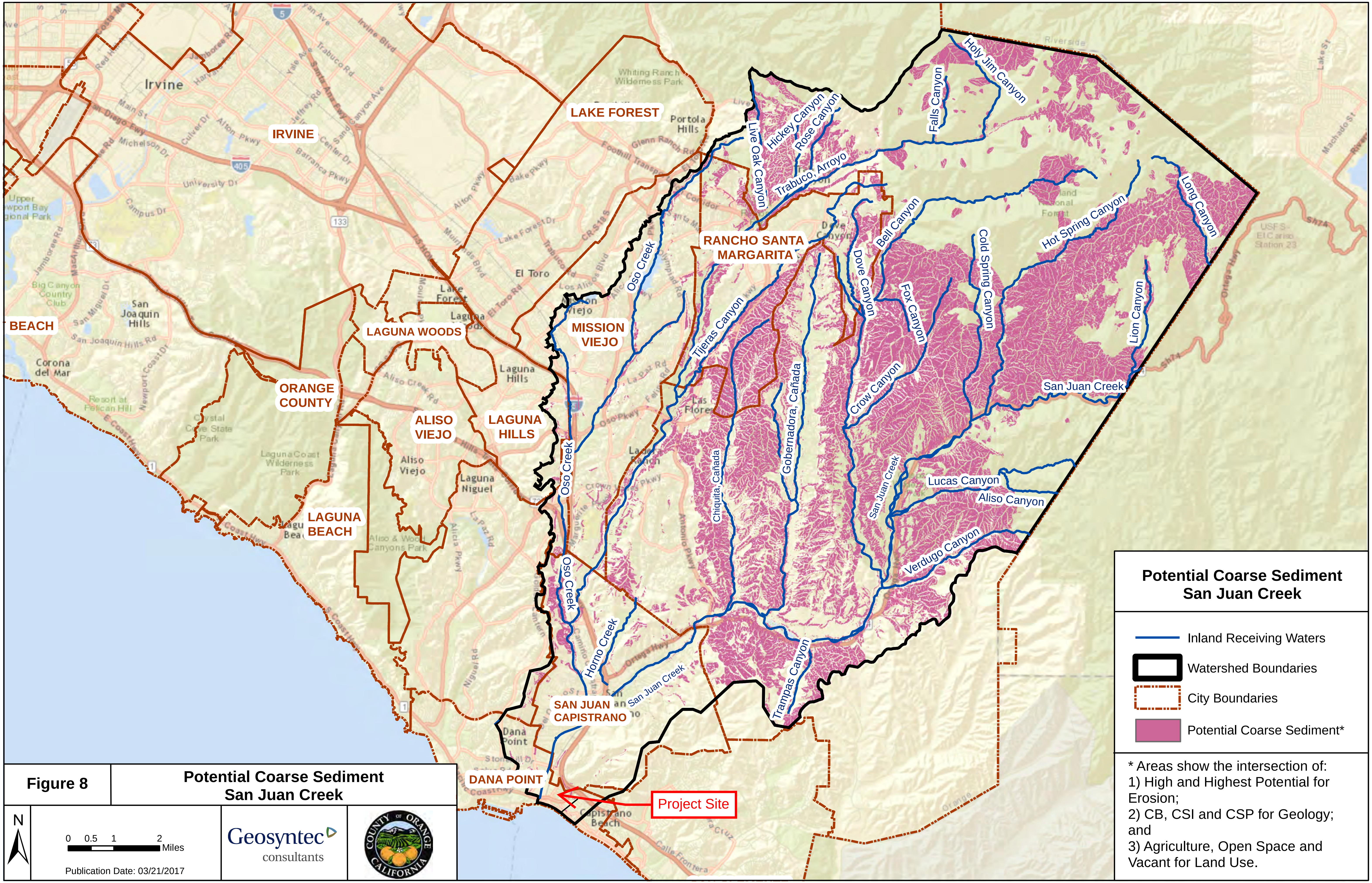
COUNTY OF ORANGE
WATERSHED INFILTRATION HYDROMODIFICATION
MANAGEMENT PLAN (WIHMP)

FIGURE 9.9a

INFILTRATION CONSTRAINT - D SOILS (LOW PERMEABLITY)
SAN JUAN CREEK WATERSHED



## Figure 8

## Potential Coarse Sediment
## San Juan Creek

Publication Date: 03/21/2017

Geosyntec consultants

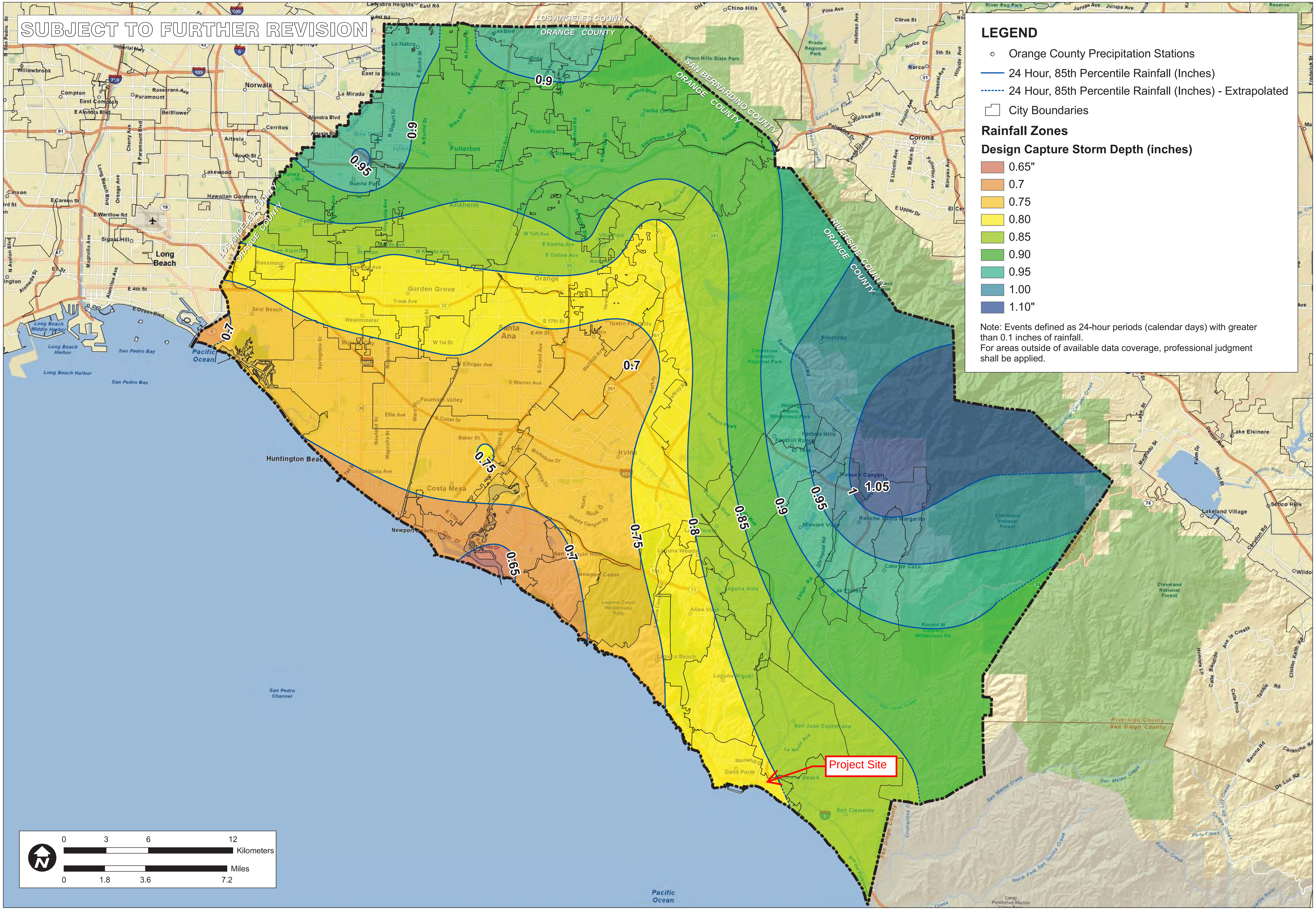
COUNTY OF ORANGE CALIFORNIA

### Potential Coarse Sediment
### San Juan Creek

| | |
|---|---|
| ━ | Inland Receiving Waters |
| ▭ | Watershed Boundaries |
| ⬚ | City Boundaries |
| ■ | Potential Coarse Sediment* |

* Areas show the intersection of:
1) High and Highest Potential for Erosion;
2) CB, CSI and CSP for Geology; and
3) Agriculture, Open Space and Vacant for Land Use.

Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community



Note: Events defined as 24-hour periods (calendar days) with greater than 0.1 inches of rainfall.
For areas outside of available data coverage, professional judgment shall be applied.

TITLE
RAINFALL ZONES

JOB
ORANGE COUNTY
TECHNICAL GUIDANCE
DOCUMENT

ORANGE CO.
CA

| | |
|---|---|
| SCALE | 1" = 1.8 miles |
| DESIGNED | TH |
| DRAWING | TH |
| CHECKED | BMP |
| DATE | 04/22/10 |
| JOB NO. | 9526-E |

PACE
Advanced Water Engineering

FIGURE
XVI-1

P:\9526E16-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-1_RainfallZones_20110215.mxd

# ATTACHMENT D

# BMP DESIGN CALCULATIONS & DETAILS

## Worksheet 1: Infiltration Feasibility Categorization

| ***Categorization of Infiltration Feasibility Condition*** | ***Page 1 of 5*** |
|---|---|

***Part 1: Physical Limitations of Infiltration***

Based on the criteria for physical limitations of infiltration described in Section 4.2.2.2, what level of physical feasibility of infiltration is the maximum that the BMP location will support?

| | **Physical Infiltration Feasibility Category** | **Mark applicable category** | **Next step** |
|---|---|---|---|
| 1 | Full Infiltration of the DCV | | Continue to Part 2 |
| | Biotreatment with Partial Infiltration | | Continue to Part 3 |
| | Biotreatment with No Infiltration | X | Select and Utilize Biotreatment without Infiltration |

Provide summary of basis:

*Full and partial infiltration is considered infeasible on the project site due to several limiting site conditions. According to Section 4.2.2.3 of the TGD, full and partial infiltration of the DCV is prohibited if seasonally high groundwater or mounded groundwater is less than 5 feet below the designed bottom of the infiltration facility. As stated in Section 3.1.2.1, seasonally high groundwater is 5 feet below ground surface making infiltration infeasible.*

*In addition to shallow groundwater and clayey soils, the site is also subject to liquefaction. Section 4.2.2.4 notes that full infiltration in locations less than 50 feet away from slopes steeper than 15 percent poses a significant risk. Variable slopes are present offsite and border the project site to the south east.*

*Lastly, Geotracker found past contamination onsite. Although the case has been closed, past contamination and shallow groundwater are major concerns for implementing infiltration BMPs and potentially contaminating groundwater. Full and partial infiltration has been deemed infeasible. BMPs will be designed as biotreatment with no infiltration.*

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

<table>
<tr><th colspan="2"><em>Categorization of Infiltration Feasibility Condition</em></th><th colspan="2"><em>Page 2 of 5</em></th></tr>
<tr><td colspan="2"><strong><em>Part 2: Risks Limiting Full Infiltration of the DCV –</em></strong><em>Would infiltration of the full DCV introduce risks of undesirable consequences that cannot reasonably be mitigated?</em></td><td><strong><em>Yes</em></strong></td><td><strong><em>No</em></strong></td></tr>
<tr><td>2</td><td><strong>Would infiltration of the DCV pose significant risk for groundwater related concerns?</strong> Use criteria described in Section 4.2.2.3 and results from <strong>Worksheet 2</strong> (Appendix C) to describe groundwater-related infiltration feasibility criteria.</td><td>X</td><td></td></tr>
<tr><td colspan="4">Provide basis:<br><br><em>There is a LUST Cleanup Site within 250 feet of the project site. CUSD Transportation Yard (T0605902398) was discovered to have leaking underground storage tanks and was reported in December of 1989. The main contaminant of concern was gasoline and it posed a threat to other groundwater (uses other than drinking water such as municipal, agricultural, and industrial). The petroleum release was remediated and the case was closed as of July 26, 2000.</em><br><br><em>Review of the Seismic Hazard Zone Report for the Dana Point 7.5 Minute Quadrangle (California Division of Mines and Geology [CDMG], 2001) indicates the historically highest groundwater level in the area is approximately 5 feet beneath the ground surface.</em><br><br>Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td>3</td><td><strong>Would infiltration of the full DCV pose significant risk of increasing risk of geotechnical hazards that cannot be mitigated to an acceptable level</strong>? Use criteria described in Section 4.2.2.4.</td><td>X</td><td></td></tr>
<tr><td colspan="4">Provide basis:<br><br><em>Overall, the geotechnical conditions of the project site are not favorable to infiltration. In addition to poor infiltrating soils, the State of California Seismic Hazard Zone Map for the Dana Point Quadrangle (CDMG, 2001) indicates that the site is located within an area designated as having a potential for liquefaction, mostly likely due to shallow groundwater levels, a primary factor controlling liquefaction.  Liquefaction is a phenomenon in which loose, saturated, relatively cohesionless soil deposits lose shear strength during strong ground motions.</em><br><br>Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
</table>

| | | | |
|---|---|---|---|
| 4 | Would infiltration of the DCV cause an increase in groundwater flow or decrease in surface runoff over predevelopment conditions that would cause **impairment to downstream beneficial uses, such as change of seasonality of ephemeral washes or increased discharge of contaminated groundwater to surface waters?** Use criteria in Section 4.2.2.5 | | X |
| Provide basis:<br>Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability. | | | |
| ***Categorization of Infiltration Feasibility Condition*** | | ***Page 3 of 5*** | |
| ***Part 2 (continued): Risks Limiting Full Infiltration of the DCV –****Would infiltration of the full DCV introduce risks of undesirable consequences that cannot reasonably be mitigated?* | | ***Yes*** | ***No*** |
| 5 | Is there substantial evidence that infiltration of the DCV would **result in a significant increase in I&I to the sanitary sewer** that cannot be sufficiently mitigated? | | X |
| Provide basis:<br>Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability. | | | |
| 6 | Would infiltration of the DCV **violate downstream water rights**? | | X |
| Provide basis:<br>Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability. | | | |

<table>
<tr><td><b>Part 2 Result</b></td><td>If the answer to all questions 2-6 are “No”, then the DMA is categorized as “Full Infiltration” for the purposes of LID BMP type selection. Describe finding.<br><br>At the Preliminary/Conceptual WQMP phase, describe the additional design-phase testing required to confirm this determination and identify contingencies for final design.<br><br>At the Final Project WQMP phase, identify any required construction-phase testing and identify the design contingencies that should result based on construction-phase testing.<br><br>If the answer to any of questions 2-6 is “Yes” then the site cannot be categorized as “Full Infiltration”. Continue to Part 3: Partial Infiltration Feasibility</td><td colspan="2"></td></tr>
<tr><td colspan="2"><b><i>Categorization of Infiltration Feasibility Condition</i></b></td><td colspan="2"><b><i>Page 4 of 5</i></b></td></tr>
<tr><td colspan="2"><b><i>Part 3: Partial Infiltration Feasibility Criteria –</i></b><i>Would infiltration of any appreciable volume of stormwater result in risks of undesirable consequences that cannot reasonably be mitigated?</i></td><td><b><i>Yes</i></b></td><td><b><i>No</i></b></td></tr>
<tr><td>8</td><td><b>Would use of biotreatment BMPs with partial infiltration pose significant risk for groundwater related concerns?</b> Refer to criteria in Section 4.2.2.3 and Worksheet 1 (Appendix C) for guidance on groundwater-related infiltration feasibility criteria.</td><td>X</td><td></td></tr>
<tr><td colspan="4">Provide basis:<br><br><i>According to Section 4.2.2.3 of the TGD, full and partial infiltration of the DCV is prohibited if seasonally high groundwater or mounded groundwater is less than 5 feet below the designed bottom of the infiltration facility. Seasonally high groundwater or mounded groundwater is less than 5 feet below the designed bottom of the infiltration facility. Review of the Seismic Hazard Zone Report for the Dana Point 7.5 Minute Quadrangle (California Division of Mines and Geology [CDMG], 2001) indicates the historically highest groundwater level in the area is approximately 5 feet beneath the ground surface.</i><br><br>Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td>9</td><td><b>Would the use of biotreatment BMPs with partial infiltration pose elevated risks of geotechnical hazards that cannot be mitigated to an acceptable level</b>? Refer to Section 4.2.2.4.</td><td></td><td>X</td></tr>
<tr><td colspan="4">Provide basis:<br><br>Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
</table>

<table>
<tr><td>10</td><td><b>Would the use of biotreatment BMPs with partial infiltration elevate risks or introduced conflicts related to groundwater balance, inflow and infiltration, or water rights?</b> Refer to Section 4.2.2.5. Note: this is uncommon and must be supported by site-specific analysis if it is used as a basis to reject biotreatment with partial infiltration.</td><td></td><td>X</td></tr>
<tr><td colspan="4">Provide basis:<br><br>Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td colspan="2"><b><i>Categorization of Infiltration Feasibility Condition</i></b></td><td colspan="2"><b><i>Page 5 of 5</i></b></td></tr>
<tr><td><b>Part 3 Result</b></td><td>If the answer to all questions 8-10 are “No”, then the DMA is categorized as “Biotreatment with Partial Infiltration” for the purposes of LID BMP type selection.<br><br>If the answer to any of questions 8-10 is “Yes” then the site is categorized as “Biotreatment with No Infiltration” for the purposes of LID BMP type selection.</td><td colspan="2">Biotreatment with<br>No Infiltration</td></tr>
</table>

# Harvest & Reuse Irrigation Demand Calculations

## Storm Water Design Capture Volume (SQDV)

| Drainage Area / Land Use Type | Impervious Area (ac) | Irrigated Area (ac) | % impervious | Runoff Coefficient | Design Storm Depth (in) | Drainage Area (acres) | DCV (ft$^3$) | DCV (gal) |
|---|---|---|---|---|---|---|---|---|
| Total Site | 4.69 | 0.83 | 85% | 0.788 | 0.80 | 5.520 | **12,631.7** | **94,485** |
| | | | | #REF! | | | **#REF!** | **#REF!** |
| | | | | #REF! | | | **#REF!** | **#REF!** |
| | | | | #REF! | | | **#REF!** | **#REF!** |
| | | | | #REF! | | | **#REF!** | **#REF!** |
| | | | | #REF! | | | **#REF!** | **#REF!** |

| | <u>Eto</u> |
|---|---|
| Irvine | 3.00 |
| Laguna Beach | 2.75 |
| Santa Ana | 2.93 |

$$\text{Modified EAWU} = \frac{(\text{Eto} \times \text{KL} \times \text{LA} \times 0.015)}{\text{IE}}$$

$$\text{EIATA} = \frac{\text{LA} \times \text{KL}}{(\text{IE} \times \text{Tributary Imp. Area})}$$

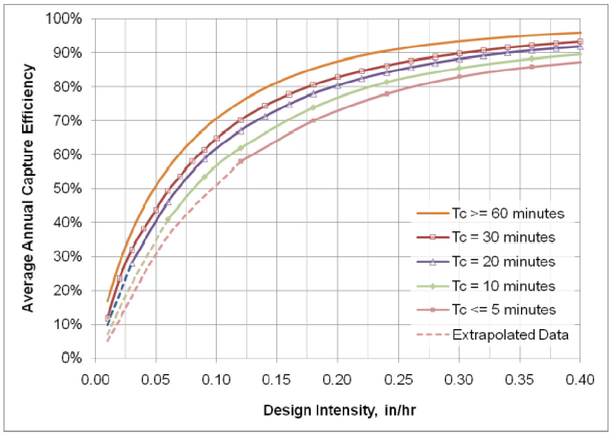
### Blend of High-Use and Low-Use Landscaping

| Drainage Area / Land Use Type | Total Area (ac) | Total Area (sf) | % Impervious | Impervious (sf) | Pervious / LA (sf) | Eto | KL | Modified EAWU | EAWU/ Impervious Acre | EIATA | Minimum EIATA (interpo-lated) | Drawdown of DCV (days) | Drawdown of DCV (hours) | Is Drawdown of DCV <48 hours? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Site | 5.520 | 240,451 | 85% | 204,384 | 36,068 | 2.75 | 0.55 | 909.21 | 193.78 | 0.11 | 0.00 | 103.9 | 2,494 | No |
| 0 | 0.000 | 0 | 0% | 0 | 0 | | 0.55 | 0.00 | #DIV/0! | #DIV/0! | 0.00 | #REF! | #REF! | |

*Source: Technical Guidance Document for the Preparation of Conceptual/Preliminary and/or Project Water Quality Management Plans (WQMPs) in South Orange County. September 28, 2017. Appendix F.*

# Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method

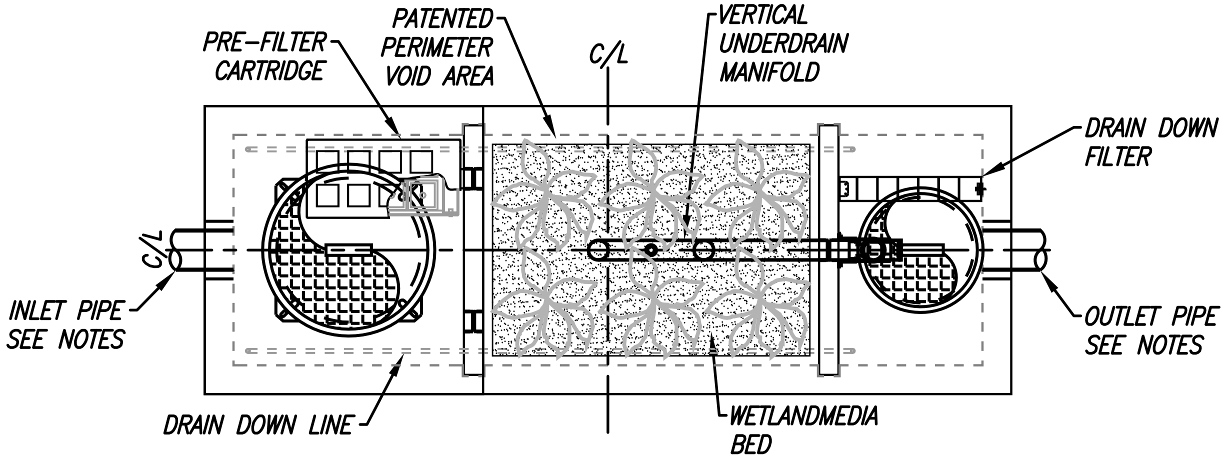
| | | DMA = | DMA 1 | DMA 2 | DMA 3 | DMA 4 | DMA 5 | DMA 6 | DMA 7 | |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Part 1: Determine the design storm intensity of the compact biofiltration BMP*** | | | | | | | | | | |
| 1 | Enter the time of concentration, $T_c$ (min) (See E.2.3) (account for upstream detention by increasing Tc to a maximum 60 minutes per Section E.3.5.2 if detention is provided) | $T_c$= | 5 | 5 | 5 | 5 | 5 | 5 | 5 | min |
| 2 | Using Figure E-7 or the figure included in the worksheet, determine the design intensity at which the estimated time of concentration ($T_c$) achieves 80% capture efficiency, $I_1$ | $I_1$= | 0.26 | 0.26 | 0.26 | 0.26 | 0.26 | 0.26 | 0.26 | in/hr |
| 3 | Enter capture efficiency corresponding to upstream HSCs and/or upstream BMPs, $Y_2$. Attach associated calculations. | $Y_2$ = | 0 | 0 | 0 | 0 | 0 | 0 | 0 | % |
| 4 | Using Figure E-7, determine the design intensity at which the time of concentration ($T_c$) achieves the upstream capture efficiency($Y_2$), $I_2$ | $I_2$= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | in/hr |
| 5 | Determine the design intensity that must be provided by BMP to achieve 80 percent capture, $I_{design}= I_1-I_2$ | $I_{design\_80\%}$= | 0.26 | 0.26 | 0.26 | 0.26 | 0.26 | 0.26 | 0.26 | in/hr |
| ***Part 2: Calculate the design flowrate of the compact biofiltration BMP (Section E.2.6)*** | | | | | | | | | | |
| 6a | Enter DMA area tributary to BMP (s), *A* (acres) | A= | 0.99 | 0.9 | 0.41 | 0.42 | 1.09 | 0.75 | 0.96 | acres |
| 6b | Enter DMA Imperviousness, imp (unitless) | imp= | 85% | 85% | 85% | 85% | 85% | 85% | 85% | |
| 6c | Calculate runoff coefficient, *c= (0.75 x imp) + 0.15* | c= | 0.788 | 0.788 | 0.788 | 0.788 | 0.788 | 0.788 | 0.788 | |
| 6d | Calculate flowrate to achieve 80 percent capture, $Q_{80\%} = (c \times I_{design} \times A)$ | $Q_{80\%}$= | 0.203 | 0.184 | 0.084 | 0.086 | 0.223 | 0.154 | 0.197 | cfs |
| 7 | Calculate design flowrate, $Q_{design} = Q_{80\%} \times 150\%$ | $Q_{design}$= | 0.304 | 0.277 | 0.126 | 0.129 | 0.335 | 0.230 | 0.295 | cfs |
| ***Part 3: Demonstrate that Supplemental Retention BMPs Conform to Volume Reduction Targets (Only DMAs Categorized as "Biotreatment with Partial Infiltration")*** | | | | | | | | | | |
| 8 | Describe system, including features to maximize volume reduction (if applicable): | | | | | | | | | |
| | *Proprietary BioTreatment (BIO-7):* | | | | | | | | | |
| | *Unit Size / Model =* | | *MWS-L-8-12* | *MWS-L-8-12* | *MWS-L-4-13* | *MWS-L-4-13* | *MWS-L-8-16* | *MWS-L-8-8* | *MWS-L-8-12* | |
| | *Unit Size / Model Treatment Capacity =* | | *0.346* | *0.346* | *0.144* | *0.144* | *0.462* | *0.231* | *0.346* | cfs |
| | *Number of Units Needed =* | | *1.000* | *1.000* | *1.000* | *1.000* | *1.000* | *1.000* | *1.000* | |
| | *Total Bio-treatment Provided =* | | *0.346* | *0.346* | *0.144* | *0.144* | *0.462* | *0.231* | *0.346* | cfs |
| 9 | Summarize calculations to demonstrate that volume reduction targets are met, where feasible and applicable. | | | | | | | | | |
| ***Supporting Calculations*** | | | | | | | | | | |
| Provide time of concentration assumptions:<br>Assumed conservative Tc of 5 min | | | | | | | | | | |
| ***Graphical Operations*** | | | | | | | | | | |



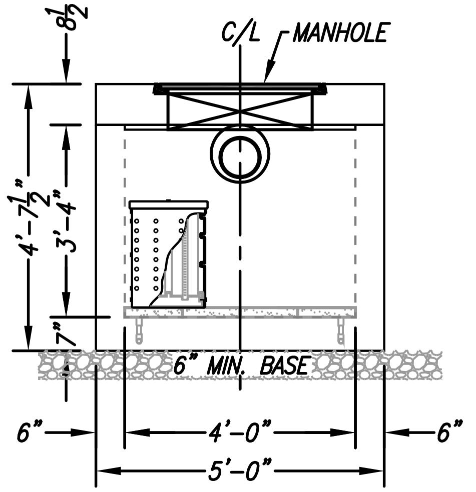
Provide supporting graphical operations in figure above.

## SITE SPECIFIC DATA

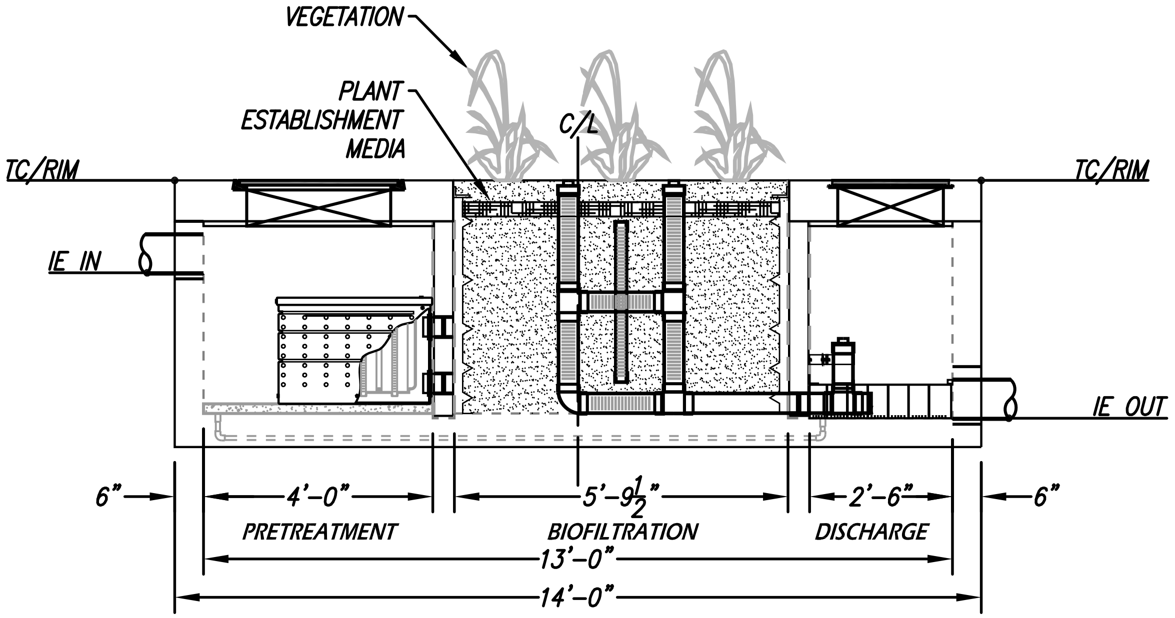
| | | | |
|---|---|---|---|
| PROJECT NAME | | | |
| PROJECT LOCATION | | | |
| STRUCTURE ID | | | |
| TREATMENT REQUIRED | | | |
| VOLUME BASED (CF) | | FLOW BASED (CFS) | |
| | | | |
| TREATMENT HGL AVAILABLE (FT) | | | |
| PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE | | | |
| PIPE DATA | I.E. | MATERIAL | DIAMETER |
| INLET PIPE 1 | | | |
| INLET PIPE 2 | | | |
| OUTLET PIPE | | | |
| | PRETREATMENT | BIOFILTRATION | DISCHARGE |
| RIM ELEVATION | | | |
| SURFACE LOAD | PARKWAY | OPEN PLANTER | PARKWAY |
| FRAME & COVER | ø30" | N/A | ø24" |
| WETLANDMEDIA VOLUME (CY) | | | 3.05 |
| WETLANDMEDIA DELIVERY METHOD | | | TBD |
| ORIFICE SIZE (DIA. INCHES) | | | ø1.71" |
| MAXIMUM PICK WEIGHT (LBS) | | | 27000 |
| NOTES: | | | |



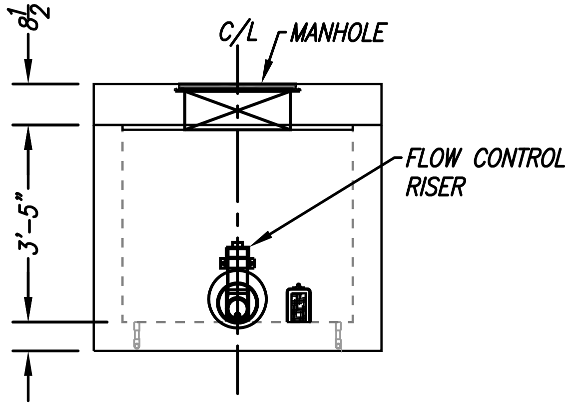
PLAN VIEW



LEFT END VIEW



ELEVATION VIEW



RIGHT 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.
3. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE. (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL GAPS AROUND PIPES SHALL BE SEALED WATER TIGHT WITH A NON-SHRINK GROUT PER MANUFACTURERS STANDARD CONNECTION DETAIL AND SHALL MEET OR EXCEED REGIONAL PIPE CONNECTION STANDARDS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. DRIP OR SPRAY IRRIGATION REQUIRED ON ALL UNITS WITH VEGETATION.

## GENERAL NOTES

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

| | |
|---|---|
| TREATMENT FLOW (CFS) | 0.144 |
| OPERATING HEAD (FT) | 3.4 |
| PRETREATMENT LOADING RATE (GPM/SF) | TBD |
| WETLAND MEDIA LOADING RATE (GPM/SF) | 1.0 |

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

MODULAR WETLANDS
www.ModularWetlands.com | (855) 5MOD-WET

# MWS-L-4-13-V
## STORMWATER BIOFILTRATION SYSTEM STANDARD DETAIL

## SITE SPECIFIC DATA

| | | | |
|---|---|---|---|
| PROJECT NUMBER | | | |
| ORDER NUMBER | | | |
| PROJECT NAME | | | |
| PROJECT LOCATION | | | |
| STRUCTURE ID | | | |
| TREATMENT REQUIRED | | | |
| VOLUME BASED (CF) | | FLOW BASED (CFS) | |
| | | | |
| TREATMENT HGL AVAILABLE (FT) | | | |
| PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE | | | |
| PIPE DATA | I.E. | MATERIAL | DIAMETER |
| INLET PIPE 1 | | | |
| INLET PIPE 2 | | | |
| OUTLET PIPE | | | |
| | PRETREATMENT | BIOFILTRATION | DISCHARGE |
| RIM ELEVATION | | | |
| SURFACE LOAD | PEDESTRIAN | OPEN PLANTER | PEDESTRIAN |
| FRAME & COVER | ø30" | N/A | ø24" |
| WETLANDMEDIA VOLUME (CY) | | | TBD |
| ORIFICE SIZE (DIA. INCHES) | | | TBD |

NOTES: PRELIMINARY NOT FOR CONSTRUCTION.

## 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.
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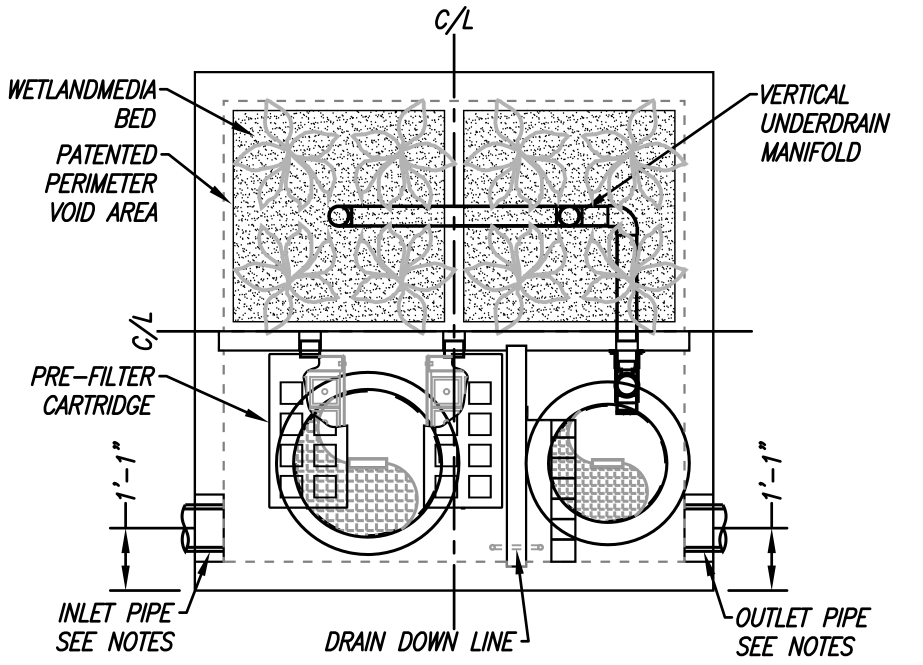
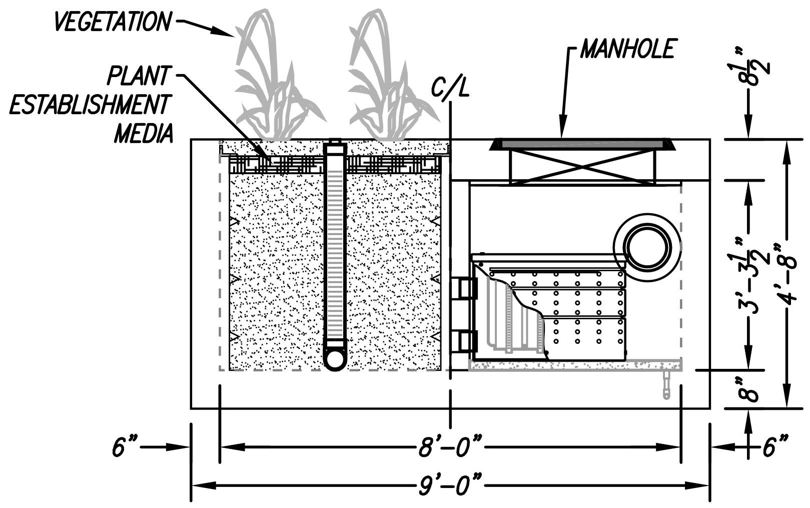
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE. (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL PIPES SHALL BE SEALED WATER TIGHT PER MANUFACTURERS STANDARD CONNECTION 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

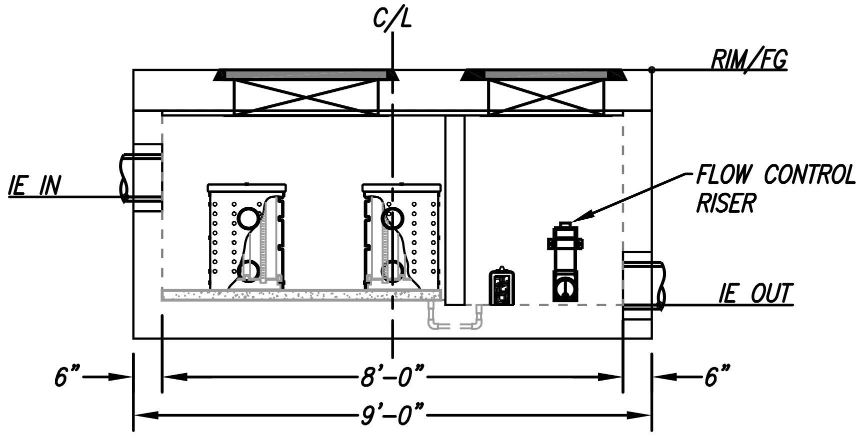
1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT BIO CLEAN.



