PROVIDENCE PARK SUBDIVISION

PRELIMINARY HYDROLOGIC AND HYDRAULIC STUDY

February 17, 2017

Prepared For:

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I. INTRODUCTION

This report presents the hydrologic and hydraulic analyses for the Providence Park Subdivision located east and west of North Antelope Road, south of PFE Road and north of the Sacramento County line in Placer County, California (See Appendix A – Vicinity Map). This study estimates the existing and proposed storm flows generated by the 10-year and 100-year storm events as outlined by the Placer County Flood Control and Water Conservation District Stormwater Manual (Reference 1, hereinafter referred to as the *Manual).*

II. PROJECT LOCATION AND DESCRIPTION

The Providence Park Subdivision project encompasses approximately 110 acres located in Placer County. There are three small existing structures located west of North Antelope; the remained of the site is undeveloped. The site is located north of a residential subdivision, east of Dry Creek Middle School and three homes on large lots located in the northeast corner of PFE and North Antelope Road that will remain.

The proposed development will consist of 314 single family homes, residential streets, two parks and underground utilities. In addition to the onsite improvements, North Antelope Road will be widened and right of way will be granted along PFE Road to allow widening to be completed during future development.

In developing a grading and draining plan for the Providence Park Subdivision, it was determined that the developed site will drain to two primary locations. The western portion will drain to project will drain from south to north toward PFE Road where storm flows will be conveyed through the underground system to east along PFE Road approximately 700 feet at which point the line will cross PFE Road and discharge to Dry Creek north of PFE. The remainder of the site will drain to the east where flows will be

discharges to Dry Creek at three outfall locations, all of which are located south of PFE Road.

III. FLOOD HAZARD AREAS

The project site is located within the area shown on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) dated December 28, 2015 Map Number 06061C1027H - index for Placer County, California and incorporated areas. There are no proposed building sites within a FEMA-designated Flood Zone or Special Flood Hazard Area (see Appendix A – FEMA Map).

IV. HYDROLOGIC METHODOLOGY

The methodology contained in this study is in compliance with the procedures presented in the *Manual.* Hydrologic analysis was completed to estimate storm runoff from the proposed project. The drainage basins and flow patterns for the developed and undeveloped conditions were determined from existing topography and the proposed grading plans. Both the Existing Shed Map and Developed Shed Map can be seen in Appendix A.

The *Manual – Peak Flows From Small Watersheds* to determine both the 10-year storm (for analysis of the onsite storm drain system) and 100-year storm (for analysis of the overland flow routes). The onsite hydrology and hydraulics and the associated details and analysis for the existing conditions can be seen in Appendix B and Appendix C for the developed condition.

V. EXISTING HYDROLOGY

The existing 100 year flood plain and the effect that the development will have on the water surface elevation was analyzed by Michael S. Thomas, P.E. in the *Preliminary Hydrology and Hydraulics Study for Estimation of 100-Year Flood Boundaries and Elevations.* A copy of the report completed by Michael S. Thomas can be seen in Appendix F.

Approximately 44.65 of the site west of North Antelope Road drains toward PFE Road, in some cases through adjacent properties as shown on the Existing Shed Map located in Appendix A. Approximately 19.77 acers of the site currently drains toward North Antelope where flows are conveyed south and appear to enter the storm drain system south of the Sacramento County line. The entire site east of North Antelope Road drains toward Dry Creek.

The site is dominated by soils belonging to the hydrologic soil group D with soils from group B present within the Dry Creek flood plain. Soils in hydrologic group D have slow infiltration rates, 0.08 inches per hour for open brush with good grass cover was used in the hydrologic calculations for the existing conditions.

Runoff estimates for the existing conditions were determined utilizing the *Manual – Peak Flows from Small Watersheds.* Response time and associated runoff calculations for the 10-year and 100-year storm events are included in Appendix B – Tables A1 & A2. Table 1 below summarizes the estimates of the storm runoff for the existing conditions. Please refer to the detailed analysis in Appendix B for supporting calculations.

TABLE 1 EXISTING PEAK FLOW CHARACTERISTICS (10 & 100-YEAR)		
Discharge Location	Q_{10} (cfs)	Q_{100} (cfs)
PFE Road	14.7	28.7
Hutchens Property (Shed A2)	8.0	15.7
Aguilar Property (Shed A3)	3.4	6.6
Hadsell Property (Shed A4)	1.5	2.7
Antelope Road (Shed B1)	11.2	22.0
Ex. DI - N. Antelope & PFE (Shed D1)	1.9	3.6
Dry Creek (Shed C1)	25.8	53.3

VI. PROPOSED HYDROLOGY

The *Manual - Peak Flows from Small Watersheds* was utilized to determine the 10-year flows for the proposed developed conditions for analysis of the proposed onsite storm drain system. In addition, the same methodology was to determine the 100-year design storm flows. The proposed site has been divided in to drainage basins as shown on the Developed Shed Map located in Appendix A. The proposed site will consist of approximately 80 percent impervious surface once construction is complete. An infiltration rate of 0.12 inches per hours for hydrologic group D soils in residential areas was used for the runoff calculations.

The 10-year and 100-year event peak flows for the developed site were determined following the procedure described in Section V in the *Manual – Peak Flows from Small Watersheds.* The peak flow calculations are included in Appendix C.

Table 2 below summarizes estimates for the storm runoff for the developed conditions. Please refer to the detailed analysis in Appendix C for supporting calculations and flows for individual onsite nodes.

TABLE 2 PROPOSED PEAK FLOW CHARACTERISTICS (10 & 100-YEAR)		
Discharge Location	Q_{10} (cfs)	Q_{100} (cfs)
PFE Road (Sheds A & O1)	36.5	65.9
PFE Culvert (Sheds B, C & D)	45.6	87.1
Southwest Antelope Rd. (Offsite)	2.7	5.4
Southeast Antelope Rd. (Offsite)	1.8	3.5

VII. PROPOSED HYDRAULICS

Storm Drain

The storm drain system (composed of curb and gutter, drop inlets, permeable pavement, stormwater quality basins and underground storm drain pipe) has been designed to convey the 10-year storm runoff. *StormCAD* software was used in the analysis of the pipe storm drain system. A drainage easement and swale are proposed along the south property lines of lots 14, 15 and 16 to maintain the existing flow pattern and convey runoff from Shed O1. *FlowMaster* software was used to analyze the discharge through the proposed swale. Hydraulic calculations can be reviewed in Appendix D.

Bio-Retention

Bio-retention basins are planned at each intersection and intermediately along street right-of ways. The bio-retention basins will be sized as treatment facilities for the residential lots.

Best Management Practices

A Storm Water Pollution Prevention Plan (SWPPP) for the D Subdivision will be prepared in accordance with the requirements set by the California State Water Resources Control Board and the General Permit. The SWPPP will address the Best

Management Practices (BMPs) needed to reduce erosion from graded surfaces and minimize water degradation from sediment and construction materials during construction.

Permeable pavement and bio-retention basins are proposed for treatment of all onsite storm drain runoff. The permeable pavement and bio-retention basins will be sized to treat the first flush which includes a majority of the lager pollutants (sand, soil, silt, grease and trash) as well as smaller pollutants (sediment, nutrient, metals, pesticides and organics). A typical detail for the permeable pavement and bio-retention basins can be seen in Appendix E.

IX. CONCLUSIONS

1. The methods used to calculate storm runoff and various hydraulic characteristics for this project are in compliance with the *Manual*.

2. The proposed developed area of the project lies outside of a FEMA-designated Flood Zone or Special Flood Hazard Area.

3. 10-Year storm flows generated from the site are conveyed through onsite curb and gutter, permeable pavement, bio-retention basins, swales, drop inlets and underground storm drain.

4. 100-Year storm flows generated from the site are conveyed through overland release routes.

5. All onsite storm runoff from developed areas shall be routed through permeable pavement and bio-retention facilities providing permanent BMP facilities.

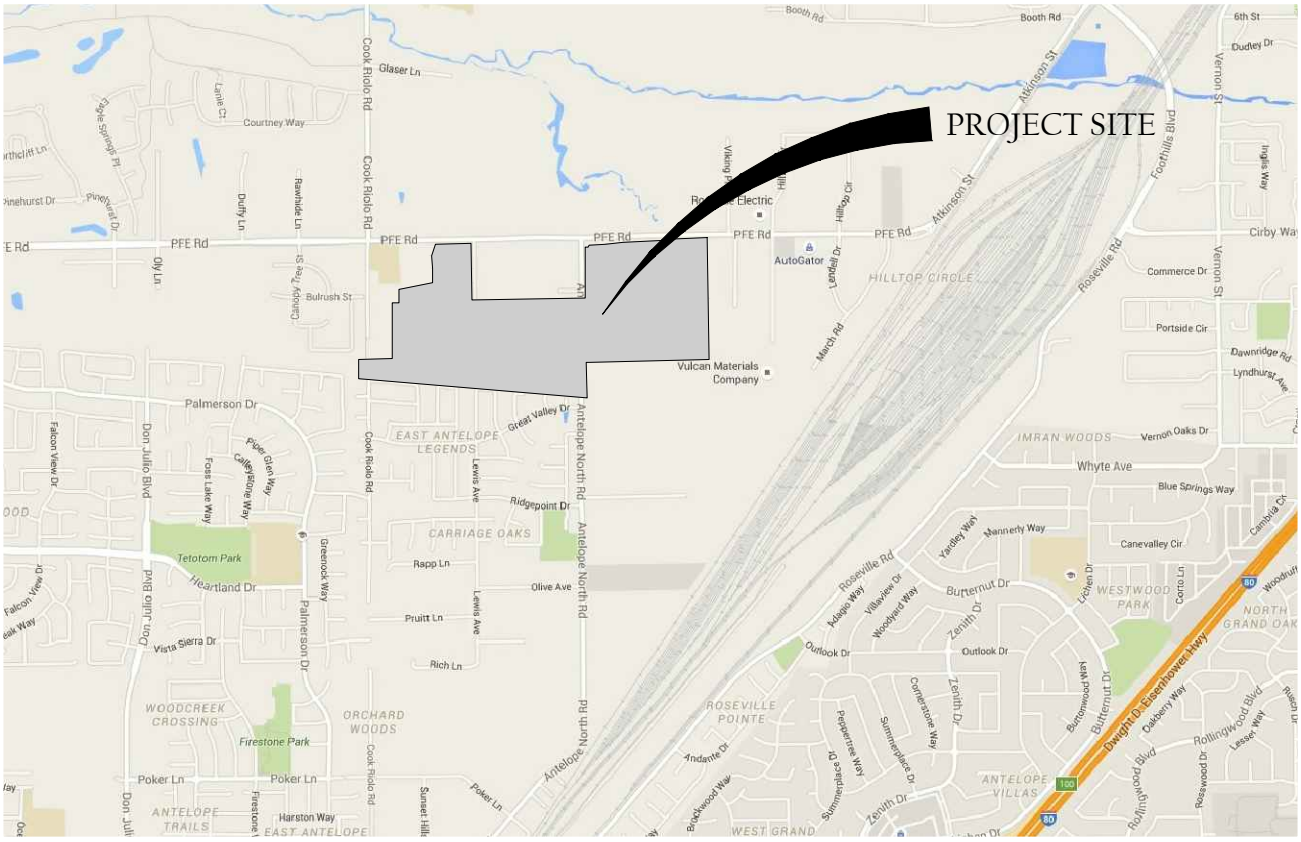
X. REFERENCES

1. Placer County Flood Control and Water Conservation District. *Stormwater Management Manual*. September 1, 1990.

2. United States Department of Agriculture. *Web Soil Survey*, Retrieved from http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

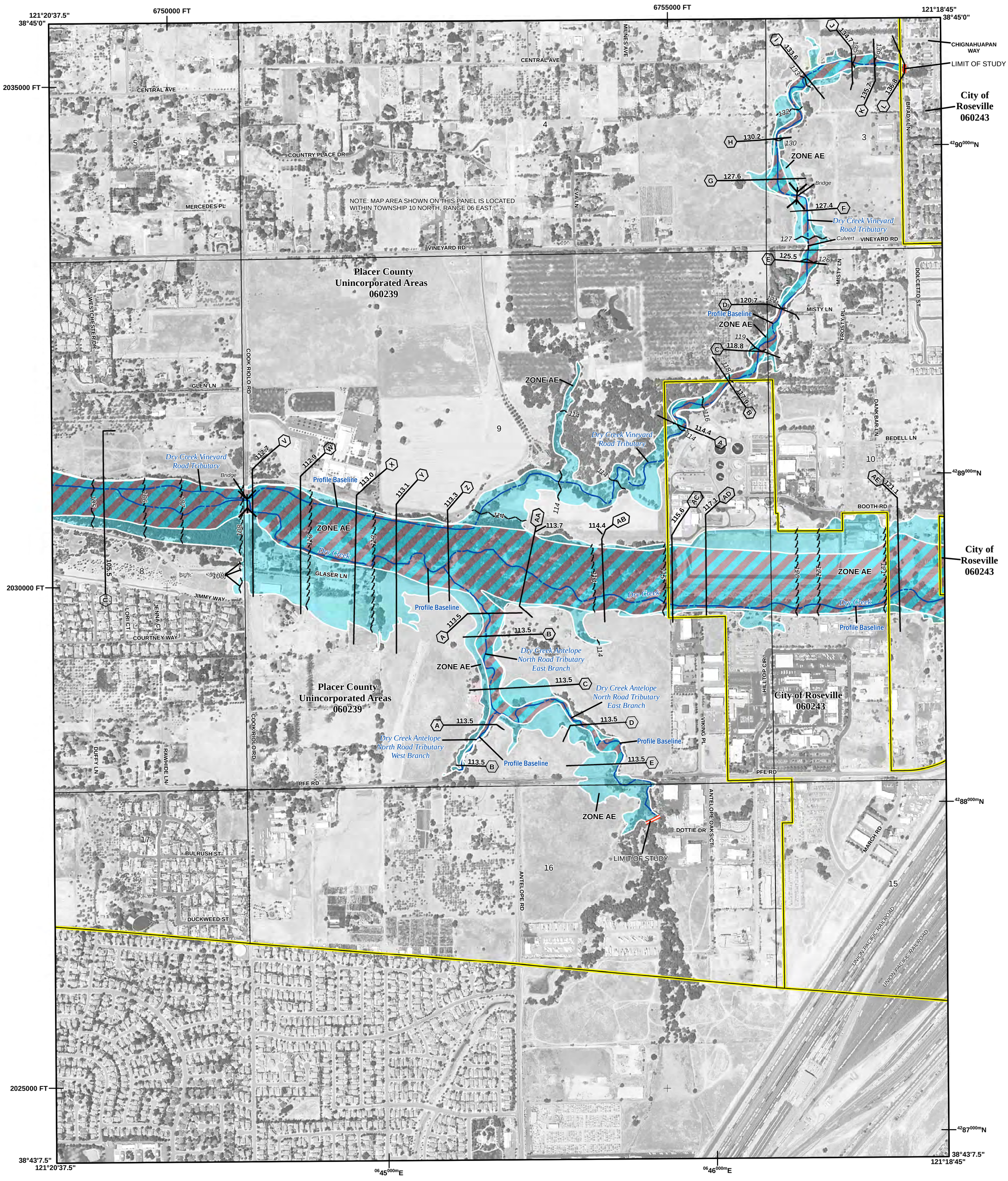
APPENDIX A- FIGURES & EXHIBITS

Vicinity Map
FEMA Map
Existing Shed Map
Developed Shed Map



VICINITY MAP

N.T.S.



