APPENDIX 4.10 - 1

HYDROLOGY STUDIES

TECH2023-01480

PRELIMINARY HYDROLOGY REPORT

Shea Festival Hills - Anaheim CA

APN: 354-451-04, 06, 08, 10, 12, 13, 17, 19, 20, 27, 28, 31, 32, 33, 37, and 38
8010-8200 East Santa Ana Canyon Road,
350 South Festival Drive,
Anaheim, CA 92808

November 2023

Updated:

PREPARED FOR:

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KHA Project Number: 194375001

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Table of Contents

Purpose of Report…….. 2

Exhibit 1 – Project Vicinity Map

Site Description and Drainage Patterns……... 2

Existing Conditions

Proposed Conditions

Methodology Used…… 3

Summary…….. 4

Table 2 – Existing Conditions

Table 3 – Proposed Conditions

Conclusion…….. 4

Table 4 – Existing vs. Proposed Peak Flow Comparison

Attachments

Attachment A – Reference Material

Attachment B – Existing Conditions Analysis

Attachment C – Proposed Conditions Analysis

Attachment D – Pipe and Inlet Sizing for 25-year Storm

Attachment E – 100 Year Analysis

Purpose of Report

Kimley-Horn and Associates, Inc. (KHA) has prepared this Drainage Study for Shea Properties. The report is intended to comply with the requirements of City of Anaheim Drainage Guidelines and Orange County Hydrology Manual to assist in the completion of a redevelopment of an existing retail center in accordance with the Submittal Requirements of the City of Anaheim.

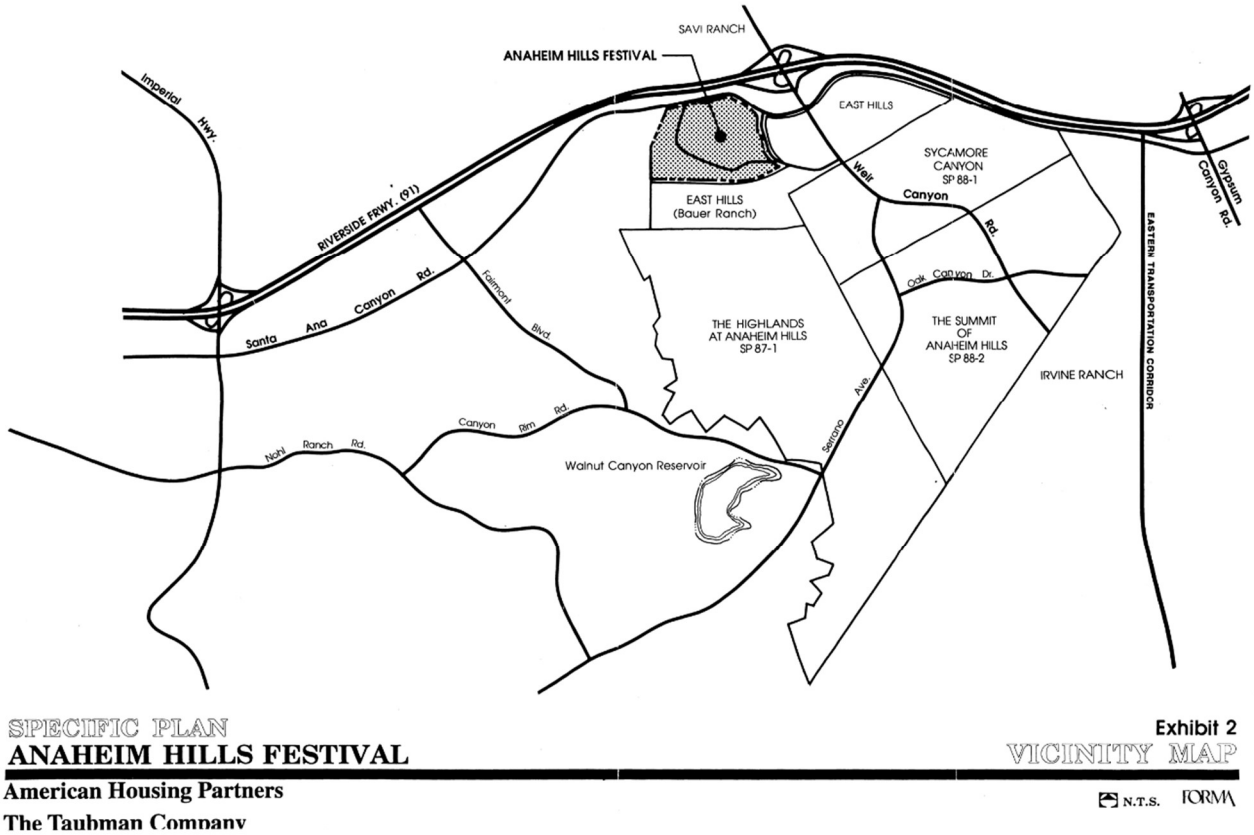


Exhibit 1 – Project Vicinity Map (Specific Plans – Anaheim Hills Festival, April 1998)

Site Description

Anaheim Hills Festival is presently covered by two General Plan land use designations: Regional Commercial for Development Areas 1-3 and Low-Medium Density Residential for the existing senior apartments constructed in Development Area 4. A city-initiated General Plan Amendment change the land use designation for new Development Area 5 from Regional Commercial to Mixed-Use High, which will allow for residential units at a density of 60 dwelling units/acre (du/ac) is expected to occur prior to this Specific Plan Amendment, see Exhibit 2 on page 3. This General Plan Amendment would accommodate the proposed residential units within Development Area 5. These units will replace the existing cinema for the first phase and the existing fitness use for buildout of a second phase on the upper tier of prior Development Area 2.

The proposed Amendment to the Anaheim Hills Festival Specific Plan will be the sixth amendment to the plan since its inception in 1990. The Amended Plan will accommodate five Development Areas, with four areas existing and a newly introduced Development Area 5 proposed to support mixed-use residential and commercial. The development planned for the amended Anaheim Hills Festival Specific Plan totals 547,350 sf with a variety of uses such as: 450 additional residential units and the existing senior

apartments, retail, commercial, business and financial services, restaurants, hotel and office uses, senior housing opportunities, and multi-family housing opportunities. These uses will work together to create a viable mixed-use development with unique features and experiences.

This report will focus on the 450 residential units being added to the western portion of DA 5, as shown below in Exhibit 2.



Exhibit 2– Anticipated General Plan Amendment

The intent of the project is to re-develop approximately 10 acres of the western portion DA 5, adding 450 residential units. The proposed development will include the demolition and removal of an existing movie theater building on the upper level of the site, parking lot and landscaping and the construction of a residential building. The existing 24-hour fitness and its parking will remain in place. Improvements within the site will include parking facilities, site utilities, and landscape improvements.

The purpose of this report is to provide information about the design of the Storm Water Management System (SWMS) for the proposed project and to compare the existing and proposed peak flow rates of the site and indicate conceptual pipe storm drainpipe routing and size.

Existing Conditions

The existing Drainage Area consists of a movie theater building, retail buildings, and a parking lot consisting of mostly asphalt pavement with landscaped islands throughout as well as a heavily landscaped swale dividing the upper and lower levels of the site. Circumnavigating the site are roads with a high point located south of the site along S Festival Dr, which drains to the east and west along the S Festival Road and/or Roosevelt Rd, ultimately draining to curb inlets N of the site along E Santa Ana Canyon Rd (private street). See proposed project site below.

The site follows three general drainage patterns. The western portion of the existing site drains to the west exiting the site through the driveway leading to S Festival Dr, following the drainage patterns of S Festival Dr. The eastern portion of the site is occupied by an existing 24 Hour Fitness building. West of the building drains to a central point in the heavily landscaped hill that divides the upper and lower levels of the site, draining to the lower site. East of the building drains to a eastern point in the heavily landscaped hill which divides the upper and lower level, draining to the lower level.

The site ultimately drains to, the Santa Ana River Channel in the Santa Ana River watershed. The Santa Ana River Channel ultimately discharges to the Pacific Ocean.

Project Conditions

The proposed site design includes 4 drainage areas analyzed, where DA-1 and DA-2 will drain to the existing west catch basins adjacent S Festival Dr. and DA 3 and OFF-1 will drain to the existing catch basin on the north side of the project site.

During small storm events (up to the 85th percentile storm), the proposed grading will convey surface runoff towards the required LID BMP's for capture, this flow will be treated using proprietary biotreatment devices, as infiltration is deemed infeasible per the Infiltration Feasibility study by NMG Geotechnical. Storm events larger than the 85th percentile storm will be diverted around the BMP devices and will routed underground to an existing storm point of connection at the western driveway on Festival Drive.

Positive overflow due to the 100-year event is accommodated through overland relief. In the event of clogging or this high volume, water will spill into the public right-of-way before eclipsing the finished floor elevation for the entire site. DA-1, 2, 3, and OFF-1 will overland flow moving west and spill towards South Festival Drive.

Since the entirety of the onsite portion of the project will equal to existing curb inlets, the storm drain system has been analyzed and such that the proposed condition does not increase 100-year runoff flow from the project site. The Project Conditions Hydrology Exhibit showing the proposed improvements can be found at the end of this report in *Appendix C.*

Methodology Used

Due to the small size of the site and subareas, volume calculations were performed using Advanced Engineering Software (AES). Calculations for the existing site conditions can be found in Attachment B. Calculations for proposed site conditions can be found in Attachment C and Attachment E (25-year storm and 100-yr storm respectively). This software is confirmed to be in accordance with the County of Orange Hydrology Manual. All software inputs were gathered from existing and proposed site configurations and Orange County Technical Guidance Document Reference maps.

Proposed pipe and inlets were sized using Bentley's FlowMaster Software per 25-year stormwater data calculated with AES. Refer to Attachment D for pipe and inlets sizing calculations. Summary Table 2 summarizes the 10, 25, and 100-year peak flows for the Existing Condition (calculations in *Attachment B*).

Table 2 - Existing Conditions

Acreage	10-year Flow (cfs)	25-year Flow (cfs)	100-year Flow (cfs)
11.37	30.47	36.53	47.21

Table 3 summarizes the 25-year and 100-year peak flow results for Project Conditions (calculations in *Attachment D and Attachment F*).

Table 3 – 25-Year & 100-Year Project Conditions

Acreage	10 Year-Flow (cfs)	25-year Flow (cfs)	100-year Flow (cfs)
11.37	30.43	36.50	46.21

Conclusion

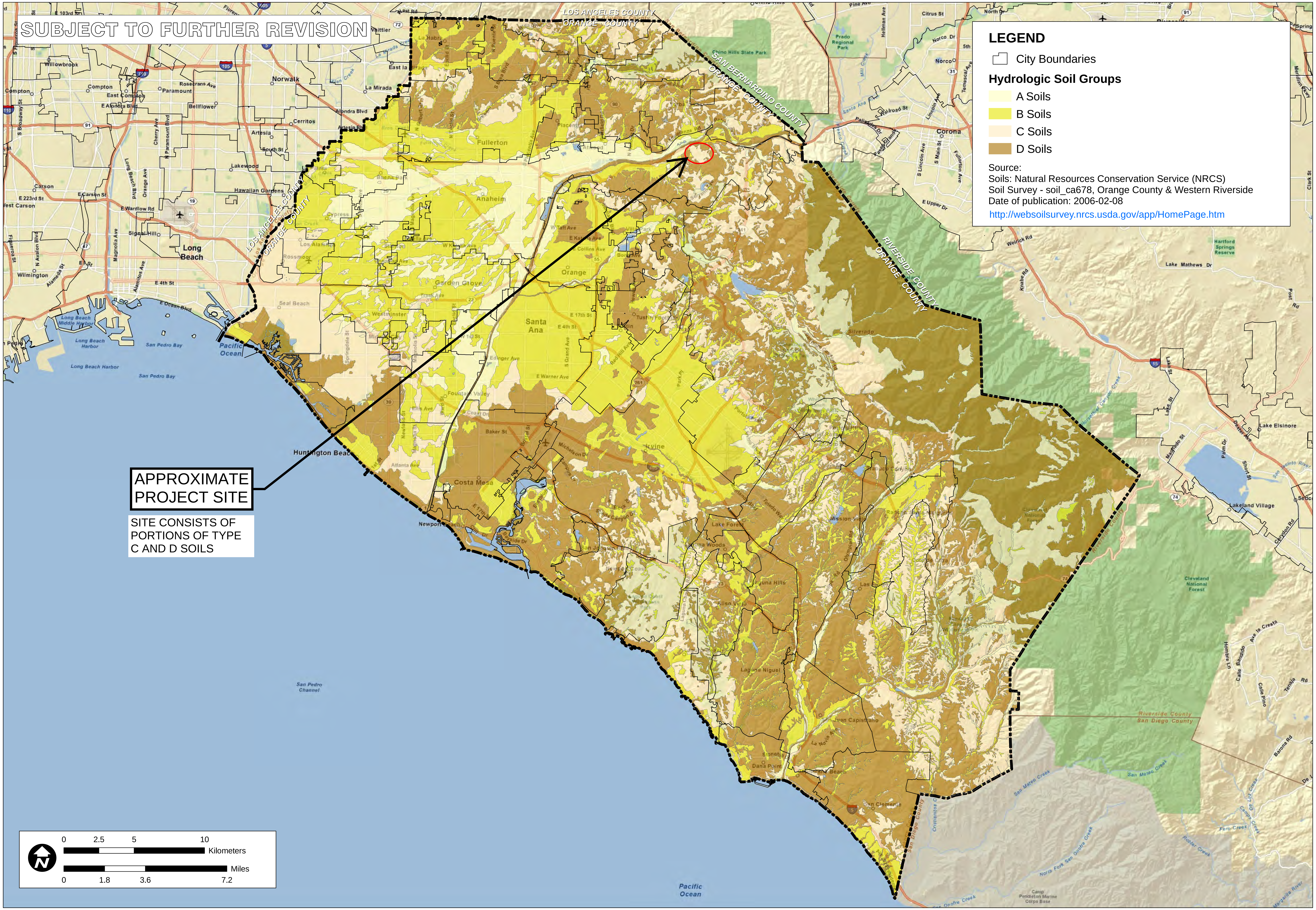
In conclusion, the study has determined that there will be no negative impact on downstream public storm drain infrastructure due to the new project redevelopment. The proposed modular wetland will treat the low flow storm events according to the project's Water Quality Manage Plan (WQMP). The event runoff will enter the catch basins towards S Festival Dr and Roosevelt Rd. The proposed conditions peak flows will remain equal or under the existing peak flows. The storm drain pipes are sized to adequately hold the 100 year storm flows, so no ponding is anticipated.

The overflow point for DA 1 and DA 2 occurs at the northwest catch basin at elevation 454.2 with the adjacent buildings at 462. The overflow point for DA 3 and Off-1 occurs at the adjacent property at elevation 451 with the adjacent buildings at 453.. The ultimate location for these overflow points have water moving towards the west South Festival Drive driveway.

Table 4 - Existing vs. Proposed Peak Flow Comparison

	Area (acres)	Pervious Area (sqft)	Impervious Area (sqft)	Peak Flow (cfs)	Flow Difference (from existing) (cfs)
10-Year Existing Condition	11.37	49528	445749	30.47	
10-Year Proposed Condition	11.37	126055	396222	30.43	**-.04**
25-Year Existing Condition	11.37	49528	445749	36.53	--
25-Year Proposed Condition	11.37	126055	396222	36.50	**-0.03**
100-Year Existing Condition	11.37	49528	445749	47.21	--
100-Year Proposed Condition	11.37	126055	396222	47.21	--

Attachment A - Reference Material



NRCS HYDROLOGIC SOILS GROUPS

TITLE

ORANGE COUNTY INFILTRATION STUDY

ORANGE CO. CA

JOB

SCALE	1" = 1.8 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	02/09/11
JOB NO.	9526-E

PACE Advanced Water Engineering

FIGURE

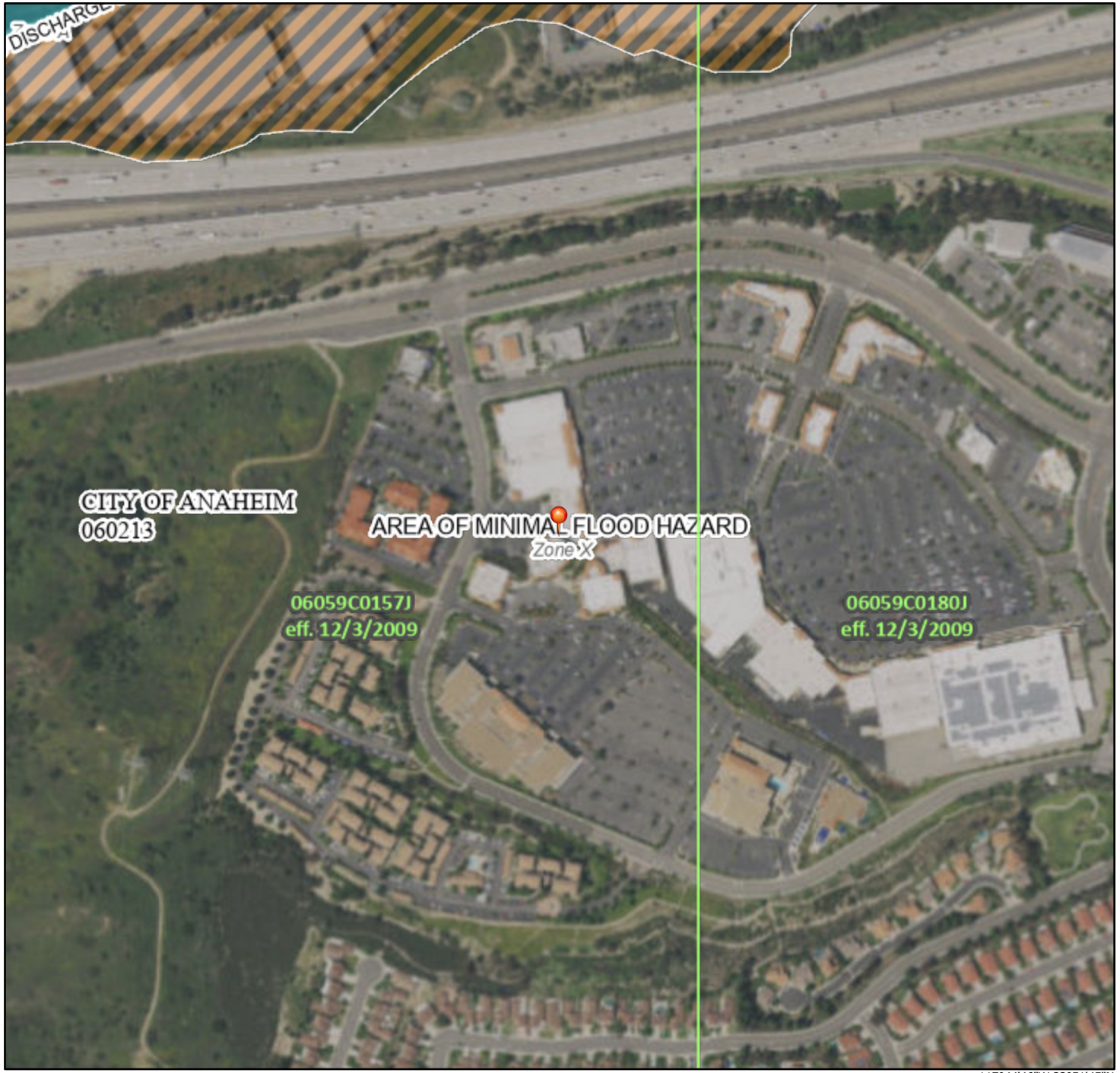
XVI-2a

P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-2a_HydroSoils_20110215.mxd

National Flood Hazard Layer FIRMette

FEMA

117°45'23"W 33°52'14"N



117°44'46"W 33°51'45"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

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
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- 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

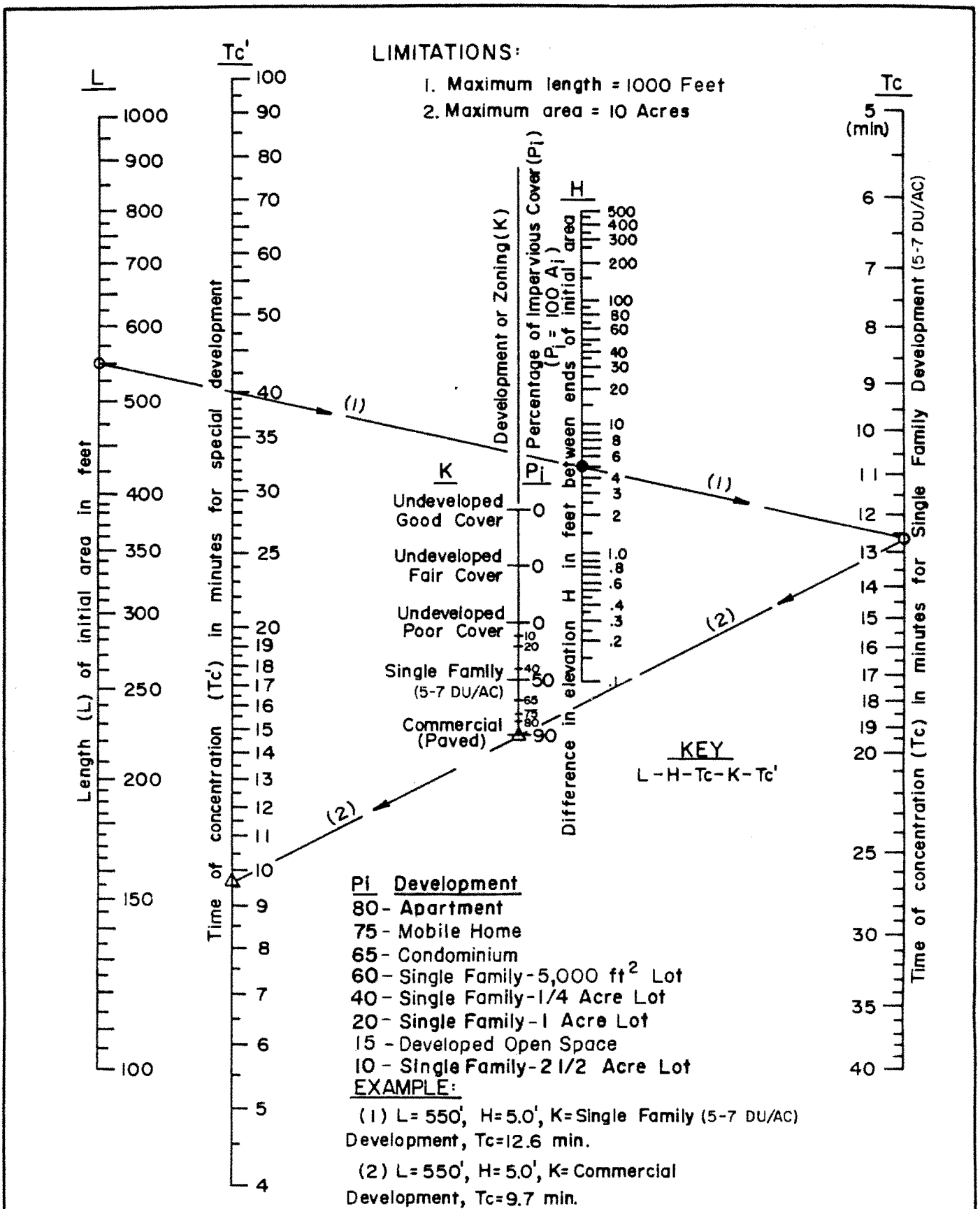
N

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 2/21/2023 at 6:23 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.



ORANGE COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

NOAA Atlas 14, Volume 6, Version 2
Location name: Anaheim, California, USA*
Latitude: 33.8665°, Longitude: -117.7513°
Elevation: 442.89 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.130** (0.108-0.156)	**0.166** (0.139-0.200)	**0.215** (0.179-0.260)	**0.255** (0.211-0.312)	**0.312** (0.249-0.395)	**0.357** (0.278-0.462)	**0.403** (0.307-0.536)	**0.452** (0.334-0.619)	**0.520** (0.367-0.744)	**0.574** (0.391-0.851)
10-min	**0.186** (0.155-0.224)	**0.238** (0.199-0.287)	**0.308** (0.257-0.373)	**0.366** (0.303-0.447)	**0.447** (0.357-0.567)	**0.512** (0.399-0.662)	**0.578** (0.440-0.768)	**0.648** (0.478-0.887)	**0.745** (0.527-1.07)	**0.823** (0.560-1.22)
15-min	**0.224** (0.188-0.271)	**0.288** (0.240-0.347)	**0.372** (0.310-0.451)	**0.443** (0.366-0.541)	**0.541** (0.432-0.685)	**0.619** (0.483-0.801)	**0.699** (0.532-0.929)	**0.784** (0.579-1.07)	**0.902** (0.637-1.29)	**0.995** (0.678-1.48)
30-min	**0.312** (0.261-0.376)	**0.399** (0.334-0.482)	**0.517** (0.431-0.626)	**0.615** (0.508-0.751)	**0.751** (0.599-0.951)	**0.859** (0.670-1.11)	**0.971** (0.738-1.29)	**1.09** (0.803-1.49)	**1.25** (0.884-1.79)	**1.38** (0.941-2.05)
60-min	**0.443** (0.371-0.534)	**0.567** (0.474-0.685)	**0.734** (0.612-0.889)	**0.873** (0.722-1.07)	**1.07** (0.851-1.35)	**1.22** (0.952-1.58)	**1.38** (1.05-1.83)	**1.55** (1.14-2.12)	**1.78** (1.26-2.54)	**1.96** (1.34-2.91)
2-hr	**0.658** (0.551-0.794)	**0.838** (0.701-1.01)	**1.08** (0.900-1.31)	**1.28** (1.06-1.57)	**1.56** (1.25-1.98)	**1.79** (1.40-2.32)	**2.02** (1.54-2.69)	**2.27** (1.68-3.11)	**2.62** (1.85-3.74)	**2.90** (1.97-4.30)
3-hr	**0.820** (0.686-0.989)	**1.04** (0.870-1.26)	**1.34** (1.12-1.62)	**1.59** (1.31-1.94)	**1.94** (1.55-2.45)	**2.22** (1.73-2.87)	**2.51** (1.91-3.33)	**2.82** (2.08-3.86)	**3.26** (2.30-4.66)	**3.62** (2.47-5.37)
6-hr	**1.17** (0.977-1.41)	**1.48** (1.24-1.79)	**1.91** (1.59-2.31)	**2.27** (1.87-2.77)	**2.76** (2.20-3.50)	**3.16** (2.46-4.09)	**3.57** (2.71-4.75)	**4.01** (2.96-5.49)	**4.64** (3.28-6.63)	**5.14** (3.50-7.63)
12-hr	**1.53** (1.28-1.85)	**1.97** (1.65-2.38)	**2.56** (2.14-3.11)	**3.05** (2.52-3.73)	**3.73** (2.98-4.72)	**4.26** (3.33-5.52)	**4.82** (3.66-6.40)	**5.40** (3.98-7.39)	**6.20** (4.38-8.87)	**6.84** (4.66-10.1)
24-hr	**2.01** (1.78-2.32)	**2.63** (2.33-3.04)	**3.47** (3.05-4.01)	**4.15** (3.63-4.85)	**5.10** (4.32-6.16)	**5.85** (4.85-7.20)	**6.61** (5.36-8.34)	**7.42** (5.84-9.60)	**8.52** (6.45-11.5)	**9.39** (6.87-13.1)
2-day	**2.50** (2.21-2.88)	**3.33** (2.94-3.85)	**4.44** (3.91-5.14)	**5.35** (4.68-6.25)	**6.61** (5.59-7.97)	**7.59** (6.29-9.34)	**8.60** (6.96-10.8)	**9.65** (7.60-12.5)	**11.1** (8.39-15.0)	**12.2** (8.95-17.1)
3-day	**2.73** (2.42-3.15)	**3.68** (3.25-4.25)	**4.95** (4.36-5.73)	**5.99** (5.23-6.99)	**7.42** (6.28-8.95)	**8.54** (7.08-10.5)	**9.68** (7.84-12.2)	**10.9** (8.57-14.1)	**12.5** (9.48-16.9)	**13.8** (10.1-19.3)
4-day	**2.96** (2.62-3.42)	**4.01** (3.54-4.63)	**5.40** (4.76-6.25)	**6.55** (5.72-7.64)	**8.13** (6.88-9.80)	**9.37** (7.77-11.5)	**10.6** (8.62-13.4)	**12.0** (9.44-15.5)	**13.8** (10.5-18.6)	**15.3** (11.2-21.3)
7-day	**3.42** (3.02-3.94)	**4.59** (4.05-5.30)	**6.17** (5.43-7.14)	**7.48** (6.54-8.73)	**9.31** (7.88-11.2)	**10.8** (8.92-13.2)	**12.3** (9.92-15.4)	**13.8** (10.9-17.9)	**16.0** (12.1-21.6)	**17.8** (13.0-24.8)
10-day	**3.72** (3.29-4.30)	**4.98** (4.40-5.76)	**6.69** (5.89-7.75)	**8.12** (7.10-9.48)	**10.1** (8.58-12.2)	**11.7** (9.73-14.4)	**13.4** (10.9-16.9)	**15.2** (12.0-19.7)	**17.7** (13.4-23.8)	**19.6** (14.4-27.4)
20-day	**4.39** (3.89-5.07)	**5.91** (5.22-6.82)	**7.98** (7.03-9.25)	**9.75** (8.52-11.4)	**12.3** (10.4-14.8)	**14.3** (11.9-17.6)	**16.4** (13.3-20.7)	**18.7** (14.8-24.3)	**22.0** (16.7-29.7)	**24.7** (18.1-34.4)
30-day	**5.18** (4.58-5.98)	**7.00** (6.18-8.08)	**9.51** (8.38-11.0)	**11.7** (10.2-13.6)	**14.7** (12.5-17.8)	**17.3** (14.3-21.2)	**19.9** (16.1-25.1)	**22.8** (18.0-29.6)	**27.0** (20.4-36.4)	**30.4** (22.2-42.3)
45-day	**6.06** (5.36-7.00)	**8.20** (7.25-9.48)	**11.2** (9.86-13.0)	**13.8** (12.0-16.1)	**17.5** (14.8-21.1)	**20.5** (17.0-25.3)	**23.8** (19.3-30.0)	**27.4** (21.6-35.4)	**32.5** (24.6-43.8)	**36.7** (26.9-51.2)
60-day	**6.96** (6.16-8.04)	**9.41** (8.32-10.9)	**12.8** (11.3-14.9)	**15.8** (13.8-18.5)	**20.1** (17.0-24.3)	**23.7** (19.6-29.1)	**27.5** (22.3-34.6)	**31.6** (24.9-41.0)	**37.7** (28.5-50.8)	**42.6** (31.2-59.5)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

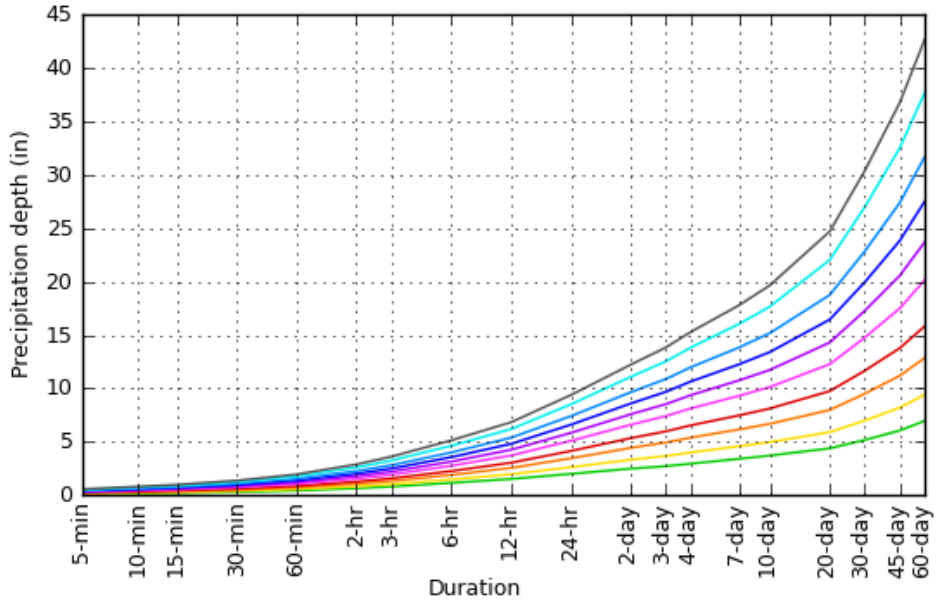
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

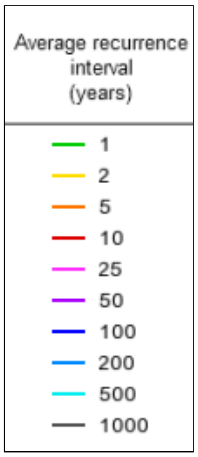
Please refer to NOAA Atlas 14 document for more information.

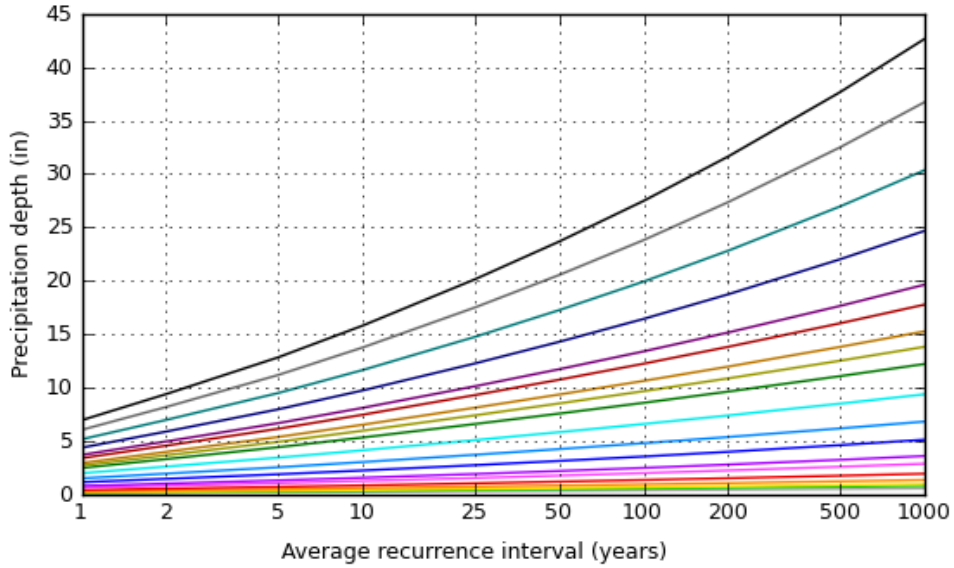
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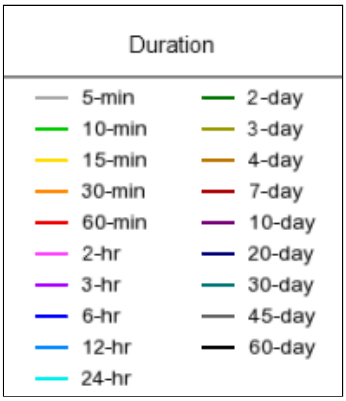
PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 33.8665°, Longitude: -117.7513°









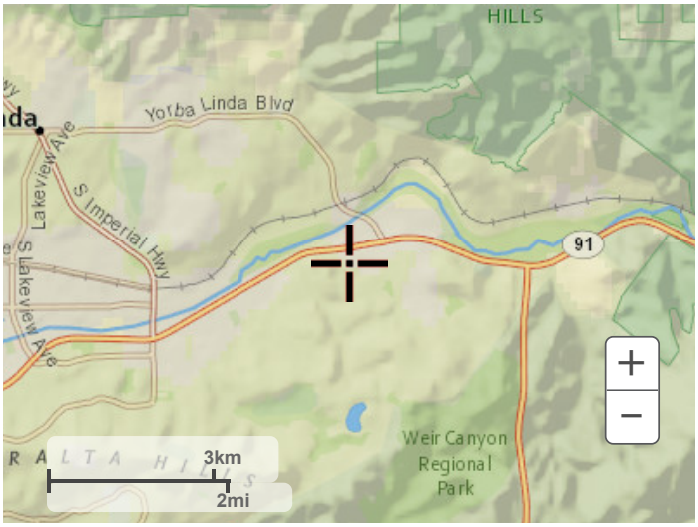
NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Wed Feb 22 00:16:37 2023

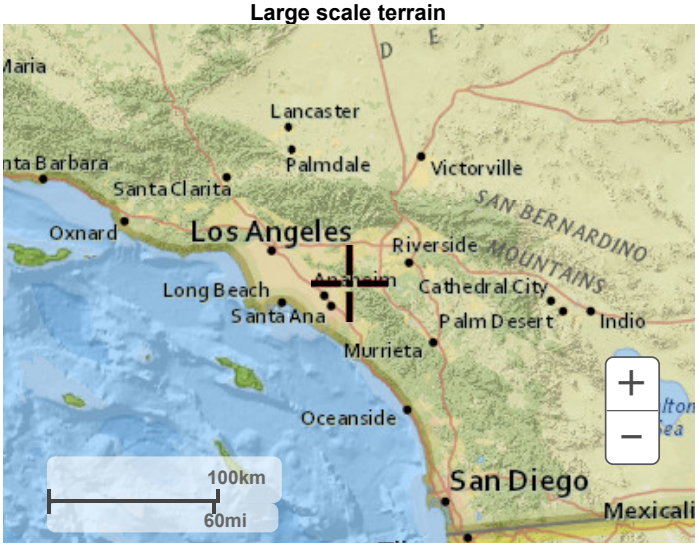
Back to Top

Maps & aerials

Small scale terrain



Large scale terrain



Large scale map



Large scale aerial



Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer



Map Scale: 1:5,090 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Orange County and Part of Riverside County, California
Survey Area Data: Version 16, Sep 6, 2022

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

Date(s) aerial images were photographed: Mar 14, 2022—Mar 17, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
107	Anaheim loam, 30 to 50 percent slopes	C	1.2	1.6%
145	Cieneba-Rock outcrop complex, 30 to 75 percent slopes	D	2.5	3.2%
173	Myford sandy loam, 2 to 9 percent slopes	C	30.0	39.1%
177	Myford sandy loam, 9 to 30 percent slopes, eroded	C	35.1	45.8%
203	Soper cobbly loam, 15 to 50 percent slopes	C	7.6	9.9%
217	Xeralfic arents, loamy, 2 to 9 percent slopes		0.3	0.4%
Totals for Area of Interest			**76.7**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

CITY OF ANAHEIM

ANAHEIM

N
W E
S

0 100 200
Feet

Legend

Point Structure

TYPE

- ANCHOR
- BULKHEAD
- CATCH BASIN
- CLEAN OUT
- COLLAR
- CONTERCEPTOR DRAIN
- CURB OPENING
- DESILTING BASIN
- DETECTION BOX
- DRAIN BOX
- DROP INLET
- FLOW THUR
- GRATE INLET
- HEADWALL
- INLET
- JUNCTION
- OUTLET
- PLUG
- PUMP STATION
- RISER
- SAND-OIL INTERCEPTOR
- STILLING WELL
- TRANSITION
- TRASH ENCLOSURE
- Manhole
- LateralPipeLines
- Catch Basin

Storm Drain

- Main Line
- Private Line
- Cal Trans Line
- County Line
- On-Site Private Line
- Other
- Building Footprints

200	206	212
201	207	213
202	208	214

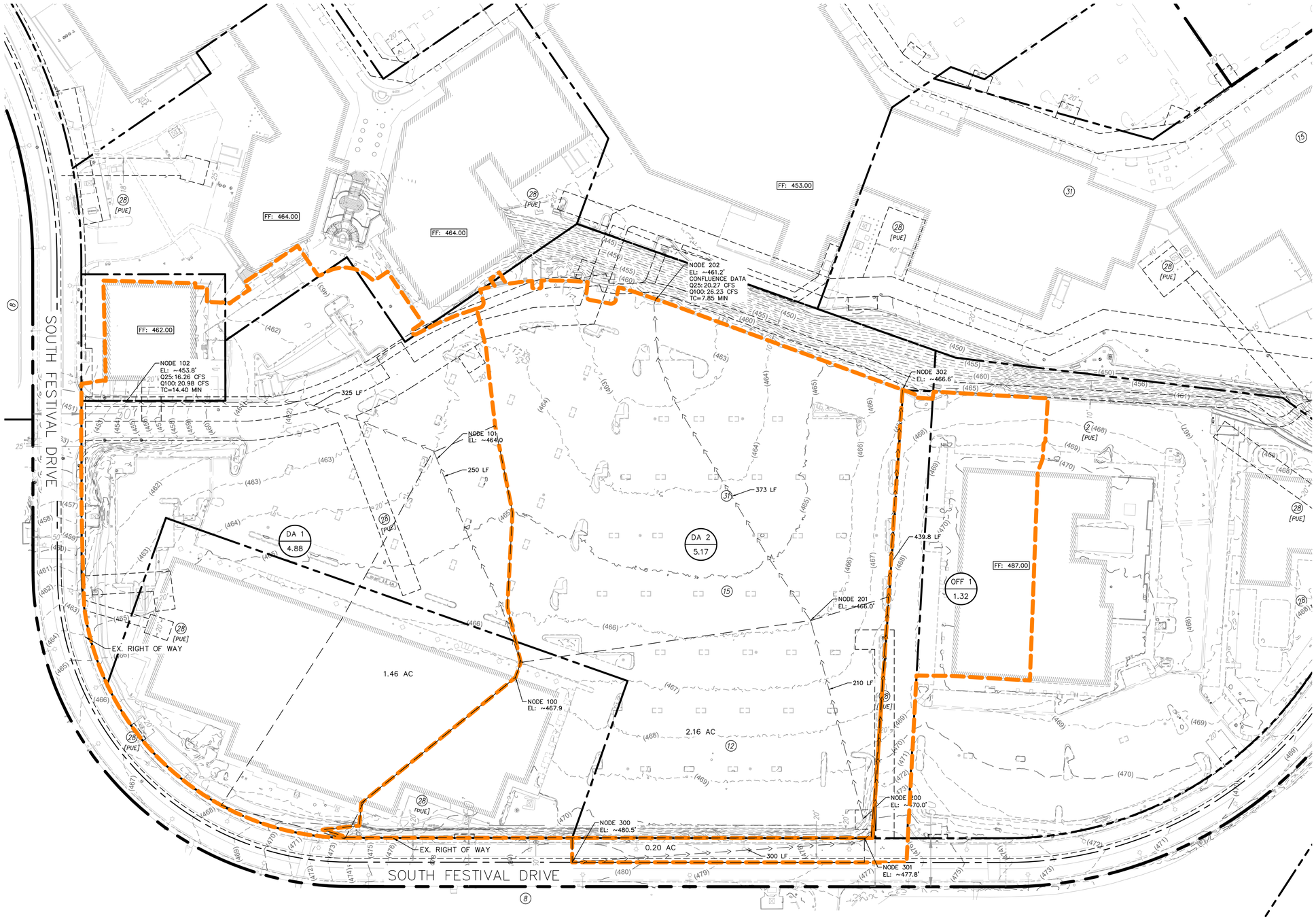
STORM DRAIN 207

Portions of these plans contain critical infrastructure information. Unauthorized release or reproduction of these documents may result in civil penalty or other action. This map is not an official record of the city but is compiled from data furnished by private contractors and other sources. Location and sizes of geographic features and facilities shown are based on these sources. This information is furnished to any person strictly as a convenience and the city does not assume any responsibility for its accuracy or completeness.

Plot Date: 5/24/2021

Attachment B - Existing Conditions Analysis

Drawing name: K:\ORA_LDEV\094810017 – Shea Festival Hill\CADD\Exhibits\Hydrology\Existing Hydrology Exhibit.dwg Nov 28, 2023 11:27am by: Kevin.huo
This document, together with the concepts and designs presented herein, as an instrument of service, is intended only for the specific purpose and client for which it was prepared. Reuse of and improper reliance on this document without written authorization and adaptation by Kimley-Horn and Associates, Inc. shall be without liability to Kimley-Horn and Associates, Inc.



LEGEND

- PROPERTY LINE
- LOT LINE
- RIGHT-OF-WAY LINE
- CENTER LINE
- EASEMENT LINE
- INITIAL AREA STUDY
- (XXX) EXISTING CONTOURS
- XXX PROPOSED CONTOURS
- EXISTING BUILDING

REVISIONS

NO.	INIT.	DATE	DESCRIPTION	APP'D	DATE
–		--	--		

BENCH MARK:

COUNTY OF ORANGE BENCHMARK "3R-105-85"
ELEVATION: 396.789 (FEET) [DATUM: NAVD 1988] YEAR LEVELED: 2006]
DESCRIBED AS: FOUND 3 3\4' OCS ALUMINUM BENCHMARK DISK STAMPED "3R-105-85', SET
IN THE SOUTHWESTERLY CORNER OF A 4 FT. BY 15 FT. CONCRETE CATCH BASIN. MONUMENT IS LOCATED ALONG THE NORTHEASTERLY SIDE OF SANTA ANA CANYON ROAD, 0.8 MILES SOUTHWESTERLY OF THE CENTERLINE OF WEIR CANYON ROAD, 354 FT. WESTERLY OF THE OF TWO STEEL TRANSMISSION LINES CROSSING SANTA ANA CANYON AND 40.5 FT. NORTHERLY OF THE CENTERLINE OF SANTA ANA CANYON. MONUMENT IS SET LEVEL WITH THE SIDEWALK.