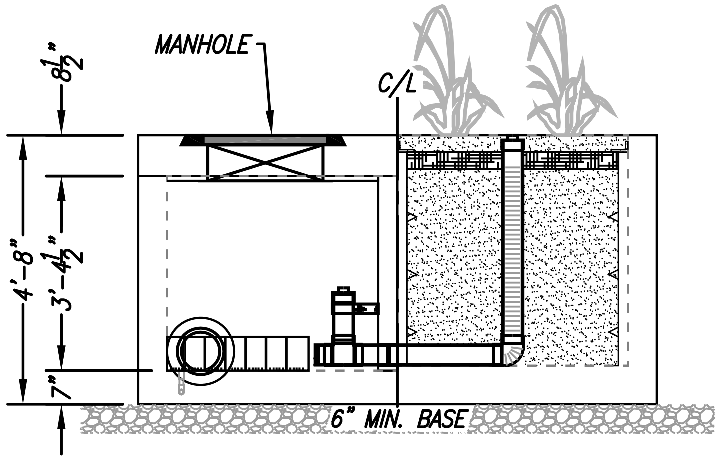
### PLAN VIEW



### LEFT END VIEW



### ELEVATION VIEW



### RIGHT END VIEW

| | |
|---|---|
| TREATMENT FLOW (CFS) | 0.231 |
| OPERATING HEAD (FT) | 3.4 |
| PRETREATMENT LOADING RATE (GPM/SF) | 2.0 |
| 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

Bio Clean
A Forterra Company

MWS-L-8-8-V
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

# MODULAR WETLAND SYSTEMS LINEAR 2.0
# VAULT TYPE

MODULAR WETLANDS™

**FLOW RATES**

PEAK TREATMENT FLOW RATE
= 0.35 CFS OR 155.49 GPM

PEAK BYPASS FLOW RATE
= N/A

**SPECIFICATIONS**

INSTALL AT SURFACE

O.D. DIMENSIONS
= 13' X 9' X 4.63'

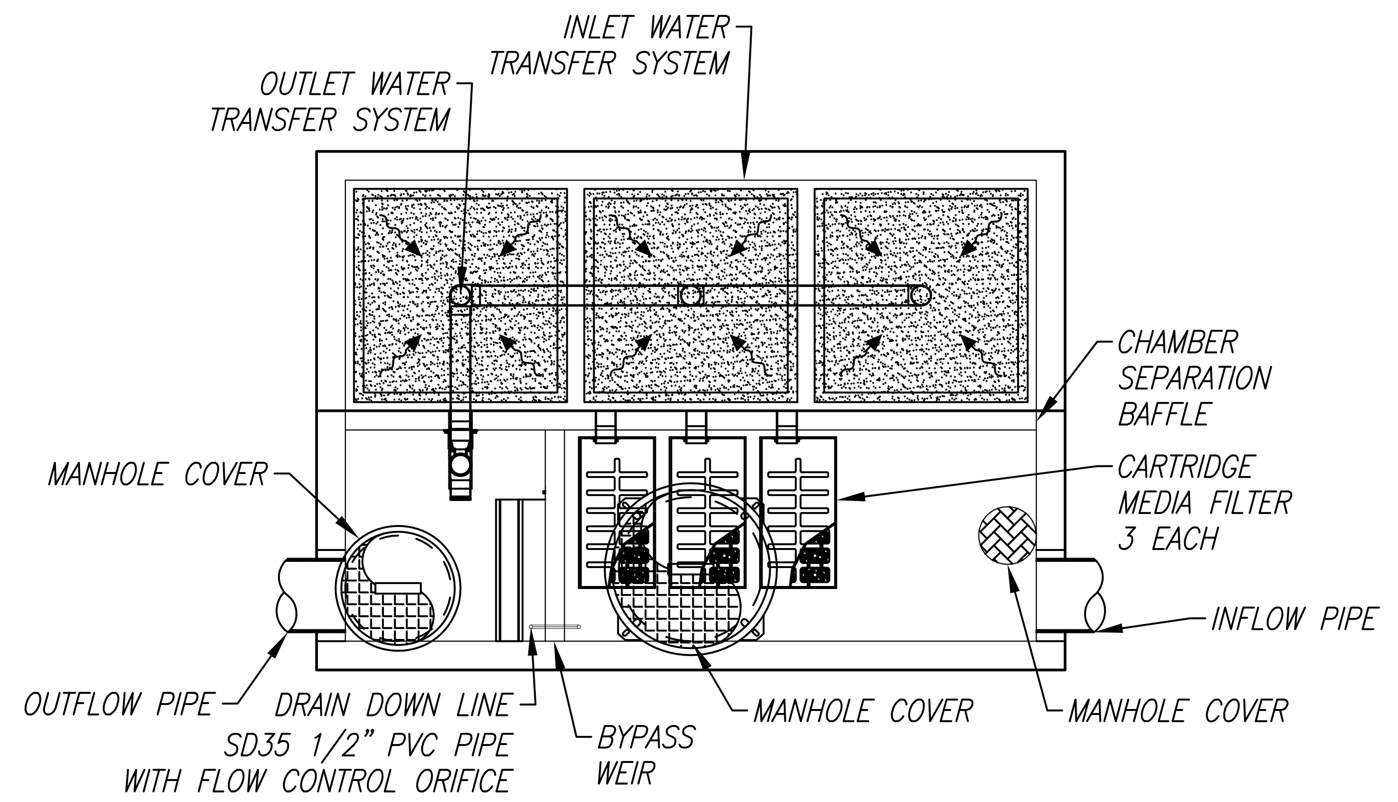
RIM ELEVATION TO IE OUT:
= 4.13'

**BIOFILTRATION CHAMBER SURFACE AREA CALCS**

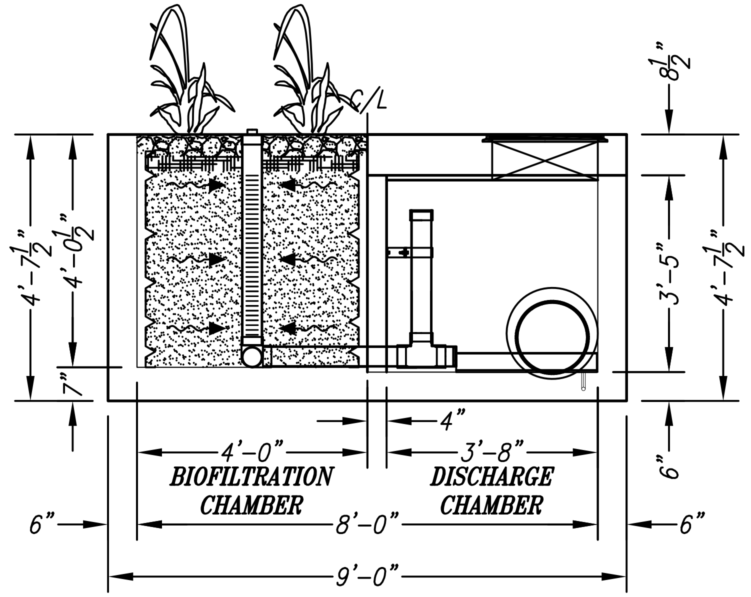
SIDES = 4
3.7' L x 3.4' H = 12.58 SF
12.58 SF X 4 SIDES = 50.32
CELLS = 3
50.32 X 3 CELLS = 150.96
TOTAL WETLAND MEDIA SURFACE AREA **= 150.96 SF**
WETLAND MEDIA LOADING RATE 155.49 GPM / 150.96 SF **= 1.03 GPM/SF**

**PRETREATMENT FILTER SURFACE AREA CALCS**

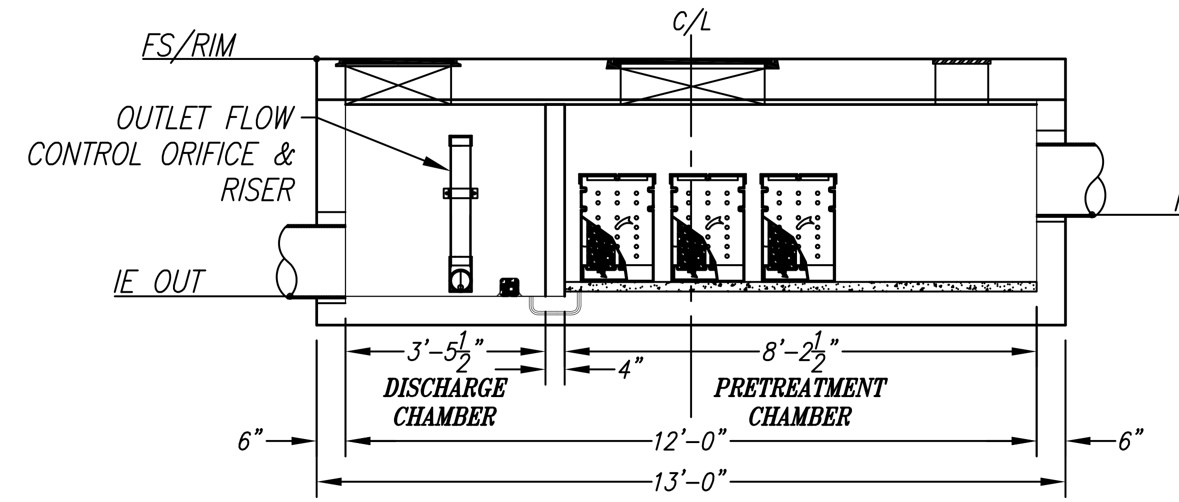
TOTAL PRETREATMENT SURFACE AREA **= 75 SF**
PRETREATMENT FILTER LOADING RATE 155.49 GPM / 75 SF **= 2.07 GPM/SF**



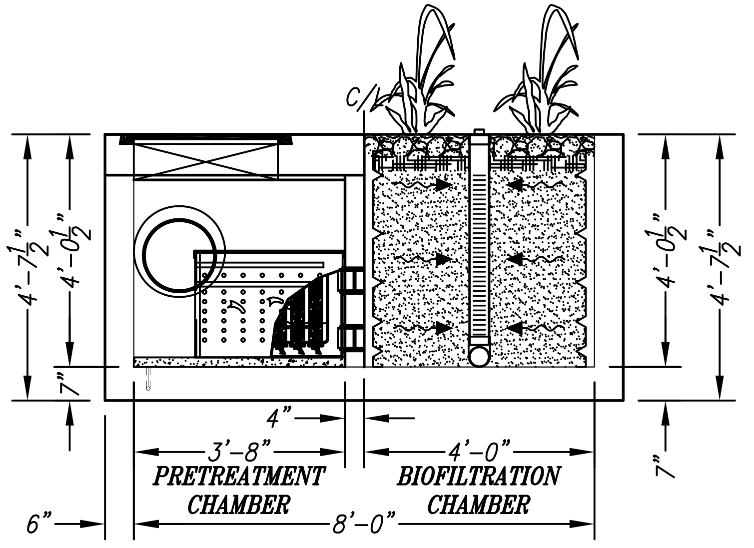
**PLAN VIEW**



**LEFT END VIEW**



**ELEVATION VIEW**



**RIGHT END VIEW**

## LEGEND

░ WETLAND MEDIA
▦ PLANT/ROOT MOISTURE RETENTION LAYER
▩ MANHOLE / ACCESS HATCH

INSTALLATION NOTES:

1. INSTALL UNIT ON LEVEL BED OF GRAVEL OF AT LEAST 6" IN DEPTH WITH 1' MINIMUM OVER EXCAVATION AROUND ENTIRE UNIT.
2. CONCRETE 28 DAY COMPRESSIVE STRENGTH fc=5,000 PSI.
3. REINFORCING: ASTM A-615, GRADE 60.
4. RATED FOR PARKWAY LOADING 300 PSF.
5. JOINT SEALANT: BUTYL RUBBER SS-S-00210

MODULAR WETLAND SYSTEMS INC.
P.O. BOX 869
OCEANSIDE, CA 92049
www.ModularWetlands.com

PROPRIETARY AND CONFIDENTIAL

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| | NAME | DATE |
|---|---|---|
| DRAWN | | |
| REVIEWED | | |
| APPROVED | | |
| COMMENTS: | | |

TITLE: MWS LINEAR 2.0 VAULT TYPE

SIZE DWG. NO. MWS-L-8-12-UG-V REV

SCALE NTS UNITS = INCHES SHEET 1 OF 2

MODULAR WETLANDS™

**FLOW RATES**

PEAK TREATMENT FLOW RATE = 0.35 CFS OR 155.49 GPM

PEAK BYPASS FLOW RATE = DEPENDENT ON PIPE SIZE

**SPECIFICATIONS**

INSTALL AT SURFACE

O.D. DIMENSIONS = 13' X 9' X 5.33'

RIM ELEVATION TO IE OUT: = 4.83'

# MODULAR WETLAND SYSTEMS LINEAR 2.0
## VAULT TYPE

**BIOFILTRATION CHAMBER SURFACE AREA CALCS**

SIDES = 4

3.7' L x 3.4' H = 12.58 SF

12.58 SF X 4 SIDES = 50.32

CELLS = 3

50.32 X 3 CELLS = 150.96

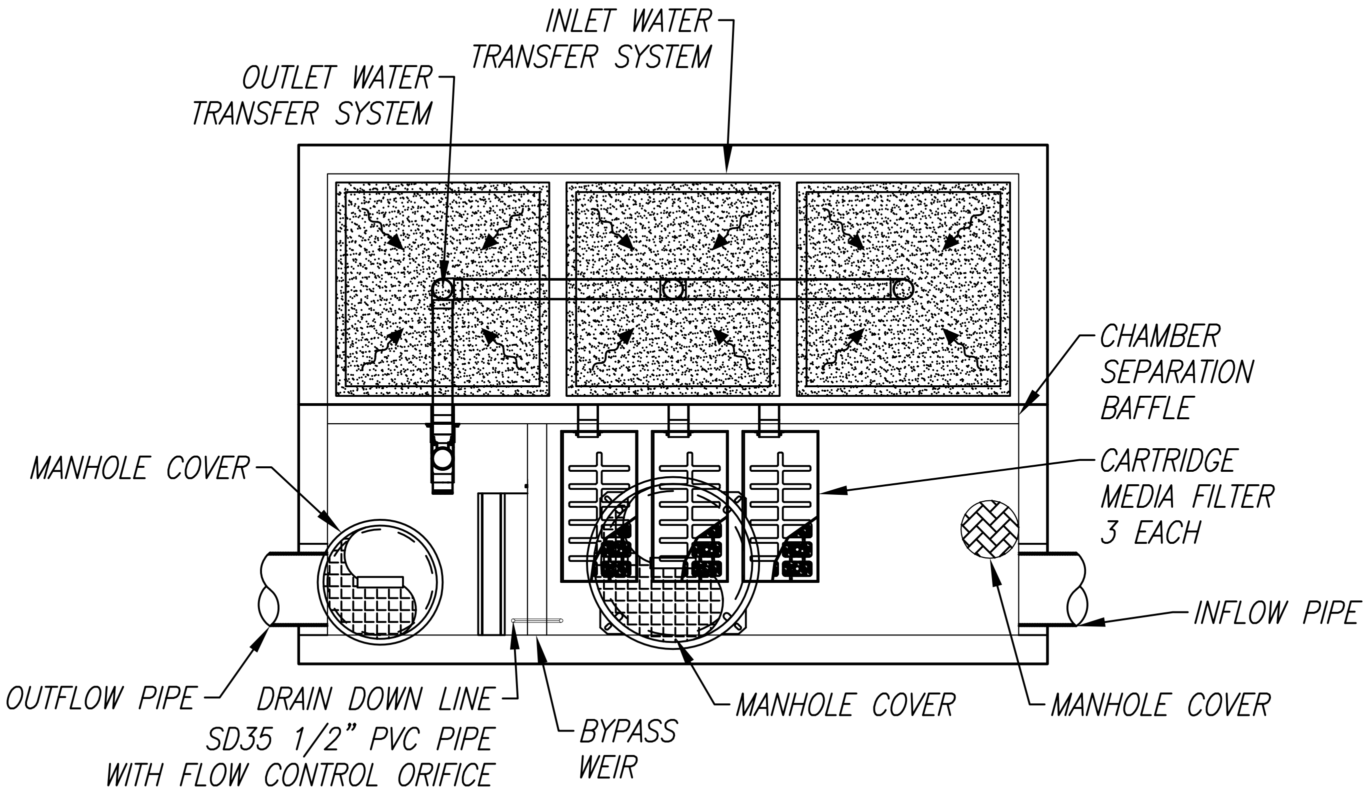
TOTAL WETLAND MEDIA SURFACE AREA **= 150.96 SF**

WETLAND MEDIA LOADING RATE 155.49 GPM / 150.96 SF **= 1.03 GPM/SF**

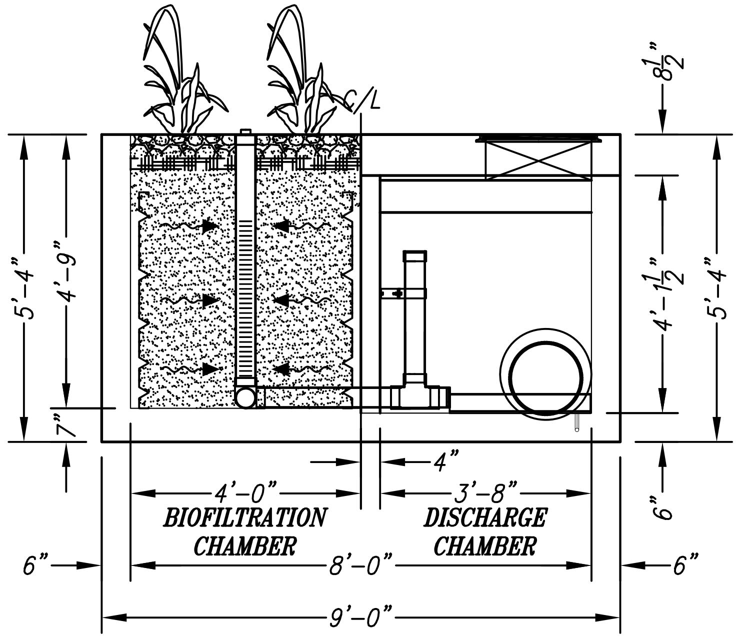
**PRETREATMENT FILTER SURFACE AREA CALCS**

TOTAL PRETREATMENT SURFACE AREA **= 75 SF**

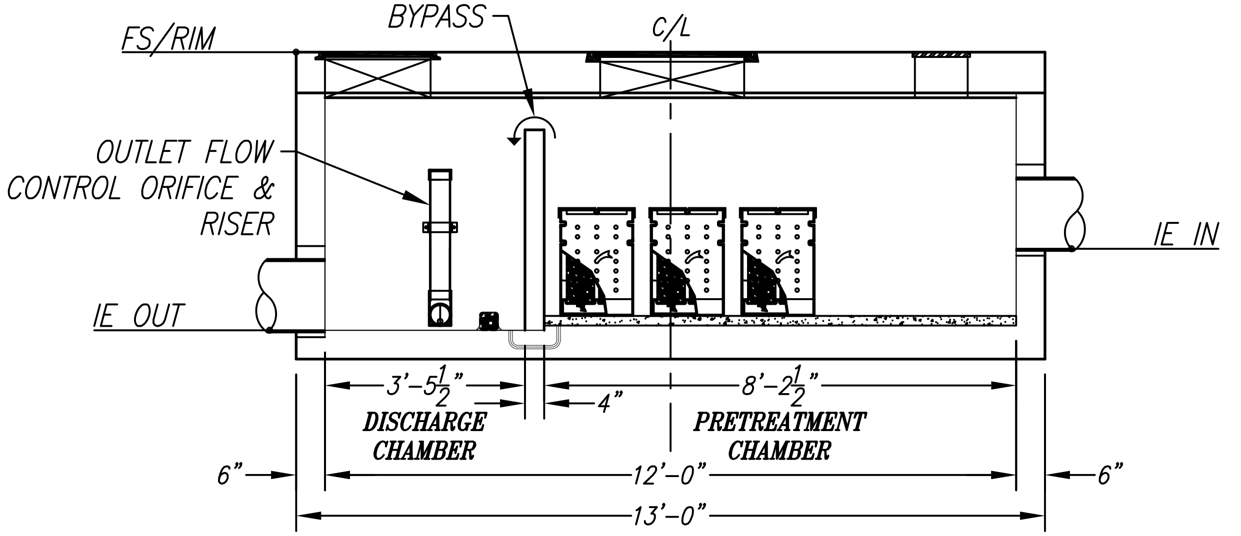
PRETREATMENT FILTER LOADING RATE 155.49 GPM / 75 SF **= 2.07 GPM/SF**



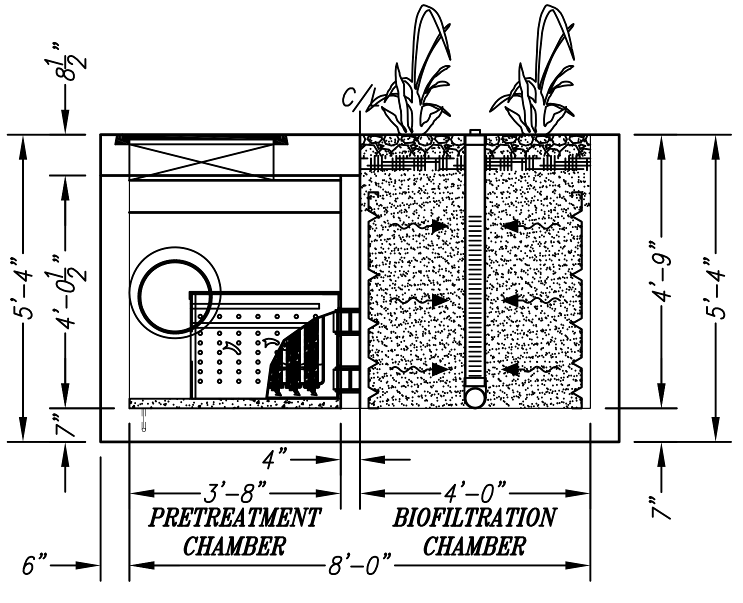
**PLAN VIEW**



**LEFT END VIEW**



**ELEVATION VIEW**



**RIGHT END VIEW**

*LEGEND*

| | |
|---|---|
| ░ | WETLAND MEDIA |
| ▦ | PLANT/ROOT MOISTURE RETENTION LAYER |
| ▨ | MANHOLE / ACCESS HATCH |

INSTALLATION NOTES:

1. INSTALL UNIT ON LEVEL BED OF GRAVEL OF AT LEAST 6" IN DEPTH WITH 1' MINIMUM OVER EXCAVATION AROUND ENTIRE UNIT.
2. CONCRETE 28 DAY COMPRESSIVE STRENGTH fc=5,000 PSI.
3. REINFORCING: ASTM A-615, GRADE 60.
4. RATED FOR PARKWAY LOADING 300 PSF.
5. JOINT SEALANT: BUTYL RUBBER SS-S-00210

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| | NAME | DATE |
|---|---|---|
| DRAWN | | |
| REVIEWED | | |
| APPROVED | | |

COMMENTS:

TITLE: MWS LINEAR 2.0 VAULT TYPE

SIZE

DWG. NO. MWS-L-8-12-UG-V

REV

SCALE NTS

UNITS = INCHES

SHEET 1 OF 2

MODULAR WETLANDS™

*FLOW RATES*

PEAK TREATMENT FLOW RATE = 0.35 CFS OR 155.49 GPM

PEAK BYPASS FLOW RATE = DEPENDENT ON PIPE SIZE

*SPECIFICATIONS*

INSTALL AT SURFACE

O.D. DIMENSIONS = 13' X 9' X 7.5'

RIM ELEVATION TO IE OUT: = 7.00'

# MODULAR WETLAND SYSTEMS LINEAR 2.0
# VAULT TYPE

**BIOFILTRATION CHAMBER SURFACE AREA CALCS**

SIDES = 4

3.7' L x 3.4' H = 12.58 SF

12.58 SF X 4 SIDES = 50.32

CELLS = 3

50.32 X 3 CELLS = 150.96

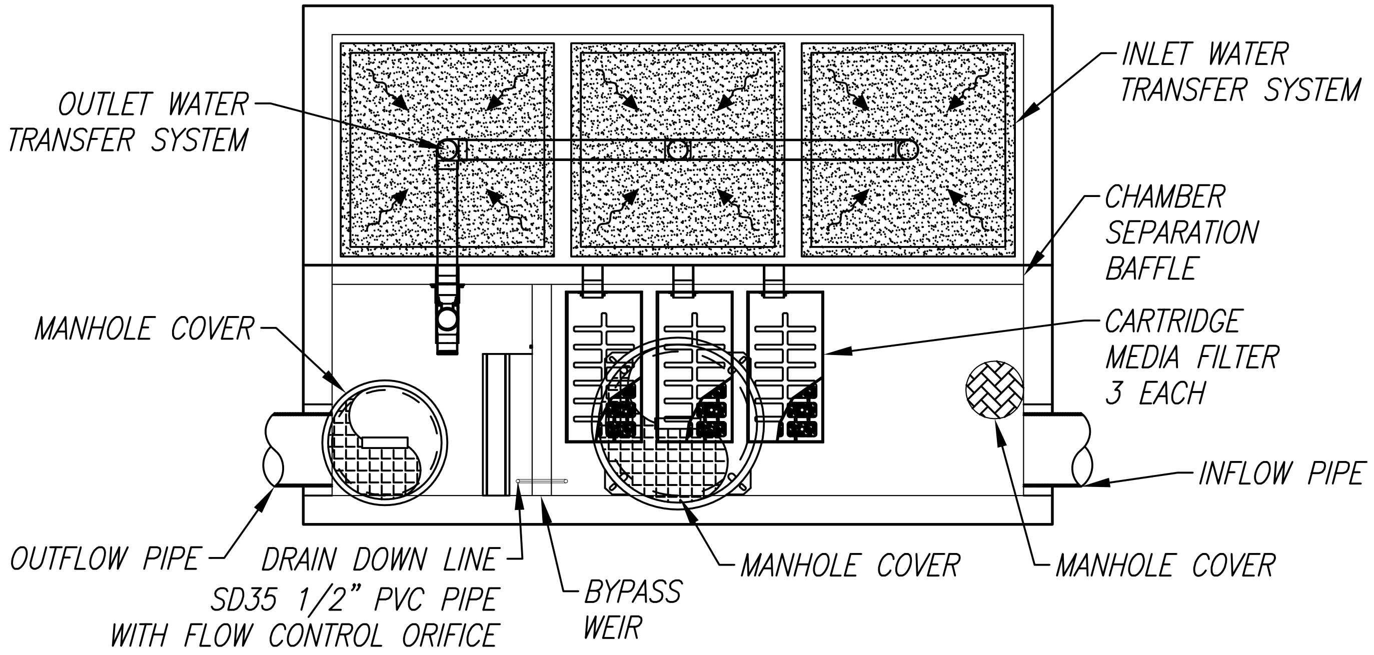
TOTAL WETLAND MEDIA SURFACE AREA **= 150.96 SF**

WETLAND MEDIA LOADING RATE 155.49 GPM / 150.96 SF **= 1.03 GPM/SF**

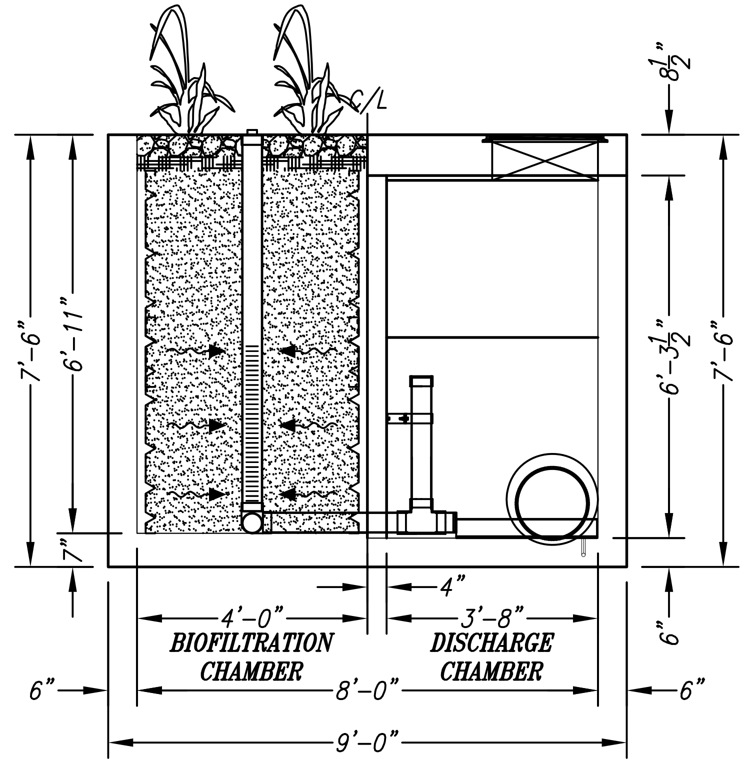
**PRETREATMENT FILTER SURFACE AREA CALCS**

TOTAL PRETREATMENT SURFACE AREA **= 75 SF**

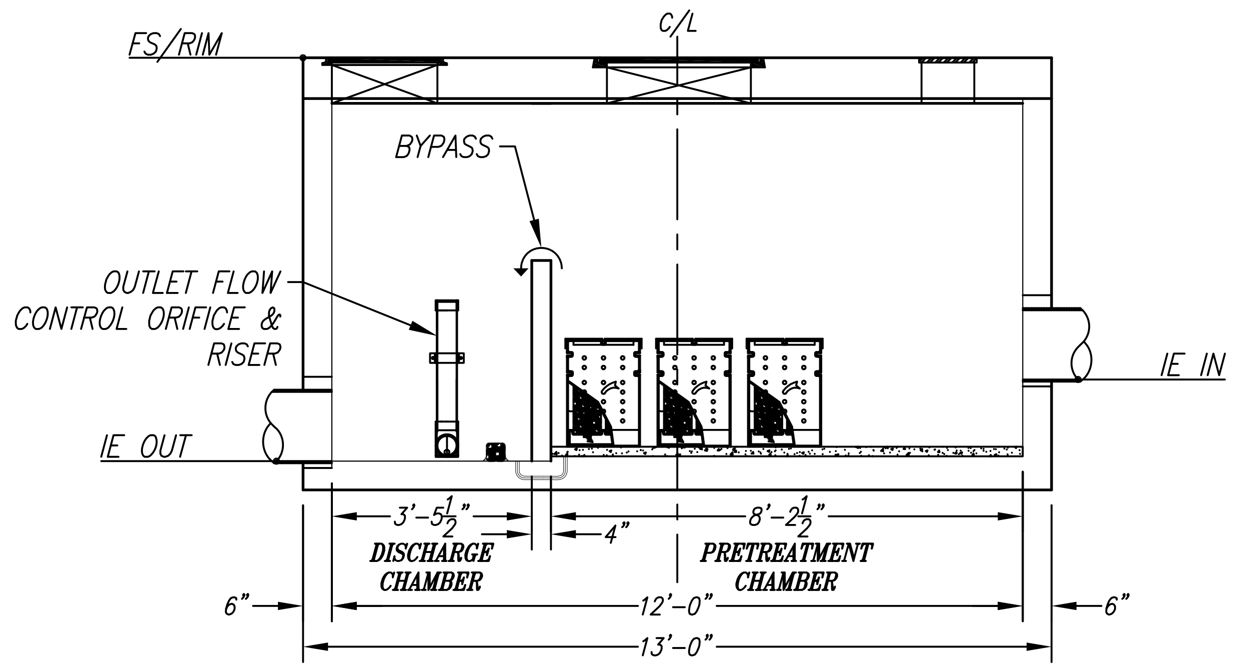
PRETREATMENT FILTER LOADING RATE 155.49 GPM / 75 SF **= 2.07 GPM/SF**



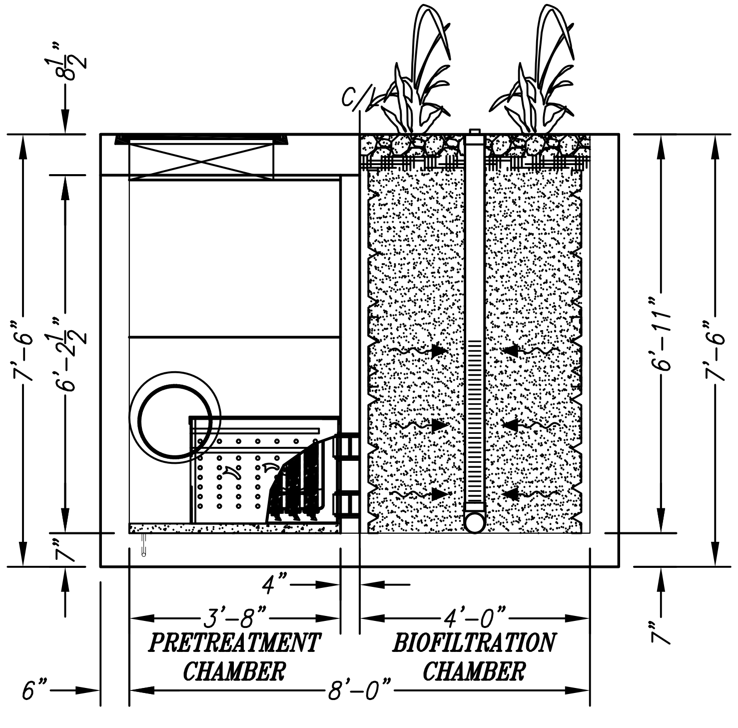
**PLAN VIEW**



**LEFT END VIEW**



**ELEVATION VIEW**



**RIGHT END VIEW**

*LEGEND*

▨ WETLAND MEDIA

▦ PLANT/ROOT MOISTURE RETENTION LAYER

▩ MANHOLE / ACCESS HATCH

INSTALLATION NOTES:

1. INSTALL UNIT ON LEVEL BED OF GRAVEL OF AT LEAST 6" IN DEPTH WITH 1' MINIMUM OVER EXCAVATION AROUND ENTIRE UNIT.
2. CONCRETE 28 DAY COMPRESSIVE STRENGTH fc=5,000 PSI.
3. REINFORCING: ASTM A-615, GRADE 60.
4. RATED FOR PARKWAY LOADING 300 PSF.
5. JOINT SEALANT: BUTYL RUBBER SS-S-00210

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PROPRIETARY AND CONFIDENTIAL

| | NAME | DATE |
|---|---|---|
| DRAWN | | |
| REVIEWED | | |
| APPROVED | | |

COMMENTS:

TITLE: MWS LINEAR 2.0 VAULT TYPE

SIZE DWG. NO. MWS-L-8-12-UG-V REV

SCALE NTS UNITS = INCHES SHEET 1 OF 2

MODULAR WETLANDS™

*FLOW RATES*

PEAK TREATMENT FLOW RATE = 0.35 CFS OR 155.49 GPM

PEAK BYPASS FLOW RATE = DEPENDENT ON PIPE SIZE

*SPECIFICATIONS*

INSTALL AT SURFACE

O.D. DIMENSIONS = 13' X 9' X 7.5'

RIM ELEVATION TO IE OUT: = 7.00'

# MODULAR WETLAND SYSTEMS LINEAR 2.0
# VAULT TYPE

**BIOFILTRATION CHAMBER SURFACE AREA CALCS**

SIDES = 4

3.7' L x 3.4' H = 12.58 SF

12.58 SF X 4 SIDES = 50.32

CELLS = 3

50.32 X 3 CELLS = 150.96

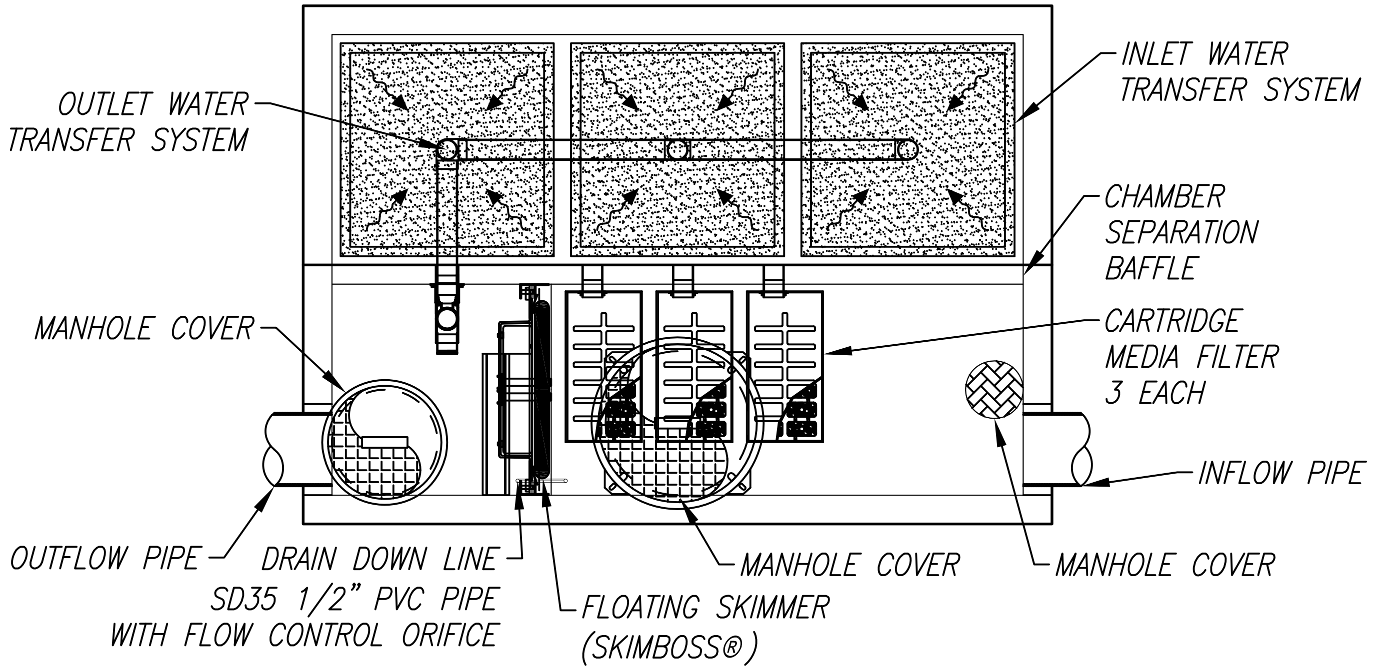
TOTAL WETLAND MEDIA SURFACE AREA
**= 150.96 SF**

WETLAND MEDIA LOADING RATE
155.49 GPM / 150.96 SF
**= 1.03 GPM/SF**

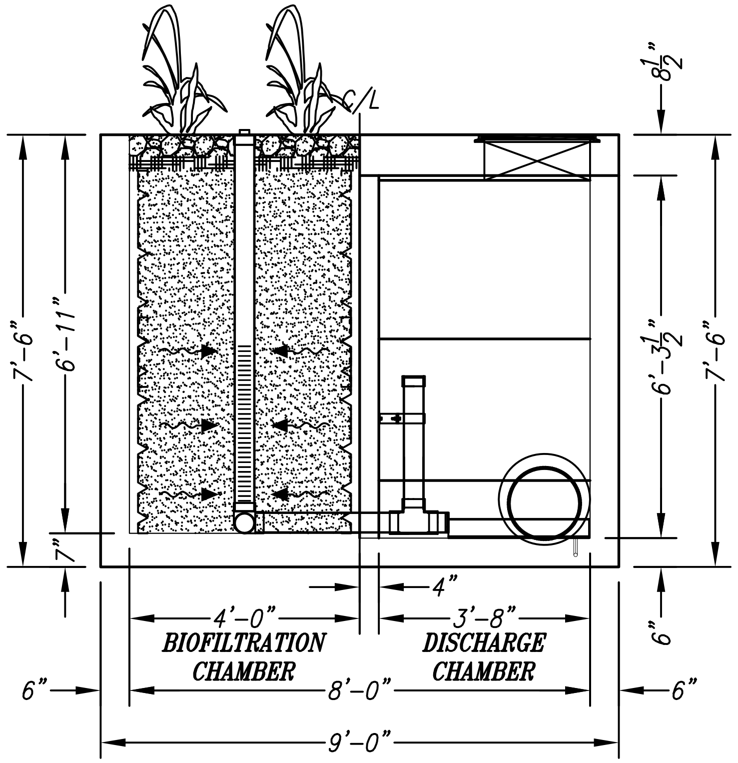
**PRETREATMENT FILTER SURFACE AREA CALCS**