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR ZONE DESCRIPTIONS AND INDEX MAP

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT

HTTP://MSC.FEMA.GOV

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*
OTHER AREAS	Areas of Minimal Flood Hazard *Zone X*
	Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES	Channel, Culvert, or Storm Sewer
	Accredited or Provisionally Accredited Levee, Dike, or Floodwall
	Non-accredited Levee, Dike, or Floodwall
OTHER FEATURES	E 18.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
	8 Coastal Transect
	Coastal Transect Baseline
	Profile Baseline
	Hydrographic Feature
	513 Base Flood Elevation Line (BFE)
	Limit of Study
	Jurisdiction Boundary

NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study report for this jurisdiction. To determine if flood insurance is available in the community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on this FIRM was provided in digital format by the USDA National Agriculture Imagery Program (NAIP). This information was photogrammetrically compiled at a scale of 1:24,000 from aerial photography dated 2014.

SCALE

N

Map Projection:

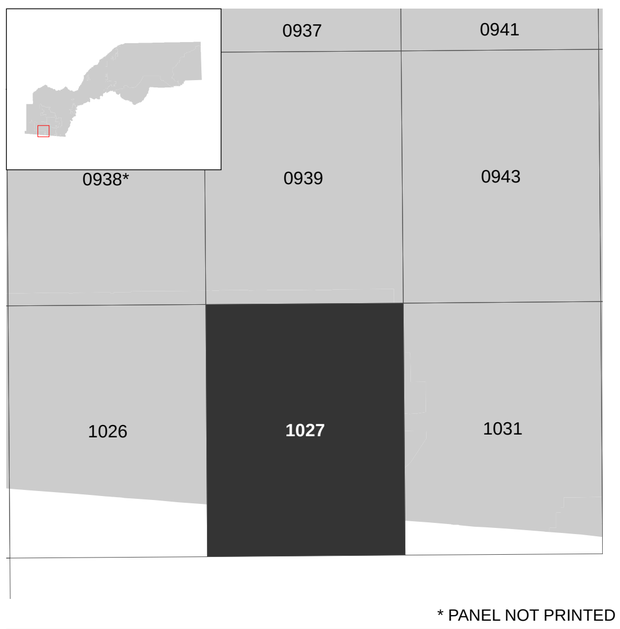
NAD83 STATE PLANE California II FIPS 0402 (Feet)
Western Hemisphere; Vertical Datum:NAVD88

1 inch = 500 feet 1:6,000

0 1,000 2,000 Feet

0 250 500 Meters

PANEL LOCATOR



* PANEL NOT PRINTED

FEMA

National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

PLACER COUNTY, CALIFORNIA
And Incorporated Areas

PANEL **1027** OF **1060**

FEMA

Panel Contains:

COMMUNITY	NUMBER	PANEL	SUFFIX
PLACER COUNTY	060239	1027	H
ROSEVILLE, CITY OF	060243	1027	H

PRELIMINARY
12/28/2015

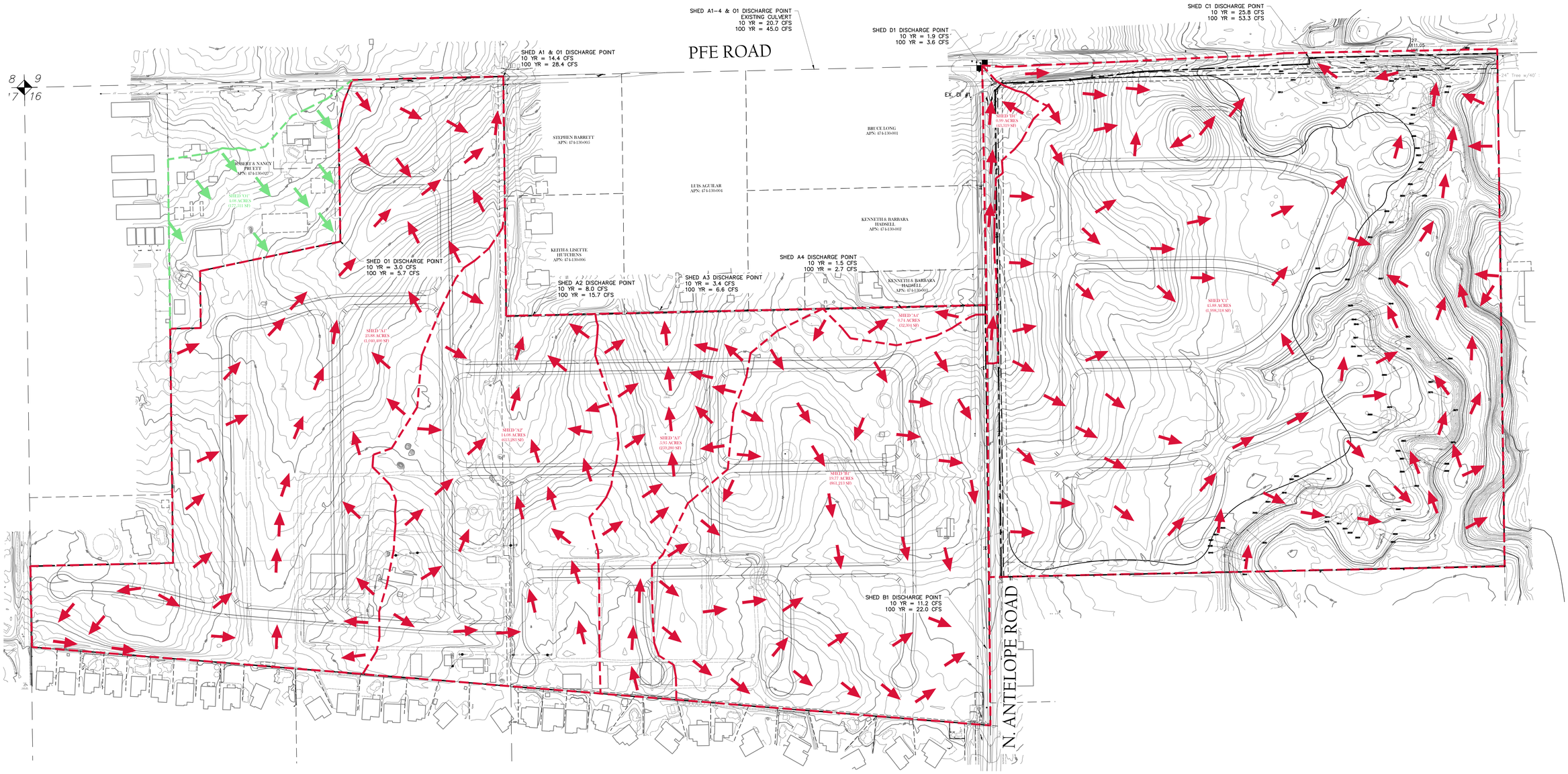
VERSION NUMBER
2.3.3.3

MAP NUMBER
06061C1027H

MAP REVISED

EXISTING SHED MAP
DANBURY PARK
PLACER COUNTY, CA

EXISTING CONDITIONS			
DISCHARGE POINT	SUB-AREA	Q10	Q100
Shed A			
PFE Roadside Ditch	A1 & O1	14.7	28.7
Hutchens Property	A2	8.0	15.7
Aguilar Property	A3	3.4	6.6
Hadsell Property	A4	1.5	2.7
Shed B			
Antelope Road	B1	11.2	22.0
Shed C			
Dry Creek	C1	25.8	53.3
Shed D			
Ex. DI	D1	1.9	3.6
Shed O			
Northwest Property Line	O1	3.0	5.7
Ex. PFE Culvert	A1-4 & O1	20.7	45.0



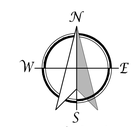
COUNTY OF PLACER DATUM

BENCHMARK: △ ELEV.-106.995

(NGVD29) RM130
A PK NAIL AND METAL DISC STAMPED "303" IN THE TOP SOUTHEAST CORNER OF THE CONCRETE HEADWALL OF THE PFE ROAD BRIDGE 0.13 MILE ± WEST OF VIKING PLACE.

FLOOD ZONE

PROJECT IS LOCATED WITHIN FLOOD ZONES DESIGNATED AS AE, BASE FLOOD ELEVATIONS DETERMINED, AND X, AREAS DETERMINED TO BE OUTSIDE THE 500-YEAR FLOOD PLAIN PER FLOOD INSURANCE PROGRAM COMMUNITY PANEL NO. 06061C0483G DATED NOVEMBER 21, 2001.



scale: 1"=100'

100 0 50 100 200

SHEET
1/2

EXISTING SHED MAP
SEPTEMBER 14, 2016

TSD ENGINEERING, INC.
expect more.
31 Natoma Street, Suite #160
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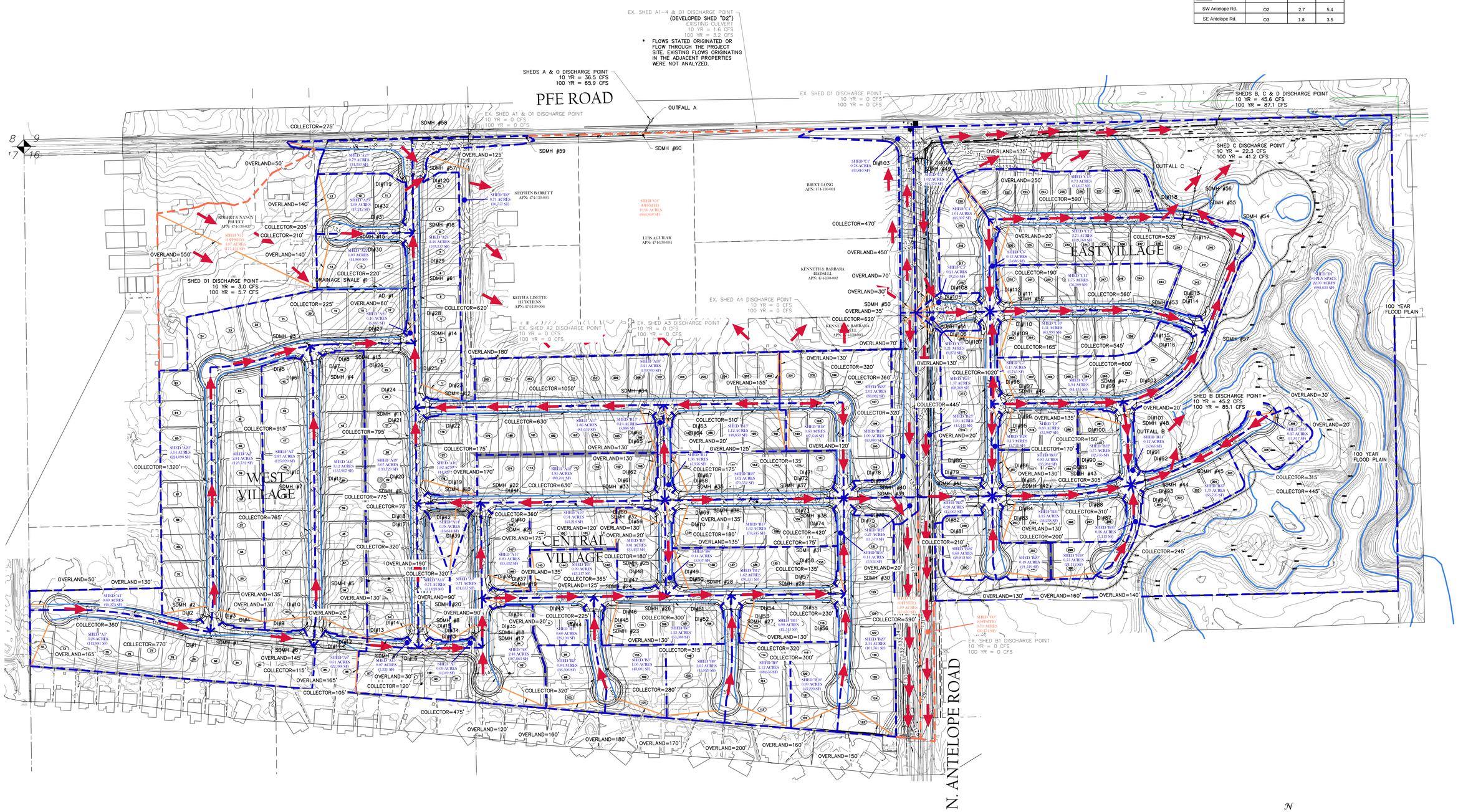
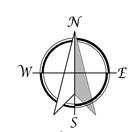
Phone: (916) 608-0707
Fax: (916) 608-0701

DEVELOPED SHED MAP
PROVIDENCE PARK
PLACER COUNTY, CA

OVERLAND FLOW
COLLECTOR FLOW

PROPOSED CONDITIONS			
DISCHARGE POINT	SUB-AREA (S)	Q10	Q100
Sheds A & O1			
OUTFALL A	A & O1	36.5	65.9
Shed B			
OUTFALL B	B	45.2	85.1
Shed C			
Outfall C	C	22.3	41.2
Sheds B, C & D			
PFE Culvert	B,C & D	45.6	87.1
Shed O			
SW Antelope Rd.	O2	2.7	5.4
SE Antelope Rd.	O3	1.8	3.5





scale: 1"=100'

100 0 50 100 50

COUNTY OF PLACER DATUM
BENCHMARK: ELEV.-106.995
(NGVD29) RM130
A PK NAIL AND METAL DISC STAMPED "303" IN THE TOP SOUTHEAST CORNER OF THE CONCRETE HEADWALL OF THE PFE ROAD BRIDGE 0.13 MILE ± WEST OF VIKING PLACE.