PREPARED BY:

ENGINEERS SEAL

Kimley»Horn

KIMLEY-HORN & ASSOCIATES, INC.
1100 W. TOWN AND COUNTRY ROAD,
SUITE 700, ORANGE, CA 92868
714-939-1030
WWW.KIMLEY-HORN.COM

811 Know what's below. Call 811 before you dig.

NORTH

GRAPHIC SCALE IN FEET
0 25 50 100

SCALE: 1" = 50'
WHEN PRINTED AT FULL SIZE 24"X36"

SITE ADDRESS: 8010-8200 EAST SANTA ANA CANYON ROAD, 350 SOUTH FESTIVAL DR, ANAHEIM, CA 92808 SHEA FESTIVAL HILL EXISTING HYDROLOGY EXHIBIT		GRAXXXX
		SHEET 01 OF 01
SCALE:	DRAWN BY: FC	CHECKED BY: --
CITY OF ANAHEIM		01

FOR CITY USE ONLY

```
_____
*****************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
         (c) Copyright 1983-2011 Advanced Engineering Software (aes)
             Ver. 18.0  Release Date: 07/01/2011  License ID 1499

                          Analysis prepared by:




 ************************* DESCRIPTION OF STUDY *************************
* ANAHEIM HILLS                                                         *
* 25 YEAR STORM                                                         *
* EXISTING CONDITION                                                    *
 *************************************************************************

  FILE NAME: ANAHEIM.DAT
  TIME/DATE OF STUDY: 16:54 11/21/2023
=============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
=============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *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    100.00 TO NODE    101.00 IS CODE =  21
```

```
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   250.00
  ELEVATION DATA: UPSTREAM(FEET) =    467.90  DOWNSTREAM(FEET) =    464.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.360
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.210
  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                 C        1.46      0.25     0.100    69    6.36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      5.50
  TOTAL AREA(ACRES) =      1.46   PEAK FLOW RATE(CFS) =      5.50

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    464.00  DOWNSTREAM(FEET) =    453.80
  CHANNEL LENGTH THRU SUBAREA(FEET) =   325.00   CHANNEL SLOPE =  0.0314
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.728
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 C        3.42      0.25     0.100    69
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      11.19
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.55
  AVERAGE FLOW DEPTH(FEET) =   0.18   TRAVEL TIME(MIN.) =   1.52
  Tc(MIN.) =    7.88
  SUBAREA AREA(ACRES) =     3.42       SUBAREA RUNOFF(CFS) =   11.40
  EFFECTIVE AREA(ACRES) =      4.88     AREA-AVERAGED Fm(INCH/HR) =   0.03
  AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        4.9         PEAK FLOW RATE(CFS) =      16.26

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.21   FLOW VELOCITY(FEET/SEC.) =   3.77
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     575.00 FEET.

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

```
 FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   210.00
 ELEVATION DATA: UPSTREAM(FEET) =    470.00  DOWNSTREAM(FEET) =    466.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.699
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.479
 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                 C        2.16      0.25     0.100    69    5.70
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =      8.66
 TOTAL AREA(ACRES) =      2.16   PEAK FLOW RATE(CFS) =      8.66

****************************************************************************
 FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    466.00  DOWNSTREAM(FEET) =    461.20
 CHANNEL LENGTH THRU SUBAREA(FEET) =   369.00   CHANNEL SLOPE =  0.0130
 CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =  99.000
 MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.703
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 C        3.01      0.25     0.100    69
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      13.65
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.70
 AVERAGE FLOW DEPTH(FEET) =   0.23   TRAVEL TIME(MIN.) =   2.28
 Tc(MIN.) =    7.98
 SUBAREA AREA(ACRES) =     3.01       SUBAREA RUNOFF(CFS) =    9.96
 EFFECTIVE AREA(ACRES) =      5.17     AREA-AVERAGED Fm(INCH/HR) =   0.03
 AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.10
 TOTAL AREA(ACRES) =        5.2          PEAK FLOW RATE(CFS) =      17.11

 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  0.25   FLOW VELOCITY(FEET/SEC.) =   2.79
 LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     579.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    202.00 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.) =    7.98
  RAINFALL INTENSITY(INCH/HR) =   3.70
  AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       5.17
  TOTAL STREAM AREA(ACRES) =       5.17
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      17.11

****************************************************************************
  FLOW PROCESS FROM NODE    300.00 TO NODE    301.00 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) =    480.50  DOWNSTREAM(FEET) =    477.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.636
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.796
  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                 C        0.20      0.25     0.100    69    7.64
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      0.68
  TOTAL AREA(ACRES) =      0.20   PEAK FLOW RATE(CFS) =      0.68

****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    302.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    477.80  DOWNSTREAM(FEET) =    466.60
  CHANNEL LENGTH THRU SUBAREA(FEET) =   439.80   CHANNEL SLOPE =  0.0255
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.081
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
```

```
     LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                C        1.12      0.25     0.100    69
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.22
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.15
  AVERAGE FLOW DEPTH(FEET) =   0.10   TRAVEL TIME(MIN.) =   3.40
  Tc(MIN.) =   11.04
  SUBAREA AREA(ACRES) =     1.12       SUBAREA RUNOFF(CFS) =    3.08
  EFFECTIVE AREA(ACRES) =      1.32     AREA-AVERAGED Fm(INCH/HR) =   0.02
  AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        1.3         PEAK FLOW RATE(CFS) =       3.63

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.12   FLOW VELOCITY(FEET/SEC.) =   2.35
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    302.00 =     739.80 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    302.00 TO NODE    202.00 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.) =   11.04
  RAINFALL INTENSITY(INCH/HR) =   3.08
  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       1.32
  TOTAL STREAM AREA(ACRES) =       1.32
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.63

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       17.11    7.98    3.703  0.25( 0.03) 0.10       5.2     200.00
      2        3.63   11.04    3.081  0.25( 0.02) 0.10       1.3     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       20.27    7.98    3.703  0.25( 0.03) 0.10       6.1     200.00
      2       17.85   11.04    3.081  0.25( 0.02) 0.10       6.5     300.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
```

```
  PEAK FLOW RATE(CFS) =      20.27    Tc(MIN.) =     7.98
  EFFECTIVE AREA(ACRES) =       6.12   AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        6.5
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    202.00 =     739.80 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        6.5  TC(MIN.) =      7.98
  EFFECTIVE AREA(ACRES) =      6.12  AREA-AVERAGED Fm(INCH/HR)=  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap = 0.100
  PEAK FLOW RATE(CFS)   =      20.27

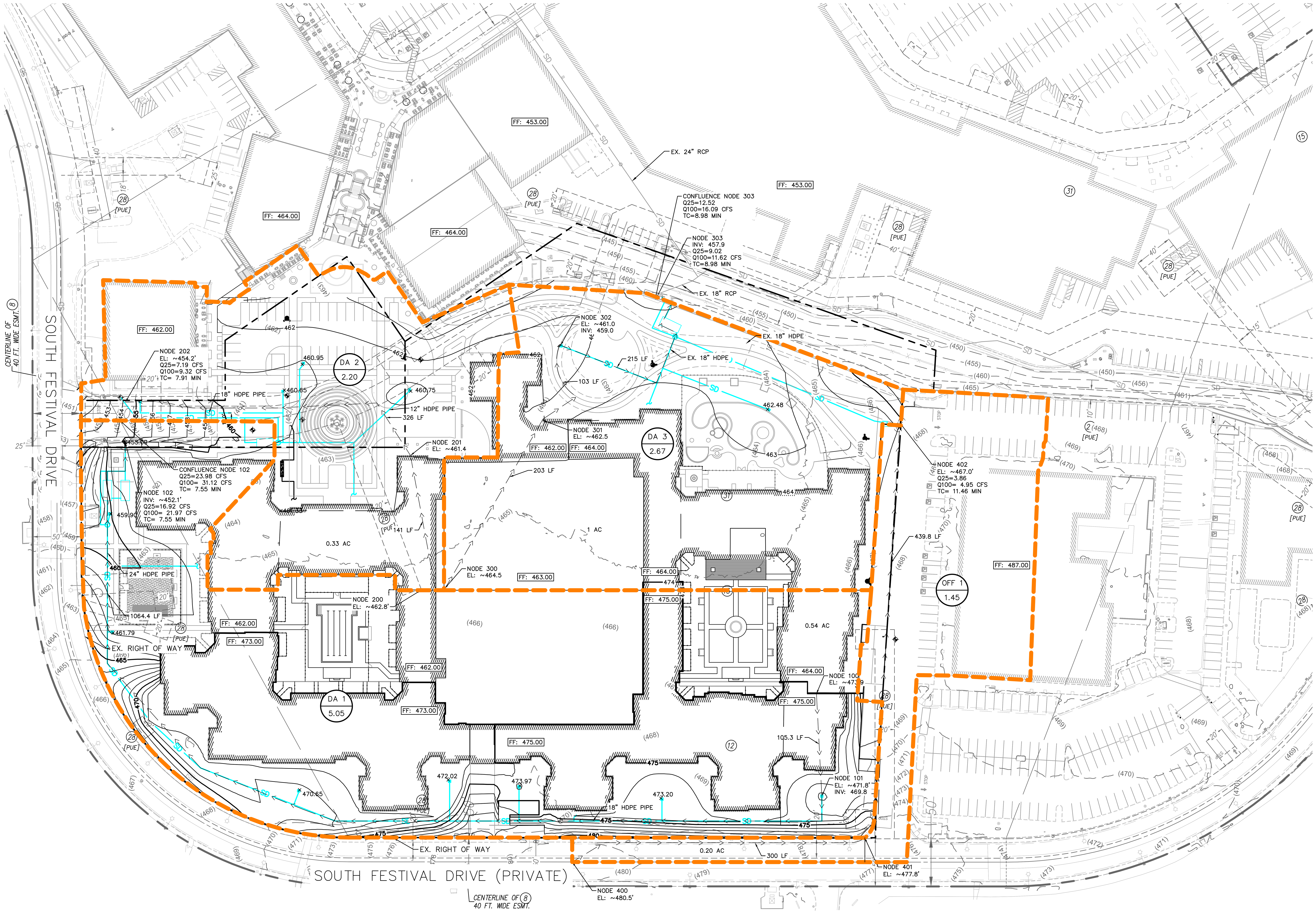
  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       20.27    7.98    3.703  0.25( 0.03) 0.10       6.1     200.00
      2       17.85   11.04    3.081  0.25( 0.02) 0.10       6.5     300.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```



Attachment C - Proposed Conditions Analysis

Drawing name: K:\ORA_LDEV\094810017 - Shea Festival Hill\CADD\Exhibits\Hydrology\Proposed Hydrology Exhibit.dwg EXISTING HYDROLOGY 1 Nov 28, 2023 11:27am by: Kevin.huo

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LEGEND

- PROPERTY LINE
- LOT LINE
- RIGHT-OF-WAY LINE
- CENTER LINE
- EASEMENT LINE
- INITIAL AREA STUDY
- CIVIL LIMIT OF WORK LINE
- EXISTING CONTOURS (XXX)
- PROPOSED CONTOURS XXX
- EXISTING BUILDING
- PROPOSED BUILDING OUTLINE
- PROPOSED CONCRETE PAVING

REVISIONS

NO.	INIT.	DATE	DESCRIPTION	APP'D	DATE
–		--	--		

BENCH MARK:

COUNTY OF ORANGE BENCHMARK "3R-105-85"
ELEVATION: 396.789 (FEET) [DATUM: NAVD 1988] YEAR LEVELED: 2006]
DESCRIBED AS: FOUND 3 3\4" OCS ALUMINUM BENCHMARK DISK STAMPED "3R-105-85", SET IN THE SOUTHWESTERLY CORNER OF A 4 FT. BY 15 FT. CONCRETE CATCH BASIN. MONUMENT IS LOCATED ALONG THE NORTHEASTERLY SIDE OF SANTA ANA CANYON ROAD, 0.8 MILES SOUTHWESTERLY OF THE CENTERLINE OF WEIR CANYON ROAD, 354 FT. WESTERLY OF THE OF TWO STEEL TRANSMISSION LINES CROSSING SANTA ANA CANYON AND 40.5 FT. NORTHERLY OF THE CENTERLINE OF SANTA ANA CANYON. MONUMENT IS SET LEVEL WITH THE SIDEWALK.

PREPARED BY:

ENGINEERS SEAL

Kimley»Horn

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811 Know what's below. Call 811 before you dig.

NORTH

GRAPHIC SCALE IN FEET
0 25 50 100

SCALE: 1" = 50'
WHEN PRINTED AT FULL
SIZE 24"X36"

SITE ADDRESS: 8010-8200 EAST SANTA ANA CANYON ROAD, 350 SOUTH FESTIVAL DR, ANAHEIM, CA 92808

SHEA FESTIVAL HILL
PROPOSED HYDROLOGY EXHIBIT

GRAXXXX

SHEET 01 OF 01

SCALE:

DRAWN BY: FC

CHECKED BY: --

CITY OF ANAHEIM

01

FOR CITY USE ONLY

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**************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
         (c) Copyright 1983-2011 Advanced Engineering Software (aes)
             Ver. 18.0  Release Date: 07/01/2011  License ID 1499

                          Analysis prepared by:
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 ************************* DESCRIPTION OF STUDY *************************
* ANAHEIM HILLS                                                        *
* 25 YEAR STORM                                                        *
* PROPOSED                                                             *
 ************************************************************************
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  FILE NAME: ANAHEIM.DAT
  TIME/DATE OF STUDY: 17:08 11/21/2023
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *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    100.00 TO NODE    101.00 IS CODE =  21
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----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   105.30
  ELEVATION DATA: UPSTREAM(FEET) =    473.90  DOWNSTREAM(FEET) =    471.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.824
  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                 C        0.54      0.25     0.200    69    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      2.34
  TOTAL AREA(ACRES) =      0.54   PEAK FLOW RATE(CFS) =      2.34

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   469.80  DOWNSTREAM(FEET) =   452.10
  FLOW LENGTH(FEET) =  1064.40   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   5.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.52
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.34
  PIPE TRAVEL TIME(MIN.) =   2.72    Tc(MIN.) =    7.72
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =    1169.70 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    7.72
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.772
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 C        4.51      0.25     0.200    69
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =    4.51      SUBAREA RUNOFF(CFS) =   15.10
  EFFECTIVE AREA(ACRES) =      5.05   AREA-AVERAGED Fm(INCH/HR) =  0.05
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  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        5.0       PEAK FLOW RATE(CFS) =      16.92

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 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.) =    7.72
  RAINFALL INTENSITY(INCH/HR) =   3.77
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       5.05
  TOTAL STREAM AREA(ACRES) =       5.05
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      16.92

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   138.00
  ELEVATION DATA: UPSTREAM(FEET) =    462.80  DOWNSTREAM(FEET) =    461.40

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.824
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.425
  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                 C        0.33      0.25     0.200    69    5.82
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      1.30
  TOTAL AREA(ACRES) =      0.33   PEAK FLOW RATE(CFS) =      1.30

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    461.40  DOWNSTREAM(FEET) =    454.20
  CHANNEL LENGTH THRU SUBAREA(FEET) =   326.00   CHANNEL SLOPE =  0.0221
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
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  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.684
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 C        1.87      0.25     0.200    69
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.37
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.44
  AVERAGE FLOW DEPTH(FEET) =   0.13   TRAVEL TIME(MIN.) =   2.23
  Tc(MIN.) =    8.05
  SUBAREA AREA(ACRES) =     1.87       SUBAREA RUNOFF(CFS) =    6.12
  EFFECTIVE AREA(ACRES) =      2.20     AREA-AVERAGED Fm(INCH/HR) =   0.05
  AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.20
  TOTAL AREA(ACRES) =        2.2         PEAK FLOW RATE(CFS) =       7.19

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.16   FLOW VELOCITY(FEET/SEC.) =   2.73
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     464.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    102.00 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.) =    8.05
  RAINFALL INTENSITY(INCH/HR) =   3.68
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       2.20
  TOTAL STREAM AREA(ACRES) =       2.20
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       7.19

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       16.92    7.72    3.772  0.25( 0.05) 0.20       5.0     100.00
      2        7.19    8.05    3.684  0.25( 0.05) 0.20       2.2     200.00

  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       23.98    7.72    3.772  0.25( 0.05) 0.20       7.2     100.00
```

```
     2       23.71    8.05    3.684  0.25( 0.05) 0.20       7.2     200.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      23.98    Tc(MIN.) =     7.72
  EFFECTIVE AREA(ACRES) =       7.16   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        7.2
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =    1169.70 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    300.00 TO NODE    301.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   203.00
  ELEVATION DATA: UPSTREAM(FEET) =    464.50  DOWNSTREAM(FEET) =    462.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.837
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.041
  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                 C        1.00      0.25     0.200    69    6.84
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      3.59
  TOTAL AREA(ACRES) =      1.00   PEAK FLOW RATE(CFS) =      3.59

****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    302.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    462.50  DOWNSTREAM(FEET) =    461.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   103.00   CHANNEL SLOPE =  0.0146
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.804
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 C        1.67      0.25     0.200    69
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       6.42
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.22
  AVERAGE FLOW DEPTH(FEET) =   0.17   TRAVEL TIME(MIN.) =   0.77
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  Tc(MIN.) =    7.61
  SUBAREA AREA(ACRES) =     1.67       SUBAREA RUNOFF(CFS) =    5.64
  EFFECTIVE AREA(ACRES) =      2.67     AREA-AVERAGED Fm(INCH/HR) =   0.05
  AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.20
  TOTAL AREA(ACRES) =        2.7         PEAK FLOW RATE(CFS) =       9.02

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.19   FLOW VELOCITY(FEET/SEC.) =   2.43
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    302.00 =     306.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    302.00 TO NODE    303.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   459.00  DOWNSTREAM(FEET) =   458.90
  FLOW LENGTH(FEET) =   215.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  30.0 INCH PIPE IS  21.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   2.34
  ESTIMATED PIPE DIAMETER(INCH) =  30.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       9.02
  PIPE TRAVEL TIME(MIN.) =   1.53    Tc(MIN.) =    9.14
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    303.00 =     521.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    303.00 TO NODE    303.00 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.) =    9.14
  RAINFALL INTENSITY(INCH/HR) =   3.43
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       2.67
  TOTAL STREAM AREA(ACRES) =       2.67
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       9.02

****************************************************************************
  FLOW PROCESS FROM NODE    400.00 TO NODE    401.00 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) =    480.50  DOWNSTREAM(FEET) =    477.80
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  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.139
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.661
  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                 C        0.20      0.25     0.200    69    8.14
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      0.65
  TOTAL AREA(ACRES) =      0.20   PEAK FLOW RATE(CFS) =      0.65

****************************************************************************
  FLOW PROCESS FROM NODE    401.00 TO NODE    402.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    477.80  DOWNSTREAM(FEET) =    467.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   439.80   CHANNEL SLOPE =  0.0246
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.009
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 C        1.25      0.25     0.200    69
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.32
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.17
  AVERAGE FLOW DEPTH(FEET) =   0.10   TRAVEL TIME(MIN.) =   3.37
  Tc(MIN.) =   11.51
  SUBAREA AREA(ACRES) =     1.25       SUBAREA RUNOFF(CFS) =    3.33
  EFFECTIVE AREA(ACRES) =      1.45     AREA-AVERAGED Fm(INCH/HR) =   0.05
  AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.20
  TOTAL AREA(ACRES) =        1.5         PEAK FLOW RATE(CFS) =       3.86

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.13   FLOW VELOCITY(FEET/SEC.) =   2.42
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    402.00 =     739.80 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    303.00 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.) =   11.51
  RAINFALL INTENSITY(INCH/HR) =   3.01
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       1.45
  TOTAL STREAM AREA(ACRES) =       1.45
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.86

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        9.02    9.14    3.429  0.25( 0.05) 0.20       2.7     300.00
      2        3.86   11.51    3.009  0.25( 0.05) 0.20       1.5     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       12.52    9.14    3.429  0.25( 0.05) 0.20       3.8     300.00
      2       11.76   11.51    3.009  0.25( 0.05) 0.20       4.1     400.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      12.52    Tc(MIN.) =     9.14
  EFFECTIVE AREA(ACRES) =       3.82   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        4.1
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    303.00 =     739.80 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        4.1  TC(MIN.) =      9.14
  EFFECTIVE AREA(ACRES) =      3.82  AREA-AVERAGED Fm(INCH/HR)=  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap = 0.200
  PEAK FLOW RATE(CFS)   =      12.52

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       12.52    9.14    3.429  0.25( 0.05) 0.20       3.8     300.00
      2       11.76   11.51    3.009  0.25( 0.05) 0.20       4.1     400.00
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```



Attachment D – Pipe and Inlet Sizing for 25-year Storm

24" PIPE DA 1 DA 2

Project Description	
Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data	
Roughness Coefficient	0.011
Channel Slope	0.700 %
Normal Depth	24.0 in
Diameter	24.0 in
Discharge	22.37 cfs

Results	
Discharge	22.37 cfs
Normal Depth	24.0 in
Flow Area	3.1 ft²
Wetted Perimeter	6.3 ft
Hydraulic Radius	6.0 in
Top Width	0.00 ft
Critical Depth	20.2 in
Percent Full	100.0 %
Critical Slope	0.667 %
Velocity	7.12 ft/s
Velocity Head	0.79 ft
Specific Energy	2.79 ft
Froude Number	(N/A)
Maximum Discharge	24.06 cfs
Discharge Full	22.37 cfs
Slope Full	0.700 %
Flow Type	Undefined

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	100.0 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	24.0 in
Critical Depth	20.2 in
Channel Slope	0.700 %
Critical Slope	0.667 %

18" PIPE DA1 DA 2

Project Description	
Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data	
Roughness Coefficient	0.011
Channel Slope	1.000 %
Normal Depth	18.0 in
Diameter	18.0 in
Discharge	12.41 cfs

Results	
Discharge	12.41 cfs
Normal Depth	18.0 in
Flow Area	1.8 ft²
Wetted Perimeter	4.7 ft
Hydraulic Radius	4.5 in
Top Width	0.00 ft
Critical Depth	16.0 in
Percent Full	100.0 %
Critical Slope	0.892 %
Velocity	7.02 ft/s
Velocity Head	0.77 ft
Specific Energy	2.27 ft
Froude Number	(N/A)
Maximum Discharge	13.35 cfs
Discharge Full	12.41 cfs
Slope Full	1.000 %
Flow Type	Undefined

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	100.0 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	18.0 in
Critical Depth	16.0 in
Channel Slope	1.000 %
Critical Slope	0.892 %

18" DA3 Off1

Project Description	
Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data	
Roughness Coefficient	0.011
Channel Slope	1.000 %
Normal Depth	18.0 in
Diameter	18.0 in
Discharge	12.41 cfs

Results	
Discharge	12.41 cfs
Normal Depth	18.0 in
Flow Area	1.8 ft²
Wetted Perimeter	4.7 ft
Hydraulic Radius	4.5 in
Top Width	0.00 ft
Critical Depth	16.0 in
Percent Full	100.0 %
Critical Slope	0.892 %
Velocity	7.02 ft/s
Velocity Head	0.77 ft
Specific Energy	2.27 ft
Froude Number	(N/A)
Maximum Discharge	13.35 cfs
Discharge Full	12.41 cfs
Slope Full	1.000 %
Flow Type	Undefined

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	100.0 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	18.0 in
Critical Depth	16.0 in
Channel Slope	1.000 %
Critical Slope	0.892 %

12" DA3 OFF1

Project Description	
Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data		
Roughness Coefficient	0.011	
Channel Slope	1.500	%
Normal Depth	12.0	in
Diameter	12.0	in
Discharge	5.16	cfs

Results		
Discharge	5.16	cfs
Normal Depth	12.0	in
Flow Area	0.8	ft²
Wetted Perimeter	3.1	ft
Hydraulic Radius	3.0	in
Top Width	0.00	ft
Critical Depth	11.1	in
Percent Full	100.0	%
Critical Slope	1.300	%
Velocity	6.57	ft/s
Velocity Head	0.67	ft
Specific Energy	1.67	ft
Froude Number	(N/A)	
Maximum Discharge	5.55	cfs
Discharge Full	5.16	cfs
Slope Full	1.500	%
Flow Type	Undefined	

GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.0	%
Normal Depth Over Rise	100.0	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	12.0	in
Critical Depth	11.1	in
Channel Slope	1.500	%
Critical Slope	1.300	%

INLET CAPACITY CALCULATIONS

Weir Equation =3*(%Percent Opening/100)*(Width)*(Ponded Depth/12)^(3/2)

Catch Basin Number	Type	Width/Perimeter (ft)	Ponded Depth (in)	% Opening of Grate	Full Capacity (cfs)	Clogging Factor (%)	Clogged Capacity (cfs)
1	12"x12" Grate	4	6	100	4.24	75	3.18
2	18"x18" Grate	6	4	100	3.46	75	2.60
2a.	18"x18" Grate	6	6	100	6.36	75	4.77
3	24"x24" Grate	8	4	100	4.62	75	3.46
3a	24"x24" Grate	8	6	100	8.49	75	6.36
4	24"x36" Grate	10	4	100	5.77	75	**4.33**
4a	24"x36" Grate	10	5	100	8.07	75	**6.05**
4b	24"x36" Grate	10	6	100	10.61	75	**7.95**
5	36"x36" Grate	12	5	100	9.68	75	**7.26**
5a.	36"x36" Grate	12	6	100	12.73	75	**9.55**
6	48"x48" Grate	16	6	100	16.97	75	**12.73**
7	3.5' Curb Inlet	3.5	8	100	5.72	75	**4.29**
8	7' Curb Inlet	7	6	100	7.42	75	**5.57**
8a.	7' Curb Inlet	7	5	100	5.65	100	**5.65**
8b.	7' Curb Inlet	7	2.5	100	2.00	100	**2.00**
9	10' Curb Inlet	10	8	100	16.33	100	**16.33**
10	14' Curb Inlet	14	8	100	22.86	100	**22.86**

Orifice Equation =5.37*Area*(Percent Opening/100)*(Ponded Depth/12)^(1/2)

Catch Basin Number	Type	Area (sq. ft.)*	Ponded Depth (in)*	% Opening of Grate	Full Capacity (cfs)	Clogging Factor (%)	Clogged Capacity (cfs)
1	12"x12" Grate	1	6	75	2.85	50	**1.42**
2	18"x18" Grate	2.25	6	75	6.41	50	**3.20**
2a	18"x18" Grate	2.25	4	75	5.23	50	**2.62**
3	24"x24" Grate	4	4	75	9.30	50	**4.65**
3a.	24"x24" Grate	4	6	75	11.39	50	**5.70**
3b	24"x24" Grate	4	3	75	8.06	50	**4.03**
4	24"x36" Grate	6.25	6	75	17.80	50	8.90
5	36"x36" Grate	9	6	75	25.63	50	12.82
6	48"x48" Grate	16	6	75	45.57	50	22.78
7	3.5' Curb Inlet	2.33	8	100	10.22	100	10.22
8	7' Curb Inlet	4.67	8	100	20.48	100	20.48
9	10' Curb Inlet	6.67	8	100	29.25	100	29.25
10	14' Curb Inlet	9.33	8	100	40.91	100	40.91

*Assumes 8" CF for curb inlet due to local sump

Attachment E – 10/100-Year Analysis

```
_____
*****************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
        (c) Copyright 1983-2011 Advanced Engineering Software (aes)
            Ver. 18.0  Release Date: 07/01/2011  License ID 1499

                          Analysis prepared by:




 ************************* DESCRIPTION OF STUDY *************************
* ANAHEIM HILLS                                                         *
* 10 YEAR STORM                                                         *
* EXISTING CONDITION                                                    *
 *************************************************************************

  FILE NAME: ANAHEIM.DAT
  TIME/DATE OF STUDY: 16:54 11/21/2023
=============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
=============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I 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    100.00 TO NODE    101.00 IS CODE =  21
```

```
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   250.00
  ELEVATION DATA: UPSTREAM(FEET) =    467.90  DOWNSTREAM(FEET) =    464.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.360
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.537
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 C        1.46      0.25     0.100    50    6.36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      4.61
  TOTAL AREA(ACRES) =      1.46   PEAK FLOW RATE(CFS) =      4.61

************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  51
------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    464.00  DOWNSTREAM(FEET) =    453.80
  CHANNEL LENGTH THRU SUBAREA(FEET) =   325.00   CHANNEL SLOPE =  0.0314
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.119
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 C        3.42      0.25     0.100    50
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       9.36
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.47
  AVERAGE FLOW DEPTH(FEET) =   0.16   TRAVEL TIME(MIN.) =   1.56
  Tc(MIN.) =    7.92
  SUBAREA AREA(ACRES) =     3.42       SUBAREA RUNOFF(CFS) =    9.52
  EFFECTIVE AREA(ACRES) =      4.88     AREA-AVERAGED Fm(INCH/HR) =   0.03
  AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        4.9         PEAK FLOW RATE(CFS) =      13.59

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.19   FLOW VELOCITY(FEET/SEC.) =   3.66
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     575.00 FEET.

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

```
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   210.00
  ELEVATION DATA: UPSTREAM(FEET) =    470.00  DOWNSTREAM(FEET) =    466.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.699
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.766
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 C        2.16      0.25     0.100    50    5.70
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      7.27
  TOTAL AREA(ACRES) =      2.16   PEAK FLOW RATE(CFS) =      7.27

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    466.00  DOWNSTREAM(FEET) =    461.20
  CHANNEL LENGTH THRU SUBAREA(FEET) =   369.00   CHANNEL SLOPE =  0.0130
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.086
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 C        3.01      0.25     0.100    50
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      11.42
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.60
  AVERAGE FLOW DEPTH(FEET) =   0.21   TRAVEL TIME(MIN.) =   2.37
  Tc(MIN.) =    8.07
  SUBAREA AREA(ACRES) =     3.01       SUBAREA RUNOFF(CFS) =    8.29
  EFFECTIVE AREA(ACRES) =      5.17     AREA-AVERAGED Fm(INCH/HR) =   0.03
  AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        5.2          PEAK FLOW RATE(CFS) =      14.24

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.23   FLOW VELOCITY(FEET/SEC.) =   2.68
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     579.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    202.00 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.) =    8.07
  RAINFALL INTENSITY(INCH/HR) =   3.09
  AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       5.17
  TOTAL STREAM AREA(ACRES) =       5.17
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      14.24

****************************************************************************
  FLOW PROCESS FROM NODE    300.00 TO NODE    301.00 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) =    480.50  DOWNSTREAM(FEET) =    477.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.636
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.185
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 C        0.20      0.25     0.100    50    7.64
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      0.57
  TOTAL AREA(ACRES) =      0.20   PEAK FLOW RATE(CFS) =      0.57

****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    302.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    477.80  DOWNSTREAM(FEET) =    466.60
  CHANNEL LENGTH THRU SUBAREA(FEET) =   439.80   CHANNEL SLOPE =  0.0255
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.566
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
```

```
     LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                C        1.12      0.25     0.100    50
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.85
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.10
  AVERAGE FLOW DEPTH(FEET) =   0.09   TRAVEL TIME(MIN.) =   3.50
  Tc(MIN.) =   11.13
  SUBAREA AREA(ACRES) =     1.12       SUBAREA RUNOFF(CFS) =    2.56
  EFFECTIVE AREA(ACRES) =      1.32     AREA-AVERAGED Fm(INCH/HR) =   0.02
  AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        1.3         PEAK FLOW RATE(CFS) =       3.02

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.11   FLOW VELOCITY(FEET/SEC.) =   2.45
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    302.00 =     739.80 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    302.00 TO NODE    202.00 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.) =   11.13
  RAINFALL INTENSITY(INCH/HR) =   2.57
  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       1.32
  TOTAL STREAM AREA(ACRES) =       1.32
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.02

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       14.24    8.07    3.086  0.25( 0.03) 0.10       5.2     200.00
      2        3.02   11.13    2.566  0.25( 0.02) 0.10       1.3     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       16.88    8.07    3.086  0.25( 0.03) 0.10       6.1     200.00
      2       14.84   11.13    2.566  0.25( 0.02) 0.10       6.5     300.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
```

```
  PEAK FLOW RATE(CFS) =      16.88    Tc(MIN.) =     8.07
  EFFECTIVE AREA(ACRES) =       6.13   AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        6.5
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    202.00 =     739.80 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        6.5  TC(MIN.) =      8.07
  EFFECTIVE AREA(ACRES) =      6.13  AREA-AVERAGED Fm(INCH/HR)=  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap = 0.100
  PEAK FLOW RATE(CFS)   =      16.88

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       16.88    8.07    3.086  0.25( 0.03) 0.10       6.1     200.00
      2       14.84   11.13    2.566  0.25( 0.02) 0.10       6.5     300.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```



```
_____
*****************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
        (c) Copyright 1983-2011 Advanced Engineering Software (aes)
            Ver. 18.0  Release Date: 07/01/2011  License ID 1499

                          Analysis prepared by:




 ************************* DESCRIPTION OF STUDY *************************
* ANAHEIM HILLS                                                         *
* 10 YEAR STORM                                                         *
* PROPOSED                                                              *
 *************************************************************************

  FILE NAME: ANAHEIM.DAT
  TIME/DATE OF STUDY: 17:09 11/21/2023
=============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
=============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I 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    100.00 TO NODE    101.00 IS CODE =  21
```

```
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   105.30
  ELEVATION DATA: UPSTREAM(FEET) =    473.90  DOWNSTREAM(FEET) =    471.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  4.060
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 C        0.54      0.25     0.200    50    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      1.96
  TOTAL AREA(ACRES) =      0.54   PEAK FLOW RATE(CFS) =      1.96

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   469.80  DOWNSTREAM(FEET) =   452.10
  FLOW LENGTH(FEET) =  1064.40   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   5.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.24
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.96
  PIPE TRAVEL TIME(MIN.) =   2.84    Tc(MIN.) =    7.84
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =    1169.70 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    7.84
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.136
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 C        4.51      0.25     0.200    50
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =    4.51      SUBAREA RUNOFF(CFS) =   12.52
  EFFECTIVE AREA(ACRES) =      5.05   AREA-AVERAGED Fm(INCH/HR) =  0.05
```

```
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        5.0       PEAK FLOW RATE(CFS) =      14.03

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 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.) =    7.84
  RAINFALL INTENSITY(INCH/HR) =   3.14
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       5.05
  TOTAL STREAM AREA(ACRES) =       5.05
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      14.03

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   138.00
  ELEVATION DATA: UPSTREAM(FEET) =    462.80  DOWNSTREAM(FEET) =    461.40

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.824
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.720
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 C        0.33      0.25     0.200    50    5.82
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      1.09
  TOTAL AREA(ACRES) =      0.33   PEAK FLOW RATE(CFS) =      1.09

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    461.40  DOWNSTREAM(FEET) =    454.20
  CHANNEL LENGTH THRU SUBAREA(FEET) =   326.00   CHANNEL SLOPE =  0.0221
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
```

```
 *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.073
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 APARTMENTS                 C        1.87      0.25     0.200    50
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.64
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.36
 AVERAGE FLOW DEPTH(FEET) =   0.12   TRAVEL TIME(MIN.) =   2.31
 Tc(MIN.) =    8.13
 SUBAREA AREA(ACRES) =     1.87       SUBAREA RUNOFF(CFS) =    5.09
 EFFECTIVE AREA(ACRES) =      2.20     AREA-AVERAGED Fm(INCH/HR) =   0.05
 AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.20
 TOTAL AREA(ACRES) =        2.2         PEAK FLOW RATE(CFS) =       5.98

 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  0.15   FLOW VELOCITY(FEET/SEC.) =   2.70
 LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     464.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    202.00 TO NODE    102.00 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.) =    8.13
 RAINFALL INTENSITY(INCH/HR) =   3.07
 AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.25
 AREA-AVERAGED Ap =  0.20
 EFFECTIVE STREAM AREA(ACRES) =       2.20
 TOTAL STREAM AREA(ACRES) =       2.20
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       5.98

 ** CONFLUENCE DATA **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1       14.03    7.84    3.136  0.25( 0.05) 0.20       5.0     100.00
     2        5.98    8.13    3.073  0.25( 0.05) 0.20       2.2     200.00

 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       19.92    7.84    3.136  0.25( 0.05) 0.20       7.2     100.00
```

```
     2       19.72    8.13    3.073  0.25( 0.05) 0.20       7.2     200.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      19.92    Tc(MIN.) =     7.84
  EFFECTIVE AREA(ACRES) =       7.17   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        7.2
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =    1169.70 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    300.00 TO NODE    301.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   203.00
  ELEVATION DATA: UPSTREAM(FEET) =    464.50  DOWNSTREAM(FEET) =    462.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.837
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.393
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 C        1.00      0.25     0.200    50    6.84
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      3.01
  TOTAL AREA(ACRES) =      1.00   PEAK FLOW RATE(CFS) =      3.01

****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    302.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    462.50  DOWNSTREAM(FEET) =    461.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   103.00   CHANNEL SLOPE =  0.0146
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.189
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 C        1.67      0.25     0.200    50
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.37
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.19
  AVERAGE FLOW DEPTH(FEET) =   0.16   TRAVEL TIME(MIN.) =   0.78
```

```
  Tc(MIN.) =    7.62
  SUBAREA AREA(ACRES) =     1.67       SUBAREA RUNOFF(CFS) =    4.72
  EFFECTIVE AREA(ACRES) =      2.67     AREA-AVERAGED Fm(INCH/HR) =   0.05
  AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.20
  TOTAL AREA(ACRES) =        2.7         PEAK FLOW RATE(CFS) =       7.54

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.18   FLOW VELOCITY(FEET/SEC.) =   2.40
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    302.00 =     306.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    302.00 TO NODE    303.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   459.00  DOWNSTREAM(FEET) =   458.90
  FLOW LENGTH(FEET) =   215.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  27.0 INCH PIPE IS  21.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   2.21
  ESTIMATED PIPE DIAMETER(INCH) =  27.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       7.54
  PIPE TRAVEL TIME(MIN.) =   1.62    Tc(MIN.) =    9.24
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    303.00 =     521.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    303.00 TO NODE    303.00 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.) =    9.24
  RAINFALL INTENSITY(INCH/HR) =   2.85
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       2.67
  TOTAL STREAM AREA(ACRES) =       2.67
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       7.54

****************************************************************************
  FLOW PROCESS FROM NODE    400.00 TO NODE    401.00 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) =    480.50  DOWNSTREAM(FEET) =    477.80
```

```
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.139
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.071
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                  C        0.20      0.25     0.200    50    8.14
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      0.54
  TOTAL AREA(ACRES) =      0.20   PEAK FLOW RATE(CFS) =      0.54

****************************************************************************
  FLOW PROCESS FROM NODE    401.00 TO NODE    402.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    477.80  DOWNSTREAM(FEET) =    467.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   439.80   CHANNEL SLOPE =  0.0246
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.503
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                  C        1.25      0.25     0.200    50
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.93
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.10
  AVERAGE FLOW DEPTH(FEET) =   0.10   TRAVEL TIME(MIN.) =   3.48
  Tc(MIN.) =   11.62
  SUBAREA AREA(ACRES) =     1.25       SUBAREA RUNOFF(CFS) =    2.76
  EFFECTIVE AREA(ACRES) =      1.45     AREA-AVERAGED Fm(INCH/HR) =   0.05
  AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.20
  TOTAL AREA(ACRES) =        1.5         PEAK FLOW RATE(CFS) =       3.20

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.12   FLOW VELOCITY(FEET/SEC.) =   2.35
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    402.00 =     739.80 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    303.00 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.) =   11.62
  RAINFALL INTENSITY(INCH/HR) =   2.50
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       1.45
  TOTAL STREAM AREA(ACRES) =       1.45
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.20

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        7.54    9.24    2.855  0.25( 0.05) 0.20       2.7     300.00
      2        3.20   11.62    2.503  0.25( 0.05) 0.20       1.5     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       10.45    9.24    2.855  0.25( 0.05) 0.20       3.8     300.00
      2        9.80   11.62    2.503  0.25( 0.05) 0.20       4.1     400.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      10.45    Tc(MIN.) =     9.24
  EFFECTIVE AREA(ACRES) =       3.82   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        4.1
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    303.00 =     739.80 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        4.1  TC(MIN.) =      9.24
  EFFECTIVE AREA(ACRES) =      3.82  AREA-AVERAGED Fm(INCH/HR)=  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap = 0.200
  PEAK FLOW RATE(CFS)   =      10.45

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       10.45    9.24    2.855  0.25( 0.05) 0.20       3.8     300.00
      2        9.80   11.62    2.503  0.25( 0.05) 0.20       4.1     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:




 ************************* DESCRIPTION OF STUDY *************************
* ANAHEIM HILLS                                                         *
* 100 YEAR STORM                                                        *
* EXISTING CONDITION                                                    *
 *************************************************************************

  FILE NAME: ANAHEIM.DAT
  TIME/DATE OF STUDY: 16:43 11/21/2023
=============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
=============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *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    100.00 TO NODE    101.00 IS CODE =  21
```

```
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   250.00
  ELEVATION DATA: UPSTREAM(FEET) =    467.90  DOWNSTREAM(FEET) =    464.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.360
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.391
  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                 C        1.46      0.25     0.100    86    6.36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      7.05
  TOTAL AREA(ACRES) =      1.46   PEAK FLOW RATE(CFS) =      7.05

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    464.00  DOWNSTREAM(FEET) =    453.80
  CHANNEL LENGTH THRU SUBAREA(FEET) =   325.00   CHANNEL SLOPE =  0.0314
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.802
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 C        3.42      0.25     0.100    86
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      14.40
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.81
  AVERAGE FLOW DEPTH(FEET) =   0.20   TRAVEL TIME(MIN.) =   1.42
  Tc(MIN.) =    7.78
  SUBAREA AREA(ACRES) =     3.42       SUBAREA RUNOFF(CFS) =   14.70
  EFFECTIVE AREA(ACRES) =      4.88     AREA-AVERAGED Fm(INCH/HR) =   0.03
  AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        4.9         PEAK FLOW RATE(CFS) =      20.98

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.23   FLOW VELOCITY(FEET/SEC.) =   4.15
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     575.00 FEET.

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

```
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   210.00
  ELEVATION DATA: UPSTREAM(FEET) =    470.00  DOWNSTREAM(FEET) =    466.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.699
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.740
  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                 C        2.16      0.25     0.100    86    5.70
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =     11.11
  TOTAL AREA(ACRES) =      2.16   PEAK FLOW RATE(CFS) =     11.11

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    466.00  DOWNSTREAM(FEET) =    461.20
  CHANNEL LENGTH THRU SUBAREA(FEET) =   369.00   CHANNEL SLOPE =  0.0130
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.779
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 C        3.01      0.25     0.100    86
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      17.56
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.86
  AVERAGE FLOW DEPTH(FEET) =   0.25   TRAVEL TIME(MIN.) =   2.15
  Tc(MIN.) =    7.85
  SUBAREA AREA(ACRES) =     3.01       SUBAREA RUNOFF(CFS) =   12.88
  EFFECTIVE AREA(ACRES) =      5.17     AREA-AVERAGED Fm(INCH/HR) =   0.03
  AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        5.2          PEAK FLOW RATE(CFS) =      22.12

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.27   FLOW VELOCITY(FEET/SEC.) =   3.02
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     579.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    202.00 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) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       5.17
  TOTAL STREAM AREA(ACRES) =       5.17
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      22.12

****************************************************************************
  FLOW PROCESS FROM NODE    300.00 TO NODE    301.00 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) =    480.50  DOWNSTREAM(FEET) =    477.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.636
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.854
  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                 C        0.20      0.25     0.100    86    7.64
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      0.87
  TOTAL AREA(ACRES) =      0.20   PEAK FLOW RATE(CFS) =      0.87

****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    302.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    477.80  DOWNSTREAM(FEET) =    466.60
  CHANNEL LENGTH THRU SUBAREA(FEET) =   439.80   CHANNEL SLOPE =  0.0255
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.985
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
```

```
     LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                C        1.12      0.25     0.100    86
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.88
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.33
  AVERAGE FLOW DEPTH(FEET) =   0.11   TRAVEL TIME(MIN.) =   3.14
  Tc(MIN.) =   10.78
  SUBAREA AREA(ACRES) =     1.12       SUBAREA RUNOFF(CFS) =    3.99
  EFFECTIVE AREA(ACRES) =      1.32     AREA-AVERAGED Fm(INCH/HR) =   0.02
  AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        1.3         PEAK FLOW RATE(CFS) =       4.70

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.13   FLOW VELOCITY(FEET/SEC.) =   2.63
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    302.00 =     739.80 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    302.00 TO NODE    202.00 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.) =   10.78
  RAINFALL INTENSITY(INCH/HR) =   3.98
  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       1.32
  TOTAL STREAM AREA(ACRES) =       1.32
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       4.70

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       22.12    7.85    4.779  0.25( 0.03) 0.10       5.2     200.00
      2        4.70   10.78    3.985  0.25( 0.02) 0.10       1.3     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       26.23    7.85    4.779  0.25( 0.03) 0.10       6.1     200.00
      2       23.13   10.78    3.985  0.25( 0.02) 0.10       6.5     300.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
```

```
  PEAK FLOW RATE(CFS) =      26.23    Tc(MIN.) =     7.85
  EFFECTIVE AREA(ACRES) =       6.13   AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        6.5
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    202.00 =     739.80 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        6.5  TC(MIN.) =      7.85
  EFFECTIVE AREA(ACRES) =      6.13  AREA-AVERAGED Fm(INCH/HR)=  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap = 0.100
  PEAK FLOW RATE(CFS)   =      26.23