TOTAL PRETREATMENT SURFACE AREA
**= 75 SF**

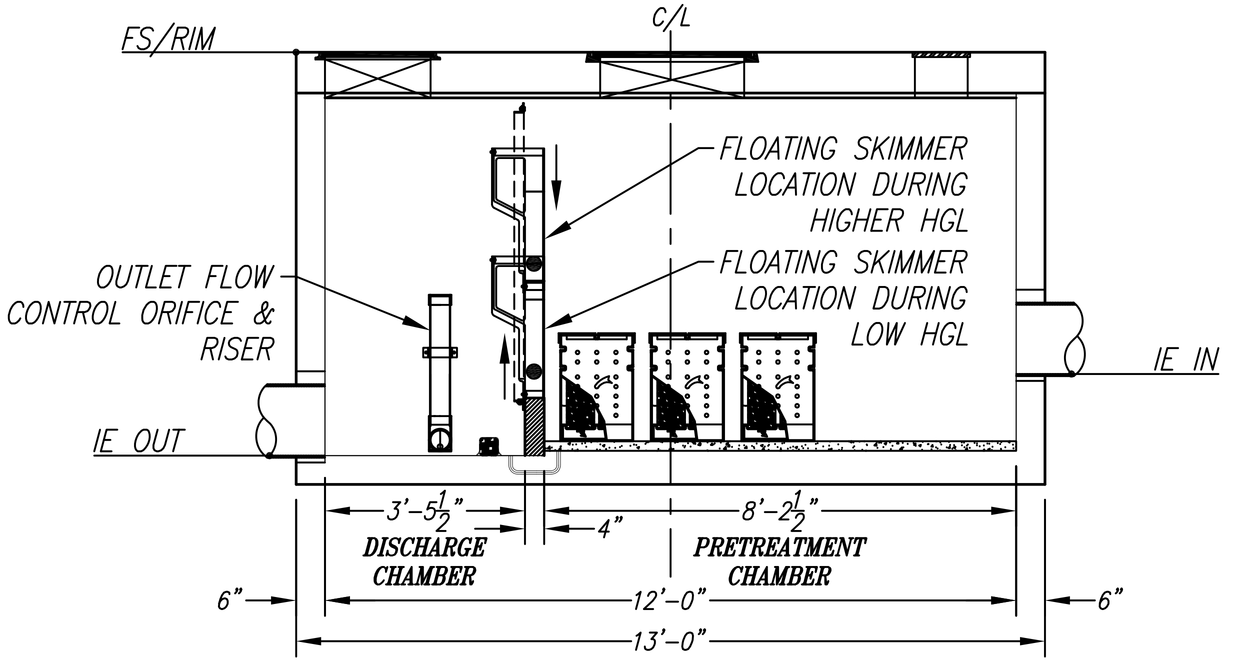
PRETREATMENT FILTER LOADING RATE
155.49 GPM / 75 SF
**= 2.07 GPM/SF**



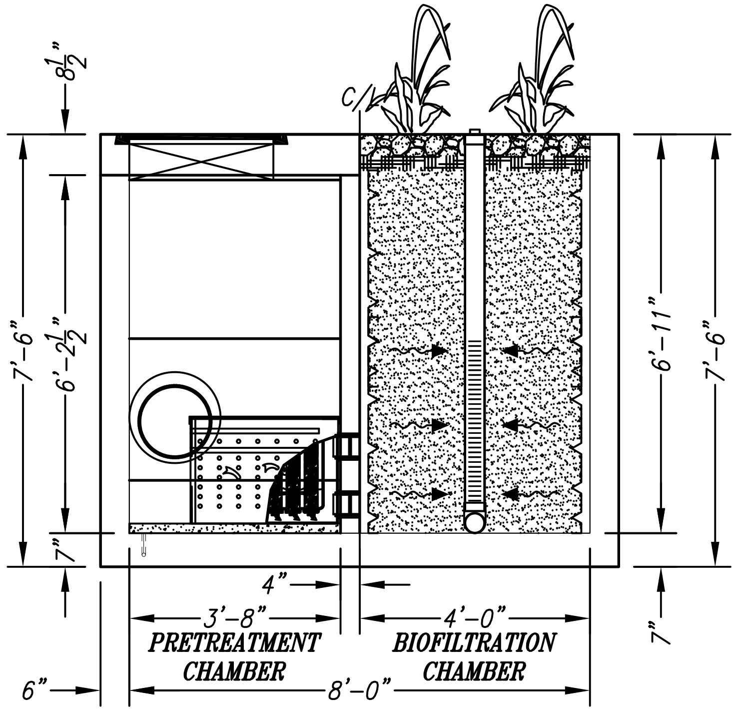
## PLAN VIEW



## LEFT END VIEW



## ELEVATION VIEW



## RIGHT END VIEW

*LEGEND*

▨ WETLAND MEDIA

▦ PLANT/ROOT MOISTURE RETENTION LAYER

▩ MANHOLE / ACCESS HATCH

INSTALLATION NOTES:

1. INSTALL UNIT ON LEVEL BED OF GRAVEL OF AT LEAST 6" IN DEPTH WITH 1' MINIMUM OVER EXCAVATION AROUND ENTIRE UNIT.
2. CONCRETE 28 DAY COMPRESSIVE STRENGTH fc=5,000 PSI.
3. REINFORCING: ASTM A-615, GRADE 60.
4. RATED FOR PARKWAY LOADING 300 PSF.
5. JOINT SEALANT: BUTYL RUBBER SS-S-00210

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| | NAME | DATE |
|---|---|---|
| DRAWN | | |
| REVIEWED | | |
| APPROVED | | |

COMMENTS:

TITLE: MWS LINEAR 2.0
VAULT TYPE

SIZE
DWG. NO. MWS-L-8-12-UG-V
REV

SCALE NTS
UNITS = INCHES
SHEET 1 OF 2

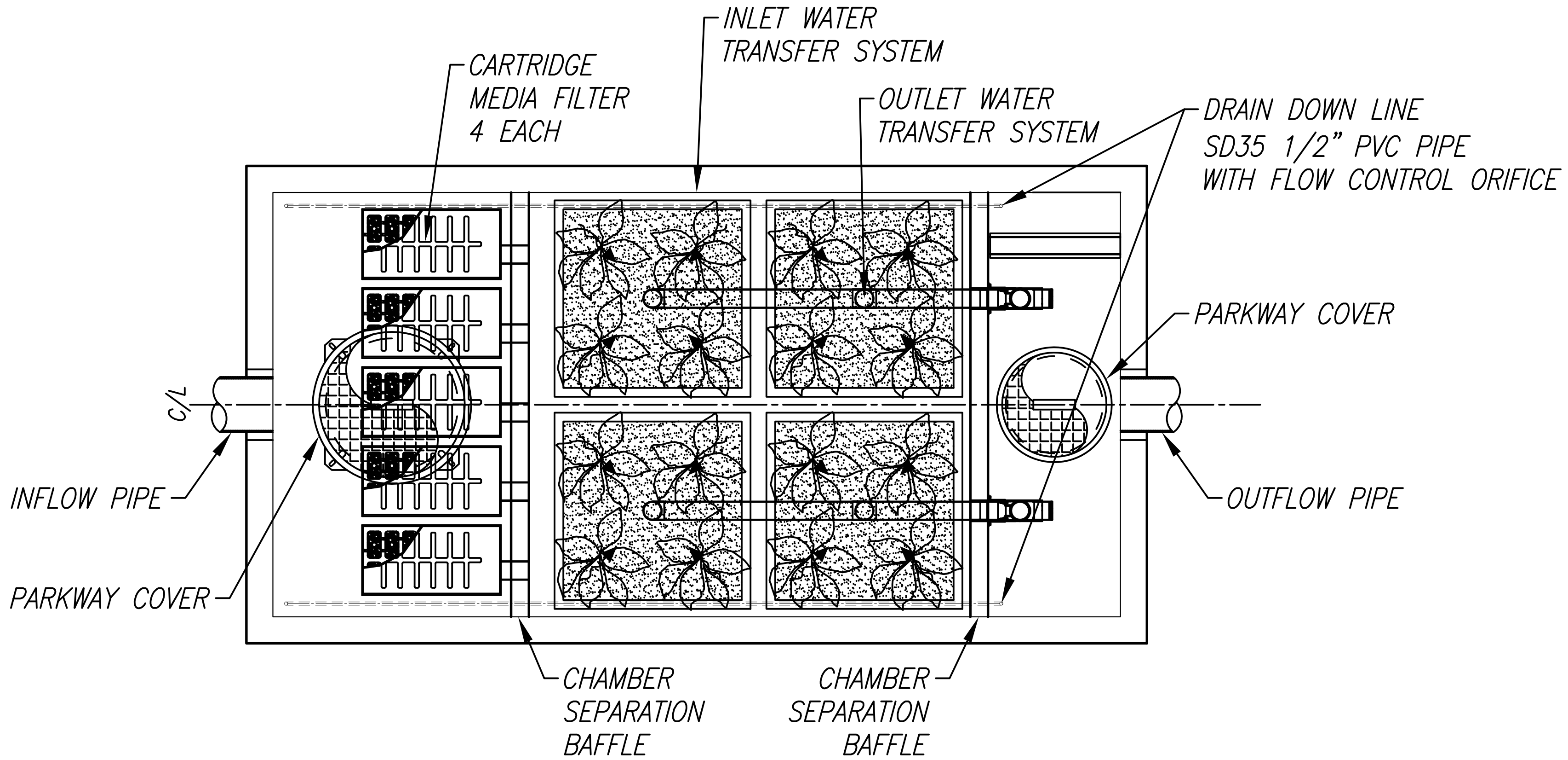
# MODULAR WETLAND SYSTEMS LINEAR 2.0 VAULT TYPE

MODULAR WETLANDS™

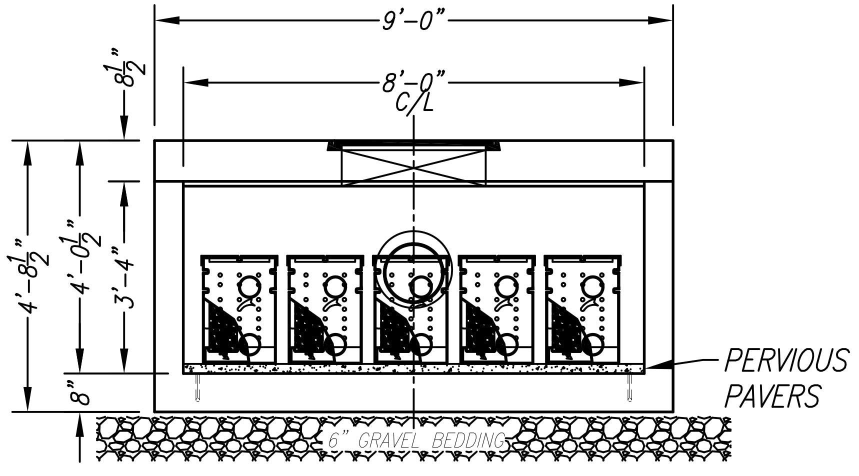
| FLOW RATES |
|---|
| PEAK TREATMENT FLOW RATE = 0.462 CFS OR 207.31 GPM |
| PEAK BYPASS FLOW RATE = N/A |

| SPECIFICATIONS |
|---|
| INSTALL AT SURFACE |
| O.D. DIMENSIONS = 17' X 9' X 4.7' |

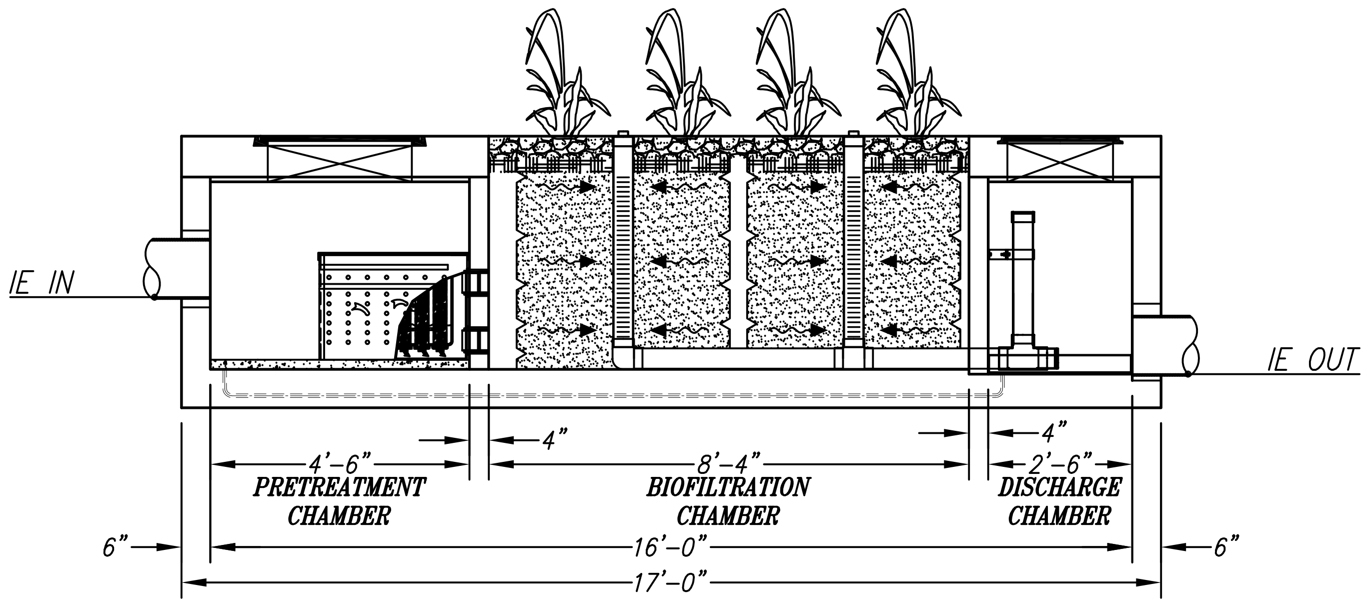
| **BIOFILTRATION CHAMBER SURFACE AREA CALCS** |
|---|
| SIDES = 4 |
| 3.7' L x 3.4' H = 12.58 SF |
| 12.58 SF X 4 SIDES = 50.32 |
| CELLS = 4 |
| 50.32 X 4 CELLS = 201.28 |
| TOTAL WETLAND MEDIA SURFACE AREA **= 201.28 SF** |
| WETLAND MEDIA LOADING RATE 207.31 GPM / 201.28 SF **= 1.03 GPM/SF** |
| **PRETREATMENT FILTER SURFACE AREA CALCS** |
| TOTAL PRETREATMENT SURFACE AREA 25 SF x 5 FILTERS **= 125.00 SF** |
| PRETREATMENT FILTER LOADING RATE 207.31 GPM / 125.00 SF **= 1.66 GPM/SF** |



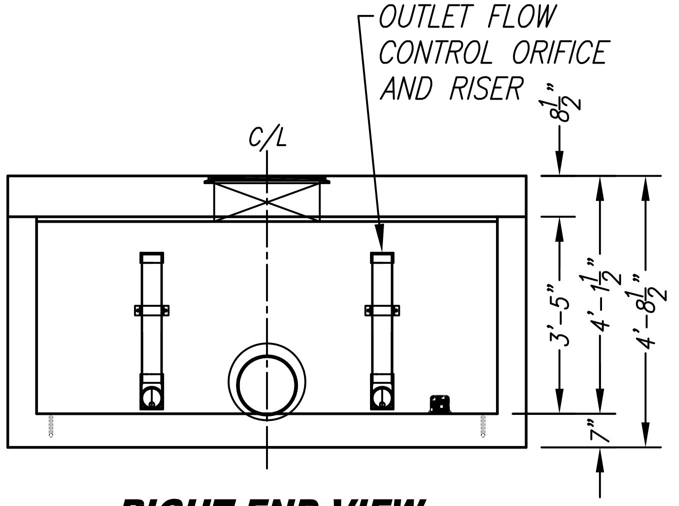
**PLAN VIEW**



**LEFT END VIEW**



**ELEVATION VIEW**



**RIGHT END VIEW**

## LEGEND

| | |
|---|---|
| ▨ | WETLAND MEDIA |
| ▦ | PLANT/ROOT MOISTURE RETENTION LAYER |
| ▩ | MANHOLE / ACCESS HATCH |

INSTALLATION NOTES:

1. INSTALL UNIT ON LEVEL BED OF GRAVEL OF AT LEAST 6" IN DEPTH WITH 1' MINIMUM OVER EXCAVATION AROUND ENTIRE UNIT.
2. CONCRETE 28 DAY COMPRESSIVE STRENGTH fc=5,000 PSI.
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5. JOINT SEALANT: BUTYL RUBBER SS-S-00210

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P.O. BOX 869
OCEANSIDE, CA 92049
www.ModularWetlands.com

| | NAME | DATE |
|---|---|---|
| DRAWN | | |
| REVIEWED | | |
| APPROVED | | |
| COMMENTS: | | |

TITLE: MWS LINEAR 2.0 CURB TYPE

| SIZE | DWG. NO. | REV |
|---|---|---|
| | MWS-L-8-16-V | |

SCALE NTS | UNITS = INCHES | SHEET 1 OF 1

# ATTACHMENT E

## CONDITIONS OF APPROVAL (PENDING ISSUANCE)

# ATTACHMENT F

## GEOTECHNICAL REPORT

GEOCON
WEST, INC.

GEOTECHNICAL
ENVIRONMENTAL
MATERIALS

# DUE-DILIGENCE GEOTECHNICAL INVESTIGATION

## PROPOSED MULTI-FAMILY RESIDENTIAL DEVELOPMENT 26126 VICTORIA BOULEVARD DANA POINT, CALIFORNIA

PREPARED FOR

TOLL BROTHERS APARTMENT LIVING
IRVINE, CALIFORNIA

PROJECT NO. A9942-88-01

MARCH 15, 2019

GEOCON
WEST, INC.
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS

Project No. A9942-88-01
March 15, 2019

Toll Brothers Apartment Living
200 Spectrum Center Drive, Suite 300
Irvine, California 92618

Attention: Mr. John Hyde

Subject: DUE-DILIGENCE GEOTECHNICAL INVESTIGATION
VICTORIA BOULEVARD APARTMENTS
MULTI-FAMILY RESIDENTIAL DEVELOPMENT
26126 VICTORIA BOULEVARD, DANA POINT, CALIFORNIA

Dear Mr. Hyde:

In accordance with your authorization of our proposal dated January 29, 2019, we have performed a due-diligence geotechnical investigation for the proposed Victoria Boulevard Apartments development located at 26126 Victoria Boulevard in the City of Dana Point, California. The accompanying report presents the findings of our study, and our conclusions and recommendations pertaining to the geotechnical aspects of proposed design and construction. Based on the results of our investigation, it is our opinion that the site can be developed as proposed.

The primary intent of this study was to address potential geologic hazards and geotechnical conditions that could impact the project. As the project design progresses, updated geotechnical recommendations should be provided for design and construction.

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

Very truly yours,

**GEOCON WEST, INC.**

Jelisa Thomas Adams
GE 3092

Jamie K. Fink
CEG 2636

John Hoobs
CEG 1524

(EMAIL) Addressee

# TABLE OF CONTENTS

## TABLE OF CONTENTS (Continued)

# DUE-DILIGENCE GEOTECHNICAL INVESTIGATION

## 1. PURPOSE AND SCOPE

This report presents the results of a due-diligence geotechnical investigation for the proposed Victoria Boulevard Apartments development located at 26126 Victoria Boulevard, Dana Point, California (see Vicinity Map, Figure 1). The purpose of the due-diligence investigation was to develop an understanding of the soil and groundwater conditions at the site as well as potential geologic and seismic hazards that may affect development of the subject site. As the project design progresses, updated geotechnical recommendations should be provided for design and construction.

The scope of this investigation included a site reconnaissance, field exploration, laboratory testing, engineering analysis, and the preparation of this report. The site was explored on February 25, 2019, by excavating five 8-inch diameter borings to depths between 31½ and 51½ feet below the existing ground surface using a truck-mounted hollow-stem auger drilling machine. On February 27, 2019, five CPTs were advanced to depths between 90 and 100 feet below the existing ground surface. The approximate locations of the exploratory borings and CPTs are depicted on the Site Plan (see Figure 2). A detailed discussion of the field investigation, including boring and CPT logs, is presented in Appendix A.

Laboratory tests were performed on selected soil samples obtained during the investigation to determine pertinent physical and chemical soil properties. Appendix B presents a summary of the laboratory test results.

The recommendations presented herein are based on analysis of the data obtained during the investigation and our experience with similar soil and geologic conditions. References reviewed to prepare this report are provided in the *List of References* section.

If project details vary significantly from those described herein, Geocon should be contacted to determine the necessity for review and possible revision of this report.

## 2. SITE AND PROJECT DESCRIPTION

The subject site is located at 26126 Victoria Boulevard in the City of Dana Point, California. The 5.52-acre lot is irregular in shape and is bounded by Victoria Boulevard to the north, an approximate 12 to 45-feet high ascending cutslope to the south and east, and by Sepulveda Avenue to the west. The existing development in the site vicinity consists of one and two-story residential and commercial structures. The property is currently occupied by the Capistrano School District Maintenance and Bus Yard which consists of several relatively small single-story buildings scattered throughout the property and abundant parking areas and storage bins. The site is very gently sloping to the northwest with approximately 12 feet of vertical relief across the property. The existing slope which bounds the site to the south and east is generally inclined at a gradient of 2:1 (H:V) and flatter. Surface water drainage at the site appears to be by sheet flow along the existing ground contours to the city streets. The site is covered predominately with asphalt and concrete.

It is our understanding that the proposed development will include 5-story apartment buildings wrapped around a 6.5-story parking structure to be constructed at or near present grade. Additional site improvements will include courtyards, landscape areas, a swimming pool, and driveways. The proposed development is depicted on the Site Plan (see Figure 2).

Based on the preliminary nature of the design at this time, wall and column loads were not available. Column loads and wall loads for the proposed parking structure are estimated be up to 650 kips and 35 kips per linear foot, respectively. Column loads and wall loads for the proposed apartment building are estimated be up to 150 kips and 6 kips per linear foot, respectively.

We understand that final design of the project has not been completed, hence, once the design phase proceeds to a more finalized plan, the recommendations within this report should be reviewed and revised, if necessary. Any changes in the design, location or elevation of any structure, as outlined in this report, should be reviewed by this office. Geocon should be contacted to determine the necessity for review and possible revision of this report.

## 3. GEOLOGIC SETTING

The site is situated in the northwestern portion of the Peninsular Ranges geomorphic province characterized by fault block northwest trending mountain ranges with intervening valleys, plains and basins. The site is located in the middle of the Dana Point 7.5-minute Quadrangle Sheet and at the southern terminus of the locally rugged San Joaquin Hills (CDMG, 1999 and Edington, 1974). The prominent structural feature within the San Joaquin Hills includes the gentle folding of the geologic units into a broad, north-trending syncline. Geologically, the site is situated approximately 2000-feet east-southeast of the mouth of the San Juan Creek and within the alluvial plain. The geologic units in the area consist of Holocene alluvium overlying Tertiary marine and nonmarine sedimentary strata ranging in age from late Miocene to early Pliocene.

The geologic formation that is present on site is the flat lying Holocene-age stream alluvial deposits, which is underlain, at depth, by Capistrano Formation. Regional faulting in the area is common with active faults including the San Joaquin Hills, Newport-Inglewood, Chino, Elsinore, and others that could influence the site.

## 4. SOIL AND GEOLOGIC CONDITIONS

Based on our field investigation and published geologic maps of the area, the site is underlain by artificial fill, Holocene age stream alluvial deposits, and ultimately, at depth, by late Miocene to early Pliocene Capistrano Formation. Detailed stratigraphic profiles of the materials encountered at the site are provided on the boring logs in Appendix A.

### 4.1 Artificial Fill

Artificial fill was encountered in our field explorations to a maximum depth of 5 feet below existing ground surface. The artificial fill generally consists of brown, gray brown, and reddish brown, sandy silty clay, clayey silt, and clayey silty sand. The artificial fill is characterized as slightly moist to moist and soft to firm or loose. The fill is likely the result of past grading or construction activities at the site. Deeper fill may exist between excavations and in other portions of the site that were not directly explored.

We understand that previously abandoned underground storage tanks were removed from the northeast most corner of the site. Based on available information, the prior excavations extended to depths of up to 29 feet below the ground surface. We have not been provided with documentation that the excavations were backfilled with certified, engineered fill. Therefore, the backfill material should be considered as undocumented artificial fill.

### 4.2 Alluvium

Holocene age alluvial stream deposits were encountered beneath the fill. The alluvial stream deposits consist of brown to dark brown to gray to olive brown, interbedded sandy clayey silt, silty clay, and clayey sand. The alluvium is characterized as slightly moist to wet and very soft to firm and medium dense.

### 4.3 Capistrano Formation (Tc)

Tertiary-age Capistrano Formation was encountered in Borings B-1, B-2, and B-5 at depths of approximately 40, 25, and 35 feet below the existing ground surface, respectively. Where encountered, the bedrock consists of clayey and sandy siltstone and silty sandstone. In general, the unit generally consists of a stiff to hard siltstone to claystone that is highly expansive.

## 5. GROUNDWATER

Review of the Seismic Hazard Zone Report for the Dana Point 7.5 Minute Quadrangle (California Division of Mines and Geology [CDMG], 2001) indicates the historically highest groundwater level in the area is approximately 5 feet beneath the ground surface.

Groundwater was encountered in our borings at depths ranging from approximately 16 to 20 feet below the existing ground surface. Considering the historic high groundwater level and the depth to groundwater observed in our borings, groundwater may be encountered during construction. It is not uncommon for groundwater levels to vary seasonally or for groundwater seepage conditions to develop where none previously existed, especially in impermeable fine-grained soils which are heavily irrigated or after seasonal rainfall. Proper surface drainage of irrigation and precipitation will be critical for future performance of the project. Recommendations for drainage are provided in the S*urface Drainage* section of this report (see Section 7.22).

# 6. GEOLOGIC HAZARDS

## 6.1 Surface Fault Rupture

The numerous faults in Southern California include active, potentially active, and inactive faults. The criteria for these major groups are based on criteria developed by the California Geological Survey (CGS, formerly known as CDMG) for the Alquist-Priolo Earthquake Fault Zone Program (CGS, 2018a). By definition, an active fault is one that has had surface displacement within Holocene time (about the last 11,700 years). A potentially active fault has demonstrated surface displacement during Quaternary time (approximately the last 1.6 million years), but has had no known Holocene movement. Faults that have not moved in the last 1.6 million years are considered inactive.

The site is not within a state-designated Alquist-Priolo Earthquake Fault Zone (CGS, 2018b). No active or potentially active faults with the potential for surface fault rupture are known to pass directly beneath the site. Therefore, the potential for surface rupture due to faulting occurring beneath the site during the design life of the proposed development is considered low. However, the site is located in the seismically active Southern California region, and could be subjected to moderate to strong ground shaking in the event of an earthquake on one of the many active Southern California faults. The faults in the vicinity of the site are shown in Figure 3, Regional Fault Map.

Localized and unnamed faults lie approximately 2000 feet and 5100 feet north and northeast of the site, respectively (Edington, 1974). Recent activity on these faults have not been established within the last 11,700 years, consequently, they are not considered active. The closest surface trace of an active fault to the site is the Newport-Inglewood Fault Zone located approximately 2.9 miles to the southwest. Other nearby active faults are the Elsinore Fault Zone and the Palos Verdes Fault (Offshore Segment) located approximately 22 miles northeast and 17 miles southwest of the site, respectively. Strong ground motion could also be expected from earthquakes occurring along the San Jacinto and San Andreas fault zones which lie northeast of the site at distances of approximately 45-miles and 56-miles, respectively. The San Clemente fault, which lies approximately 58-miles southwest of the site, as well as numerous other offshore faults, could also provide strong ground motion.

Several buried thrust faults, commonly referred to as blind thrusts, underlie the Los Angeles Basin (including the Orange County Coastal Plain) at depth. These faults are not exposed at the ground surface and are typically identified at depths greater than 3.0 kilometers. The October 1, 1987, $M_w$ 5.9 Whittier Narrows earthquake and the January 17, 1994, $M_w$ 6.7 Northridge earthquake were a result of movement on the Puente Hills Blind Thrust and the Northridge Thrust, respectively. The San Joaquin Thrust underlies the site at depth. This thrust fault and others in the greater Los Angeles/Orange County area are not exposed at the surface and do not present a potential surface fault rupture hazard at the site; however, these deep thrust faults are considered active features capable of generating future earthquakes that could result in moderate to significant ground shaking at the site.

## 6.2 Seismicity

As with all of Southern California, the site has experienced historic earthquakes from various regional faults. The seismicity of the region surrounding the site was formulated based on research of an electronic database of earthquake data. The epicenters of recorded earthquakes with magnitudes equal to or greater than 5.0 in the site vicinity are depicted on Figure 4, Regional Seismicity Map. A partial list of moderate to major magnitude earthquakes that have occurred in the Southern California area within the last 100 years is included in the following table.

### LIST OF HISTORIC EARTHQUAKES

| Earthquake (Oldest to Youngest) | Date of Earthquake | Magnitude | Distance to Epicenter (Miles) | Direction to Epicenter |
|---|---|---|---|---|
| Near Redlands | July 23, 1923 | 6.3 | 44 | NE |
| Long Beach | March 10, 1933 | 6.4 | 20 | WNW |
| Tehachapi | July 21, 1952 | 7.5 | 131 | NW |
| San Fernando | February 9, 1971 | 6.6 | 77 | NW |
| Whittier Narrows | October 1, 1987 | 5.9 | 47 | NW |
| Sierra Madre | June 28, 1991 | 5.8 | 58 | NNW |
| Landers | June 28, 1992 | 7.3 | 87 | NE |
| Big Bear | June 28, 1992 | 6.4 | 70 | NE |
| Northridge | January 17, 1994 | 6.7 | 71 | NW |
| Hector Mine | October 16, 1999 | 7.1 | 112 | NE |

The site could be subjected to strong ground shaking in the event of an earthquake. However, this hazard is common in Southern California and the effects of ground shaking can be mitigated if the proposed structures are designed and constructed in conformance with current building codes and engineering practices.

## 6.3 Seismic Design Criteria

The following table summarizes summarizes site-specific design criteria obtained from the 2016 California Building Code (CBC; Based on the 2015 International Building Code [IBC] and ASCE 7-10), Chapter 16 Structural Design, Section 1613 Earthquake Loads. The data was calculated using the computer program *U.S. Seismic Design Maps*, provided by the USGS. The short spectral response uses a period of 0.2 second. We evaluated the Site Class based on the discussion in Section 1613.3.2 of the 2016 CBC and Table 20.3-1 of ASCE 7-10. The values presented in the table on the following page are for the risk-targeted maximum considered earthquake ($MCE_R$).

## 2016 CBC SEISMIC DESIGN PARAMETERS

| Parameter | Value | 2016 CBC Reference |
|---|---|---|
| Site Class | D | Section 1613.3.2 |
| $MCE_R$ Ground Motion Spectral Response Acceleration – Class B (short), $S_S$ | 1.391g | Figure 1613.3.1(1) |
| $MCE_R$ Ground Motion Spectral Response Acceleration – Class B (1 sec), $S_1$ | 0.523g | Figure 1613.3.1(2) |
| Site Coefficient, $F_A$ | 1.0 | Table 1613.3.3(1) |
| Site Coefficient, $F_V$ | 1.5 | Table 1613.3.3(2) |
| Site Class Modified $MCE_R$ Spectral Response Acceleration (short), $S_{MS}$ | 1.391g | Section 1613.3.3 (Eqn 16-37) |
| Site Class Modified $MCE_R$ Spectral Response Acceleration – (1 sec), $S_{M1}$ | 0.784g | Section 1613.3.3 (Eqn 16-38) |
| 5% Damped Design Spectral Response Acceleration (short), $S_{DS}$ | 0.927g | Section 1613.3.4 (Eqn 16-39) |
| 5% Damped Design Spectral Response Acceleration (1 sec), $S_{D1}$ | 0.523g | Section 1613.3.4 (Eqn 16-40) |

The table below presents the mapped maximum considered geometric mean ($MCE_G$) seismic design parameters for projects located in Seismic Design Categories of D through F in accordance with ASCE 7-10.

## ASCE 7-10 PEAK GROUND ACCELERATION

| Parameter | Value | ASCE 7-10 Reference |
|---|---|---|
| Mapped $MCE_G$ Peak Ground Acceleration, PGA | 0.553g | Figure 22-7 |
| Site Coefficient, $F_{PGA}$ | 1.0 | Table 11.8-1 |
| Site Class Modified $MCE_G$ Peak Ground Acceleration, $PGA_M$ | 0.553g | Section 11.8.3 (Eqn 11.8-1) |

The Maximum Considered Earthquake Ground Motion (MCE) is the level of ground motion that has a 2 percent chance of exceedance in 50 years, with a statistical return period of 2,475 years. According to the 2016 California Building Code and ASCE 7-10, the MCE is to be utilized for the evaluation of liquefaction, lateral spreading, seismic settlements, and it is our understanding that the intent of the Building code is to maintain "Life Safety" during a MCE event. The Design Earthquake Ground Motion (DE) is the level of ground motion that has a 10 percent chance of exceedance in 50 years, with a statistical return period of 475 years.

Deaggregation of the MCE peak ground acceleration was performed using the USGS online Unified Hazard Tool, 2008 Conterminous U.S. Dynamic edition. The result of the deaggregation analysis indicates that the predominant earthquake contributing to the MCE peak ground acceleration is characterized as a 6.72 magnitude event occurring at a hypocentral distance of 11.35 kilometers from the site.

Deaggregation was also performed for the Design Earthquake (DE) peak ground acceleration, and the result of the analysis indicates that the predominant earthquake contributing to the DE peak ground acceleration is characterized as a 6.68 magnitude occurring at a hypocentral distance of 21.2 kilometers from the site.

Conformance to the criteria in the above tables for seismic design does not constitute any kind of guarantee or assurance that significant structural damage or ground failure will not occur if a large earthquake occurs. The primary goal of seismic design is to protect life, not to avoid all damage, since such design may be economically prohibitive.

### 6.4 Liquefaction Potential

Liquefaction is a phenomenon in which loose, saturated, relatively cohesionless soil deposits lose shear strength during strong ground motions. Primary factors controlling liquefaction include intensity and duration of ground motion, gradation characteristics of the subsurface soils, in-situ stress conditions, and the depth to groundwater. Liquefaction is typified by a loss of shear strength in the liquefied layers due to rapid increases in pore water pressure generated by earthquake accelerations.

The current standard of practice, as outlined in the “Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction in California” and “Special Publication 117A, Guidelines for Evaluating and Mitigating Seismic Hazards in California” requires liquefaction analysis to a depth of 50 feet below the lowest portion of the proposed structure. Liquefaction typically occurs in areas where the soils below the water table are composed of poorly consolidated, fine to medium-grained, primarily sandy soil. In addition to the requisite soil conditions, the ground acceleration and duration of the earthquake must also be of a sufficient level to induce liquefaction.

The State of California Seismic Hazard Zone Map for the Dana Point Quadrangle (CDMG, 2001) indicates that the site is located within an area designated as having a potential for liquefaction.

Liquefaction analysis of the soils underlying the site was performed using an updated version of the spreadsheet template LIQ2_30.WQ1 developed by Thomas F. Blake (1996). This program utilizes the 1996 NCEER method of analysis. This semi-empirical method is based on a correlation between values of Standard Penetration Test (SPT) resistance and field performance data.

Screening criteria presented by Bray and Sancio (2006) was used to evaluate the liquefaction susceptibility of the fine-grained soils encountered in the boring. Based on these screening criteria, fine-grained soils with a plasticity index of greater than 18 and fine-grained soils with a plasticity index of greater than 12 and a saturated water content of less than 85 percent of the liquid limit are considered not susceptible to liquefaction. Laboratory test results used for the screening criteria are presented as Figures B7 and B8.

The liquefaction analysis was performed for a Design Earthquake level by using a historic high groundwater table of 5 feet below the ground surface, a magnitude 6.68 earthquake, and a peak horizontal acceleration of 0.369g (⅔$PGA_M$). The enclosed liquefaction analyses, included herein for boring B4, indicate that the alluvial soils below the historic high groundwater would not be susceptible to liquefaction induced settlement during Design Earthquake ground motion (see enclosed calculation sheets, Figures 5 and 6).

A comparative analysis was also performed by using select CPTs and the program CLiq (Version 2.2). This program utilizes the Boulanger & Idriss (2014) method of analysis, and the same values for the historic high water table, earthquake magnitude, and peak ground acceleration as indicated above.

Based on the analyses of CPT-1 through CPT-5, subsequent to the recommended grading the alluvial soils below the historic high groundwater depth may be susceptible to less than ½ inch of settlement during Design Earthquake ground motion (see enclosed settlement report, Figure 7).

Given that the CPTs generate a continuous soil profile, and that the driven samples in the borings may not capture thin layers of soils between the samples, the boring and CPT analyses appear to be in agreement regarding the general magnitude of potential liquefaction settlement during Design Earthquake ground motion. It is recommended that the proposed project be designed for up to ½ inch of differential liquefaction induced settlement during Design Earthquake ground motion.

It is our understanding that the intent of the Building Code is to maintain “Life Safety” during Maximum Considered Earthquake level events. Therefore, additional analysis was performed to evaluate the potential for liquefaction during a MCE event. The structural engineer should evaluate the proposed structure for the anticipated MCE liquefaction induced settlements and verify that anticipated deformations would not cause the foundation system to lose the ability to support the gravity loads and/or cause collapse of the structure.

The liquefaction analysis was also performed for the Maximum Considered Earthquake level by using a historic high groundwater table of 5 feet below the ground surface, a magnitude 6.72 earthquake, and a peak horizontal acceleration of 0.553g ($PGA_M$). The enclosed liquefaction analyses, included herein for boring B4, indicate that the alluvial soils below the historic high groundwater would not be susceptible to liquefaction induced settlement during Maximum Considered Earthquake ground motion (see enclosed calculation sheets, Figures 8 and 9).

Based on the analyses of CPT-1 through CPT-5, subsequent to the recommended grading the alluvial soils below the historic high groundwater depth may be susceptible to less than 1 inch of settlement during Maximum Considered Earthquake ground motion (see enclosed settlement report, Figure 10).

## 6.5 Slope Stability

The topography at the site is relatively flat with no pronounced highs or lows. Offsite slopes bounding the southwestern portion of the property range from 12 feet on the southwest to 45 feet at the northeast corner. The slopes are generally inclined at 2:1 (horizontal to vertical) or flatter.

The site is not located within an area identified as having a potential for seismic slope instability (CDMG, 2001). There are no known landslides near the site, nor is the site in the path of any known or potential landslides. Therefore, the potential for slope stability hazards to adversely affect the proposed development is considered low.

## 6.6 Tsunamis, Seiches, and Flooding

The site is located within a coastal area and therefore, tsunamis, seiches, and flooding are considered possible geologic hazards in the site vicinity. The site is not located within the tsunami inundation area (CEMA, 2009), therefore, the risk of tsunami inundation is considered unlikely.

Seiches are large waves generated in enclosed bodies of water in response to ground shaking. No major water-retaining structures are located immediately up gradient from the project site. Therefore, flooding resulting from a seismically-induced seiche is considered unlikely.

The majority of the site is within an area of minimal flooding (Zone X) as defined by the Federal Emergency Management Agency (FEMA, 2018), the northeastern most portion of the site, see Figure 11, is categorized as being in Flood Zone A. Flood Zone A, as defined by FEMA, area areas with a 1% annual change of flooding and a 26% change of flooding over the life of a 30-year mortgage. No depths of base flood elevations were provided by FEMA in these areas because detailed analyses were not performed. The Dana Point Shoreline Management Plan (Project Dimensions, 2014) does not indicate the area lies within the 100-year coastal flood event.

## 6.7 Oil Fields & Methane Potential

Based on a review of the California Division of Oil, Gas and Geothermal Resources (DOGGR) Well Finder Website, the site is not located within the limits of an oilfield and active oil or gas wells are not located in the immediate site vicinity (DOGGR, 2018). The closest well to the site is the Union Oil Company of California, Well Number 5, a plugged core hole, located approximately 2,650 feet to the west. However, due to the voluntary nature of record reporting by the oil well drilling companies, wells may be improperly located or not shown on the location map and undocumented wells could be encountered during construction. Any wells encountered during construction will need to be properly abandoned in accordance with the current requirements of the DOGGR.

Since the site is not located within the boundaries of a known oil field, the potential for the presence of methane or other volatile gases at the site is considered low. However, should it be determined that a methane study is required for the proposed development it is recommended that a qualified methane consultant be retained to perform the study and provide mitigation measures as necessary.

## 6.8 Subsidence

Subsidence occurs when a large portion of land is displaced vertically, usually due to the withdrawal of groundwater, oil, or natural gas. Soils that are particularly subject to subsidence include those with high silt or clay content. The site is not located within an area of known ground subsidence. No large-scale extraction of groundwater, gas, oil, or geothermal energy is occurring or planned at the site or in the general site vicinity. There appears to be little or no potential for ground subsidence due to withdrawal of fluids or gases at the site.

# 7. CONCLUSIONS AND RECOMMENDATIONS

## 7.1 General

7.1.1 It is our opinion that neither soil nor geologic conditions were encountered during the investigation that would preclude the construction of the proposed site improvements provided the recommendations presented herein are followed and implemented during design and construction.

7.1.2 Up to 5 feet of existing artificial fill was encountered during site exploration. Additionally, it is our understanding that deeper fill on the order of 29 feet may exist in the northeast corner of the site. Deeper fill may exist in other areas of the site that were not directly explored. It is our opinion that the existing fill, in its present condition, is not suitable for direct support of proposed foundations or slabs. The existing fill and site soils are suitable for re-use as engineered fill provided the recommendations in the Grading section of this report are followed (see Section 7.4).