FLOOD ZONE
PROJECT IS LOCATED WITHIN FLOOD ZONES DESIGNATED AS AE, BASE FLOOD ELEVATIONS DETERMINED, AND X, AREAS DETERMINED TO BE OUTSIDE THE 500-YEAR FLOOD PLAIN PER FLOOD INSURANCE PROGRAM COMMUNITY PANEL NO. 06061C1027H DATED DECEMBER 28, 2018.

REGISTERED PROFESSIONAL ENGINEER
No. 58930
Exp. 6-30-17
CIVIL
STATE OF CALIFORNIA

DEVELOPED SHED MAP
FEBRUARY 14, 2017

SHEET 2/2

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APPENDIX B - EXISTING HYDROLOGY

Existing Conditions
Peak Flows from Small Watersheds

Tables A1 & A2
10-Year
100-Year

PLACER COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
SMALL WATERSHED RESPONSE TIME WORKSHEET
EXISTING CONDITION

PROJECT **PROVIDENCE PARK SUBDIVISION**
DATE **9/14/2016**

PROJECT GENERAL INFORMATION

ELEVATION	130
SCS SOIL	D

INDIVIDUAL SUB-AREA

	OVERLAND RESPONSE TIME						COLLECTOR FLOW TIME							
DESIGN POINT	SUB-AREA	LENGTH (ft)	MANNING	SLOPE (%)	To (min)		LENGTH (ft)	MANNING	SIDE SLOPE	CHANNEL SLOPE (%)	AREA (ac)	Tc (min)		Tr (min)
Shed A														
PFE Roadside Ditch	A1	600	0.4	2	31		1635	0.04	50	1.5	23.88	6		37
Hutchens Property	A2	600	0.4	1.5	34		479	0.04	50	1.5	14.08	2		36
Aguilar Property	A3	600	0.4	1.5	34		540	0.04	50	1.5	5.95	3		36
Hadsell Property	A4	120	0.4	4	10		0	0.04	50	4	0.74	0		10
Shed B														
Antelope Road	B1	600	0.4	1.5	34		630	0.04	50	1.5	19.77	3		36
Shed C														
Dry Creek	C1	600	0.4	2	31		1070	0.04	50	2	45.88	3		34
Shed D														
Ex. DI	D1	40	0.4	2	6		775	0.02	30	0.5	0.99	5		11
Shed O														
Northwest Property Line	O1	530	0.4	2	29		0	0.04	50	2	4.08	0		29

CUMULATIVE SUB-AREA

	OVERLAND RESPONSE TIME						COLLECTOR FLOW TIME							
DESIGN POINT	SUB-AREA	LENGTH (ft)	MANNING	SLOPE (%)	To (min)		LENGTH (ft)	MANNING	SIDE SLOPE	CHANNEL SLOPE (%)	AREA (ac)	Tc (min)		Tr (min)
Shed A & O1														
PFE Roadside Ditch	A1 & O1				37		640	0.04	50	1.5	27.96	2		39
Ex. PFE Culvert	A1-4 & O1				39		700	0.02	30	1.5	48.73	1		41

PLACER COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
SMALL WATERSHED PEAK FLOW WORKSHEET
EXISTING CONDITION

PROJECT **PROVIDENCE PARK SUBDIVISION**
DATE **9/14/2016**

PROJECT GENERAL INFORMATION

ELEVATION 130
SCS SOIL D

INDIVIDUAL SUB-AREA

	UNIT PEAK DISCHARGE (fig. 5-3)					INFILTRATION FACTOR			PEAK FLOW			
DESIGN POINT	SUB-AREA	Tr (min)	ELEV (ft)	q10 (cfs/ac)	q100 (cfs/ac)	ELEV (ft)	INFLT RATE (tbl 5-3)	Fi (cfs/ac)	AREA (ac)	% PERVIOUS	Q10 (cfs)	Q100 (cfs)
Shed A												
PFE Roadside Ditch	A1	37	130	0.70	1.20	130	0.08	0.14	24	95	13.6	25.5
Hutchens Property	A2	36	130	0.70	1.25	130	0.08	0.14	14	95	8.0	15.7
Aguilar Property	A3	36	130	0.70	1.25	130	0.08	0.14	5.95	98	3.4	6.6
Hadsell Property	A4	10	130	2.10	3.80	130	0.08	0.14	0.74	100	1.5	2.7
Shed B												
Antelope Road	B1	36	130	0.70	1.25	130	0.08	0.14	19.77	98	11.2	22.0
Shed C												
Dry Creek	C1	34	130	0.70	1.30	130	0.08	0.14	45.88	100	25.8	53.3
Shed D												
Ex. DI	D1	11	130	2.05	3.75	130	0.08	0.14	0.99	100	1.9	3.6
Shed O												
Northwest Property Line	O1	29	130	0.85	1.50	130	0.08	0.14	4.08	80	3.0	5.7

CUMULATIVE SUB-AREA

	UNIT PEAK DISCHARGE (fig. 5-3)					INFILTRATION FACTOR			PEAK FLOW			
DESIGN POINT	SUB-AREA	Tr (min)	ELEV (ft)	q10 (cfs/ac)	q100 (cfs/ac)	ELEV (ft)	INFLT RATE (tbl 5-3)	Fi (cfs/ac)	AREA (ac)	% PERVIOUS	Q10 (cfs)	Q100 (cfs)
Shed A & O1												
PFE Roadside Ditch	A1 & O1	39	130	0.65	1.15	130	0.08	0.14	27.96	90	14.7	28.7
Ex. PFE Culvert	A1-4 & O1	41	130	0.55	1.05	130	0.08	0.14	48.73	91	20.7	45.0

APPENDIX C- PROPOSED HYDROLOGY

Developed Conditions
Peak Flows from Small Watersheds

Tables B1 & B2
10-Year
100-Year

TABLE B1
SMALL WATERSHED RESPONSE TIME
PROPOSED CONDITIONS

PROJECT: **PROVIDENCE PARK SUBDIVISION**
DATE: 2/14/2017

PROJECT GENERAL INFORMATION

ELEVATION	130
SCS SOIL	D
%IMPERVIOUS	80
%PERVIOUS	20

INDIVIDUAL SUB-AREA

OVERLAND RESPONSE TIME						COLLECTOR FLOW TIME						
DESIGN POINT	SUB-AREA	LENGTH (ft)	MANNING (n) Table 5-5	SLOPE (%)	To (min)	LENGTH (ft)	MANNING n	SLOPE (%)	SIDE SLOPE (h:v)	AREA (ac)	Tc (min)	Tr (min)
Shed A												
DI#1	A1	50	0.24	1	6.3	360	0.012	0.5	1	0.69	0.9	7
DI#5	A2	135	0.24	1	11.4	915	0.012	1.5	1	2.84	1.1	12
DI #6	A3	130	0.24	1	11.1	765	0.012	1.7	1	2.87	0.9	12
DI #7	A4	145	0.24	1	11.9	775	0.012	1.7	1	3.12	0.9	13
DI #9	A5	165	0.24	1	12.8	770	0.012	0.8	1	3.28	1.1	14
DI #12	A6	165	0.24	1	12.8	115	0.012	1.0	1	0.51	0.2	13
DI #33	A7	20	0.011	2	0.5	120	0.012	2.5	1	0.09	0.3	1
DI #35	A8	120	0.24	1	10.6	475	0.012	1.0	1	2.48	0.7	11
DI #39	A9	90	0.24	1	8.9	320	0.012	1.0	1	0.71	0.6	10
DI #41	A10	120	0.24	1	10.6	360	0.012	0.8	1	0.91	0.7	11
DI#40	A11	135	0.24	1	11.4	175	0.012	1.0	1	0.81	0.3	12
DI #19	A12	130	0.24	1	11.1	630	0.012	0.8	1	1.85	1.0	12
DI #17	A13	90	0.24	1	8.9	320	0.012	2.5	1	0.71	0.4	9
DI #18	A14	190	0.24	1	14.0	75	0.012	1.0	1	0.38	0.2	14
DI #13	A15	20	0.24	2	2.9	105	0.012	1.5	1	0.07	0.3	3
DI #21	A16	170	0.24	1	13.1	175	0.012	2.5	1	1.02	0.2	13
DI #22	A17	130	0.24	1	11.1	630	0.012	0.8	1	1.86	1.0	12
DI #23	A18	155	0.24	1	12.4	1050	0.012	2.0	1	3.21	1.1	13
DI #26	A19	140	0.24	1	11.6	795	0.012	2.5	1	3.07	0.8	12
DI #27	A20	130	0.24	1	11.1	1320	0.012	1.5	1	5.14	1.3	12
DI #29	A21	60	0.24	2	5.7	220	0.012	0.5	1	0.16	0.8	6
DI #30	A22	140	0.24	1	11.6	210	0.012	1.8	1	1.03	0.3	12
DI #31	A23	140	0.24	1	11.6	205	0.012	1.8	1	1.08	0.3	12

INDIVIDUAL SUB-AREA

OVERLAND RESPONSE TIME						COLLECTOR FLOW TIME						
DESIGN POINT	SUB-AREA	LENGTH (ft)	MANNING (n) Table 5-5	SLOPE (%)	To (min)	LENGTH (ft)	MANNING n	SLOPE (%)	SIDE SLOPE (h:v)	AREA (ac)	Tc (min)	Tr (min)
DI #120	A24	190	0.24	1	14.0	620	0.012	0.5	1	2.46	1.1	15
DI #119	A25	50	0.011	2	0.8	275	0.012	0.5	1	0.79	0.7	1
Shed B												
DI #43	B1	20	0.011	2	0.5	225	0.012	1.0	1	0.60	0.5	1
DI #44	B2	160	0.24	1	12.6	320	0.012	0.5	1	0.84	0.8	13
DI #45	B3	180	0.24	1	13.5	280	0.012	0.5	1	1.00	0.6	14
DI #47	B4	125	0.24	1	10.9	365	0.012	0.5	1	0.99	0.8	12
DI #48	B5	130	0.24	1	11.1	180	0.012	2.5	1	0.81	0.2	11
DI #49	B6	20	0.011	2	0.5	180	0.012	2.5	1	0.14	0.4	1
DI #51	B7	130	0.24	1	11.1	300	0.012	0.5	1	1.23	0.7	12
DI #52	B8	170	0.24	1	13.1	315	0.012	0.5	1	1.05	0.7	14
DI #53	B9	200	0.24	1	14.4	320	0.012	0.5	1	1.12	0.7	15
DI #56	B10	160	0.24	1	12.6	300	0.012	0.5	1	0.99	0.7	13
DI #55	B11	130	0.24	1	11.1	230	0.012	0.5	1	0.98	0.5	12
DI #57	B12	135	0.24	1	11.4	420	0.012	0.5	1	1.62	0.9	12
DI #63	B13	125	0.24	1	10.9	510	0.012	2.5	1	1.12	0.6	12
DI #64	B14	20	0.011	2	0.5	175	0.012	2.5	1	1.36	0.2	1
DI #65	B15	20	0.011	2	0.5	175	0.012	2.5	1	0.14	0.4	1
DI #74	B16	20	0.011	2	0.5	175	0.012	0.5	1	0.14	0.7	1
DI #73	B17	135	0.24	1	11.4	420	0.012	2.0	1	1.62	0.5	12
DI #71	B18	120	0.24	1	10.6	320	0.012	2.5	1	0.63	0.5	11
DI #72	B19	135	0.24	1	11.4	420	0.012	2.0	1	1.62	0.5	12
DI #75	B20	150	0.24	1	12.1	590	0.012	0.5	1	2.34	1.1	13
DI #76	B21	65	0.011	2	0.9	85	0.012	0.5	1	0.27	0.3	1
DI #78	B22	130	0.24	1	11.1	360	0.012	2.5	1	2.02	0.4	12
DI #77	B23	35	0.011	2	0.6	620	0.012	1.5	1	1.00	0.9	2
DI #80	B24	130	0.24	1	11.1	445	0.012	2.0	1	1.57	0.5	12
DI #79	B25	70	0.011	2	1.0	1020	0.012	1.5	1	1.04	1.5	3
DI #81	B26	130	0.24	1	11.1	210	0.012	0.5	1	0.68	0.5	12
DI #82	B27	75	0.011	2	1.0	110	0.012	0.7	1	0.28	0.3	1
DI #86	B28	20	0.011	2	0.5	170	0.012	2.0	1	0.13	0.4	1
DI #83	B29	160	0.24	1	12.6	200	0.012	0.5	1	0.49	0.6	13
DI #87	B30	140	0.24	1	11.6	245	0.012	1.5	1	0.55	0.4	12
DI #88	B31	130	0.24	1	11.1	310	0.012	3.0	1	1.25	0.3	11
DI #90	B32	135	0.24	1	11.4	150	0.012	1.0	1	0.75	0.3	12
DI #89	B33	130	0.24	1	11.1	305	0.012	3.0	1	0.83	0.4	12
DI #91	B34	20	0.011	2	0.5	135	0.012	1.0	1	0.12	0.4	1