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       26.23    7.85    4.779  0.25( 0.03) 0.10       6.1     200.00
      2       23.13   10.78    3.985  0.25( 0.02) 0.10       6.5     300.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```



```
_____
*****************************************************************************
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                          Analysis prepared by:




 ************************* DESCRIPTION OF STUDY *************************
* ANAHEIM HILLS                                                         *
* 100 YEAR STORM                                                        *
* PROPOSED                                                              *
 *************************************************************************

  FILE NAME: ANAHEIM.DAT
  TIME/DATE OF STUDY: 17:07 11/21/2023
=============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
=============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *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    100.00 TO NODE    101.00 IS CODE =  21
```

```
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   105.30
  ELEVATION DATA: UPSTREAM(FEET) =    473.90  DOWNSTREAM(FEET) =    471.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  6.187
  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                 C        0.54      0.25     0.200    86    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      3.00
  TOTAL AREA(ACRES) =      0.54   PEAK FLOW RATE(CFS) =      3.00

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   469.80  DOWNSTREAM(FEET) =   452.10
  FLOW LENGTH(FEET) =  1064.40   MANNING'S N =  0.011
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   6.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.95
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.00
  PIPE TRAVEL TIME(MIN.) =   2.55    Tc(MIN.) =    7.55
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =    1169.70 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    7.55
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.885
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 C        4.51      0.25     0.200    86
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =    4.51      SUBAREA RUNOFF(CFS) =   19.61
  EFFECTIVE AREA(ACRES) =      5.05   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
```

```
  TOTAL AREA(ACRES) =        5.0       PEAK FLOW RATE(CFS) =      21.97

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 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.) =    7.55
  RAINFALL INTENSITY(INCH/HR) =   4.88
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       5.05
  TOTAL STREAM AREA(ACRES) =       5.05
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      21.97

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   138.00
  ELEVATION DATA: UPSTREAM(FEET) =    462.80  DOWNSTREAM(FEET) =    461.40

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.824
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.669
  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                 C        0.33      0.25     0.200    86    5.82
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      1.67
  TOTAL AREA(ACRES) =      0.33   PEAK FLOW RATE(CFS) =      1.67

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    461.40  DOWNSTREAM(FEET) =    454.20
  CHANNEL LENGTH THRU SUBAREA(FEET) =   326.00   CHANNEL SLOPE =  0.0221
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.759
```

```
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                  C        1.87      0.25     0.200    86
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.65
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.61
  AVERAGE FLOW DEPTH(FEET) =   0.15   TRAVEL TIME(MIN.) =   2.08
  Tc(MIN.) =    7.91
  SUBAREA AREA(ACRES) =     1.87       SUBAREA RUNOFF(CFS) =    7.92
  EFFECTIVE AREA(ACRES) =      2.20     AREA-AVERAGED Fm(INCH/HR) =   0.05
  AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.20
  TOTAL AREA(ACRES) =        2.2          PEAK FLOW RATE(CFS) =       9.32

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.18   FLOW VELOCITY(FEET/SEC.) =   2.96
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     464.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    102.00 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.) =    7.91
  RAINFALL INTENSITY(INCH/HR) =   4.76
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       2.20
  TOTAL STREAM AREA(ACRES) =       2.20
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       9.32

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       21.97    7.55    4.885  0.25( 0.05) 0.20       5.0     100.00
      2        9.32    7.91    4.759  0.25( 0.05) 0.20       2.2     200.00

  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       31.12    7.55    4.885  0.25( 0.05) 0.20       7.2     100.00
      2       30.72    7.91    4.759  0.25( 0.05) 0.20       7.2     200.00
```

```
  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      31.12    Tc(MIN.) =     7.55
  EFFECTIVE AREA(ACRES) =       7.15   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        7.2
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =    1169.70 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    300.00 TO NODE    301.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   203.00
  ELEVATION DATA: UPSTREAM(FEET) =    464.50  DOWNSTREAM(FEET) =    462.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.837
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.172
  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                 C        1.00      0.25     0.200    86    6.84
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      4.61
  TOTAL AREA(ACRES) =      1.00   PEAK FLOW RATE(CFS) =      4.61

****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    302.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    462.50  DOWNSTREAM(FEET) =    461.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   103.00   CHANNEL SLOPE =  0.0146
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.886
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 C        1.67      0.25     0.200    86
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       8.25
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.41
  AVERAGE FLOW DEPTH(FEET) =   0.19   TRAVEL TIME(MIN.) =   0.71
  Tc(MIN.) =    7.55
```

```
  SUBAREA AREA(ACRES) =     1.67       SUBAREA RUNOFF(CFS) =    7.27
  EFFECTIVE AREA(ACRES) =      2.67     AREA-AVERAGED Fm(INCH/HR) =   0.05
  AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.20
  TOTAL AREA(ACRES) =        2.7         PEAK FLOW RATE(CFS) =      11.62

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.21   FLOW VELOCITY(FEET/SEC.) =   2.64
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    302.00 =     306.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    302.00 TO NODE    303.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   459.00  DOWNSTREAM(FEET) =   458.90
  FLOW LENGTH(FEET) =   215.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  33.0 INCH PIPE IS  24.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   2.50
  ESTIMATED PIPE DIAMETER(INCH) =  33.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      11.62
  PIPE TRAVEL TIME(MIN.) =   1.43    Tc(MIN.) =    8.98
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    303.00 =     521.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    303.00 TO NODE    303.00 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.) =    8.98
  RAINFALL INTENSITY(INCH/HR) =   4.42
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       2.67
  TOTAL STREAM AREA(ACRES) =       2.67
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      11.62

****************************************************************************
  FLOW PROCESS FROM NODE    400.00 TO NODE    401.00 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) =    480.50  DOWNSTREAM(FEET) =    477.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
```

```
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.139
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.680
  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                 C        0.20      0.25     0.200    86    8.14
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      0.83
  TOTAL AREA(ACRES) =      0.20   PEAK FLOW RATE(CFS) =      0.83

****************************************************************************
  FLOW PROCESS FROM NODE    401.00 TO NODE    402.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    477.80  DOWNSTREAM(FEET) =    467.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   439.80   CHANNEL SLOPE =  0.0246
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.846
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 C        1.25      0.25     0.200    86
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.00
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.21
  AVERAGE FLOW DEPTH(FEET) =   0.12   TRAVEL TIME(MIN.) =   3.32
  Tc(MIN.) =   11.46
  SUBAREA AREA(ACRES) =     1.25       SUBAREA RUNOFF(CFS) =    4.27
  EFFECTIVE AREA(ACRES) =      1.45     AREA-AVERAGED Fm(INCH/HR) =   0.05
  AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.20
  TOTAL AREA(ACRES) =        1.5         PEAK FLOW RATE(CFS) =       4.95

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.14   FLOW VELOCITY(FEET/SEC.) =   2.55
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    402.00 =     739.80 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    303.00 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.) =   11.46
```

```
  RAINFALL INTENSITY(INCH/HR) =   3.85
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       1.45
  TOTAL STREAM AREA(ACRES) =       1.45
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       4.95

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       11.62    8.98    4.423  0.25( 0.05) 0.20       2.7     300.00
      2        4.95   11.46    3.846  0.25( 0.05) 0.20       1.5     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       16.09    8.98    4.423  0.25( 0.05) 0.20       3.8     300.00
      2       15.04   11.46    3.846  0.25( 0.05) 0.20       4.1     400.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      16.09    Tc(MIN.) =     8.98
  EFFECTIVE AREA(ACRES) =       3.81   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        4.1
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    303.00 =     739.80 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        4.1  TC(MIN.) =      8.98
  EFFECTIVE AREA(ACRES) =      3.81  AREA-AVERAGED Fm(INCH/HR)=  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap = 0.200
  PEAK FLOW RATE(CFS)   =      16.09

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       16.09    8.98    4.423  0.25( 0.05) 0.20       3.8     300.00
      2       15.04   11.46    3.846  0.25( 0.05) 0.20       4.1     400.00
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```



ANAH-WQMP-20XX-XXXXX

County of Orange/Santa Ana Region Priority Project Conceptual Water Quality Management Plan (WQMP)

Project Name:

Shea Festival Hill

PRELIMINARY WQMP

350 SOUTH FESTIVAL DRIVE, ANAHEIM, CA 92808

APN: 354-451-19, 32

Prepared for:

Shea Properties

130 Vantis, Suite 200

Aliso Viejo, CA 92656

Prepared by:

Kimley-Horn and Associates

1100 Town and Country Rd, Suite 700

Orange, CA 92868

(714) 705-1368

Terrence Gaines, P.E.

November 2023

Project Owner's Certification			
Planning Application No. (If applicable)		Grading Permit No.	
Tract/Parcel Map and Lot(s) No.	354-451-19, 32	Building Permit No.	
Address of Project Site and APN (If no address, specify Tract/Parcel Map and Lot Numbers)			350 South Festival Drive, Anaheim, CA 92808

This Water Quality Management Plan (WQMP) has been prepared for Shea Properties by Kimley-Horn and Associates. The WQMP is intended to comply with the requirements of the County of Orange 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 , including the ongoing operation and maintenance of all best management practices (BMPs), 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 Santa Ana Region. 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:			
Title	Sean McEachern		
Company	Shea Properties		
Address	130 Vantis, Suite 200 Aliso Viejo, CA 92656		
Email	sean.mceachern@sheaproperties.com		
Telephone #	949-389-7038		
I understand my responsibility to implement the provisions of this WQMP including the ongoing operation and maintenance of the best management practices (BMPs) described herein.			
Owner Signature		Date	

Preparer (Engineer): Terrence Gaines			
Title	P.E.	PE Registration #	C89265
Company	Kimley-Horn and Associates		
Address	1100 Town and Country Rd, Suite 700 Orange, CA 92868		
Email	Terrence.gaines@kimley-horn.com		
Telephone #	714-786-6119		
I hereby certify that this Water Quality Management Plan is in compliance with, and meets the requirements set forth in, Order No. R8-2009-0030/NPDES No. CAS618030, of the Santa Ana Regional Water Quality Control Board.			
Preparer Signature		Date	11/22/23
Place Stamp Here			

Contents

Page No.

Section I **Permit(s) and Water Quality Conditions of Approval or Issuance 1**
Section II **Project Description 3**
Section III **Site Description 8**
Section IV **Best Management Practices (BMPs) 10**
Section V **Inspection/Maintenance Responsibility for BMPs 24**
Section VI **BMP Exhibit (Site Plan) 25**
Section VII **Educational Materials 26**

Attachments

Attachment A – Calculations, Worksheets, and Cross-Sections –
Attachment B – 2-Year Storm Event Hydrology Calculations (Not Applicable)
Attachment C – O+M Plan
Attachment D – Educational Materials (Include Reference/Link Only)
Attachment E – Geotechnical Report
Attachment F – Notice of Transfer of Responsibility Form
Attachment G – City of Anaheim Correspondence, if Applicable
Attachment H – Additional Attachments

Section I Permit(s) and Water Quality Conditions of Approval or Issuance

Project Infomation			
Permit/Application No. (If applicable)	Preliminary Grading Review		
Address of Project Site (or Tract Map and Lot Number if no address) and APN	350 South Festival Drive, Anaheim, CA 92808 345-451-19, 345-451-32		

Water Quality Conditions of Approval or Issuance	
Water Quality Conditions of Approval or Issuance applied to this project. (Please list verbatim.)	Prior to the issuance by the City of Anaheim of a grading permit, building permit and/or conditional use permit for any new development or significant redevelopment, the property owner shall submit to and obtain the approval of the Public Works Department of a water quality management plan. If the new development or significant redevelopment will be approved without application for a grading permit, building permit or conditional use permit, the property owner shall submit to and obtain the approval of the Public Works Department of a water quality management plan prior to the issuance of a discretionary land use approval or, at the City's discretion, prior to recordation of a subdivision map.

Conceptual WQMP	
Was a Conceptual Water Quality Management Plan previously approved for this project?	No. This document will serve as a conceptual WQMP.

Watershed-Based Plan Conditions	
Provide applicable conditions from watershed - based plans including WIHMPs and TMDLS.	The project lies within the Santa Ana River Watershed. No TMDLs are reported per the 2014-16 Integrated Report for Santa Ana River, Reach 1 and 2. Per the hydromodification susceptibility map, the project area is not located within potential areas of erosion, habitat, and physical structure susceptibility. The site is adjacent to potential areas of erosion, habitat, and physical structure susceptibility on the east, south, and west. The project area discharges to the Santa Ana River Channel, Reach 2. Most likely through local storm drainage on East Santa Ana Canyon Rd (to be confirmed). The Santa Ana River Channel Discharges directly to the Pacific Ocean. The State Water Resources Control Board trash amendments require full capture of trash.

Section II Project Description

II.1 Project Description

<table>
<tr><th colspan="5">Description of Proposed Project</th></tr>
<tr><td>Development Category (From Model WQMP, Table 7.11-2; or -3):</td><td colspan="4">All significant redevelopment projects, where significant redevelopment is defined as the addition or replacement of 5,000 or more square feet of impervious surface on an already developed site. Redevelopment does not include routine maintenance activities that are conducted to maintain original line and grade, hydraulic capacity, original purpose of the facility, or emergency redevelopment activity required to protect public health and safety.

If the redevelopment results in the addition or replacement of less than 50 percent of the impervious area on-site and the existing development was not subject to WQMP requirement, the numeric sizing criteria discussed in Section 7.II-2.0 only applies to the addition or replacement area. If the addition or replacement accounts for 50 percent or more of the impervious area, the Project WQMP requirements apply to the entire development.</td></tr>
<tr><td>Project Area (ft²): 454,957</td><td colspan="3">Number of Dwelling Units: 450</td><td>SIC Code: 1522</td></tr>
<tr><td rowspan="2">Project Area</td><td colspan="2">Pervious</td><td colspan="2">Impervious</td></tr>
<tr><td>Area (acres or sq ft)</td><td>Percentage</td><td>Area (acres or sq ft)</td><td>Percentage</td></tr>
<tr><td>Pre-Project Conditions</td><td>43,821</td><td>10</td><td>394,392</td><td>90</td></tr>
<tr><td>Post-Project Conditions</td><td>87,642</td><td>20</td><td>350,570</td><td>80</td></tr>
<tr><td>Drainage Patterns/Connections</td><td colspan="4">The existing Drainage Area is a shopping center and consists of a movie theater building on site and a parking lot consisting of asphalt pavement with landscaped islands throughout as well as a heavily landscaped swale/hill along the northern parcel line. S Festival Dr is located to the south and west of the site. The site follows three general drainage patterns. The western portion of the site drains to the west exiting the site through the curb inlets located on the driveway leading to S Festival Dr. The eastern portion of the site drains to a central point in the heavily landscaped swale/hill along the northern parcel line that divides the upper and lower levels of the existing shopping center draining to the lower level of the shopping center. An additional drainage area exists adjacent to the parcel which drains into the eastern portion of the site, following the drainage pattern into the heavily landscaped swale/hill along the northern parcel line, draining to the lower level of the existing shopping center.</td></tr>
</table>

	Offsite, the drainage patterns are assumed to flow to the north to curb inlets along E Santa Ana Canyon Rd. The site drains to the Santa Ana River Channel in the Santa Ana River watershed. The Santa Ana River Channel ultimately discharges to the Pacific Ocean. The proposed site design will closely follow the existing topography of the site and maintain overall drainage patterns. DA 1 and DA 2 connect to the existing catch basins next to South Festival Drive. DA 3 connects to the existing catch basin, mirroring the existing condition, that drains through the adjacent site and towards the South Festival Drive storm drain mainline.

Narrative Project Description: (Use as much space as necessary.)	The existing site encapsulates approximately 10-acre site located south of the Riverside (91) Freeway and southwest of the intersection of East Santa Ana Canyon Road and S Weir Canyon Road in the city of Anaheim, California in Anaheim Hills. The Site is currently a portion of an existing shopping center known as Anaheim Hills Festival also known as SP 90-1 - The Festival per the City of Anaheim Zoning. Current zoning designation is RC/E - Retail Commercial and Entertainment. The intent of the project is to add multi-use and residential uses to the existing shopping center. The project consists of the construction of a multi-level residential apartment building, the construction of a multi-level parking structure, parking lot redevelopment, and the development of a plaza entrance including uncovered parking and landscaping, coming off S Festival Dr on the west. The proposed development will also include the demolition and removal of an existing movie theater building. The apartment building is to hold approximately 450 dwelling units (subject to change). The residential building has an approximate footprint of 197,634 S.F. which includes the apartment building and the parking structure. Additional community features are to be determined but may include open green patio areas, swimming pool, jacuzzi, and laundry. R.O.W. improvements are not anticipated for this site.

II.2 Potential Stormwater Pollutants

Pollutants of Concern			
Pollutant	Check One for each: E=Expected to be of concern N=Not Expected to be of concern		Additional Information and Comments
Suspended-Solid/ Sediment	E ☒	N ☐	
Nutrients	E ☒	N ☐	
Heavy Metals	E ☐	N ☒	Heavy metals are not expected to be generated in this category of project;
Pathogens (Bacteria/Virus)	E ☒	N ☐	
Pesticides	E ☒	N ☐	
Oil and Grease	E ☒	N ☒	
Toxic Organic Compounds	E ☐	N ☒	Toxic organic compounds are not expected to be generated in this category of project; i
Trash and Debris	E ☒	N ☐	There is potential for trash and debris. The State Water Resources Control Board trash amendment would require full capture.

II.3 Hydrologic Conditions of Concern

☒ No – Show map

☐ Yes – Describe applicable hydrologic conditions of concern below. *Refer to Section 2.2.3 in the Technical Guidance Document (TGD).*

The project is located outside of the potential areas of susceptibility. See Attachment H for the hydromodification susceptibility map.

II.4 Post Development Drainage Characteristics

Roof drains will discharge at the surface or connect directly into the proposed on-site storm drain system. The percentages of impervious and pervious areas are anticipated to remain relatively unchanged. Therefore, existing off-site storm drain utilities are anticipated to be sufficient and remain unchanged. The point of connection to the City's storm drain system are the existing curb inlets located on the western driveway off S Festival Dr and the existing inlets located on the existing lower level of the shopping center. The site drains to the Santa Ana River Channel which flows to the Pacific Ocean.

II.5 Property Ownership/Management

Maintenance of the WQMP facilities will be the responsibility of the property owner:

The owner may choose to contract the appropriate employers for the maintenance of stormwater to whom will provide the proper equipment if the current owners do not have the proper equipment and/or knowledge to do so.

Section III Site Description

III.1 Physical Setting

Name of Planned Community/Planning Area (if applicable)	N/A
Location/Address	City of Anaheim
	350 South Festival Drive
General Plan Land Use Designation	RC/E - Retail Commercial and Entertainment
Zoning	SP 90-1 - The Festival
Acreage of Project Site	10.06-acre parcel
Predominant Soil Type	Type C with some Type D

III.2 Site Characteristics

Site Characteristics	
Precipitation Zone	24 Hour, 85th Percentile Rainfall equals 0.85 inches
Topography	The existing project site lies within a fully developed and relatively flat parcel (approximately 2.2%-2.8%).
Drainage Patterns/Connections	See Section II.1 for a complete description of existing and proposed drainage patterns and connections.
Soil Type, Geology, and Infiltration Properties	The site soil type is a mix of hydrological soil group C soils and group D soils per Technical Guidance Document Appendix XVI criteria. The geotechnical report states that the top portion of the site consists of

	clayey sand (SC) and silty sand (SM) and low plasticity sand silty clays (CL) .
Hydrogeologic (Groundwater) Conditions	Depth to first groundwater was not encountered in geotechnical borings.
Geotechnical Conditions (relevant to infiltration)	According to GeoTracker, there is no record of past or present soil and groundwater contamination within a 250-foot radius of the project site. Refer to Appendix B for additional information. Geotechnical report states that infiltration is not feasible. Nuisance seepage may need to be mitigated at the site and the pad consists entirely of very dense bedrock and compacted fill. Furthermore, any infiltration system would need to be deep enough to not adversely impact the adjacent retail site (which, due to the depth would be founded in bedrock).
Off-Site Drainage	Existing conditions show off-site run-on flowing from the adjacent parcel to the east as well as from S Festival Dr on the southeast corner of the parcel into drainage area DA 2. Following existing drainage, the off-site run-on will not be diverted away from the project site but will be incorporated into the drainage area.
Utility and Infrastructure Information	Gas, electrical, water, sewer, and storm lines are located in Festival Dr. New utility connections for the new building will be added.

III.3 Watershed Description

Receiving Waters	Santa Ana River Channel, Pacific Ocean
303(d) Listed Impairments	None listed per 2014-16 Integrated Report
Applicable TMDLs	None listed per 2014-16 Integrated Report
Pollutants of Concern for the Project	Suspended-Solid/Sediment; Nutrients; Heavy Metals; Pathogens (Bacteria/Virus); Pesticides; Oil and Grease; Toxic Organic Compounds; Trash and Debris
Environmentally Sensitive and Special Biological Significant Areas	N/A

Section IV Best Management Practices (BMPs)

IV. 1 Project Performance Criteria

(NOC Permit Area only) Is there an approved WIHMP or equivalent for the project area that includes more stringent LID feasibility criteria or if there are opportunities identified for implementing LID on regional or sub-regional basis?	YES ☐	NO ☒
If yes, describe WIHMP feasibility criteria or regional/sub-regional LID opportunities.	N/A	

Project Performance Criteria	
If HCOC exists, list applicable hydromodification control performance criteria (Section 7.II-2.4.2.2 in MWQMP)	N/A

List applicable LID performance criteria (Section 7.II-2.4.3 from MWQMP)	Biotreat, on-site, additional runoff, as feasible, up to 80 percent average annual capture efficiency (cumulative, retention plus biotreatment)
List applicable treatment control BMP performance criteria (Section 7.II-3.2.2 from MWQMP)	Since it is not feasible to meet LID performance criteria through infiltration or storage and reuse, biofiltration BMPs in the form of Modular Wetlands shall be provided on-site prior to discharge to waters of the US.
Calculate LID design storm capture volume for Project.	Q=CIA C = (0.75x0.8+.15) =0.75 I=.26 DMA 1: A=2.20 AC Q=0.43 CFS DMA 2: A=5.11 AC Q=1.00 CFS DMA 3: A=2.75 AC Q=0.54 CFS

IV.2. Site Design and Drainage

DMA Number	Area (AC)	DCV (CF)	Q (CFS)	Treatment Device	Device Capacity (CFS)
DA 1	2.20	-	0.43	Modular Westland MWS-L-8-16	0.46
DA 2	5.11	-	1.00	Modular Westland MWS-L-8-20 (2)	1.15
DA 3	2.75	-	0.58	Modular Westland MWS-L-8-20	0.58

IV.3 LID BMP Selection and Project Conformance Analysis

IV.3.1 Hydrologic Source Controls (HSCs)

If required HSCs are included, fill out applicable check box forms. If the retention criteria are otherwise met with other LID BMPs, include a statement indicating HSCs not required.

Name	Included?
Localized on-lot infiltration	☐
Impervious area dispersion (e.g. roof top disconnection)	☐
Street trees (canopy interception)	☐
Residential rain barrels (not actively managed)	☐
Green roofs/Brown roofs	☐
Blue roofs	☐
Impervious area reduction (e.g. permeable pavers, site design)	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐

While Infiltration rates with a design factor of safety of 2 are greater than 0.3 in/hr Per the geotechnical report addendum in Attachment C, there is a potential for liquefaction on-site. Thus, infiltration is not feasible. Therefore, Biofiltration BMP's will be implemented onsite to treat the 85th percentile storm event.

Impervious area dispersion (e.g. roof top disconnection): The overall project density is incompatible with typical rooftop disconnection. Proprietary biofiltration BMPs with some evapotranspiration benefits are proposed.

Street trees (canopy interception): Limited canopy coverage is proposed on-site. The potential reduction of treatment area is not accounted for in the BMP sizing.

Residential rain barrels (not actively managed): This does not apply to large multifamily sites.

Green roofs/Brown roofs: Green roofs are not feasible in this construction type

Blue roofs: Blue roofs are not feasible in this consturction type.

Impervious area reduction (e.g. permeable pavers, site design): Due to the overall site density, impervious area reduction is not proposed. Proprietary biofiltration BMPs with some evapotranspiration benefits are proposed.

HSC's will not be calculated as part of this project design. Proprietary biotreatment will be used as described in Section IV.3.4.

IV.3.2 Infiltration BMPs

Identify infiltration BMPs to be used in project. If design volume cannot be met, state why.

Name	Included?
Bioretention without underdrains	☐
Rain gardens	☐
Porous landscaping	☐
Infiltration planters	☐
Retention swales	☐
Infiltration trenches	☐
Infiltration basins	☐
Drywells	☐
Subsurface infiltration galleries	☐
French drains	☐
Permeable asphalt	☐

Permeable concrete	☐
Permeable concrete pavers	☐
Other:	☐
Other:	☐

Per the geotechnical report addendum in Attachment C, infiltration is not feasible. Therefore, Biofiltration BMP's will be implemented onsite to treat the 85th percentile storm event.

IV.3.3 Evapotranspiration, Rainwater Harvesting BMPs

Name	Included?
All HSCs; *See Section IV.3.1*	☐
Surface-based infiltration BMPs	☐
Biotreatment BMPs	☒
Above-ground cisterns and basins	☐
Underground detention	☐
Other:	☐
Other:	☐
Other:	☐

Per the geotechnical report addendum in Attachment C, infiltration is not feasible. Therefore, Biofiltration BMP's will be implemented onsite to treat the 85th percentile storm event.

IV.3.4 Biotreatment BMPs

If the full Design Storm Capture Volume cannot be met with infiltration BMPs, and/or evapotranspiration and rainwater harvesting BMPs, describe biotreatment BMPs included. Include sections for selection, suitability, sizing, and infeasibility, as applicable.

Name	Included?
Bioretention with underdrains	☐
Stormwater planter boxes with underdrains	☐
Rain gardens with underdrains	☐
Constructed wetlands	☐
Vegetated swales	☐
Vegetated filter strips	☐
Proprietary vegetated biotreatment systems	☒
Wet extended detention basin	☐
Dry extended detention basins	☐
Other:	☐
Other:	☐

Per the geotechnical report addendum in Attachment C, infiltration is not feasible. Therefore, Biofiltration BMP's will be implemented onsite to treat the 85th percentile storm event.

IV.3.5 Hydromodification Control BMPs

The Project 2-year runoff volume is not increased by more than 5% and the project time of concentration is not reduced by more than 5%, therefore county Hydromodification requirements are met without the implementation of hydromodification control BMPs.

IV.3.6 Regional/Sub-Regional LID BMPs

Regional/Sub-Regional LID BMPs
N/A

IV.3.7 Treatment Control BMPs

Not proposed for this project, since biotreatment fully treats the treatment flow.

IV.3.8 Non-structural Source Control BMPs

Fill out non-structural source control check box forms or provide a brief narrative explaining if non-structural source controls were not used.

Non-Structural Source Control BMPs				
Identifier	**Name**	**Check One**		**If not applicable, state brief reason**
		Included	**Not Applicable**	
N1	Education for Property Owners, Tenants and Occupants	☒	☐	
N2	Activity Restrictions	☒	☐	
N3	Common Area Landscape Management	☒	☐	
N4	BMP Maintenance	☒	☐	
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	No hazardous waste will be handled onsite.
N6	Local Industrial Permit Compliance	☐	☒	Industrial uses are not present on-site.
N7	Spill Contingency Plan	☒	☐	
N8	Underground Storage Tank Compliance	☐	☒	No USTs proposed.
N9	Hazardous Materials Disclosure Compliance	☐	☒	No hazardous material will be handled onsite.
N10	Uniform Fire Code Implementation	☐	☒	No flammable materials will be stored on-site
N11	Common Area Litter Control	☒	☐	
N12	Employee Training	☒	☐	
N13	Housekeeping of Loading Docks	☐	☒	
N14	Common Area Catch Basin Inspection	☒	☐	
N15	Street Sweeping Private Streets and Parking Lots	☒	☐	
N16	Retail Gasoline Outlets	☐	☒	Retail fueling stations are not proposed.

Implementation of Non-Structural BMPS

N1. Education of Property Owners, Tenants and Occupants.

Responsible Party for Implementation of BMP: Property Owner's Association.

Implementation Frequency: Ongoing. Orientation shall be given to new owners, tenants, and occupants within 30 days of startup.

Educational material and information shall be provided by the property owner to new owners/tenants/occupants on general good housekeeping BMPs and other practices that contribute to protection of storm water quality. This WQMP shall be provided with emphasis placed on the materials included in, but not limited to, Sections N, V, VI and VII of this report. For additional information, see the BMP Maintenance Responsibility /Frequency Matrix in Section V. Educational Materials to be used include, but are not limited to, SC-10, Non-Stormwater Discharges, SC- 30, Outdoor Loading/Unloading, SC-34, Waste Handling & Disposal, SC-41, Building & Grounds Maintenance, SC-43, Parking/Storage Area Maintenance, The Ocean Begins at Your Front Door, After the Storm, Protecting Water Quality from Urban Runoff, Preventing Pollution Through Efficient Water Use, and Your Business and the County- Partners in Protecting the Ocean. In addition to the attachments, the following resource can be contacted to obtain updated educational information free of charge http://ocwatersheds.com/PublicEd. See Table V-1 in Section V for inspection and maintenance activity requirements.