7.1.3 Based on the enclosed liquefaction induced settlement calculations and subsequent to the recommended grading, it is recommended that the proposed project be designed for up to ½ inches of settlement as a result the Design Earthquake peak ground acceleration. The grading and foundation recommendations presented herein are intended to minimize and design for the effects of liquefaction settlement on proposed structures.

7.1.4 Based on the results of our laboratory testing, the existing alluvium could yield excessive static and differential settlements upon application of the foundation loads associated with the proposed parking structure. Based on this consideration, it is recommended that soil modification (e.g. rammed aggregate piers) be considered below the parking structure. Recommendations for Rammed Aggregate Piers (RAP) foundations are provided in Section 7.7.

7.1.5 Where supported on ground improvement, it is recommended that the upper 3 feet of existing site soils within the footprint of the proposed parking structure be excavated and properly compacted for foundation and slab support. The engineered fill blanket should extend at least 3 feet beyond the edge of foundations, including building appurtenances, or for a distance equal to the depth of fill below the foundations, whichever is greater. Recommendations for earthwork are provided in the *Grading* section of this report (see Section 7.4).

7.1.6 As a minimum, the upper 6 feet of existing soils within the footprint areas of the proposed apartment buildings should be excavated and properly compacted for foundation and slab support. The engineered fill blanket should extend at least 3 feet beyond the edge of foundations or for a distance equal to the depth of fill below the foundations, whichever is greater. Proposed foundations should be underlain by at least 4 feet of newly compacted engineered fill. It is recommended that the grading contractor verify the depth of all building foundations prior to commencement of site grading activities in order to correctly determine the required grading overexcavations for foundations. Deeper fill or soft soils encountered during site grading operations should be completely over-excavated as necessary at the direction of the Geotechnical Engineer. The limits of existing fill and/or soft soil removal will be verified by the Geocon representative during site grading operations.

7.1.7 Subsequent to the recommended grading, the proposed apartment buildings may be supported on a post-tensioned foundation system deriving support in the newly placed engineered fill. Recommendations for the design of a post-tensioned foundation system are provided in Section 7.9.

7.1.8 Soft alluvium is anticipated to be exposed throughout the excavation bottoms and these soils will likely be very moist to wet and subject to excessive pumping. Operation of rubber tire equipment on these subgrade soils may cause excessive disturbance of the soils, and equipment may sink and become stuck in the soft soils. Excavation activities to establish the finished subgrade elevation must be conducted carefully and methodically to avoid excessive disturbance to the subgrade. Track-mounted equipment should be considered. Stabilization of the bottom of the excavation may be required in order to provide a firm working surface upon which heavy equipment can operate. Recommendations for bottom stabilization and earthwork are provided in the *Grading* section of this report (see Section 7.4).

7.1.9 The upper alluvial soils as encountered during site exploration were very moist and the grading contractor should be aware that the existing soils are currently near or slightly above optimum moisture content. Conditions could change seasonally. If the soils are more than 3 percent above the optimum moisture content at the time of construction the soils will likely require some spreading and drying activities in order to achieve proper compaction.

7.1.10 Soil additives, like lime or cement, can also be considered to reduce the moisture content, reduce the expansion potential, and stabilize the upper soils. Recommendations for soil stabilization through the use of lime or cement can be addressed under separate cover, if desired.

7.1.11 Groundwater was encountered at depths of approximately 16 to 20 feet during the field investigation at the subject site. The depth to groundwater at the time of construction may be different. We expect groundwater would be encountered during the installation of rammed aggregate piers or deep drilled excavations.

7.1.12 It is anticipated that stable excavations for the recommended grading associated with the proposed structures can be achieved with sloping measures. However, if excavations in close proximity to an adjacent property line and/or structure are required, special excavation measures may be necessary in order to maintain lateral support of offsite improvements. Excavation recommendations are provided in the *Temporary Excavations* section of this report (Section 7.20).

7.1.13 At this time, it is unknown if the deeper artificial fill associated with the former USTs will be excavated and recompacted as engineered fill. Based on available information, the artificial fill may extend to depths of up to 29 feet below the ground surface. Temporary excavations to remove this artificial fill will likely require sloping and or shoring measures. Furthermore, the excavation would extend below the groundwater table and temporary dewatering measures may be required. Once the project proceeds to a more finalized state, additional recommendations for deeper temporary excavations can be provided under separate cover.

7.1.14 Where miscellaneous subterranean improvements are planned (Elevator Pits and Swimming Pool), the structures may be supported on a conventional foundation system deriving support in the undisturbed alluvial soils found at and below a depth of 6 feet. If necessary, these miscellaneous improvements may derive support in a combination of newly placed engineered fill and undisturbed alluvium found at and below a depth of 6 feet. Stabilization of the alluvial soils at the excavation bottom may be necessary. It is the intent of the Geotechnical Engineer to allow miscellaneous subterranean structures to derive support in both engineered fill and alluvium if project conditions warrant such an occurrence. Recommendations for swimming pool and elevator pit design are provided in Sections 7.17 and 7.18 of this report, respectively.

7.1.15 Improvements which are not supported on deepened foundations, such as walkways, paving, and utilities, may still be subject to seismic and/or static settlement. Furthermore, the upper portion of existing site soils have a medium expansive potential and could be subject to heave and settlement if the soil is subjected to repeated wetting and drying. The client should consider the flexibility of the products and pavements being installed. It is recommended that all utilities traversing through existing site soils utilize flexible connections in order to minimize the damage to underground installations caused by potential soil movements.

7.1.16 Foundations for small outlying structures, such as block walls less than 6 feet high, planter walls or trash enclosures, which will not be tied to the proposed structure, may be supported on conventional foundations deriving support on a minimum of 12 inches of newly placed engineered fill which extends laterally at least 12 inches beyond the foundation area. Where excavation and proper compaction cannot be performed or is undesirable, foundations may derive support directly in the undisturbed alluvial soils found at or below a depth of 2 feet and should be deepened as necessary to maintain a minimum 12-inch embedment into the recommended bearing materials. If the soils exposed in the excavation bottom are soft or loose, compaction of the soils will be required prior to placing steel or concrete. Compaction of the foundation excavation bottom is typically accomplished with a compaction wheel or mechanical whacker and must be observed and approved in writing by a Geocon representative.

7.1.17 Where new paving is to be placed, it is recommended that all existing fill and soft alluvial soils be excavated and properly compacted for paving support. The client should be aware that excavation and compaction of all existing fill and soft soils in the area of new paving is not required; however, paving constructed over existing uncertified fill or unsuitable alluvium may experience increased settlement and/or cracking, and may therefore have a shorter design life and increased maintenance costs. As a minimum, the upper 12 inches of soil should be scarified and properly compacted for paving support. Paving recommendations are provided in *Preliminary Pavement Recommendations* section of this report (see Section 7.13).

7.1.18 Based on the presence of expansive soils and relatively shallow groundwater at the subject site, infiltration of stormwater is not consider feasible and is not recommended for this development.

7.1.19 Once the design and foundation loading configuration for the proposed structure proceeds to a more finalized plan, the recommendations within this report should be reviewed and revised, if necessary. Based on the final foundation loading configurations, the potential for settlement should be re-evaluated by this office.

7.1.20 Any changes in the design, location or elevation, as outlined in this report, should be reviewed by this office. Geocon should be contacted to determine the necessity for review and possible revision of this report.

## 7.2 Soil and Excavation Characteristics

7.2.1 The in-situ soils can be excavated with light to moderate effort using conventional excavation equipment. Moderate caving and slumping should be anticipated in unshored excavations, especially where granular or saturated soil is encountered

7.2.2 It is the responsibility of the contractor to ensure that all excavations and trenches are properly shored and maintained in accordance with applicable OSHA rules and regulations to maintain safety and maintain the stability of adjacent existing improvements.

7.2.3 All onsite excavations must be conducted in such a manner that potential surcharges from existing structures, construction equipment, and vehicle loads are resisted. The surcharge area may be defined by a 1:1 projection down and away from the bottom of an existing foundation or vehicle load. Penetrations below this 1:1 projection will require special excavation measures such as sloping and shoring. Temporary excavation recommendations are provided in Section of this report (see Section 7.20).

7.2.4 Based on laboratory test results, the near surface site soils encountered during the field investigation are considered to have a "medium" (expansion index of 90 or less) expansive potential and are classified as "expansive" in accordance with the 2016 California Building Code (CBC) Section 1803.5.3. The recommendations presented herein assume that the building foundations, slabs, and paving will derive support in these materials.

## 7.3 Minimum Resistivity, pH, and Water-Soluble Sulfate

7.3.1 Potential of Hydrogen (pH) and resistivity testing as well as chloride content testing were performed on representative samples of soil to generally evaluate the corrosion potential to surface utilities. The tests were performed in accordance with California Test Method Nos. 643 and 422 and indicate that the soils are considered "severely corrosive" with respect to corrosion of buried ferrous metals on site. The results are presented in Appendix B (Figure B10) and should be considered for design of underground structures. Due to the corrosive potential of the soils, it is recommended that ABS pipes be considered in lieu of cast-iron for subdrains and retaining wall drains.

7.3.2 Laboratory tests were performed on representative samples of the site materials to measure the percentage of water-soluble sulfate content. Results from the laboratory water-soluble sulfate tests are presented in Appendix B (Figure B10) and indicate that the on-site materials possess a sulfate exposure class of "S0" to concrete structures as defined by 2016 CBC Section 1904 and ACI 318-14 Table 19.3.1.1.

7.3.3 Geocon West, Inc. does not practice in the field of corrosion engineering and mitigation. If corrosion sensitive improvements are planned, it is recommended that a corrosion engineer be retained to evaluate corrosion test results and incorporate the necessary precautions to avoid premature corrosion of buried metal pipes and concrete structures in direct contact with the soils.

## 7.4 Grading

7.4.1 Earthwork should be observed, and compacted fill tested by representatives of Geocon West, Inc. The existing fill encountered during exploration is suitable for re-use as an engineered fill, provided any encountered oversize material (greater than 6 inches) and any encountered deleterious debris is removed.

7.4.2 A preconstruction conference should be held at the site prior to the beginning of grading operations with the owner, contractor, civil engineer, geotechnical engineer, and building official in attendance. Special soil handling requirements can be discussed at that time.

7.4.3 Grading should commence with the removal of all existing vegetation and existing improvements from the area to be graded. Deleterious debris such as wood and root structures should be exported from the site and should not be mixed with the fill soils. Asphalt and concrete should not be mixed with the fill soils unless approved by the Geotechnical Engineer. All existing underground improvements planned for removal should be completely excavated and the resulting depressions properly backfilled in accordance with the procedures described herein. Once a clean excavation bottom has been established it must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.).

7.4.4 As a minimum, the upper 6 feet of existing soils within the footprint areas of the proposed apartment structures should be excavated and properly compacted for foundation and slab support. The engineered fill blanket should extend at least 3 feet beyond the edge of foundations or for a distance equal to the depth of fill below the foundations, whichever is greater. Proposed foundations should be underlain by at least 4 feet of newly compacted engineered fill. It is recommended that the grading contractor verify the depth of all building foundations prior to commencement of site grading activities in order to correctly determine the required grading overexcavations for foundations. Deeper fill or soft soils encountered during site grading operations should be completely over-excavated as necessary at the direction of the Geotechnical Engineer. The limits of existing fill and/or soft soil removal will be verified by the Geocon representative during site grading operations.

7.4.5 Where supported on ground improvement, it is recommended that the upper 3 feet of existing site soils within the footprint of the proposed structures be excavated and properly compacted for foundation and slab support. The engineered fill blanket should extend at least 3 feet beyond the edge of foundations, including building appurtenances, or for a distance equal to the depth of fill below the foundations, whichever is greater.

7.4.6 All excavations must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon). Prior to placing any fill, the excavation bottom must be proof-rolled with heavy equipment in the presence of the Geotechnical Engineer (a representative of Geocon West, Inc.). If determined to be excessively soft, additional removals or stabilization of the excavation bottom may be required in order to provide a firm working surface upon which engineered fill can be placed and heavy equipment can operate.

7.4.7 If subgrade stabilization is required at the excavation bottom, rubber tire equipment should not be allowed in the excavation bottom until it is stabilized or extensive soil disturbance could result. It is suggested that excavation and grading be performed during the summer season to promote moisture control of the soils. In addition, the use of track equipment should be considered to minimize disturbance to the soils if they become wet at the excavation bottom. Bottom stabilization, if necessary, may be achieved by introducing a thin lift of 3- to 6-inch diameter crushed angular rock into the soft excavation bottom. The use of crushed concrete will also be acceptable. The crushed rock should be spread thinly across the excavation bottom and pressed into the soils by track rolling or wheel rolling with heavy equipment. It is very important that voids between the rock fragments are not created so the rock must be thoroughly pressed or blended into the soils.

7.4.8 The upper alluvial soils at the site are currently very moist and the grading contractor should be aware that the existing soils are currently near or slightly above optimum moisture content. Conditions could change seasonally. If the soils are in excess of 3 percent above optimum moisture content at the time of construction the soils will likely require some spreading and drying activities in order to achieve proper compaction.

7.4.9 All fill and backfill soils should be placed in horizontal loose layers approximately 6 to 8 inches thick, moisture conditioned to 2 percent above optimum moisture content, and properly compacted to a minimum 90 percent of the maximum dry density in accordance with ASTM D 1557 (latest edition).

7.4.10 It is anticipated that stable excavations for the recommended grading can be achieved with sloping measures. However, if excavations in close proximity to an adjacent property line and/or structure are required, special excavation measures may be necessary in order to maintain lateral support of the existing offsite improvements. Excavation recommendations are provided in the *Temporary Excavations* section of this report (Section 7.20).

7.4.11. Where new paving is to be placed, it is recommended that all existing fill and soft alluvium be excavated and properly compacted for paving support. As a minimum, the upper 12 inches of soil should be scarified, moisture conditioned to optimum moisture content, and compacted to at least 92 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition). Paving recommendations are provided in *Preliminary Pavement Recommendations* section of this report (see Section 7.13).

7.4.12 Foundations for small outlying structures, such as block walls less than 6 feet high, planter walls or trash enclosures, which will not be tied to the proposed building, may be supported on conventional foundations deriving support on a minimum of 12 inches of newly placed engineered fill which extends laterally at least 12 inches beyond the foundation area. Where excavation and proper compaction cannot be performed or is undesirable, foundations may derive support directly in the undisturbed alluvial soils found at or below a depth of 2 feet, and should be deepened as necessary to maintain a minimum 12 inch embedment into the recommended bearing materials. If the soils exposed in the excavation bottom are soft or loose, compaction of the soils will be required prior to placing steel or concrete. Compaction of the foundation excavation bottom is typically accomplished with a compaction wheel or mechanical whacker and must be observed and approved by a Geocon representative.

7.4.13 It is recommended that flexible utility connections be utilized for all rigid utilities to minimize or prevent damage to utilities from minor differential soil movements and subsidence. Utility trenches should be properly backfilled in accordance with the requirements of the Green Book (latest edition). The pipe should be bedded with clean sands (Sand Equivalent greater than 30) to a depth of at least 1 foot over the pipe, and the bedding material must be inspected and approved in writing by the Geotechnical Engineer (a representative of Geocon). The use of gravel is not acceptable unless used in conjunction with filter fabric to prevent the gravel from having direct contact with soil. The remainder of the trench backfill may be derived from onsite soil or approved import soil, compacted as necessary, until the required compaction is obtained. The use of minimum 2-sack slurry is also acceptable as backfill. Prior to placing any bedding materials or pipes, the excavation bottom must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon).

7.4.14 Although not anticipated for this project, all imported fill shall be observed, tested, and approved by Geocon West, Inc. prior to bringing soil to the site. Rocks larger than 6 inches in diameter shall not be used in the fill. If necessary, import soils used as structural fill should have an expansion index less than 50 and soil corrosivity properties that are equally or less detrimental to that of the existing onsite soils (see Figure B10).

7.4.15 All trench and foundation excavation bottoms must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon), prior to placing bedding materials, fill, steel, gravel or concrete.

## 7.5 Shrinkage

7.5.1 Shrinkage results when a volume of material removed at one density is compacted to a higher density. A shrinkage factor of up to 10 percent should be anticipated when excavating and compacting the upper 5 feet of existing earth materials on the site to an average relative compaction of 92 percent.

7.4.2 If import soils will be utilized in the building pad, the soils must be placed uniformly and at equal thickness at the direction of the Geotechnical Engineer (a representative of Geocon West, Inc.). Soils can be borrowed from non-building pad areas and later replaced with imported soils.

## 7.6 Foundation Design – General

7.6.1 Due to the expansive nature of the on-site soils, the moisture content of untreated subgrade soils should be maintained at 2 to 3 percent above optimum moisture content prior to and at the time of concrete placement. If the subgrade is allowed to dry out, presaturation and/or moisture conditioning and recompacting will be required.

7.6.2 Foundation excavations should be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to the placement of reinforcing steel and concrete to verify that the excavations and exposed soil conditions are consistent with those anticipated. If unanticipated soil conditions are encountered, foundation modifications may be required.

7.6.3 Where side by side construction is planned for the residential structure and parking structure it is recommended that the parking structure be constructed prior to the adjacent residential structure in order to allow the majority of the static settlement to occur in the parking structure. This will help to minimize differential settlements between the two structures. It is recommended that either a seismic separation or flexible connection be utilized where the apartment structures and parking structure may be attached. The design of the connection is at the discretion of the project structural engineer. Additional settlement analyses should be performed once the foundation loading configuration for the proposed structures is established to further evaluate the potential for differential settlement between the residential structure and parking structure. The utilization of a lesser bearing value, or increasing the thickness of engineered fill below the foundations, would further reduce the anticipated settlements and could be evaluated once the design becomes more finalized.

7.6.4 It is recommended that a seismic separation or flexible connection be utilized where the adjacent structures abut. The design of the connection is at the discretion of the project structural engineer and should take into account potential differential settlements between structures.

7.6.5 It is recommended that flexible utility connections be utilized for all rigid utilities to minimize or prevent damage to utilities from minor differential movements.

7.6.6 This office should be provided a copy of the final construction plans so that the excavation recommendations presented herein could be properly reviewed and revised if necessary.

7.6.7 Once the design and foundation loading configurations for the proposed structures proceeds to a more finalized plan, the estimated settlements presented in this report should be reviewed and revised, if necessary. If the final foundation loading configurations are greater than the assumed loading conditions, the potential for settlement should be reevaluated by this office.

## 7.7 Rammed Aggregate Piers (RAP)

7.7.1 Due to the compressible alluvial soils, it is recommended that soil improvement (e.g. Rammed Aggregate Piers) be considered below the proposed parking structure. Subsequent to construction of the Rammed Aggregate Pier (RAP), the proposed parking structure may be supported on a conventional foundation system deriving support in the improved soils. The foundation should be designed to derive vertical support from the RAP improved soils and may develop lateral resistance at the foundation perimeter, as well as by friction beneath the foundations, if necessary.

7.7.2 The RAP system is based on soil improvement that consists of installing densified, aggregate columns to depths typically ranging up to about 25 feet below the proposed foundation elevation. The system increases density and lateral stress in the surrounding soil and claims improvement in bearing capacity and settlement potential. RAP elements are constructed by creating shafts (commonly 30 inches in diameter) by drilling or displacement methods, and backfilling the open shaft with specially rammed/compacted, open graded crushed rock and Class 2 AB in 10- to 12-inch lifts. It should be noted that creating the shaft using the displacement method, advancing the shaft with a displacement mandrel, reduces the soil cuttings generated during the creation of the shaft.

7.7.3 The pattern and depth of ground improvements may vary depending upon the purposes of mitigation and stratigraphic conditions. The contractor should design the RAP to incorporate allowable static and seismic settlements in accordance with the recommendations of the project structural engineer. The RAP contractor should evaluate the post-installation static and dynamic settlement within the remediation zone of the RAP. In addition, the project structural engineer should evaluate if the planned structures can tolerate the planned settlements after the installation of the RAP.

7.7.4 Spacing and diameter should be selected by the specialty contractor to obtain the necessary remediation as outlined herein. The RAP mitigation should extend at least 15 feet laterally outside the edge of planned building structures, where practical.

7.7.5 RAP design should be based on settlement criterial of a maximum combined static and seismic differential settlement of 1 inch between adjacent columns. The anticipated seismic induced differential settlement should be evaluated once the depth of the RAP ground improvement is established, as the ground improvement may mitigate some of the potentially liquefiable soil layers.

7.7.6 The RAP design package should be submitted to Geocon West, Inc. for review at least two weeks prior to mobilization for construction. Within the design package, the specialty contractor should outline a performance and load testing program to verify the effectiveness of the ground improvement and to confirm the bearing capacity of the improved soils with a full-scale load test. During the load testing, a representative of Geocon should be present to observe RAP installation and testing. The information obtained from the load testing should be used to modify the depth necessary to achieve design capacities, as well as develop installation criteria that can be used during construction.

## 7.8 Conventional Foundation Design – Parking Structure

7.8.1 The proposed parking structure may be supported on a conventional spread foundation system deriving support on the RAP ground improvement. All foundation excavations must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon), prior to placing steel or concrete.

7.8.2 Continuous footings should be a minimum of 12 inches in width, 24 inches in depth below the lowest adjacent grade, and 12 inches into the recommended bearing material. Isolated spread foundations should be a minimum of 24 inches in width, 24inches in depth below the lowest adjacent grade, and 12 inches into the recommended bearing material. Foundations constructed over RAP ground improvement can achieve relatively high bearing pressures. For preliminary design purposes, a bearing pressure of 6,000 psf may be assumed; however, the design bearing pressure should be provided by the RAP contractor.

7.8.3 The allowable bearing pressures may be increased by one-third for transient loads due to wind or seismic forces.

7.8.4 For preliminary design purposes, a modulus of subgrade reaction of 150 pounds per cubic inch (pci) may be utilized for design of the mat foundations where directly underlain by compacted fill. However, the RAP contractor should provide the structural engineer a revised modulus value incorporating the planned improvement techniques. Additionally, where a higher subgrade modulus is required beneath the foundation system, the site soils can be stabilized using lime or cement, or can be replaced with a more granular imported soil. This value is a unit value for use with a 1-foot square footing. The modulus should be reduced in accordance with the following equation when used with larger foundations:

$$K_R = K\left[\frac{B+1}{2B}\right]^2$$

where: $K_R$ = reduced subgrade modulus
K = unit subgrade modulus
B = foundation width (in feet)

7.8.5 If depth increases are utilized for the exterior wall footings, this office should be provided a copy of the final construction plans so that the excavation recommendations presented herein could be properly reviewed and revised if necessary.

7.8.6 Continuous footings should be reinforced with four No. 4 steel reinforcing bars, two placed near the top of the footing and two near the bottom. Reinforcement for spread footings should be designed by the project structural engineer.

7.8.7 The above foundation dimensions and minimum reinforcement recommendations are based on soil conditions and building code requirements only, and are not intended to be used in lieu of those required for structural purposes.

7.8.8 Due to the expansive nature of the on-site soils, the moisture content of untreated subgrade soils should be maintained at 2 to 5 percent above optimum moisture content prior to and at the time of concrete placement. If the subgrade is allowed to dry out, presaturation and/or moisture conditioning and recompacting will be required.

7.8.9 Foundation excavations should be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to the placement of reinforcing steel and concrete to verify that the excavations and exposed soil conditions are consistent with those anticipated. If unanticipated soil conditions are encountered, foundation modifications may be required.

7.8.10 This office should be provided a copy of the final construction plans so that the excavation recommendations presented herein could be properly reviewed and revised if necessary.

## 7.9 Post-Tensioned Foundation Recommendations

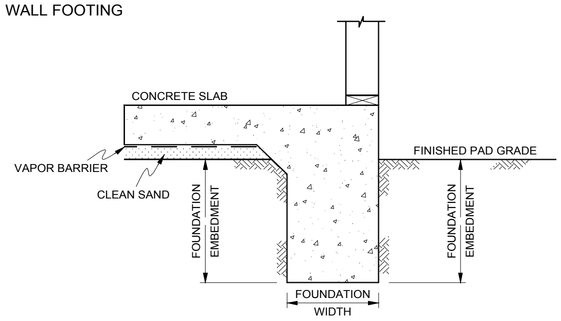
7.9.1 Subsequent to the recommended grading, it is recommended that a post-tensioned foundation system be utilized for support of the proposed apartment buildings. Proposed post-tensioned foundations should be underlain by at least 4 feet of newly placed engineered fill. Additional grading should be conducted as necessary in order to maintain the required 4-foot-thick blanket of engineered fill below foundations.

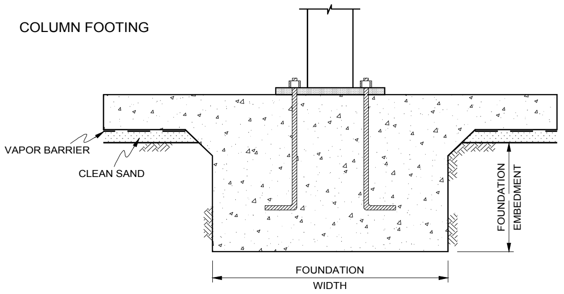
7.9.2 The post-tensioned system should be designed by a structural engineer experienced in post-tensioned slab design and design criteria of the Post-Tensioning Institute (PTI) DC 10.5-12 *Standard Requirements for Design and Analysis of Shallow Post-Tensioned Concrete Foundations on Expansive Soils* or *WRI/CRSI Design of Slab-on-Ground Foundations*, as required by the 2016 California Building Code (CBC Section 1808.6.2). Although this procedure was developed for expansive soil conditions, we understand it can also be used to reduce the potential for foundation distress due to differential settlement. The post-tensioned design should incorporate the geotechnical parameters presented in the following table, which are based on the guidelines presented in the PTI, Third Edition design manual. The parameters presented below are based on a medium expansive potential ($50<EI\leq90$), as well as the potential for and magnitude of anticipated seismically induced settlements.

**POST-TENSIONED FOUNDATION SYSTEM DESIGN PARAMETERS**

| **Post-Tensioning Institute (PTI) DC 10.5-12 Design Parameters** | **Value** |
|---|---|
| Thornthwaite Index | -20 |
| Equilibrium Suction | 3.9 |
| Edge Lift Moisture Variation Distance, $e_M$ (Feet) | 5.1 |
| Edge Lift, $y_M$ (Inches) | 1.10 |
| Center Lift Moisture Variation Distance, $e_M$ (Feet) | 9.0 |
| Center Lift, $y_M$ (Inches) | 0.47 |

7.9.3 The foundations for the post-tensioned slabs should be embedded in accordance with the recommendations of the structural engineer. If a post-tensioned mat foundation system is proposed, the slab should possess a thickened edge with a minimum width of 12 inches and extend below the clean sand or crushed rock layer. A graphic depicting the foundation embedment is provided below.





7.9.4 If the structural engineer proposes a post-tensioned foundation design method other than PTI DC 10.5:

- The criteria presented in the above table are still applicable.
- Interior stiffener beams should be used.
- The width of the perimeter foundations should be at least 12 inches.
- The perimeter footing embedment depths should be at least 24 inches. The embedment depths should be measured from the lowest adjacent pad grade.

7.9.5 During the construction of the post-tension foundation system, the concrete should be placed monolithically. Under no circumstances should cold joints form between the footings/grade beams and the slab during the construction of the post-tension foundation system unless specifically designed by the structural engineer.

7.9.6 Post-tensioned foundations for support of the apartment structures may be designed for an allowable soil bearing pressure of 2,500 psf (dead plus live load). This bearing pressure may be increased by one-third for transient loads due to wind or seismic forces. We estimate the total static settlements under the imposed allowable loads to be about ⅔ inch with differential settlements on the order of ½ inch over a horizontal distance of 20 feet. A majority of the settlement of the foundation system is expected to occur on initial application of loading; however, additional settlements are expected within the first twelve months. Based on seismic considerations, the proposed structures supported on should be designed for a combined static and seismically induced differential settlement of 1 inch over a distance of 20 feet.

7.9.7 Isolated footings, if present, should have a minimum embedment depth and width of 24 inches. The use of isolated footings, which are located beyond the perimeter of the building and support structural elements connected to the building, are not recommended. If this condition cannot be avoided, the isolated footings should be connected to the building foundation system with grade beams. In addition, consideration should be given to connecting patio slabs, which exceed 5 feet in width, to the building foundation to reduce the potential for future separation to occur.

7.9.8 Due to the expansive potential of the subgrade soils, the moisture content in the slab and foundation subgrade should be maintained between 2 and 3 percent above optimum moisture content prior to and at the time of concrete placement.

7.9.9 The recommendations of this report are intended to reduce the potential for cracking of slabs and foundations due to expansive soil (if present), differential settlement of fill soil with varying thicknesses. However, even with the incorporation of the recommendations presented herein, foundations, stucco walls, and slabs-on-grade placed on such conditions may still exhibit some cracking due to soil movement and/or shrinkage. The occurrence of concrete shrinkage cracks is independent of the supporting soil characteristics. Their occurrence may be reduced by limiting the slump of the concrete, proper concrete placement and curing, and by the placement of crack control joints at periodic intervals, in particular, where re-entrant slab corners occur.

7.9.10 Interior stiffening beams should be incorporated into the design of the foundation system in accordance with the PTI design procedures.

7.9.11 Foundation excavations should be observed by the Geotechnical Engineer (a representative of Geocon West, Inc.) prior to the placement of reinforcing steel and concrete to check that the exposed soil conditions are consistent with those expected and have been extended to appropriate bearing strata. If unexpected soil conditions are encountered, foundation modifications may be required.

7.9.12 Our experience indicates post-tensioned slabs may be susceptible to excessive edge lift, regardless of the underlying soil conditions. Placing reinforcing steel at the bottom of the perimeter footings and the interior stiffener beams may mitigate this potential. The structural engineer should design the foundation system to reduce the potential of edge lift occurring for the proposed structures.

7.9.13 During the construction of the post-tension foundation system, the concrete should be placed monolithically. Under no circumstances should cold joints form between the footings/grade beams and the slab during the construction of the post-tension foundation system unless designed by the structural engineer.

7.9.14 Geocon should observe the foundation excavations prior to the placement of reinforcing steel to check that the exposed soil conditions are similar to those expected and that they have been extended to the appropriate bearing strata. If unexpected soil conditions are encountered, foundation modifications may be required.

## 7.10 Lateral Design

7.10.1 Resistance to lateral loading may be provided by friction acting at the base of foundations, slabs and by passive earth pressure. An allowable coefficient of friction of 0.25 may be used with the dead load forces in the competent alluvial soils or in properly compacted engineered fill.

7.10.2 Passive earth pressure for the sides of foundations and slabs poured against properly compacted engineered fill or competent alluvial soils may be computed as an equivalent fluid having a density of 200 pcf with a maximum earth pressure of 2,000 psf. When combining passive and friction for lateral resistance, the passive component should be reduced by one-third.

## 7.11 Miscellaneous Foundations

7.11.1 Foundations for small outlying structures, such as block walls up to 6 feet in height, planter walls or trash enclosures, which will not be structurally supported by the proposed building, may be supported on conventional foundations deriving support on a minimum of 12 inches of newly placed engineered fill which extends laterally at least 12 inches beyond the foundation area. Where excavation and compaction cannot be performed, such as adjacent to property lines, foundations may derive support in the undisturbed alluvial soils found at or below a depth of 2 feet, and should be deepened as necessary to maintain a minimum 12-inch embedment into the recommended bearing materials.

7.11.2 If the soils exposed in the excavation bottom are soft, compaction of the soft soils will be required prior to placing steel or concrete. Compaction of the foundation excavation bottom is typically accomplished with a compaction wheel or mechanical whacker and must be observed and approved by a Geocon representative. Miscellaneous foundations may be designed for a bearing value of 1,500 psf, and should be a minimum of 12 inches in width, 18 inches in depth below the lowest adjacent grade and 12 inches into the recommended bearing material. The allowable bearing pressure may be increased by up to one-third for transient loads due to wind or seismic forces.

7.11.3 Foundation excavations should be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to the placement of reinforcing steel and concrete to verify that the excavations and exposed soil conditions are consistent with those anticipated.

## 7.12 Concrete Slabs-on-Grade

7.12.1 Where supported on a conventional foundation system underlain by RAP ground improvement, concrete slabs-on-grade for structures subject to vehicle loading should be a minimum 5 inches of concrete reinforced with No. 4 steel reinforcing bars placed 16 inches on center in both horizontal directions. Steel reinforcing should be positioned vertically near the slab midpoint. The slab-on-grade may derive support in the newly placed engineered fill.

7.12.2 Slabs-on-grade at the ground surface that may receive moisture-sensitive floor coverings or may be used to store moisture-sensitive materials should be underlain by a vapor retarder placed directly beneath the slab. The vapor retarder and acceptable permeance should be specified by the project architect or developer based on the type of floor covering that will be installed. The vapor retarder design should be consistent with the guidelines presented in Section 9.3 of the American Concrete Institute's (ACI) *Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials* (ACI 302.2R-06) and should be installed in general conformance with ASTM E 1643 (latest edition) and the manufacturer's recommendations. A minimum thickness of 15 mils extruded polyolefin plastic is recommended; vapor retarders which contain recycled content or woven materials are not recommended. The vapor retarder should have a permeance of less than 0.01 perms demonstrated by testing before and after mandatory conditioning. The vapor retarder should be installed in direct contact with the concrete slab with proper perimeter seal. If the California Green Building Code requirements apply to this project, the vapor retarder should be underlain by 4 inches of clean aggregate. It is important that the vapor retarder be puncture resistant since it will be in direct contact with angular gravel. As an alternative to the clean aggregate suggested in the California Green Building Code, it is our opinion that the concrete slab-on-grade may be underlain by a vapor retarder over 4 inches of clean sand (sand equivalent greater than 30), since the sand will serve a capillary break and will minimize the potential for punctures and damage to the vapor barrier.

7.12.3 For seismic design purposes, a coefficient of friction of 0.25 may be utilized between concrete slabs and subgrade soils without a moisture barrier, and 0.15 for slabs underlain by a moisture barrier.

7.12.4 Exterior slabs, not subject to traffic loads, should be at least 4 inches thick and reinforced with No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions, positioned near the slab midpoint. Prior to construction of slabs, the upper 12 inches of subgrade should be moistened to near optimum moisture content and properly compacted to at least 92 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition). Crack control joints should be spaced at intervals not greater than 10 feet and should be constructed using saw-cuts or other methods as soon as practical following concrete placement. Crack control joints should extend a minimum depth of one-fourth the slab thickness. The project structural engineer should design construction joints as necessary.

8.12.6 Due to the expansive potential of the anticipated subgrade soils, the moisture content of the slab subgrade should be maintained and sprinkled as necessary to maintain a moist condition as would be expected in any concrete placement. Furthermore, consideration should be given to doweling slabs into adjacent curbs and foundations to minimize movements and offsets which could lead to a potential tripping hazard. As an alternative, the upper 18 inches of soil could be replaced with granular, non-expansive soils which will reduce the potential for movements and offsets.

7.12.5 The recommendations of this report are intended to reduce the potential for cracking of slabs due to settlement. However, even with the incorporation of the recommendations presented herein, foundations, stucco walls, and slabs-on-grade may exhibit some cracking due to minor soil movement and/or concrete shrinkage. The occurrence of concrete shrinkage cracks is independent of the supporting soil characteristics. Their occurrence may be reduced and/or controlled by limiting the slump of the concrete, proper concrete placement and curing, and by the placement of crack control joints at periodic intervals, in particular, where re-entrant slab corners occur.

## 7.13 Preliminary Pavement Recommendations

7.13.1 Where new paving is to be placed, it is recommended that all existing fill and soft or unsuitable soils be excavated and properly compacted for paving support. The client should be aware that excavation and compaction of all soft or unsuitable soils in the area of new paving is not required, however, paving constructed over existing unsuitable soils may experience increased settlement and/or cracking, and may therefore have a shorter design life and increased maintenance costs. As a minimum, the upper 12 inches of soil should be scarified and recompacted to at least 92 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition).

7.13.2 The following pavement sections are based on an assumed R-Value of 10. Once site grading activities are complete an R-Value should be obtained by laboratory testing to confirm the properties of the soils serving as paving subgrade, prior to placing pavement.

7.13.3 The Traffic Indices listed below are estimates. Geocon does not practice in the field of traffic engineering. The actual Traffic Index for each area should be determined by the project civil engineer. If pavement sections for Traffic Indices other than those listed below are required, Geocon should be contacted to provide additional recommendations. Pavement thicknesses were determined following procedures outlined in the *California Highway Design Manual* (Caltrans). It is anticipated that the majority of traffic will consist of automobile and large truck traffic.

**PRELIMINARY PAVEMENT DESIGN SECTIONS**

| Location | Estimated Traffic Index (TI) | Asphalt Concrete (inches) | Class 2 Aggregate Base (inches) |
|---|---|---|---|
| Automobile Parking And Driveways | 5.0 | 3.0 | 9.0 |
| Trash Truck & Fire Lanes | 7.0 | 4.0 | 14.5 |

7.13.4 Asphalt concrete should conform to Section 203-6 of the "*Standard Specifications for Public Works Construction"* (Green Book). Class 2 aggregate base materials should conform to Section 26-1.02A of the "*Standard Specifications of the State of California, Department of Transportation"* (Caltrans). Crushed Miscellaneous Base should conform to Section 200-2.4 of the "*Standard Specifications for Public Works Construction"* (Green Book).

7.13.5 Unless specifically designed and evaluated by the project structural engineer, where concrete paving will be utilized for support of vehicles, we recommend that the concrete be a minimum of 6 inches thick and reinforced with No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions. Concrete paving supporting vehicular traffic should be underlain by a minimum of 4 inches of aggregate base and a properly compacted subgrade. The subgrade and base material should be compacted to at least 92 percent and 95 percent relative compaction, respectively, as determined by ASTM Test Method D 1557 (latest edition).

7.13.6 The performance of pavements is highly dependent upon providing positive surface drainage away from the edge of pavements. Ponding of water on or adjacent to the pavement will likely result in saturation of the subgrade materials and subsequent cracking, subsidence and pavement distress. If planters are planned adjacent to paving, it is recommended that the perimeter curb be extended at least 12 inches below the bottom of the aggregate base to minimize the introduction of water beneath the paving.

## 7.14 Retaining Wall Design

7.14.1 The recommendations presented below are generally applicable to the design of rigid concrete or masonry retaining walls having a maximum height of 8 feet. In the event that walls significantly higher than 8 feet are planned, Geocon should be contacted for additional recommendations.

7.14.2 Retaining walls with a level backfill surface that are not restrained at the top should be designed utilizing a triangular distribution of pressure (active pressure) of 40 pcf.

7.14.3 Restrained walls are those that are not allowed to rotate more than 0.001H (where H equals the height of the retaining portion of the wall in feet) at the top of the wall. Where walls are restrained from movement at the top, walls may be designed utilizing a triangular distribution of pressure (at-rest pressure) of 60 pcf.

7.14.4 The wall pressures provided above assume that the retaining wall will be properly drained preventing the buildup of hydrostatic pressure. If retaining wall drainage is not implemented, the equivalent fluid pressure to be used in design of undrained walls is 80 pcf. The value includes hydrostatic pressures plus buoyant lateral earth pressures.

7.14.5 The wall pressures provided above assume that the proposed retaining walls will support either relatively undisturbed alluvial soils or engineered fill derived from onsite soils. If import soils are used as wall backfill, revised earth pressures may be required to account for the characteristics of the import soil.

7.14.6 Additional active pressure should be added for a surcharge condition due to sloping ground, vehicular traffic or adjacent structures and should be designed for each condition as the project progresses. Recommendations for the incorporation of surcharges are provided in section 7.21 of this report.

7.14.7 In addition to the recommended earth pressure, the upper 10 feet of the subterranean wall adjacent to the street or driveway areas should be designed to resist a uniform lateral pressure of 100 psf, acting as a result of an assumed 300 psf surcharge behind the wall due to normal street traffic. If the traffic is kept back at least 10 feet from the subterranean walls, the traffic surcharge may be neglected.

7.14.8 Seismic lateral forces should be incorporated into the design as necessary, and recommendations for seismic lateral forces are presented below.

## 7.15 Dynamic (Seismic) Lateral Forces

7.15.1 The structural engineer should determine the seismic design category for the project in accordance with Section 1613 of the CBC. If the project possesses a seismic design category of D, E, or F, proposed retaining walls in excess of 6 feet in height should be designed with seismic lateral pressure (Section 1803.5.12 of the 2016 CBC).