INDIVIDUAL SUB-AREA

OVERLAND RESPONSE TIME						COLLECTOR FLOW TIME						
DESIGN POINT	SUB-AREA	LENGTH (ft)	MANNING (n) Table 5-5	SLOPE (%)	To (min)	LENGTH (ft)	MANNING n	SLOPE (%)	SIDE SLOPE (h:v)	AREA (ac)	Tc (min)	Tr (min)
DI #92	B35	30	0.011	2	0.6	315	0.012	0.5	1	0.27	1.0	2
DI #94	B36	20	0.011	2	0.5	95	0.012	1.5	1	0.16	0.2	1
DI #93	B37	20	0.012	2	0.5	445	0.012	0.5	1	1.53	0.9	1
Shed C												
DI #103	C1	35	0.011	2	0.6	470	0.012	3.2	1	0.78	0.6	1
DI #104	C2	70	0.011	2	1.0	450	0.012	3.2	1	1.02	0.5	1
DI #106	C3	70	0.011	2	1.0	90	0.012	3.9	1	0.21	0.1	1
DI #108	C4	135	0.24	1	11.4	250	0.012	1.0	1	1.04	0.4	12
DI #105	C5	70	0.011	2	1.0	90	0.012	3.9	1	0.21	0.1	1
DI #112	C6	20	0.011	2	0.5	190	0.012	1.0	1	0.13	0.6	1
DI #98	C7	20	0.011	2	0.5	165	0.012	0.5	1	0.13	0.6	1
DI #99	C8	130	0.24	1	11.1	290	0.012	3.9	1	0.83	0.3	11
DI #116	C9	130	0.24	1	11.1	600	0.012	3.9	1	1.94	0.5	12
DI #115	C10	130	0.24	1	11.1	545	0.012	2.7	1	1.51	0.7	12
DI #114	C11	130	0.24	1	11.1	560	0.012	2.7	1	1.75	0.6	12
DI #117	C12	130	0.24	1	11.1	525	0.012	3.8	1	2.75	0.4	12
DI #118	C13	130	0.24	1	11.1	590	0.012	3.8	1	0.73	0.7	12
Shed D												
PFE Culvert	D1	650	0.24	1	29.2	1900	0.03	0.5	3	22.93	4.5	34
Barrett Property	D2	125	0.24	5.5	6.5	0	0.03	0.5	3	0.71	0.0	7
Offsite												
AD #1	O1	550	0.4	2.5	27.3	255	0.02	1.0	1	4.07	0.5	28
SW Antelope Rd.	O2	45	0.011	2	0.8	635	0.012	1.5	1	1.09	1.0	2
SE Antelope Rd.	O3	45	0.011	2	0.8	635	0.012	1.5	1	0.70	1.1	2

CUMULATIVE SUB-AREA

	OVERLAND RESPONSE TIME					COLLECTOR FLOW TIME						
DESIGN POINT	SUB-AREAS	LENGTH (ft)	MANNING n	SLOPE (%)	To (min)	LENGTH (ft)	MANNING	SLOPE (%)	SIDE SLOPE (h:v)	AREA (ac)	Tc (min)	Tr (min)
Sheds A & O1												
DI #6	A2-3				12	30	0.012	0.5	50	5.71	0.1	13
SDMH #4	A2-4				13	20	0.012	2.0	50	8.83	0.0	13
SDMH #5	A5-6				14	50	0.012	2.0	50	3.79	0.1	14
SDMH #6	A1& A5-6				14	40	0.012	1.0	50	4.48	0.1	14
SDMH #8	A1 & A5-6 & A15				14	395	0.012	1.0	50	4.55	1.1	15
SDMH #20	A7-8				11	95	0.012	1.0	50	2.57	0.3	12
DI #40	A10-11				12	0	0.012	1.0	50	1.72	0.0	12
SDMH #21	A7-11				12	17	0.012	1.0	50	5.00	0.0	12
DI #18	A13-14				14	0	0.012	0.5	50	1.09	0.0	14
SDMH #10	A7-14				14	21	0.012	1.0	50	7.94	0.0	14
SDMH #9	A1 & A5-15				14	43	0.012	1.0	50	12.49	0.1	14
DI #22	A16-17				13	30	0.012	0.5	50	2.88	0.1	13
SDMH #12	A16-18				13	22	0.012	2.0	50	6.09	0.0	13
SDMH #11	A1 & A5-18				14	285	0.012	1.0	50	18.58	0.5	15
SDMH #13	A2-4 & A19-20				13	325	0.012	1.0	50	17.04	0.6	13
SDMH #14	A1-20				15	195	0.012	1.0	50	35.62	0.3	15
SDMH #61	A1-20 & O1				28	28	0.012	1.0	50	39.69	0.0	28
DI #30	A21-22				12	0	0.012	0.5	50	1.19	0.0	12
SDMH #15	A21-23				12	17	0.012	2.0	50	2.27	0.0	12
SDMH #16	A1-23 & O1				28	330	0.012	2.0	50	41.96	0.4	28
SDMH #57	A1-25 & O1				28	170	0.012	1.0	50	45.21	0.3	28
Shed B												
DI #44	B1-2				13	0	0.012	0.5	50	1.44	0.0	13
SDMH #23	B1-3				14	21	0.012	2.0	50	2.44	0.1	14
DI #48	B4-5				12	30	0.012	2.0	50	1.80	0.1	12
SDMH #25	B4-6				12	18	0.012	2.0	50	1.94	0.0	12
SDMH #26	B1-6				14	260	0.012	1.0	50	4.38	0.7	15
DI #52	B7-8				14	0	0.012	0.5	50	2.28	0.0	14
SDMH #27	B7-9				15	21	0.012	2.0	50	3.40	0.0	15
SDMH #28	B1-9				15	195	0.012	2.0	50	7.78	0.4	15
DI #55	B10-11				13	30	0.012	0.5	50	1.97	0.1	13
SDMH #29	B1-12				15	300	0.012	1.0	50	11.37	0.7	16
DI #64	B13-14				12	30	0.012	0.5	50	2.48	0.1	12
SDMH #34	B13-15				12	20	0.012	2.0	50	2.62	0.0	12
DI #73	B16-17				12	30	0.012	0.5	50	1.76	0.1	12
DI #72	B18-19				12	0	0.012	0.5	50	2.25	0.0	12

CUMULATIVE SUB-AREA

		OVERLAND RESPONSE TIME				COLLECTOR FLOW TIME						
DESIGN POINT	**SUB-AREAS**	**LENGTH (ft)**	**MANNING n**	**SLOPE (%)**	**To (min)**	**LENGTH (ft)**	**MANNING**	**SLOPE (%)**	**SIDE SLOPE (h:v)**	**AREA (ac)**	**Tc (min)**	**Tr (min)**
SDMH #37	B13-19				12	450	0.012	2.0	50	6.63	0.9	13
SDMH #38	B1-19				16	290	0.012	1.0	50	18.00	0.6	17
DI #76	B20-21				13	30	0.012	0.5	50	2.61	0.1	13
DI #77	B22-23				12	30	0.012	0.5	50	3.02	0.1	12
SDMH #39	B1-23				17	85	0.012	1.0	50	23.63	0.2	17
DI #79	B24-25				12	30	0.012	0.5	50	2.61	0.1	12
DI #82	B26-27				12	30	0.012	0.5	50	0.96	0.2	12
SDMH #41	B1-27				17	360	0.012	1.0	50	27.20	0.6	17
SDMH #42	B1-29				17	85	0.012	1.0	50	27.82	0.1	17
DI #88	B30-31				12	30	0.012	0.5	50	1.80	0.1	12
DI #89	B32-33				12	30	0.012	0.5	50	1.58	0.1	12
SDMH #43	B1-33				17	335	0.012	1.5	50	31.20	0.5	18
DI #92	B34-35				2	50	0.012	0.5	50	0.39	0.3	2
DI #93	B36-37				1	30	0.012	0.5	50	1.69	0.1	1
SDMH #44	B1-37				18	85	0.012	1.0	50	33.28	0.1	18
Shed C												
SDMH #49	C1-2				1	40	0.012	2.0	50	1.80	0.1	2
DI #105	C4-5				12	30	0.012	0.5	50	1.25	0.1	12
SDMH #51	C1-5				12	20	0.012	1.0	50	3.26	0.1	12
SDMH #52	C1-6				12	50	0.012	1.0	50	3.39	0.1	12
SDMH #47	C7-8				11	85	0.012	3.0	50	0.96	0.2	12
DI #115	C9-10				12	30	0.012	0.5	50	3.45	0.1	12
SDMH #53	C1-6 & C9-11				12	560	0.012	1.0	50	8.59	1.3	13
SDMH #57	C1-11				13	40	0.012	1.0	50	9.55	0.1	14
SDMH #56	C12-13				12	20	0.012	2.0	50	3.48	0.0	12
SDMH #55	C1-13				13	470	0.012	1.0	50	13.03	1.0	14
Sheds B, C & D												
PFE Culvert	B1-37, C1-13 & D1				34	0	0.012	0.5	50	69.24	0.0	34

TABLE B2
SMALL WATERSHED PEAK FLOW
PROPOSED CONDITIONS

PROJECT **PROVIDENCE PARK SUBDIVISION**
DATE 2/14/2017

PROJECT GENERAL INFORMATION

ELEVATION	130
SCS SOIL	D
%IMPERVIOUS	80
%PERVIOUS	20

INDIVIDUAL SUB-AREA

	UNIT PEAK DISCHARGE (fig. 5-3)					INFILTRATION FACTOR			PEAK FLOW		
DESIGN POINT	**SUB-AREA**	**Tr (min)**	**ELEV (ft)**	**q10 (cfs/ac)**	**q100 (cfs/ac)**	**ELEV (ft)**	**INFLT RATE (tbl 5-3)**	**Fi (cfs/ac)**	**AREA (ac)**	**Q10 (cfs)**	**Q100 (cfs)**
Shed A											
DI#1	A1	7	130	2.35	4.50	130	0.12	0.21	0.69	1.6	3.1
DI#5	A2	12	130	1.95	3.50	130	0.12	0.21	2.84	5.4	9.8
DI #6	A3	12	130	1.95	3.50	130	0.12	0.21	2.87	5.5	9.9
DI #7	A4	13	130	1.85	3.35	130	0.12	0.21	3.12	5.6	10.3
DI #9	A5	14	130	1.75	3.20	130	0.12	0.21	3.28	5.6	10.4
DI #12	A6	13	130	1.85	3.35	130	0.12	0.21	0.51	0.9	1.7
DI #33	A7	1	130	2.55	5.00	130	0.12	0.21	0.09	0.2	0.4
DI #35	A8	11	130	2.00	3.65	130	0.12	0.21	2.48	4.9	8.9
DI #39	A9	10	130	2.10	3.80	130	0.12	0.21	0.71	1.5	2.7
DI #41	A10	11	130	2.00	3.65	130	0.12	0.21	0.91	1.8	3.3
DI#40	A11	12	130	1.95	3.50	130	0.12	0.21	0.81	1.5	2.8
DI #19	A12	12	130	1.95	3.50	130	0.12	0.21	1.85	3.5	6.4
DI #17	A13	9	130	2.20	4.00	130	0.12	0.21	0.71	1.5	2.8
DI #18	A14	14	130	1.75	3.20	130	0.12	0.21	0.38	0.6	1.2
DI #13	A15	3	130	2.55	5.00	130	0.12	0.21	0.07	0.2	0.3
DI #21	A16	13	130	1.85	3.35	130	0.12	0.21	1.02	1.8	3.4
DI #22	A17	12	130	1.95	3.50	130	0.12	0.21	1.86	3.5	6.4
DI #23	A18	13	130	1.85	3.35	130	0.12	0.21	3.21	5.8	10.6
DI #26	A19	12	130	1.95	3.50	130	0.12	0.21	3.07	5.9	10.6
DI #27	A20	12	130	1.95	3.50	130	0.12	0.21	5.14	9.8	17.8
DI #29	A21	6	130	2.45	4.75	130	0.12	0.21	0.16	0.4	0.8
DI #30	A22	12	130	1.95	3.50	130	0.12	0.21	1.03	2.0	3.6