N2. Activity Restrictions.

Responsible Party for Implementation of BMP: Property Owner's Association.

Implementation Frequency: Daily management of operation. Orientation shall be given to new owners, tenants, and occupants within 30 days of startup. Refreshing orientation shall be given annually.

Onsite activities shall be restricted to those currently granted by the City of Santa Ana and as stated in the Conditions, Covenants, and Restrictions (CCRs), which will be available in the near future. Parking restrictions include, but are not limited to, provisions regulating vehicle and truck deliveries, vehicle and truck parking, loading and unloading activities, etc. Some other common restrictions to be adhered to are as follows:

- No discharges of fertilizer, pesticides, and wastes to streets or storm drains
- No blowing or sweeping of debris into streets or storm drains
- No hosing down of paved surfaces
- No vehicle washing or maintenance.
- Do not perform paint cleanup activities in paved areas or allow rinse water from these activities to enter the storm drain system. Clean brushes containing water-based paint in a sink that is connected to the sanitary sewer system.

- Do not use detergents or other chemical additives when washing concrete sidewalks or building exteriors, use potable water only and collect wash water runoff using a vacuum truck, for proper offsite disposal.
- Keep premises, as well as trash container areas, free of litter. See Table V -1 in Section V for inspection and maintenance activity requirements.

In addition, onsite activities shall be limited to the requirements of this WQMP as described herein.

N3. Common Area Landscape Management.

Responsible Party for Implementation of BMP: Property Owner's Association.

Implementation Frequency: Landscape areas shall be maintained on a weekly basis through Grounds and Maintenance personnel.

All maintenance shall be consistent with the City of Santa Ana Water Quality Ordinance and Santa Ana Municipal Code General guidelines include the following: Plant vegetation that reduces water, fertilizer, herbicide, and pesticide use. Waste shall be disposed of by composting or at a permitted landfill and shall not be raked or blown into the street, gutter, or storm drains. Irrigation systems shall be inspected monthly for leaks. Leaks shall be repaired as soon as they are observed. A void over-watering of vegetation. If excessive runoff is observed, automatic timers shall be adjusted. Fertilizers, herbicides, and pesticides shall be used as directed on the label. If fertilizer is

spilled on a paved surface it should be swept up immediately and placed in its container. Water shall not be used to clean fertilizer spills unless necessary and only after the area has been thoroughly cleaned using dry cleaning methods. Pesticides, herbicides, and fertilizers shall not be applied within 48 hours prior to rain or if wind speeds exceed 5 mph. For additional information, see Help Prevent Ocean Pollution - Proper Maintenance Practices for Your Business included in Section VII of this report. Also refer to BMP SC-41, Building & Grounds Maintenance, included in Section VII and the BMP Maintenance Responsibility /Frequency Matrix in Section V for details.

N4. BMP Maintenance.

Responsible Party for Implementation of BMP: Property Owner's Association.

Implementation Frequency: Individual BMPs shall be inspected based on the required frequency of each BMP as suggested in the Maintenance Responsibility /Frequency Matrix. See the BMP Maintenance Responsibility /Frequency Matrix in Section V for details.

N11. Common Area Litter Control

Responsible Party for Implementation of BMP: Property Owner's Association.

Implementation Frequency: On a weekly basis through a maintenance firm.

To reduce the likelihood of polluting storm water runoff, regular maintenance will be conducted. This will consist of, at a minimum, site-wide litter control, emptying of trash receptacles in common areas, sweeping of dumpster enclosure areas, and reporting trash disposal violations to the owner or POA for investigation. The landscape maintenance may be contracted for common area litter control as well. See Table V-1 in Section V for inspection and maintenance activity requirements. Trash enclosures will include roofs.

N12 Employee Training

Responsible Party for Implementation of BMP: Property Owner's Association.

Implementation Frequency: Education of applicable employees for the tenants shall continue an ongoing basis and shall be done within 30 days of startup. Each new applicable onsite employee shall be given a water quality orientation within 30 days of hire using this WQMP Report as a reference. At a minimum, each applicable onsite employee shall have an annual review of the provisions of the WQMP Report for this project

See Table V -1 in Section V for inspection and maintenance activity requirements.

N14. Common Area Catch Basin Inspection.

Responsible Party for Implementation of BMP: Property Owner's Association.

Implementation Frequency: Twice a month to remove debris and after every major storm event.

The site's proposed drainage is picked up in catch basins at various places and is transported underground to the main storm drain. These catch basins are to be maintained a at the frequency

N15. Street Sweeping Private Streets and Parking Lots.

Responsible Party for Implementation of BMP: Property Owner's Association.

Implementation Frequency: Twice a month to remove debris.

The Property Owners' Association shall be responsible for sweeping the surrounding parking lot on a regular basis to remove debris. At minimum, the streets and parking lots will be required to be swept prior to the storm season, in late summer or early fall, prior to the start of the rainy season, or equivalent as required by the governing jurisdiction. For additional information, see BMP SC-34, Waste Handling and · Disposal and BMP SC-43, Parking/Storage Area Maintenance, included in Section VII, and the BMP Maintenance Responsibility /Frequency Matrix in Section V.

IV.3.9 Structural Source Control BMPs

Fill out structural source control check box forms or provide a brief narrative explaining if structural source controls were not used.

Structural Source Control BMPs				
Identifier	**Name**	**Check One**		**If not applicable, state brief reason**
		Included	**Not Applicable**	
S1	Provide storm drain system stenciling and signage	☒	☐	
S2	Design and construct outdoor material storage areas to reduce pollution introduction	☐	☒	Outdoor material storage areas are not proposed.
S3	Design and construct trash and waste storage areas to reduce pollution introduction	☐	☒	Trash/waste storage area are inside building
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	☒	☐	
S5	Protect slopes and channels and provide energy dissipation	☐	☒	Slopes and channels are not anticipated.
	Incorporate requirements applicable to individual priority project categories (from SDRWQCB NPDES Permit)	☐	☒	N/A – North OC template.
S6	Dock areas	☐	☒	Dock Area Proposed on north side of office building
S7	Maintenance bays	☐	☒	Maintenance bays are not proposed.
S8	Vehicle wash areas	☐	☒	Vehicle wash areas are not proposed.
S9	Outdoor processing areas	☐	☒	Outdoor processing areas are not proposed.
S10	Equipment wash areas	☐	☒	Equipment wash areas are not proposed.
S11	Fueling areas	☐	☒	Fueling areas are not proposed.
S12	Hillside landscaping	☐	☒	No hillsides are proposed.
S13	Wash water control for food preparation areas	☐	☒	Outdoor wash areas are not proposed.

S14	Community car wash racks	☐	☒	Car wash racks are not proposed.
	Full Trash Capture	☒	☐	Filter Inlets are proposed.

Implementation of Structural BMPs

S1. Storm Drain System Stenciling and Signage

Phrase "No-Dumping- Drains to Oceans" or equally effective phrase is to be placed on each catch basin and storm drain inlet to inform the public of the destination of pollutants discharged into stormwater. Catch basin signage shall be inspected for legibility no less than once per year. The catch basin stencil shall be kept onsite. Catch basins shall be re-stenciled when phrase is no longer legible. See BMP SD-13, Storm Drain Signage, in Section VII for more information.

S3. Design and construct trash and waste storage areas

The trash storage areas will be paved with an impervious surface. No drainage will be directed toward the trash areas and the enclosures will be walled and/or gated on all four sides to minimize spillage of trash into the Site. For additional information, see BMP SD-32, Trash Storage Areas, in Section VII.

Storm drain inlets near or adjacent to trash enclosures must be checked and cleared of debris on a regular basis, and before and after storms.

S4. Use efficient irrigation systems & landscape design

The proposed landscape and irrigation system shall group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration and shall comply with the Santa Ana Municipal Code. Monthly inspection of the irrigation system shall be conducted to ensure efficient water uses. See BMPs SC-41, Building and Grounds Maintenance, SD-10, Site Design and Landscape Planning, and SD-12, Efficient Irrigation, in Section VII.

Full Trash Capture

The proposed storm drain system shall have filter inlets installed at each grate and curb inlet to capture trash and pollutant

IV.4 Alternative Compliance Plan (If Applicable)

IV.4.1 Water Quality Credits

<table>
<tr><th colspan="5">Description of Proposed Project</th></tr>
<tr><td colspan="5">Project Types that Qualify for Water Quality Credits (Select all that apply):</td></tr>
<tr><td colspan="2">☐Redevelopment projects that reduce the overall impervious footprint of the project site.</td><td colspan="2">☐Brownfield redevelopment, meaning redevelopment, expansion, or reuse of real property which may be complicated by the presence or potential presence of hazardous substances, pollutants or contaminants, and which have the potential to contribute to adverse ground or surface WQ if not redeveloped.</td><td>☐ Higher density development projects which include two distinct categories (credits can only be taken for one category): those with more than seven units per acre of development (lower credit allowance); vertical density developments, for example, those with a Floor to Area Ratio (FAR) of 2 or those having more than 18 units per acre (greater credit allowance).</td></tr>
<tr><td colspan="2">☐ Mixed use development, such as a combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that can demonstrate environmental benefits that would not be realized through single use projects (e.g. reduced vehicle trip traffic with the potential to reduce sources of water or air pollution).</td><td colspan="2">☐ Transit-oriented developments, such as a mixed use residential or commercial area designed to maximize access to public transportation; similar to above criterion, but where the development center is within one half mile of a mass transit center (e.g. bus, rail, light rail or commuter train station). Such projects would not be able to take credit for both categories, but may have greater credit assigned</td><td>☐ Redevelopment projects in an established historic district, historic preservation area, or similar significant city area including core City Center areas (to be defined through mapping).</td></tr>
<tr><td>☐Developments with dedication of undeveloped portions to parks, preservation areas and other pervious uses.</td><td>☐ Developments in a city center area.</td><td>☐ Developments in historic districts or historic preservation areas.</td><td>☐ Live-work developments, a variety of developments designed to support residential and vocational needs together – similar to criteria to mixed use development; would not be able to take credit for both categories.</td><td>☐In-fill projects, the conversion of empty lots and other underused spaces into more beneficially used spaces, such as residential or commercial areas.</td></tr>
<tr><td>Calculation of Water Quality Credits
(if applicable)</td><td colspan="4">N/A in anaheim</td></tr>
</table>

IV.4.2 Alternative Compliance Plan Information

An alternative compliance plan is not being pursued.

Section V Inspection/Maintenance Responsibility for BMPs

The following tables indicate BMP inspection and maintenance responsibility. These tables identify the party responsible for inspection and maintenance, a description of the inspection and/or maintenance activity, and a frequency for the inspection and/or maintenance activity. Records of maintenance and inspections shall be kept for a period of five years and shall be made available for review by government agencies.

Responsible party details are to be determined during the final WQMP. At this time a Property Management Association is assumed to take responsibility for the Maintenance of all onsite BMPs.

Owner/Property Management Association

Name: Sean McEachern

Title: Senior Vice President

Company: Shea Properties

Address: 130 Vantis, Suite 200 Aliso Viejo, CA 92656

Phone Number: (949) 389-7038

BMP Name and BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Inspection / Maintenance Activities Required	Person or Entity with Operation & Maintenance Responsibility
Non-Structural Source Control BMPs			
N1. Education for Property Owners, Tenants and Occupants	Upon Tenant Occupancy	Educational material shall be provided to all employees and tenants.	Owner
N2. Activity Restriction	Monthly	The owner shall develop activity restrictions to minimize the threat of hazardous waste or contamination into the storm drainage system. Car washing is not allowed on-site at any time.	Owner
N3. Common Area Landscape Management	Weekly with routine landscape activity	Training on landscape management consistent with County Water Conservation Resolution or City equivalent, plus Management Guidelines for Fertilizers (DAMP Section 5.5) shall be conducted for all new field landscape maintenance personnel.	Owner
N4. BMP Maintenance	See below	Maintenance of BMPs implemented at the project site shall be performed at the frequency prescribed in this WQMP.	Owner

BMP Name and BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Inspection / Maintenance Activities Required	Person or Entity with Operation & Maintenance Responsibility
N11. Common Area Litter Control	Daily	Litter patrol, violations investigation, reporting and other litter control activities shall be performed in conjunction with maintenance activities.	Owner
N12. Employee Training	Yearly for all employees and within 6 months of hire date for new employees.	Education programs shall be implemented as they apply to future employees and training of current employees.	Owner
N14. Common Area Catch Basin Inspection	Minimum of once a year prior to rainy season.	Litter and debris removal, illicit discharge violations investigation and reporting shall be performed in conjunction with maintenance activities.	Owner
N15. Street Sweeping Private Streets and Parking Lots	Monthly	Private streets and parking area within the project shall be swept at a minimum frequency of once a month.	Owner
Structural Source Control BMPs			

BMP Name and BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Inspection / Maintenance Activities Required	Person or Entity with Operation & Maintenance Responsibility
S1. Provide Storm Drain System Stenciling and Signage	Yearly	All proposed inlets shall be marked with the appropriate "No Dumping. Drains to Ocean." Stencil. The stencils must be repainted when they become illegible, but at a minimum once every five years.	Owner
S4. Use Efficient Irrigation Systems & Landscape Design	Monthly	Verify that landscape design continues to function properly by correctly adjusting to eliminate overspray to hardscape areas, and to verify that irrigation timing and cycle lengths are adjusted in accordance with water demands, given time of year, and day or night time temperatures.	Owner
S6. Dock Areas	N/A	New dock areas shall include specific BMPs such as catch basin filters to treat runoff before discharge to the storm drain system. Docks shall be designed to minimize run-on. The move in loading areas are covered by the structure.	Owner

BMP Name and BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Inspection / Maintenance Activities Required	Person or Entity with Operation & Maintenance Responsibility
Low Impact Development (LID) and Treatment Control BMPs			
Modular Wetlands	Bi- annual	Inspect and remove trash and debris from outlet pipe and vault twice a year.	Owner
Filter Inlets	Bi- annual	Inspect and remove trash and debris from outlet pipe and vault twice a year.	Owner
Stormwater Bypass Manholes	Bi- annual	Inspect and remove trash and debris from outlet pipe and vault twice a year.	Owner

Note: The rainy season occurs from October 1st to April 15th.

Vector note: Vector control is provided through the proper sizing of BMPs. BMPs are designed to drain completely within 48 hours. Any ponded water on-site in excess of a 24-hour period is an indication that storm drain system maintenance and inspection is required.

Section VI BMP Exhibit (Site Plan)

VI.1 BMP Exhibit (Site Plan)

See attachedment A for the Proposed WQMP Exhibit

VI.2 Submittal and Recordation of Water Quality Management Plan

A PDF of the full report is included with the submittal.

Section VII Educational Materials

Education Materials			
Residential Material (http://www.ocwatersheds.com)	Check If Applicable	Business Material (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	☐
Homeowners Guide for Sustainable Water Use	☐	Proper Maintenance Practices for Your Business	☐
Household Tips	☐	Other Material	Check If Attached
Proper Disposal of Household Hazardous Waste	☐		
Recycle at Your Local Used Oil Collection Center (North County)	☐	Bioclean Product Information	☒
Recycle at Your Local Used Oil Collection Center (Central County)	☐	Tips for Pest Control	☒
Recycle at Your Local Used Oil Collection Center (South County)	☐	Landscape Maintenance	☒
Tips for Maintaining a Septic Tank System	☐	Proper Maintenance Practices for Your Business	☒
Responsible Pest Control	☐	SC-10 Non-Stormwater Discharge	☒
Sewer Spill	☐	SC-30 Outdoor Loading/Unloading	☒
Tips for the Home Improvement Projects	☐	SC-34 Waste Handling and Disposal	☒
Tips for Horse Care	☐	SC-41 Building and Grounds Maintenance	☒
Tips for Landscaping and Gardening	☐	SC-43 Parking/Storage Area Maintenance	☒
Tips for Pet Care	☐	SC-44 Drainage System Maintenance	☒
Tips for Pool Maintenance	☐	SC-70 Road and Street Maintenance	☒
Tips for Residential Pool, Landscape and Hardscape Drains	☐	SD-10 Site Design and Landscape Planning	☒
Tips for Projects Using Paint	☐	SD-12 Efficient Irrigation	☒

Appendix A: Calculations, Worksheets, and Cross Sections

DMA	% Impervious	C	I (in/hr)	A (acres)	Q (cfs)	Treatment Device	Treatment Capacity	Location
DA 1	80%	0.750	0.26	2.20	0.43	MWS 8-16	0.46	33.865746, -117.751614
DA 2	80%	0.750	0.26	5.11	1.00	MWS 8-20 (2)	1.15	33.865660, -117.752075
DA 3	80%	0.750	0.26	2.75	0.54	MWS 8-20	0.58	33.865535, -117.750317

LEGEND

- PROPERTY LINE
- CENTER LINE
- EASEMENT OR SETBACK LINE
- DRAINAGE MANAGEMENT AREA
- SD — STORM DRAIN
- MODULAR WETLAND
- PERVIOUS AREA

NOTE: ALL INLETS WILL HAVE FILTER SCREENS FOR TRASH CAPTURE

SOUTH FESTIVAL DRIVE

DA 1 2.20

DA 2 5.11

DA 3 2.75

CONNECT TO EXISTING CURB INLET

CONNECT TO EXISTING CURB INLET

PROPOSED MWS

PROPOSED HIGH FLOW BYPASS MANHOLE

PROPOSED HIGH FLOW BYPASS MANHOLE

PROPOSED INLET

PROPOSED INLET

PROPOSED INLET

PROPOSED INLET

PROPOSED INLET

PROPOSED INLET

PROPOSED INLET

PROPOSED INLET

PROPOSED INLET

PROPOSED INLET

EX. RIGHT OF WAY

EX. RIGHT OF WAY

SD

STOP

NORTH

GRAPHIC SCALE IN FEET
0 20 40 80

REVISIONS

NO.	INIT.	DATE	DESCRIPTION	APP'D	DATE

BENCH MARK:

COUNTY OF ORANGE BENCHMARK "3R-105-85"
ELEVATION: 396.789 (FEET) [DATUM: NAVD 1988] YEAR LEVELED: 2006]
DESCRIBED AS: FOUND 3 3\4"OCS ALUMINUM BENCHMARK DISK STAMPED "3R-105-85"; SET IN THE SOUTHWESTERLY CORNER OF A 4 FT. BY 15 FT. CONCRETE CATCH BASIN. MONUMENT IS LOCATED ALONG THE NORTHEASTERLY SIDE OF SANTA ANA CANYON ROAD, 0.8 MILES SOUTHWESTERLY OF THE CENTERLINE OF WEIR CANYON ROAD, 354 FT. WESTERLY OF THE OF TWO STEEL TRANSMISSION LINES CROSSING SANTA ANA CANYON AND 40.5 FT. NORTHERLY OF THE CENTERLINE OF SANTA ANA CANYON. MONUMENT IS SET LEVEL WITH THE SIDEWALK.

Kimley»Horn

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1100 TOWN AND COUNTRY ROAD, SUITE 700, ORANGE, CA 92868
PHONE: 714-939-1030
WWW.KIMLEY-HORN.COM

LICENSED PROFESSIONAL

JASON MARECHAL, P.E.

CA LICENSE NUMBER 63164

PLOT DATE: 11/28/2023

PRELIMINARY WQMP EXHIBIT

SHEA FESTIVAL HILL
PREPARED FOR
SHEA PROPERTIES

(GRADING) PLANS
SITE ADDRESS: 8020 E SANTA ANA CANYON ROAD ANAHEIM, CA 92808

GRA

SHEET____ OF ____

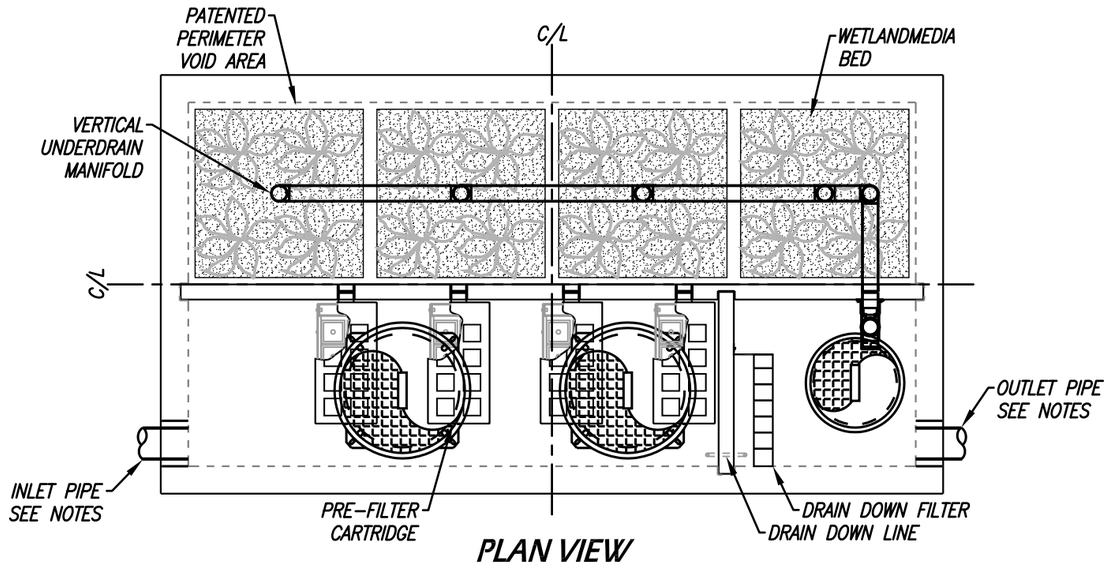
DESIGNED BY: TG | DRAWN BY: FC | CHECKED BY: JM

CITY OF ANAHEIM

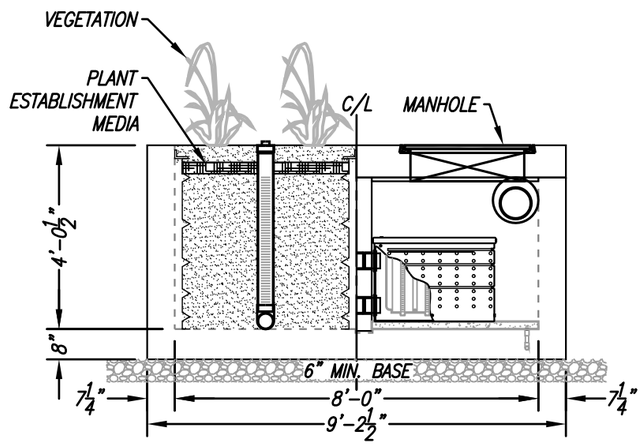
FOR CITY USE ONLY

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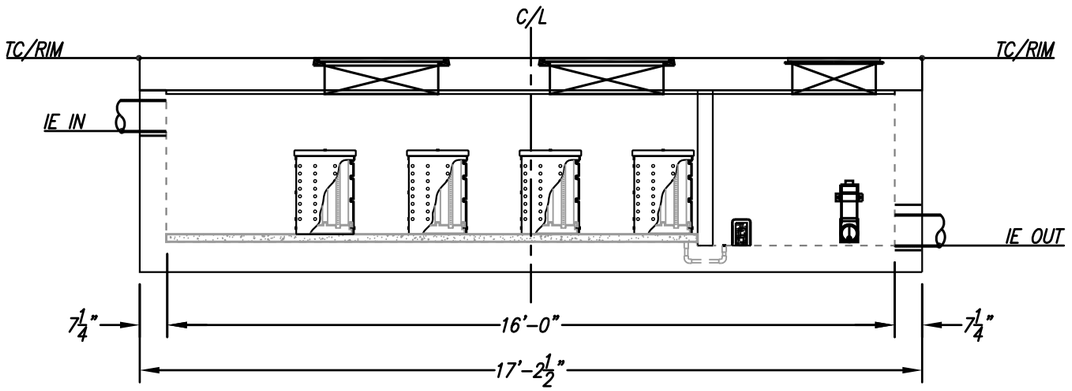
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PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
TREATMENT HGL AVAILABLE (FT)			
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PARKWAY	OPEN PLANTER	PARKWAY
FRAME & COVER	ø30"	N/A	ø24"
WETLANDMEDIA VOLUME (CY)			9.50
WETLANDMEDIA DELIVERY METHOD			TBD
ORIFICE SIZE (DIA. INCHES)			ø3.07"
MAXIMUM PICK WEIGHT (LBS)			TBD
NOTES:			



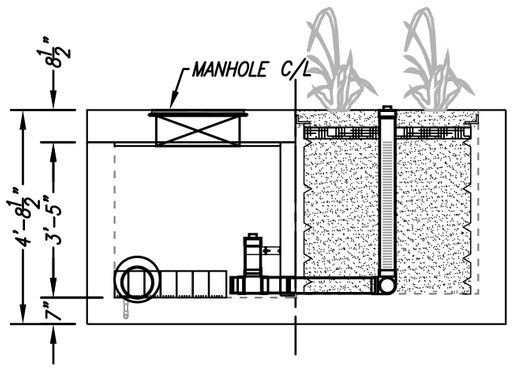
PLAN VIEW



LEFT END VIEW
BIOFILTRATION/PRETREATMENT



ELEVATION VIEW



RIGHT END VIEW
DISCHARGE/BIOFILTRATION

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.
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

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TREATMENT FLOW (CFS)	0.462
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

PROPRIETARY AND CONFIDENTIAL:

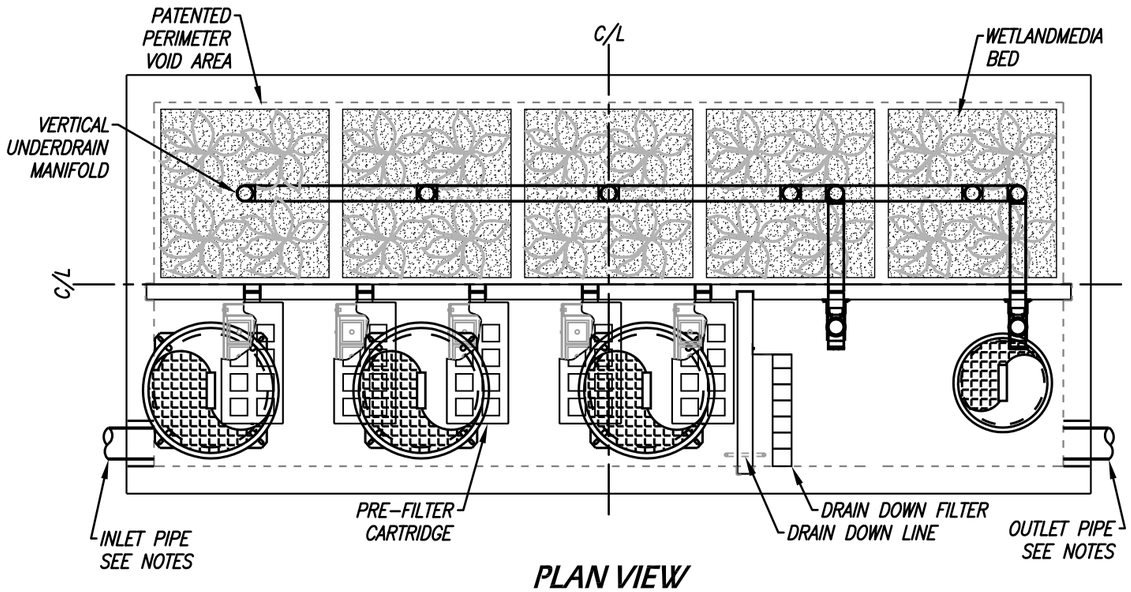
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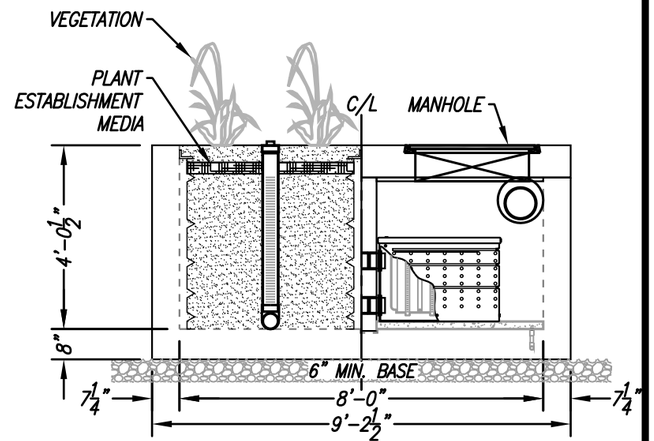
MWS-L-8-16-V
STORMWATER BIOFILTRATION SYSTEM STANDARD DETAIL

3/11/15/JOHN

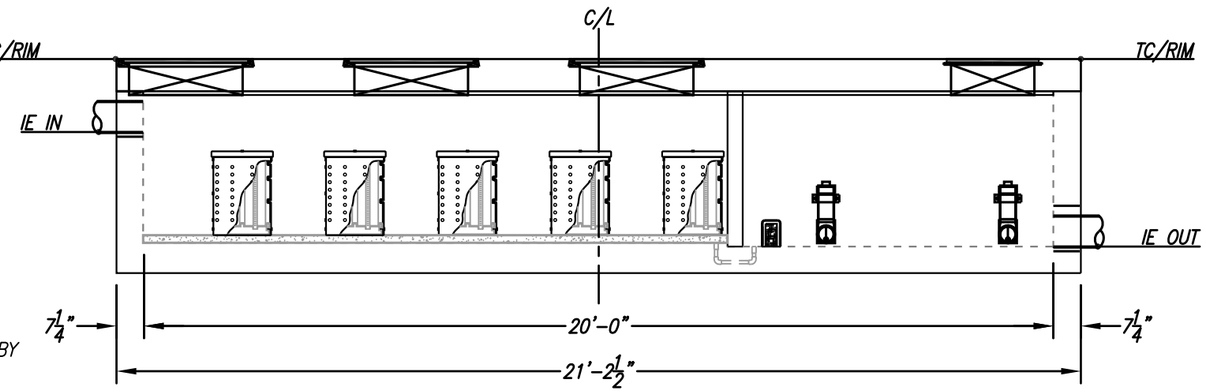
SITE SPECIFIC DATA			
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
TREATMENT HGL AVAILABLE (FT)			
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PARKWAY	OPEN PLANTER	PARKWAY
FRAME & COVER	ø30"	N/A	ø24"
WETLANDMEDIA VOLUME (CY)			11.85
WETLANDMEDIA DELIVERY METHOD			TBD
ORIFICE SIZE (DIA. INCHES)			ø2.43"
MAXIMUM PICK WEIGHT (LBS)			TBD
NOTES:			



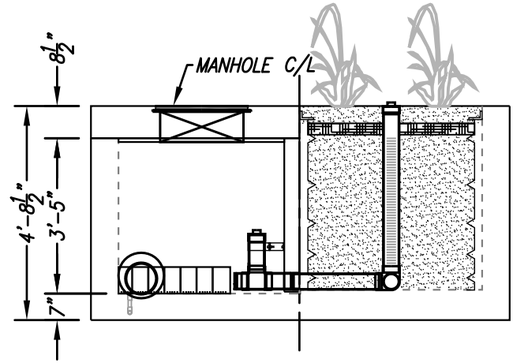
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LEFT END VIEW
BIOFILTRATION/PRETREATMENT



ELEVATION VIEW



RIGHT END VIEW
DISCHARGE/BIOFILTRATION

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TREATMENT FLOW (CFS)	0.577
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	TBD
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

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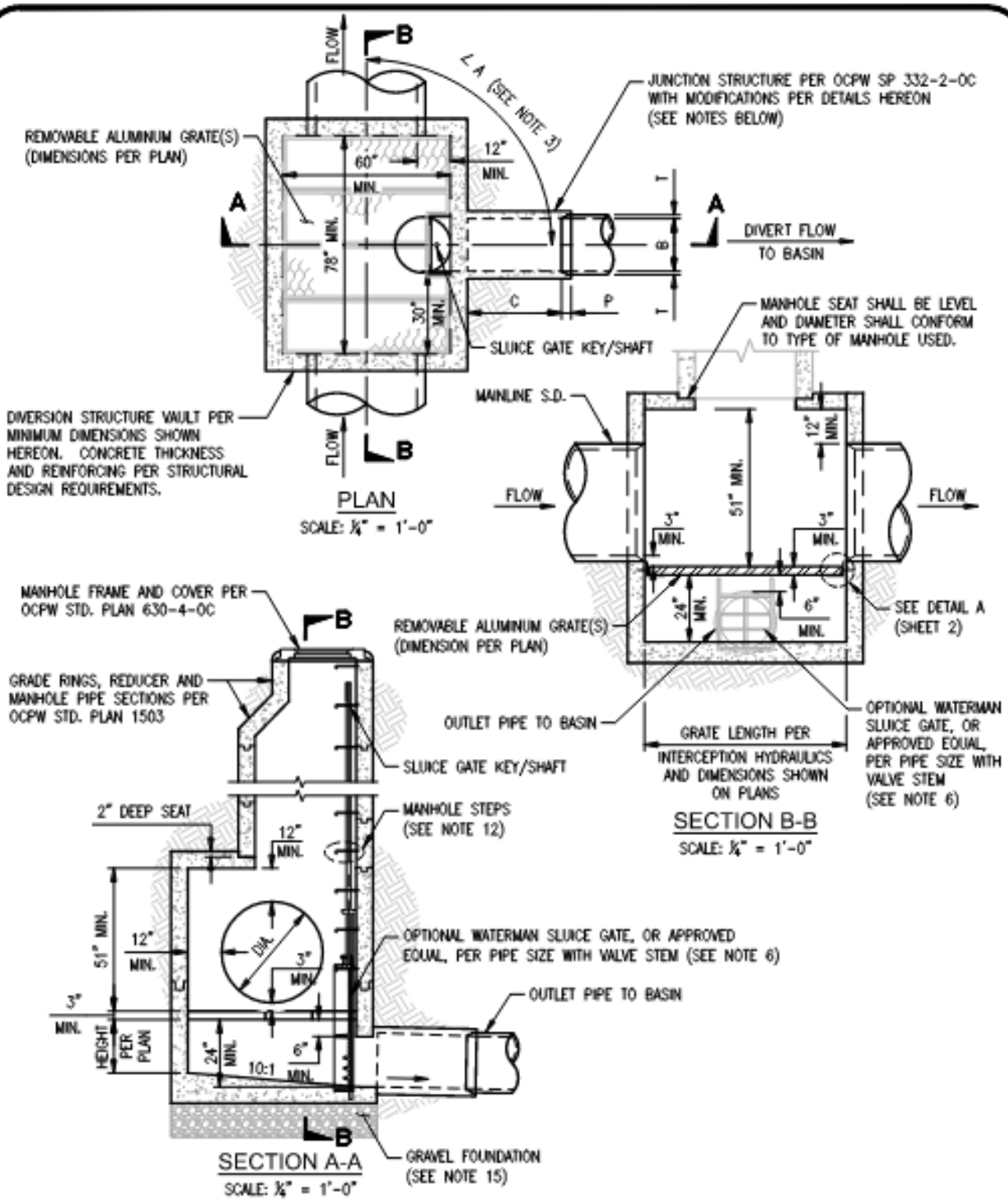
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MWS-L-8-20-V
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

6/2/15/JOHN



COUNTY OF ORANGE, OC PUBLIC WORKS DEPARTMENT

Approved *Kevin Onuma* Kevin Onuma, County Engineer

May 2021

STD. PLAN

1902

SHT. 1 OF 3

STORM DRAIN DIVERSION STRUCTURE

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See **Appendix IV.2**)	T_c=	5	min
2	Using **Figure III.4**, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.26	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (**Worksheet A**)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (**Worksheet A**)	Y_2=	0	%
5	Using **Figure III.4**, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	in/hr
6	Determine the design intensity that must be provided by BMP, $I_{design}= I_1-I_2$	I_{design}=	0.26	in/hr
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	10.06	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.80	
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=	0.75	
4	Calculate design flowrate, $Q_{design}= (C \times i_{design} \times A)$	Q_{design}=	1.96	cfs

Supporting Calculations

Describe system:

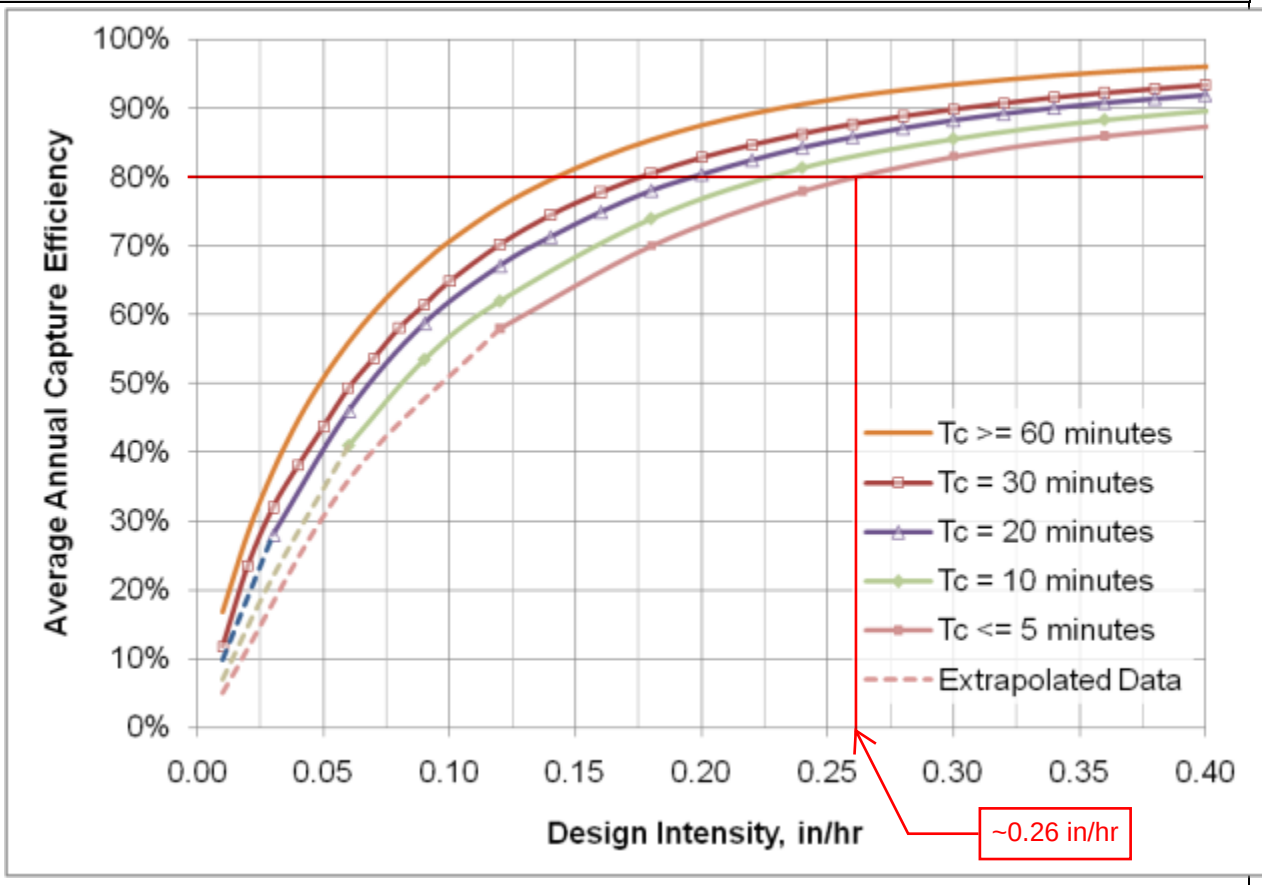
Q=CIA
C = (0.75x0.8+.15) =0.75 I=.26
DMA 1: A=2.20 AC Q=0.43 CFS
DMA 2: A=5.11 AC Q=1.00 CFS
DMA 3: A=2.75 AC Q=0.54 CFS

Provide time of concentration assumptions:

Preliminary DMA of 10.06 acres is assumed to be divided into several sub-DMA's, with short overland paths and smaller areas. Minimum Tc of 5 min is assumed.

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

Graphical Operations



Provide supporting graphical operations. See Example III.7.

Festival Hills
WQMP Flow Rate Calculations

DMA	% Impervious	C	I (in/hr)	A (acres)	Q (cfs)	Treatment Device	Treatment Capacity	Location
DA 1	80%	0.750	0.26	2.20	0.43	MWS 8-16	0.46	33.865746, -117.751614
DA 2	80%	0.750	0.26	5.11	1.00	MWS 8-20 (2)	1.15	33.865660, -117.752075
DA 3	80%	0.750	0.26	2.75	0.54	MWS 8-20	0.58	33.865535, -117.750317

minimum incremental benefit required to mandate its use (See discussion of threshold incremental benefit in **Appendix XIII**). This level of performance is termed the "minimum partial capture." A harvest and use system would be considered to achieve less than "minimum partial capture" if:

- Based on a system sized for the full DCV from the tributary area, and
- Based on the combined project demand for harvested water,
- The system draws down in greater than 30 days (720 hours), therefore captures less than 40 percent of average annual runoff (See Figure III.2).

Harvest and use systems with demand lower than required to achieve minimum partial capture are not required to be considered to demonstrate retention of stormwater to the MEP. If this is the case, other LID BMPs must be evaluated for retention and/or biotreatment of the Project DCV.

X.3.2. Demand Thresholds for Minimum Partial Capture

Table X.6 provides the minimum combined project demand to meet the minimum partial capture for the range of precipitation zones found in Orange County. Projects with a total demand below this value not required to prepare a project specific evaluation of harvest and use feasibility.

Table X.6: Harvested Water Demand Thresholds for Minimum Partial Capture

Design Capture Storm Depth[1], inches	Wet Season Demand Required for Minimum Partial Capture[2], gpd per impervious acre
0.60	490
0.65	530
0.70	570
0.75	610
0.80	650
0.85	690
0.90	730
0.95	770
1.00	810

1 - Based on isopluvial map (See **XVI.1**)

2 –Minimum Partial Capture is a performance standard whereby system performance exceeds 40 percent capture (See **Appendix** XIII) , such that the system must be considered for use even if it cannot achieve the full DCV.

Table X.8: Minimum Irrigated Area for Potential Partial Capture Feasibility

General Landscape Type	Conservation Design: K_L = 0.35			Active Turf Areas: K_L = 0.7		
Closest ET Station	*Irvine*	*Santa Ana*	*Laguna*	*Irvine*	*Santa Ana*	*Laguna*
Design Capture Storm Depth, inches	**Minimum Required Irrigated Area per Tributary Impervious Acre for Potential Partial Capture, ac/ac**					
0.60	0.66	0.68	0.72	0.33	0.34	0.36
0.65	0.72	0.73	0.78	0.36	0.37	0.39
0.70	0.77	0.79	0.84	0.39	0.39	0.42
0.75	0.83	0.84	0.90	0.41	0.42	0.45
0.80	0.88	0.90	0.96	0.44	0.45	0.48
0.85	0.93	0.95	1.02	0.47	0.48	0.51
0.90	0.99	1.01	1.08	0.49	0.51	0.54
0.95	1.04	1.07	1.14	0.52	0.53	0.57
1.00	1.10	1.12	1.20	0.55	0.56	0.60

Worksheet J: Summary of Harvested Water Demand and Feasibility

1	What demands for harvested water exist in the tributary area (check all that apply):			
2	Toilet and urinal flushing		X	
3	Landscape irrigation		X	
4	Other:_____		□	
5	What is the design capture storm depth? (**Figure III.1**)	d	.9	inches
6	What is the project size?	A	9.2	ac
7	What is the acreage of impervious area?	IA	1.8	ac
	For projects with multiple types of demand (toilet flushing, indoor demand, and/or other demand)			
8	What is the minimum use required for partial capture? (**Table X.6**)		730	gpd
9	What is the project estimated wet season total daily use?		unknown	gpd
10	Is partial capture potentially feasible? (Line 9 > Line 8?)		unknown	
	For projects with only toilet flushing demand			
11	What is the minimum TUTIA for partial capture? (**Table X.7**)			
12	What is the project estimated TUTIA?			

Table 2.7: Infiltration BMP Feasibility Worksheet

	Infeasibility Criteria	*Yes*	*No*
1	**Would Infiltration BMPs pose significant risk for groundwater related concerns?** Refer to **Appendix VIII** (Worksheet I) for guidance on groundwater-related infiltration feasibility criteria.		x
Provide basis: Per the geotech report, the groundwater table is deep, but nuisance seepage is possible because the soil is entirely of dense bedrock and compacted fill. Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
2	Would Infiltration BMPs **pose significant risk of increasing risk of geotechnical hazards that cannot be mitigated to an acceptable level**? (Yes if the answer to any of the following questions is yes, as established by a geotechnical expert): • The BMP can only be located less than 50 feet away from slopes steeper than 15 percent • The BMP can only be located less than eight feet from building foundations or an alternative setback. • A study prepared by a geotechnical professional or an available watershed study substantiates that stormwater infiltration would potentially result in significantly increased risks of geotechnical hazards that cannc	x	
Per the geotech report: Based on our exploration, testing and analyses, we conclude that the proposed improvements are feasible from a geotechnical viewpoint. Potential constraints include differential settlement due to the varying fill depths associated with the canyon fill, previously mitigated presence of nuisance seepage, seismic shaking typical to the region and the logistics of constructing a new development while maintaining the adjacent retail development functional. The soils at the site are classified as having "low to medium" expansion potential. Geologic conditions are such that storm water infiltration is not feasible at the site.			
3	Would infiltration of the DCV from drainage area **violate downstream water rights**?		x
Provide basis: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			

Table 2.7: Infiltration BMP Feasibility Worksheet (continued)

	Partial Infeasibility Criteria	*Yes*	*No*
4	Is proposed infiltration facility **located on HSG D soils** or the site geotechnical investigation identifies presence of soil characteristics which support categorization as D soils?		x
Provide basis: Per the TGD map, the HSG soils are type C. Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
5	Is **measured infiltration rate below proposed facility less than 0.3 inches per hour**? This calculation shall be based on the methods described in **Appendix VII**.	x	
Provide basis: Per Geotech report, no infiltration feasible on the site. Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
6	Would **reduction of over predeveloped conditions cause impairments to downstream beneficial uses, such as change of seasonality of ephemeral washes or increased discharge of contaminated groundwater to surface waters?**		x
Provide citation to applicable study and summarize findings relative to the amount of infiltration that is permissible: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
7	Would **an increase in infiltration over predeveloped conditions cause impairments to downstream beneficial uses, such as change of seasonality of ephemeral washes or increased discharge of contaminated groundwater to surface waters?**		x
Provide citation to applicable study and summarize findings relative to the amount of infiltration that is permissible: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			

Table 2.7: Infiltration BMP Feasibility Worksheet (continued)

Infiltration Screening Results (check box corresponding to result):		
8	Is there substantial evidence that infiltration from the project would result in a significant increase in I&I to the sanitary sewer that cannot be sufficiently mitigated? (See **Appendix XVII**) Provide narrative discussion and supporting evidence: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.	no
9	If any answer from row 1-3 is yes: infiltration of any volume is **not feasible** within the DMA or equivalent. Provide basis: Summarize findings of infeasibility screening	Not feasible. Geotech report cites low to medium expansion potential of soils.
10	If any answer from row 4-7 is yes, infiltration is **permissible but is not presumed to be feasible for the entire DCV.** Criteria for designing biotreatment BMPs to achieve the maximum feasible infiltration and ET shall apply. Provide basis: Summarize findings of infeasibility screening	n/a
11	If all answers to rows 1 through 11 are no, infiltration of the full DCV is potentially feasible, BMPs must be designed to infiltrate the full DCV to the maximum extent practicable.	No infiltration to be done

Harvest and Use Infeasibility

Harvest and use infeasibility criteria include:

- If inadequate demand exists for the use of the harvested rainwater. See **Appendix X** for guidance on determining harvested water demand and applicable feasibility thresholds.
- If the use of harvested water for the type of demand on the project violates codes or ordinances most applicable to stormwater harvesting in effect at the time of project application and a waiver of these codes and/or ordinances cannot be obtained. It is noted that codes and ordinances most applicable to stormwater harvesting may change

Worksheet I: Summary of Groundwater-related Feasibility Criteria

1	Is project large or small? (as defined by **Table VIII.2**) circle one	(Large)	Small	
2	What is the tributary area to the BMP?	A	10.06	acres
3	What type of BMP is proposed?	N/A		
4	What is the infiltrating surface area of the proposed BMP?	A_{BMP}	N/A	sq-ft