7.15.2 A seismic load of 10 pcf should be used for design of walls that support more than 6 feet of backfill in accordance with Section 1803.5.12 of the 2016 CBC. The seismic load is applied as an equivalent fluid pressure along the height of the wall and the calculated loads result in a maximum load exerted at the base of the wall and zero at the top of the wall. This seismic load should be applied in addition to the active earth pressure. The earth pressure is based on half of two thirds of $PGA_M$ calculated from ASCE 7-10 Section 11.8.3.

## 7.16 Retaining Wall Drainage

7.16.1 Retaining walls should be provided with a drainage system extended at least two-thirds the height of the wall. At the base of the drain system, a subdrain covered with a minimum of 12 inches of gravel should be installed, and a compacted fill blanket or other seal placed at the surface (see Figure 11). The clean bottom and subdrain pipe, behind a retaining wall, should be observed by the Geotechnical Engineer (a representative of Geocon), prior to placement of gravel or compacting backfill.

7.16.2 As an alternative, a plastic drainage composite such as Miradrain or equivalent may be installed in continuous, 4-foot wide columns along the entire back face of the wall, at 8 feet on center. The top of these drainage composite columns should terminate approximately 18 inches below the ground surface, where either hardscape or a minimum of 18 inches of relatively cohesive material should be placed as a cap (see Figure 12). These vertical columns of drainage material would then be connected at the bottom of the wall to a collection panel or a 1-cubic-foot rock pocket drained by a 4-inch subdrain pipe.

7.16.3 Subdrainage pipes at the base of the retaining wall drainage system should outlet to an acceptable location via controlled drainage structures.

7.16.4 Moisture affecting below grade walls is one of the most common post-construction complaints. Poorly applied or omitted waterproofing can lead to efflorescence or standing water. Particular care should be taken in the design and installation of waterproofing to avoid moisture problems, or actual water seepage into the structure through any normal shrinkage cracks which may develop in the concrete walls, floor slab, foundations and/or construction joints. The design and inspection of the waterproofing is not the responsibility of the geotechnical engineer. A waterproofing consultant should be retained in order to recommend a product or method, which would provide protection to subterranean walls, floor slabs and foundations.

## 7.17 Swimming Pool

7.17.1 The proposed swimming pools should be designed as free-standing structures deriving support in newly placed engineered fill and/or the competent alluvial soils found at or below a depth of 6 feet. Swimming pool walls may be designed in accordance with the *Retaining Wall Design* section of this report (see Section 7.14). The proposed pools should be constructed utilizing an expansive soils design and a hydrostatic relief valve should be considered as part of the swimming pool design unless a gravity drain system can be placed beneath the pool shell.

7.17.2 If a spa is proposed it should be constructed independent of the swimming pool and must not be cantilevered from the swimming pool shell.

## 7.18 Elevator Pit Design

7.18.1 The elevator pit slab and retaining wall should be designed by the project structural engineer. As a minimum the slab-on-grade for the elevator pit bottom should be at least 4 inches thick and reinforced with No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions, positioned near the slab midpoint. Elevator pit walls may be designed in accordance with the recommendations in the *Retaining Wall Design* section of this report (see Section 7.14).

7.18.2 Additional active pressure should be added for a surcharge condition due to sloping ground, vehicular traffic or adjacent foundations and should be designed for each condition as the project progresses.

7.18.3 If retaining wall drainage is to be provided, the drainage system should be designed in accordance with the *Retaining Wall Drainage* section of this report (see Section 7.16).

7.18.4 It is suggested that the exterior walls and slab be waterproofed to prevent excessive moisture inside of the elevator pit. Waterproofing design and installation is not the responsibility of the geotechnical engineer.

## 7.19 Elevator Piston

7.19.1 If a plunger-type elevator piston is installed for this project, a deep drilled excavation will be required. It is important to verify that the drilled excavation is not situated immediately adjacent to a foundation or shoring pile, or the drilled excavation could compromise the existing foundation or pile support, especially if the drilling is performed subsequent to the foundation or pile construction.

7.19.2 Casing may be required if caving is encountered in the drilled excavation. The contractor should be prepared to use casing and should have it readily available at the commencement of drilling activities. The contractor should also be prepared to mitigate buoyant forces during installation of the piston casing. Continuous observation of the drilling and installation of the elevator piston by the Geotechnical Engineer (a representative of Geocon West, Inc.) is required.

7.19.3 The annular space between the piston casing and drilled excavation wall should be filled with a minimum of 1½-sack slurry pumped from the bottom up. As an alternative, pea gravel may be utilized. The use of soil to backfill the annular space is not acceptable.

## 7.20 Temporary Excavations

7.20.1 Excavations on the order of 6 feet in height are generally anticipated during grading operations. Deeper excavations may be required in the northeast corner of the site. The excavations are expected to expose artificial fill and alluvial soils, which may be subject to caving where granular or saturated soils are exposed. Vertical excavations up to 5 feet in height may be attempted where not surcharged by adjacent traffic or structures.

7.20.2 Vertical excavations greater than 5 feet or where surcharged by existing structures will require sloping or shoring measures in order to provide a stable excavation. Where sufficient space is available, temporary unsurcharged embankments could be sloped back at a uniform 1:1 slope gradient or flatter up to maximum height of 15 feet. A uniform slope does not have a vertical portion.

7.20.3 If excavations in close proximity to an adjacent property line and/or structure are required, special excavation measures such as slot-cutting or shoring may be necessary in order to maintain lateral support of offsite improvements. Recommendations for special temporary excavation measures can be provided under separate cover once the proposed building layout is established.

7.20.4 Where temporary slopes are utilized, the top of the slope should be barricaded to prevent vehicles and storage loads at the top of the slope within a horizontal distance equal to the height of the slope. If the temporary construction slopes are to be maintained during the rainy season, berms are suggested along the tops of the slopes where necessary to prevent runoff water from entering the excavation and eroding the slope faces. The soils exposed in the slopes should be inspected during excavation by our personnel so that modifications of the slopes can be made if variations in the soil conditions occur. All excavations should be stabilized within 30 days of initial excavation.

## 7.21 Surcharge from Adjacent Structures and Improvements

7.21.1 Additional active pressure should be added for a surcharge condition due to sloping ground, vehicular traffic or adjacent structures and should be designed for each condition as the project progresses.

7.21.2 It is recommended that line-load surcharges from adjacent wall footings, use horizontal pressures generated from NAV-FAC DM 7.2. The governing equations are:

$$For\ {}^{x}/_{H} \leq 0.4$$

$$\sigma_H(z) = \frac{0.20 \times \left(\frac{z}{H}\right)}{\left[0.16 + \left(\frac{z}{H}\right)^2\right]^2} \times \frac{Q_L}{H}$$

and

$$For\ {}^{x}/_{H} > 0.4$$

$$\sigma_H(z) = \frac{1.28 \times \left(\frac{x}{H}\right)^2 \times \left(\frac{z}{H}\right)}{\left[\left(\frac{x}{H}\right)^2 + \left(\frac{z}{H}\right)^2\right]^2} \times \frac{Q_L}{H}$$

where $x$ is the distance from the face of the excavation or wall to the vertical line-load, $H$ is the distance from the bottom of the footing to the bottom of excavation or wall, $z$ is the depth at which the horizontal pressure is desired, $Q_L$ is the vertical line-load and $\sigma_H(z)$ is the horizontal pressure at depth $z$.

7.21.3 It is recommended that vertical point-loads, from construction equipment outriggers or adjacent building columns use horizontal pressures generated from NAV-FAC DM 7.2. The governing equations are:

$$For\ {}^{x}/_{H} \leq 0.4$$

$$\sigma_H(z) = \frac{0.28 \times \left(\frac{z}{H}\right)^2}{\left[0.16 + \left(\frac{z}{H}\right)^2\right]^3} \times \frac{Q_P}{H^2}$$

and

$$For\ {}^{x}/_{H} > 0.4$$

$$\sigma_H(z) = \frac{1.77 \times \left(\frac{x}{H}\right)^2 \times \left(\frac{z}{H}\right)^2}{\left[\left(\frac{x}{H}\right)^2 + \left(\frac{z}{H}\right)^2\right]^3} \times \frac{Q_P}{H^2}$$

then

$$\sigma'_H\ (z) = \sigma_H(z)cos^2(1.1\theta)$$

where $x$ is the distance from the face of the excavation/wall to the vertical point-load, $H$ is distance from the outrigger/bottom of column footing to the bottom of excavation, $z$ is the depth at which the horizontal pressure is desired, $Q_P$ is the vertical point-load, $\sigma_H(z)$ is the horizontal pressure at depth $z$, $\theta$ is the angle between a line perpendicular to the excavation/wall and a line from the point-load to location on the excavation/wall where the surcharge is being evaluated, and $\sigma_H(z)$ is the horizontal pressure at depth $z$.

## 7.22 Surface Drainage

7.22.1 Proper surface drainage is critical to the future performance of the project. Uncontrolled infiltration of irrigation excess and storm runoff into the soils can adversely affect the performance of the planned improvements. Saturation of a soil can cause it to lose internal shear strength and increase its compressibility, resulting in a change in the original designed engineering properties. Proper drainage should be maintained at all times.

7.22.2 Site drainage should be collected and controlled in non-erosive drainage devices. Drainage should not be allowed to pond anywhere on the site, and especially not against any foundation or retaining wall. The site should be graded and maintained such that surface drainage is directed away from structures in accordance with 2016 CBC 1804.4 or other applicable standards. In addition, drainage should not be allowed to flow uncontrolled over any descending slope. Discharge from downspouts, roof drains and scuppers are not recommended onto unprotected soils within 5 feet of the building perimeter. Planters which are located adjacent to foundations should be sealed to prevent moisture intrusion into the soils providing foundation support. Landscape irrigation is not recommended within 5 feet of the building perimeter footings except when enclosed in protected planters.

7.22.3 Positive site drainage should be provided away from structures, pavement, and the tops of slopes to swales or other controlled drainage structures. The building pads and pavement areas should be fine graded such that water is not allowed to pond.

7.22.4 Landscaping planters immediately adjacent to paved areas are not recommended due to the potential for surface or irrigation water to infiltrate the pavement's subgrade and base course. Either a subdrain, which collects excess irrigation water and transmits it to drainage structures, or an impervious above-grade planter boxes should be used. In addition, where landscaping is planned adjacent to the pavement, it is recommended that consideration be given to providing a cutoff wall along the edge of the pavement that extends at least 12 inches below the base material.

## 7.23 Plan Review

7.23.1 Grading, foundation, and shoring plans should be reviewed by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to finalization to verify that the plans have been prepared in substantial conformance with the recommendations of this report and to provide additional analyses or recommendations.

## LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The recommendations of this report pertain only to the site investigated and are based upon the assumption that the soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon West, Inc. should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon West, Inc.

2. This report is issued with the understanding that it is the responsibility of the owner, or of his representative, to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

3. The findings of this report are valid as of the date of this report. However, changes in the conditions of a property can occur with the passage of time, whether they are due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.

4. The firm that performed the geotechnical investigation for the project should be retained to provide testing and observation services during construction to provide continuity of geotechnical interpretation and to check that the recommendations presented for geotechnical aspects of site development are incorporated during site grading, construction of improvements, and excavation of foundations. If another geotechnical firm is selected to perform the testing and observation services during construction operations, that firm should prepare a letter indicating their intent to assume the responsibilities of project geotechnical engineer of record. A copy of the letter should be provided to the regulatory agency for their records. In addition, that firm should provide revised recommendations concerning the geotechnical aspects of the proposed development, or a written acknowledgement of their concurrence with the recommendations presented in our report. They should also perform additional analyses deemed necessary to assume the role of Geotechnical Engineer of Record.

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DRAFTED BY: JA
CHECKED BY: JTA

# VICINITY MAP

VICTORIA BOULEVARD APARTMENTS
26126 VICTORIA BOULEVARD
DANA POINT, CALIFORNIA

MARCH 2019
PROJECT NO. A9942-88-01
FIG. 1

## LEGEND

| | |
|---|---|
| B5 | Approximate Location of Boring |
| ▲ CPT5 | Approximate Location of CPT |

0 80' 160'

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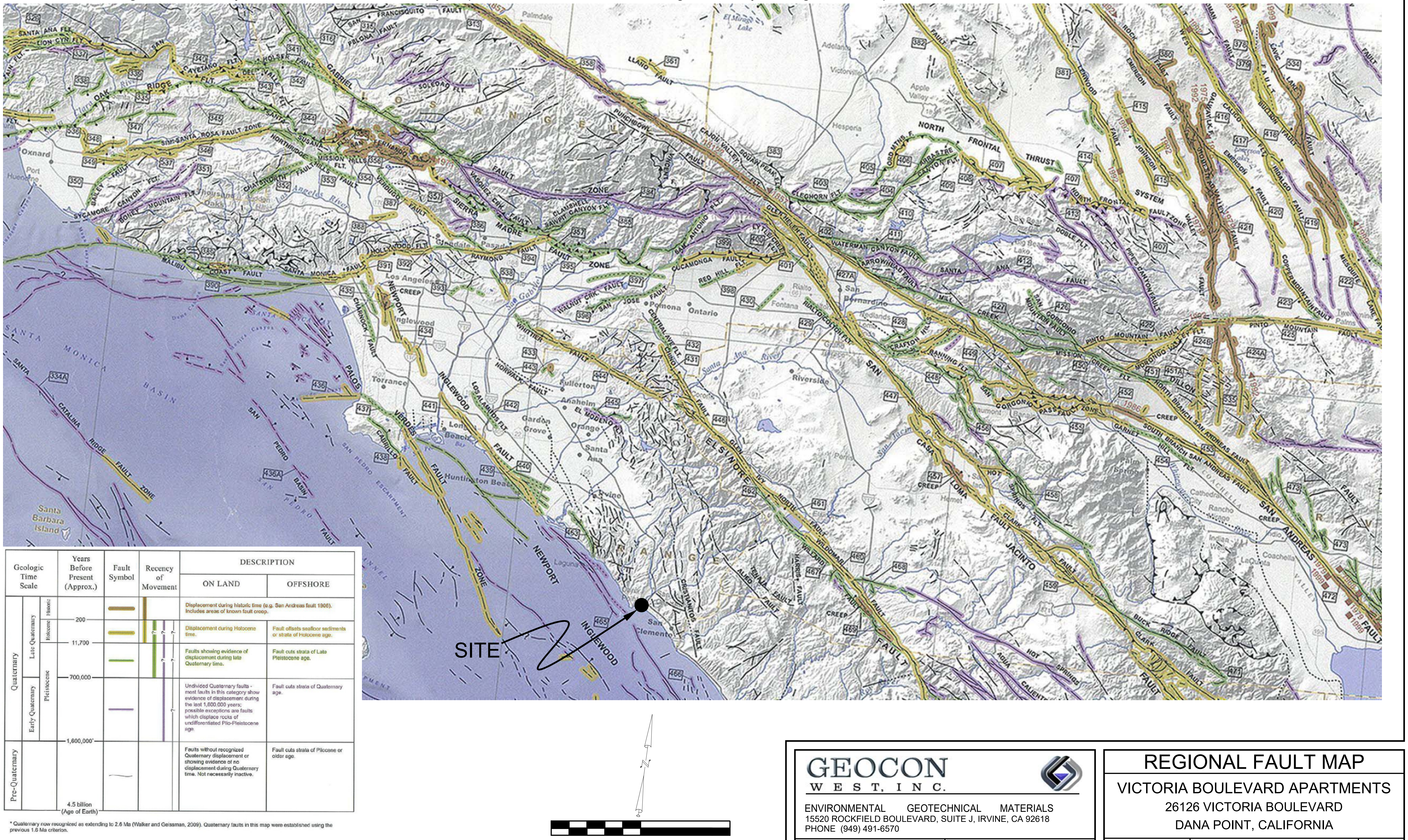
## SITE PLAN

VICTORIA BOULEVARD APARTMENTS
26126 VICTORIA BOULEVARD
DANA POINT, CALIFORNIA

MARCH 2019 PROJECT NO. A9942-88-01 FIG. 2

Reference: Jennings, C.W. and Bryant, W. A., 2010, Fault Activity Map of California, California Geological Survey Geologic Data Map No. 6.



| Geologic Time Scale | | | Years Before Present (Approx.) | Fault Symbol | Recency of Movement | DESCRIPTION | |
|---|---|---|---|---|---|---|---|
| | | | | | | ON LAND | OFFSHORE |
| Quaternary | Late Quaternary | Historic | 200 | 🟫 | | Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep. | |
| | | Holocene | 11,700 | 🟨 | ? ? ? | Displacement during Holocene time. | Fault offsets seafloor sediments or strata of Holocene age. |
| | | Pleistocene | 700,000 | 🟩 | ? ? | Faults showing evidence of displacement during late Quaternary time. | Fault cuts strata of Late Pleistocene age. |
| | Early Quaternary | | 1,600,000* | 🟪 | ? | Undivided Quaternary faults - most faults in this category show evidence of displacement during the last 1,600,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age. | Fault cuts strata of Quaternary age. |
| Pre-Quaternary | | | 4.5 billion (Age of Earth) | — | | Faults without recognized Quaternary displacement or showing evidence of no displacement during Quaternary time. Not necessarily inactive. | Fault cuts strata of Pliocene or older age. |

* Quaternary now recognized as extending to 2.6 Ma (Walker and Geissman, 2009). Quaternary faults in this map were established using the previous 1.6 Ma criterion.

0 12 24 Miles

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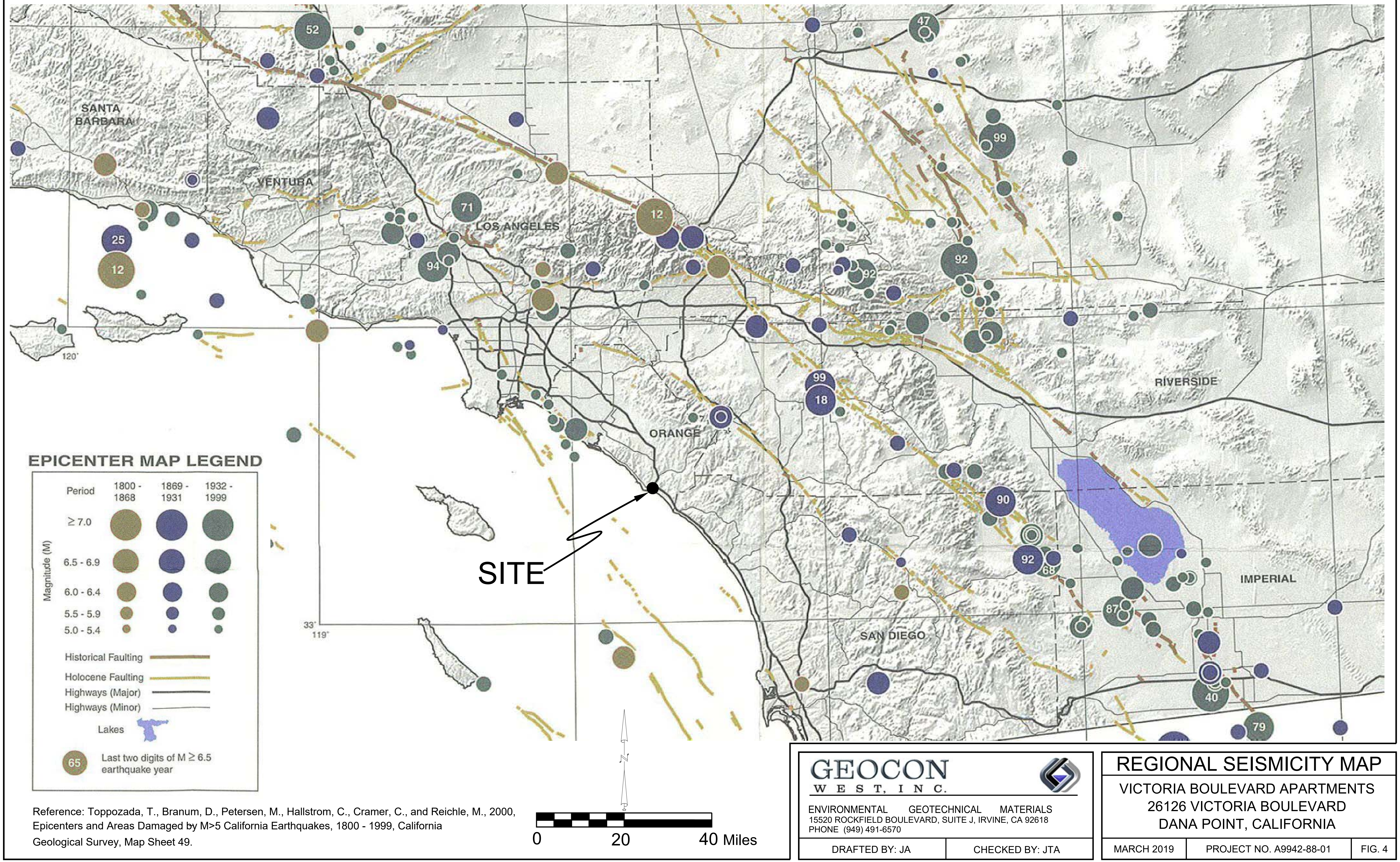
# REGIONAL FAULT MAP

VICTORIA BOULEVARD APARTMENTS
26126 VICTORIA BOULEVARD
DANA POINT, CALIFORNIA

MARCH 2019
PROJECT NO. A9942-88-01
FIG. 3



Reference: Toppozada, T., Branum, D., Petersen, M., Hallstrom, C., Cramer, C., and Reichle, M., 2000, Epicenters and Areas Damaged by M>5 California Earthquakes, 1800 - 1999, California Geological Survey, Map Sheet 49.

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# REGIONAL SEISMICITY MAP

VICTORIA BOULEVARD APARTMENTS
26126 VICTORIA BOULEVARD
DANA POINT, CALIFORNIA

MARCH 2019
PROJECT NO. A9942-88-01
FIG. 4

Client : Toll Brothers
File No. : A9942-88-01
Boring : 4

# EMPIRICAL ESTIMATION OF LIQUEFACTION POTENTIAL
## DESIGN EARTHQUAKE

NCEER (1996) METHOD

EARTHQUAKE INFORMATION:

| | |
|---|---|
| Earthquake Magnitude: | 6.68 |
| Peak Horiz. Acceleration $PGA_M$ (g): | 0.553 |
| 2/3 $PGA_M$ (g): | 0.369 |
| Calculated Mag.Wtg.Factor: | 0.747 |
| Historic High Groundwater: | 5.0 |
| Groundwater Depth During Exploration: | 17.0 |

By Thomas F. Blake (1994-1996)

ENERGY & ROD CORRECTIONS:

| | |
|---|---|
| Energy Correction (CE) for N60: | 1.25 |
| Rod Len.Corr.(CR)(0-no or 1-yes): | 1.0 |
| Bore Dia. Corr. (CB): | 1.00 |
| Sampler Corr. (CS): | 1.20 |
| Use Ksigma (0 or 1): | 1.0 |

LIQUEFACTION CALCULATIONS:

| | |
|---|---|
| Unit Wt. Water (pcf): | 62.4 |

| Depth to Base (ft) | Total Unit Wt. (pcf) | Water (0 or 1) | FIELD SPT (N) | Depth of SPT (ft) | Liq.Sus. (0 or 1) | -200 (%) | Est. Dr (%) | CN Factor | Corrected (N1)60 | Eff. Unit Wt. (psf) | Resist. CRR | rd Factor | Induced CSR | Liquefac. Safe.Fact. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.0 | 120.0 | 0 | 9.0 | 1.0 | 0 | | | 1.700 | 17.2 | 120.0 | ~ | 0.998 | 0.179 | ~ |
| 2.0 | 120.0 | 0 | 9.0 | 2.0 | 0 | | | 1.700 | 17.2 | 120.0 | ~ | 0.993 | 0.178 | ~ |
| 3.0 | 120.0 | 0 | 9.0 | 3.0 | 0 | | | 1.700 | 17.2 | 120.0 | ~ | 0.989 | 0.177 | ~ |
| 4.0 | 120.0 | 0 | 9.0 | 4.0 | 0 | | | 1.700 | 17.2 | 120.0 | ~ | 0.984 | 0.176 | ~ |
| 5.0 | 120.0 | 0 | 9.0 | 5.0 | 0 | | | 1.700 | 17.2 | 120.0 | ~ | 0.979 | 0.175 | ~ |
| 6.0 | 120.0 | 1 | 6.0 | 6.0 | 0 | | | 1.700 | 11.5 | 57.6 | ~ | 0.975 | 0.183 | ~ |
| 7.0 | 120.0 | 1 | 6.0 | 7.0 | 0 | | | 1.636 | 11.0 | 57.6 | ~ | 0.970 | 0.197 | ~ |
| 8.0 | 120.0 | 1 | 6.0 | 8.0 | 0 | | | 1.523 | 10.3 | 57.6 | ~ | 0.966 | 0.209 | ~ |
| 9.0 | 120.0 | 1 | 6.0 | 9.0 | 0 | | | 1.431 | 9.7 | 57.6 | ~ | 0.961 | 0.219 | ~ |
| 10.0 | 120.0 | 1 | 6.0 | 10.0 | 0 | | | 1.353 | 9.1 | 57.6 | ~ | 0.957 | 0.227 | ~ |
| 11.0 | 120.0 | 1 | 6.0 | 10.0 | 0 | | | 1.287 | 8.7 | 57.6 | ~ | 0.952 | 0.234 | ~ |
| 12.0 | 120.0 | 1 | 4.0 | 10.0 | 0 | | | 1.230 | 5.5 | 57.6 | ~ | 0.947 | 0.240 | ~ |
| 13.0 | 120.0 | 1 | 4.0 | 12.5 | 0 | | | 1.180 | 5.3 | 57.6 | ~ | 0.943 | 0.245 | ~ |
| 14.0 | 120.0 | 1 | 4.0 | 12.5 | 0 | | | 1.135 | 5.1 | 57.6 | ~ | 0.938 | 0.250 | ~ |
| 15.0 | 120.0 | 1 | 4.0 | 12.5 | 0 | | | 1.095 | 4.9 | 57.6 | ~ | 0.934 | 0.254 | ~ |
| 16.0 | 120.0 | 1 | 4.0 | 12.5 | 0 | | | 1.060 | 4.8 | 57.6 | ~ | 0.929 | 0.257 | ~ |
| 17.0 | 120.0 | 1 | 2.0 | 17.5 | 0 | | | 1.035 | 2.7 | 57.6 | ~ | 0.925 | 0.260 | ~ |
| 18.0 | 120.0 | 1 | 2.0 | 17.5 | 0 | | | 1.020 | 2.6 | 57.6 | ~ | 0.920 | 0.262 | ~ |
| 19.0 | 120.0 | 1 | 2.0 | 17.5 | 0 | | | 1.006 | 2.6 | 57.6 | ~ | 0.915 | 0.264 | ~ |
| 20.0 | 120.0 | 1 | 2.0 | 17.5 | 0 | | | 0.992 | 2.5 | 57.6 | ~ | 0.911 | 0.266 | ~ |
| 21.0 | 120.0 | 1 | 2.0 | 17.5 | 0 | | | 0.979 | 2.5 | 57.6 | ~ | 0.906 | 0.268 | ~ |
| 22.0 | 120.0 | 1 | 3.0 | 22.5 | 0 | | | 0.966 | 4.0 | 57.6 | ~ | 0.902 | 0.269 | ~ |
| 23.0 | 120.0 | 1 | 3.0 | 22.5 | 0 | | | 0.954 | 4.0 | 57.6 | ~ | 0.897 | 0.270 | ~ |
| 24.0 | 120.0 | 1 | 3.0 | 22.5 | 0 | | | 0.942 | 3.9 | 57.6 | ~ | 0.893 | 0.271 | ~ |
| 25.0 | 120.0 | 1 | 3.0 | 22.5 | 0 | | | 0.931 | 3.9 | 57.6 | ~ | 0.888 | 0.271 | ~ |
| 26.0 | 120.0 | 1 | 3.0 | 22.5 | 0 | | | 0.920 | 3.8 | 57.6 | ~ | 0.883 | 0.272 | ~ |
| 27.0 | 120.0 | 1 | 2.0 | 27.5 | 0 | | | 0.909 | 2.7 | 57.6 | ~ | 0.879 | 0.272 | ~ |
| 28.0 | 120.0 | 1 | 2.0 | 27.5 | 0 | | | 0.899 | 2.6 | 57.6 | ~ | 0.874 | 0.273 | ~ |
| 29.0 | 120.0 | 1 | 2.0 | 27.5 | 0 | | | 0.889 | 2.6 | 57.6 | ~ | 0.870 | 0.273 | ~ |
| 30.0 | 120.0 | 1 | 2.0 | 27.5 | 0 | | | 0.880 | 2.6 | 57.6 | ~ | 0.865 | 0.273 | ~ |
| 31.0 | 120.0 | 1 | 2.0 | 27.5 | 0 | | | 0.871 | 2.6 | 57.6 | ~ | 0.861 | 0.273 | ~ |
| 32.0 | 120.0 | 1 | 3.0 | 32.5 | 0 | | | 0.862 | 3.9 | 57.6 | ~ | 0.856 | 0.273 | ~ |
| 33.0 | 120.0 | 1 | 3.0 | 32.5 | 0 | | | 0.853 | 3.8 | 57.6 | ~ | 0.851 | 0.272 | ~ |
| 34.0 | 120.0 | 1 | 3.0 | 32.5 | 0 | | | 0.844 | 3.8 | 57.6 | ~ | 0.847 | 0.272 | ~ |
| 35.0 | 120.0 | 1 | 4.0 | 37.5 | 0 | | | 0.836 | 5.0 | 57.6 | ~ | 0.842 | 0.272 | ~ |
| 36.0 | 120.0 | 1 | 4.0 | 37.5 | 0 | | | 0.828 | 5.0 | 57.6 | ~ | 0.838 | 0.271 | ~ |
| 37.0 | 120.0 | 1 | 4.0 | 37.5 | 0 | | | 0.821 | 4.9 | 57.6 | ~ | 0.833 | 0.271 | ~ |
| 38.0 | 120.0 | 1 | 4.0 | 37.5 | 0 | | | 0.813 | 4.9 | 57.6 | ~ | 0.829 | 0.270 | ~ |
| 39.0 | 120.0 | 1 | 4.0 | 37.5 | 0 | | | 0.806 | 4.8 | 57.6 | ~ | 0.824 | 0.270 | ~ |
| 40.0 | 120.0 | 1 | 4.0 | 37.5 | 0 | | | 0.799 | 4.8 | 57.6 | ~ | 0.819 | 0.269 | ~ |
| 41.0 | 120.0 | 1 | 4.0 | 37.5 | 0 | | | 0.792 | 4.8 | 57.6 | ~ | 0.815 | 0.268 | ~ |
| 42.0 | 120.0 | 1 | 6.0 | 42.5 | 0 | | | 0.785 | 7.1 | 57.6 | ~ | 0.810 | 0.267 | ~ |
| 43.0 | 120.0 | 1 | 6.0 | 42.5 | 0 | | | 0.778 | 7.0 | 57.6 | ~ | 0.806 | 0.267 | ~ |
| 44.0 | 120.0 | 1 | 6.0 | 42.5 | 0 | | | 0.772 | 6.9 | 57.6 | ~ | 0.801 | 0.266 | ~ |
| 45.0 | 120.0 | 1 | 6.0 | 42.5 | 0 | | | 0.766 | 6.9 | 57.6 | ~ | 0.797 | 0.265 | ~ |
| 46.0 | 120.0 | 1 | 6.0 | 42.5 | 0 | | | 0.760 | 6.8 | 57.6 | ~ | 0.792 | 0.264 | ~ |
| 47.0 | 120.0 | 1 | 18.0 | 47.5 | 0 | | | 0.754 | 20.3 | 57.6 | ~ | 0.787 | 0.263 | ~ |
| 48.0 | 120.0 | 1 | 18.0 | 47.5 | 0 | | | 0.748 | 20.2 | 57.6 | ~ | 0.783 | 0.262 | ~ |
| 49.0 | 120.0 | 1 | 18.0 | 47.5 | 0 | | | 0.742 | 20.0 | 57.6 | ~ | 0.778 | 0.261 | ~ |
| 50.0 | 120.0 | 1 | 18.0 | 47.5 | 0 | | | 0.736 | 19.9 | 57.6 | ~ | 0.774 | 0.260 | ~ |

GEOCON

Client : Toll Brothers
File No. : A9942-88-01
Boring : 4

# LIQUEFACTION SETTLEMENT ANALYSIS
# DESIGN EARTHQUAKE

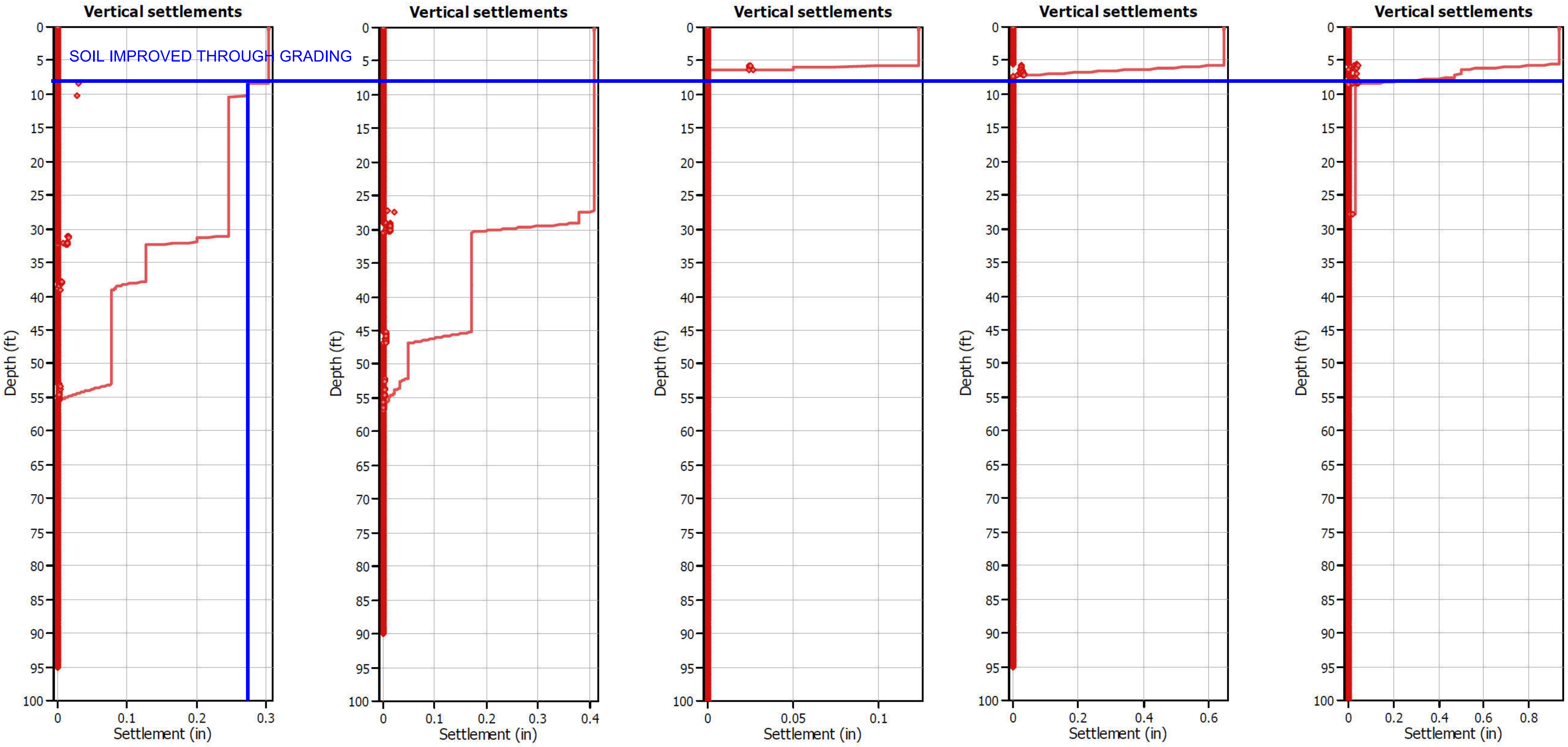
(SATURATED SAND AT INITIAL LIQUEFACTION CONDITION)

NCEER (1996) METHOD
EARTHQUAKE INFORMATION:

| | |
|---|---|
| Earthquake Magnitude: | 6.68 |
| PGAM (g): | 0.553 |
| 2/3 PGAM (g): | 0.37 |
| Calculated Mag.Wtg.Factor: | 0.747 |
| Historic High Groundwater: | 5.0 |
| Groundwater @ Exploration: | 17.0 |

| DEPTH TO BASE | BLOW COUNT N | WET DENSITY (PCF) | TOTAL STRESS O (TSF) | EFFECT STRESS O' (TSF) | REL. DEN. Dr (%) | ADJUST BLOWS (N1)60 | Tav/$\sigma'_o$ | LIQUEFACTION SAFETY FACTOR | Volumetric Strain [$e_{15}$} (%) | EQ. SETTLE. Pe (in.) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 9 | 120 | 0.030 | 0.030 | | 17 | 0.240 | ~ | 0.00 | 0.00 |
| 2 | 9 | 120 | 0.090 | 0.090 | | 17 | 0.240 | ~ | 0.00 | 0.00 |
| 3 | 9 | 120 | 0.150 | 0.150 | | 17 | 0.240 | ~ | 0.00 | 0.00 |
| 4 | 9 | 120 | 0.210 | 0.210 | | 17 | 0.240 | ~ | 0.00 | 0.00 |
| 5 | 9 | 120 | 0.270 | 0.270 | | 17 | 0.240 | ~ | 0.00 | 0.00 |
| 6 | 6 | 120 | 0.330 | 0.314 | | 11 | 0.252 | ~ | 0.00 | 0.00 |
| 7 | 6 | 120 | 0.390 | 0.343 | | 11 | 0.272 | ~ | 0.00 | 0.00 |
| 8 | 6 | 120 | 0.450 | 0.372 | | 10 | 0.290 | ~ | 0.00 | 0.00 |
| 9 | 6 | 120 | 0.510 | 0.401 | | 10 | 0.305 | ~ | 0.00 | 0.00 |
| 10 | 6 | 120 | 0.570 | 0.430 | | 9 | 0.318 | ~ | 0.00 | 0.00 |
| 11 | 6 | 120 | 0.630 | 0.458 | | 9 | 0.330 | ~ | 0.00 | 0.00 |
| 12 | 4 | 120 | 0.690 | 0.487 | | 6 | 0.340 | ~ | 0.00 | 0.00 |
| 13 | 4 | 120 | 0.750 | 0.516 | | 5 | 0.348 | ~ | 0.00 | 0.00 |
| 14 | 4 | 120 | 0.810 | 0.545 | | 5 | 0.356 | ~ | 0.00 | 0.00 |
| 15 | 4 | 120 | 0.870 | 0.574 | | 5 | 0.364 | ~ | 0.00 | 0.00 |
| 16 | 4 | 120 | 0.930 | 0.602 | | 5 | 0.370 | ~ | 0.00 | 0.00 |
| 17 | 2 | 120 | 0.990 | 0.631 | | 3 | 0.376 | ~ | 0.00 | 0.00 |
| 18 | 2 | 120 | 1.050 | 0.660 | | 3 | 0.381 | ~ | 0.00 | 0.00 |
| 19 | 2 | 120 | 1.110 | 0.689 | | 3 | 0.386 | ~ | 0.00 | 0.00 |
| 20 | 2 | 120 | 1.170 | 0.718 | | 3 | 0.391 | ~ | 0.00 | 0.00 |
| 21 | 2 | 120 | 1.230 | 0.746 | | 3 | 0.395 | ~ | 0.00 | 0.00 |
| 22 | 3 | 120 | 1.290 | 0.775 | | 4 | 0.399 | ~ | 0.00 | 0.00 |
| 23 | 3 | 120 | 1.350 | 0.804 | | 4 | 0.403 | ~ | 0.00 | 0.00 |
| 24 | 3 | 120 | 1.410 | 0.833 | | 4 | 0.406 | ~ | 0.00 | 0.00 |
| 25 | 3 | 120 | 1.470 | 0.862 | | 4 | 0.409 | ~ | 0.00 | 0.00 |
| 26 | 3 | 120 | 1.530 | 0.890 | | 4 | 0.412 | ~ | 0.00 | 0.00 |
| 27 | 2 | 120 | 1.590 | 0.919 | | 3 | 0.415 | ~ | 0.00 | 0.00 |
| 28 | 2 | 120 | 1.650 | 0.948 | | 3 | 0.417 | ~ | 0.00 | 0.00 |
| 29 | 2 | 120 | 1.710 | 0.977 | | 3 | 0.420 | ~ | 0.00 | 0.00 |
| 30 | 2 | 120 | 1.770 | 1.006 | | 3 | 0.422 | ~ | 0.00 | 0.00 |
| 31 | 2 | 120 | 1.830 | 1.034 | | 3 | 0.424 | ~ | 0.00 | 0.00 |
| 32 | 3 | 120 | 1.890 | 1.063 | | 4 | 0.426 | ~ | 0.00 | 0.00 |
| 33 | 3 | 120 | 1.950 | 1.092 | | 4 | 0.428 | ~ | 0.00 | 0.00 |
| 34 | 3 | 120 | 2.010 | 1.121 | | 4 | 0.430 | ~ | 0.00 | 0.00 |
| 35 | 4 | 120 | 2.070 | 1.150 | | 5 | 0.432 | ~ | 0.00 | 0.00 |
| 36 | 4 | 120 | 2.130 | 1.178 | | 5 | 0.433 | ~ | 0.00 | 0.00 |
| 37 | 4 | 120 | 2.190 | 1.207 | | 5 | 0.435 | ~ | 0.00 | 0.00 |
| 38 | 4 | 120 | 2.250 | 1.236 | | 5 | 0.436 | ~ | 0.00 | 0.00 |
| 39 | 4 | 120 | 2.310 | 1.265 | | 5 | 0.438 | ~ | 0.00 | 0.00 |
| 40 | 4 | 120 | 2.370 | 1.294 | | 5 | 0.439 | ~ | 0.00 | 0.00 |
| 41 | 4 | 120 | 2.430 | 1.322 | | 5 | 0.441 | ~ | 0.00 | 0.00 |
| 42 | 6 | 120 | 2.490 | 1.351 | | 7 | 0.442 | ~ | 0.00 | 0.00 |
| 43 | 6 | 120 | 2.550 | 1.380 | | 7 | 0.443 | ~ | 0.00 | 0.00 |
| 44 | 6 | 120 | 2.610 | 1.409 | | 7 | 0.444 | ~ | 0.00 | 0.00 |
| 45 | 6 | 120 | 2.670 | 1.438 | | 7 | 0.445 | ~ | 0.00 | 0.00 |
| 46 | 6 | 120 | 2.730 | 1.466 | | 7 | 0.446 | ~ | 0.00 | 0.00 |
| 47 | 18 | 120 | 2.790 | 1.495 | | 20 | 0.447 | ~ | 0.00 | 0.00 |
| 48 | 18 | 120 | 2.850 | 1.524 | | 20 | 0.448 | ~ | 0.00 | 0.00 |
| 49 | 18 | 120 | 2.910 | 1.553 | | 20 | 0.449 | ~ | 0.00 | 0.00 |
| 50 | 18 | 120 | 2.970 | 1.582 | | 20 | 0.450 | ~ | 0.00 | 0.00 |