INDIVIDUAL SUB-AREA

	UNIT PEAK DISCHARGE (fig. 5-3)						INFILTRATION FACTOR				PEAK FLOW		
DESIGN POINT	**SUB-AREA**	**Tr (min)**	**ELEV (ft)**	**q10 (cfs/ac)**	**q100 (cfs/ac)**		**ELEV (ft)**	**INFLT RATE (tbl 5-3)**	**Fi (cfs/ac)**		**AREA (ac)**	**Q10 (cfs)**	**Q100 (cfs)**
DI #31	A23	12	130	1.95	3.50		130	0.12	0.21		1.08	2.1	3.7
DI #120	A24	15	130	1.70	3.10		130	0.12	0.21		2.46	4.1	7.5
DI #119	A25	1	130	2.55	5.00		130	0.12	0.21		0.79	2.0	3.9
Shed B													
DI #43	B1	1	130	2.55	5.00		130	0.12	0.21		0.60	1.5	3.0
DI #44	B2	13	130	1.85	3.35		130	0.12	0.21		0.84	1.5	2.8
DI #45	B3	14	130	1.75	3.20		130	0.12	0.21		1.00	1.7	3.2
DI #47	B4	12	130	1.95	3.50		130	0.12	0.21		0.99	1.9	3.4
DI #48	B5	11	130	2.00	3.65		130	0.12	0.21		0.81	1.6	2.9
DI #49	B6	1	130	2.55	5.00		130	0.12	0.21		0.14	0.4	0.7
DI #51	B7	12	130	1.95	3.50		130	0.12	0.21		1.23	2.3	4.3
DI #52	B8	14	130	1.75	3.20		130	0.12	0.21		1.05	1.8	3.3
DI #53	B9	15	130	1.70	3.10		130	0.12	0.21		1.12	1.9	3.4
DI #56	B10	13	130	1.85	3.35		130	0.12	0.21		0.99	1.8	3.3
DI #55	B11	12	130	1.95	3.50		130	0.12	0.21		0.98	1.9	3.4
DI #57	B12	12	130	1.95	3.50		130	0.12	0.21		1.62	3.1	5.6
DI #63	B13	12	130	1.95	3.50		130	0.12	0.21		1.12	2.1	3.9
DI #64	B14	1	130	2.55	5.00		130	0.12	0.21		1.36	3.4	6.7
DI #65	B15	1	130	2.55	5.00		130	0.12	0.21		0.14	0.4	0.7
DI #74	B16	1	130	2.55	5.00		130	0.12	0.21		0.14	0.4	0.7
DI #73	B17	12	130	1.95	3.50		130	0.12	0.21		1.62	3.1	5.6
DI #71	B18	11	130	2.00	3.65		130	0.12	0.21		0.63	1.2	2.3
DI #72	B19	12	130	1.95	3.50		130	0.12	0.21		1.62	3.1	5.6
DI #75	B20	13	130	1.85	3.35		130	0.12	0.21		2.34	4.2	7.7
DI #76	B21	1	130	2.55	5.00		130	0.12	0.21		0.27	0.7	1.3
DI #78	B22	12	130	1.95	3.50		130	0.12	0.21		2.02	3.9	7.0
DI #77	B23	2	130	2.55	5.00		130	0.12	0.21		1.00	2.5	5.0
DI #80	B24	12	130	1.95	3.50		130	0.12	0.21		1.57	3.0	5.4
DI #79	B25	3	130	2.55	5.00		130	0.12	0.21		1.04	2.6	5.2
DI #81	B26	12	130	1.95	3.50		130	0.12	0.21		0.68	1.3	2.4
DI #82	B27	1	130	2.55	5.00		130	0.12	0.21		0.28	0.7	1.4
DI #86	B28	1	130	2.55	5.00		130	0.12	0.21		0.13	0.3	0.6
DI #83	B29	13	130	1.85	3.35		130	0.12	0.21		0.49	0.9	1.6
DI #87	B30	12	130	1.95	3.50		130	0.12	0.21		0.55	1.0	1.9
DI #88	B31	11	130	2.00	3.65		130	0.12	0.21		1.25	2.4	4.5

INDIVIDUAL SUB-AREA

	UNIT PEAK DISCHARGE (fig. 5-3)						INFILTRATION FACTOR				PEAK FLOW		
DESIGN POINT	**SUB-AREA**	**Tr (min)**	**ELEV (ft)**	**q10 (cfs/ac)**	**q100 (cfs/ac)**		**ELEV (ft)**	**INFLT RATE (tbl 5-3)**	**Fi (cfs/ac)**		**AREA (ac)**	**Q10 (cfs)**	**Q100 (cfs)**
DI #90	B32	12	130	1.95	3.50		130	0.12	0.21		0.75	1.4	2.6
DI #89	B33	12	130	1.95	3.50		130	0.12	0.21		0.83	1.6	2.9
DI #91	B34	1	130	2.55	5.00		130	0.12	0.21		0.12	0.3	0.6
DI #92	B35	2	130	2.55	5.00		130	0.12	0.21		0.27	0.7	1.3
DI #94	B36	1	130	2.55	5.00		130	0.12	0.21		0.16	0.4	0.8
DI #93	B37	1	130	2.55	5.00		130	0.12	0.21		1.53	3.8	7.6
Shed C													
DI #103	C1	1	130	2.55	5.00		130	0.12	0.21		0.78	2.0	3.9
DI #104	C2	1	130	2.55	5.00		130	0.12	0.21		1.02	2.6	5.1
DI #106	C3	1	130	2.55	5.00		130	0.12	0.21		0.21	0.5	1.0
DI #108	C4	12	130	1.95	3.50		130	0.12	0.21		1.04	2.0	3.6
DI #105	C5	1	130	2.55	5.00		130	0.12	0.21		0.21	0.5	1.0
DI #112	C6	1	130	2.55	5.00		130	0.12	0.21		0.13	0.3	0.6
DI #98	C7	1	130	2.55	5.00		130	0.12	0.21		0.13	0.3	0.6
DI #99	C8	11	130	2.00	3.65		130	0.12	0.21		0.83	1.6	3.0
DI #116	C9	12	130	1.95	3.50		130	0.12	0.21		1.94	3.7	6.7
DI #115	C10	12	130	1.95	3.50		130	0.12	0.21		1.51	2.9	5.2
DI #114	C11	12	130	1.95	3.50		130	0.12	0.21		1.75	3.3	6.1
DI #117	C12	12	130	1.95	3.50		130	0.12	0.21		2.75	5.2	9.5
DI #118	C13	12	130	1.95	3.50		130	0.12	0.21		0.73	1.4	2.5
Shed D													
PFE Culvert	D1	34	130	0.70	1.30		130	0.12	0.21		22.93	15.1	28.9
Barrett Property	D2	7	130	2.35	4.50		130	0.12	0.21		0.71	1.6	3.2
Offsite													
AD #1	O1	28	130	0.90	1.60		130	0.12	0.21		4.07	3.5	6.3
SW Antelope Rd.	O2	2	130	2.55	5.00		130	0.12	0.21		1.09	2.7	5.4
SE Antelope Rd.	O3	2	130	2.55	5.00		130	0.12	0.21		0.70	1.8	3.5

CUMULATIVE SUB-AREA

	UNIT PEAK DISCHARGE (fig. 5-3)						INFILTRATION FACTOR				PEAK FLOW		
DESIGN POINT	SUB-AREA	Tr (min)	ELEV (ft)	q10 (cfs/ac)	q100 (cfs/ac)		ELEV (ft)	INFLT RATE (tbl 5-3)	Fi (cfs/ac)		AREA (ac)	Q10 (cfs)	Q100 (cfs)
Sheds A & O1													
DI #6	A2-3	13	130	1.85	3.35		130	0.12	0.21		5.71	10.3	18.9
SDMH #4	A2-4	13	130	1.85	3.35		130	0.12	0.21		8.83	16.0	29.2
SDMH #5	A5-6	14	130	1.75	3.20		130	0.12	0.21		3.79	6.5	12.0
SDMH #6	A1& A5-6	14	130	1.75	3.20		130	0.12	0.21		4.48	7.7	14.1
SDMH #8	A1 & A5-6 & A15	15	130	1.70	3.10		130	0.12	0.21		4.55	7.5	13.9
SDMH #20	A7-8	12	130	1.95	3.50		130	0.12	0.21		2.57	4.9	8.9
DI #40	A10-11	12	130	1.95	3.50		130	0.12	0.21		1.72	3.3	5.9
SDMH #21	A7-11	12	130	1.95	3.50		130	0.12	0.21		5.00	9.5	17.3
DI #18	A13-14	14	130	1.75	3.20		130	0.12	0.21		1.09	1.9	3.4
SDMH #10	A7-14	14	130	1.75	3.20		130	0.12	0.21		7.94	13.6	25.1
SDMH #9	A1 & A5-15	14	130	1.75	3.20		130	0.12	0.21		12.49	21.3	39.4
DI #22	A16-17	13	130	1.85	3.35		130	0.12	0.21		2.88	5.2	9.5
SDMH #12	A16-18	13	130	1.85	3.35		130	0.12	0.21		6.09	11.0	20.1
SDMH #11	A1 & A5-18	15	130	1.70	3.10		130	0.12	0.21		18.58	30.8	56.8
SDMH #13	A2-4 & A19-20	13	130	1.85	3.35		130	0.12	0.21		17.04	30.8	56.4
SDMH #14	A1-20	15	130	1.70	3.10		130	0.12	0.21		35.62	59.1	108.9
SDMH #61	A1-20 & O1	28	130	0.85	1.50		130	0.12	0.21		39.69	32.1	57.9
DI #30	A21-22	12	130	1.95	3.50		130	0.12	0.21		1.19	2.3	4.1
SDMH #15	A21-23	12	130	1.95	3.50		130	0.12	0.21		2.27	4.3	7.9
SDMH #16	A1-23 & O1	28	130	0.85	1.50		130	0.12	0.21		41.96	33.9	61.2
SDMH #57	A1-25 & O1	28	130	0.85	1.50		130	0.12	0.21		45.21	36.5	65.9
Shed B													
DI #44	B1-2	13	130	1.85	3.35		130	0.12	0.21		1.44	2.6	4.8
SDMH #23	B1-3	14	130	1.75	3.20		130	0.12	0.21		2.44	4.2	7.7
DI #48	B4-5	12	130	1.95	3.50		130	0.12	0.21		1.80	3.4	6.2
SDMH #25	B4-6	12	130	1.95	3.50		130	0.12	0.21		1.94	3.7	6.7
SDMH #26	B1-6	15	130	1.70	3.10		130	0.12	0.21		4.38	7.3	13.4
DI #52	B7-8	14	130	1.75	3.20		130	0.12	0.21		2.28	3.9	7.2
SDMH #27	B7-9	15	130	1.70	3.10		130	0.12	0.21		3.40	5.6	10.4
SDMH #28	B1-9	15	130	1.70	3.10		130	0.12	0.21		7.78	12.9	23.8
DI #55	B10-11	13	130	1.85	3.35		130	0.12	0.21		1.97	3.6	6.5
SDMH #29	B1-12	16	130	1.60	2.90		130	0.12	0.21		11.37	17.7	32.5
DI #64	B13-14	12	130	1.95	3.50		130	0.12	0.21		2.48	4.7	8.6
SDMH #34	B13-15	12	130	1.95	3.50		130	0.12	0.21		2.62	5.0	9.1