5	What land use activities are present in the tributary area (list all) The site is a proposed multifamily building.			
6	What land use-based risk category is applicable?	(L)	M	H
7	If M or H, what pretreatment and source isolation BMPs have been considered and are proposed (describe all):			
8	What minimum separation to mounded seasonally high groundwater applies to the proposed BMP? See Section **VIII.2** (circle one)	5 ft	(10 ft)	
9	Provide rationale for selection of applicable minimum separation to seasonally high mounded groundwater: N/A			
10	What is separation from the infiltrating surface to seasonally high groundwater?	SHGWT	N/A	ft
11	What is separation from the infiltrating surface to mounded seasonally high groundwater?	Mounded SHGWT	N/A	ft
12	Describe assumptions and methods used for mounding analysis: N/A			
13	Is the site within a plume protection boundary (See **Figure**	Y	(N)	N/A

Worksheet I: Summary of Groundwater-related Feasibility Criteria

	VIII.2)?	
14	Is the site within a selenium source area or other natural plume area (See Figure VIII.2)?	Y (N) N/A
15	Is the site within 250 feet of a contaminated site?	Y (N) N/A
16	If site-specific study has been prepared, provide citation and briefly summarize relevant findings: Per site specific geotechnical investigation report prepared by NMG, infiltration is not feasible due to the bedrock and densely packed fill Soil. Soil are a mix of sand and silt. Groundwater was not encountered in the subsurface investigation. See Appendix E for full report.	
17	Is the site within 100 feet of a water supply well, spring, septic system?	Y (N) N/A
18	Is infiltration feasible on the site relative to groundwater-related criteria?	(Y) N
Provide rationale for feasibility determination: Per site specific geotechnical investigation report prepared by Nova, the site location has soil with low to medium expansion potential, therefore no infiltration is feasbile. Based on the GeoTracker, the site is not within 250 ft of a contaminated area. See Appendix C for site-specific maps.		

Note: if a single criterion or group of criteria would render infiltration infeasible, it is not necessary to evaluate every question in this worksheet.

Table VIII.2: Definition of Project Size Categories

	Residential	Commercial, Institutional	Industrial
Small Projects	Less than 10 acres and less than 30 DU	Less than 5 acres and less than 50,000 SF	Less than 2 acre and less than 20,000 SF
Large Projects	Greater than 10 acres or greater than 30 DU	Greater than 5 acres or greater than 50,000 SF	Greater than 2 acre or greater than 20,000 SF

NMG Geotechnical, Inc.

November 23, 2022

Project No. 22023-01

To: Shea Properties
130 Vantis, Suite 200
Aliso Viejo, California 92656

Attention: Mr. Sean McEachern, Vice President of Development

Subject: Geotechnical Exploration and Feasibility Report for Proposed Multi-Family Residential Development, Anaheim Hills Festival Retail Center, City of Anaheim, California

In accordance with your request, NMG Geotechnical, Inc. (NMG) has conducted a geotechnical exploration and feasibility study for the upper pad of the Anaheim Hills Festival Retail Center, in the city of Anaheim. The purpose of our study was to evaluate the geotechnical site conditions in light of the proposed improvements in order to determine project feasibility and provide preliminary geotechnical recommendations for the project design, grading, and construction.

Our scope of services was based on review of two options for conceptual site development and included review of background site information, review of prior geotechnical reports by others, drilling and logging of five hollow-stem-auger borings, advancement of seven cone penetrometer tests (CPTs), laboratory testing, geotechnical review of the preliminary design information, geotechnical analysis, and preparation of this report. This report presents our findings, conclusions and preliminary recommendations.

The site was graded in the 1990s for the retail development and is underlain by compacted artificial fill and sandstone/siltstone bedrock. The compacted artificial fill is primarily in the northern portion of the site and in a prior canyon in the east-central portion of the site. The fill is up to 38 feet thick along the former canyon alignment. Bedrock is exposed at the surface in the southwestern portion of the site and is present beneath the compacted fill. Groundwater was not encountered in borings drilled during our exploration; however, prior work at the site encountered considerable seepage in the southwest and a mitigation system was installed. Please note, environmental evaluation of onsite soils is not a part of this report and is the purview of others.

Based on our exploration, testing and analyses, we conclude that the proposed improvements are feasible from a geotechnical viewpoint. Potential constraints include differential settlement due to the varying fill depths associated with the canyon fill, previously mitigated presence of nuisance seepage, seismic shaking typical to the region and the logistics of constructing a new development while maintaining the adjacent retail development functional. The soils at the site are classified as having "low to medium" expansion potential. Geologic conditions are such that storm water infiltration is not feasible at the site.

Appendix B: 2-Year Storm Event Hydrology Calculations (Not Applicable)

Appendix C: O+M Plan

Operation and Maintenance Plan

I. Inspection and Maintenance Log

BMP INSPECTION & MAINTENANCE LOG

Today's Date: _____

Name of Person Performing Activity (Printed): _____

Signature: _____

BMP Name (As Shown in O&M Plan)	Brief Description of Implementation, Maintenance, and Inspection Activity Performed	Date
Proprietary Biotreatment		

II. Responsibility of Maintenance

A. General

A copy of the operation and maintenance agreement has been included as an attachment to the Operation and Maintenance (O&M) Plan:

The following party is responsible for the operation and maintenance of all LID BMPs and roadway adjacent bioretention facilities within the landscape easement:

Shea Properties

130 Vantis, Suite 200 Aliso Viejo, CA 92656

The responsible party shall serve or designate a corporate officer authorized to negotiate and execute any contracts that might be necessary for future changes to operation and maintenance of the LID BMPs or implement remedial measures if problems occur.

Employees or contractors who will report to the designated contact and are responsible for conducting Stormwater BMP operation and maintenance procedures within this document. All pertinent forms of educational materials for those personnel that will be maintaining the proposed BMPs have been included in Appendix 10.

Designated Respondent in case of off-hours maintenance problem:

_____

Designated Respondent Printed Name/Title

_____

Phone Number

Note: Updated contact information must be provided to the Permittee immediately whenever a property is sold or transferred and whenever designated individuals or contractors change.

WQMP Implementation and Funding Responsibility

This project-specific WQMP has been prepared for JP Morgan by Kimley-Horn and Associates, Inc. for the Chase Oak Creek project. This document is intended to provide guidance for proper BMP implementation and on-going maintenance for the Project BMP facilities.

The undersigned shall be responsible for the implementation of this O&M Plan and ensure that this document is amended as appropriate to reflect up-to-date conditions at the site. The O&M plan will be reviewed by maintenance and service employees, outside contractors, or any other persons having responsibility from implementation portions of the O&M plan. At least one copy of this O&M Plan and WQMP will be maintained at the project site or project office in perpetuity.

The undersigned is authorized to certify and to approve implementation of this O&M Plan and WQMP. The undersigned is aware that implementation of this O&M Plan and WQMP is enforceable under the County of Orange Water Quality Ordinance. If the undersigned transfers interest in the subject property, the undersigned shall notify the successor their responsibility to implement the O&M Plan and WQMP. It is still the responsibility of the owner to maintain the LID BMPs in accordance with the O&M Plan until that responsibility is formally transferred.

The funding source for operation and maintenance of each BMP identified in the project-specific WQMP shall be the responsibility of MJPA until responsibility is transferred. The owner/operator recognizes that a source of funding is required to support the ongoing operation and maintenance of BMPs, and that funding will continue for the life of the project. By certifying the final project specific WQMP, the Project applicant is certifying that the funding responsibilities have been addressed and will be transferred to future owners as deemed necessary.

_____

Owner's /Responsible Party Signature

_____

Owner's /Responsible Party Printed Name

_____

Owner's /Responsible Party Title or Position

_____Date

B. Staff Training Program

All staff will undergo training to learn about the stormwater treatment mechanism and proper maintenance of the LID BMPs. Training will be required for all persons responsible for maintenance of the roadside BMPs. Due to the location of the BMPs along the roadway, safety training for maintenance personnel will be required. Documentation and records of each staff (contractor or personal) member who has received training shall be recorded in the log below.

BMP STAFF TRAINING

Today's Date: _____

Name of Person Performing Activity (Printed): _____

Signature: _____

Staff Name	Date	Brief Description of training received

III. Stormwater BMP Design Documentation

This section of the O&M Manual is designated for As-Builts of each stormwater BMP and Manufacturer's data, manuals and maintenance requirements.

V. Maintenance Schedule or Matrix

BMP Name and BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Inspection / Maintenance Activities Required	Person or Entity with Operation & Maintenance Responsibility
Non-Structural Source Control BMPs			
N1. Education for Property Owners, Tenants and Occupants	Upon Tenant Occupancy	Educational material shall be provided to all employees and tenants.	Owner
N2. Activity Restriction	Monthly	The owner shall develop activity restrictions to minimize the threat of hazardous waste or contamination into the storm drainage system. Car washing is not allowed on-site at any time.	Owner
N3. Common Area Landscape Management	Weekly with routine landscape activity	Training on landscape management consistent with County Water Conservation Resolution or City equivalent, plus Management Guidelines for Fertilizers (DAMP Section 5.5) shall be conducted for all new field landscape maintenance personnel.	Owner
N4. BMP Maintenance	See below	Maintenance of BMPs implemented at the project site shall be performed at the frequency prescribed in this WQMP.	Owner

BMP Name and BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Inspection / Maintenance Activities Required	Person or Entity with Operation & Maintenance Responsibility
N11. Common Area Litter Control	Daily	Litter patrol, violations investigation, reporting and other litter control activities shall be performed in conjunction with maintenance activities.	Owner
N12. Employee Training	Yearly for all employees and within 6 months of hire date for new employees.	Education programs shall be implemented as they apply to future employees and training of current employees.	Owner
N13. Housekeeping of Loading Docks	Weekly with standard maintenance.	Sweeping, litter control and immediate clean up of spills and broken containers. Avoid use of water if possible to prevent contaminated water entering storm drain system.	Owner
N14. Common Area Catch Basin Inspection	Minimum of once a year prior to rainy season.	Litter and debris removal, illicit discharge violations investigation and reporting shall be performed in conjunction with maintenance activities.	Owner
N15. Street Sweeping Private Streets and Parking Lots	Monthly	Private streets and parking area within the project shall be swept at a minimum frequency of once a month.	Owner

BMP Name and BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Inspection / Maintenance Activities Required	Person or Entity with Operation & Maintenance Responsibility
Structural Source Control BMPs			
S1. Provide Storm Drain System Stenciling and Signage	Yearly	All proposed inlets shall be marked with the appropriate "No Dumping. Drains to Ocean." Stencil. The stencils must be repainted when they become illegible, but at a minimum once every five years.	Owner
S3. Design and Construct Outdoor Material Storage Areas to Reduce Pollutant Introduction	Weekly	Trash receptacles shall be placed on a paved area. Sweep trash area at least once per week. Maintain area clean of trash and debris.	Owner
S4. Use Efficient Irrigation Systems & Landscape Design	Monthly	Verify that landscape design continues to function properly by correctly adjusting to eliminate overspray to hardscape areas, and to verify that irrigation timing and cycle lengths are adjusted in accordance with water demands, given time of year, and day or night time temperatures.	Owner
BMP Name and BMP Implementation, Maintenance, and Inspection Procedures	**Implementation, Maintenance, and Inspection Frequency and Schedule**	**Inspection / Maintenance Activities Required**	**Person or Entity with Operation & Maintenance Responsibility**
S6. Dock Areas	N/A	New dock areas shall include specific BMPs such as catch basin filters to treat runoff before discharge to the storm drain system. Docks shall be designed to minimize run-on. The move in loading areas are covered by the structure.	Owner
Low Impact Development (LID) and Treatment Control BMPs			
Modular Wetlands	Bi- annual	Inspect and remove trash and debris from outlet pipe and vault twice a year.	Owner

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.

Trash Storage Areas SD-32

Description

Trash storage areas are areas where a trash receptacle (s) are located for use as a repository for solid wastes. Stormwater runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or creeks. Waste handling operations that may be sources of stormwater pollution include dumpsters, litter control, and waste piles.

Approach

This fact sheet contains details on the specific measures required to prevent or reduce pollutants in stormwater runoff associated with trash storage and handling. Preventative measures including enclosures, containment structures, and impervious pavements to mitigate spills, should be used to reduce the likelihood of contamination.

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- Collect and Convey

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

Design requirements for waste handling areas are governed by Building and Fire Codes, and by current local agency ordinances and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements. Hazardous waste should be handled in accordance with legal requirements established in Title 22, California Code of Regulation.

Wastes from commercial and industrial sites are typically hauled by either public or commercial carriers that may have design or access requirements for waste storage areas. The design criteria in this fact sheet are recommendations and are not intended to be in conflict with requirements established by the waste hauler. The waste hauler should be contacted prior to the design of your site trash collection areas. Conflicts or issues should be discussed with the local agency.

Designing New Installations

Trash storage areas should be designed to consider the following structural or treatment control BMPs:

- Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This might include berming or grading the waste handling area to prevent run-on of stormwater.
- Make sure trash container areas are screened or walled to prevent off-site transport of trash.

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- Use lined bins or dumpsters to reduce leaking of liquid waste.
- Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
- Pave trash storage areas with an impervious surface to mitigate spills.
- Do not locate storm drains in immediate vicinity of the trash storage area.
- Post signs on all dumpsters informing users that hazardous materials are not to be disposed of therein.

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.

Additional Information

Maintenance Considerations

The integrity of structural elements that are subject to damage (i.e., screens, covers, and signs) must be maintained by the owner/operator. Maintenance agreements between the local agency and the owner/operator may be required. Some agencies will require maintenance deed restrictions to be recorded of the property title. If required by the local agency, maintenance agreements or deed restrictions must be executed by the owner/operator before improvement plans are approved.

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.

Water Quality Inlet TC-50

Description

Water quality inlets (WQIs), also commonly called trapping catch basins, oil/grit separators or oil/water separators, consist of one or more chambers that promote sedimentation of coarse materials and separation of free oil (as opposed to emulsified or dissolved oil) from stormwater. Some WQIs also contain screens to help retain larger or floating debris, and many of the newer designs also include a coalescing unit that helps promote oil/water separation. A typical WQI, as shown in the schematic, consists of a sedimentation chamber, an oil separation chamber, and a discharge chamber.

These devices are appropriate for capturing hydrocarbon spills, but provide very marginal sediment removal and are not very effective for treatment of stormwater runoff. WQIs typically capture only the first portion of runoff for treatment and are generally used for pretreatment before discharging to other best management practices (BMPs).

California Experience

Caltrans investigated the use of coalescing plate oil/water separators at maintenance stations in Southern California. Twenty-two maintenance stations were originally considered for implementation of this technology; however, only one site appeared to have concentrations that were sufficiently high to warrant installation of an oil-water separator. Concentrations of free oil in stormwater runoff observed during the course of the study even from this site were too low for effective operation of this technology, and no free oil was ever captured by the device.

Advantages

- Can provide spill control.

Limitations

- WQIs generally provide limited hydraulic and residuals storage. Due to the limited storage, WQIs do not provide substantial stormwater improvement.
- Standing water in the devices can provide a breeding ground for mosquitoes.
- Certain designs maintain permanent sources of standing water where mosquito and other vector breeding may to occur.

Design and Sizing Guidelines

- Water quality inlets are most effective for spill control and should be sized accordingly.

Design Considerations

- Area Required

Targeted Constituents

✓	Sediment	●
✓	Nutrients	●
✓	Trash	▲
✓	Metals	●
✓	Bacteria	●
✓	Oil and Grease	▲
✓	Organics	●

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

CASQA California Stormwater Quality Association

- Designs that utilize covered sedimentation and filtration basins should be accessible to vector control personnel via access doors to facilitate vector surveillance and controlling the basins if needed.

Performance

WQIs are primarily utilized to remove sediment from stormwater runoff. Grit and sediment are partially removed by gravity settling within the first two chambers. A WQI with a detention time of 1 hour may expect to have 20 to 40 percent removal of sediments. Hydrocarbons associated with the accumulated sediments are also often removed from the runoff through this process. The WQI achieves slight, if any, removal of nutrients, metals and organic pollutants other than free petroleum products (Schueler, 1992).

A 1993 MWCOG study found that an average of less than 5 centimeters (2 inches) of sediments (mostly coarse-grained grit and organic matter) were trapped in the WQIs. Hydrocarbon and total organic carbon (TOC) concentrations of the sediments averaged 8,150 and 53,900 milligrams per kilogram, respectively. The mean hydrocarbon concentration in the WQI water column was 10 milligrams per liter. The study also indicated that sediment accumulation did not increase over time, suggesting that the sediments become re-suspended during storm events. The authors concluded that although the WQI effectively separates oil and grease from water, re-suspension of the settled matter appears to limit removal efficiencies. Actual removal only occurs when the residuals are removed from the WQI (Schueler 1992).

A 1990 report by API found that the efficiency of oil and water separation in a WQI is inversely proportional to the ratio of the discharge rate to the unit's surface area. Due to the small capacity of the WQI, the discharge rate is typically very high and the detention time is very short. For example, the MWCOG study found that the average detention time in a WQI is less than 0.5 hour. This can result in minimal pollutant settling (API, 1990). However, the addition of coalescing units in many current WQI units may increase oil/water separation efficiency. Most coalescing units are designed to achieve a specific outlet concentration of oil and grease (for example, 10-1 5m/L oil and grease).

Pollutant removal in stormwater inlets can be somewhat improved using inserts, which are promoted for removal of oil and grease, trash, debris, and sediment. Some inserts are designed to drop directly into existing catch basins, while others may require extensive retrofit construction.

Siting Criteria

Oil/water separation units are often utilized in specific industrial areas, such as airport aprons, equipment washdown areas, or vehicle storage areas. In these instances, runoff from the area of concern will usually be diverted directly into the unit, while all other runoff is sent to the storm drain downstream from the oil/water separator. Oil/water separation tanks are often fitted with diffusion baffles at the inlets to prevent turbulent flow from entering the unit and resuspending settled pollutants.

Additional Design Guidelines

Prior to WQI design, the site should be evaluated to determine if another BMP would be more cost-effective in removing the pollutants of concern. WQIs should be used when no other BMP is feasible. The WQI should be constructed near a storm drain network so that flow can be easily diverted to the WQI for treatment (NVPDC, 1992). Any construction activities within the

drainage area should be completed before installation of the WQI, and the drainage area should be revegetated so that the sediment loading to the WQI is minimized.

WQIs are most effective for small drainage areas. Drainage areas of 0.4 hectares (1 acre) or less are often recommended. WQIs are typically used in an off-line configuration (i.e., portions of runoff are diverted to the WQI), but they can be used as on-line units (i.e., receive all runoff). Generally, off-line units are designed to handle the first 1.3 centimeters (0.5 inches) of runoff from the drainage areas. Upstream isolation/diversion structures can be used to divert the water to the off-line structure (Schueler, 1992). On-line units receive higher flows that will likely cause increased turbulence and resuspension of settled material, thereby reducing WQI performance.

Oil/water separation tanks are often fitted with diffusion baffles at the inlets to prevent turbulent flow from entering the unit and resuspending settled pollutants. WQIs are available as pre-manufactured units or can be cast in place. Reinforced concrete should be used to construct below-grade WQIs. The WQIs should be water tight to prevent possible ground water contamination.

Maintenance

Typical maintenance of WQIs includes trash removal if a screen or other debris capturing device is used, and removal of sediment using a vactor truck. Operators need to be properly trained in WQI maintenance. Maintenance should include keeping a log of the amount of sediment collected and the date of removal. Some cities have incorporated the use of GIS systems to track sediment collection and to optimize future catch basin cleaning efforts.

One study (Pitt, 1985) concluded that WQIs can capture sediments up to approximately 60 percent of the sump volume. When sediment fills greater than 60 percent of their volume, catch basins reach steady state. Storm flows can then resuspend sediments trapped in the catch basin, and will bypass treatment. Frequent clean-out can retain the volume in the catch basin sump available for treatment of stormwater flows.

At a minimum, these inlets should be cleaned at least twice during the wet season. Two studies suggest that increasing the frequency of maintenance can improve the performance of catch basins, particularly in industrial or commercial areas. One study of 60 catch basins in Alameda County, California, found that increasing the maintenance frequency from once per year to twice per year could increase the total sediment removed by catch basins on an annual basis (Mineart and Singh, 1994). Annual sediment removed per inlet was 54 pounds for annual cleaning, 70 pounds for semi-annual and quarterly cleaning, and 160 pounds for monthly cleaning. For catch basins draining industrial uses, monthly cleaning increased total annual sediment collected to six times the amount collected by annual cleaning (180 pounds versus 30 pounds). These results suggest that, at least for industrial uses, more frequent cleaning of catch basins may improve efficiency.

BMPs designed with permanent water sumps, vaults, and/or catch basins (frequently installed below-ground) can become a nuisance due to mosquito and other vector breeding. Preventing mosquito access to standing water sources in BMPs (particularly below-ground) is the best prevention plan, but can prove challenging due to multiple entrances and the need to maintain the hydraulic integrity of the system. BMPs that maintain permanent standing water may require routine inspections and treatments by local mosquito and vector control agencies to

suppress mosquito production. Standing water in oil/water separators may contain sufficient floating hydrocarbons to prevent mosquito breeding, but this is not a reliable control alternative to vector exclusion or chemical treatment.

Cost

A typical pre-cast catch basin costs between $2,000 and $3,000; however, oil/water separators can be much more expensive. The true pollutant removal cost associated with catch basins, however, is the long-term maintenance cost. A vactor truck, the most common method of catch basin cleaning, costs between $125,000 and $150,000. This initial cost may be high for smaller Phase II communities. However, it may be possible to share a vactor truck with another community. Typical vactor trucks can store between 10 and 15 cubic yards of material, which is enough storage for three to five catch basins. Assuming semi-annual cleaning, and that the vactor truck could be filled and material disposed of twice in one day, one truck would be sufficient to clean between 750 and 1,000 catch basins. Another maintenance cost is the staff time needed to operate the truck. Depending on the regulations within a community, disposal costs of the sediment captured in catch basins may be significant.

References and Sources of Additional Information

American Petroleum Institute (API),1990. *Monographs on Refinery Environmental Control - Management of Water Discharges (Design and Operation of Oil-Water Separators).* Publication 421, First Edition.

Aronson, G., D. Watson, and W. Pisaro. *Evaluation of Catch Basin Performance for Urban Stormwater Pollution Control.* U.S. Environmental Protection Agency, Washington, DC.

Berg, V.H, 1991. *Water Quality Inlets (Oil/Grit Separators).* Maryland Department of the Environment, Sediment and Stormwater Administration.

Lager, J., W. Smith, R. Finn, and E. Finnemore. 1977. *Urban Stormwater Management and Technology: Update and Users' Guide.* Prepared for U.S. Environmental Protection Agency. EPA-600/8-77-014. 313 pp.

Metropolitan Washington Council of Governments (MWCOG), 1993. *The Quality of Trapped Sediments and Pool Water Within Oil Grit Separators in Suburban Maryland.* Interim Report.

Metzger, M. E., D. F. Messer, C. L. Beitia, C. M. Myers, and V. L. Kramer. 2002. The Dark Side Of Stormwater Runoff Management: Disease Vectors Associated With Structural Bmps. Stormwater 3(2): 24-39.

Metzger, M. E., and S. Kluh. 2003. Surface Hydrocarbons Vs. Mosquito Breeding. Stormwater 4(1): 10.

Mineart, P., and S. Singh. 1994. *Storm Inlet Pilot Study.* Alameda County Urban Runoff Clean Water Program, Oakland, CA.

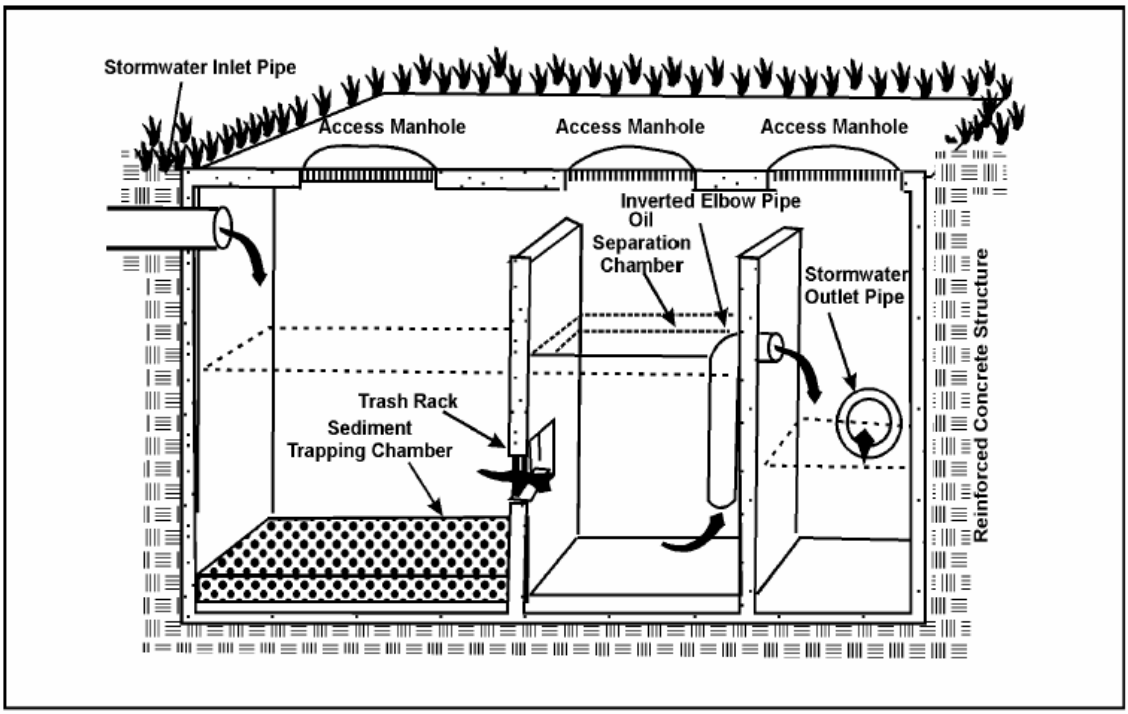
Northern Virginia Planning District Commission (NVPDC) and Engineers and Surveyors Institute, 1992. *Northern Virginia BMP Handbook.*

Pitt, R., and P. Bissonnette. 1984. *Bellevue Urban Runoff Program Summary Report.* U.S. Environmental Protection Agency, Water Planning Division, Washington, DC.

Pitt, R., M. Lilburn, S. Nix, S.R. Durrans, S. Burian, J. Voorhees, and J. Martinson. 2000. *Guidance Manual for Integrated Wet Weather Flow (WWF) Collection and Treatment Systems for Newly Urbanized Areas (New WWF Systems)*. U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, OH.

Schueler, T.R., 1992. *A Current Assessment of Urban Best Management Practices*. Metropolitan Washington Council of Governments.

U.S. EPA, 1999, Stormwater Technology Fact Sheet: Water Quality Inlets, EPA 832-F-99-029, Office of Water, Washington DC.


Stormwater Inlet Pipe
Access Manhole
Access Manhole
Access Manhole
Inverted Elbow Pipe
Oil
Separation
Chamber
Stormwater
Outlet Pipe
Trash Rack
Sediment
Trapping Chamber
Reinforced Concrete Structure

Appendix D: Educational Materials

LIST OF EDUCATIONAL MATERIAL APPLICABLE

1. THE OCEAN BEGINS AT YOUR FRONT DOOR
2. HOMEOWNERS GUIDE FOR SUSTAINABLE WATER USE
3. HOUSEHOLD TIPS
4. PROPER DISPOSAL OF HOUSEHOLD HAZARDOUS WASTE
5. RESPONSIBLE PEST CONTROL
6. TIPS FOR LANDSCAPING AND GARDENING

Refer to ocwatersheds.com for educational information pamphlets

Appendix E: Geotechnical Report

NMG Geotechnical, Inc.

November 23, 2022

Project No. 22023-01

To: Shea Properties
130 Vantis, Suite 200
Aliso Viejo, California 92656

Attention: Mr. Sean McEachern, Vice President of Development

Subject: Geotechnical Exploration and Feasibility Report for Proposed Multi-Family Residential Development, Anaheim Hills Festival Retail Center, City of Anaheim, California

In accordance with your request, NMG Geotechnical, Inc. (NMG) has conducted a geotechnical exploration and feasibility study for the upper pad of the Anaheim Hills Festival Retail Center, in the city of Anaheim. The purpose of our study was to evaluate the geotechnical site conditions in light of the proposed improvements in order to determine project feasibility and provide preliminary geotechnical recommendations for the project design, grading, and construction.

Our scope of services was based on review of two options for conceptual site development and included review of background site information, review of prior geotechnical reports by others, drilling and logging of five hollow-stem-auger borings, advancement of seven cone penetrometer tests (CPTs), laboratory testing, geotechnical review of the preliminary design information, geotechnical analysis, and preparation of this report. This report presents our findings, conclusions and preliminary recommendations.

The site was graded in the 1990s for the retail development and is underlain by compacted artificial fill and sandstone/siltstone bedrock. The compacted artificial fill is primarily in the northern portion of the site and in a prior canyon in the east-central portion of the site. The fill is up to 38 feet thick along the former canyon alignment. Bedrock is exposed at the surface in the southwestern portion of the site and is present beneath the compacted fill. Groundwater was not encountered in borings drilled during our exploration; however, prior work at the site encountered considerable seepage in the southwest and a mitigation system was installed. Please note, environmental evaluation of onsite soils is not a part of this report and is the purview of others.

Based on our exploration, testing and analyses, we conclude that the proposed improvements are feasible from a geotechnical viewpoint. Potential constraints include differential settlement due to the varying fill depths associated with the canyon fill, previously mitigated presence of nuisance seepage, seismic shaking typical to the region and the logistics of constructing a new development while maintaining the adjacent retail development functional. The soils at the site are classified as having "low to medium" expansion potential. Geologic conditions are such that storm water infiltration is not feasible at the site.

If you have any questions regarding this report, please contact us. We appreciate the opportunity to provide our services.

Respectfully submitted,

NMG GEOTECHNICAL, INC.

Lynne Yost, CEG 2317
Principal Geologist

Ted Miyake, RCE 44864
Principal Engineer

LY/TM/je

Distribution: Addressee (E-Mail)
Mr. Jon Stephani, Shea Properties (E-Mail)





TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 Purpose and Scope of Services 1
1.2 Site Location and Existing Conditions 2
1.3 Site History and Prior Studies 2
1.4 Proposed Development 3
1.5 Field Exploration 3
1.6 Laboratory Tests 4
2.0 GEOTECHNICAL FINDINGS 5
2.1 Geologic Conditions and Earth Units 5
2.2 Groundwater 5
2.3 Regional Faulting, Seismicity and Seismic Hazards 6
2.4 Engineering Characteristics of Onsite Soils 6
2.5 Settlement Potential 7
2.6 Infiltration Feasibility 8