TOTAL SETTLEMENT = 0.0 INCHES



CPT 1

Total Anticiapted Settlement = 0.3 in

Anticiapted Settlement Subsequent
to Recommended Grading = 0.25 in

CPT 2

Total Anticiapted Settlement = 0.41 in

Anticiapted Settlement Subsequent
to Recommended Grading = 0.41 in

CPT 3

Total Anticiapted Settlement = 0.12 in

Anticiapted Settlement Subsequent
to Recommended Grading = 0 in

CPT 4

Total Anticiapted Settlement = 0.65 in

Anticiapted Settlement Subsequent
to Recommended Grading = 0 in

CPT 5

Total Anticiapted Settlement = 0.93 in

Anticiapted Settlement Subsequent
to Recommended Grading = 0 in

GEOCON
WEST, INC.
ENVIRONMENTAL GEOTECHNICAL MATERIALS
15520 ROCKFIELD BOULEVARD, SUITE J, IRVINE, CA 92618
PHONE (949) 491-6570

| | |
|---|---|
| DRAFTED BY: JTA | CHECKED BY: JTA |

DE ESTIMATION OF LIQUEFACTION SETTLEMENTS

VICTORIA BOULEVARD APARTMENTS
26126 VICTORIA BOULEVARD
DANA POINT, CALIFORNIA

| | | |
|---|---|---|
| MARCH 2019 | PROJECT NO. A9942-88-01 | FIG. 7 |

GEOCON

Client : Toll Brothers
File No. : A9942-88-01
Boring : 4

# EMPIRICAL ESTIMATION OF LIQUEFACTION POTENTIAL
# MAXIMUM CONSIDERED EARTHQUAKE

NCEER (1996) METHOD

By Thomas F. Blake (1994-1996)

EARTHQUAKE INFORMATION:

| | |
|---|---|
| Earthquake Magnitude: | 6.72 |
| Peak Horiz. Acceleration PGA$_M$ (g): | 0.553 |
| Calculated Mag.Wtg.Factor: | 0.759 |
| Historic High Groundwater: | 5.0 |
| Groundwater Depth During Exploration: | 17.0 |

ENERGY & ROD CORRECTIONS:

| | |
|---|---|
| Energy Correction (CE) for N60: | 1.25 |
| Rod Len.Corr.(CR)(0-no or 1-yes): | 1.0 |
| Bore Dia. Corr. (CB): | 1.00 |
| Sampler Corr. (CS): | 1.20 |
| Use Ksigma (0 or 1): | 1.0 |

LIQUEFACTION CALCULATIONS:

| | |
|---|---|
| Unit Wt. Water (pcf): | 62.4 |

| Depth to Base (ft) | Total Unit Wt. (pcf) | Water (0 or 1) | FIELD SPT (N) | Depth of SPT (ft) | Liq.Sus. (0 or 1) | -200 (%) | Est. Dr (%) | CN Factor | Corrected (N1)60 | Eff. Unit Wt. (psf) | Resist. CRR | rd Factor | Induced CSR | Liquefac. Safe.Fact. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.0 | 120.0 | 0 | 9.0 | 1.0 | 0 | | | 1.700 | 17.2 | 120.0 | ~ | 0.998 | 0.272 | ~ |
| 2.0 | 120.0 | 0 | 9.0 | 2.0 | 0 | | | 1.700 | 17.2 | 120.0 | ~ | 0.993 | 0.271 | ~ |
| 3.0 | 120.0 | 0 | 9.0 | 3.0 | 0 | | | 1.700 | 17.2 | 120.0 | ~ | 0.989 | 0.270 | ~ |
| 4.0 | 120.0 | 0 | 9.0 | 4.0 | 0 | | | 1.700 | 17.2 | 120.0 | ~ | 0.984 | 0.268 | ~ |
| 5.0 | 120.0 | 0 | 9.0 | 5.0 | 0 | | | 1.700 | 17.2 | 120.0 | ~ | 0.979 | 0.267 | ~ |
| 6.0 | 120.0 | 1 | 6.0 | 6.0 | 0 | | | 1.700 | 11.5 | 57.6 | ~ | 0.975 | 0.279 | ~ |
| 7.0 | 120.0 | 1 | 6.0 | 7.0 | 0 | | | 1.636 | 11.0 | 57.6 | ~ | 0.970 | 0.301 | ~ |
| 8.0 | 120.0 | 1 | 6.0 | 8.0 | 0 | | | 1.523 | 10.3 | 57.6 | ~ | 0.966 | 0.319 | ~ |
| 9.0 | 120.0 | 1 | 6.0 | 9.0 | 0 | | | 1.431 | 9.7 | 57.6 | ~ | 0.961 | 0.333 | ~ |
| 10.0 | 120.0 | 1 | 6.0 | 10.0 | 0 | | | 1.353 | 9.1 | 57.6 | ~ | 0.957 | 0.346 | ~ |
| 11.0 | 120.0 | 1 | 6.0 | 10.0 | 0 | | | 1.287 | 8.7 | 57.6 | ~ | 0.952 | 0.357 | ~ |
| 12.0 | 120.0 | 1 | 4.0 | 10.0 | 0 | | | 1.230 | 5.5 | 57.6 | ~ | 0.947 | 0.366 | ~ |
| 13.0 | 120.0 | 1 | 4.0 | 12.5 | 0 | | | 1.180 | 5.3 | 57.6 | ~ | 0.943 | 0.374 | ~ |
| 14.0 | 120.0 | 1 | 4.0 | 12.5 | 0 | | | 1.135 | 5.1 | 57.6 | ~ | 0.938 | 0.380 | ~ |
| 15.0 | 120.0 | 1 | 4.0 | 12.5 | 0 | | | 1.095 | 4.9 | 57.6 | ~ | 0.934 | 0.386 | ~ |
| 16.0 | 120.0 | 1 | 4.0 | 12.5 | 0 | | | 1.060 | 4.8 | 57.6 | ~ | 0.929 | 0.391 | ~ |
| 17.0 | 120.0 | 1 | 2.0 | 17.5 | 0 | | | 1.035 | 2.7 | 57.6 | ~ | 0.925 | 0.395 | ~ |
| 18.0 | 120.0 | 1 | 2.0 | 17.5 | 0 | | | 1.020 | 2.6 | 57.6 | ~ | 0.920 | 0.399 | ~ |
| 19.0 | 120.0 | 1 | 2.0 | 17.5 | 0 | | | 1.006 | 2.6 | 57.6 | ~ | 0.915 | 0.402 | ~ |
| 20.0 | 120.0 | 1 | 2.0 | 17.5 | 0 | | | 0.992 | 2.5 | 57.6 | ~ | 0.911 | 0.405 | ~ |
| 21.0 | 120.0 | 1 | 2.0 | 17.5 | 0 | | | 0.979 | 2.5 | 57.6 | ~ | 0.906 | 0.407 | ~ |
| 22.0 | 120.0 | 1 | 3.0 | 22.5 | 0 | | | 0.966 | 4.0 | 57.6 | ~ | 0.902 | 0.409 | ~ |
| 23.0 | 120.0 | 1 | 3.0 | 22.5 | 0 | | | 0.954 | 4.0 | 57.6 | ~ | 0.897 | 0.411 | ~ |
| 24.0 | 120.0 | 1 | 3.0 | 22.5 | 0 | | | 0.942 | 3.9 | 57.6 | ~ | 0.893 | 0.412 | ~ |
| 25.0 | 120.0 | 1 | 3.0 | 22.5 | 0 | | | 0.931 | 3.9 | 57.6 | ~ | 0.888 | 0.413 | ~ |
| 26.0 | 120.0 | 1 | 3.0 | 22.5 | 0 | | | 0.920 | 3.8 | 57.6 | ~ | 0.883 | 0.414 | ~ |
| 27.0 | 120.0 | 1 | 2.0 | 27.5 | 0 | | | 0.909 | 2.7 | 57.6 | ~ | 0.879 | 0.415 | ~ |
| 28.0 | 120.0 | 1 | 2.0 | 27.5 | 0 | | | 0.899 | 2.6 | 57.6 | ~ | 0.874 | 0.415 | ~ |
| 29.0 | 120.0 | 1 | 2.0 | 27.5 | 0 | | | 0.889 | 2.6 | 57.6 | ~ | 0.870 | 0.415 | ~ |
| 30.0 | 120.0 | 1 | 2.0 | 27.5 | 0 | | | 0.880 | 2.6 | 57.6 | ~ | 0.865 | 0.415 | ~ |
| 31.0 | 120.0 | 1 | 2.0 | 27.5 | 0 | | | 0.871 | 2.6 | 57.6 | ~ | 0.861 | 0.415 | ~ |
| 32.0 | 120.0 | 1 | 3.0 | 32.5 | 0 | | | 0.862 | 3.9 | 57.6 | ~ | 0.856 | 0.415 | ~ |
| 33.0 | 120.0 | 1 | 3.0 | 32.5 | 0 | | | 0.853 | 3.8 | 57.6 | ~ | 0.851 | 0.415 | ~ |
| 34.0 | 120.0 | 1 | 3.0 | 32.5 | 0 | | | 0.844 | 3.8 | 57.6 | ~ | 0.847 | 0.414 | ~ |
| 35.0 | 120.0 | 1 | 4.0 | 37.5 | 0 | | | 0.836 | 5.0 | 57.6 | ~ | 0.842 | 0.414 | ~ |
| 36.0 | 120.0 | 1 | 4.0 | 37.5 | 0 | | | 0.828 | 5.0 | 57.6 | ~ | 0.838 | 0.413 | ~ |
| 37.0 | 120.0 | 1 | 4.0 | 37.5 | 0 | | | 0.821 | 4.9 | 57.6 | ~ | 0.833 | 0.412 | ~ |
| 38.0 | 120.0 | 1 | 4.0 | 37.5 | 0 | | | 0.813 | 4.9 | 57.6 | ~ | 0.829 | 0.411 | ~ |
| 39.0 | 120.0 | 1 | 4.0 | 37.5 | 0 | | | 0.806 | 4.8 | 57.6 | ~ | 0.824 | 0.410 | ~ |
| 40.0 | 120.0 | 1 | 4.0 | 37.5 | 0 | | | 0.799 | 4.8 | 57.6 | ~ | 0.819 | 0.409 | ~ |
| 41.0 | 120.0 | 1 | 4.0 | 37.5 | 0 | | | 0.792 | 4.8 | 57.6 | ~ | 0.815 | 0.408 | ~ |
| 42.0 | 120.0 | 1 | 6.0 | 42.5 | 0 | | | 0.785 | 7.1 | 57.6 | ~ | 0.810 | 0.407 | ~ |
| 43.0 | 120.0 | 1 | 6.0 | 42.5 | 0 | | | 0.778 | 7.0 | 57.6 | ~ | 0.806 | 0.406 | ~ |
| 44.0 | 120.0 | 1 | 6.0 | 42.5 | 0 | | | 0.772 | 6.9 | 57.6 | ~ | 0.801 | 0.405 | ~ |
| 45.0 | 120.0 | 1 | 6.0 | 42.5 | 0 | | | 0.766 | 6.9 | 57.6 | ~ | 0.797 | 0.403 | ~ |
| 46.0 | 120.0 | 1 | 6.0 | 42.5 | 0 | | | 0.760 | 6.8 | 57.6 | ~ | 0.792 | 0.402 | ~ |
| 47.0 | 120.0 | 1 | 18.0 | 47.5 | 0 | | | 0.754 | 20.3 | 57.6 | ~ | 0.787 | 0.401 | ~ |
| 48.0 | 120.0 | 1 | 18.0 | 47.5 | 0 | | | 0.748 | 20.2 | 57.6 | ~ | 0.783 | 0.399 | ~ |
| 49.0 | 120.0 | 1 | 18.0 | 47.5 | 0 | | | 0.742 | 20.0 | 57.6 | ~ | 0.778 | 0.398 | ~ |
| 50.0 | 120.0 | 1 | 18.0 | 47.5 | 0 | | | 0.736 | 19.9 | 57.6 | ~ | 0.774 | 0.396 | ~ |

Client : Toll Brothers
File No. : A9942-88-01
Boring : 4

# LIQUEFACTION SETTLEMENT ANALYSIS
# MAXIMUM CONSIDERED EARTHQUAKE

(SATURATED SAND AT INITIAL LIQUEFACTION CONDITION)

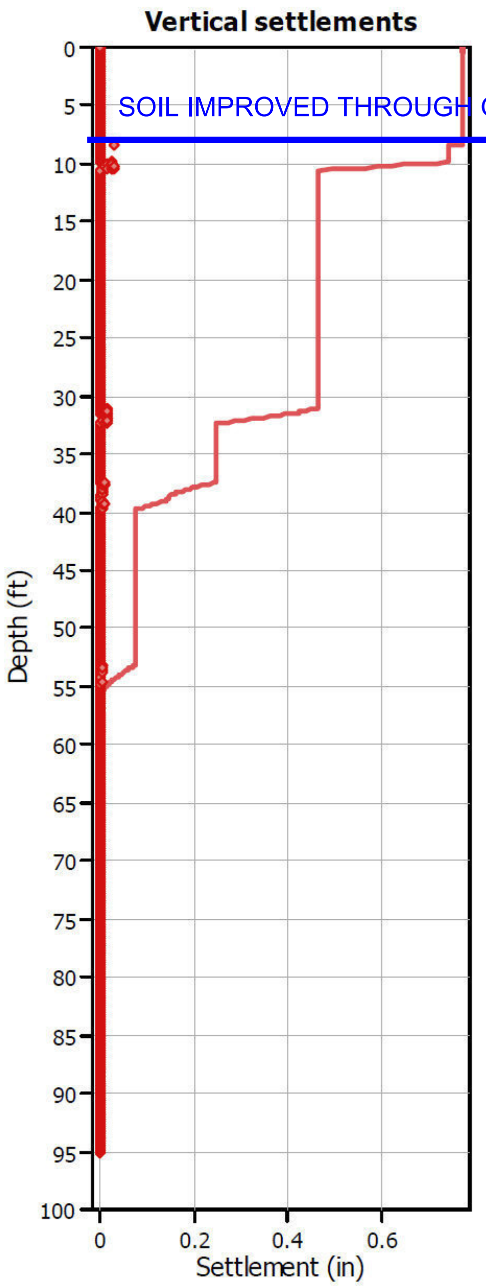
NCEER (1996) METHOD
EARTHQUAKE INFORMATION:

| | |
|---|---|
| Earthquake Magnitude: | 6.72 |
| PGA$_M$ (g): | 0.553 |
| Calculated Mag.Wtg.Factor: | 0.759 |
| Historic High Groundwater: | 5.0 |
| Groundwater @ Exploration: | 17.0 |

| DEPTH TO BASE | BLOW COUNT N | WET DENSITY (PCF) | TOTAL STRESS O (TSF) | EFFECT STRESS O' (TSF) | REL. DEN. Dr (%) | ADJUST BLOWS (N1)60 | Tav/σ'$_o$ | LIQUEFACTION SAFETY FACTOR | Volumetric Strain [e$_{15}$} (%) | EQ. SETTLE. Pe (in.) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 9 | 120 | 0.030 | 0.030 | | 17 | 0.359 | ~ | 0.00 | 0.00 |
| 2 | 9 | 120 | 0.090 | 0.090 | | 17 | 0.359 | ~ | 0.00 | 0.00 |
| 3 | 9 | 120 | 0.150 | 0.150 | | 17 | 0.359 | ~ | 0.00 | 0.00 |
| 4 | 9 | 120 | 0.210 | 0.210 | | 17 | 0.359 | ~ | 0.00 | 0.00 |
| 5 | 9 | 120 | 0.270 | 0.270 | | 17 | 0.359 | ~ | 0.00 | 0.00 |
| 6 | 6 | 120 | 0.330 | 0.314 | | 11 | 0.377 | ~ | 0.00 | 0.00 |
| 7 | 6 | 120 | 0.390 | 0.343 | | 11 | 0.408 | ~ | 0.00 | 0.00 |
| 8 | 6 | 120 | 0.450 | 0.372 | | 10 | 0.435 | ~ | 0.00 | 0.00 |
| 9 | 6 | 120 | 0.510 | 0.401 | | 10 | 0.457 | ~ | 0.00 | 0.00 |
| 10 | 6 | 120 | 0.570 | 0.430 | | 9 | 0.477 | ~ | 0.00 | 0.00 |
| 11 | 6 | 120 | 0.630 | 0.458 | | 9 | 0.494 | ~ | 0.00 | 0.00 |
| 12 | 4 | 120 | 0.690 | 0.487 | | 6 | 0.509 | ~ | 0.00 | 0.00 |
| 13 | 4 | 120 | 0.750 | 0.516 | | 5 | 0.522 | ~ | 0.00 | 0.00 |
| 14 | 4 | 120 | 0.810 | 0.545 | | 5 | 0.534 | ~ | 0.00 | 0.00 |
| 15 | 4 | 120 | 0.870 | 0.574 | | 5 | 0.545 | ~ | 0.00 | 0.00 |
| 16 | 4 | 120 | 0.930 | 0.602 | | 5 | 0.555 | ~ | 0.00 | 0.00 |
| 17 | 2 | 120 | 0.990 | 0.631 | | 3 | 0.564 | ~ | 0.00 | 0.00 |
| 18 | 2 | 120 | 1.050 | 0.660 | | 3 | 0.572 | ~ | 0.00 | 0.00 |
| 19 | 2 | 120 | 1.110 | 0.689 | | 3 | 0.579 | ~ | 0.00 | 0.00 |
| 20 | 2 | 120 | 1.170 | 0.718 | | 3 | 0.586 | ~ | 0.00 | 0.00 |
| 21 | 2 | 120 | 1.230 | 0.746 | | 3 | 0.592 | ~ | 0.00 | 0.00 |
| 22 | 3 | 120 | 1.290 | 0.775 | | 4 | 0.598 | ~ | 0.00 | 0.00 |
| 23 | 3 | 120 | 1.350 | 0.804 | | 4 | 0.604 | ~ | 0.00 | 0.00 |
| 24 | 3 | 120 | 1.410 | 0.833 | | 4 | 0.609 | ~ | 0.00 | 0.00 |
| 25 | 3 | 120 | 1.470 | 0.862 | | 4 | 0.613 | ~ | 0.00 | 0.00 |
| 26 | 3 | 120 | 1.530 | 0.890 | | 4 | 0.618 | ~ | 0.00 | 0.00 |
| 27 | 2 | 120 | 1.590 | 0.919 | | 3 | 0.622 | ~ | 0.00 | 0.00 |
| 28 | 2 | 120 | 1.650 | 0.948 | | 3 | 0.626 | ~ | 0.00 | 0.00 |
| 29 | 2 | 120 | 1.710 | 0.977 | | 3 | 0.629 | ~ | 0.00 | 0.00 |
| 30 | 2 | 120 | 1.770 | 1.006 | | 3 | 0.633 | ~ | 0.00 | 0.00 |
| 31 | 2 | 120 | 1.830 | 1.034 | | 3 | 0.636 | ~ | 0.00 | 0.00 |
| 32 | 3 | 120 | 1.890 | 1.063 | | 4 | 0.639 | ~ | 0.00 | 0.00 |
| 33 | 3 | 120 | 1.950 | 1.092 | | 4 | 0.642 | ~ | 0.00 | 0.00 |
| 34 | 3 | 120 | 2.010 | 1.121 | | 4 | 0.645 | ~ | 0.00 | 0.00 |
| 35 | 4 | 120 | 2.070 | 1.150 | | 5 | 0.647 | ~ | 0.00 | 0.00 |
| 36 | 4 | 120 | 2.130 | 1.178 | | 5 | 0.650 | ~ | 0.00 | 0.00 |
| 37 | 4 | 120 | 2.190 | 1.207 | | 5 | 0.652 | ~ | 0.00 | 0.00 |
| 38 | 4 | 120 | 2.250 | 1.236 | | 5 | 0.654 | ~ | 0.00 | 0.00 |
| 39 | 4 | 120 | 2.310 | 1.265 | | 5 | 0.656 | ~ | 0.00 | 0.00 |
| 40 | 4 | 120 | 2.370 | 1.294 | | 5 | 0.659 | ~ | 0.00 | 0.00 |
| 41 | 4 | 120 | 2.430 | 1.322 | | 5 | 0.661 | ~ | 0.00 | 0.00 |
| 42 | 6 | 120 | 2.490 | 1.351 | | 7 | 0.662 | ~ | 0.00 | 0.00 |
| 43 | 6 | 120 | 2.550 | 1.380 | | 7 | 0.664 | ~ | 0.00 | 0.00 |
| 44 | 6 | 120 | 2.610 | 1.409 | | 7 | 0.666 | ~ | 0.00 | 0.00 |
| 45 | 6 | 120 | 2.670 | 1.438 | | 7 | 0.668 | ~ | 0.00 | 0.00 |
| 46 | 6 | 120 | 2.730 | 1.466 | | 7 | 0.669 | ~ | 0.00 | 0.00 |
| 47 | 18 | 120 | 2.790 | 1.495 | | 20 | 0.671 | ~ | 0.00 | 0.00 |
| 48 | 18 | 120 | 2.850 | 1.524 | | 20 | 0.672 | ~ | 0.00 | 0.00 |
| 49 | 18 | 120 | 2.910 | 1.553 | | 20 | 0.674 | ~ | 0.00 | 0.00 |
| 50 | 18 | 120 | 2.970 | 1.582 | | 20 | 0.675 | ~ | 0.00 | 0.00 |

TOTAL SETTLEMENT = 0.0 INCHES

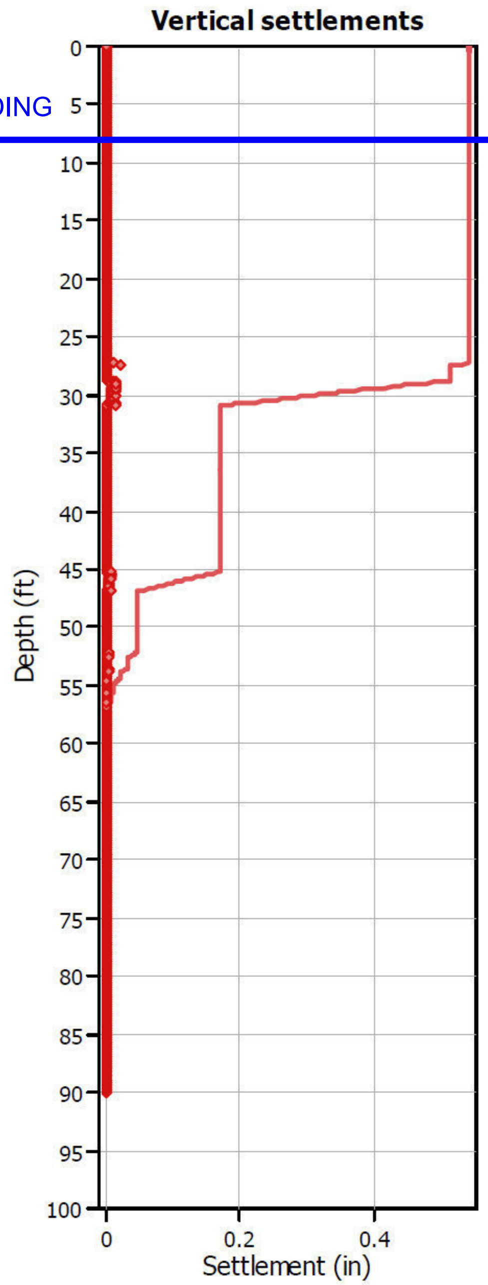
Figure 9



## CPT 1

Total Anticiapted Settlement = 0.77in

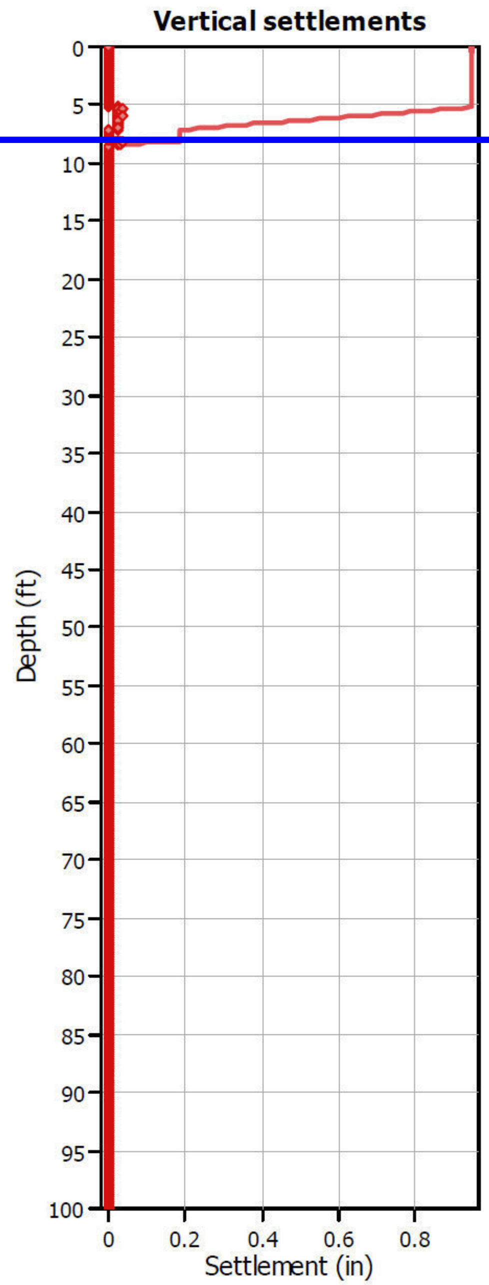
Anticiapted Settlement Subsequent
to Recommended Grading = 0.77 in



## CPT 2

Total Anticiapted Settlement = 0.54 in

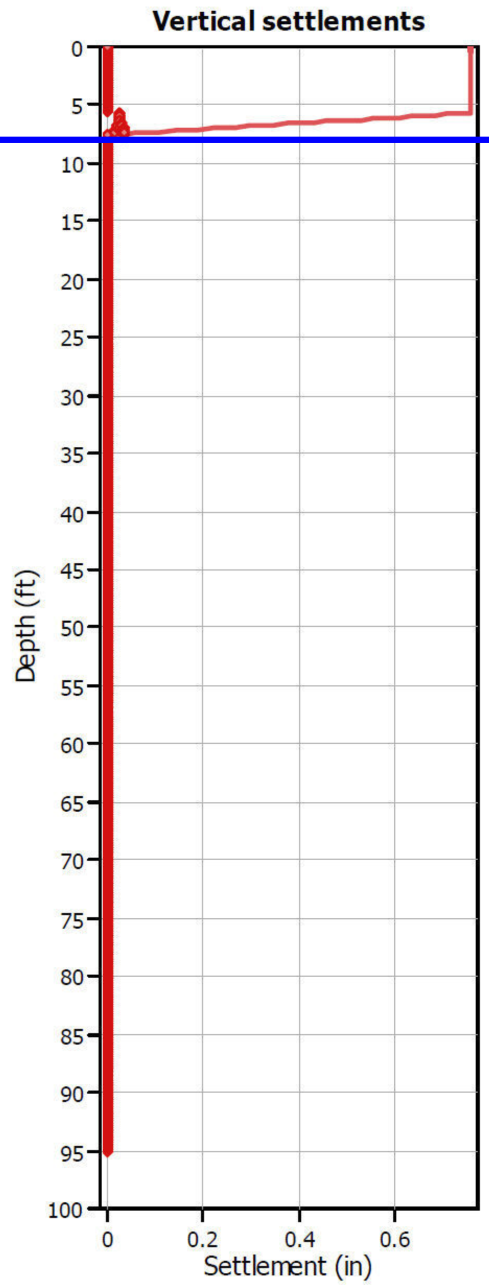
Anticiapted Settlement Subsequent
to Recommended Grading = 0.54 in



## CPT 3

Total Anticiapted Settlement = 0.95 in

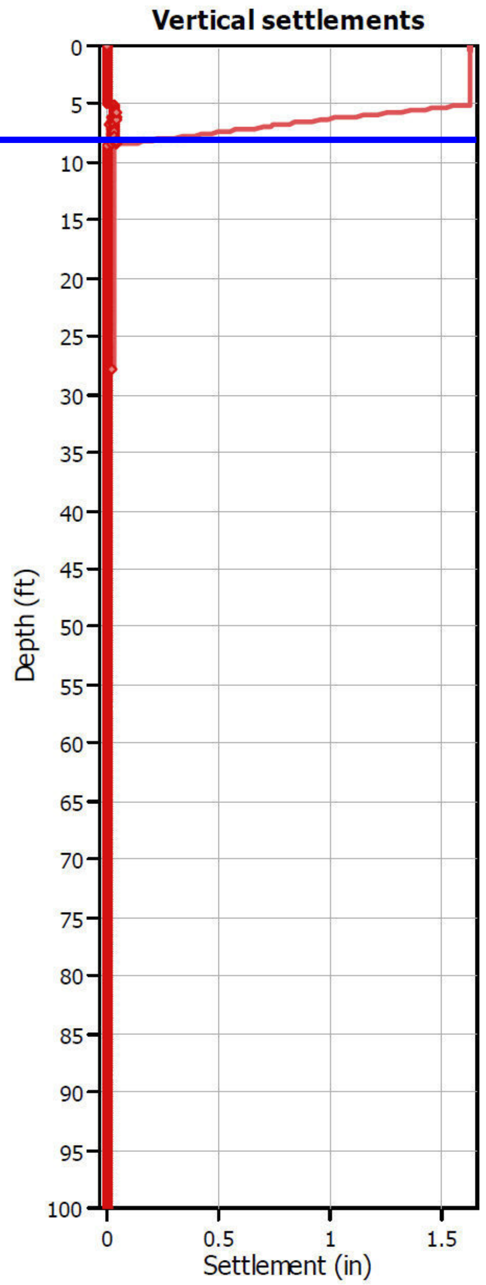
Anticiapted Settlement Subsequent
to Recommended Grading = 0 in



## CPT 4

Total Anticiapted Settlement = 0.76 in

Anticiapted Settlement Subsequent
to Recommended Grading = 0 in



## CPT 5

Total Anticiapted Settlement = 1.6 in

Anticiapted Settlement Subsequent
to Recommended Grading = 0 in

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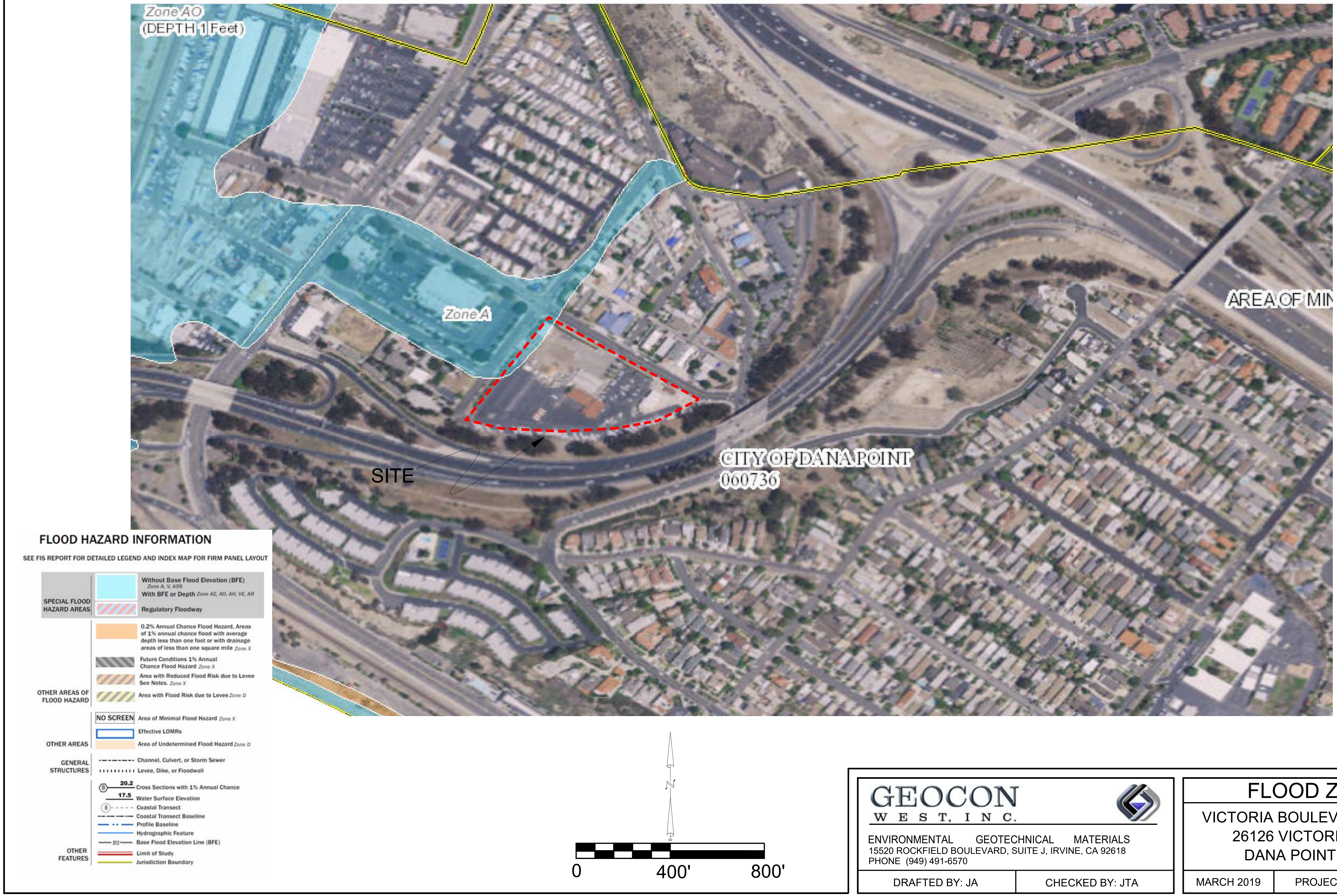
PHONE (949) 491-6570

DRAFTED BY: JTA
CHECKED BY: JTA

MCE ESTIMATION OF LIQUEFACTION SETTLEMENTS

VICTORIA BOULEVARD APARTMENTS
26126 VICTORIA BOULEVARD
DANA POINT, CALIFORNIA

MARCH 2019
PROJECT NO. A9942-88-01
FIG. 10



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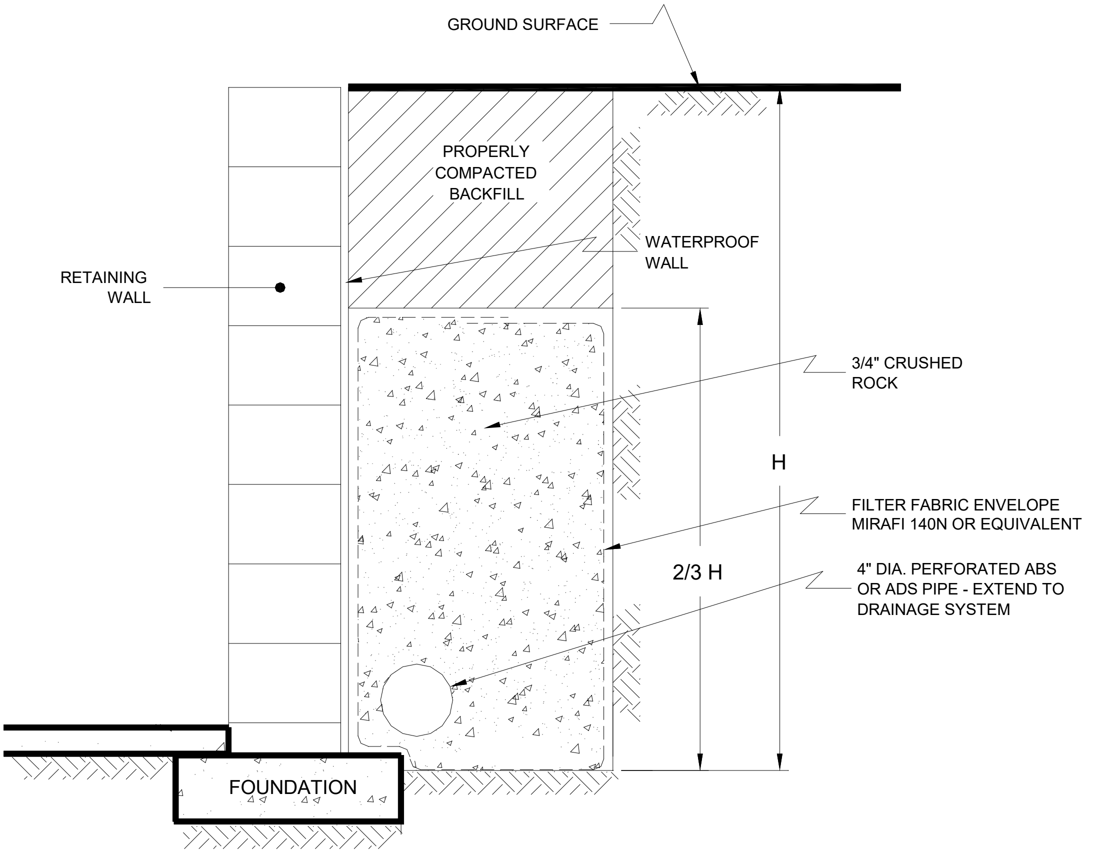
# FLOOD ZONE MAP

VICTORIA BOULEVARD APARTMENTS
26126 VICTORIA BOULEVARD
DANA POINT, CALIFORNIA

MARCH 2019 | PROJECT NO. A9942-88-01 | FIG. 11



NO SCALE

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ENVIRONMENTAL GEOTECHNICAL MATERIALS
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# RETAINING WALL DRAINAGE

VICTORIA BOULEVARD APARTMENTS
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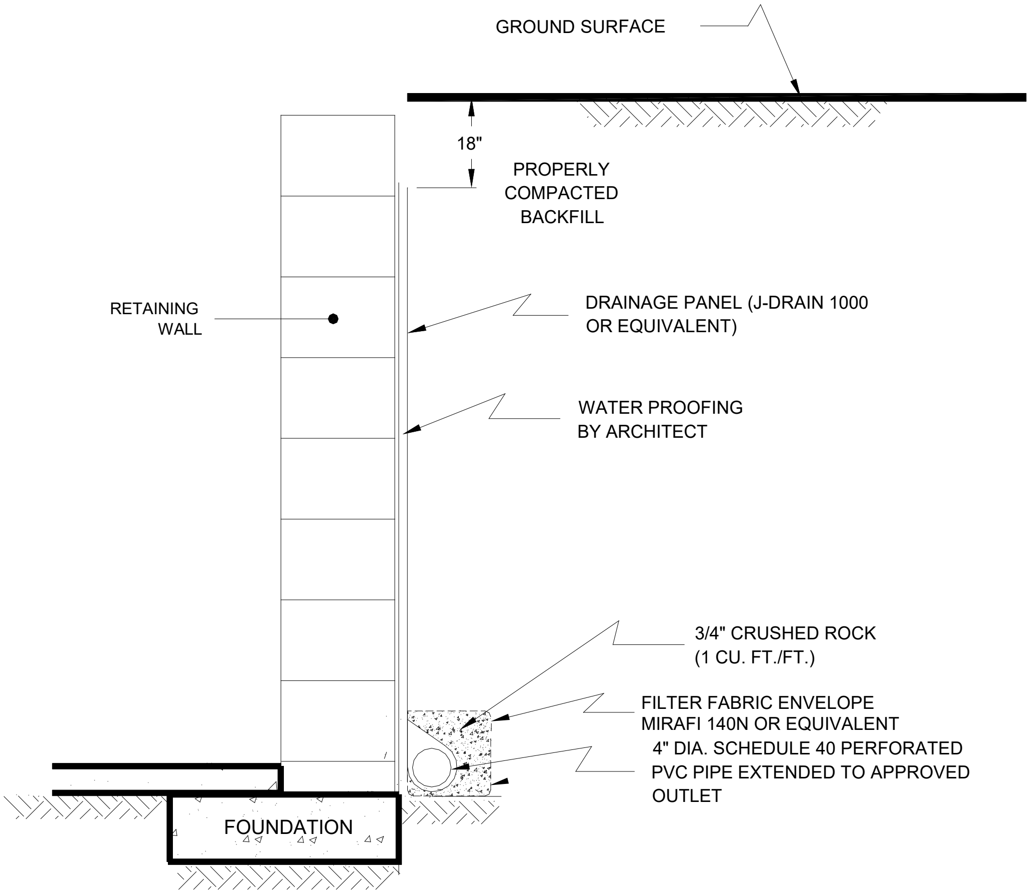
DANA POINT, CALIFORNIA

MARCH 2019 | PROJECT NO. A9942-88-01 | FIG. 12



NO SCALE

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W E S T, I N C.