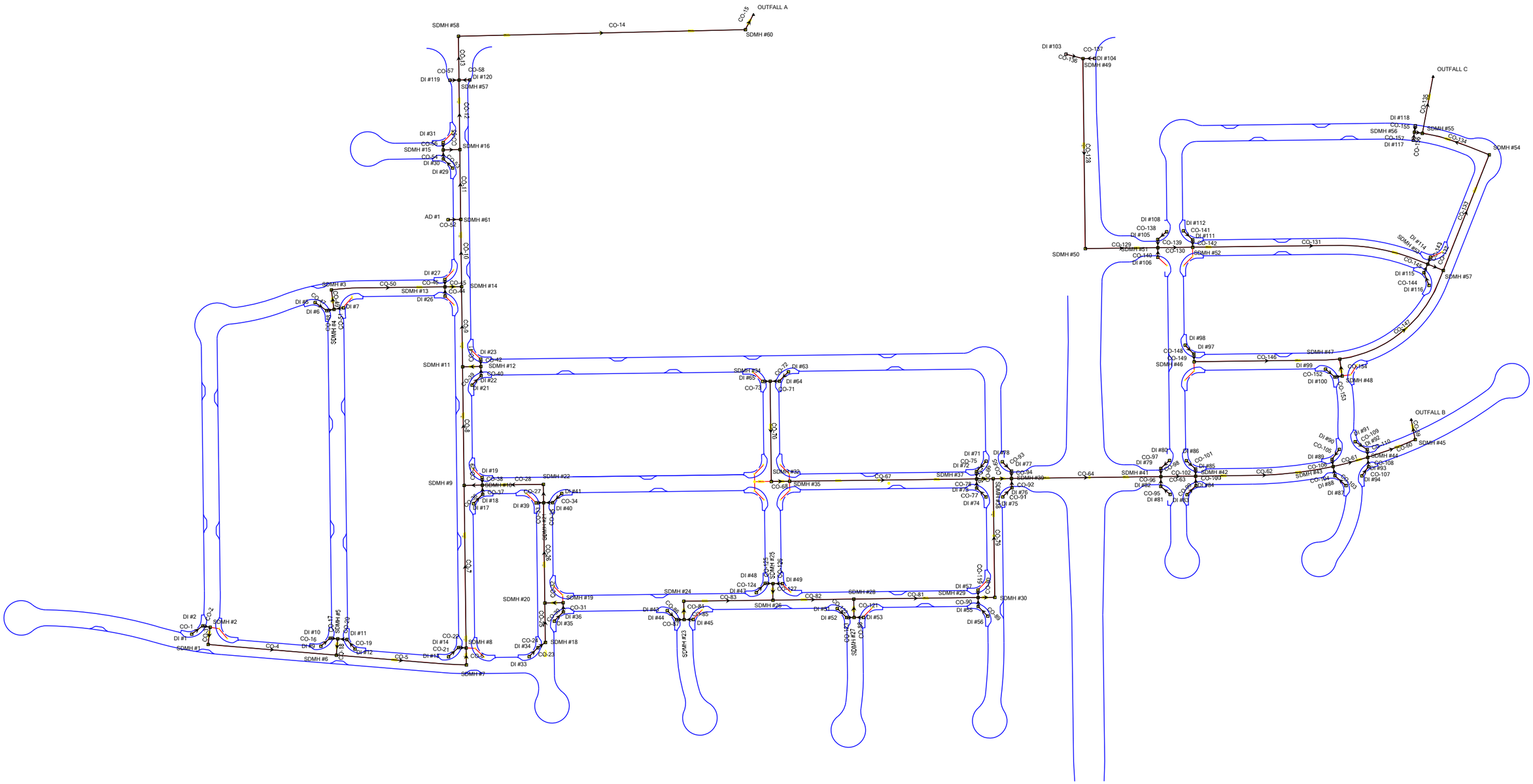
CUMULATIVE SUB-AREA

		UNIT PEAK DISCHARGE (fig. 5-3)					INFILTRATION FACTOR				PEAK FLOW		
DESIGN POINT	SUB-AREA	Tr (min)	ELEV (ft)	q10 (cfs/ac)	q100 (cfs/ac)		ELEV (ft)	INFLT RATE (tbl 5-3)	Fi (cfs/ac)		AREA (ac)	Q10 (cfs)	Q100 (cfs)
DI #73	B16-17	12	130	1.95	3.50		130	0.12	0.21		1.76	3.4	6.1
DI #72	B18-19	12	130	1.95	3.50		130	0.12	0.21		2.25	4.3	7.8
SDMH #37	B13-19	13	130	1.85	3.35		130	0.12	0.21		6.63	12.0	21.9
SDMH #38	B1-19	17	130	1.50	2.75		130	0.12	0.21		18.00	26.3	48.8
DI #76	B20-21	13	130	1.85	3.35		130	0.12	0.21		2.61	4.7	8.6
DI #77	B22-23	12	130	1.95	3.50		130	0.12	0.21		3.02	5.8	10.4
SDMH #39	B1-23	17	130	1.50	2.75		130	0.12	0.21		23.63	34.5	64.0
DI #79	B24-25	12	130	1.95	3.50		130	0.12	0.21		2.61	5.0	9.0
DI #82	B26-27	12	130	1.95	3.50		130	0.12	0.21		0.96	1.8	3.3
SDMH #41	B1-27	17	130	1.50	2.75		130	0.12	0.21		27.20	39.7	73.7
SDMH #42	B1-29	17	130	1.50	2.75		130	0.12	0.21		27.82	40.6	75.3
DI #88	B30-31	12	130	1.95	3.50		130	0.12	0.21		1.80	3.4	6.2
DI #89	B32-33	12	130	1.95	3.50		130	0.12	0.21		1.58	3.0	5.5
SDMH #43	B1-33	18	130	1.40	2.60		130	0.12	0.21		31.20	42.4	79.8
DI #92	B34-35	2	130	2.55	5.00		130	0.12	0.21		0.39	1.0	1.9
DI #93	B36-37	1	130	2.55	5.00		130	0.12	0.21		1.69	4.2	8.4
SDMH #44	B1-37	18	130	1.40	2.60		130	0.12	0.21		33.28	45.2	85.1
Shed C													
SDMH #49	C1-2	2	130	2.55	5.00		130	0.12	0.21		1.80	4.5	8.9
DI #105	C4-5	12	130	1.95	3.50		130	0.12	0.21		1.25	2.4	4.3
SDMH #51	C1-5	12	130	1.95	3.50		130	0.12	0.21		3.26	6.2	11.3
SDMH #52	C1-6	12	130	1.95	3.50		130	0.12	0.21		3.39	6.5	11.7
SDMH #47	C7-8	12	130	1.95	3.50		130	0.12	0.21		0.96	1.8	3.3
DI #115	C9-10	12	130	1.95	3.50		130	0.12	0.21		3.45	6.6	11.9
SDMH #53	C1-6 & C9-11	13	130	1.85	3.35		130	0.12	0.21		8.59	15.5	28.4
SDMH #57	C1-11	14	130	1.75	3.20		130	0.12	0.21		9.55	16.3	30.2
SDMH #56	C12-13	12	130	1.95	3.50		130	0.12	0.21		3.48	6.6	12.0
SDMH #55	C1-13	14	130	1.75	3.20		130	0.12	0.21		13.03	22.3	41.2
Sheds B, C & D													
PFE Culvert	B1-37, C1-13 & D1	34	130	0.70	1.30		130	0.12	0.21		69.24	45.6	87.1

APPENDIX D- PIPE HYDRAULICS

10-Year Pipe Hydraulics

Scenario: Base



FlexTable: Catch Basin Table (2017-0214 Providence Park.stc)

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Flow (Known) (ft³/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Structure Type
DI #1	153.00	143.50	1.60	144.07	144.07	Box Structure
DI #2	152.00	143.33	1.60	143.87	143.87	Box Structure
SDMH #2	152.00	142.97	1.60	143.51	143.51	Circular Structure
SDMH #1	153.00	142.55	1.60	143.09	143.09	Circular Structure
SDMH #6	150.00	139.45	7.70	140.53	140.53	Circular Structure
SDMH #7	150.00	136.31	7.70	137.39	137.39	Circular Structure
SDMH #8	148.50	135.90	7.50	136.87	136.87	Circular Structure
SDMH #9	138.00	131.98	21.30	133.63	133.63	Circular Structure
SDMH #11	133.00	129.12	30.80	130.92	130.92	Circular Structure
SDMH #14	131.00	127.19	59.10	129.68	129.68	Circular Structure
SDMH #61	129.50	125.57	32.10	127.41	127.41	Circular Structure
SDMH #16	129.00	123.89	33.90	125.78	125.78	Circular Structure
SDMH #57	128.50	122.21	36.50	124.18	124.18	Circular Structure
SDMH #58	136.00	121.15	36.50	123.12	123.12	Circular Structure
SDMH #60	128.00	107.31	36.50	109.28	109.28	Circular Structure
DI #9	150.00	140.36	5.60	143.02	143.02	Box Structure
DI #10	148.00	140.21	5.60	142.30	142.30	Box Structure
SDMH #5	149.00	139.85	6.50	141.86	141.86	Circular Structure
DI #12	150.00	140.44	0.90	141.89	141.89	Box Structure
DI #11	150.00	140.29	0.90	141.87	141.87	Box Structure
DI #13	146.00	136.41	0.20	136.87	136.87	Box Structure
DI #14	146.00	136.26	0.20	136.87	136.87	Box Structure
DI #33	146.00	138.29	0.20	140.51	140.51	Box Structure
DI #34	145.00	138.14	0.20	140.51	140.51	Box Structure
SDMH #18	145.00	137.70	0.20	140.51	140.51	Circular Structure
SDMH #20	143.00	136.75	4.90	140.51	140.51	Circular Structure
SDMH #21	142.00	134.33	9.50	135.93	135.93	Circular Structure
SDMH #22	140.00	133.89	9.50	135.57	135.57	Circular Structure
SDMH #10	138.00	132.42	13.60	134.37	134.37	Circular Structure
DI #35	143.00	137.79	4.90	142.35	142.35	Box Structure
DI #36	143.00	137.63	4.90	141.76	141.76	Box Structure
SDMH #19	142.00	137.19	4.90	141.34	141.34	Circular Structure
DI #39	141.00	134.69	1.50	135.96	135.96	Circular Structure
DI #41	141.50	134.92	1.80	136.20	136.20	Box Structure
DI #40	142.00	134.77	3.30	136.12	136.12	Box Structure
DI #17	138.00	133.46	1.50	134.49	134.49	Box Structure
DI #18	138.00	132.86	1.90	134.43	134.43	Box Structure
DI #19	138.00	132.78	3.50	134.54	134.54	Box Structure
DI #21	132.00	130.15	1.80	132.00	132.00	Box Structure
DI #22	132.00	130.00	5.20	132.00	132.00	Box Structure
SDMH #12	140.00	129.56	11.00	135.11	135.11	Circular Structure
DI #23	132.00	129.92	5.80	132.00	132.00	Box Structure
DI #26	131.00	128.03	5.90	131.00	131.00	Box Structure
SDMH #13	131.50	127.59	30.80	130.42	130.42	Circular Structure
DI #27	131.00	127.95	9.80	131.00	131.00	Box Structure
DI #5	137.00	131.31	5.40	135.09	135.09	Box Structure
DI #6	137.00	131.16	10.30	134.40	134.40	Box Structure
SDMH #4	136.50	130.80	16.00	132.89	132.89	Circular Structure
SDMH #3	136.00	130.33	16.00	131.77	131.77	Circular Structure
DI #7	137.00	131.26	5.60	133.46	133.46	Box Structure
AD #1	129.50	126.19	3.50	127.71	127.71	Circular Structure
DI #29	129.00	125.28	0.40	126.46	126.46	Box Structure
DI #30	130.00	125.13	2.30	126.46	126.46	Box Structure
SDMH #15	130.00	124.69	4.30	126.36	126.36	Circular Structure
DI #31	130.00	125.05	2.10	126.43	126.43	Box Structure

FlexTable: Catch Basin Table (2017-0214 Providence Park.stc)

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Flow (Known) (ft³/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Structure Type
DI #119	129.00	122.65	2.00	124.24	124.24	Box Structure
DI #120	129.00	122.73	4.10	124.52	124.52	Box Structure
SDMH #45	118.50	114.50	45.20	116.69	116.69	Circular Structure
SDMH #44	118.50	115.11	45.20	117.46	117.46	Circular Structure
SDMH #43	120.00	116.29	42.40	118.41	118.41	Circular Structure
SDMH #42	127.00	121.29	40.60	123.37	123.37	Circular Structure
SDMH #41	129.00	122.13	39.70	124.18	124.18	Circular Structure
SDMH #39	134.00	125.73	34.50	127.73	127.73	Circular Structure
SDMH #38	134.00	126.17	26.30	127.92	127.92	Circular Structure
SDMH #37	134.50	126.57	12.00	128.44	128.44	Circular Structure
SDMH #35	144.00	135.59	5.00	136.45	136.45	Circular Structure
SDMH #32	144.00	136.47	5.00	137.33	137.33	Circular Structure
SDMH #34	139.75	137.68	5.00	138.58	138.58	Circular Structure
DI #64	139.00	138.12	4.70	139.00	139.00	Circular Structure
DI #63	139.00	138.28	2.10	139.00	139.00	Circular Structure
DI #65	139.00	138.04	0.40	138.58	138.58	Box Structure
DI #71	134.00	127.09	1.20	128.74	128.74	Box Structure
DI #72	134.00	126.93	4.30	128.70	128.70	Box Structure
DI #74	134.00	127.17	0.40	128.64	128.64	Box Structure
DI #73	134.00	127.01	3.40	128.64	128.64	Circular Structure
SDMH #30	135.00	129.03	17.70	130.55	130.55	Circular Structure
SDMH #29	135.00	129.43	17.70	130.95	130.95	Circular Structure
SDMH #28	138.50	132.43	12.90	133.72	133.72	Circular Structure
SDMH #26	138.00	134.38	7.30	135.43	135.43	Circular Structure
SDMH #24	139.00	136.53	4.20	137.32	137.32	Circular Structure
SDMH #23	139.00	136.97	4.20	138.06	138.06	Circular Structure
DI #45	139.00	137.41	1.70	137.96	137.96	Box Structure
DI #43	139.00	137.49	1.50	138.08	138.08	Box Structure
DI #44	139.00	137.33	2.60	138.02	138.02	Box Structure
DI #51	136.00	133.83	2.30	135.15	135.15	Box Structure
DI #52	136.00	133.67	3.90	135.03	135.03	Box Structure
SDMH #27	136.00	133.31	5.60	134.81	134.81	Circular Structure
DI #53	136.00	133.77	1.90	134.87	134.87	Box Structure
DI #56	135.00	130.04	1.80	131.26	131.26	Box Structure
DI #55	135.00	129.87	3.60	131.17	131.17	Box Structure
DI #75	134.00	126.33	4.20	128.54	128.54	Box Structure
DI #76	134.00	126.17	4.70	128.11	128.11	Box Structure
DI #78	134.00	126.24	3.90	128.57	128.57	Box Structure
DI #77	134.00	126.09	5.80	128.20	128.20	Box Structure
DI #81	128.00	122.76	1.30	124.28	124.28	Box Structure
DI #82	128.00	122.61	1.80	124.24	124.24	Box Structure
DI #80	129.00	122.67	3.00	124.77	124.77	Box Structure
DI #79	128.00	122.53	5.00	124.58	124.58	Box Structure
DI #83	127.00	121.90	0.90	123.40	123.40	Box Structure
DI #84	127.00	121.75	0.90	123.38	123.38	Box Structure
DI #86	128.00	121.78	0.30	123.37	123.37	Box Structure
DI #85	127.00	121.63	0.30	123.37	123.37	Box Structure
DI #87	117.50	116.93	1.00	117.50	117.50	Box Structure
DI #88	118.00	116.75	3.40	118.00	118.00	Box Structure
DI #90	117.50	116.80	1.40	117.50	117.50	Box Structure
DI #89	118.00	116.65	3.00	118.00	118.00	Box Structure
DI #94	117.50	115.71	0.40	117.50	117.50	Box Structure
DI #93	117.50	115.57	4.20	117.50	117.50	Box Structure
DI #91	117.50	115.67	0.30	117.48	117.48	Box Structure
DI #92	117.50	115.49	1.00	117.47	117.47	Box Structure

FlexTable: Catch Basin Table (2017-0214 Providence Park.stc)