2.7 Existing Improvements 8
2.8 Earthwork Shrinkage, Bulking and Subsidence 8
3.0 CONCLUSIONS AND PRELIMINARY RECOMMENDATIONS 9
3.1 General Conclusions and Recommendation 9
3.2 Protection of Existing Improvements and Utilities 9
3.3 Demolition and Site Preparation 9
3.4 Grading and Earthwork 10
3.5 Groundwater and Subdrainage 11
3.6 Settlement 11
3.7 Building Foundations and Slabs 11
3.8 Preliminary Seismic Design Parameters 12
3.9 Soil Corrosivity and Soluble Sulfate Contents 12
3.10 Pavements 13
3.10.1 Non-vehicular Pavements 13
3.10.2 Vehicular Pavements 13
3.11 Temporary Excavations and Shoring 13
3.12 Utility Installation and Trench Backfill 13
3.13 Additional Geotechnical Exploration 14
4.0 LIMITATIONS 15

Figures

Figure 1 – Site Location Map – Rear of Text
Figure 2 – Seismic Hazards Map – Rear of Text
Figure 3 – Regional Fault Map – Rear of Text

Illustrations

Plate 1 – Geotechnical Map – Rear of Text
Plate 2 – Geologic Cross-Sections A-A' and B-B' – Rear of Text

Appendices

Appendix A – References
Appendix B – Geotechnical Boring Logs
Appendix C – Laboratory Test Results
Appendix D – Seismicity Data
Appendix E – General Grading and Earthwork Specifications

1.0 INTRODUCTION

1.1 Purpose and Scope of Services

The purpose of this study and subsurface exploration was to evaluate the existing geotechnical site conditions in light of the proposed development in order to determine project feasibility, identify geotechnical constraints and provide preliminary recommendations for design, grading, and construction.

Our scope of services was intended to collect sufficient geotechnical data to determine the site history and characterize the existing subsurface conditions, with respect to the proposed development. This report is based on the following scope of services:

- Review and compilation of available published geologic maps and geotechnical reports for the subject site and surrounding area. A list of references is included in Appendix A.
- Review of historic aerial photographs and topographic maps readily available from online sources.
- Site reconnaissance to review the conditions of the existing asphalt pavements, building exteriors and the perimeter gravity walls.
- Notification and coordination with DigAlert to identify and clear underground utilities at the boring and CPT locations. We also met with representatives of Vestar to clear the locations with their facilities/tenants.
- Drilling, sampling, and visual logging of five hollow-stem-auger borings (H-1 through H-5) to depths ranging from 15.3 to 25.8 feet below ground surface (bgs). Advancement of eight CPTs (CPT-1 through CPT-7) to depths of 6.2 to 37.3 feet were also performed. Shear wave measurements were obtained in CPT-4A to aid in the characterization of site class for seismic design. The approximate locations of these borings and CPTs are depicted on the Geotechnical Map (Plate 1) and the boring and CPT logs are included in Appendix B.
- Laboratory testing of selected samples to classify the onsite soils and evaluate in-situ moisture and density, grain-size distribution, maximum density and optimum moisture content, corrosivity, expansion index, shear strength, and consolidation. Laboratory test results are included in Appendix C.
- Review of the "Festival Hills Residential Building Site Plan" prepared by AO Architecture, received by NMG on November 10, 2022. The same plan was used as the base map to depict the geotechnical site conditions (Plate 1).
- Geotechnical evaluation and analysis of the compiled data with respect to the anticipated residential development.
- Preparation of this feasibility report with our findings, conclusions, and preliminary recommendations for the subject project.

1.2 Site Location and Existing Conditions

The approximately 10-acre site is a part of and located within the southern portion of the existing Anaheim Hills Festival retail center in the city of Anaheim, California. The site is bounded by South Festival Drive on the west and south, the existing shopping center on the north and 24-Hour Fitness building on the east (Figure 1). The subject area of this study currently consists of an existing movie theater building, asphalt parking lot with drive aisles, parking lots and overhead lighting. The northerly and southerly perimeter of the site consists of Loffelstein™ (loffel) segmented block gravity retaining walls up to approximately 15 feet in height. Based on review of GeoSoils report (1992c), it is unclear if any kind of geogrid reinforcement was installed in these perimeter walls. A fill slope up to approximately 17 feet high ascends from the northern gravity wall to the subject site.

Five "Groundwater Removal Pumps" are located between the movie theater and South Festival Drive. These pump units are housed in metal cages and the power supply to some of them appears to be disconnected.

1.3 Site History and Prior Studies

We reviewed historic aerial photographs dating from 1946 through 2021. The site was in a natural condition from 1946 through 1972. The central portion of the site had a distinct drainage running from south to north with small landslides on the west side of the drainage. Two small water reservoirs/ponds to the east of the site show in the 1946 through 1980 photos. By 1972, State Route 91 had just been widened and improved with on/off ramps to Wier Canyon. Santiago Canyon Road was complete and Wier Canyon Road was only complete to Santiago Canyon Road. By 1992, the site had been mass graded and the reservoirs/ponds to the east had been removed and there were houses/roads over the former ponds. In 1993, the movie theater and parking lot had been constructed (although the movie theater footprint was much smaller). Between 1997 and 1998, additions to both ends of the movie theater was complete and both the 24-hour Fitness and daycare facility had been constructed. From 1998 to present, the site has remained essentially unchanged.

A preliminary geologic and soils investigation prior to site development was performed by Medall, Aragon, Worswick & Associates (MAW) in 1979 for the overall shopping center development. The report includes exploratory data and provides original topography prior to development (MAW, 1979). They later prepared a supplemental report which included additional field exploration and geologic cross-sections (MAW, 1980).

The project was taken over in the late 1980s by GeoSoils, Inc. (GeoSoils), who performed additional subsurface exploration to support development of the Anaheim Hills Festival Shopping Center project (1989). GeoSoils provided observation and testing during mass grading of the site which included remedial earthwork, installation of a canyon-type subdrain, placement of compacted fill in the canyon areas, and design cuts up to 50 feet deep within the southwest portion of the site (GeoSoils, 1992a). Significant nuisance seepage was observed in the deep design cut areas upon completion of mass grading, and later in 1992. GeoSoils recommended an intricate subdrain system surrounding the movie theater which included five groundwater

pumping wells, all of which drained to a storm drain device located at the westerly entrance road off South Festival Drive (GeoSoils, 1992b). GeoSoils also provided observation and testing during subdrain installation and construction of the loffel (gravity) walls on the north and south perimeter of the site (1992c).

The pertinent prior borings, limits of compacted fill and approximate locations of the subdrain systems are depicted on the Geotechnical Map (Plate 1).

1.4 Proposed Development

Based on review of the conceptual plan, the proposed apartment development will consist of a "wrap" with residential buildings wrapped around a centrally located concrete parking garage and courtyards. We anticipate the parking structure will be on the order of four to five-levels, with possibly one-half level being subterranean. The residential structures will likely be up to five-story, wood-framed apartment buildings. A fitness center and clubhouse, leasing center, amenity building and supporting utility infrastructure is also planned.

1.5 Field Exploration

Our field exploration was performed on October 26, 2022, and included excavation of five 8-inch-diameter hollow-stem-auger borings to depths ranging from 15.3 to 25.8 feet bgs and advancement of eight CPTs to depths of 6.2 to 37.3 bgs. The borings were geotechnically logged and samples were taken at selected intervals. Relatively undisturbed soil ring samples were obtained from the borings with a 2.5-inch inside-diameter, split-barrel sampler. Samplers were driven into the soil with a 140-pound automatic safety hammer, free-falling 30 inches. The drive samples were also used to obtain a measure of resistance of the soil to penetration (recorded as blows-per-foot on our geotechnical boring logs). Representative bulk samples of onsite soils were collected from the drill cuttings and used for additional soil identification purposes. The borings were backfilled with native soils and tamped and an asphalt concrete (AC) patch was applied to the surface.

The Cone Penetration Test (CPT) uses an integrated electronic cone system that measures and records tip resistance, sleeve friction, and friction ratio parameters at 5-cm depth intervals by advancement of a 1.25-inch-diameter, pointed steel probe that is hydraulically pushed into the ground at a constant rate. The CPT provides a detailed subsurface profile and soil behavior type information. At CPT-4A, shear wave measurements were obtained at 10, 20, 30 and 35 feet deep. The shear wave is generated using an air-actuated hammer, located inside the front jack of the CPT rig. The cone tip has a triaxial geophone, which records the shear wave signal generated by the air hammer. The CPT data was used with the boring information and laboratory test data to develop a consistent interpretation of the subsurface conditions. The CPT data was utilized for the assessment of the potential liquefaction and dry sand settlement. Please note, the CPTs were all terminated due to refusal. The CPTs were backfilled with bentonite pellets and capped with AC patch.

The boring and CPT locations are depicted on Plate 1 and the geotechnical boring logs and CPT logs are included in Appendix B.

1.6 Laboratory Tests

We conducted the following tests on representative undisturbed and bulk earth samples to characterize their engineering properties:

- Moisture content and dry density;
- Particle-size sieve analysis;
- Atterberg Limits;
- Direct shear (undisturbed sample);
- Consolidation;
- Expansion Index; and
- Soil corrosivity.

Laboratory tests were conducted in general conformance with applicable ASTM International standard test methods. Laboratory test results are provided in Appendix C. In-situ moisture content and dry density data are included on the geotechnical boring logs (Appendix B).

We have also reviewed pertinent prior laboratory testing by GeoSoils (1989). Their findings are generally consistent with the NMG test results reported herein.

2.0 GEOTECHNICAL FINDINGS

2.1 Geologic Conditions and Earth Units

The subject site is located in the Peninsular Range geomorphic province, in the northwestern foothills of the Peralta Hills. During the Quaternary period, active faulting (associated with the San Andreas Fault system) subjected the region to compression and regional uplift, forming the Santa Ana Mountains and foothills. Also during the Quaternary period, active streams channels cut canyons into the emergent bedrock. However, during past grading operations, the natural terrain was modified by cutting the ridges and filling canyon areas resulting in the current site configuration.

The site is mapped as underlain by the Sycamore Canyon Member of the Puente Formation (Morton and Miller, 2006). Based on our review of the geotechnical report of rough grading prepared by GeoSoils (1992a), the subject site consists of up to approximately 38 feet of compacted fill and bedrock of the Puente Formation.

Artificial compacted fill materials (**Map Symbol: Af**) were encountered in Borings H-3, H-4 and H-5. The compacted fill materials encountered generally consist of mottled olive brown to dark gray brown clayey sand and sandy clay that was damp to moist and very dense to hard, plastic, and locally iron-stained. Although the grading report by GeoSoils (1992a) did not include removal bottom elevations, it did include some isolated fill thickness values. We modeled the limits and depths of compacted fill from the fill thickness values by GeoSoils and by comparing the original topography with their recommended remedial measures (GeoSoils, 1989). The areas of fill are illustrated on the Geotechnical Map (Plate 1) and Cross-Sections A-A' and B-B' (Plate 2).

The southern and southwestern portion of the site consists of sedimentary bedrock of the Puente Formation, Sycamore Canyon Member (**Map Symbol: Tpsc**). This late Miocene-aged marine formation was encountered in all our borings and typically consists of interlayered sandstone and siltstone/claystone. The sandstone was found to be light brown, damp, very dense, micaceous and locally friable. The clayey siltstone/silty claystone was generally dark gray to black, damp, hard, micaceous, slightly plastic with some visible layers dipping 25 to 35 degrees.

Some geologic mapping was performed during the prior grading operations (GeoSoils, 1992a), including limits of the earth units described above, as well as local lenses of terrace deposits (**Map Symbol: Qt**) consisting of red-brown clay, silt, sand and gravel. They also mapped locations of faults, clay beds, groundwater seepage (and subdrains), and bedding generally dipping 15 to 48 degrees to the northwest.

2.2 Groundwater

Groundwater was not encountered during our exploration to a maximum depth of 25.8 feet bgs and groundwater was not encountered during the initial site exploration to depths of 100 feet below original ground surface (MAW, 1979 and GeoSoils, 1989). During rough grading of the site in the early 1990s, considerable nuisance seepage was observed and mapped in the design

cut area in the southwest portion of the site – specifically south of the movie theater, within South Festival Drive and within the residential development to the south. Based on review of GeoSoils (1992a), the rough grading included over 50 feet of design cut in this area and several clay beds, as well as a fault were mapped in the keyway immediately south of Festival Drive. Upon completion of rough grading and prior to development of the movie theater, GeoSoils documented installation of an elaborate subdrain system, including five groundwater pumping wells that outlet into an assumed storm drain system in the northwest portion of the site (GeoSoils, 1992b). This subdrain system is depicted on Plate 1.

The historic high groundwater mapping by California Division of Mines and Geology (CDMG, 1997 and 2000) indicates high groundwater at the site is greater than 40 feet deep.

2.3 Regional Faulting, Seismicity and Seismic Hazards

The subject site is not located within a fault-rupture hazard zone as defined by the Alquist-Priolo Special Studies Zone Act (CGS, 2018). No active faults are mapped at the site (Jennings and Bryant, 2010) and no evidence of active faulting was observed during prior studies (Appendix A) or this exploration. The potential for primary ground rupture at the site is considered low. The primary seismic hazard at the subject site is ground shaking due to a future earthquake on a regional active fault.

Using the USGS deaggregation computer program (USGS, 2022) and the site coordinates of 33.8652 degrees north latitude and 117.7512 degrees west longitude, the closest major active faults to the site are the Peralta Hills Fault located 1.7 miles southwest of the site and the Whittier Fault located 1.9 miles to the northeast; with the Whittier Fault the controlling fault for seismicity. The maximum moment magnitude (M_W) for the controlling fault is 7.5, which would be generated from the Whittier Fault.

Properties in southern California are subject to seismic hazards of varying degrees depending upon the proximity, degree of activity, and capability of nearby faults. These hazards can be primary (i.e., directly related to the energy release of an earthquake, such as surface rupture and ground shaking) or secondary (i.e., related to the effect of earthquake energy on the physical world which can cause phenomena, such as liquefaction and ground lurching).

The subject site is not located within a potential liquefaction hazard zone (CDMG, 1998 and 2001). Based on site specific geotechnical exploration and considering the site is underlain by very dense to hard artificial fill and sedimentary bedrock, as well as the absence of groundwater, the potential for seismic liquefaction at the subject site is considered very low. Tsunami and seiche are not considered hazards at the site due to the elevation and distance from the ocean or any substantial confined body of water.

2.4 Engineering Characteristics of Onsite Soils

The following includes a summary of the subsurface geotechnical conditions based on the boring logs and laboratory test results performed on in-situ samples (Appendix C).

Soil Properties: Grain-size distribution tests were conducted on two near-surface samples. The fines content (passing No. 200 sieve) varied from 35 to 40 percent. The plasticity indices (PI) for these samples were 12 and 19, respectively. In general, the near-surface artificial fill soils encountered during our exploration were classified as clayey sand (SC), silty sand (SM) and low plasticity sandy silty clays (CL).

Shear Strength: Direct shear testing conducted on two relatively undisturbed ring samples of the artificial fill resulted in both peak and ultimate internal friction angles of 30 degrees with cohesions of 1,150 and 650 pounds per square foot (psf). A sandstone bedrock sample test resulted in a peak strength of 42 degrees with 300 psf cohesion and an ultimate friction angle of 36 degrees

Consolidation: Consolidation tests were performed on four relatively undisturbed ring samples of the artificial fill from depths of 5 and 10 feet. The samples have very low to low consolidation potential with no hydro-collapse potential.

Expansion Potential: Two expansion potential tests on bulk samples collected from 1 to 5 feet below ground resulted in indicies of 26 and 51, which corresponds to "low" to "medium" potential.

Soluble Sulfate Content and Soil Corrosivity: The soluble sulfate exposure of two bulk samples from the upper 5 feet was classified as "S0 to S1" per Table 19.3.1.1 of ACI-318-14. Saturated resistivities ranged from 800 to 880 ohm-cm ("severely corrosive" to ferrous metals). pH levels were near normal and chloride contents were relatively low (less than 140 ppm).

2.5 Settlement Potential

Significant increases in grades above existing grades are not anticipated for the proposed project. Therefore, post-construction settlements of structures will be based on the foundation loads of those structures and the consolidation properties of the earth materials at the site. Large areas of the planned structure footprints have bedrock at the surface or relatively thin fills over bedrock. The heaviest proposed structure, the parking structure, is currently planned over an area with bedrock at the surface. Therefore, the settlement of that structure is expected to be relatively minor.

Before site development, a relatively broad drainage canyon traversed the site in a generally north-south direction. The canyon subdrain installed during site rough grading is shown on the Geotechnical Map and represents the bottom trace of this canyon. The deepest fill within the proposed building footprint is on the order of 35 feet deep and located within this filled-in canyon. The apartment structure to the east of the planned parking structure will straddle this canyon fill as illustrated on Cross-Section B-B'. Fortunately, the artificial fill at the site is medium dense/dense and stiff/hard with relatively low consolidation potential based on our drilling and laboratory testing. The underlying bedrock is also dense to hard and may be considered essentially incompressible under the anticipated structural loads.

We performed feasibility level settlement analyses of the canyon fill assuming 6 to 6.5-foot square column footings with loads ranging from 100 to 150 kips. Using software-based Westergaard and Boussinesq stress transfer methods, the resulting total settlements ranged from ½ to ¾ inch. Foundations founded on fills of 5 feet or less or on the bedrock will undergo negligible post-construction settlement. We estimate that differential settlements between columns in the vicinity of the deeper canyon fills would be on the same order of magnitude as the total settlements (½ to ¾ inch).

Potential settlement induced by earthquakes (seismic settlement) should be negligible due to the density of the engineered fill and bedrock underlying the site.

2.6 Infiltration Feasibility

Based on the data we have compiled to date, infiltration or percolation of storm water into the subsurface is not considered feasible. Although the regional groundwater table is very deep, nuisance seepage needed to be mitigated at the site and the pad consists entirely of very dense bedrock and compacted fill. Furthermore, any infiltration system would need to be deep enough to not adversely impact the adjacent retail site to the south (which, due to the depth, would be founded in bedrock).

2.7 Existing Improvements

There are several existing improvements within and along the perimeter of the site. The perimeter gravity walls along both the northerly and southerly boundary are up to approximately 15 feet high. These walls were designed and constructed based on the current site configuration. The existing asphalt pavement parking lot consists of 2.5 to 5 inches of asphalt concrete (AC) over 3 to 5 inches of aggregate base (AB). Utility line manholes and catch basins, including storm drain, sewer, water, and electric vaults, were observed along the drive aisles, near the toe-of-slope and along the perimeter of the site. Also, five groundwater pumping wells are located along the rear of the existing movie theater.

2.8 Earthwork Shrinkage, Bulking and Subsidence

The loss or gain of volume (shrinkage or bulking, respectively) of excavated natural materials and re-compaction as fill varies according to earth material type and location. This volume change is represented as a percentage shrinkage (volume loss) and as a percentage bulking (volume gain) after re-compaction of a unit volume of cut in this same material in its natural state. We anticipate the compacted fill materials may shrink up to 1 percent or bulk up to 1 percent (essentially they should have no volume change) and the bedrock materials may bulk on the order of 2 to 5 percent. Also, due to prior site use, ground subsidence at the site is anticipated to be negligible.

3.0 CONCLUSIONS AND PRELIMINARY RECOMMENDATIONS

3.1 General Conclusions and Recommendation

Based on the results of our subsurface exploration and feasibility study, construction of the proposed improvements, as described herein, is considered geotechnically feasible. Limited additional exploration, soil testing, and analyses may be required once the site plan with structure type and structure locations are finalized in order to provide more detailed design level recommendations.

The preliminary recommendations in this report are provided for broad feasibility and planning purposes. More detailed recommendations for design and construction will be provided following additional exploration (as needed), testing, and analysis, based on the final grading structure design information. These preliminary recommendations are considered minimum and may be superseded by more restrictive requirements of others. In addition to the following recommendations, General Earthwork and Grading Specifications are provided in Appendix E.

3.2 Protection of Existing Improvements and Utilities

Existing buildings, improvements and utilities adjacent to the site that are to be protected in-place should be located and visually marked prior to demolition and grading operations. Excavations adjacent to improvements to be protected in-place or any utility easement should be performed with care so as not to destabilize the adjacent ground. Utility lines that are to be abandoned (if any) should be removed and the excavation should be backfilled and compacted in accordance with the recommendations provided herein.

Stockpiling of soils (more than 5 feet in height) at or near existing structures and over utility lines that are to remain in-place (if any) should not be allowed without review by the geotechnical consultant and the structure/utility line owner(s).

We recommend that the conditions (fascia block, drainage devices, etc.) of the existing gravity walls along the perimeter of the site be visually assessed prior to and during demolition, grading and construction.

3.3 Demolition and Site Preparation

We anticipate the existing theater building has shallow spread footing foundations; hence, no removals of deep foundations are anticipated for that building. Significant amounts of concrete and asphalt concrete will be generated from site demolition. Portland Cement Concrete (PCC) and AC are likely to be suitable to be re-used as a crushed miscellaneous base product should crushing operations be feasible at the site. We anticipate the five pumping units south of the movie theater will also be abandoned. These should be completely removed along with the associated piping (electrical, drain lines, etc.) and disposed of offsite. Recommendations for additional subdrainage are provided in Section 3.5.

Prior to grading, the site should be cleared of deleterious materials (including vegetation, concrete, AC and existing utility pipelines to be demolished) and disposed of offsite.

3.4 Grading and Earthwork

General: Grading and excavations should be performed in accordance with the requirements of the City of Anaheim and NMG's General Earthwork and Grading Specifications provided in Appendix E.

Remedial Removals/Overexcavation: The recommended geotechnical remedial removals across the site include removal of the near-surface disturbed soils following completion of demolition operations and overexcavation of the bedrock. The anticipated depth of removals in existing compacted fill areas is generally on the order of 1 to 2 feet below existing grades. In areas near prior trees and bushes, the removals may need to be deeper in order to remove the roots/root balls. Deeper excavations, if any, during the remedial removal operations should be laid-back at a minimum of 1.5H:1V inclination to reduce the potential for failures near the property lines.

The majority of the site is anticipated to expose sandstone and siltstone bedrock at finish grade. Due to the potential for variations in the bedrock lithology, we recommend a minimum 3-foot overexcavation and recompaction of the bedrock materials below the future building pads to provide more uniform subgrades for slabs-on-grade and foundations. Within courtyards, drive aisles and surface parking, overexcavation is not deemed necessary; however, the upper 6 inches of subgrade should be processed as outlined below. Although very dense and locally cemented, we anticipate the bedrock materials to be rippable with conventional earthmoving equipment.

As mentioned earlier, we understand that the majority of the utility pipelines will be abandoned. Following clearance of the existing utility lines, the remedial removals should include removal of remnants of pipe lines/conduits and backfill soils, along with disturbed soils to expose competent native soils and replacement with compacted fill.

Fill Placement: The soils exposed at the bottom of the remedial removals and excavations should be observed and accepted by the geotechnical consultant prior to placement of fill materials. After the remedial removals and overexcavation, the bottoms should be scarified and moisture-conditioned prior to placement of fill. Onsite soil materials that are relatively free of organic materials and debris are considered suitable to be used as fill materials below the building slabs and footings. The soils should be mixed to provide a uniform blend of material. Fill should be placed in nearly horizontal loose lifts of approximately 8 inches in thickness, moisture-conditioned to 2 to 3 percent above optimum moisture content, and compacted to a minimum relative compaction of 90 percent (per ASTM D1557). We recommend that fills in the upper 18 inches be placed at 1.2 times optimum moisture content in order to mitigate the moderately expansive soils at the site and to expedite construction. Fills placed against ground sloping more than 5H:1V should be keyed and benched into competent material as the new fill is placed.

3.5 Groundwater and Subdrainage

The outlet for the subdrain system located in the western portion of the site should be located in the field and the functionality should be assessed. Future remedial earthwork in the area will include overexcavation of bedrock, which will likely include removal of portions of the subdrain system. We also anticipate the groundwater pumping units will be demolished/abandoned. If encountered and/or broken, the subdrain system should be repaired and/or removed.

We also recommend an additional subdrain be installed along the southern perimeter of the site due to the site geological conditions, including the mapped faults and clay beds to the south. The subdrain should consist of a 4-foot-deep trench excavation with 4-inch-diameter Schedule 40 PVC pipe surrounded by 3 cubic feet of ½- to ¾-inch crushed rock and wrapped in filter fabric (Mirafi 140N or approved equivalent). The subdrain should be installed such that it flows a minimum of 1.5 percent to a suitable outlet device (catch basin or storm drain pipeline).

3.6 Settlement

From the settlement analysis described in Section 2.5, and assuming the proposed site development as shown on Plate 1, total post-construction settlement of structures is anticipated to be on the order of 1 to 1.5 inches. Maximum differential static settlements should be on the order of ½-inch and ¾-inch over a span of 30 feet. Note that these maximum settlements should be isolated to the portions of buildings that straddle the area of deeper canyon fill (eastern half of the site). Seismic settlement is not expected to be significant.

Additional settlement analyses may be necessary once grading and structural designs are more complete and if additional exploration and laboratory testing is performed.

3.7 Building Foundations and Slabs

The slab and foundations should be designed by the project structural engineer based on the proposed structure type and the anticipated loading conditions. As mentioned in the prior settlement section, shallow spread footings should be feasible for the parking structure provided the structure is not located over the deeper canyon fill. If it is, shallow foundations may still be feasible for the parking structure but with some remedial measures.

The near-surface soils at the site have "low" to "medium" expansion potentials; therefore, the apartment buildings will require either a post-tension slab-on-grade system or a slab design per the Wire Reinforcement Institute method.

The recommended net allowable bearing capacities for foundations on compacted fill is expected to start at 2,000 psf with increases up to 4,000 psf. Bearing capacities for foundation on the existing bedrock should range from 4,000 to 5,000 psf.

We understand that partial subterranean parking is being considered. The local groundwater table is deep within the vicinity of the parking structure and no special subdrainage or slab design related to groundwater will be necessary.

The current building footprints along north side of the site are sufficiently far away from the existing gravity retaining wall and therefore no foundation setbacks related to that wall or other significant slopes is anticipated.

3.8 Preliminary Seismic Design Parameters

The following table summarizes the seismic design criteria for the subject site. These seismic design parameters are developed in accordance with ASCE 7-16 and 2019 CBC. The seismic response coefficient, C_s, should be determined per the parameters provided below and using equation 12.8-2 of ASCE 7-16.

Please note, as of January 1, 2023 the 2022 CBC will be adopted by local governing agencies. The updated code will include ASCE7-16 Supplements 1 through 3, which includes either site specific ground motion hazard analysis or a 50 percent increase for the value of S_{M1} and the subsequent applications of S_{M1} (which specifically include S_{D1} and T_S) for all sites considered to be Site Class D. The following values do not include the increase to S_{M1}; however, updated seismic design parameters should be provided during the design phase of the project.

Selected Seismic Design Parameters from 2019 CBC/ASCE 7-16	***Seismic Design Values***	***Reference***
Latitude	33.8652 North	
Longitude	117.7512 West	
Controlling Seismic Source	Whittier Fault	USGS, 2022
Distance to Controlling Seismic Source	1.9 mi	USGS, 2022
Site Class per Table 20.3-1 of ASCE 7-16	D	SEA/OSHPD, 2022
Spectral Acceleration for Short Periods (Ss)	1.84 g	SEA/OSHPD, 2022
Spectral Accelerations for 1-Second Periods (S_1)	0.65 g	SEA/OSHPD, 2022
Site Coefficient F_a, Table 11.4-1 of ASCE 7-16	1.0	SEA/OSHPD, 2022
Site Coefficient F_v, Table 11.4-2 of ASCE 7-16	1.7	
Design Spectral Response Acceleration at Short Periods (S_{DS}) from Equation 11.4-3 of ASCE 7-16	1.23 g	SEA/OSHPD, 2022
Design Spectral Response Acceleration at 1-Second Period (S_{D1}) from Equation 11.4-4 of ASCE 7-16	0.74 g	
T_S, S_{D1}/ S_{DS}, Section 11.4.6 of ASCE 7-16	0.60 sec	
T_L, Long-Period Transition Period	8 sec	SEA/OSHPD, 2022