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# RETAINING WALL DRAINAGE

VICTORIA BOULEVARD APARTMENTS
26126 VICTORIA BOULEVARD
DANA POINT, CALIFORNIA

MARCH 2019 | PROJECT NO. A9942-88-01 | FIG. 13

# APPENDIX A

# APPENDIX A

## FIELD INVESTIGATION

The site was explored on February 25, 2019, by excavating five 8-inch diameter borings to depths between 31½ and 51½ feet below the existing ground surface utilizing a truck-mounted hollow-stem auger drilling machine. Representative and relatively undisturbed samples were obtained by driving a 3-inch, O. D., California Modified Sampler into the "undisturbed" soil mass with blows from a 140-pound auto-hammer falling 30 inches. The California Modified Sampler was equipped with 1-inch high by 2³/₈-inch diameter brass sampler rings to facilitate soil removal and testing. Bulk samples were also obtained in the upper 5-feet on each of the borings. Standard Penetration Tests (SPTs) were also performed. On February 27, 2019, five CPTs were advanced to depths between 90 and 100 feet below the existing ground surface. The approximate locations of the exploratory borings and CPTs are depicted on the Site Plan (see Figure 2).

The soil conditions encountered in the borings were visually examined, classified and logged in general accordance with the Unified Soil Classification System (USCS). The logs of the hollow-stem auger borings are presented on Figures A1 through A5 and the logs of the CPTs are presented on Figures A6 through A10. The logs depict the soil and geologic conditions encountered and the depth at which samples were obtained. The logs also include our interpretation of the conditions between sampling intervals. Therefore, the logs contain both observed and interpreted data. We determined the lines designating the interface between soil materials on the logs using visual observations, penetration rates, excavation characteristics and other factors. The transition between materials may be abrupt or gradual. Where applicable, the boring logs were revised based on subsequent laboratory testing.

PROJECT NO. A9942-88-01

## BORING 1

ELEV. (MSL.) -- DATE COMPLETED 02/25/2019

EQUIPMENT HOLLOW STEM AUGER BY: SAF

| DEPTH IN FEET | SAMPLE NO. | LITHOLOGY | GROUNDWATER | SOIL CLASS (USCS) | MATERIAL DESCRIPTION | PENETRATION RESISTANCE (BLOWS/FT*) | DRY DENSITY (P.C.F.) | MOISTURE CONTENT (%) |
|---|---|---|---|---|---|---|---|---|
| 0 | BULK<br>0-5' | ⊠ | | | **ASPHALT: 3" BASE: 6"**<br>**ARTIFICIAL FILL**<br>Sandy Silty Clay, soft, moist, brown. | | | |
| 2 | | | | | | | | |
| 4 | | | | | | | | |
| | B1@5' | ■ | | | **ALLUVIUM**<br>Silty Clay, soft, moist, brown. | 5 | 70.6 | 15.7 |
| 6 | | | | | | | | |
| 8 | | | | | | | | |
| 10 | B1@10' | ■ | | | - slightly reddish brown, sand in sample, mica present | 7 | 101.5 | 20.7 |
| 12 | | | | | | | | |
| 14 | | | | | | | | |
| | B1@15' | ■ | | | - firm to stiff, dry to slightly moist, dark brown | 26 | 98.9 | 24.2 |
| 16 | | | | | | | | |
| 18 | | | | CL | | | | |
| 20 | B1@20' | ■ | ▼ | | - pocket of oxidized Sandy Clay to Clayey very fine Sand in light to dark brown Sandy Silty Clay | 14 | 99.3 | 24.1 |
| 22 | | | | | | | | |
| 24 | | | | | | | | |
| | B1@25' | ■ | | | | 6 | 96.2 | 28.5 |
| 26 | | | | | | | | |
| 28 | | | | | | | | |

**Figure A1,**
**Log of Boring 1, Page 1 of 2**

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL
◧ ... STANDARD PENETRATION TEST
■ ... DRIVE SAMPLE (UNDISTURBED)
⊠ ... DISTURBED OR BAG SAMPLE
◪ ... CHUNK SAMPLE
▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. A9942-88-01

## BORING 1

ELEV. (MSL.) **--** DATE COMPLETED **02/25/2019**

EQUIPMENT **HOLLOW STEM AUGER** BY: **SAF**

| DEPTH IN FEET | SAMPLE NO. | LITHOLOGY | GROUNDWATER | SOIL CLASS (USCS) | MATERIAL DESCRIPTION | PENETRATION RESISTANCE (BLOWS/FT*) | DRY DENSITY (P.C.F.) | MOISTURE CONTENT (%) |
|---|---|---|---|---|---|---|---|---|
| 30 | B1@30' ■ | | | | Clayey Silty Sand, saturated, loose, light to dark brown, fine-grained. | 8 | 113.4 | 17.5 |
| 32 | | | | | | | | |
| 34 | | | | | | | | |
| | B1@35' ■ | | | SM | - medium dense, moist, light brown to gray with orange/gray mottled sand, fine- to medium-grained, mica present | 26 | | 15.9 |
| 36 | | | | | | | | |
| 38 | | | | | | | | |
| 40 | B1@40' ■ | | | | - tip of sample (~2") was Silty Clay, firm, moist, highly weathered Capistrano Formation | 11 | | 26.5 |

Total depth of boring: 41.5 feet.
Fill to 5 feet.
Grounwater encountered at 20 feet.
No caving.
Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.

**Figure A1,**
**Log of Boring 1, Page 2 of 2**

SAMPLE SYMBOLS
☐ ... SAMPLING UNSUCCESSFUL
◧ ... STANDARD PENETRATION TEST
■ ... DRIVE SAMPLE (UNDISTURBED)
☒ ... DISTURBED OR BAG SAMPLE
◪ ... CHUNK SAMPLE
▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. A9942-88-01

## BORING 2

ELEV. (MSL.) -- DATE COMPLETED 02/25/2019

EQUIPMENT HOLLOW STEM AUGER BY: JF

| DEPTH IN FEET | SAMPLE NO. | LITHOLOGY | GROUNDWATER | SOIL CLASS (USCS) | MATERIAL DESCRIPTION | PENETRATION RESISTANCE (BLOWS/FT*) | DRY DENSITY (P.C.F.) | MOISTURE CONTENT (%) |
|---|---|---|---|---|---|---|---|---|
| 0 | BULK 0-5' | | | | **ASPHALT: 4" BASE: 4"**<br>**ARTIFICIAL FILL**<br>Silty Clay, soft to firm, moist, gray brown. | | | |
| 2 | | | | | | | | |
| 4 | | | | | **ALLUVIUM**<br>Sandy Clay and Silty Clay, soft to firm, moist, brown. | | | |
| 6 | B2@5' | | | CL | | 20 | 103.9 | 23.2 |
| 8 | | | | | | | | |
| 10 | B2@10' | | | | Silty Sand and Sandy Clayey Silt, loose to medium-dense and soft to firm, moist, light brown, fine-grained, some clay partings, scattered cobble. | 13 | 106.6 | 13.5 |
| 12 | | | | | | | | |
| 14 | | | | | | | | |
| 16 | B2@15' | | | | - sample distrubed, only 3 rings recovered | 49 | 114.8 | 20.2 |
| 18 | | | ▼ | SM/ML | | | | |
| 20 | B2@20' | | | | - no recovery, driller reports difficult drilling, cobbles/gravel | 31 | | |
| 22 | | | | | | | | |
| 24 | | | | | | | | |
| 26 | B2@25' | | | | **CAPISTRANO FORMATION (Tcs)**<br>Silty Sandstone and Sandy Siltstone, moderately weathered, gray. | 24 | | 38.7 |
| 28 | | | | | | | | |

A9942-88-01 BORING LOGS.GPJ

**Figure A2,**
**Log of Boring 2, Page 1 of 2**

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL
◧ ... STANDARD PENETRATION TEST
■ ... DRIVE SAMPLE (UNDISTURBED)
☒ ... DISTURBED OR BAG SAMPLE
◪ ... CHUNK SAMPLE
▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. A9942-88-01

| DEPTH IN FEET | SAMPLE NO. | LITHOLOGY | GROUNDWATER | SOIL CLASS (USCS) | **BORING 2**<br>ELEV. (MSL.) **--** DATE COMPLETED **02/25/2019**<br>EQUIPMENT **HOLLOW STEM AUGER** BY: **JF** | PENETRATION RESISTANCE (BLOWS/FT*) | DRY DENSITY (P.C.F.) | MOISTURE CONTENT (%) |
|---|---|---|---|---|---|---|---|---|
| | | | | | MATERIAL DESCRIPTION | | | |
| 30 | B2@30' ■ | | | | - dark gray | 67 | 97.7 | 36.9 |
| | | | | | Total depth of boring: 31.5 feet.<br>Fill to 4 feet.<br>Groundwater encountered at 17 feet.<br>No caving.<br>Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer. | | | |

**Figure A2,**
**Log of Boring 2, Page 2 of 2**

| SAMPLE SYMBOLS | | | |
|---|---|---|---|
| | ☐ ... SAMPLING UNSUCCESSFUL | ◧ ... STANDARD PENETRATION TEST | ■ ... DRIVE SAMPLE (UNDISTURBED) |
| | ☒ ... DISTURBED OR BAG SAMPLE | ◪ ... CHUNK SAMPLE | ▼ ... WATER TABLE OR SEEPAGE |

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. A9942-88-01

## BORING 3

ELEV. (MSL.) -- DATE COMPLETED **02/25/2019**

EQUIPMENT **HOLLOW STEM AUGER** BY: **JF**

| DEPTH IN FEET | SAMPLE NO. | LITHOLOGY | GROUNDWATER | SOIL CLASS (USCS) | MATERIAL DESCRIPTION | PENETRATION RESISTANCE (BLOWS/FT*) | DRY DENSITY (P.C.F.) | MOISTURE CONTENT (%) |
|---|---|---|---|---|---|---|---|---|
| 0 | BULK 0-5' | ☒ | | | **CONCRETE: 4" BASE: 4"**<br>**ARTIFICIAL FILL**<br>Sandy Clayey Silt and Sandy Silt, soft, moist, reddish brown. | | | |
| 4 | | | | | **ALLUVIUM**<br>Sandy Clayey Silt, soft, moist, brown, scattered micas. | | | |
| 5 | B3@5' | ■ | | | | 13 | 111.1 | 25.9 |
| 10 | B3@10' | ■ | | | | 9 | 107.6 | 23.6 |
| 15 | B3@15' | ■ | | | | 4 | 102.4 | 31.4 |
| 17 | | | | ML | | | | |
| 19 | | | ▼ | | | | | |
| 20 | B3@20' | ■ | | | - becomes sandier, sand stringers present | 11 | 106.4 | 32.2 |
| 25 | B3@25' | ■ | | | | 8 | 113.9 | 27.8 |

**Figure A3,**
**Log of Boring 3, Page 1 of 2**

A9942-88-01 BORING LOGS.GPJ

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL
◧ ... STANDARD PENETRATION TEST
■ ... DRIVE SAMPLE (UNDISTURBED)
☒ ... DISTURBED OR BAG SAMPLE
◪ ... CHUNK SAMPLE
▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

| DEPTH IN FEET | SAMPLE NO. | LITHOLOGY | GROUNDWATER | SOIL CLASS (USCS) | **BORING 3**<br>ELEV. (MSL.) **--** DATE COMPLETED **02/25/2019**<br>EQUIPMENT **HOLLOW STEM AUGER** BY: **JF** | PENETRATION RESISTANCE (BLOWS/FT*) | DRY DENSITY (P.C.F.) | MOISTURE CONTENT (%) |
|---|---|---|---|---|---|---|---|---|
| | | | | | MATERIAL DESCRIPTION | | | |
| 30 | B3@30' ■ | ▨ | | ML | | 10 | 106.0 | 29.5 |

Total depth of boring: 31.5 feet.
Fill to 4 feet.
Groundwater encountered at 19 feet.
No caving.
Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.

## Figure A3,
## Log of Boring 3, Page 2 of 2

A9942-88-01 BORING LOGS.GPJ

| SAMPLE SYMBOLS | | | |
|---|---|---|---|
| | ☐ ... SAMPLING UNSUCCESSFUL | ◧ ... STANDARD PENETRATION TEST | ■ ... DRIVE SAMPLE (UNDISTURBED) |
| | ☒ ... DISTURBED OR BAG SAMPLE | ◪ ... CHUNK SAMPLE | ▼ ... WATER TABLE OR SEEPAGE |

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. A9942-88-01

## BORING 4

ELEV. (MSL.) **--** DATE COMPLETED **02/25/2019**

EQUIPMENT **HOLLOW STEM AUGER** BY: **JF**

| DEPTH IN FEET | SAMPLE NO. | LITHOLOGY | GROUNDWATER | SOIL CLASS (USCS) | MATERIAL DESCRIPTION | PENETRATION RESISTANCE (BLOWS/FT*) | DRY DENSITY (P.C.F.) | MOISTURE CONTENT (%) |
|---|---|---|---|---|---|---|---|---|
| 0 | BULK 0-5' | | | | **CONCRETE: 4" BASE: 4"**<br>**ARTIFICIAL FILL**<br>Clayey and Silty Sand and Sandy Clayey Silt, loose and soft, moist, reddish brown. | | | |
| 2 | B4@2.5' | | | | | 9 | | 24.0 |
| 4 | | | | | | | | |
| | B4@5' | | | | **ALLUVIUM**<br>Sandy Clayey Silt and Silty Clay, soft, moist to wet, olive brown, scattered mica. | 10 | 113.6 | 22.1 |
| 6 | | | | | | | | |
| 8 | B4@7.5'<br>BULK 8-12' | | | | | 6 | | 21.9 |
| 10 | B4@10' | | | | | 9 | 105.7 | 21.8 |
| 12 | | | | ML/CL | | | | |
| | B4@12.5' | | | | - sand lenses present | 4 | | 25.2 |
| 14 | | | | | | | | |
| | B4@15' | | | | | 10 | 111.9 | 26.1 |
| 16 | | | ▼ | | | | | |
| 18 | B4@17.5' | | | | Silty Clay and Clayey Silt, very soft, moist to saturated, sand stringers. | 2 | | 31.0 |
| 20 | B4@20' | | | | | 5 | 105.8 | 32.5 |
| 22 | B4@22.5' | | | | | 3 | | 29.7 |
| 24 | | | | ML/CH | | | | |
| | B4@25' | | | | | 9 | 105.7 | 28.7 |
| 26 | | | | | | | | |
| 28 | B4@27.5' | | | | | 2 | | 28.0 |

A9942-88-01 BORING LOGS.GPJ

**Figure A4,**
**Log of Boring 4, Page 1 of 2**

| SAMPLE SYMBOLS | | | |
|---|---|---|---|
| | ☐ ... SAMPLING UNSUCCESSFUL | ◧ ... STANDARD PENETRATION TEST | ■ ... DRIVE SAMPLE (UNDISTURBED) |
| | ⊠ ... DISTURBED OR BAG SAMPLE | ◩ ... CHUNK SAMPLE | ▼ ... WATER TABLE OR SEEPAGE |

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. A9942-88-01

## BORING 4

ELEV. (MSL.) -- DATE COMPLETED 02/25/2019

EQUIPMENT **HOLLOW STEM AUGER** BY: **JF**

| DEPTH IN FEET | SAMPLE NO. | LITHOLOGY | GROUNDWATER | SOIL CLASS (USCS) | MATERIAL DESCRIPTION | PENETRATION RESISTANCE (BLOWS/FT*) | DRY DENSITY (P.C.F.) | MOISTURE CONTENT (%) |
|---|---|---|---|---|---|---|---|---|
| 30 | B4@30' | | | | Silty Clay and Clayey Silt, very soft, moist to saturated. | 9 | 107.8 | 29.0 |
| 32 | | | | | | | | |
| | B4@32.5' | | | ML/CL | | 3 | | 28.7 |
| 34 | | | | | | | | |
| | B4@35' | | | | Sandy Clayey Silt, very soft to soft, moist, gray. | 6 | 103.8 | 32.0 |
| 36 | | | | | | | | |
| 38 | B4@37.5' | | | | | 4 | | 28.9 |
| 40 | B4@40' | | | ML | | 10 | 96.0 | 36.0 |
| 42 | | | | | - increase in sand content, still a Sandy Clayey Silt and Silty Sandy Clay | | | |
| | B4@42.5' | | | | | 6 | | 33.3 |
| 44 | | | | | | | | |
| | B4@45' | | | | Sandy Silty Clay, firm, moist, dark gray to gray. | 19 | 108.1 | 26.9 |
| 46 | | | | | | | | |
| 48 | B4@47.5' | | | CL | | 18 | | 27.5 |
| 50 | B4@50' | | | | | 18 | 107.1 | 29.4 |

Total depth of boring: 51.5 feet.
Fill to 5 feet.
Groundwater encountered at 17 feet.
No caving.
Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.

A9942-88-01 BORING LOGS.GPJ

**Figure A4,**
**Log of Boring 4, Page 2 of 2**

| SAMPLE SYMBOLS | ☐ ... SAMPLING UNSUCCESSFUL | ◧ ... STANDARD PENETRATION TEST | ■ ... DRIVE SAMPLE (UNDISTURBED) |
|---|---|---|---|
| | ☒ ... DISTURBED OR BAG SAMPLE | ◪ ... CHUNK SAMPLE | ▼ ... WATER TABLE OR SEEPAGE |

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. A9942-88-01

## BORING 5

ELEV. (MSL.) **--** DATE COMPLETED **02/25/2019**

EQUIPMENT **HOLLOW STEM AUGER** BY: **SAF**

| DEPTH IN FEET | SAMPLE NO. | LITHOLOGY | GROUNDWATER | SOIL CLASS (USCS) | MATERIAL DESCRIPTION | PENETRATION RESISTANCE (BLOWS/FT*) | DRY DENSITY (P.C.F.) | MOISTURE CONTENT (%) |
|---|---|---|---|---|---|---|---|---|
| 0 | BULK 0-5' ☒ | | | | **ASPHALT: 7" NO BASE**<br>**ARTIFICIAL FILL**<br>Silty Sand, loose to very loose, slightly moist, light to dark brown, fine-grained. | | | |
| 4 | | | | | **ALLUVIUM**<br>Silty Clay, soft, moist, gray to brownish gray. | | | |
| 5 | B5@5' ■ | | | | | 10 | | 7.6 |
| 10 | | | | | - scattered small pebbles | | | |
| 12 | | | | CL | | | | |
| 15 | B5@15' ■ | | ▼ | | | 7 | | 17.2 |
| 20 | B5@20' ■ | | | | Sandy Clayey Silt, soft, slightly moist. | 8 | | 20.5 |
| 22 | | | | ML | | | | |
| 25 | B5@25' ■ | | | | Clayey Sand, medium dense, moist to wet, fine- to medium-grained. | 27 | | 20.0 |
| 27 | | | | SC | | | | |

# Figure A5,
# Log of Boring 5, Page 1 of 2

A9942-88-01 BORING LOGS.GPJ

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL

◧ ... STANDARD PENETRATION TEST

■ ... DRIVE SAMPLE (UNDISTURBED)

☒ ... DISTURBED OR BAG SAMPLE

◪ ... CHUNK SAMPLE

▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. A9942-88-01

## BORING 5

ELEV. (MSL.) -- DATE COMPLETED 02/25/2019

EQUIPMENT **HOLLOW STEM AUGER** BY: **SAF**

| DEPTH IN FEET | SAMPLE NO. | LITHOLOGY | GROUNDWATER | SOIL CLASS (USCS) | MATERIAL DESCRIPTION | PENETRATION RESISTANCE (BLOWS/FT*) | DRY DENSITY (P.C.F.) | MOISTURE CONTENT (%) |
|---|---|---|---|---|---|---|---|---|
| 30<br>32<br>34 | B5@30' ■ | | | CL | Silty Clay, very soft to soft, moist to wet, brown with occasional pockets of fine- to medium-grained sand. | 9 | | 21.5 |
| 36<br>38 | B5@35' ■ | | | ML | **CAPISTRANO FORMATION (Tcs)**<br>Clayey and Sandy Siltstone, moderately weathered, gray. | 15 | 92.5 | 40.8 |
| 40 | | | | | Total depth of boring: 40 feet.<br>Fill to 4 feet.<br>Groundwater encountered at 16 feet.<br>No caving.<br>Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer. | | | |

**Figure A5,**
**Log of Boring 5, Page 2 of 2**

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL
◧ ... STANDARD PENETRATION TEST
■ ... DRIVE SAMPLE (UNDISTURBED)
☒ ... DISTURBED OR BAG SAMPLE
◪ ... CHUNK SAMPLE
▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

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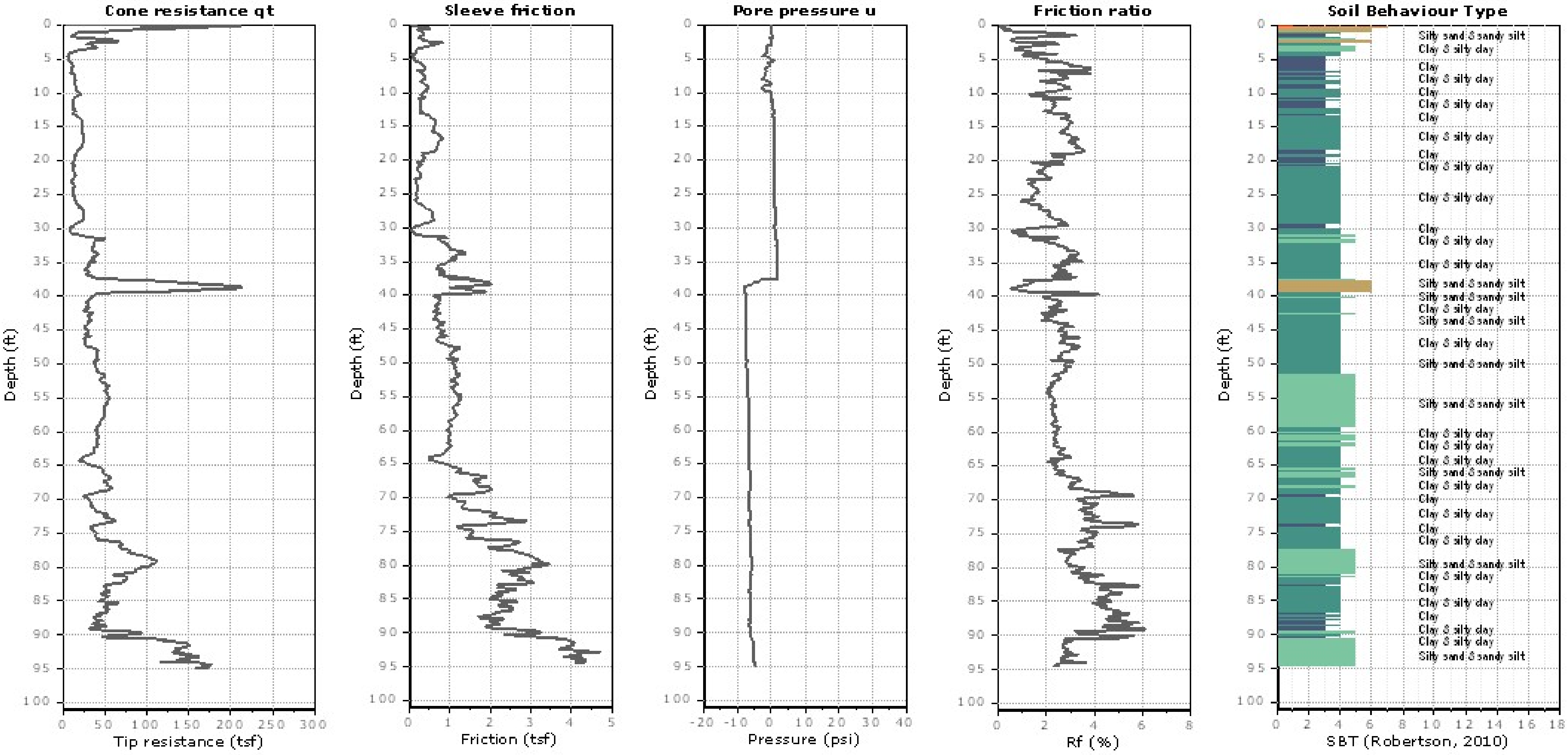
steve@kehoetesting.com
www.kehoetesting.com

**CPT-1**

**Project:** **Geocon West**
**Location:** **26126 Victoria Blvd, Dana Point, CA**

Total depth: 95.08 ft, Date: 2/26/2019
Cone Type: Vertek



Geocon Project No. A9442-88-01

**Kehoe Testing and Engineering**
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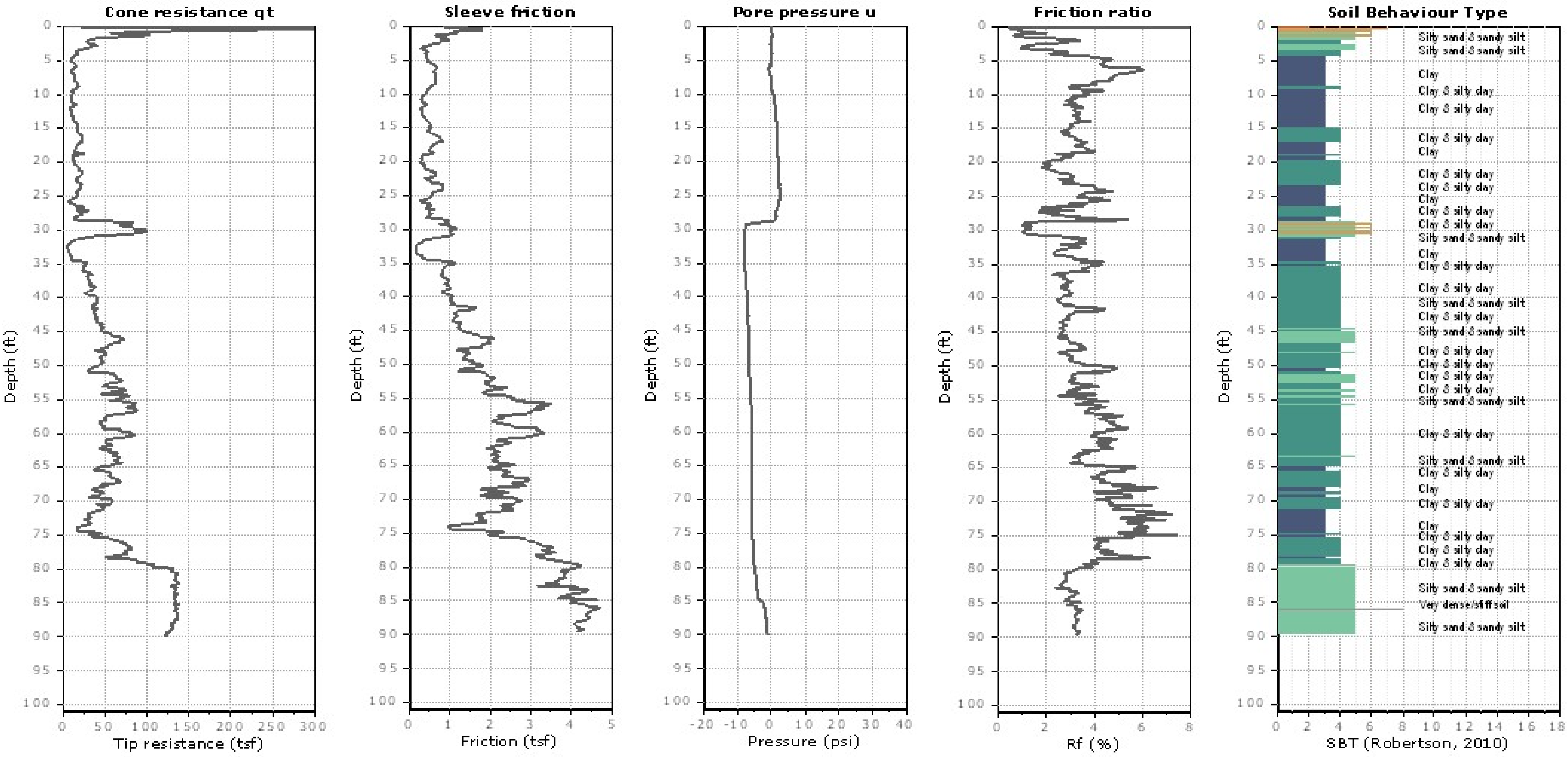
steve@kehoetesting.com
www.kehoetesting.com

**CPT-2**

**Project:** **Geocon West**
**Location:** **26126 Victoria Blvd, Dana Point, CA**

Total depth: 90.03 ft, Date: 2/26/2019
Cone Type: Vertek



Geocon Project No. A9442-88-01

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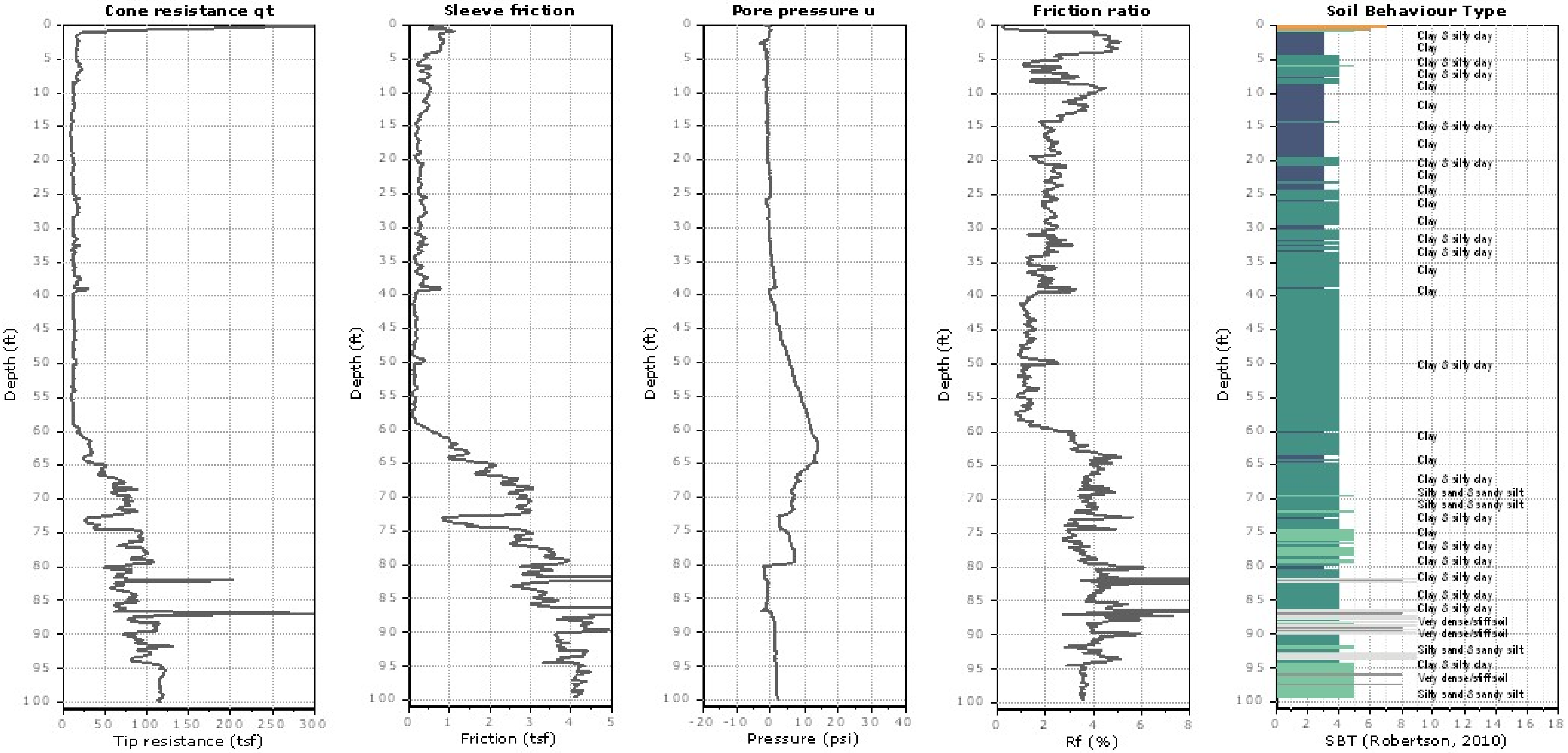
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

**CPT-3**

**Project:** **Geocon West**
**Location:** **26126 Victoria Blvd, Dana Point, CA**

Total depth: 100.07 ft, Date: 2/26/2019
Cone Type: Vertek



Geocon Project No. A9442-88-01

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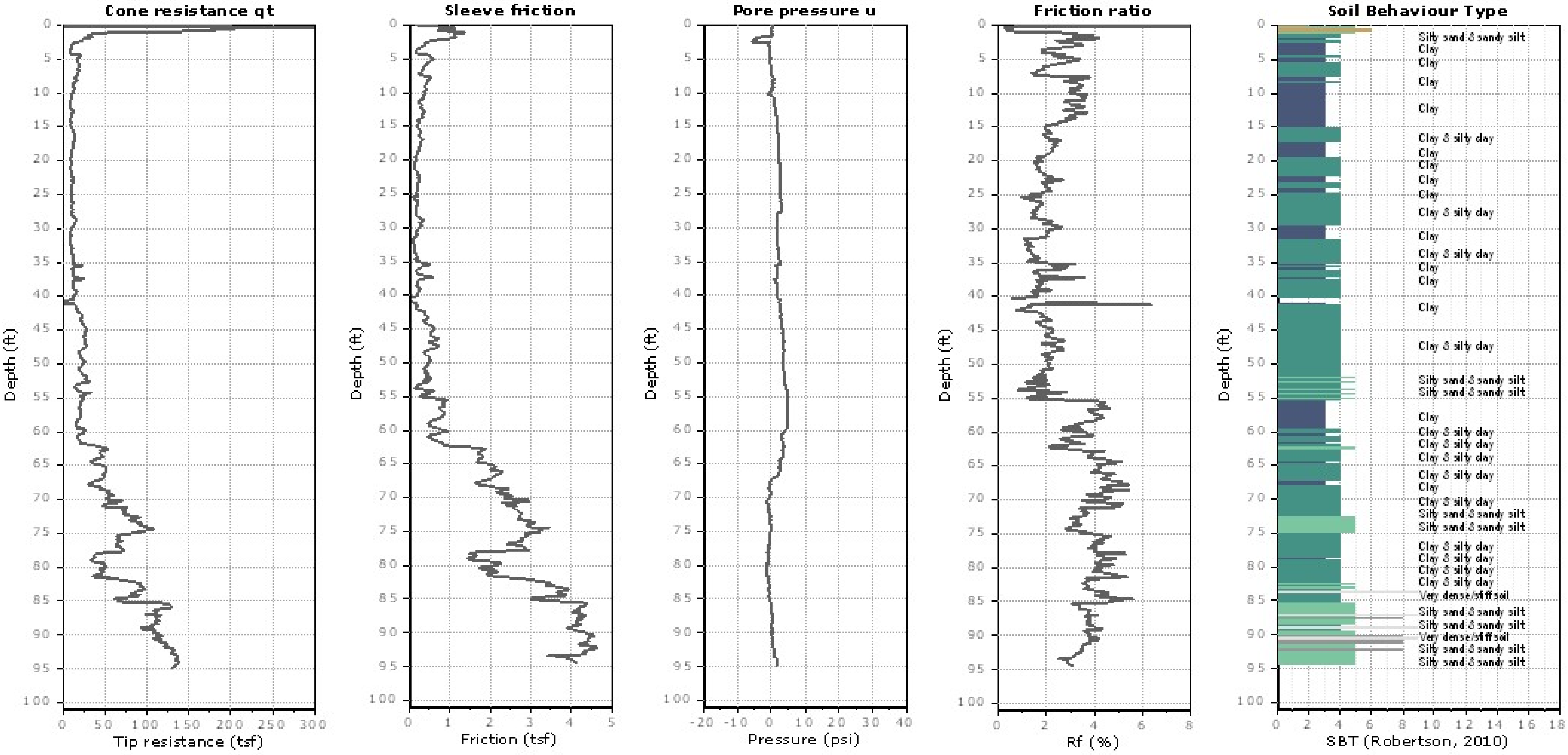
steve@kehoetesting.com
www.kehoetesting.com