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Flow (Known) (ft³/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Structure Type
DI #57	135.00	129.79	3.10	131.08	131.08	Box Structure
DI #47	138.00	135.32	1.90	136.02	136.02	Box Structure
DI #48	138.00	135.16	3.40	135.95	135.95	Box Structure
SDMH #25	138.00	134.78	3.70	135.86	135.86	Circular Structure
DI #49	138.00	135.24	0.40	135.86	135.86	Box Structure
SDMH #49	127.00	124.51	4.50	125.35	125.35	Circular Structure
SDMH #50	141.00	122.22	4.50	123.03	123.03	Circular Structure
SDMH #51	135.00	120.47	6.20	121.35	121.35	Circular Structure
SDMH #52	132.00	119.63	6.50	120.53	120.53	Circular Structure
SDMH #53	117.50	113.90	15.50	115.32	115.32	Circular Structure
SDMH #57	117.00	113.50	16.30	114.96	114.96	Circular Structure
SDMH #54	115.00	110.50	16.30	111.96	111.96	Circular Structure
SDMH #55	114.00	108.80	22.30	110.49	110.49	Circular Structure
DI #103	128.00	125.35	2.00	125.95	125.95	Box Structure
DI #104	128.00	125.07	2.60	125.76	125.76	Box Structure
DI #108	134.00	121.01	2.00	121.68	121.68	Box Structure
DI #105	135.00	120.87	2.40	121.53	121.53	Box Structure
DI #106	134.00	120.93	0.50	121.32	121.32	Box Structure
DI #112	132.00	120.15	0.30	120.53	120.53	Box Structure
DI #111	132.00	119.99	0.30	120.53	120.53	Circular Structure
DI #114	117.00	114.26	3.30	115.47	115.47	Box Structure
DI #116	117.50	114.53	3.70	116.46	116.46	Circular Structure
DI #115	117.50	114.36	6.60	116.11	116.11	Box Structure
SDMH #46	132.00	127.50	0.30	127.73	127.73	Circular Structure
SDMH #47	119.00	116.97	1.80	117.47	117.47	Circular Structure
DI #98	132.00	128.03	0.30	128.26	128.26	Box Structure
DI #97	132.00	127.88	0.30	128.11	128.11	Box Structure
DI #99	119.50	117.89	1.60	118.47	118.47	Box Structure
DI #100	119.50	117.74	1.60	118.28	118.28	Box Structure
SDMH #48	119.00	117.38	1.60	117.92	117.92	Circular Structure
DI #118	114.00	109.48	1.40	111.16	111.16	Box Structure
SDMH #56	114.00	109.18	6.60	111.14	111.14	Circular Structure
DI #117	114.00	109.58	5.20	111.56	111.56	Box Structure

Conduit FlexTable: Combined Pipe/Node Report (2017-0214 Providence Park.stc)

Label	Start Node	Stop Node	Length (Unified) (ft)	Diameter (in)	Manning's n	Invert (Upstream) (ft)	Invert (Downstream) (ft)	Slope (ft/ft)	Capacity (Full Flow) (ft³/s)	System Known Flow (ft³/s)	Velocity (Average) (ft/s)	Flow / Capacity (Full) (%)	Elevation Ground (Start) (ft)	Hydraulic Grade Line (Out) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (In) (ft)
CO-72	DI #63	DI #64	31.0	12.0	0.013	138.28	138.12	0.005	2.56	2.10	3.64	82.0	139.00	139.00	139.00	139.08
CO-71	DI #64	SDMH #34	22.0	12.0	0.013	138.12	137.68	0.020	5.04	4.70	7.29	93.3	139.00	138.58	139.75	139.02
CO-73	DI #65	SDMH #34	18.0	12.0	0.013	138.04	137.68	0.020	5.04	0.40	3.83	7.9	139.00	138.58	139.75	138.58
CO-70	SDMH #34	SDMH #32	242.0	18.0	0.013	137.68	136.47	0.005	7.43	5.00	4.51	67.3	139.75	137.33	144.00	138.58
CO-68	SDMH #32	SDMH #35	44.0	18.0	0.013	136.47	135.59	0.020	14.85	5.00	7.58	33.7	144.00	136.20	144.00	137.33
CO-67	SDMH #35	SDMH #37	451.0	18.0	0.013	135.59	126.57	0.020	14.85	5.00	7.58	33.7	144.00	128.44	134.50	136.45
CO-75	DI #71	DI #72	34.0	12.0	0.013	127.09	126.93	0.005	2.44	1.20	1.53	49.1	134.00	128.70	134.00	128.74
CO-76	DI #72	SDMH #37	18.0	12.0	0.013	126.93	126.57	0.020	5.04	4.30	5.47	85.3	134.00	128.44	134.50	128.70
CO-77	DI #74	DI #73	31.0	12.0	0.013	127.17	127.01	0.005	2.56	0.40	0.51	15.6	134.00	128.64	134.00	128.64
CO-78	DI #73	SDMH #37	22.0	12.0	0.013	127.01	126.57	0.020	5.04	3.40	4.33	67.5	134.00	128.44	134.50	128.64
CO-66	SDMH #37	SDMH #38	40.0	18.0	0.013	126.57	126.17	0.010	10.50	12.00	6.79	114.2	134.50	127.92	134.00	128.44
CO-85	DI #45	SDMH #23	22.0	12.0	0.013	137.41	136.97	0.020	5.04	1.70	5.79	33.7	139.00	138.06	139.00	137.96
CO-86	DI #43	DI #44	31.0	12.0	0.013	137.49	137.33	0.005	2.56	1.50	3.39	58.6	139.00	138.02	139.00	138.08
CO-87	DI #44	SDMH #23	18.0	12.0	0.013	137.33	136.97	0.020	5.04	2.60	6.47	51.6	139.00	138.06	139.00	138.02
CO-84	SDMH #23	SDMH #24	44.0	12.0	0.013	136.97	136.53	0.010	3.56	4.20	5.35	117.9	139.00	137.39	139.00	138.06
CO-83	SDMH #24	SDMH #26	215.0	18.0	0.013	136.53	134.38	0.010	10.50	4.20	5.61	40.0	139.00	135.43	138.00	137.32
CO-124	DI #47	DI #48	31.0	12.0	0.013	135.32	135.16	0.005	2.56	1.90	3.57	74.2	138.00	135.95	138.00	136.02
CO-125	DI #48	SDMH #25	19.0	12.0	0.013	135.16	134.78	0.020	5.04	3.40	6.89	67.5	138.00	135.86	138.00	135.95
CO-126	DI #49	SDMH #25	23.0	12.0	0.013	135.24	134.78	0.020	5.04	0.40	3.83	7.9	138.00	135.86	138.00	135.86
CO-127	SDMH #25	SDMH #26	40.0	12.0	0.013	134.78	134.38	0.010	3.56	3.70	4.71	103.9	138.00	135.43	138.00	135.86
CO-82	SDMH #26	SDMH #28	195.0	18.0	0.013	134.38	132.43	0.010	10.50	7.30	6.42	69.5	138.00	133.72	138.50	135.43
CO-122	DI #51	DI #52	31.0	12.0	0.013	133.83	133.67	0.005	2.56	2.30	2.93	89.9	136.00	135.03	136.00	135.15
CO-123	DI #52	SDMH #27	18.0	12.0	0.013	133.67	133.31	0.020	5.04	3.90	4.97	77.4	136.00	134.81	136.00	135.03
CO-88	DI #53	SDMH #27	23.0	12.0	0.013	133.77	133.31	0.020	5.04	1.90	2.42	37.7	136.00	134.81	136.00	134.87
CO-121	SDMH #27	SDMH #28	44.0	12.0	0.013	133.31	132.43	0.020	5.04	5.60	7.13	111.1	136.00	133.72	138.50	134.81
CO-81	SDMH #28	SDMH #29	300.0	24.0	0.013	132.43	129.43	0.010	22.62	12.90	7.44	57.0	138.50	130.95	135.00	133.72
CO-89	DI #56	DI #55	33.0	12.0	0.013	130.04	129.87	0.005	2.56	1.80	2.29	70.4	135.00	131.17	135.00	131.26
CO-90	DI #55	SDMH #29	22.0	12.0	0.013	129.87	129.43	0.020	5.04	3.60	4.58	71.5	135.00	130.95	135.00	131.17
CO-119	DI #57	SDMH #29	18.0	12.0	0.013	129.79	129.43	0.020	5.04	3.10	3.95	61.5	135.00	130.95	135.00	131.08
CO-80	SDMH #29	SDMH #30	40.0	24.0	0.013	129.43	129.03	0.010	22.62	17.70	7.97	78.2	135.00	130.38	135.00	130.95
CO-79	SDMH #30	SDMH #38	286.0	24.0	0.013	129.03	126.17	0.010	22.62	17.70	7.97	78.2	135.00	127.92	134.00	130.55
CO-65	SDMH #38	SDMH #39	44.0	30.0	0.013	126.17	125.73	0.010	41.01	26.30	8.87	64.1	134.00	127.73	134.00	127.92
CO-91	DI #75	DI #76	31.0	12.0	0.013	126.33	126.17	0.005	2.56	4.20	5.35	164.1	134.00	128.11	134.00	128.54
CO-92	DI #76	SDMH #39	22.0	12.0	0.013	126.17	125.73	0.020	5.04	4.70	5.98	93.3	134.00	127.73	134.00	128.11
CO-93	DI #78	DI #77	31.0	12.0	0.013	126.24	126.09	0.005	2.48	3.90	4.97	157.4	134.00	128.20	134.00	128.57
CO-94	DI #77	SDMH #39	18.0	12.0	0.013	126.09	125.73	0.020	5.04	5.80	7.38	115.1	134.00	127.73	134.00	128.20
CO-64	SDMH #39	SDMH #41	360.0	30.0	0.013	125.73	122.13	0.010	41.01	34.50	9.36	84.1	134.00	124.18	129.00	127.73
CO-95	DI #81	DI #82	30.0	12.0	0.013	122.76	122.61	0.005	2.52	1.30	1.66	51.6	128.00	124.24	128.00	124.28
CO-96	DI #82	SDMH #41	24.0	12.0	0.013	122.61	122.13	0.020	5.04	1.80	2.29	35.7	128.00	124.18	129.00	124.24
CO-97	DI #80	DI #79	28.0	12.0	0.013	122.67	122.53	0.005	2.52	3.00	3.82	119.1	129.00	124.58	128.00	124.77
CO-98	DI #79	SDMH #41	20.0	12.0	0.013	122.53	122.13	0.020	5.04	5.00	6.37	99.2	128.00	124.18	129.00	124.58
CO-63	SDMH #41	SDMH #42	84.0	36.0	0.013	122.13	121.29	0.010	66.69	39.70	9.84	59.5	129.00	123.37	127.00	124.18
CO-99	DI #83	DI #84	30.0	12.0	0.013	121.90	121.75	0.005	2.52	0.90	1.15	35.7	127.00	123.38	127.00	123.40
CO-100	DI #84	SDMH #42	23.0	12.0	0.013	121.75	121.29	0.020	5.04	0.90	1.15	17.9	127.00	123.37	127.00	123.38
CO-101	DI #86	DI #85	30.0	12.0	0.013	121.78	121.63	0.005	2.52	0.30	0.38	11.9	128.00	123.37	127.00	123.37
CO-102	DI #85	SDMH #42	17.0	12.0	0.013	121.63	121.29	0.020	5.04	0.30	0.38	6.0	127.00	123.37	127.00	123.37
CO-62	SDMH #42	SDMH #43	333.0	36.0	0.013	121.29	116.29	0.015	81.72	40.60	11.54	49.7	127.00	118.41	120.00	123.37
CO-103	DI #87	DI #88	36.0	12.0	0.013	116.93	116.75	0.005	2.52	1.00	1.27	39.7	117.50	118.00	118.00	118.03

Conduit FlexTable: Combined Pipe/Node Report (2017-0214 Providence Park.stc)