Peak Ground Acceleration Corrected for Site Class Effects (PGA_M) from Equation 11.8-1 of ASCE 7-16	0.86 g	SEA/OSHPD, 2022
Seismic Design Category, Section 11.6 of ASCE 7-16	D	

3.9 Soil Corrosivity and Soluble Sulfate Contents

Existing soil is classified as "severely corrosive" to ferrous metals in contact with soil. Soluble sulfates were found to be in the S0 to S1 classification. Additional soil testing is recommended to determine whether the S0 classification may be more prevalent at the site.

3.10 Pavements

The following pavement sections should be considered preliminary. Actual pavement sections should be designed based on laboratory R-value testing after re-grading of the site.

3.10.1 Non-vehicular Pavements

As the onsite soils are, at worst, moderately expansive, non-vehicular and non-structural PCC slabs may be 4 inches thick, unreinforced, and with no subbase required. Moderate pre-saturation of such flatwork subgrade soil will be recommended.

3.10.2 Vehicular Pavements

Onsite soils are a mixture of sands, silts and clays and are therefore considered "fair" in terms of vehicular pavement subgrades. The existing pavement sections encountered in the borings for this study were consistently 4 to 5 inches of AC over 4 to 5 inches of AB. Future AC pavements sections are expected to be of this same general magnitude for the planned residential development.

PCC pavements should range from 4 to 5 inches thick with nominal reinforcements (No. 3 rebar, 24 inches on-center). Trash enclosure pavements should be thicker with heavier reinforcement.

3.11 Temporary Excavations and Shoring

The majority of the proposed parking structure is anticipated to expose bedrock. If one-half to one level of subterranean parking is planned, temporary excavations should be laid back at 1H:1.5V slope ratios in order to account for potential adverse bedding conditions. For vertical temporary excavations, cantilever solder pile or sheet pile walls should be feasible and parameters should be provided during the future design phase.

3.12 Utility Installation and Trench Backfill

Excavations should conform to the latest edition of OSHA requirements (shoring or layback of trench or excavation walls). The near-surface soils across most of the site are anticipated to be classified as Type C for CalOSHA trenching and shoring excavation requirements, due to the potential for adverse bedding conditions.

The published OSHA shoring design systems may be used for conventional shoring excavations less than 20 feet in depth. Soil loadings are provided below that do not include the effects of the additional loads from other surcharges. The geotechnical consultant should review the conditions during the deeper excavation and installation of shoring. Care should be taken at all times by personnel and/or equipment operators working adjacent to the excavations.

Native soils should generally be suitable for use as trench backfill. Backfill materials should be compacted to a minimum relative compaction of 90 percent (per ASTM D1557). We recommend that moisture content of native backfill be over optimum moisture content. Native soils that are

found to be wet will require reprocessing (e.g., mixing or drying) to achieve the uniform moisture content. Select backfill may be used in lieu of native soils.

Special bedding material may be required for trenches that encounter wet and/or soft soils at pipe depth. This will include overexcavating the trench 12 inches and providing the trench bottom with an additional layer of compacted crushed rock to create a firm bottom. Specific bedding and shading requirements for the pipelines should be provided by the governing agency.

If high-density polyethylene (HDPE) pipe is proposed for the development, then excavation, installation, bedding, shading and backfilling should be in strict accordance with the project and manufacturer's requirements. HDPE pipe has specific requirements for the width of the trench excavation. Also, HDPE pipe requires appropriate bedding and compaction of select granular backfill material in the pipe zone in order to provide uniform and adequate support. The initial backfill in the pipe zone (haunch) needs to be properly placed around the HDPE pipe, distributed by shovel to provide uniform support, "knifed-in" to remove voids and tamped for compaction.

3.13 Additional Geotechnical Exploration

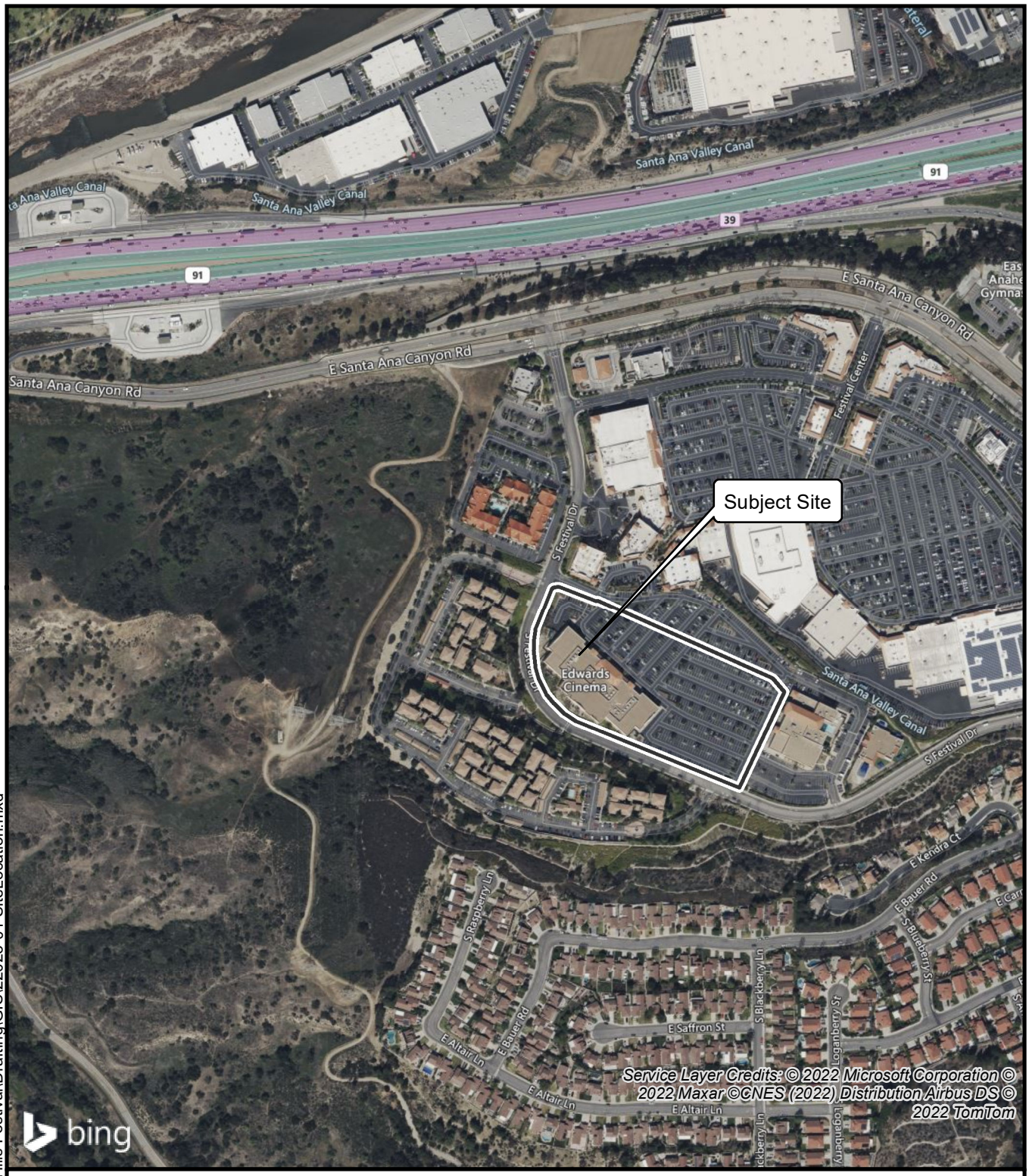
The preliminary recommendations herein are based on the proposed residential design as depicted on Plate 1. Future modifications to the conceptual design and the rough grading plan should be reviewed by the geotechnical consultant. Additional geotechnical exploration may be needed at the site to better assess the subsurface soil conditions, once the actual development plans are prepared. Additional laboratory testing and engineering analysis may also need to be performed for the final design.

4.0 LIMITATIONS

This report has been prepared for the exclusive use of our client, Shea Properties for the specific residential project proposed at the Anaheim Hills retail center. This report or its contents should not be used or relied upon for other projects or purposes or by other parties without the written consent of NMG and the involvement of a geotechnical professional. The means and methods used by NMG for this study are based on local geotechnical standards of practice, care, and requirements of governing agencies. No warranty or guarantee, express or implied is given.

The findings, conclusions, and recommendations herein are professional opinions based on interpretations and inferences made from geologic and engineering data from specific locations and depths, observed or collected at a given time. By nature, geologic conditions can vary from point to point, can be very different in between points, and can also change over time. Our conclusions and recommendations are subject to verification and/or modification during excavation and construction when more subsurface conditions are exposed.

NMG's expertise and scope of services did not include assessment of potential subsurface environmental contaminants or environmental health hazards.



0 250 500 Feet

1 inch = 500 feet

N

SITE LOCATION MAP

FESTIVAL HILLS
CITY OF ANAHEIM, CALIFORNIA

Project Number: 22023-01 By: TM/LY
Project Name: Shea Prop/Anaheim Hills Festival
Date: 11/23/2022 Figure 1

NMG

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Legend

- Earthquake-Induced Landslide Zones
- Liquefaction Zones

0 250 500 Feet

1 inch = 1,000 feet

N

SEISMIC HAZARDS AND FAULT ZONES MAP

Base: California Geological Survey, Earthquake Zones of Required Investigation, Black Star Canyon and Orange Quadrangles
Dated: January 17, 2001 and April 15, 1998

FESTIVAL HILLS

CITY OF ANAHEIM, CALIFORNIA

Project Number: 22023-01 By: TM/LY

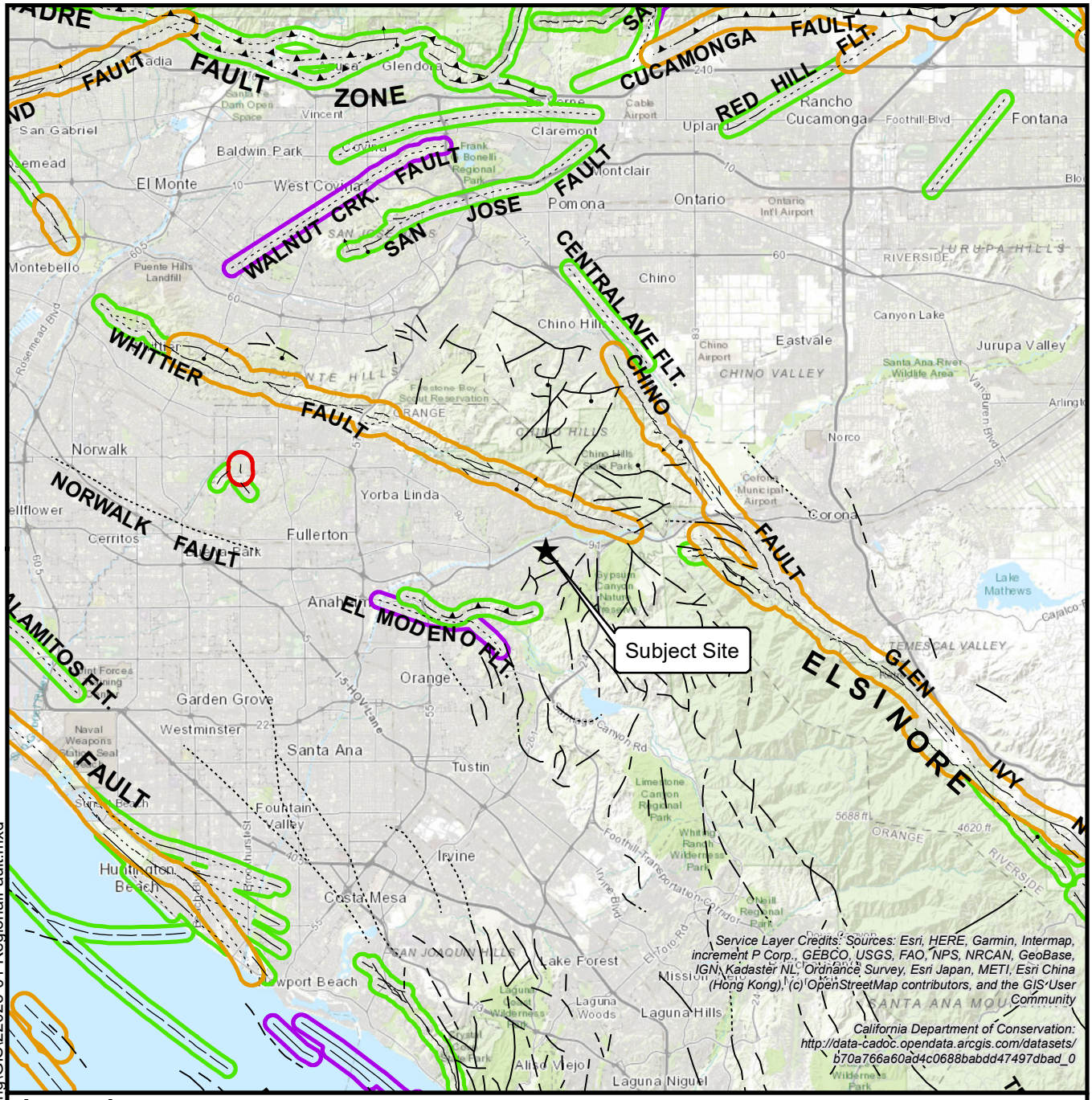
Project Name: Shea Prop/Anaheim Hills Festival

Date: 11/23/2022

Figure 2

NMG

P:\2022\22023-01 Shea Prop Anaheim Hills Festival\Drafting\GIS\22023-01 SeismicHazards.mxd



Legend

Faults

- Certain
- Approximately Located
- Concealed

Recency of Movement

- Historic
- Holocene
- Late Quaternary
- Quaternary

0 3 6 Miles

1 inch = 6 miles

N

REGIONAL FAULT MAP

Base: California Geological Survey, Fault Activity Map of California, 2010

FESTIVAL HILLS

CITY OF ANAHEIM, CALIFORNIA

Project Number: 22023-01 By: TM/LY

Project Name: Shea Prop/Anaheim Hills Festival

Date: 11/23/2022 Figure 3

NMG

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LEGEND

EARTH UNITS - CIRCLED WHERE BURIED

- **Af** — ARTIFICIAL FILL, PLACED UNDER OBSERVATION AND TESTING OF GEOSOILS, INC. (1992a) APPROXIMATE LIMITS HIGHLIGHTED IN GREEN
- **Qt** — TERRACE DEPOSIT
- **Tpsc** — PUENTE FORMATION, SYCAMORE CANYON MEMBER

SYMBOLS - LOCATIONS ARE APPROXIMATE, QUERIED WHERE UNCERTAIN

- GEOLOGIC CONTACT, DOTTED WHERE BURIED
- FAULT, DOTTED WHERE BURIED
- LIMITS OF EXISTING FILL
- CLAY BED (BURIED)

GEOLOGIC ATTITUDES- LOCATIONS ARE APPROXIMATE, DASHED WHERE BURIED

- E-W / 30 — BEDDING
- FAULT/SHEAR SURFACE ATTITUDE

OTHER SYMBOLS - LOCATIONS ARE APPROXIMATE

- **H-5** T.D.25.5' Tpsc@15' No — HOLLOW STEM AUGER BORING, THIS INVESTIGATION SHOWING TOTAL DEPTH, DEPTH TO EARTH UNITS AND DEPTH TO GROUNDWATER (5 TOTAL)
- **CPT-7** T.D.6.2' (Refusal) — CONE PENETROMETER TEST, SHOWING TOTAL DEPTH
- **GB-21** el.46.5' T.D.40' Tpsc@0' No — BUCKET AUGER BORING BY GEO SOILS, INC. (1989), SHOWING TOP OF BORING ELEVATION, TOTAL DEPTH, DEPTH TO EARTH UNITS AND DEPTH TO GROUNDWATER (6 TOTAL)
- **B-10** el.492' T.D.47' Qt@1' Tpsc@7' No — BUCKET AUGER BORING BY MEDALL, ARAGON, WORSWICK & ASSOCIATES (1979), SHOWING TOP OF BORING ELEVATION, TOTAL DEPTH, DEPTH TO EARTH UNITS AND DEPTH TO GROUNDWATER (2 TOTAL)

OTHER SYMBOLS - CONTINUED

- 4" — EXISTING SUBDRAIN WITH PIPE DIAMETER LABELED, ARROW INDICATES FLOW DIRECTION (GEOSOILS, 1992a, b, c)
- B — B' — GEOLOGIC CROSS-SECTION (2 TOTAL)
- 38' — THICKNESS OF COMPACTED FILL (GEOSOILS, INC. 1992a)

GRAPHIC SCALE

40 0 20 40 80

(IN FEET)

1 inch = 40 ft.

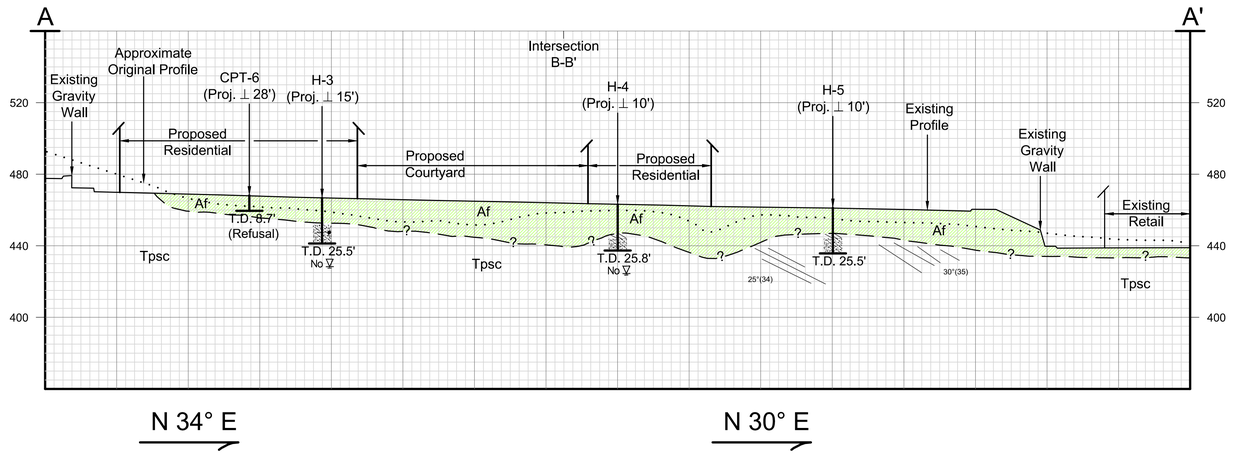
PLATE 1

GEOTECHNICAL MAP
FESTIVAL HILLS
CITY OF ANAHEIM, CALIFORNIA

Project No.: 22023-01 By:TM/LY
Project Name: Shea Prop/Anaheim Hills Festival
Date: 11/23/2022 SCALE: 1" = 40'

NMG Geotechnical, Inc.

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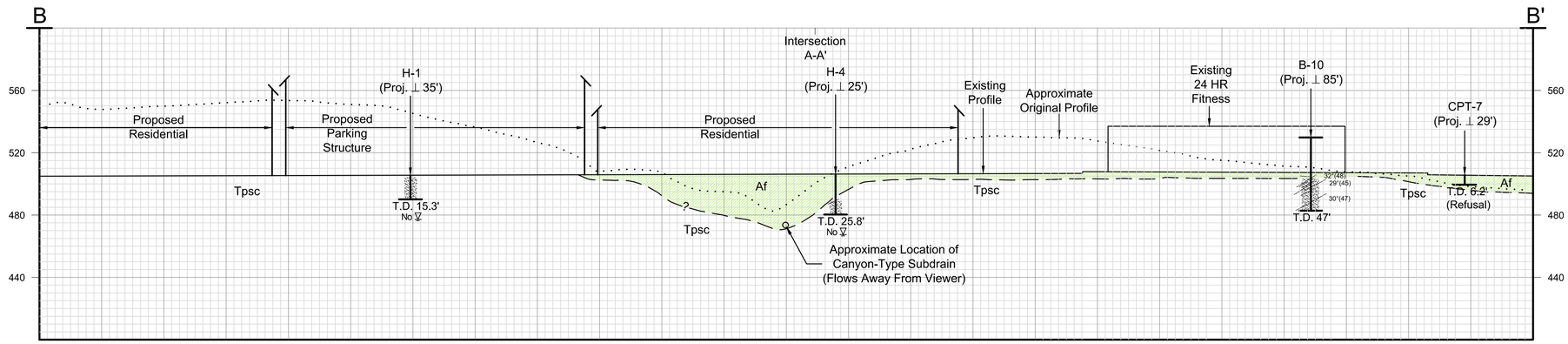


PLATE 2

Project No.: 22023-01	By:TM/LY
Project Name: Shea Prop/Anaheim Hills Festival	
Date: 11/23/2022	SCALE: 1" = 40'

NMG Geotechnical, Inc.

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APPENDIX A

APPENDIX A

REFERENCES

California Division of Mines and Geology (CDMG), 1997, Seismic Hazard Zone Report for the Orange 7.5-Minute Quadrangle, California, Seismic Hazard Zone Report 011.

California Division of Mines and Geology (CDMG), 1998, Seismic Hazard Zones, Orange Quadrangle, Official Map dated April 15, 1998.

California Division of Mines and Geology (CDMG), 2000, Seismic Hazard Zone Evaluation Report for the Black Star Canyon 7.5-Minute Quadrangle, California, Seismic Hazard Zone Report 046.

California Division of Mines and Geology (CDMG), 2001, Seismic Hazard Zones, Black Star Canyon Quadrangle, Revised Official Map dated January 17, 2001.

California Geological Survey (CGS), 2018, Earthquake Fault Zones, A Guide for Government Agencies, Property Owners / Developers, and Geoscience Practitioners for Assessing Fault Rupture Hazards in California, Special Publication 42, Revised 2018.

GeoSoils, Inc., 1989, Geotechnical Investigation and Review of 100-Scale Grading Plans, Anaheim Hills Festival Project, Anaheim Hills, Orange County, California, W.O. 1993-A-OC, Dated September 15, 1989.

GeoSoils, Inc., 1992a, Final Rough Grade Soil and Geologic Report, Anaheim Hills Festival Project, Anaheim Hills, Orange County, California, Dated June 2, 1992.

GeoSoils, Inc., 1992b, Subdrainage Constructed for Perched Groundwater Mitigation, Theatre Pad and Festival Drive, Anaheim Hills Festival Project, Anaheim Hills, California, Dated August 10, 1992.

GeoSoils, Inc., 1992c, Gravity (Loffel) Wall and Retaining Wall Backfill Compaction Report, Anaheim Hills Festival Project, Anaheim Hills, County of Orange, California, Project No. 1993-F1-OC, dated September 11, 1992.

GeoSoils, Inc., 1992d, Final Soils Compaction Report (Trench Backfills and Site Improvements), Anaheim Hills Festival Project, Anaheim Hills, California, Project No. 1993-C1, D1-OC, dated October 14, 1992.

Jennings, Charles W. and Bryant W.A., 2010, Fault Activity Map of California, Department of Conservation, California Geological Survey, Geologic Data Map No. 6.

Medall, Aragon, Worswick & Associates, Inc., 1979, Geologic and Soils Investigation, Bauer Ranch Regional Shopping Development, Portion of 400-Acre Bauer Ranch, Anaheim, County of Orange, California for Kaufman and Broad Homes, Inc., Project No. S1628-B, Dated December 5, 1979.

APPENDIX A

REFERENCES (Continued)

Medall, Aragon, Worswick and Associates, Inc., 1980, Supplemental Geologic and Soils Studies, Phase I, Grading and Culvert Construction, Santa Ana Canyon Road Relocation, Bauer Ranch, Anaheim, California for Kaufman and Broad Homes, Inc., Project No. S1628-I, dated July 8, 1980.

Morton, D.M., and Miller, F.K., 2006, Geologic map of the San Bernardino and Santa Ana 30' x 60' quadrangles, California: U.S. Geological Survey, Open-File Report OF-2006-1217, scale 1:100,000.

Structural Engineers Association/Office of Statewide Health Planning and Development, 2022, U.S. Seismic Design Maps, web site address: https://seismicmaps.org/; Date Accessed: November 20, 2022.

U.S. Geological Survey, 2022, Unified Hazard Tool, NSHM 2014 Dynamic Deaggregation Program; web site address: https://earthquake.usgs.gov/hazards/interactive/; Date Accessed: November 20, 2022.

APPENDIX B

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	*GRAVEL AND GRAVELLY SOILS* MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	*CLEAN GRAVELS* (LITTLE OR NO FINES)	GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	*CLEAN SANDS* (LITTLE OR NO FINES)	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	SM	SILTY SANDS, SAND - SILT MIXTURES
			SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	*SILTS AND CLAYS*	LIQUID LIMIT LESS THAN 50	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: Dual symbols are used to indicate gravels or sand with 5-12% fines and soils with fines classifying as CL-ML. Symbols separated by a slash indicate borderline soil classifications.

Sampler and Symbol Descriptions

- Modified California sample (D-#)
- Standard Penetration Test (S-#)
- Shelby tube sample (T-#)
- Large bulk sample (B-#)
- Small bulk sample (SB-#)
- Approximate depth of groundwater during drilling
- Approximate depth of static groundwater

Note: Number of blows required to advance driven sample 12 inches (or length noted).

Laboratory and Field Test Abbreviations

AL	Atterberg limits (plasticity)
CC	Chemical Testing incl. Soluble Sulfate
CN	Consolidation
DS	Direct Shear
EI	Expansion Index
GS	Grain Size Analysis (Sieve, Hydro. and/or -No. 200)
MD	Maximum Density and Optimum Moisture
RV	Resistance Value (R-Value)
SE	Sand Equivalent
UU	Unconsolidated Undrained Shear Strength

GENERAL NOTES

1. Soil classifications are based on the Unified Soil Classification System and include color, moisture, and relative density or consistency. Field descriptions have been modified to reflect results of laboratory tests where deemed appropriate. Bedrock descriptions are based on visual classification and include rock type, moisture, color, grain size, strength, and weathering.
2. Descriptions on these boring logs apply only at the specific boring locations and at the time the borings were drilled. They are not warranted to be representative of subsurface conditions at other locations or times.

KEY TO LOG OF BORING

Shea/ Anaheim Hills Festival
Anaheim Hills, CA
PROJECT NO. 22023-01

NMG Geotechnical, Inc.

Report: HOLLOW STEM; Project: 22023-01.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 11/17/22

Date(s) Drilled	**10/26/22**	Logged By	**BF**
Drilling Company	**2R Drilling, Inc.**	Drill Bit Size/Type	**8"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs. @ 30 Inch Drop**
Sampling Method(s)	**Modified California, Bulk**		
Approximate Groundwater Depth:	**No Groundwater Encountered.**		
Comments			

H-1

Sheet 1 of 1

Total Depth Drilled (ft)	**15.3**
Approximate Ground Surface Elevation (ft)	**464.0 msl**

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0					SAND STONE	Surface: Parking lot, 2.5" of asphaltic concrete over 3" of aggregate base.			
							Puente Formation, Sycamore Canyon Member (Tpsc)			B-1 @ 1-5'
							@ 0.5': Light yellowish brown (2.5Y 6/3) fine SANDSTONE, damp, very dense, micaceous, trace silt, slightly friable.			
			B-1							
460										
	5		D-1	50/6"			@ 5': Light yellowish brown (2.5Y 6/4) fine SANDSTONE, damp, very dense, micaceous, slightly friable.	7.5	117.8	DS
	10		D-2	50/5"			@ 10': Light yellowish brown (2.5Y 6/4) fine SANDSTONE, damp, very dense, micaceous, slightly friable.	6.2	105.5	
450										
	15		D-3	50/4"			@ 15': Light yellowish brown (2.5Y 6/4) fine SANDSTONE, damp, very dense, micaceous, slightly friable.	11.6		Disturbed
							Notes: Total Depth: 15.3 Feet. No Groundwater Encountered. Backfilled with Cuttings and Tamped. Patched with Quickset Concrete and Black Dye.			
	20									
440										
	25									

LOG OF BORING

Shea/ Anaheim Hills Festival
Anaheim Hills, CA
PROJECT NO. 22023-01

NMG

Report: HOLLOW STEM; Project: 22023-01.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 11/17/22

Date(s) Drilled	10/26/22	Logged By	BF
Drilling Company	2R Drilling, Inc.	Drill Bit Size/Type	8"
Drill Rig Type	CME 75 Hollow Stem	Hammer Data	140 lbs. @ 30 Inch Drop
Sampling Method(s)	Modified California, Bulk		
Approximate Groundwater Depth:	No Groundwater Encountered.		
Comments			

H-2

Sheet 1 of 1

Total Depth Drilled (ft)	15.5
Approximate Ground Surface Elevation (ft)	467.0 msl

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0					SC	Surface: Parking lot, 4" of asphaltic concrete over 4" of aggregate base.			
							Artificial Fill (Af)			B-1 @ 1-5'
						SILT STONE/ CLAY STONE	@ 0.5': Dark olive brown (2.5Y 3/3) silty clayey SAND, damp, dense, micaceous, mottled.			
							Puente Formation, Sycamore Canyon Member (Tpsc)			
			B-1				@ 1.5': Very dark gray to black (2.5Y 3/1 to 2.5/1) silty CLAYSTONE/ clayey SILTSTONE, damp, hard, micaceous.			
	5		D-1	90/9"			@ 5': Black (2.5Y 2.5/1) clayey SILTSTONE/ silty CLAYSTONE, damp, hard, micaceous, laminated, slightly plastic.	19.0	98.7	
460										
	10		D-2	50/6"			@ 10': Black (2.5Y 2.5/1) clayey SILTSTONE/ silty CLAYSTONE, damp, hard, micaceous, laminated, slightly plastic, beds dipping approximately 24°-34°.	18.5	96.9	
	15		D-3	50/6"			@ 15': Black (2.5Y 2.5/1) clayey SILTSTONE/ silty CLAYSTONE, damp, hard, micaceous, laminated, slightly plastic, beds dipping approximately 25°.	19.0	102.5	
450							Notes: Total Depth: 15.5 Feet. No Groundwater Encountered. Backfilled with Cuttings and Tamped. Patched with Quickset Concrete and Black Dye.			
	20									
	25									

LOG OF BORING

Shea/ Anaheim Hills Festival
Anaheim Hills, CA
PROJECT NO. 22023-01

NMG

Report: HOLLOW STEM; Project: 22023-01.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 11/17/22

Date(s) Drilled	**10/26/22**	Logged By	**BF**
Drilling Company	**2R Drilling, Inc.**	Drill Bit Size/Type	**8"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs. @ 30 Inch Drop**
Sampling Method(s)	**Modified California, Bulk**		
Approximate Groundwater Depth:	**Seepage at approximately 20 feet.**		
Comments			

H-3

Sheet 1 of 2

Total Depth Drilled (ft)	**25.5**
Approximate Ground Surface Elevation (ft)	**465.0 msl**

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0						Surface: Parking lot, 5" of asphaltic concrete over 5" of aggregate base.			
			B-1			SC-CL	**Artificial Fill (Af)** @ 0.8': Olive brown (2.5Y 4/4) silty clayey fine SAND to sandy CLAY, damp, dense/ hard, micaceous, trace gravel 1"-diameter, slightly plastic.			B-1 @ 1-5' CC,EI,GS
460	5		D-1	81		CL	@ 5': Dark grayish brown (2.5Y 4/2) silty sandy CLAY, damp, hard, micaceous, small sand lenses, trace to few rootlets, FeO staining, slightly plastic.	13.2	116.0	CN, DS
	10		D-2	42			@ 10': Dark grayish brown (2.5Y 4/2) silty sandy CLAY, damp, hard, micaceous, small sand lenses, FeO staining, slightly plastic.	17.3	110.8	CN
450	15		D-3	66		SAND STONE	**Puente Formation, Sycamore Canyon Member (Tpsc)** @ 15': Yellowish brown to dark yellowish brown (10YR 5/6 to 4/6) fine to medium SANDSTONE, very moist, very dense, micaceous, slightly friable.	13.7	117.8	
	20		D-4	50/6"			@ 20': Yellowish brown to dark yellowish brown (10YR 5/6 to 4/6) fine SANDSTONE, wet, very dense, micaceous, slightly friable.	20.2	107.1	
440	25									

LOG OF BORING

Shea/ Anaheim Hills Festival
Anaheim Hills, CA
PROJECT NO. 22023-01

NMG

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
440	25	■	D-5	50/6"		SAND STONE	@ 25': Yellowish brown and gray (10YR 5/6 and 5Y 5/1) fine SANDSTONE, wet, very dense, micaceous, laminated, slightly friable, bedding dipping approximately 25°.	18.9	108.7	

Notes:
Total Depth: 25.5 Feet.
Seepage at 20 Feet.
Boring Caved in at 15 Feet.
Backfilled with Cuttings and Tamped.
Patched with Quickset Concrete and Black Dye.

430 35
420 45
410 55

LOG OF BORING

Shea/ Anaheim Hills Festival
Anaheim Hills, CA

PROJECT NO. 22023-01

NMG

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Report: HOLLOW STEM; Project: 22023-01.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 11/17/22

Date(s) Drilled	10/26/22	Logged By	BF
Drilling Company	2R Drilling, Inc.	Drill Bit Size/Type	8"
Drill Rig Type	CME 75 Hollow Stem	Hammer Data	140 lbs. @ 30 Inch Drop
Sampling Method(s)	Modified California, Bulk		
Approximate Groundwater Depth:	No Groundwater Encountered.		
Comments			

H-4

Sheet 1 of 2

Total Depth Drilled (ft)	25.8
Approximate Ground Surface Elevation (ft)	463.0 msl

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0					SC-CL	Surface: Parking lot, 4.5" of asphaltic concrete over 4.5" of aggregate base. **Artificial Fill (Af)** @ 0.75': Light olive brown (2.5Y 5/3) silty clayey fine SAND to sandy CLAY, damp, medium dense/ very stiff, trace mica, few subangular gravel 1"-diameter, slightly plastic.			B-1 @ 1-5' CN
460			B-1							
	5		D-1	42		SC	@ 5': Light olive brown (2.5Y 5/4) silty clayey fine SAND, damp, medium dense, micaceous, trace fine gravel, trace roots, slightly plastic.	9.8	112.6	
	10		D-2	43			@ 10': Light olive brown (2.5Y 5/4) silty clayey fine SAND, damp, medium dense, micaceous, small lenses of clean sand, slightly plastic.	11.8	117.0	
450										
	15		D-3	90/9"		SILT STONE/ CLAY STONE	**Puente Formation, Sycamore Canyon Member (Tpsc)** @ 15': Dark greenish gray (GLEY 4/1) clayey SILTSTONE/ silty CLAYSTONE, moist, hard, trace mica, thinly bedded, FeO staining, plastic.	25.5	99.5	
	20		D-4	50/6"		SAND STONE	@ 20': Brownish yellow (10YR 6/6) fine SANDSTONE, moist, very dense, micaceous, mica beds, thinly bedded, friable to highly friable.	12.2	101.9	
440										
	25									

LOG OF BORING

Shea/ Anaheim Hills Festival
Anaheim Hills, CA
PROJECT NO. 22023-01

NMG

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	25		D-5	80/9"		SILTSTONE	@ 25': Very dark greenish gray (GLEY 3/1) clayey SILTSTONE, moist, hard, micaceous, laminated, mica beds, rip-up clasts of gray sandstone, FeO staining, slightly plastic, very moist to wet sandstone in shoe.	19.7	105.5	
							Notes: Total Depth: 25.75 Feet. No Groundwater Encountered. Backfilled with Cuttings and Tamped. Patched with Quickset Concrete and Black Dye.			
430	30									
	35									
	40									
420										
	45									
	50									
410										
	55									

LOG OF BORING

Shea/ Anaheim Hills Festival
Anaheim Hills, CA

PROJECT NO. 22023-01

NMG

Report: HOLLOW STEM; Project: 22023-01.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 11/17/22

Report: HOLLOW STEM; Project: 22023-01.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 11/17/22

Date(s) Drilled	**10/26/22**	Logged By	**BF**
Drilling Company	**2R Drilling, Inc.**	Drill Bit Size/Type	**8"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs. @ 30 Inch Drop**
Sampling Method(s)	**Modified California, Bulk**		
Approximate Groundwater Depth:	**No Groundwater Encountered.**		
Comments			

H-5

Sheet 1 of 2

Total Depth Drilled (ft)	**25.5**
Approximate Ground Surface Elevation (ft)	**463.0 msl**

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0					SC-CL	Surface: Parking lot, 4" of asphaltic concrete over 4" of aggregate base. **Artificial Fill (Af)** @ 0.7': Light olive brown (2.5Y 5/3) silty clayey fine SAND to sandy CLAY, damp, dense/ very stiff, roots at 3'.			B-1 @ 1-5' CC,EI,GS
460			B-1							
	5		D-1	70		SM-SC	@ 5': Olive brown (2.5Y 4/3) clayey silty fine SAND to silty clayey fine SAND, damp, very dense, micaceous, trace subangular gravel 1"-diameter, trace rootlets, small lenses of clean sand.	12.7	106.0	
	10		D-2	47		CL	@ 10': Olive brown to dark olive brown (2.5Y 4/3 to 3/3) sandy silty CLAY, moist, hard, micaceous, trace subangular gravel 1/2"-diameter, small lenses of clean sand, FeO staining, plastic.	12.8	118.2	CN,DS
450										
	15		D-3	50/6"		SAND STONE/ SILT STONE	**Puente Formation, Sycamore Canyon Member (Tpsc)** @ 15': Upper: Yellow to brownish yellow (10YR 7/6 to 6/6) fine SANDSTONE, damp, very dense, micaceous, highly friable. Lower: Gray (5Y 5/1) silty CLAYSTONE/ clayey SILTSTONE, damp, hard, laminated, plastic.	6.9	109.4	
	20		D-4	50/4"		SAND STONE	@ 20': Light olive brown (2.5Y 5/4) fine SANDSTONE, damp, very dense, micaceous, highly friable.	5.2	108.3	
440										
	25									

LOG OF BORING

Shea/ Anaheim Hills Festival
Anaheim Hills, CA
PROJECT NO. 22023-01

NMG

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	25	■	D-5	50/6"		SILTSTONE/ CLAYSTONE	@ 25': Olive brown and very dark grayish brown (2.5Y 6/6 and 3/2) clayey SILTSTONE/ silty CLAYSTONE, damp, hard, micaceous, laminated, plastic.	19.9	97.5	
							Notes: Total Depth: 25.5 Feet. No Groundwater Encountered. Backfilled with Cuttings and Tamped. Patched with Quickset Concrete and Black Dye.			
430	30									
	35									
	40									
420										
	45									
	50									
410										
	55									

LOG OF BORING

Shea/ Anaheim Hills Festival
Anaheim Hills, CA

PROJECT NO. 22023-01

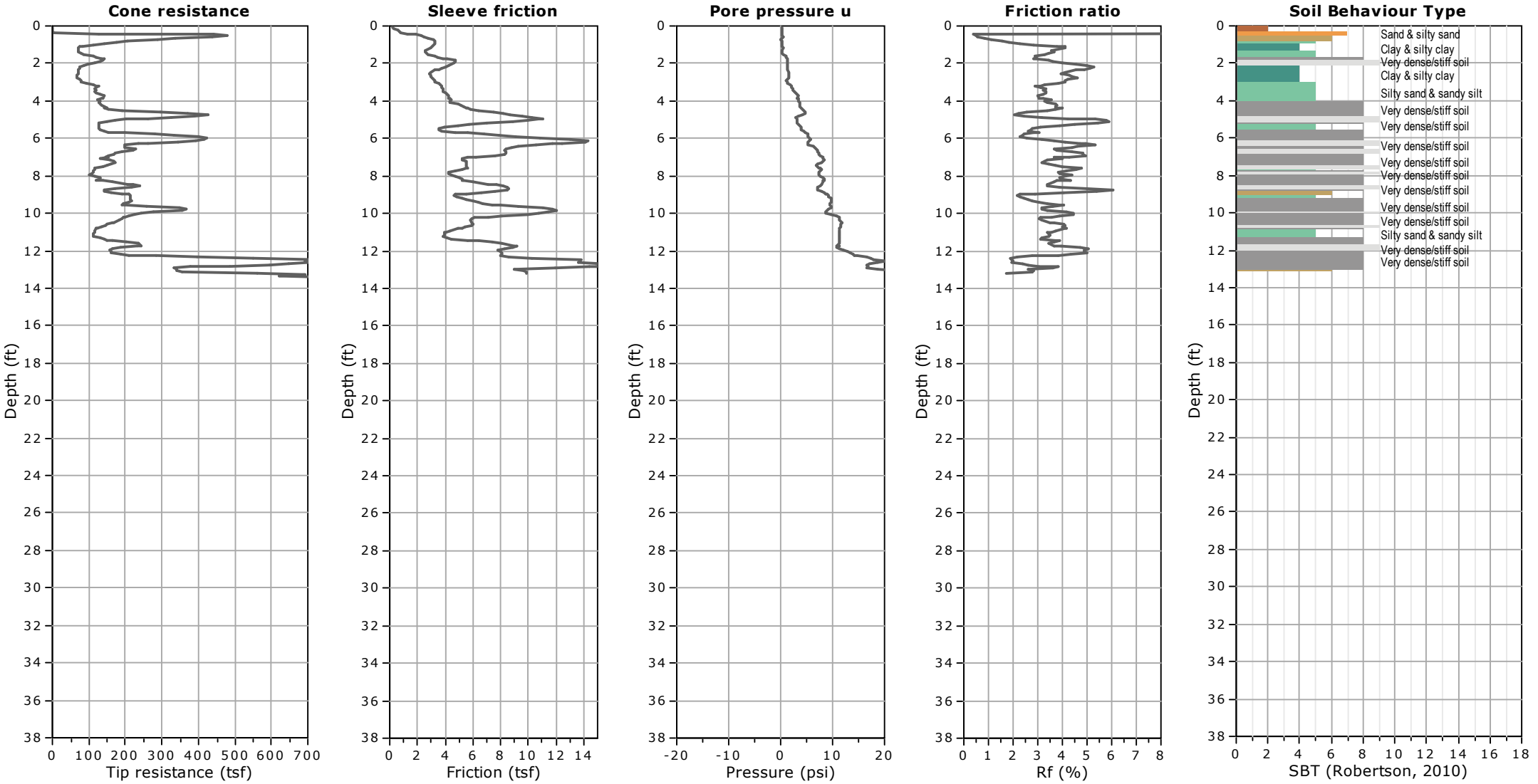
NMG

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Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
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Project: NMG Geotechnical
Location: 300 S. Festival Dr, Anaheim, CA

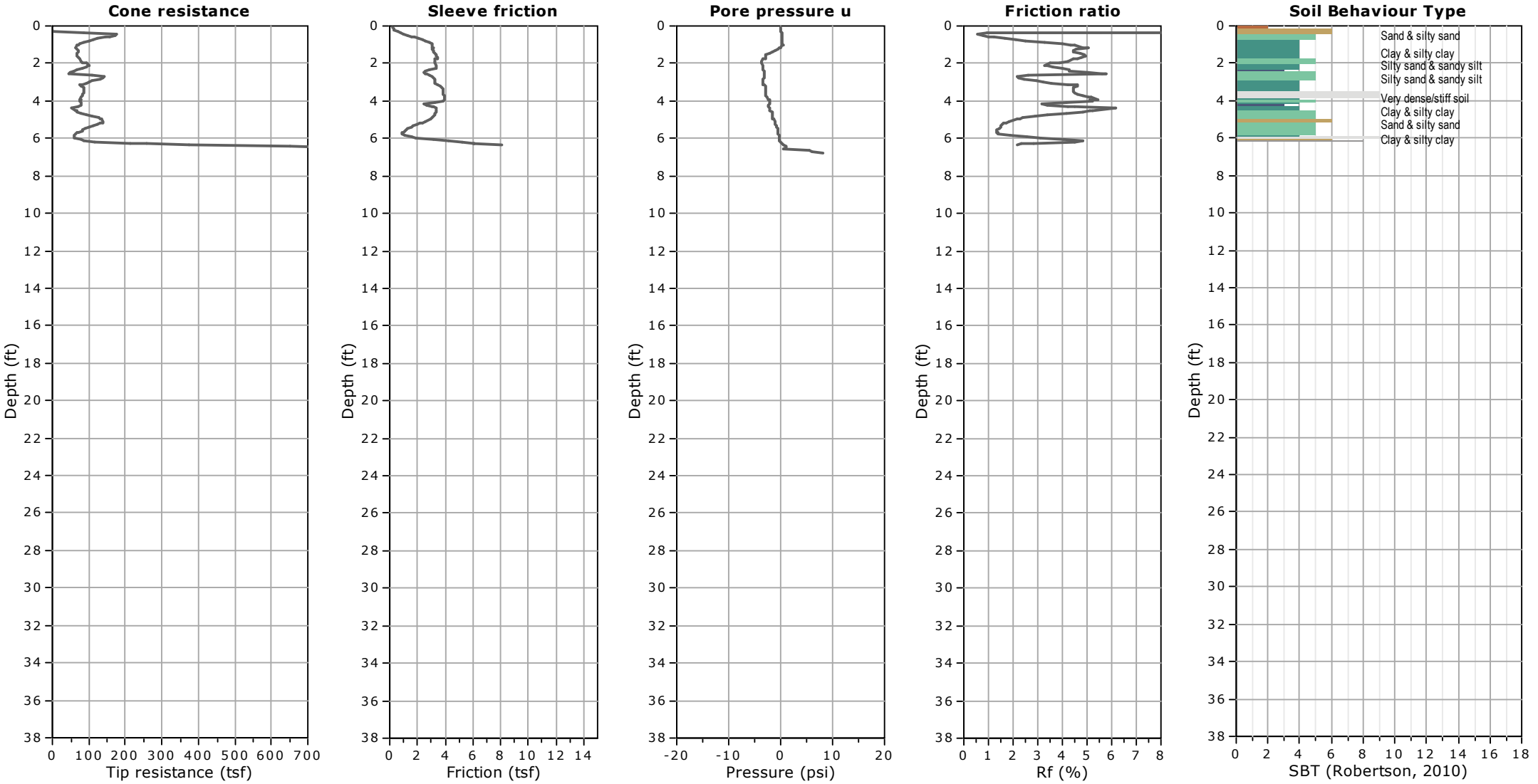
CPT-1
Total depth: 13.58 ft, Date: 10/26/2022



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Project: NMG Geotechnical
Location: 300 S. Festival Dr, Anaheim, CA

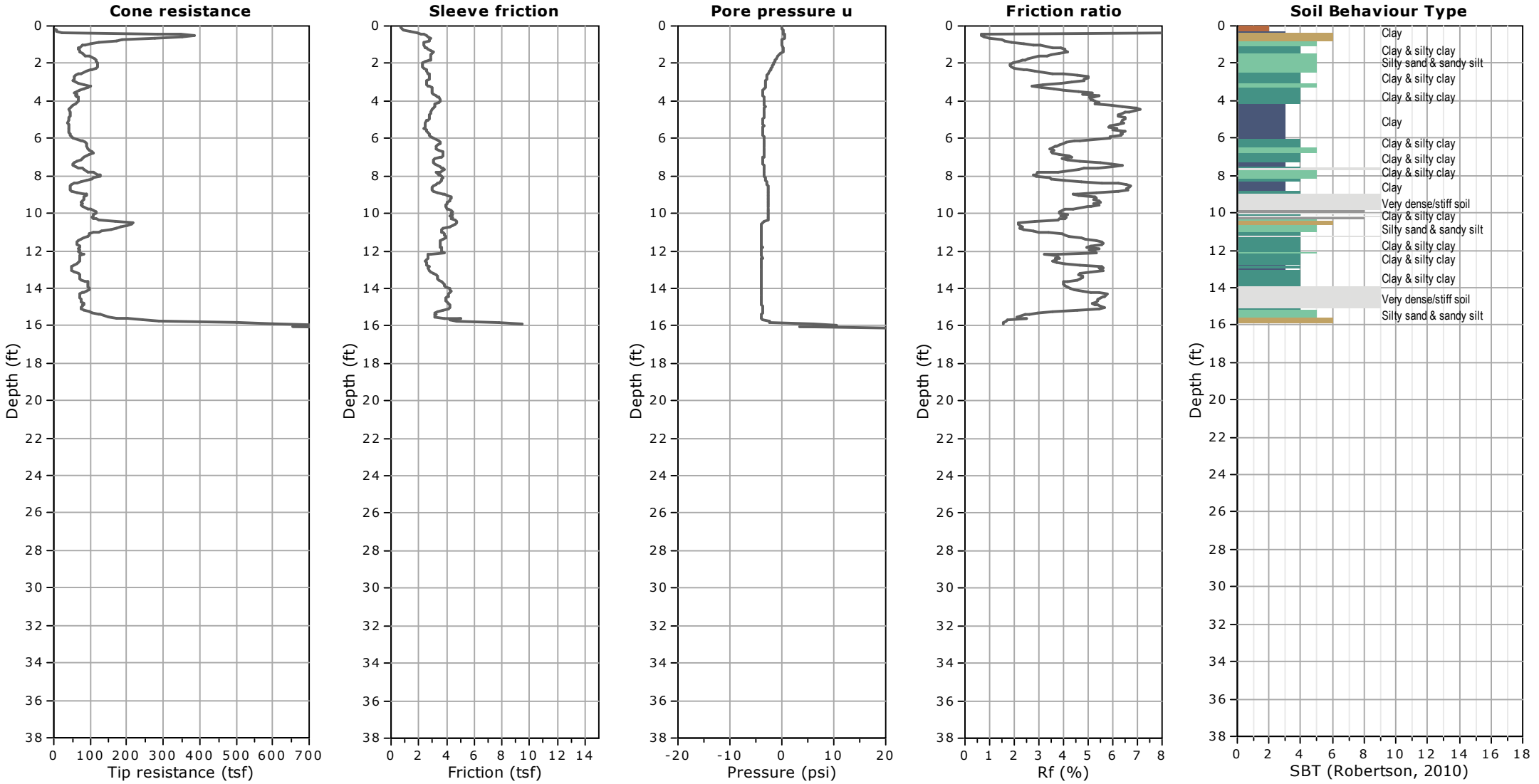
CPT-2A
Total depth: 6.77 ft, Date: 10/26/2022



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Project: NMG Geotechnical
Location: 300 S. Festival Dr, Anaheim, CA

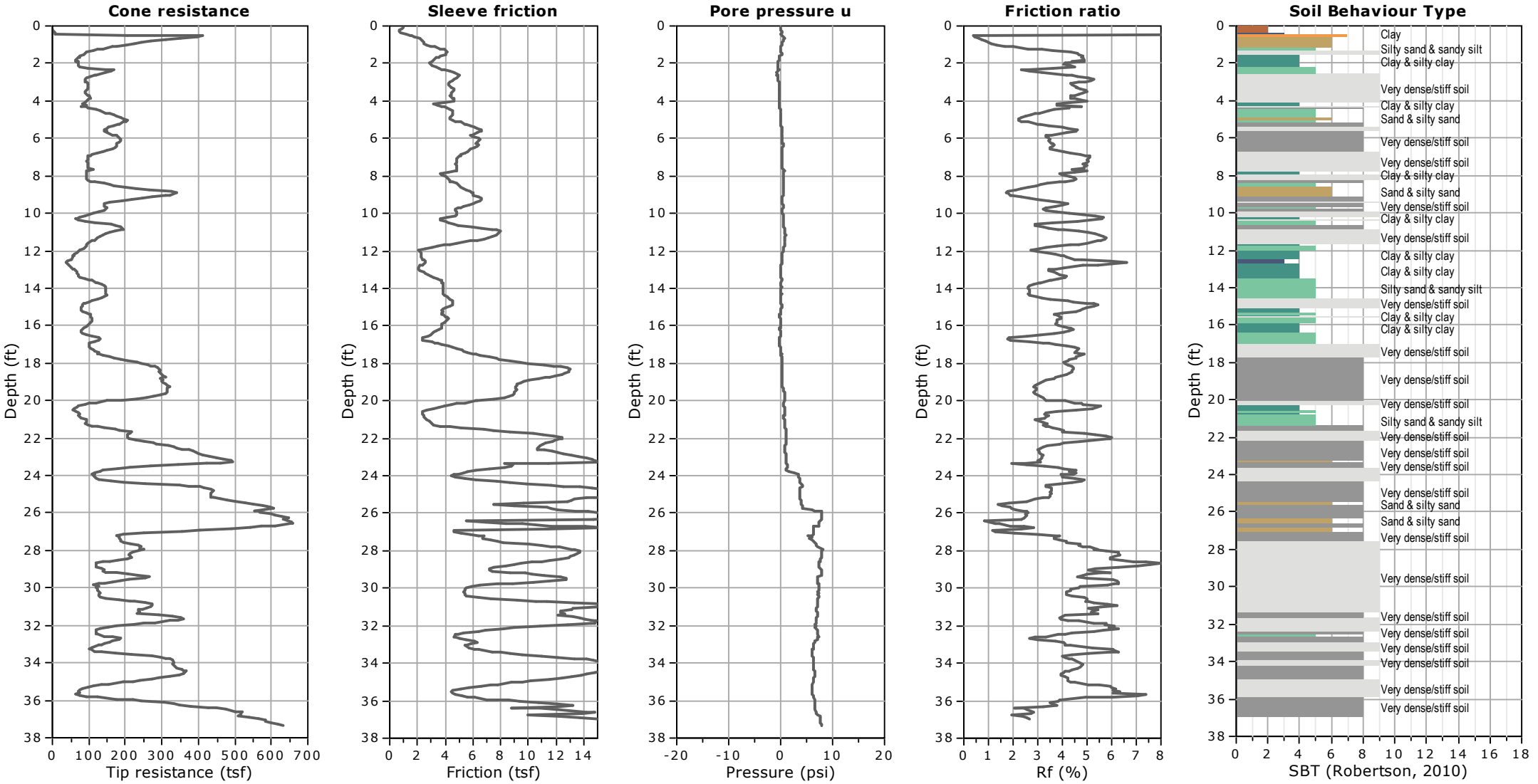
CPT-3
Total depth: 16.29 ft, Date: 10/26/2022



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Project: NMG Geotechnical
Location: 300 S. Festival Dr, Anaheim, CA

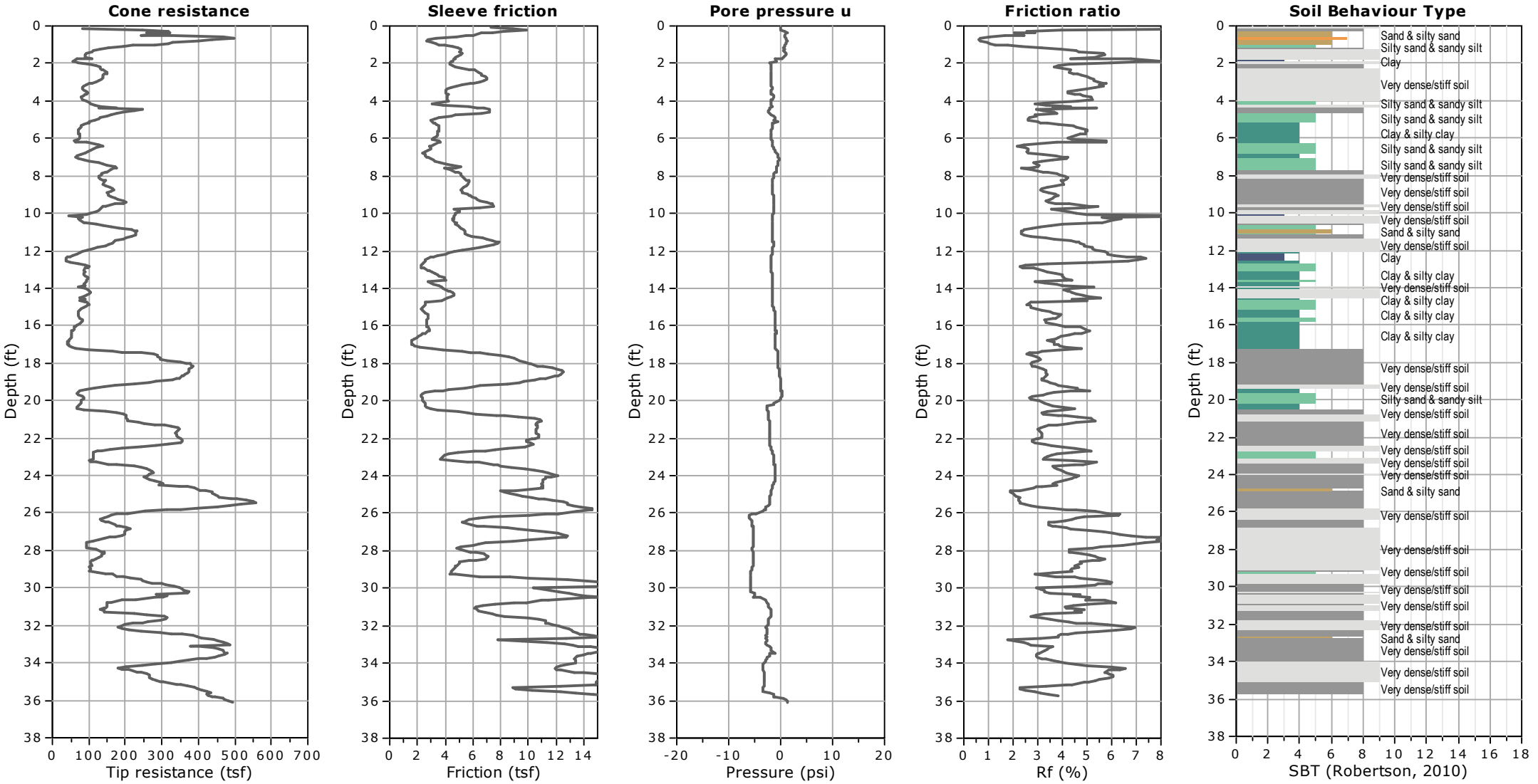
CPT-4
Total depth: 37.34 ft, Date: 10/26/2022



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Project: NMG Geotechnical
Location: 300 S. Festival Dr, Anaheim, CA

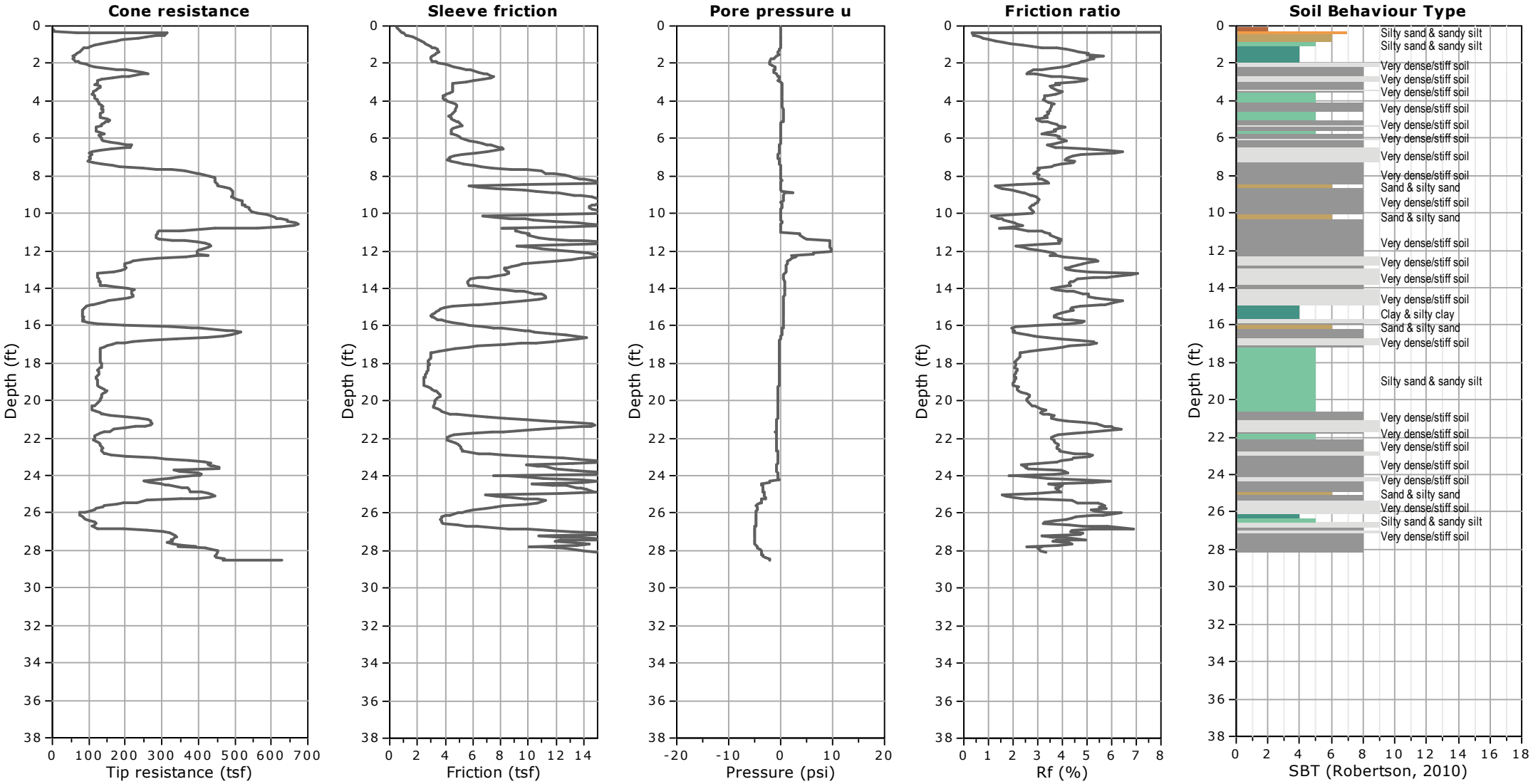
CPT-4A
Total depth: 36.10 ft, Date: 10/26/2022



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Project: NMG Geotechnical
Location: 300 S. Festival Dr, Anaheim, CA

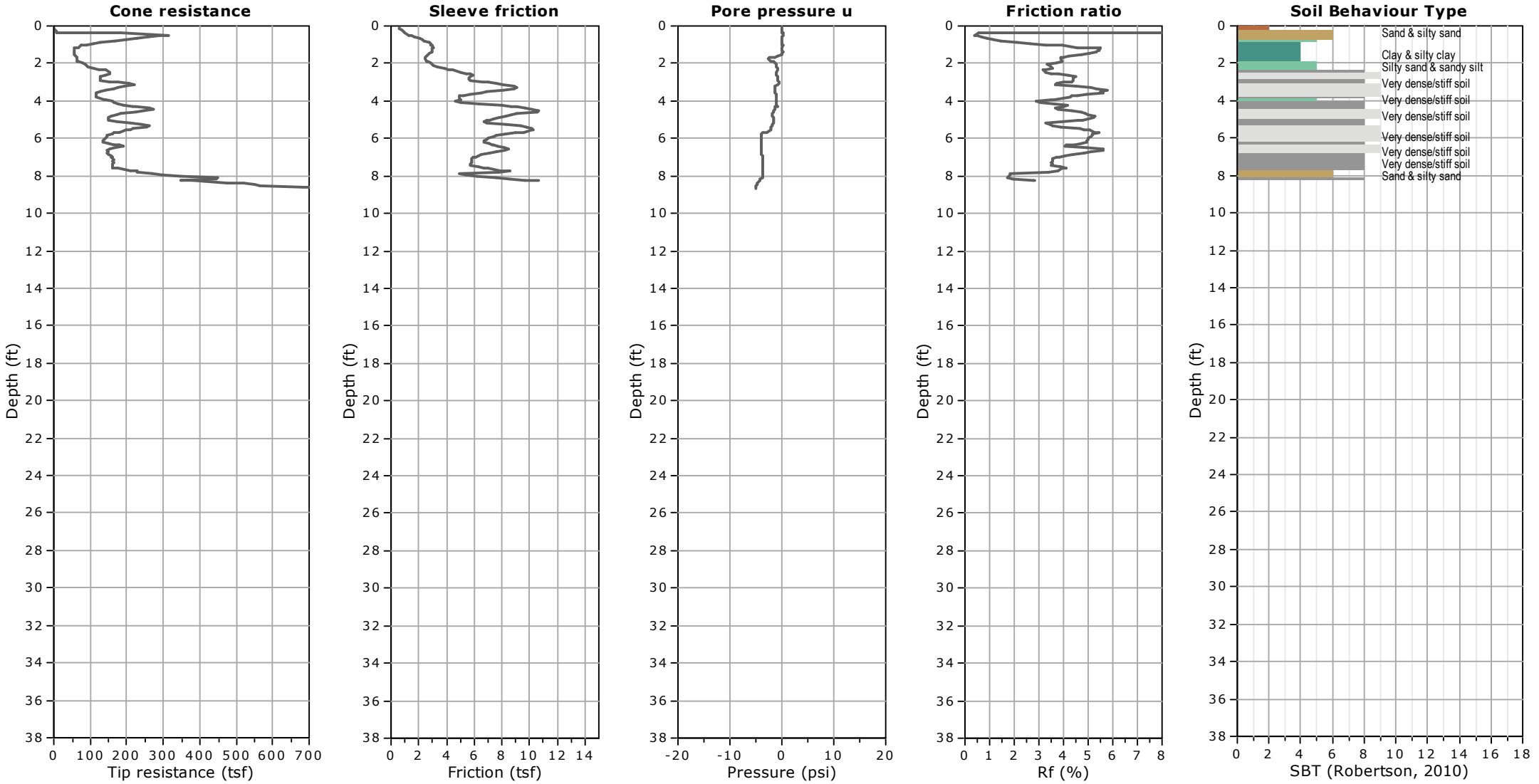
CPT-5
Total depth: 28.55 ft, Date: 10/26/2022



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www.kehoetesting.com

Project: **NMG Geotechnical**
Location: **300 S. Festival Dr, Anaheim, CA**

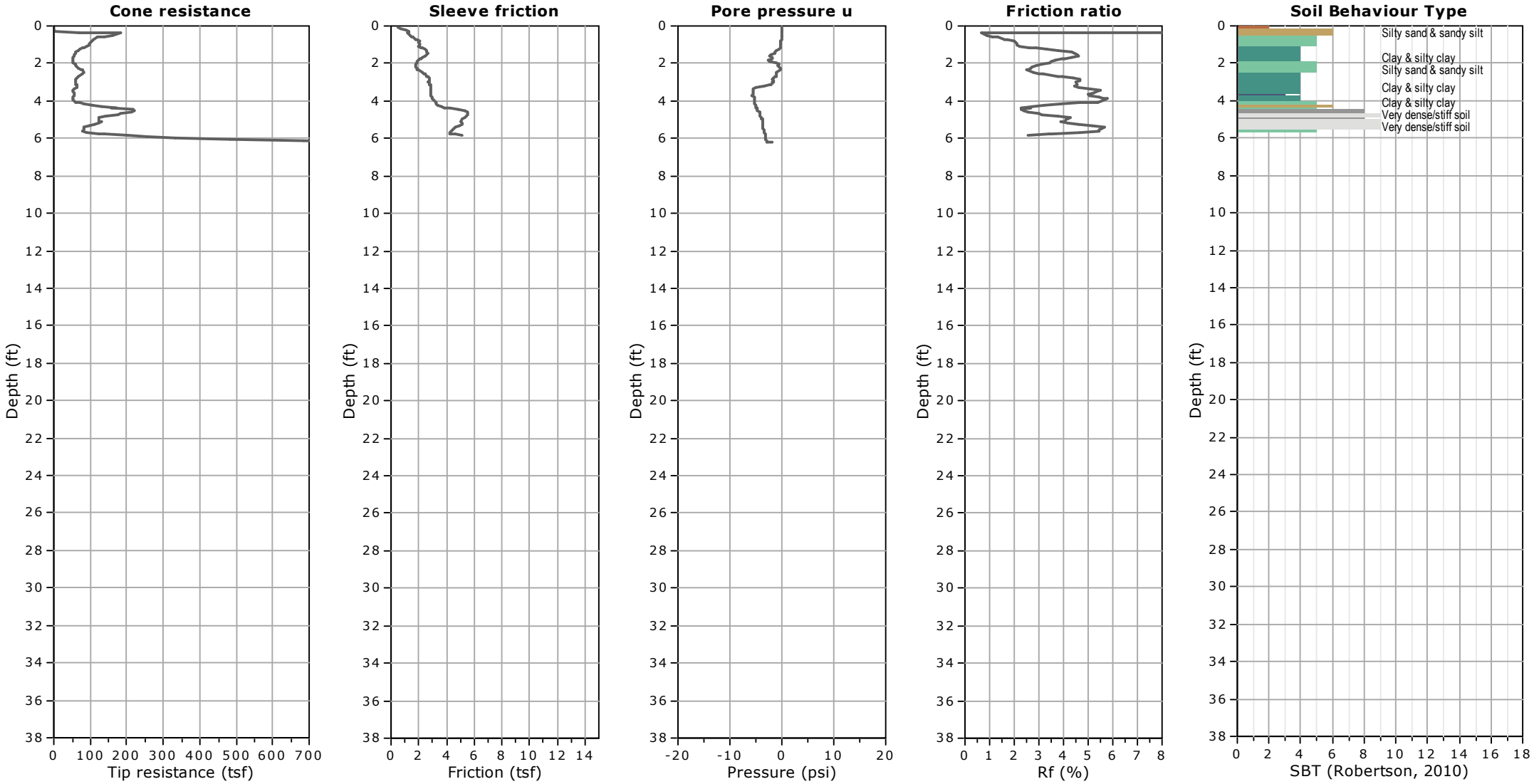
CPT-6
Total depth: 8.66 ft, Date: 10/26/2022



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Project: **NMG Geotechnical**
Location: **300 S. Festival Dr, Anaheim, CA**

CPT-7
Total depth: 6.24 ft, Date: 10/26/2022



NMG Geotechnical
300 S. Festival Dr.
Anaheim, CA

CPT Shear Wave Measurements

Location	Tip Depth (ft)	Geophone Depth (ft)	Travel Distance (ft)	S-Wave Arrival (msec)	S-Wave Velocity from Surface (ft/sec)	Interval S-Wave Velocity (ft/sec)
CPT-2	5.02	4.02	4.49	3.30	1361	
CPT-2A	5.09	4.09	4.55	3.96	1150	
	6.73	5.73	6.07	5.36	1132	1083
CPT-4A	5.02	4.02	4.49	3.30	1361	
	10.10	9.10	9.32	7.48	1246	1155
	15.06	14.06	14.20	12.08	1176	1062
	20.08	19.08	19.18	17.66	1086	893
	25.07	24.07	24.15	22.70	1064	986
	30.09	29.09	29.16	26.96	1082	1175
	35.01	34.01	34.07	30.92	1102	1240

Shear Wave Source Offset - 2 ft

S-Wave Velocity from Surface = Travel Distance/S-Wave Arrival
Interval S-Wave Velocity = (Travel Dist2-Travel Dist1)/(Time2-Time1)

BORINGS BY GEOSOILS, INC.

1989

GeoSoils, Inc. • BORING LOG GB-6

CLIENT TRAMMEL CROW W.O. 1993A DATE DRILLED 8-28-89 LOGGED BY F.A.

PROJECT ANA. FESTIVAL SURFACE ELEV. 440 ± DRIVING WT. 2700 → 25'

WATER	DEPTH (FEET)	GRAPHIC LOG		GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C-CORE B-BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
			TOPSOIL: SANDY SILT (ML) LOOSE, LT BRN. DRY, ROOTED					
			TERRACE DEPOSIT (Qt) CLAYEY SILT (ML)					
	5		STIFF TO HARD SLI MOIST MOD. POROUS		5	C		
	10		SILTY SAND W/ CLAY (ML-SM), STIFF TO HARD, RED. BRN. MOIST		5	C		
	15				3	C,B		
			TOTAL DEPTH 15'					
			NO G.W. NO CAVING					

PLATE ____

GeoSoils, Inc. • BORING LOG GB-7

CLIENT TRAMMEL CROW W.O. 393A DATE DRILLED 4-30-99 LOGGED BY F.A.

PROJECT _____ SURFACE ELEV. 475 ± DRIVING WT. _____

WATER	DEPTH (FEET)	GRAPHIC LOG		GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C-CORE B-BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
			TOPSOIL: SILTY SAND (SM), LOOSE, MD. BRN., DRY, ROOTED					
	5		TERRACE DEPOSIT (Qt): SANDY SILT W/ CLAY (ML), STIFF, RED. BRN., SLI MOIST. SLI MICACEOUS					
			@ 5' CLAYEY SILT (ML), STIFF, RED BRN. MOIST TO V. MOIST					
	10		BEDROCK (TPSS): WELL GRAINED SANDSTONE, MASSIVE, MOD. HARD, DEL. BRN., SLI MOIST, MOD. WEATHERED					
	15		TOTAL DEPTH 15' NO G.W. NO CAVING					
	20							

PLATE ____

GeoSoils, Inc. •

BORING LOG GB-16

CLIENT TRAMMEL CROW W.O. 1993A DATE DRILLED 8/29/89 LOGGED BY F.A.

PROJECT ANA FESTIVAL SURFACE ELEV. 425± DRIVING WT. 2700 → 25'

WATER	DEPTH (FEET)	GRAPHIC LOG		GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C-CORE B-BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
			TOPSOIL: SANDY SILT (ML), LOOSE, LT. BRN. DRY, ROOTED					
	5		Qt: SANDY SILT W/CLAY (ML), STIFF, RED BRN. SLI MOIST		3	C		
	10		@ 5' SANDY SILT W/CLAY (SM-SC), DENSE RED. BRN. MOIST, MOD. POROUS					
	15		@ 14' SILTY COARSE SAND (SM), V. DENSE RED. BRN. MOIST		3	C		
			TOTAL DEPTH 15'					
			NO G.W. NO CAVING					

PLATE ____

GeoSoils, Inc. • BORING LOG GB-17

CLIENT TRAMMELL CROW W. O. 1993 A DATE DRILLED 8/30/99 LOGGED BY T. A.

PROJECT _____ SURFACE ELEV. 460± DRIVING WT. _____

WATER	DEPTH (FEET)	GRAPHIC LOG		GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C-CORE B-BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
	5		BEDROCK (Tpss): SANDSTONE, HARD, YELLO. BRN., DRY TO SLI MOIST, MOD WEATHERED					
			@ 3', 6-7" SHALY INTERBED BEDDING, N42E, 36NW					
	10		@ 7', 3" SHALY INTERBED BEDDING, N65E, 36NW					
	15							
	20		TOTAL DEPTH 20' NO G.W. NO CAVING					

PLATE _____

GeoSoils, Inc. • BORING LOG GB-20

CLIENT TRAMMEL CROW W. O. 1993A DATE DRILLED 1-30-89 LOGGED BY _____

PROJECT _____ SURFACE ELEV. 460± DRIVING WT. 2700 → 25'

WATER	DEPTH (FEET)	GRAPHIC LOG		GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C - CORE B - BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
			TOPSOIL : SILTY SAND (SM), LOOSE, LT. BRN.					
	5		Qt : @ 1-5' CLAYEY SILT (ML), STIFF, RED-BRN; MOIST, MOD. WEATHERED					
	10		@ 5' GRADES TO SILTY COARSE SAND, DENSE, SLI MOIST TO MOIST, NUMEROUS LAYES OF SAND (SW) AND SMALL CHUNKS OF BEDROCK (S.S. + SH)					
	15							
	20		TOTAL DEPTH 21'		4	C,B		
			BR. = 21' NO G.W. NO CAVING					

PLATE _____

GeoSoils, Inc. • BORING LOG GB-21

CLIENT TRAMMEL CROW W.O. 1993A DATE DRILLED 4-28-89 LOGGED BY F.A.

PROJECT ANA FESTIVAL SURFACE ELEV. 465± DRIVING WT. _____

WATER	DEPTH (FEET)	GRAPHIC LOG		GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C - CORE B - BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
	5		BEDROCK (Tpss): SHALE, MOD HARD, GRAY, DRY TO SLI. MOIST. W/FEW SANDY LENSES, MOD. FRACTURED, MOD WEATHERED @3' BEDDING E-W, 34 N @5' BEDDING E-W, 35 N @9' BEDDING E-W, 52 N @9' SANDY INTERBEDS						
	10							
	15		@13' N75E, 30N 14' SHALE BECOMES MOISTER						
	20		@18' SANDY INTERBEDS E-W, 32 N						
	25		@22' SANDY INTERBEDS N 85 E, 31 N SANDY INTERBEDS						
	30							
	35		@34' BEDDING, E-W, 38 N						

PLATE _____

GeoSoils, Inc. • BORING LOG GB-21

CLIENT TRAMMEL CROW W.O. 1993A DATE DRILLED 8/28/89 LOGGED BY F.A.

PROJECT ANA. FESTIVAL SURFACE ELEV. 465± DRIVING WT. _____

WATER	DEPTH (FEET)	GRAPHIC LOG		GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C - CORE B - BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
	40		TOTAL DEPTH 40' NO G.W. NO CAVING					

PLATE _____

BORINGS BY MEDALL, ARAGON,

WORSWICK AND ASSOCIATES

1979

BORING LOG

Logged By:	Date Drilled:	Drill Rig:	Boring Diameter:	Boring Number:
H.P.	10-24-79	Bucket Auger	24"	B-9

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

Boring Elevation: 435

SAMPLE BULK	SAMPLE TUBE	DRIVE ENERGY FT. KIPS/FT.	FIELD MOISTURE % DRY WEIGHT	DRY DENSITY LB./CU. FT.	SHEAR RESISTANCE KIPS/SQ. FT.	DEPTH, FEET	SOIL/ROCK TYPE	GEOLOGICAL/ENGINEERING Description and Remarks
							SM	TOPSOIL Silty SAND Loose, reddish brown, dry to damp.
	■	30	11	119				TERRACE DEPOSITS - (Qt) Silty Fine SAND Medium dense to dense, reddish brown, slightly moist to moist.
	■	14	12	118		5		
	■	20	12	118				
	■	15	10	114		10		
								Yellow brown with scattered gravel.
	■	11	8	105		15		
	■	13	7	109		20	SP	SAND

Medall, Aragon, Worswick & Associates, Inc.
Consulting Engineers and Geologists

LOS ANGELES
SANTA ANA
RIVERSIDE

PROJECT NO.: 1628B

FIGURE NO.: A-13

BORING LOG

Logged By:	Date Drilled:	Drill Rig:	Boring Diameter:	Boring Number:
H.P.	10-24-79	Bucket Auger	24"	B-9 Continued

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

Boring Elevation: 435

SAMPLE BULK	SAMPLE TUBE	DRIVE ENERGY FT. KIPS/FT.	FIELD MOISTURE % DRY WEIGHT	DRY DENSITY LB./CU. FT.	SHEAR RESISTANCE KIPS/SQ. FT.	DEPTH, FEET	SOIL/ROCK TYPE	GEOLOGICAL/ENGINEERING Description and Remarks
							SP	TERRACE DEPOSITS - (Qt) Continued SAND Medium dense to dense, yellow brown to yellow, slightly moist to moist, fine to medium grained, slightly silty, minor amounts of scattered coarse sand and gravel.
		23	9	113		25		
						30		Silty SAND Dense, brown, slightly moist to moist, scattered coarse sand and gravel.