**CPT-4**

**Project:** **Geocon West**
**Location:** **26126 Victoria Blvd, Dana Point, CA**

Total depth: 95.03 ft, Date: 2/26/2019
Cone Type: Vertek



Geocon Project No. A9442-88-01

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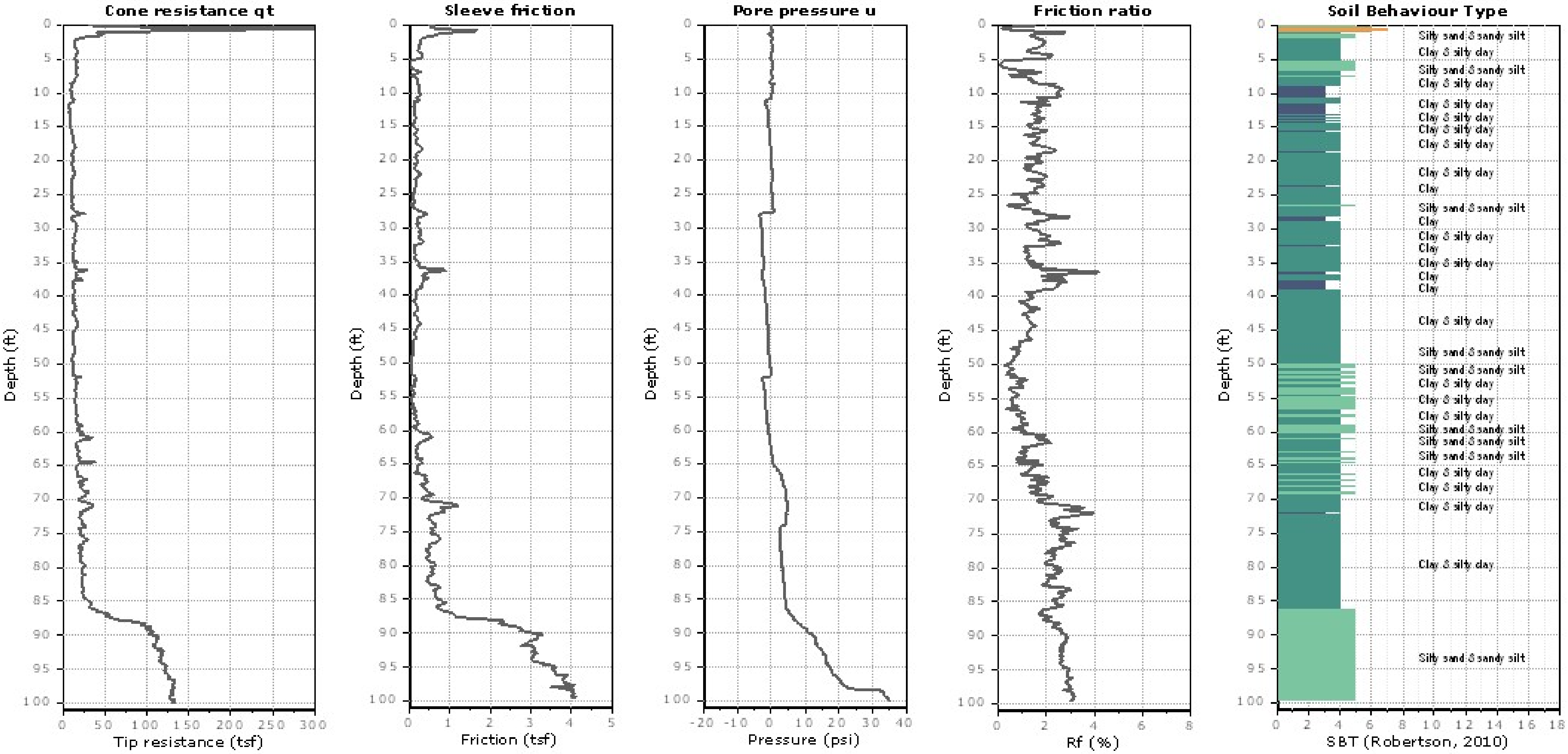
www.kehoetesting.com

**CPT-5**

**Project:** **Geocon West**
**Location:** **26126 Victoria Blvd, Dana Point, CA**

Total depth: 100.07 ft, Date: 2/26/2019
Cone Type: Vertek



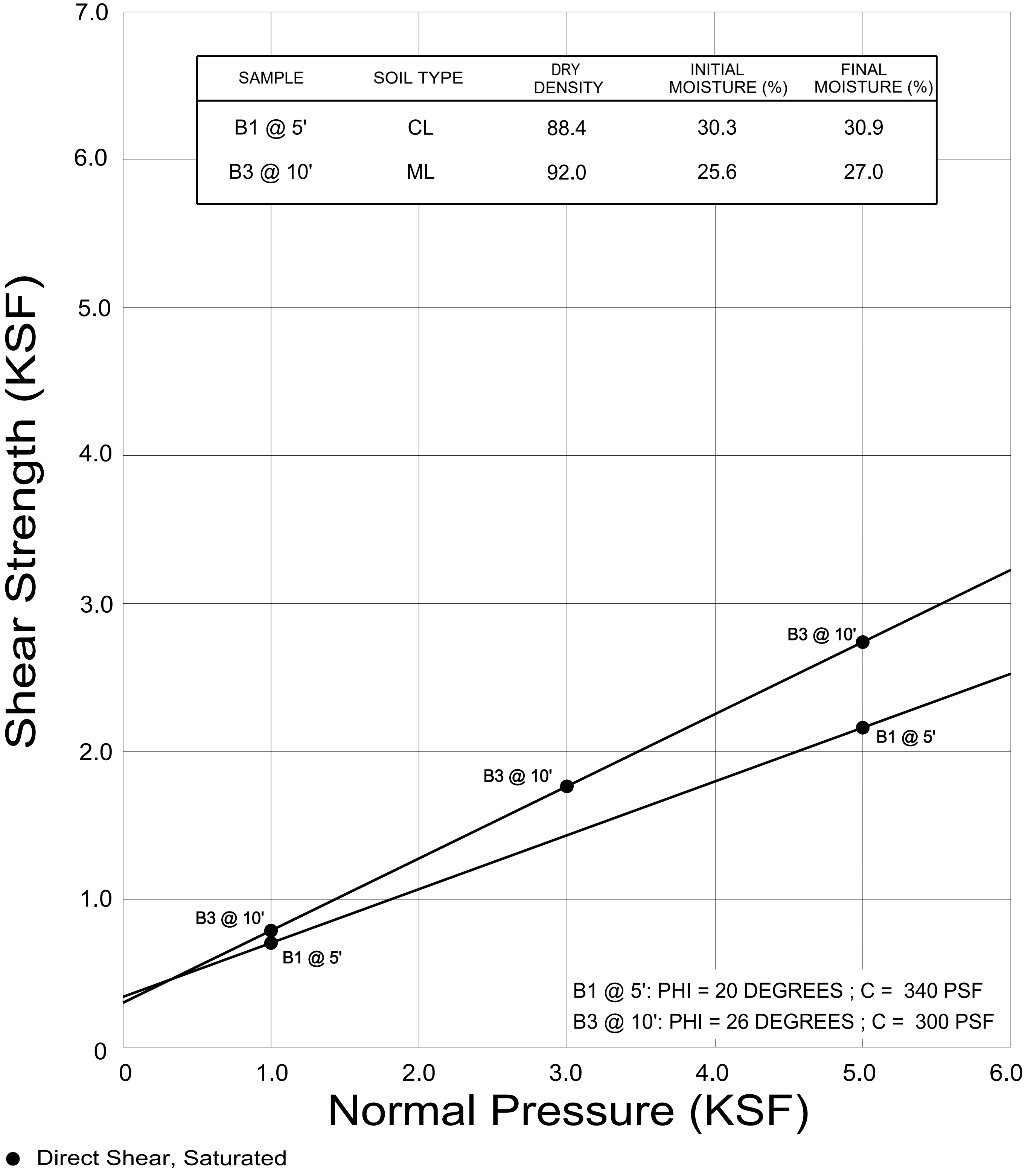
Geocon Project No. A9442-88-01

# APPENDIX B

# APPENDIX B

# LABORATORY TESTING

Laboratory tests were performed in accordance with generally accepted test methods of the "American Society for Testing and Materials (ASTM)", or other suggested procedures. Selected samples were tested for direct shear strength, consolidation, expansion characteristics, Atterberg limits, corrosivity, and in-place dry density and moisture content. The results of the laboratory tests are summarized in Figures B1 through B10. The in-place dry density and moisture content of the samples tested are presented on the boring logs, Appendix A.



| SAMPLE | SOIL TYPE | DRY DENSITY | INITIAL MOISTURE (%) | FINAL MOISTURE (%) |
|---|---|---|---|---|
| B1 @ 5' | CL | 88.4 | 30.3 | 30.9 |
| B3 @ 10' | ML | 92.0 | 25.6 | 27.0 |

B1 @ 5': PHI = 20 DEGREES ; C = 340 PSF
B3 @ 10': PHI = 26 DEGREES ; C = 300 PSF

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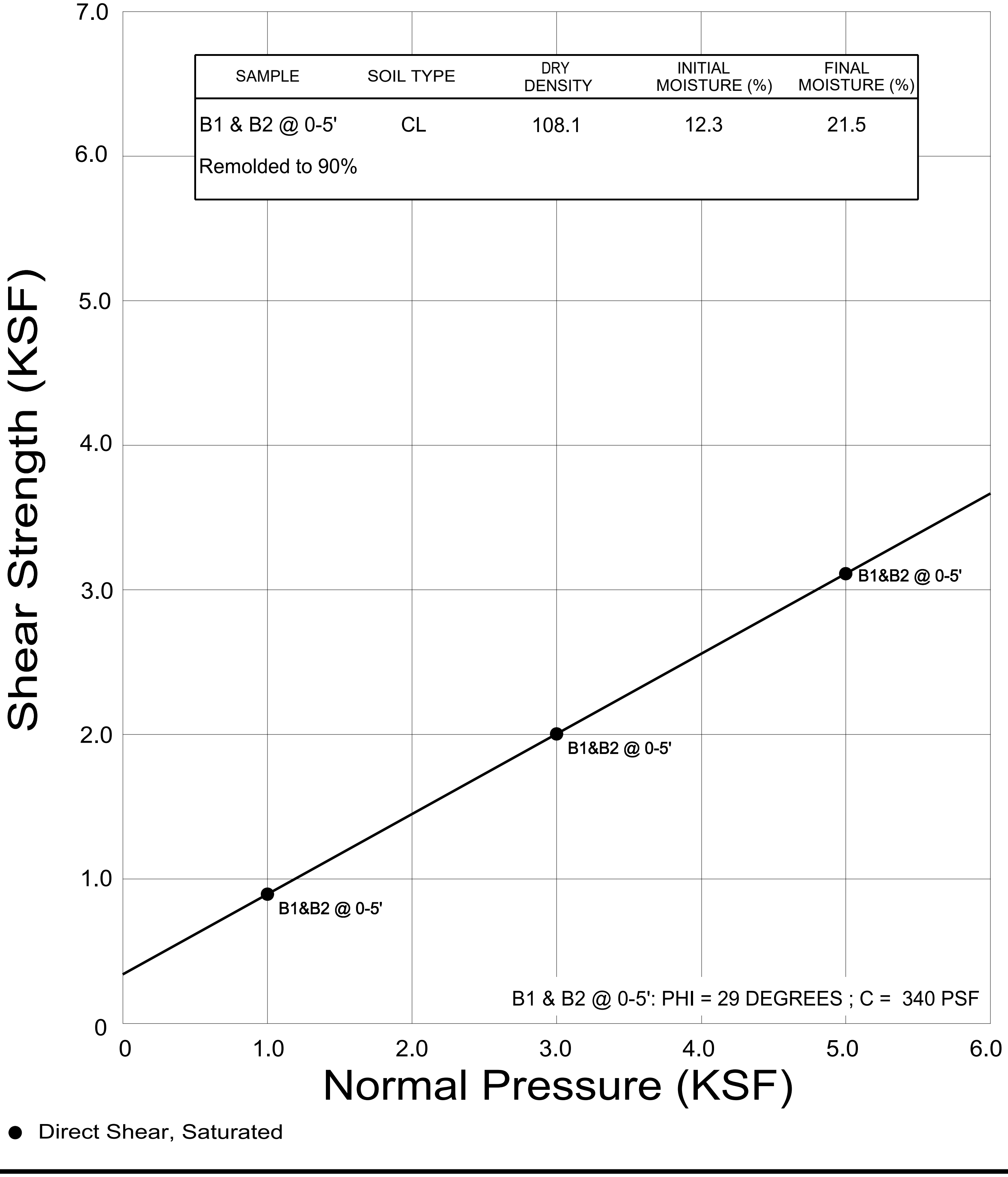
DRAFTED BY: JTA | CHECKED BY: NDB

## DIRECT SHEAR TEST RESULTS

VICTORIA BOULEVARD APARTMENTS
26126 VICTORIA BOULEVARD
DANA POINT, CALIFORNIA

MARCH 2019 | PROJECT NO. A9942-88-01 | FIG. B1



| SAMPLE | SOIL TYPE | DRY DENSITY | INITIAL MOISTURE (%) | FINAL MOISTURE (%) |
|---|---|---|---|---|
| B1 & B2 @ 0-5'<br>Remolded to 90% | CL | 108.1 | 12.3 | 21.5 |

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## DIRECT SHEAR TEST RESULTS

VICTORIA BOULEVARD APARTMENTS
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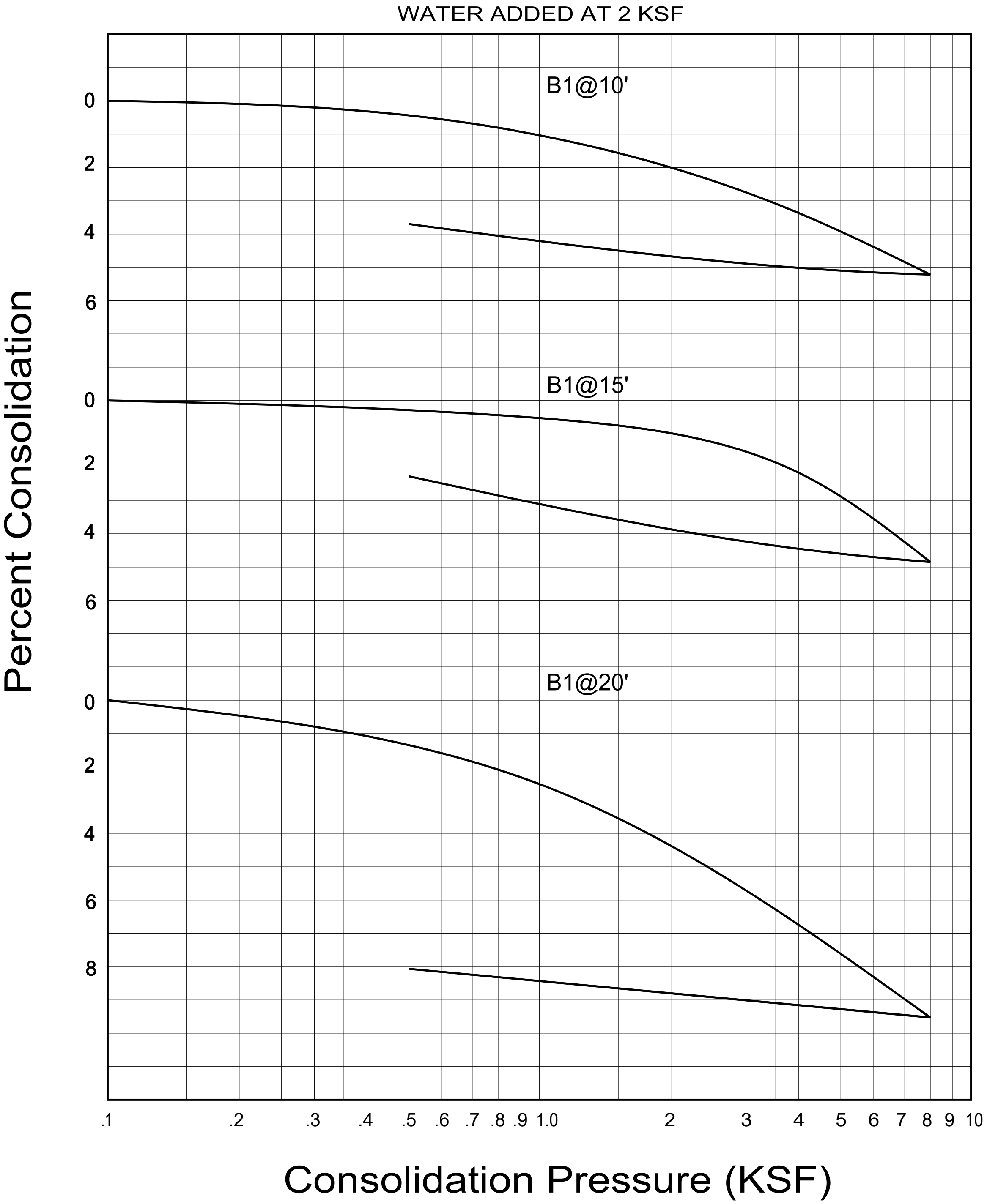
| DRAFTED BY: JTA | CHECKED BY: NDB | MARCH 2019 | PROJECT NO. A9942-88-01 | FIG. B2 |
|---|---|---|---|---|



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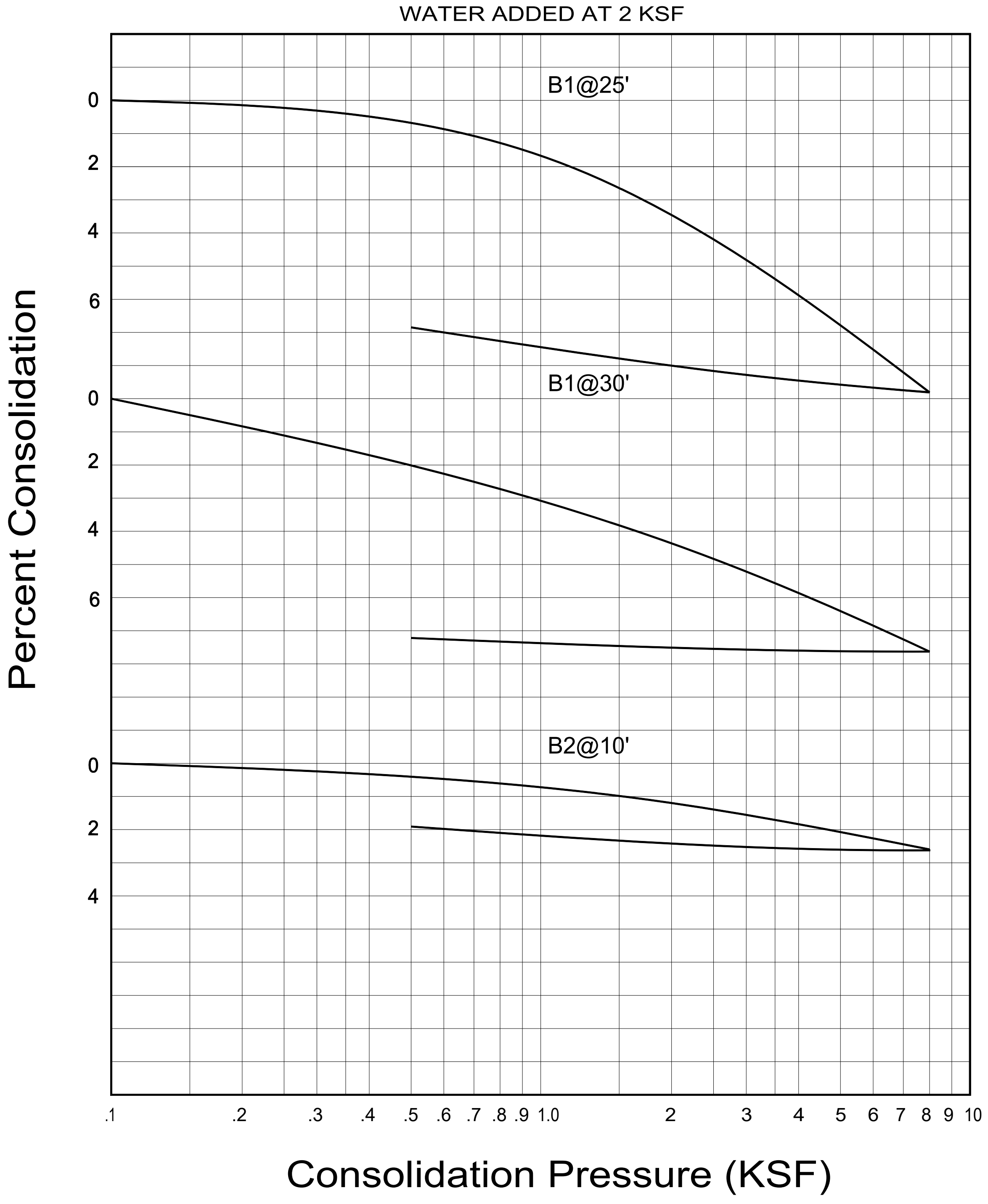
# CONSOLIDATION TEST RESULTS

VICTORIA BOULEVARD APARTMENTS
26126 VICTORIA BOULEVARD
DANA POINT, CALIFORNIA

MARCH 2019 | PROJECT NO. A9942-88-01 | FIG. B3



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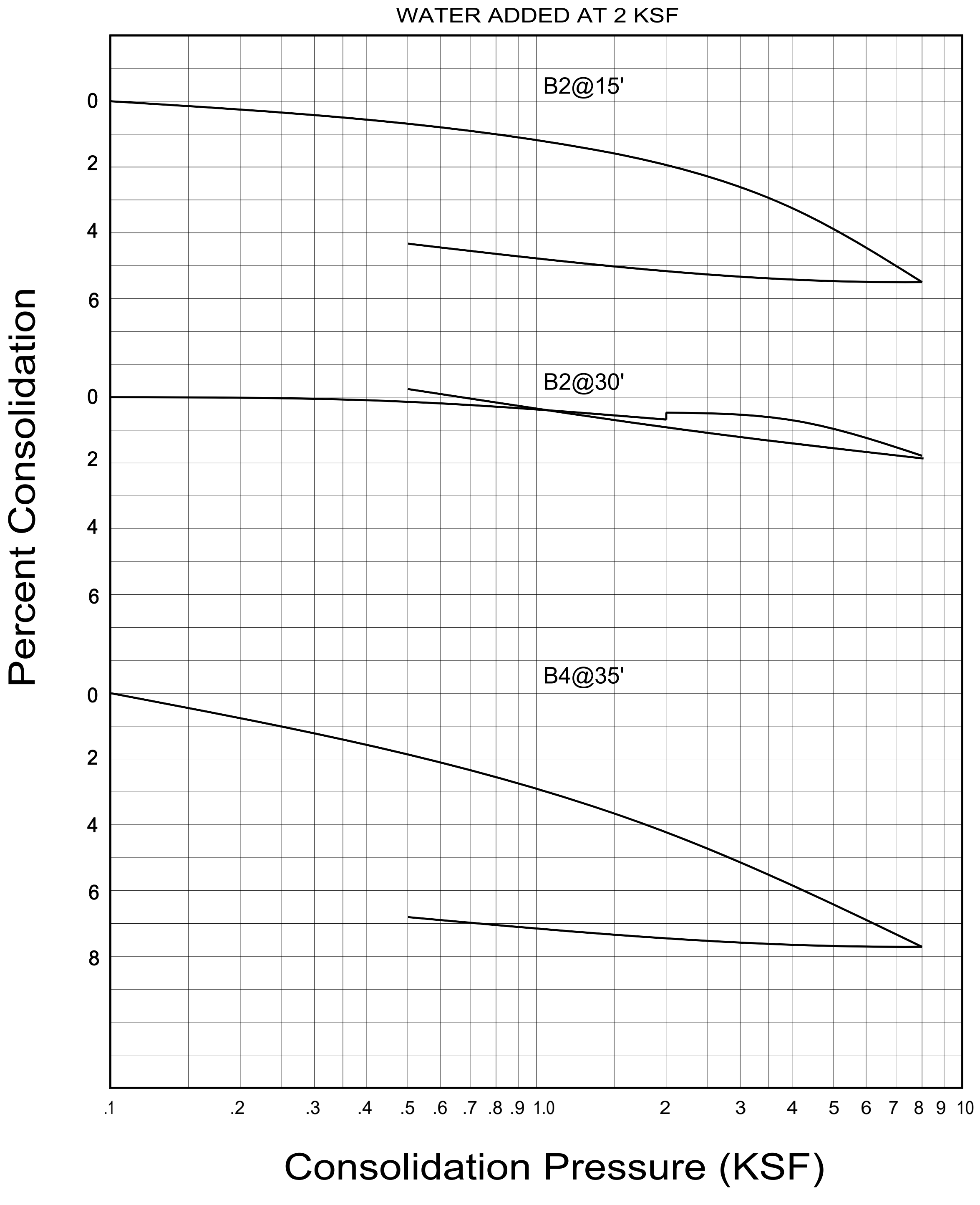
# CONSOLIDATION TEST RESULTS

VICTORIA BOULEVARD APARTMENTS
26126 VICTORIA BOULEVARD
DANA POINT, CALIFORNIA

MARCH 2019
PROJECT NO. A9942-88-01
FIG. B4



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| | |
|---|---|
| Drafted by: JTA | Checked by: NDB |

# CONSOLIDATION TEST RESULTS

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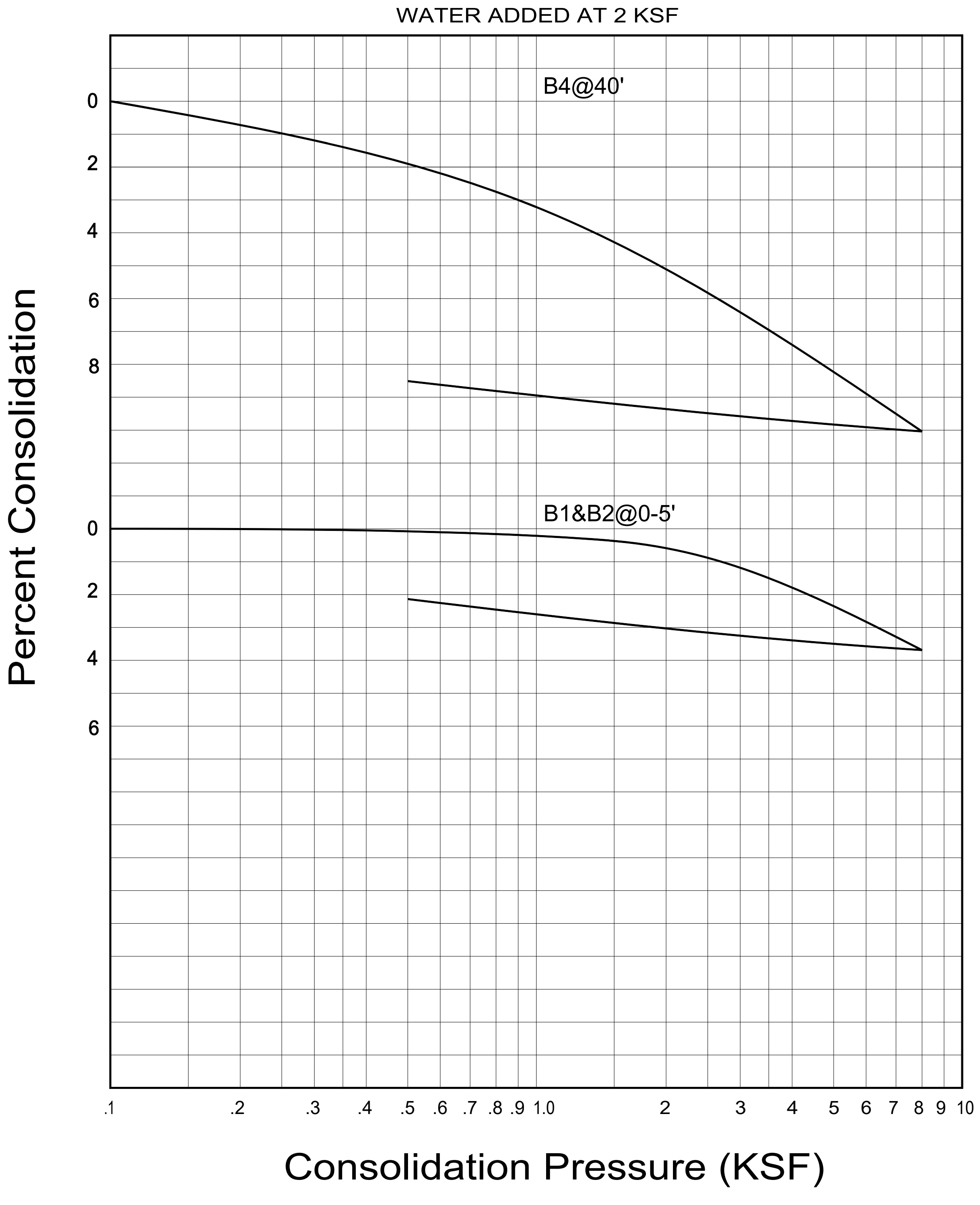
DANA POINT, CALIFORNIA

| | | |
|---|---|---|
| MARCH 2019 | PROJECT NO. A9942-88-01 | FIG. B5 |



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# CONSOLIDATION TEST RESULTS

VICTORIA BOULEVARD APARTMENTS
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| | | | | |
|---|---|---|---|---|
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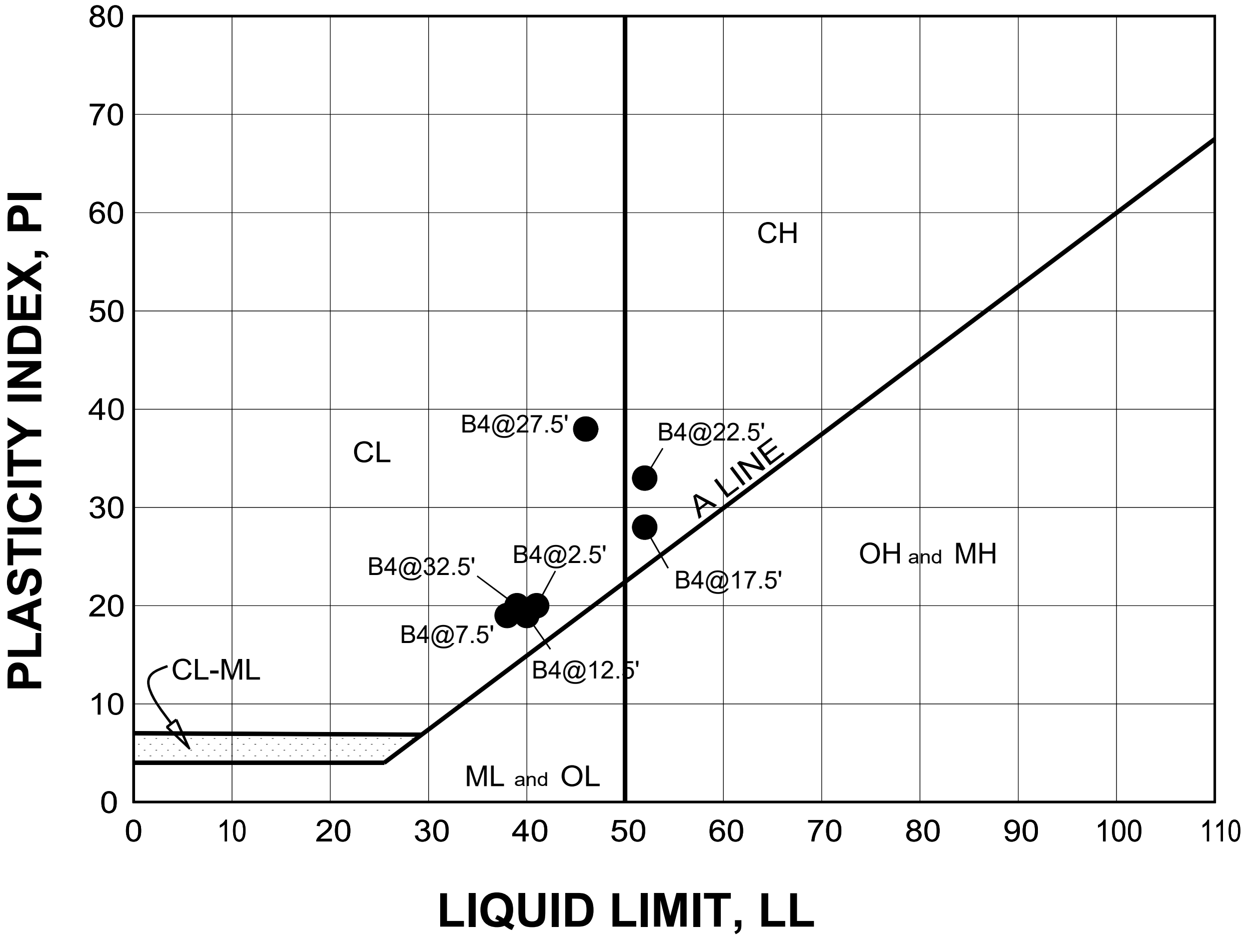

| BORING NUMBER | DEPTH (FEET) | LL | PL | PI | MOISTURE CONTENT AT SATURATION | SOIL BEHAVIOR |
|---|---|---|---|---|---|---|
| **B4** | **2.5** | **41** | **21** | **20** | **- -** | **CL** |
| **B4** | **7.5** | **38** | **19** | **19** | **- -** | **CL** |
| **B4** | **12.5** | **40** | **21** | **19** | **- -** | **CL** |
| **B4** | **17.5** | **52** | **24** | **28** | **- -** | **CH** |
| **B4** | **22.5** | **52** | **19** | **33** | **- -** | **CH** |
| **B4** | **27.5** | **46** | **18** | **28** | **- -** | **CL** |
| **B4** | **32.5** | **39** | **19** | **20** | **- -** | **CL** |

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ATTERBERG LIMITS

VICTORIA BOULEVARD APARTMENTS
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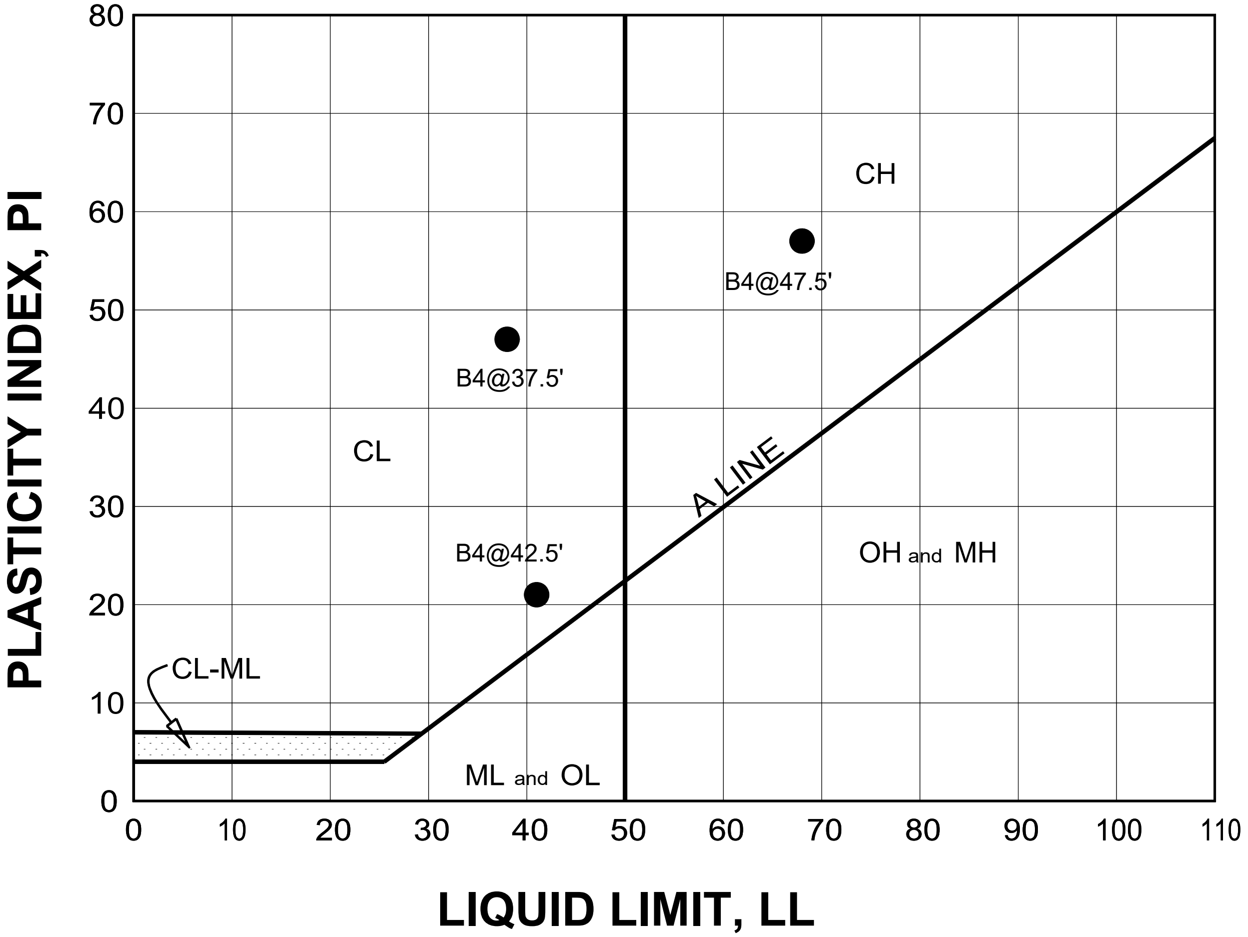
DANA POINT, CALIFORNIA

MARCH 2019
PROJECT NO. A9942-88-01
FIG. B7



| BORING NUMBER | DEPTH (FEET) | LL | PL | PI | MOISTURE CONTENT AT SATURATION | SOIL BEHAVIOR |
|---|---|---|---|---|---|---|
| **B4** | **37.5** | **38** | **21** | **17** | **- -** | **CL** |
| **B4** | **42.5** | **41** | **20** | **21** | **- -** | **CL** |
| **B4** | **47.5** | **68** | **21** | **47** | **- -** | **CH** |

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ATTERBERG LIMITS

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# SUMMARY OF LABORATORY EXPANSION INDEX TEST RESULTS
## ASTM D 4829-11

| Sample No. | Moisture Content (%) |  | Dry Density (pcf) | Expansion Index | *UBC Classification | **CBC Classification |
|---|---|---|---|---|---|---|
|  | Before | After |  |  |  |  |
| B1&B2 @ 0-5' | 10.0 | 19.1 | 109.8 | 50 | Medium | Expansive |

* Reference: 1997 Uniform Building Code, Table 18-I-B.

** Reference: 2016 California Building Code, Section 1803.5.3

# SUMMARY OF LABORATORY MAXIMUM DENSITY AND AND OPTIMUM MOISTURE CONTENT TEST RESULTS
## ASTM D 1557-12

| Sample No. | Soil Description | Maximum Dry Density (pcf) | Optimum Moisture (%) |
|---|---|---|---|
| B1&B2 @ 0-5' | Dark Olive Brown Clay | 123.0 | 10.2 |

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LABORATORY TEST RESULTS

VICTORIA BOULEVARD APARTMENTS
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MARCH 2019 | PROJECT NO. A9942-88-01 | FIG. B9

## SUMMARY OF LABORATORY POTENTIAL OF HYDROGEN (pH) AND RESISTIVITY TEST RESULTS
## CALIFORNIA TEST NO. 643

| **Sample No.** | **pH** | **Resistivity (ohm centimeters)** |
|---|---|---|
| B1&B2 @ 0-5' | 8.03 | 560 (Severely Corrosive) |

## SUMMARY OF LABORATORY CHLORIDE CONTENT TEST RESULTS
## EPA NO. 325.3

| **Sample No.** | Chloride Ion Content (%) |
|---|---|
| B1&B2 @ 0-5' | 0.085 |

## SUMMARY OF LABORATORY WATER SOLUBLE SULFATE TEST RESULTS
## CALIFORNIA TEST NO. 417

| **Sample No.** | Water Soluble Sulfate (% $SO_4$) | Sulfate Exposure* |
|---|---|---|
| B1&B2 @ 0-5' | 0.002 | Negligible |

* Reference: 2016 California Building Code, Section 1904.3 and ACI 318-14 Table 19.3.1.1

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CORROSIVITY TEST RESULTS

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MARCH 2019 | PROJECT NO. A9942-88-01 | FIG. B10

# APPENDIX C

# APPENDIX C

# CLIQ LIQUEFACTION ANALYSIS REPORT – DE AND MCE OUTPUTS

(CD Only)