		19	10	115				End of Boring at 31½ feet No groundwater No caving Hole backfilled
						35		
						40		

BORING LOG

Logged By:	Date Drilled:	Drill Rig:	Boring Diameter:	Boring Number:
H.P.	10-24-79	Bucket Auger	24"	B-10

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

Boring Elevation: 492

SAMPLE BULK	SAMPLE TUBE	DRIVE ENERGY FT. KIPS/FT.	FIELD MOISTURE % DRY WEIGHT	DRY DENSITY LB./CU. FT.	SHEAR RESISTANCE KIPS/SQ. FT.	DEPTH, FEET	SOIL/ROCK TYPE	GEOLOGICAL/ENGINEERING Description and Remarks
							SM	TOPSOIL Silty SAND Loose to medium dense, reddish brown to yellow brown, dry to damp, porous.
						5		TERRACE DEPOSITS - (Qt) Silty SAND Medium dense to dense, yellow brown to reddish brown, slightly moist.
	■	42	9	120				BEDROCK - (Tpss) SANDSTONE Moderately hard to hard, yellow, damp, fine to medium grained, slightly micaceous, interbedded gray siltstone (75% sandstone - 25% siltstone) moderately weathered to fresh, minor amounts of gypsum, orange oxidized laminations and mottling, slightly weathered to fresh, hard at 10'.
						10		
						15		B EW 42N
	■	38	7	114				
						20		B EW 40N

Medall, Aragon, Worswick & Associates, Inc.
Consulting Engineers and Geologists

LOS ANGELES
SANTA ANA
RIVERSIDE

PROJECT NO.: 1628B

FIGURE NO.: A-15

BORING LOG

Logged By:	Date Drilled:	Drill Rig:	Boring Diameter:	Boring Number:
H.P.	10-24-79	Bucket Auger	24"	B-10 Continued

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

Boring Elevation: 492

SAMPLE BULK	SAMPLE TUBE	DRIVE ENERGY FT. KIPS/FT.	FIELD MOISTURE % DRY WEIGHT	DRY DENSITY LB./CU. FT.	SHEAR RESISTANCE KIPS/SQ. FT.	DEPTH, FEET	SOIL/ROCK TYPE	GEOLOGICAL/ENGINEERING Description and Remarks
								BEDROCK - (Tpss) Continued SANDSTONE
						25		B N85E 48NW
								Hard
		38	15	99				B N85E 45NW
						30		SILTSTONE AND SANDSTONE Hard, brown and dark gray, dry, silicified, fine grained, highly cemented-resistant to weathering.
						35		SANDSTONE Moderately hard to hard, yellow, fine to medium grained, slightly micaceous, with gray interbedded siltstone, damp, micaceous, fresh-unweathered. B N85E
		58	12	114		40		B N85E 47NW

Medall, Aragon, Worswick & Associates, Inc.	LOS ANGELES SANTA ANA RIVERSIDE	PROJECT NO.:	FIGURE NO.:
Consulting Engineers and Geologists		1628B	A-16

BORING LOG

Logged By:	Date Drilled:	Drill Rig:	Boring Diameter:	Boring Number:
H.P.	10-24-79	Bucket Auger	24"	B-10 Continued

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

Boring Elevation: 492

SAMPLE: BULK	SAMPLE: TUBE	DRIVE ENERGY FT. KIPS/FT.	FIELD MOISTURE % DRY WEIGHT	DRY DENSITY LB./CU. FT.	SHEAR RESISTANCE KIPS/SQ. FT.	DEPTH, FEET	SOIL/ROCK TYPE	GEOLOGICAL/ENGINEERING Description and Remarks
						45		BEDROCK - (Tpss) Continued SANDSTONE
						50		End of Boring at 47 feet No groundwater No caving Hole backfilled
						55		
						60		

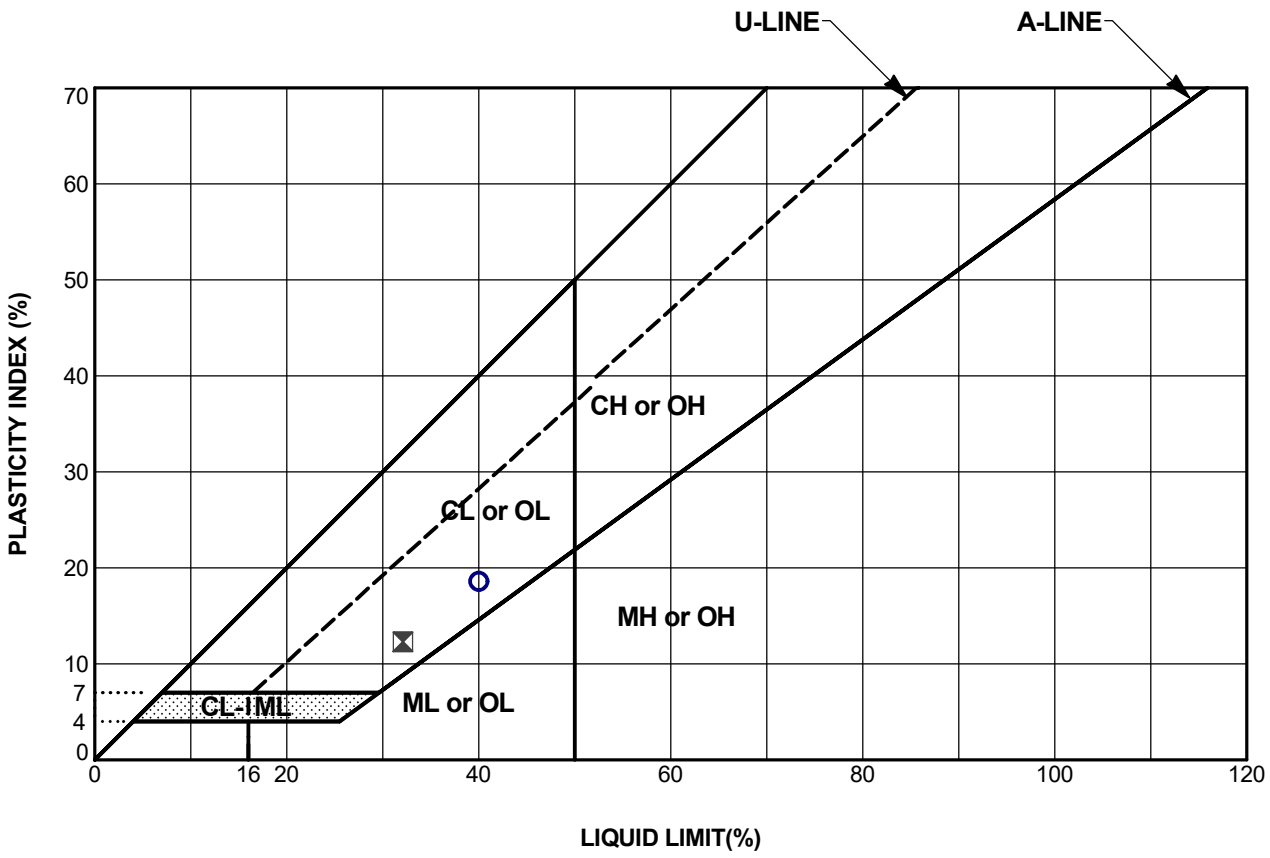
APPENDIX C

Shea/ Anaheim Hills Festival
Project Number: 22023-01

APPENDIX C
SUMMARY OF SOIL LABORATORY DATA

Anaheim Hills, CA

Boring/Sample Information						Field Wet Density (pcf)	Field Dry Density (pcf)	Field Moisture Content (%)	Degree of Sat. (%)	Sieve/ Hydrometer		Atterberg Limits		USCS Group Symbol	Direct Shear				Compaction		Expansion Index	R-Value	Soluble Sulfate Content (% by wt)	Remarks
															Ultimate		Peak		Maximum Dry Density (pcf)	Optimum Moisture Content (%)				
Boring No.	Sample No.	Depth (feet)	End Depth (feet)	Elevation (feet)	Blow Count (N)					Fines Content (% pass. #200)	Clay Content (% pass. 2μ)	LL (%)	PI (%)		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)						
H-1	B-1	1.0		463.0																				
H-1	D-1	5.0		459.0	50/6"	126.6	117.8	7.5	46.8					SM	250	32	300	42.0						
H-1	D-2	10.0		454.0	50/5"	112.0	105.5	6.2	27.9															
H-1	D-3	15.0		449.0	50/4"			11.6																Disturbed
H-2	B-1	1.5		465.5																				
H-2	D-1	5.0		462.0	90/9"	117.5	98.7	19.0	72.5															
H-2	D-2	10.0		457.0	50/6"	114.7	96.9	18.5	67.4															
H-2	D-3	15.0		452.0	50/6"	121.9	102.5	19.0	79.6															
H-3	B-1	1.0	5.0	464.0						40	14	40	19	SC							51			CC
H-3	D-1	5.0		460.0	81	131.3	116.0	13.2	78.8					CL	350	30	1150	30.0						CN
H-3	D-2	10.0		455.0	42	129.9	110.8	17.3	89.5					CL										CN
H-3	D-3	15.0		450.0	66	133.9	117.8	13.7	86.1															
H-3	D-4	20.0		445.0	50/6"	128.7	107.1	20.2	95.2															
H-3	D-5	25.0		440.0	50/6"	129.2	108.7	18.9	92.6															
H-4	B-1	1.0		462.0																				
H-4	D-1	5.0		458.0	42	123.6	112.6	9.8	53.2					SM										CN
H-4	D-2	10.0		453.0	43	130.9	117.0	11.8	72.7															
H-4	D-3	15.0		448.0	90/9"	124.8	99.5	25.5	99.2															
H-4	D-4	20.0		443.0	50/6"	114.4	101.9	12.2	50.6															
H-4	D-5	25.0		438.0	80/9"	126.3	105.5	19.7	89.2															
H-5	B-1	1.0	5.0	462.0						35	12	32	12	SC							26			CC
H-5	D-1	5.0		458.0	70	119.5	106.0	12.7	58.3															
H-5	D-2	10.0		453.0	47	133.3	118.2	12.8	81.0					ML	150	30	650	30.0						CN
H-5	D-3	15.0		448.0	50/6"	117.0	109.4	6.9	34.4															
H-5	D-4	20.0		443.0	50/4"	114.0	108.3	5.2	25.2															
H-5	D-5	25.0		438.0	50/6"	116.9	97.5	19.9	73.7															



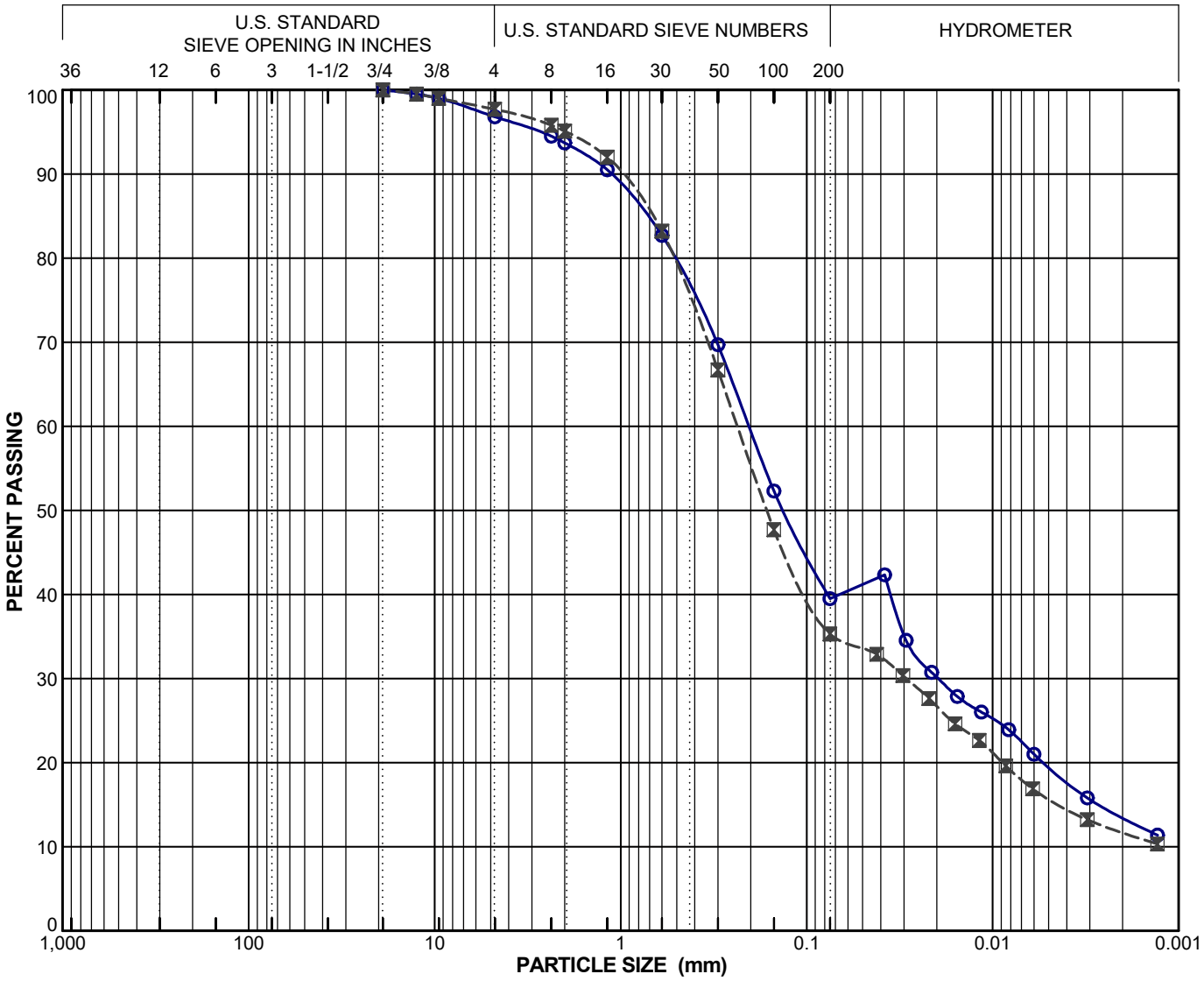
Symbol	Boring Number	Sample Number	Depth (feet)	Passing No. 200 Sieve (%)	LL	PI	USCS	Description
○	H-3	B-1	1.0 - 5.0	40	40	19	SC	(Af) Light olive brown clayey SAND
⊠	H-5	B-1	1.0 - 5.0	35	32	12	SC	(Af) Light olive brown clayey SAND

PLASTICITY CHART

Shea/ Anaheim Hills Festival
Anaheim Hills, CA
PROJECT NO. 22023-01

NMG Geotechnical, Inc.

BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

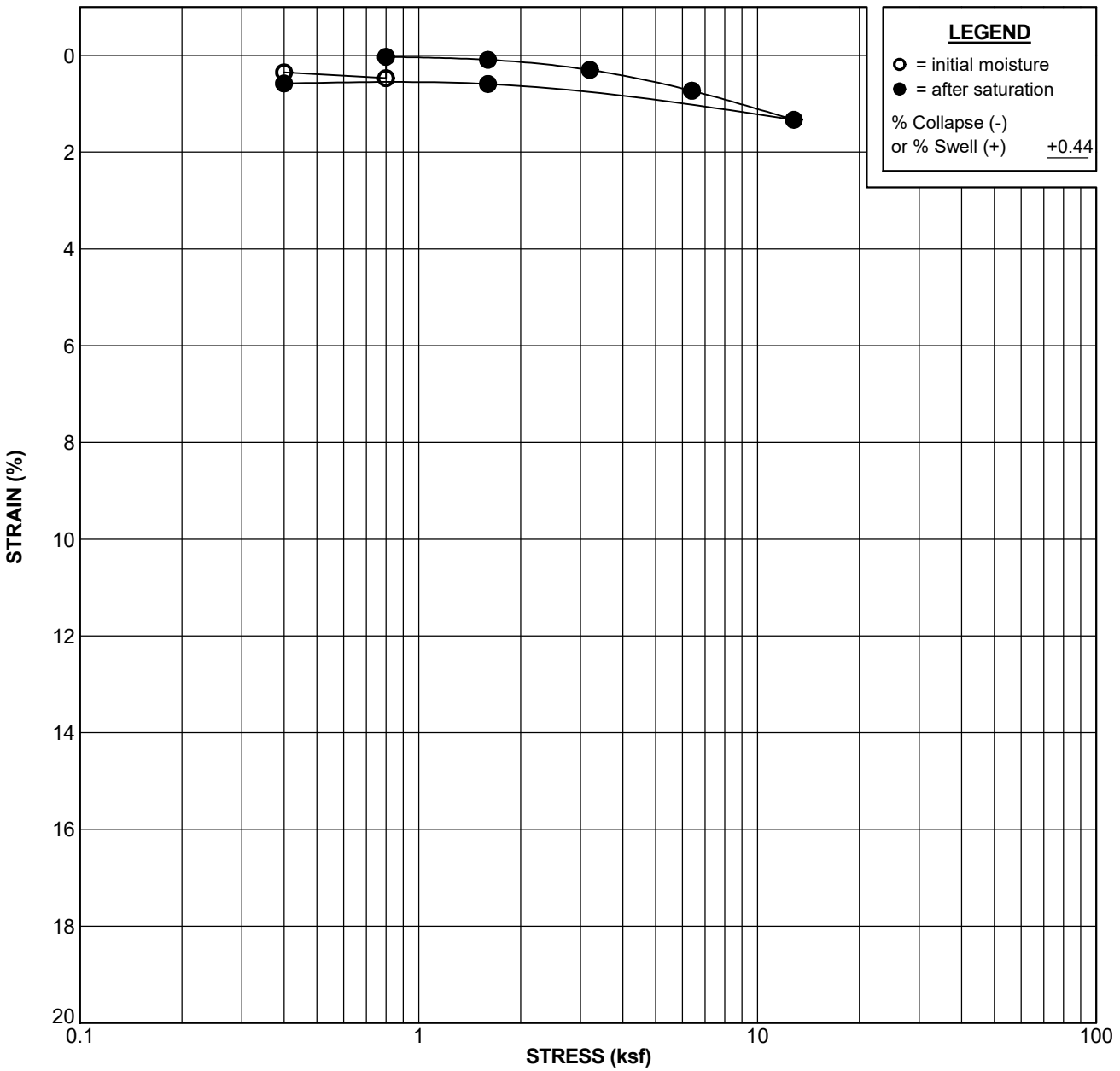


Symbol	Boring Number	Sample Number	Depth (feet)	Field Moisture (%)	LL	PI	Activity PI/-2μ	C_u	C_c	Passing No. 200 Sieve (%)	Passing 2μ (%)	USCS
O	H-3	B-1	1.0 - 5.0		40	19	1.36			40	14	SC
⊠	H-5	B-1	1.0 - 5.0		32	12	1.00			35	12	SC

PARTICLE SIZE DISTRIBUTION

Shea/ Anaheim Hills Festival
Anaheim Hills, CA
PROJECT NO. 22023-01

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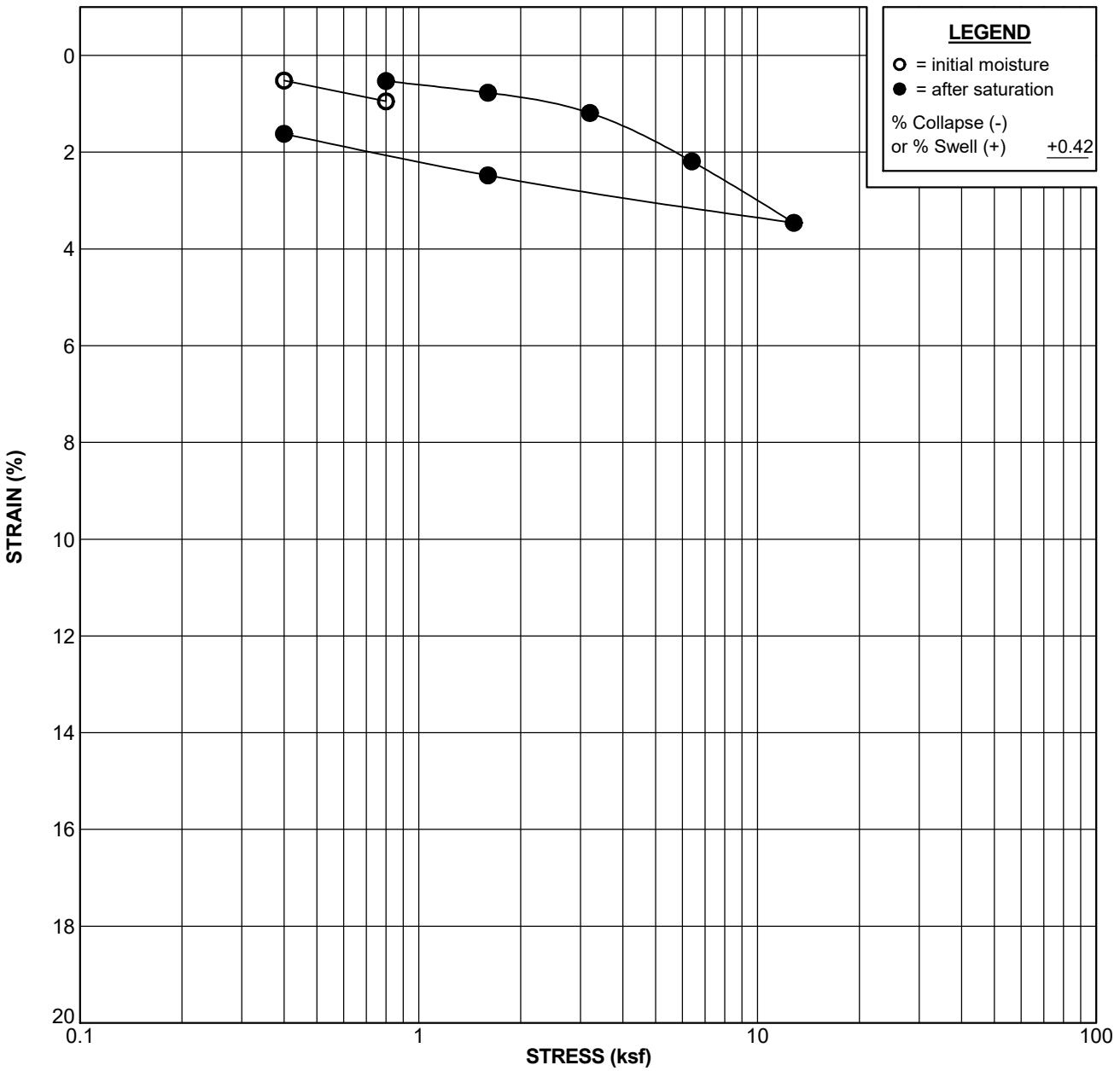
Boring No. H-3	Sample No. D-1	Depth: 5.0 ft
Sample Description: (Af) Olive brown silty sandy CLAY		**USCS:** CL
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	14.8	112.6	62.0	0.757
Final	19.1	113.2	81.0	0.747

CONSOLIDATION TEST RESULTS

Shea/ Anaheim Hills Festival
Anaheim Hills, CA
PROJECT NO. 22023-01

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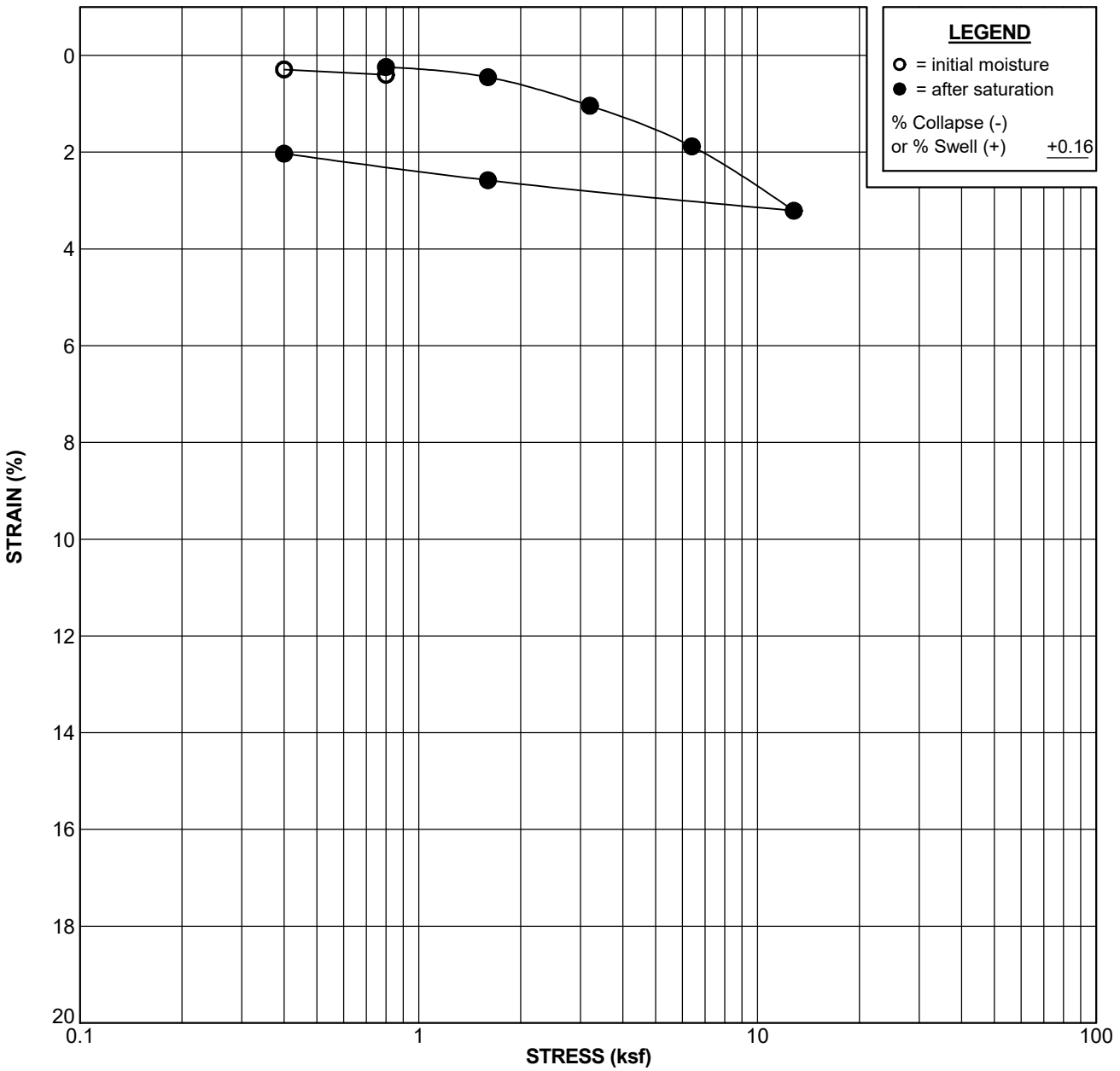
Boring No. H-3	**Sample No. D-2**	**Depth: 10.0 ft**
Sample Description: (Af) Grayish brown sandy CLAY		**USCS:** CL
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	16.6	106.4	79.4	0.554
Final	19.9	108.1	99.6	0.530

CONSOLIDATION TEST RESULTS

Shea/ Anaheim Hills Festival
Anaheim Hills, CA
PROJECT NO. 22023-01

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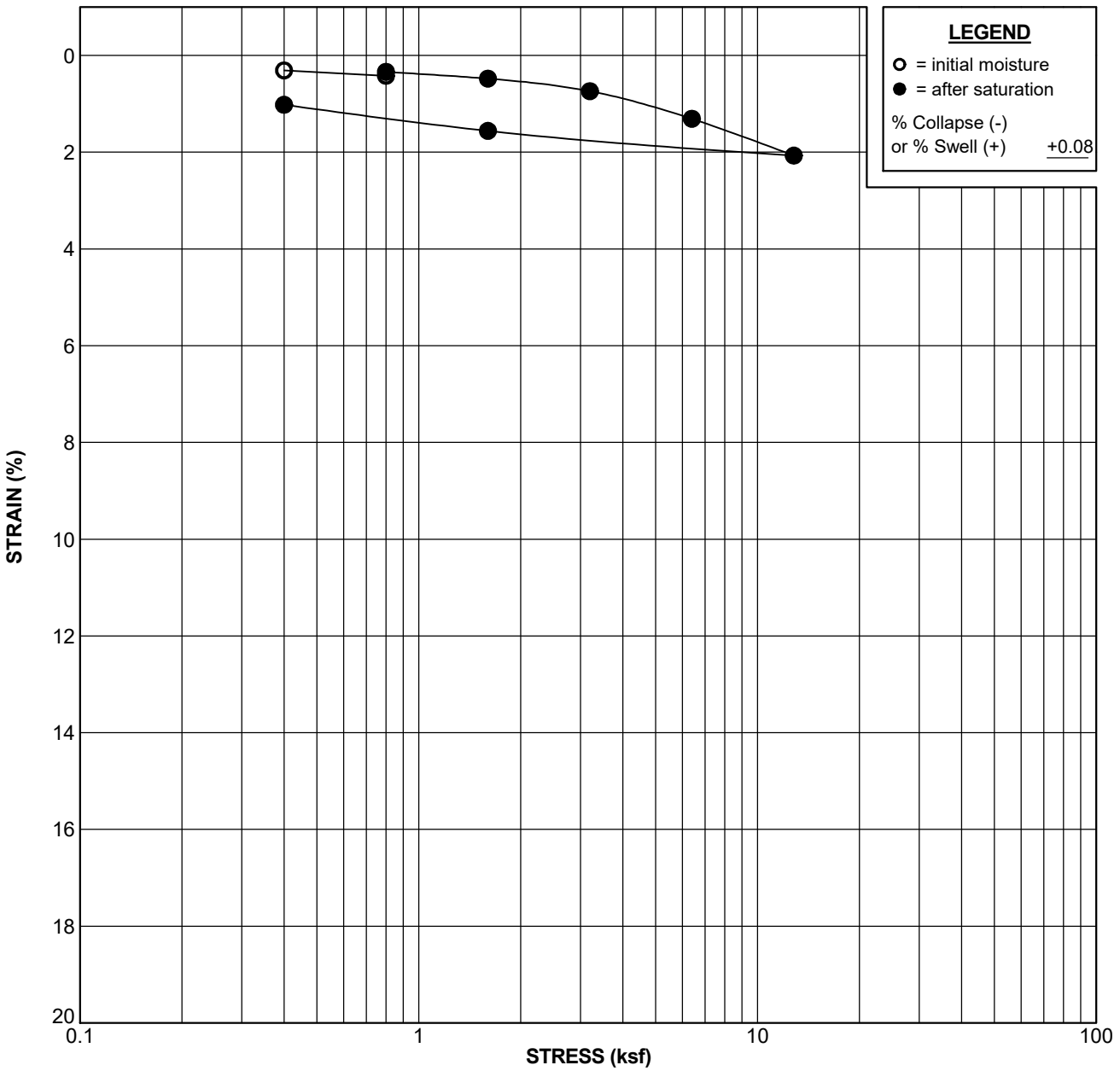
Boring No. H-4	Sample No. D-1	Depth: 5.0 ft
Sample Description: (Af) Light yellowish brown silty SAND		**USCS:** SM
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	8.7	110.2	46.2	0.498
Final	17.6	112.5	99.7	0.467

CONSOLIDATION TEST RESULTS

Shea/ Anaheim Hills Festival
Anaheim Hills, CA
PROJECT NO. 22023-01

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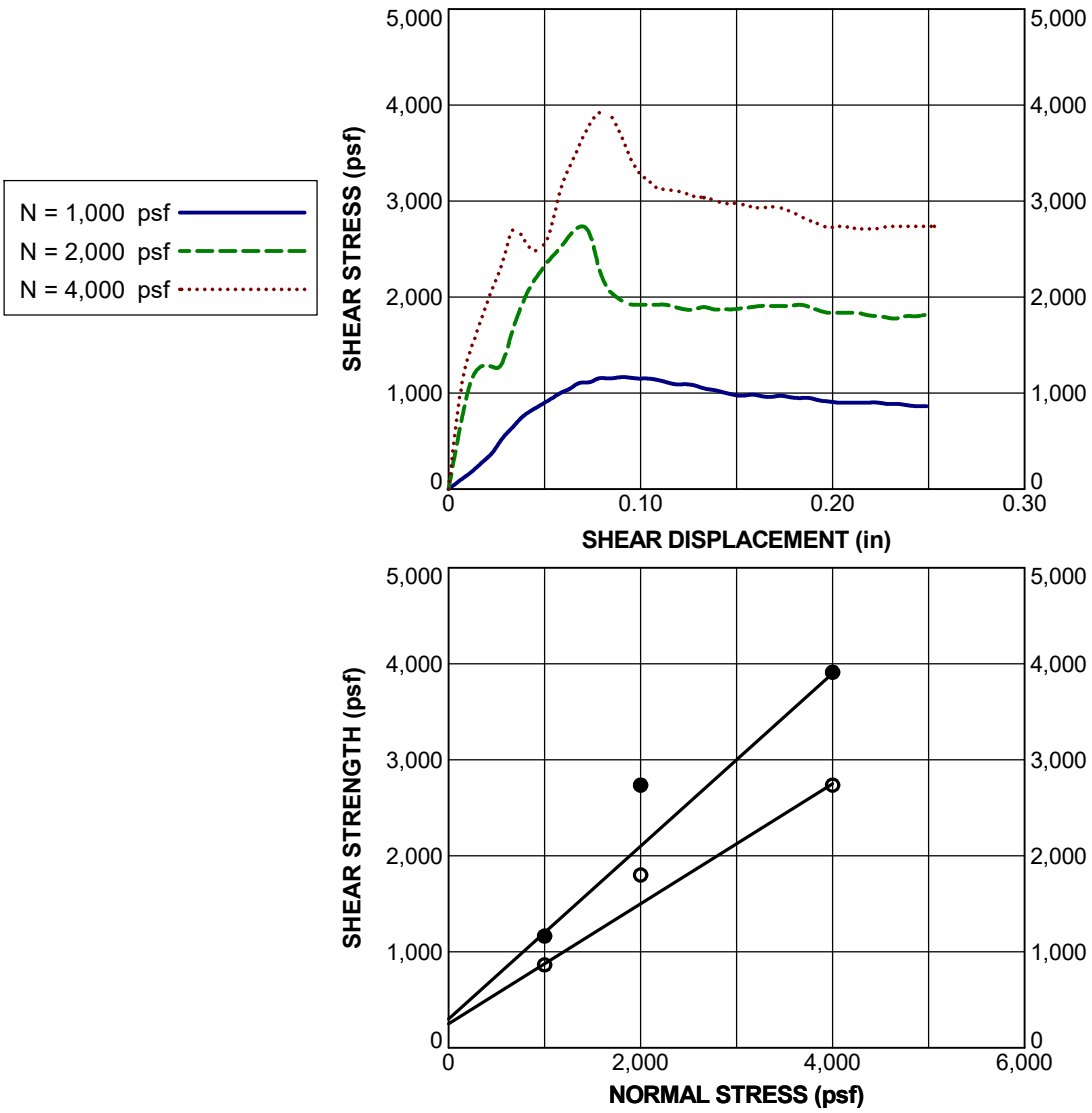
Boring No. H-5	Sample No. D-2	Depth: 10.0 ft
Sample Description: (Af) Olive brown clayey sandy SILT		**USCS:** ML
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	13.1	117.1	62.0	0.657
Final	15.6	118.3	75.8	0.640

CONSOLIDATION TEST RESULTS

Shea/ Anaheim Hills Festival
Anaheim Hills, CA
PROJECT NO. 22023-01

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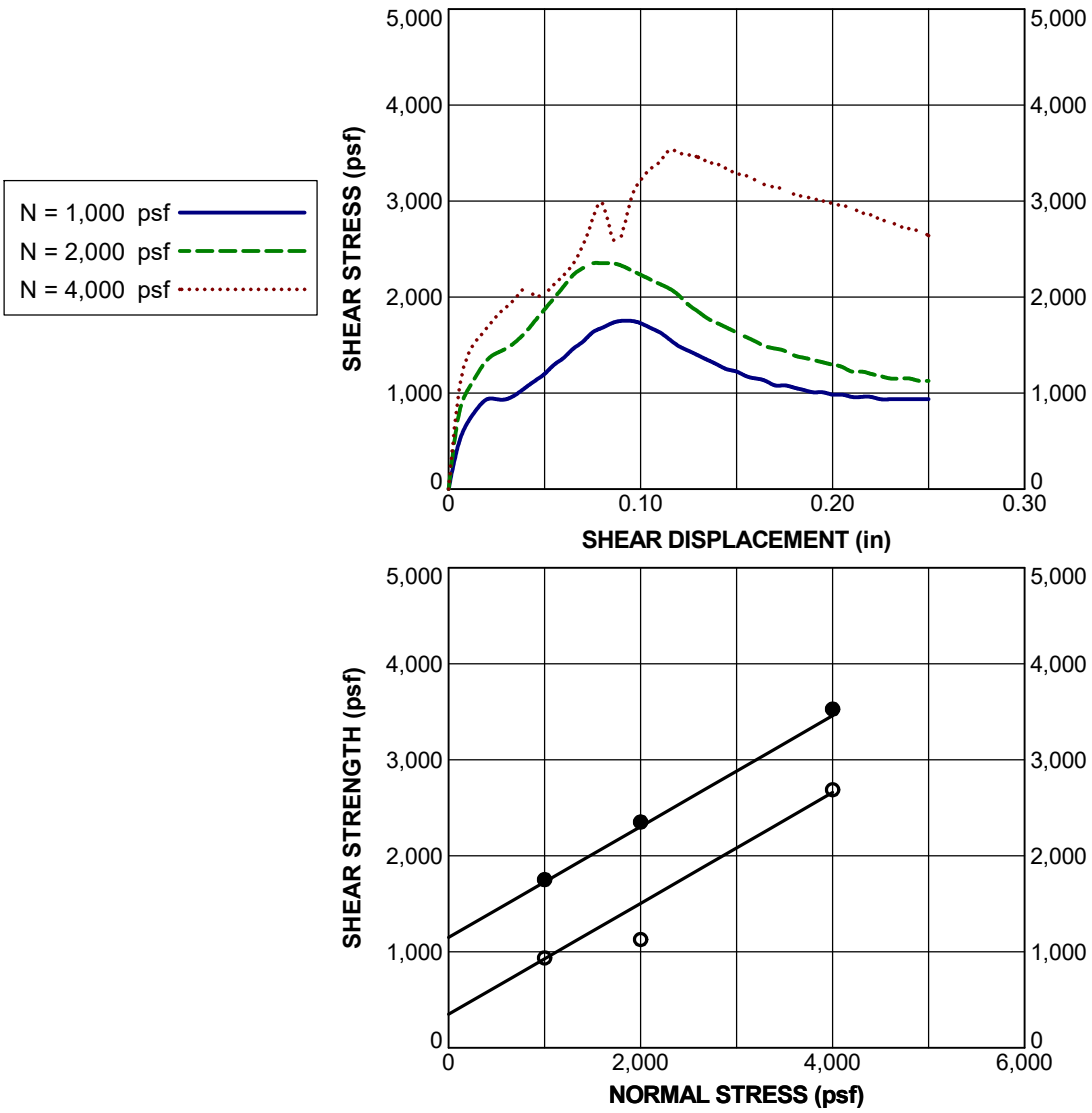
Boring No. H-1		**Sample No. D-1**		**Depth: 5.0 ft**	
Sample Description: (Tpsc) Yellowish brown silty SAND (sandstone)				**USCS:**	SM
Liquid Limit:		**Plasticity Index:**		**Percent Passing No. 200 Sieve:**	
Final Moisture Content (%):	20.8	**Final Dry Density (pcf):**	110.0	**Degree of Saturation (%):**	100
Sample Type:	Undisturbed	**Rate of Shear (in./min.):**	0.05		

SHEAR STRENGTH PARAMETERS		
Parameter	**Peak ●**	**Ultimate ○**
Cohesion (psf)	300	250
Friction Angle (degrees)	42.0	32.0

DIRECT SHEAR TEST RESULTS

Shea/ Anaheim Hills Festival
Anaheim Hills, CA
PROJECT NO. 22023-01

NMG Geotechnical, Inc.



Boring No. H-3	**Sample No. D-1**	**Depth: 5.0 ft**
Sample Description: (Af) Olive brown silty sandy CLAY		**USCS:** CL
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**
Final Moisture Content (%): 23.9	**Final Dry Density (pcf):** 112.4	**Degree of Saturation (%):** 100
Sample Type: Undisturbed	**Rate of Shear (in./min.):** 0.005	

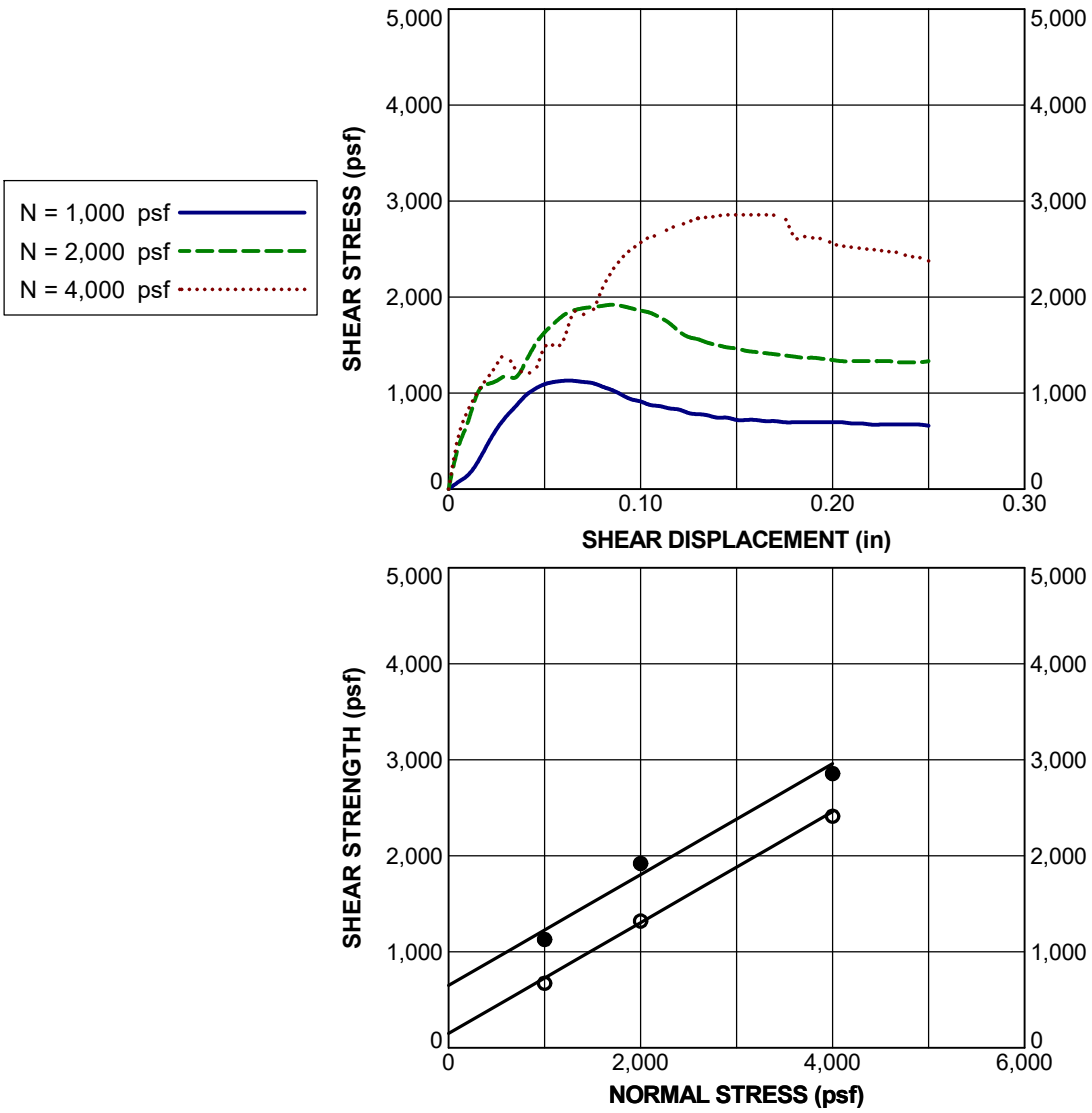
SHEAR STRENGTH PARAMETERS

Parameter	Peak ●	Ultimate ○
Cohesion (psf)	1150	350
Friction Angle (degrees)	30.0	30.0

DIRECT SHEAR TEST RESULTS

Shea/ Anaheim Hills Festival
Anaheim Hills, CA
PROJECT NO. 22023-01

NMG Geotechnical, Inc.



Boring No. H-5	**Sample No. D-2**	**Depth: 10.0 ft**
Sample Description: (Af) Olive brown clayey sandy SILT		**USCS:** ML
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**
Final Moisture Content (%): 23.7	**Final Dry Density (pcf):** 111.1	**Degree of Saturation (%):** 99
Sample Type:	**Rate of Shear (in./min.):** 0.005	

SHEAR STRENGTH PARAMETERS

Parameter	Peak ●	Ultimate ○
Cohesion (psf)	650	150
Friction Angle (degrees)	30.0	30.0

DIRECT SHEAR TEST RESULTS

Shea/ Anaheim Hills Festival
Anaheim Hills, CA
PROJECT NO. 22023-01

NMG Geotechnical, Inc.

Sample	Compacted Moisture (%)	Compacted Dry Density (pcf)	Final Moisture (%)	Volumetric Swell (%)	Expansion Index[1] Value/Method		Expansive Classification[2]	Soluble Sulfate (%)	Sulfate Exposure[3]
H-3 B-1 1-5'	11.0	105.1	22.8	5.05	51	A	Medium	--	--
H-5 B-1 1-5'	11.0	107.0	19.4	2.61	26	A	Low	--	--

Test Method:
ASTM D4829

HACH SF-1 (Turbidimetric)

Notes:
1. Expansion Index (EI) method of determination*:*
   [A] E.I. determined by adjusting water content to achieve a 50 ±2% degree of saturation
   [B] E.I. calculated based on measured saturation within the range of 40% and 60%
2. ASTM D4829 *(Classification of Expansive Soil)*
3. ACI-318-19 Table 19.3.1.1 *(Exposure Categories and Classes)*

Expansion Index and Soluble Sulfate Test Results

(FRM001 Rev.5)

Project No. 22023-01

Project Name: Shea / Anaheim Hills Festival

NMG

Table 1 - Laboratory Tests on Soil Samples

NMG Geotechnical, Inc.
SheaAnaheim Hills Festival
Your #22023-01, HDR Lab #22-1061LAB
10-Nov-22

Sample ID			H-3, B-1 @ 1-5'	H-5, B-1 @ 1-5'
Resistivity		**Units**		
as-received		ohm-cm	20,000	10,800
saturated		ohm-cm	800	880
pH			6.7	6.6
Electrical Conductivity		mS/cm	0.59	0.37
Chemical Analyses				
Cations				
calcium	Ca^{2+}	mg/kg	153	96
magnesium	Mg^{2+}	mg/kg	32	30
sodium	Na^{1+}	mg/kg	234	128
potassium	K^{1+}	mg/kg	32	15
ammonium	NH_4^{1+}	mg/kg	ND	ND
Anions				
carbonate	CO_3^{2-}	mg/kg	ND	ND
bicarbonate	HCO_3^{1-}	mg/kg	174	122
fluoride	F^{1-}	mg/kg	9.2	6.6
chloride	Cl^{1-}	mg/kg	138	61
sulfate	SO_4^{2-}	mg/kg	1,270	794
nitrate	NO_3^{1-}	mg/kg	2.0	ND
phosphate	PO_4^{3-}	mg/kg	ND	ND
Other Tests				
sulfide	S^{2-}	qual	na	na
Redox		mV	na	na

Resistivity per ASTM G187, pH per ASTM G51, Cations per ASTM D6919, Anions per ASTM D4327, and Alkalinity per APHA 2320-B.

Electrical conductivity in millisiemens/cm and chemical analyses were made on a 1:5 soil-to-water extract.

mg/kg = milligrams per kilogram (parts per million) of dry soil.

Redox = oxidation-reduction potential in millivolts

ND = not detected

na = not analyzed

431 West Baseline Road · Claremont, CA 91711
Phone: 909.962.5485 · Fax: 909.626.3316

APPENDIX D

Shea Prop/Festival

Latitude, Longitude: 33.8652, -117.7512



Date	11/20/2022, 11:36:16 AM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Stiff Soil

Type	Value	Description
S_S	1.841	MCE_R ground motion. (for 0.2 second period)
S_1	0.649	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.841	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	1.227	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.78	MCE_G peak ground acceleration
F_{PGA}	1.1	Site amplification factor at PGA
PGA_M	0.858	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.841	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	2.017	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	2.317	Factored deterministic acceleration value. (0.2 second)
S1RT	0.649	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.712	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.881	Factored deterministic acceleration value. (1.0 second)
PGAd	0.955	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.78	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.913	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.912	Mapped value of the risk coefficient at a period of 1 s
C_V	1.468	Vertical coefficient

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition

Dynamic: Conterminous U.S. 2014 (u…

Spectral Period

Peak Ground Acceleration

Latitude

Decimal degrees

33.8652

Time Horizon

Return period in years

2475

Longitude

Decimal degrees, negative values for western longitudes

-117.7512

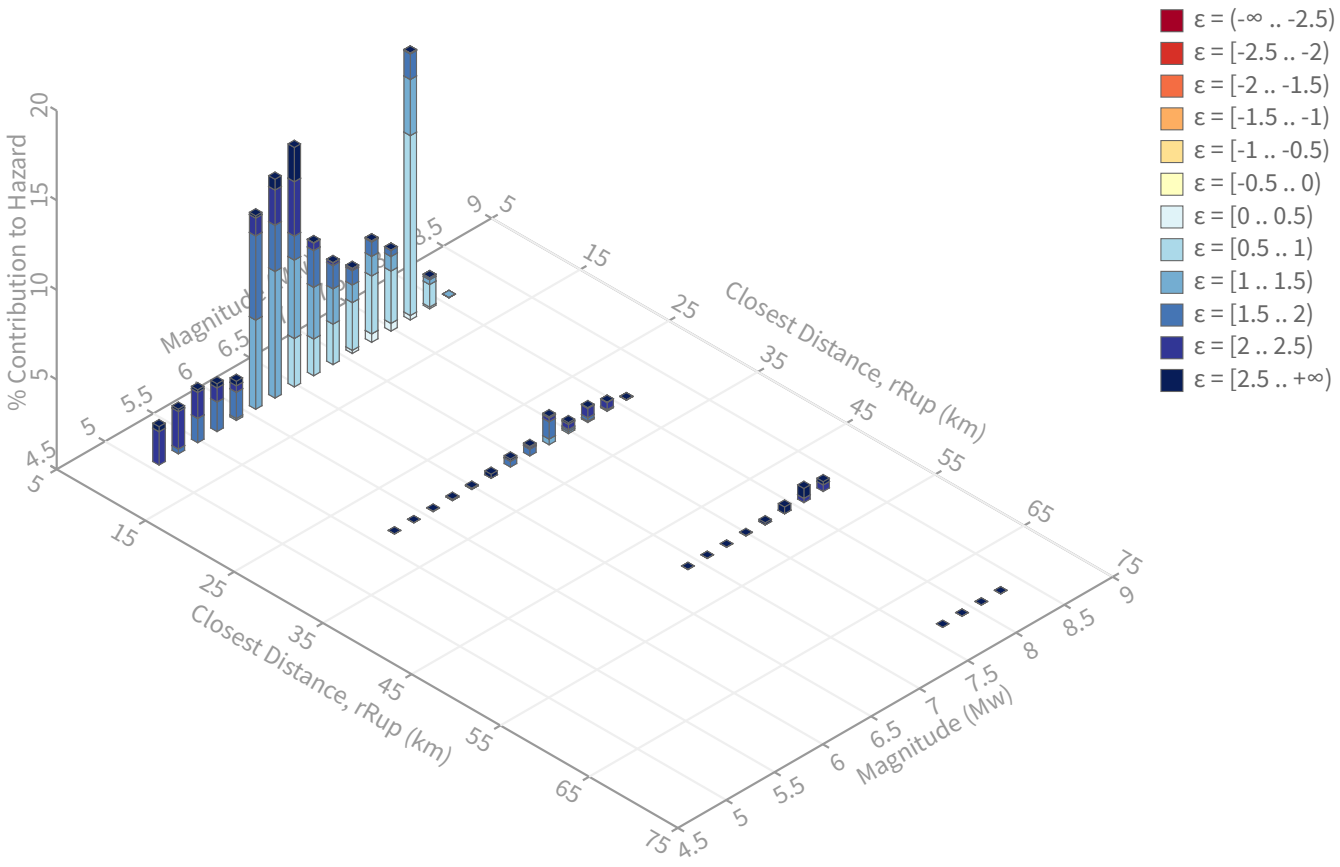
Site Class

259 m/s (Site class D)

Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.81706111 g

Recovered targets

Return period: 2901.8505 yrs
Exceedance rate: 0.00034460769 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.05 %

Mean (over all sources)

m: 6.74
r: 8.45 km
ε_0: 1.44 σ

Mode (largest m-r bin)

m: 7.72
r: 3.8 km
ε_0: 0.89 σ
Contribution: 14.88 %

Mode (largest m-r-ε_0 bin)

m: 7.72
r: 3.38 km
ε_0: 0.72 σ
Contribution: 10.03 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
UC33brAvg_FM31	System							46.29
Whittier alt 1 [2]		3.04	7.30	0.94	117.740°W	33.888°N	21.79	14.12
Chino alt 1 [3]		7.90	6.60	1.27	117.669°W	33.917°N	52.83	9.25
Peralta Hills [0]		2.70	6.81	0.89	117.751°W	33.846°N	179.10	4.79
Chino alt 1 [2]		7.90	6.24	1.32	117.676°W	33.924°N	46.98	3.50
Chino alt 1 [1]		9.17	6.08	1.70	117.703°W	33.950°N	25.13	3.45
Elsinore (Glen Ivy) rev [0]		15.48	6.53	2.38	117.590°W	33.829°N	105.13	3.11
Whittier alt 1 [1]		4.76	6.86	1.25	117.702°W	33.874°N	78.31	1.71
Compton [0]		20.15	7.25	1.67	118.043°W	33.702°N	236.24	1.18
UC33brAvg_FM32	System							36.02
Whittier alt 2 [2]		3.03	7.51	0.88	117.737°W	33.886°N	28.43	11.72
Chino alt 2 [1]		9.36	6.72	1.38	117.670°W	33.921°N	50.55	6.15
Richfield [0]		6.51	6.30	1.56	117.803°W	33.889°N	298.91	3.57
Peralta Hills [0]		2.70	7.25	0.76	117.751°W	33.846°N	179.10	3.38
Elsinore (Glen Ivy) rev [0]		15.48	6.52	2.39	117.590°W	33.829°N	105.13	3.16
Chino alt 2 [2]		9.36	6.73	1.39	117.670°W	33.921°N	50.55	1.77
Compton [0]		20.15	7.31	1.64	118.043°W	33.702°N	236.24	1.28
Whittier alt 2 [1]		3.56	7.12	1.06	117.719°W	33.878°N	63.66	1.15
UC33brAvg_FM32 (opt)	Grid							9.00
PointSourceFinite: -117.751, 33.915		7.55	5.58	1.85	117.751°W	33.915°N	0.00	1.61
PointSourceFinite: -117.751, 33.915		7.55	5.58	1.85	117.751°W	33.915°N	0.00	1.61
PointSourceFinite: -117.751, 33.924		8.23	5.60	1.94	117.751°W	33.924°N	0.00	1.15
PointSourceFinite: -117.751, 33.924		8.23	5.60	1.94	117.751°W	33.924°N	0.00	1.15
PointSourceFinite: -117.751, 33.942		9.18	5.85	1.97	117.751°W	33.942°N	0.00	1.09
PointSourceFinite: -117.751, 33.942		9.18	5.85	1.97	117.751°W	33.942°N	0.00	1.09
UC33brAvg_FM31 (opt)	Grid							8.69
PointSourceFinite: -117.751, 33.915		7.57	5.56	1.86	117.751°W	33.915°N	0.00	1.57
PointSourceFinite: -117.751, 33.915		7.57	5.56	1.86	117.751°W	33.915°N	0.00	1.57
PointSourceFinite: -117.751, 33.942		9.15	5.87	1.96	117.751°W	33.942°N	0.00	1.11
PointSourceFinite: -117.751, 33.942		9.15	5.87	1.96	117.751°W	33.942°N	0.00	1.11

APPENDIX E

APPENDIX E

GENERAL EARTHWORK AND GRADING SPECIFICATIONS

1.0 General

1.1 Intent: These General Earthwork and Grading Specifications are for the grading and earthwork shown on the approved grading plan(s) and/or indicated in the geotechnical report(s). These Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the specific recommendations in the geotechnical report shall supersede these more general Specifications. Observations of the earthwork by the project Geotechnical Consultant during the course of grading may result in new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

1.2 Geotechnical Consultant: Prior to commencement of work, the owner shall employ a geotechnical consultant. The geotechnical consultant shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of the grading.

Prior to commencement of grading, the Geotechnical Consultant shall review the "work plan" prepared by the Earthwork Contractor (Contractor) and schedule sufficient personnel to perform the appropriate level of observation, mapping, and compaction testing.

During the grading and earthwork operations, the Geotechnical Consultant shall observe, map, and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the Geotechnical Consultant shall inform the owner, recommend appropriate changes in design to accommodate the observed conditions, and notify the review agency where required. Subsurface areas to be geotechnically observed, mapped, elevations recorded, and/or tested include natural ground after it has been cleared for receiving fill but before fill is placed, bottoms of all "remedial removal" areas, all key bottoms, and benches made on sloping ground to receive fill.

The Geotechnical Consultant shall observe the moisture-conditioning and processing of the subgrade and fill materials and perform relative compaction testing of fill to determine the attained level of compaction. The Geotechnical Consultant shall provide the test results to the owner and the Contractor on a routine and frequent basis.

1.3 The Earthwork Contractor: The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Specifications prior to commencement of grading. The Contractor shall be solely responsible for performing the grading in accordance with the plans and specifications.

The Contractor shall prepare and submit to the owner and the Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "spreads" of work and the estimated quantities of daily earthwork contemplated for the site prior to commencement of grading. The Contractor shall inform the owner and the Geotechnical Consultant of changes in work schedules and updates to the work plan at least 24 hours in advance of such changes so that appropriate observations and tests can be planned and accomplished. The Contractor shall not assume that the Geotechnical Consultant is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the earthwork in accordance with the applicable grading codes and agency ordinances, these Specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of the Geotechnical Consultant, unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, insufficient buttress key size, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the Geotechnical Consultant shall reject the work and may recommend to the owner that construction be stopped until the conditions are rectified.

2.0 Preparation of Areas to be Filled

2.1 Clearing and Grubbing: Vegetation, such as brush, grass, roots, and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies, and the Geotechnical Consultant.

The Geotechnical Consultant shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 1 percent of organic materials (by volume). No fill lift shall contain more than 5 percent of organic matter. Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed

immediately for proper evaluation and handling of these materials prior to continuing to work in that area.

As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed.

2.2 Processing: Existing ground that has been declared satisfactory for support of fill by the Geotechnical Consultant shall be scarified to a minimum depth of 6 inches. Existing ground that is not satisfactory shall be overexcavated as specified in the following section. Scarification shall continue until soils are broken down and free of large clay lumps or clods and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction.

2.3 Overexcavation: In addition to removals and overexcavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be overexcavated to competent ground as evaluated by the Geotechnical Consultant during grading.

2.4 Benching: Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), the ground shall be stepped or benched. Please see the Standard Details for a graphic illustration. The lowest bench or key shall be a minimum of 15 feet wide and at least 2 feet deep, into competent material as evaluated by the Geotechnical Consultant. Other benches shall be excavated a minimum height of 4 feet into competent material or as otherwise recommended by the Geotechnical Consultant. Fill placed on ground sloping flatter than 5:1 shall also be benched or otherwise overexcavated to provide a flat subgrade for the fill.

2.5 Evaluation/Acceptance of Fill Areas: All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive fill. The Contractor shall obtain a written acceptance from the Geotechnical Consultant prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys, and benches.

3.0 Fill Material

3.1 General: Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by the Geotechnical Consultant prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to the Geotechnical Consultant or mixed with other soils to achieve satisfactory fill material.

3.2 Oversize: Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 12 inches, shall not be buried or placed in fill unless location, materials, and placement methods are specifically accepted by the Geotechnical Consultant. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 vertical feet of finish grade or within 2 feet of future utilities or underground construction.

3.3 Import: If importing of fill material is required for grading, proposed import material shall meet the requirements of Section 3.1. The potential import source shall be given to the Geotechnical Consultant at least 48 hours (2 working days) before importing begins so that its suitability can be determined and appropriate tests performed.

4.0 Fill Placement and Compaction

4.1 Fill Layers: Approved fill material shall be placed in areas prepared to receive fill (per Section 3.0) in near-horizontal layers not exceeding 8 inches in loose thickness. The Geotechnical Consultant may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

4.2 Fill Moisture Conditioning: Fill soils shall be watered, dried back, blended, and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM Test Method D1557-91).

4.3 Compaction of Fill: After each layer has been moisture-conditioned, mixed, and evenly spread, it shall be uniformly compacted to not less than 90 percent of maximum dry density (ASTM Test Method D1557-91). Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

4.4 Compaction of Fill Slopes: In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by backrolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet in fill elevation, or by other methods producing satisfactory results acceptable to the Geotechnical Consultant. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of maximum density per ASTM Test Method D1557-91.

4.5 Compaction Testing: Field tests for moisture content and relative compaction of the fill soils shall be performed by the Geotechnical Consultant. Location and frequency of tests shall be at the Consultant's discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

4.6 Frequency of Compaction Testing: Tests shall be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of compacted fill soils embankment. In addition, as a guideline, at least one test shall be taken on slope faces for each 5,000 square feet of slope face and/or each 10 feet of vertical height of slope. The Contractor shall assure that fill construction is such that the testing schedule can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork construction if these minimum standards are not met.

4.7 Compaction Test Locations: The Geotechnical Consultant shall document the approximate elevation and horizontal coordinates of each test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that the Geotechnical Consultant can determine the test locations with sufficient accuracy. At a minimum, two grade stakes within a horizontal distance of 100 feet and vertically less than 5 feet apart from potential test locations shall be provided.

5.0 Subdrain Installation

Subdrain systems shall be installed in accordance with the approved geotechnical report(s), the grading plan, and the Standard Details. The Geotechnical Consultant may recommend additional subdrains and/or changes in subdrain extent, location, grade, or material depending on conditions encountered during grading. All subdrains shall be surveyed by a land surveyor/civil engineer for line and grade after installation and prior to burial. Sufficient time should be allowed by the Contractor for these surveys.

6.0 Excavation

Excavations, as well as over-excavation for remedial purposes, shall be evaluated by the Geotechnical Consultant during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by the Geotechnical Consultant based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, evaluated, and accepted by the Geotechnical Consultant prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by the Geotechnical Consultant.

7.0 Trench Backfills

7.1 Contractor shall follow all OHSA and Cal/OSHA requirements for safety of trench excavations.

7.2 Bedding and backfill of utility trenches shall be done in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding material shall have a Sand Equivalent greater than 30 (SE>30). The bedding shall be placed to 1 foot over the top of the conduit and densified by jetting. Backfill shall be placed and densified to a minimum 90 percent of maximum from 1 foot above the top of the conduit to the surface, except in traveled ways (see Section 7.6 below).

7.3 Jetting of the bedding around the conduits shall be observed by the Geotechnical Consultant.

7.4 Geotechnical Consultant shall test the trench backfill for relative compaction. At least one test should be made for every 300 feet of trench and 2 feet of fill.

7.5 Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method.

7.6 Trench backfill in the upper foot measured from finish grade within existing or future traveled way, shoulder, and other paved areas (or areas to receive pavement) should be placed to a minimum 95 percent relative compaction.

Appendix F: Notice of Transfer of Responsibility Form

Exhibit D

Water Quality Management Plan
Notice of Transfer of Responsibility

Tracking No. Assigned by the City of Anaheim: _____

Submission of this Notice of Transfer of Responsibility constitutes notice to the City of Anaheim 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 SiteTransferred 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 not 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 "Previous Owner," and those portions previously transferred 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 Owner 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

Appendix G: City of Anaheim Corresponsdence

Appendix H: Additional Forms

SUBJECT TO FURTHER REVISION

APPROXIMATE PROJECT SITE

LOS ANGELES COUNTY
ORANGE COUNTY
SAN BERNARDINO COUNTY
RIVERSIDE COUNTY

0.9
0.95
0.7
0.75
0.65
1
1.05
0.8
0.85

LEGEND

- Orange County Precipitation Stations
- 24 Hour, 85th Percentile Rainfall (Inches)
- 24 Hour, 85th Percentile Rainfall (Inches) - Extrapolated
- City Boundaries

Rainfall Zones

Design Capture Storm Depth (inches)

- 0.65"
- 0.7
- 0.75
- 0.80
- 0.85
- 0.90
- 0.95
- 1.00
- 1.10"

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.

0 3 6 12 Kilometers
0 1.8 3.6 7.2 Miles

P:\9526E\16-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-1_RainfallZones_20110215.mxd

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

SUBJECT TO FURTHER REVISION

APPROXIMATE PROJECT SITE

LEGEND

City Boundaries

Hydrologic Soil Groups

- A Soils
- B Soils
- C Soils
- D Soils

Source:
Soils: Natural Resources Conservation Service (NRCS)
Soil Survey - soil_ca678, Orange County & Western Riverside
Date of publication: 2006-02-08
http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm

0 2.5 5 10 Kilometers

0 1.8 3.6 7.2 Miles

TITLE

NRCS HYDROLOGIC SOILS GROUPS

JOB

ORANGE COUNTY INFILTRATION STUDY

ORANGE CO. CA

SCALE	1" = 1.8 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	02/09/11
JOB NO.	9526-E

PACE
Advanced Water Engineering

FIGURE

XVI-2a

P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-2a_HydroSoils_20110215.mxd

SUBJECT TO FURTHER REVISION

APPROXIMATE PROJECT SITE

LOS ANGELES COUNTY
ORANGE COUNTY

SAN BERNARDINO COUNTY
ORANGE COUNTY

RIVERSIDE COUNTY
ORANGE COUNTY

LEGEND

City Boundaries

Seismic Hazards

Potential Landslide Area

Source:
Seismic Hazard Zone Maps
Division of Mines and Geology, California Geology Survey,
Publication Date: 2005; Data Downloaded 02-09-2011
http://www.conservation.ca.gov/cgs/shzp/Pages/Index.aspx

0 2.5 5 10 Kilometers

0 1.8 3.6 7.2 Miles

TITLE
HYDROLOGIC SOIL GROUP
TYPE D NRCS SOIL SURVEY

JOB
ORANGE COUNTY
INFILTRATION STUDY
ORANGE CO. CA

SCALE	1" = 1.25 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	02/09/11
JOB NO.	9526-E

PACE
Advanced Water Engineering

FIGURE
XVI-2c

P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasibility_20110215\9526E_FigureXVI-2c_Landslides_20110215.mxd

SUBJECT TO FURTHER REVISION

LEGEND

- Depth To First Groundwater Contours
- City Boundaries
- OCWD Groundwater Basin Protection Boundary

Note: Data are not available for South Orange County at this time.

Source:
Sprotte, Fuller and Greenwood, 1980.
California Division of Mines and Geology;
California Geological Survey

APPROXIMATE PROJECT SITE

LOS ANGELES COUNTY
ORANGE COUNTY
SAN BERNARDINO COUNTY
RIVERSIDE COUNTY

0 2 4 8 Kilometers
0 1.25 2.5 5 Miles

TITLE
NORTH ORANGE COUNTY
MAPPED DEPTH TO FIRST
GROUNDWATER

JOB
ORANGE COUNTY
INFILTRATION STUDY
ORANGE CO. CA

SCALE	1" = 1.25 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	02/09/11
JOB NO.	9526-E

PACE
Advanced Water Engineering

FIGURE
XVI-2d

P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-2d_DepthToGroundwaterOverview_20110215.mxd

SUBJECT TO FURTHER REVISION

LOS ANGELES COUNTY
ORANGE COUNTY

SAN BERNARDINO COUNTY
ORANGE COUNTY

APPROXIMATE PROJECT SITE

RIVERSIDE COUNTY
ORANGE COUNTY

LOS ANGELES COUNTY
ORANGE COUNTY

LEGEND

- City Boundaries
- OCWD Groundwater Basin Protection Boundary

Depth To Groundwater

- <= 5'
- 5-10'

Note: Data are not available for South Orange County at this time.

Source:
Sprotte, Fuller and Greenwood, 1980.
California Division of Mines and Geology;
California Geological Survey

0 2 4 8 Kilometers

0 1.25 2.5 5 Miles

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TITLE
NORTH ORANGE COUNTY
MAPPED SHALLOW GROUNDWATER

ORANGE COUNTY
INFILTRATION STUDY

JOB
ORANGE CO. CA

SCALE	1" = 1.25 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	02/09/11
JOB NO.	9526-E

PACE
Advanced Water Engineering

FIGURE
XVI-2e

SUBJECT TO FURTHER REVISION

APPROXIMATE PROJECT SITE

LOS ANGELES COUNTY
ORANGE COUNTY

SAN BERNARDINO COUNTY
ORANGE COUNTY

RIVERSIDE COUNTY
ORANGE COUNTY

LEGEND

- City Boundaries
- OCWD Groundwater Basin Protection Boundary

Plume Protection Boundaries

- North Basin Groundwater Protection Project
- South Basin Groundwater Protection Project
- El Toro Marine Base
- Tustin Marine Air Base
- Approximate Selenium Contamination Area

Note: Individual contamination sites are not plotted.
See State Water Resources Control Board Geotracker database (http://geotracker.waterboards.ca.gov),
Department of Toxic Substance Control Envirostor database (http://www.envirostor.dtsc.ca.gov) and other applicable sources for current listing of active contaminated sites.

Groundwater basin and plume protection boundaries for South Orange County are not shown on this exhibit at this time

0 2 4 8 Kilometers
0 1.25 2.5 5 Miles

P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-2f_NorthOCGroundwaterProtectionAreasStreetMap_20110215.mxd

TITLE
NORTH ORANGE COUNTY
GROUNDWATER PROTECTION
AREAS

ORANGE COUNTY
INFILTRATION STUDY

JOB
ORANGE CO.

CA

SCALE	1" = 1.25 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/22/10
JOB NO.	9526-E

PACE
Advanced Water Engineering

FIGURE
XVI-2f

SUSCEPTIBILITY MAP UPATE (FEB 2013)

Susceptibility

Potential Areas of Erosion, Habitat, & Physical Structure Susceptibility

Channel Type

- Earth (Unstable)
- Earth (Stabilized)
- Stabilized

Tidel Influence

- <= Mean High Water Line (4.28')

Water Body

- Basin
- Dam
- Lake
- Reservoir

Forest Areas

- Cleveland National Forest

Federal Lands

- Amarus Salt Marsh

San Gabriel-Coyote Creek Watershed

San Bernardino County

Carbon Canyon

Yorba Linda Reservoir

Miller Retarding Basin

Anaheim Lake

Warner Basin

Kraemer Basin

Walnut Canyon Reservoir

Olive Hills

Fletcher Retarding Basin

Villa Park Dam

Peters Canyon Reservoir

Irvine Lake

Riverside County

APPROXIMATE PROJECT SITE

Stabilized by Grade Control Structure

AnaheimBay-HuntingtonHarbor Watershed

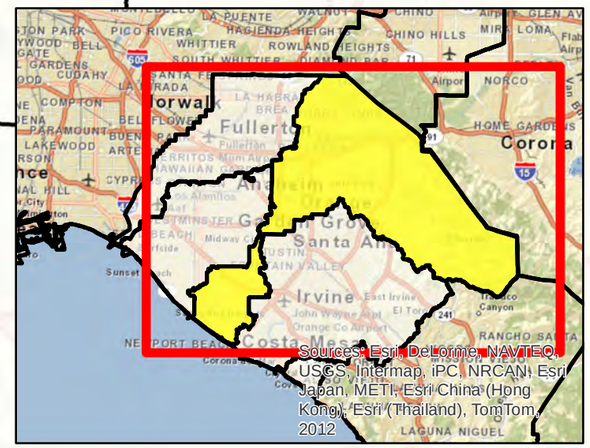
SOUTHPARK PUMP STATION

Bartlett Retarding Basin

Cleveland National Forest

Newport Bay Watershed

South Orange County



0 12,000 24,000 Feet

Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012

TITLE: SUSCEPTIBILITY ANALYIS SANTA ANA RIVER

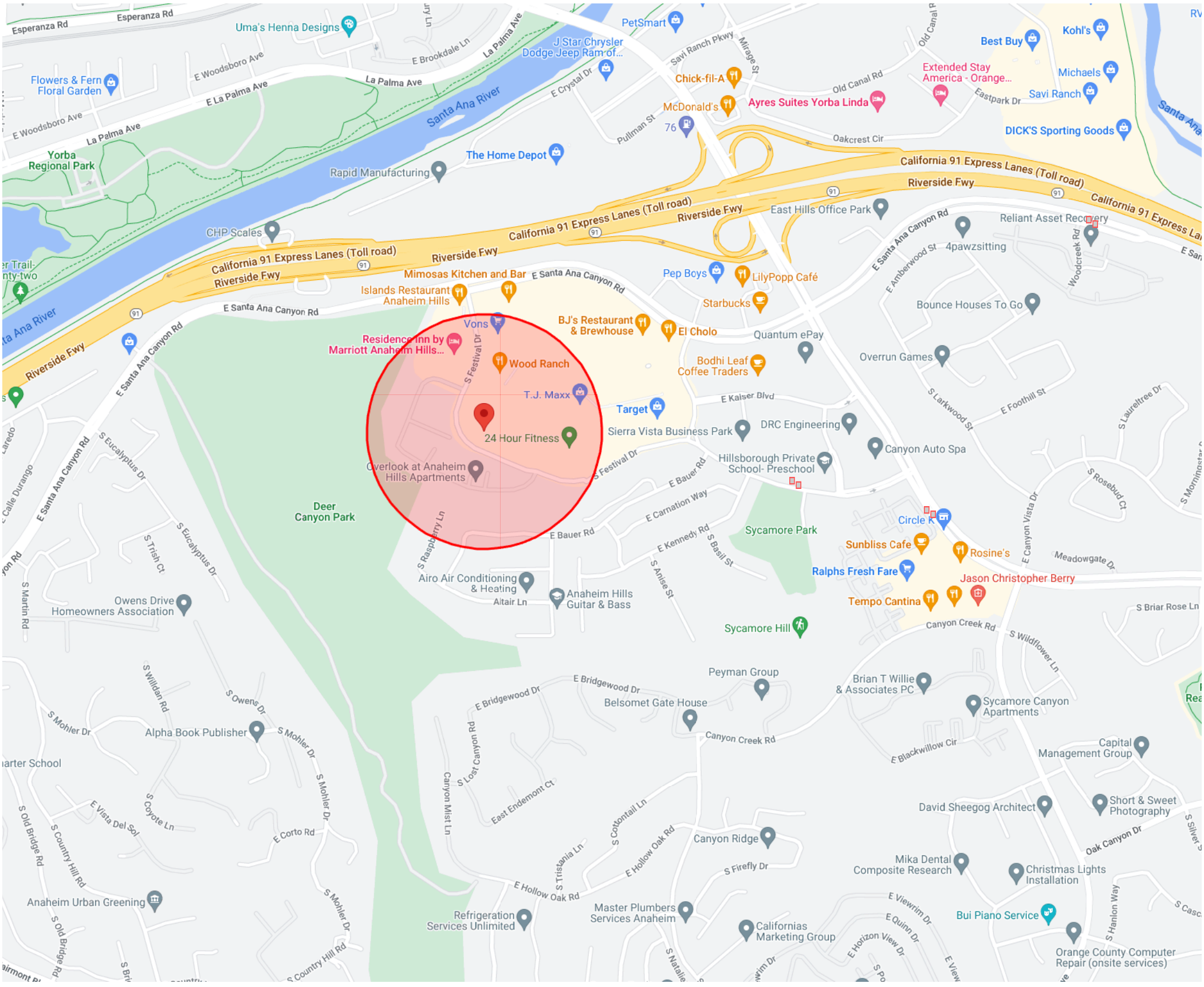
JOB: ORANGE COUNTY WATERSHED MASTER PLANNING ORANGE CO. CA

SCALE	DESIGNED	DRAWING	CHECKED	DATE	JOB NO.
1" = 12000'	TH	TH	BMP	04/30/10	9526-E

PACE Advanced Water Engineering

FIGURE 3

P:\9526E\6-GIS\Mxds\SuceptabilityMaps_20100505\9526E_SantaAnaRiverSusceptibility_20100430.mxd



LEGEND - CHOOSE MORE SITES

- LUST Cleanup Sites - REMOVE
- Cleanup Program Sites - REMOVE
- Military Cleanup Sites - REMOVE
- Military Privatized Sites - REMOVE
- Military UST Sites - REMOVE

☒ *Signifies a Closed Site*

LIST SITES VISIBLE ON MAP

Map data ©2023 100 m | Report a map error

Sites Shown on Map: 8 Total Sites | 0 Open Sites | 8 Closed Sites | 0 Sites w/Water Quality Data