Label	Start Node	Stop Node	Length (Unified) (ft)	Diameter (in)	Manning's n	Invert (Upstream) (ft)	Invert (Downstream) (ft)	Slope (ft/ft)	Capacity (Full Flow) (ft³/s)	System Known Flow (ft³/s)	Velocity (Average) (ft/s)	Flow / Capacity (Full) (%)	Elevation Ground (Start) (ft)	Hydraulic Grade Line (Out) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (In) (ft)
CO-104	DI #88	SDMH #43	22.0	12.0	0.013	116.75	116.29	0.021	5.15	3.40	4.33	66.0	118.00	118.41	120.00	118.61
CO-105	DI #90	DI #89	30.0	12.0	0.013	116.80	116.65	0.005	2.52	1.40	1.78	55.6	117.50	118.00	118.00	118.05
CO-106	DI #89	SDMH #43	18.0	12.0	0.013	116.65	116.29	0.020	5.04	3.00	3.82	59.5	118.00	118.41	120.00	118.54
CO-61	SDMH #43	SDMH #44	86.0	36.0	0.013	116.29	115.11	0.014	78.12	42.40	11.28	54.3	120.00	117.46	118.50	118.41
CO-107	DI #94	DI #93	27.0	12.0	0.013	115.71	115.57	0.005	2.57	0.40	0.51	15.6	117.50	117.50	117.50	117.50
CO-108	DI #93	SDMH #44	23.0	12.0	0.013	115.57	115.11	0.020	5.04	4.20	5.35	83.4	117.50	117.46	118.50	117.78
CO-109	DI #91	DI #92	35.0	12.0	0.013	115.67	115.49	0.005	2.55	0.30	0.38	11.7	117.50	117.47	117.50	117.48
CO-110	DI #92	SDMH #44	19.0	12.0	0.013	115.49	115.11	0.020	5.04	1.00	1.27	19.8	117.50	117.46	118.50	117.47
CO-60	SDMH #44	SDMH #45	122.0	36.0	0.013	115.11	114.50	0.005	47.16	45.20	7.60	95.8	118.50	116.69	118.50	117.46
CO-59	SDMH #45	OUTFALL B	49.0	36.0	0.013	114.50	114.00	0.010	67.37	45.20	10.22	67.1	118.50	115.88	117.00	116.69
CO-155	DI #118	SDMH #56	15.0	12.0	0.013	109.48	109.18	0.020	5.04	1.40	1.78	27.8	114.00	111.14	114.00	111.16
CO-157	DI #117	SDMH #56	20.0	12.0	0.013	109.58	109.18	0.020	5.04	5.20	6.62	103.2	114.00	111.14	114.00	111.56
CO-156	SDMH #56	SDMH #55	19.0	12.0	0.013	109.18	108.80	0.020	5.04	6.60	8.40	131.0	114.00	110.49	114.00	111.14
CO-148	DI #98	DI #97	30.0	12.0	0.013	128.03	127.88	0.005	2.52	0.30	2.16	11.9	132.00	128.11	132.00	128.26
CO-149	DI #97	SDMH #46	19.0	12.0	0.013	127.88	127.50	0.020	5.04	0.30	3.52	6.0	132.00	127.67	132.00	128.11
CO-146	SDMH #46	SDMH #47	351.0	12.0	0.013	127.50	116.97	0.030	6.17	0.30	4.06	4.9	132.00	117.47	119.00	127.73
CO-152	DI #99	DI #100	30.0	12.0	0.013	117.89	117.74	0.005	2.52	1.60	3.40	63.5	119.50	118.28	119.50	118.47
CO-153	DI #100	SDMH #48	18.0	12.0	0.013	117.74	117.38	0.020	5.04	1.60	5.69	31.8	119.50	117.78	119.00	118.28
CO-154	SDMH #48	SDMH #47	41.0	12.0	0.013	117.38	116.97	0.010	3.56	1.60	4.41	44.9	119.00	117.44	119.00	117.92
CO-147	SDMH #47	SDMH #57	347.0	18.0	0.013	116.97	113.50	0.010	10.50	1.80	4.44	17.1	119.00	114.96	117.00	117.47
CO-143	DI #114	SDMH #53	18.0	12.0	0.013	114.26	113.90	0.020	5.04	3.30	4.20	65.5	117.00	115.32	117.50	115.47
CO-144	DI #116	DI #115	33.0	12.0	0.013	114.53	114.36	0.005	2.56	3.70	4.71	144.7	117.50	116.11	117.50	116.46
CO-145	DI #115	SDMH #53	23.0	12.0	0.013	114.36	113.90	0.020	5.04	6.60	8.40	131.0	117.50	115.32	117.50	116.11
CO-141	DI #112	DI #111	31.0	12.0	0.013	120.15	119.99	0.005	2.56	0.30	2.18	11.7	132.00	120.53	132.00	120.53
CO-142	DI #111	SDMH #52	18.0	12.0	0.013	119.99	119.63	0.020	5.04	0.30	3.52	6.0	132.00	120.53	132.00	120.53
CO-138	DI #108	DI #105	28.0	12.0	0.013	121.01	120.87	0.005	2.52	2.00	3.56	79.4	134.00	121.53	135.00	121.68
CO-139	DI #105	SDMH #51	20.0	12.0	0.013	120.87	120.47	0.020	5.04	2.40	6.34	47.6	135.00	121.35	135.00	121.53
CO-140	DI #106	SDMH #51	23.0	12.0	0.013	120.93	120.47	0.020	5.04	0.50	4.09	9.9	134.00	121.35	135.00	121.32
CO-137	DI #104	SDMH #49	28.0	12.0	0.013	125.07	124.51	0.020	5.04	2.60	6.47	51.6	128.00	125.35	127.00	125.76
CO-136	DI #103	SDMH #49	42.0	12.0	0.013	125.35	124.51	0.020	5.04	2.00	6.04	39.7	128.00	125.35	127.00	125.95
CO-128	SDMH #49	SDMH #50	458.0	18.0	0.013	124.51	122.22	0.005	7.43	4.50	4.40	60.6	127.00	123.03	141.00	125.35
CO-129	SDMH #50	SDMH #51	175.0	18.0	0.013	122.22	120.47	0.010	10.50	4.50	5.71	42.8	141.00	121.35	135.00	123.03
CO-130	SDMH #51	SDMH #52	84.0	24.0	0.013	120.47	119.63	0.010	22.62	6.20	6.14	27.4	135.00	120.53	132.00	121.35
CO-131	SDMH #52	SDMH #53	573.0	24.0	0.013	119.63	113.90	0.010	22.62	6.50	6.22	28.7	132.00	115.32	117.50	120.53
CO-132	SDMH #53	SDMH #57	40.0	24.0	0.013	113.90	113.50	0.010	22.62	15.50	7.76	68.5	117.50	114.96	117.00	115.32
CO-133	SDMH #57	SDMH #54	300.0	24.0	0.013	113.50	110.50	0.010	22.62	16.30	7.84	72.1	117.00	111.76	115.00	114.96
CO-134	SDMH #54	SDMH #55	170.0	24.0	0.013	110.50	108.80	0.010	22.62	16.30	7.84	72.1	115.00	110.49	114.00	111.96
CO-135	SDMH #55	OUTFALL C	140.0	24.0	0.013	108.80	106.00	0.020	31.99	22.30	11.01	69.7	114.00	107.23	109.00	110.49
CO-58	DI #120	SDMH #57	26.0	12.0	0.013	122.73	122.21	0.020	5.04	4.10	5.22	81.4	129.00	124.18	128.50	124.52
CO-57	DI #119	SDMH #57	22.0	12.0	0.013	122.65	122.21	0.020	5.04	2.00	2.55	39.7	129.00	124.18	128.50	124.24
CO-53	DI #29	DI #30	30.0	12.0	0.013	125.28	125.13	0.005	2.52	0.40	0.51	15.9	129.00	126.46	130.00	126.46
CO-54	DI #30	SDMH #15	22.0	12.0	0.013	125.13	124.69	0.020	5.04	2.30	2.93	45.7	130.00	126.36	130.00	126.46
CO-56	DI #31	SDMH #15	18.0	12.0	0.013	125.05	124.69	0.020	5.04	2.10	2.67	41.7	130.00	126.36	130.00	126.43
CO-55	SDMH #15	SDMH #16	40.0	12.0	0.013	124.69	123.89	0.020	5.04	4.30	5.47	85.3	130.00	125.78	129.00	126.36
CO-52	AD #1	SDMH #61	31.0	12.0	0.013	126.19	125.57	0.020	5.04	3.50	4.46	69.5	129.50	127.41	129.50	127.71
CO-44	DI #26	SDMH #13	22.0	12.0	0.013	128.03	127.59	0.020	5.04	5.90	7.51	117.1	131.00	130.42	131.50	131.02
CO-46	DI #27	SDMH #13	18.0	12.0	0.013	127.95	127.59	0.020	5.04	9.80	12.48	194.5	131.00	130.42	131.50	131.78
CO-51	DI #7	SDMH #4	23.0	12.0	0.013	131.26	130.80	0.020	5.04	5.60	7.13	111.1	137.00	132.89	136.50	133.46

Conduit FlexTable: Combined Pipe/Node Report (2017-0214 Providence Park.stc)

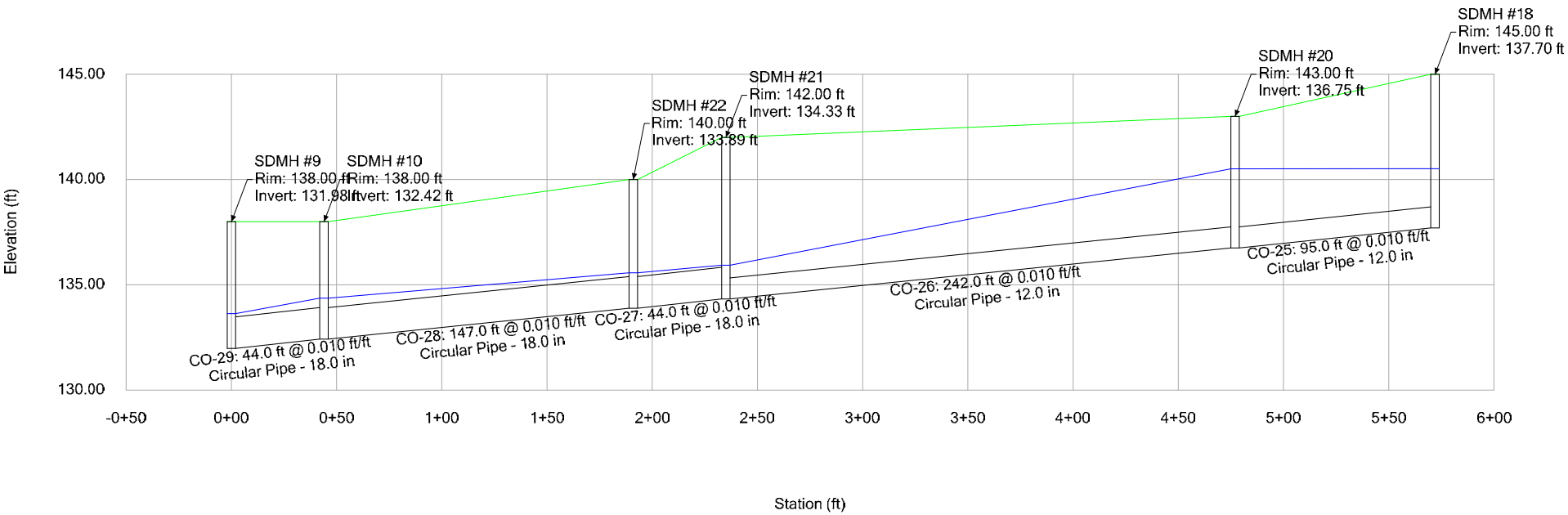
Label	Start Node	Stop Node	Length (Unified) (ft)	Diameter (in)	Manning's n	Invert (Upstream) (ft)	Invert (Downstream) (ft)	Slope (ft/ft)	Capacity (Full Flow) (ft³/s)	System Known Flow (ft³/s)	Velocity (Average) (ft/s)	Flow / Capacity (Full) (%)	Elevation Ground (Start) (ft)	Hydraulic Grade Line (Out) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (In) (ft)
CO-47	DI #5	DI #6	30.0	12.0	0.013	131.31	131.16	0.005	2.52	5.40	6.88	214.4	137.00	134.40	137.00	135.09
CO-48	DI #6	SDMH #4	18.0	12.0	0.013	131.16	130.80	0.020	5.04	10.30	13.11	204.4	137.00	132.89	136.50	134.40
CO-49	SDMH #4	SDMH #3	47.0	18.0	0.013	130.80	130.33	0.010	10.50	16.00	9.05	152.3	136.50	131.77	136.00	132.89
CO-50	SDMH #3	SDMH #13	274.0	24.0	0.013	130.33	127.59	0.010	22.62	16.00	7.81	70.7	136.00	130.42	131.50	131.77
CO-45	SDMH #13	SDMH #14	40.0	24.0	0.013	127.59	127.19	0.010	22.62	30.80	9.80	136.2	131.50	129.68	131.00	130.42
CO-39	DI #21	DI #22	30.0	12.0	0.013	130.15	130.00	0.005	2.52	1.80	2.29	71.5	132.00	132.00	132.00	132.08
CO-40	DI #22	SDMH #12	22.0	12.0	0.013	130.00	129.56	0.020	5.04	5.20	6.62	103.2	132.00	135.11	140.00	135.58
CO-42	DI #23	SDMH #12	18.0	12.0	0.013	129.92	129.56	0.020	5.04	5.80	7.38	115.1	132.00	135.11	140.00	135.59
CO-41	SDMH #12	SDMH #11	44.0	12.0	0.013	129.56	129.12	0.010	3.56	11.00	14.01	308.8	140.00	130.92	133.00	135.11
CO-33	DI #39	SDMH #21	18.0	12.0	0.013	134.69	134.33	0.020	5.04	1.50	1.91	29.8	141.00	135.93	142.00	135.96
CO-34	DI #41	DI #40	30.0	12.0	0.013	134.92	134.77	0.005	2.52	1.80	2.29	71.5	141.50	136.12	142.00	136.20
CO-35	DI #40	SDMH #21	22.0	12.0	0.013	134.77	134.33	0.020	5.04	3.30	4.20	65.5	142.00	135.93	142.00	136.12
CO-30	DI #35	DI #36	31.0	12.0	0.013	137.79	137.63	0.005	2.56	4.90	6.24	191.4	143.00	141.76	143.00	142.35
CO-31	DI #36	SDMH #19	22.0	12.0	0.013	137.63	137.19	0.020	5.04	4.90	6.24	97.3	143.00	141.34	142.00	141.76
CO-32	SDMH #19	SDMH #20	44.0	12.0	0.013	137.19	136.75	0.010	3.56	4.90	6.24	137.5	142.00	140.51	143.00	141.34
CO-23	DI #33	DI #34	30.0	12.0	0.013	138.29	138.14	0.005	2.52	0.20	0.25	7.9	146.00	140.51	145.00	140.51
CO-24	DI #34	SDMH #18	22.0	12.0	0.013	138.14	137.70	0.020	5.04	0.20	0.25	4.0	145.00	140.51	145.00	140.51
CO-25	SDMH #18	SDMH #20	95.0	12.0	0.013	137.70	136.75	0.010	3.56	0.20	0.25	5.6	145.00	140.51	143.00	140.51
CO-26	SDMH #20	SDMH #21	242.0	12.0	0.013	136.75	134.33	0.010	3.56	4.90	6.24	137.5	143.00	135.93	142.00	140.51
CO-27	SDMH #21	SDMH #22	44.0	18.0	0.013	134.33	133.89	0.010	10.50	9.50	5.38	90.4	142.00	135.57	140.00	135.93
CO-28	SDMH #22	SDMH #10	147.0	18.0	0.013	133.89	132.42	0.010	10.50	9.50	5.38	90.4	140.00	134.37	138.00	135.57
CO-36	DI #17	DI #18	30.0	12.0	0.013	133.46	132.86	0.020	5.04	1.50	1.91	29.8	138.00	134.43	138.00	134.49
CO-37	DI #18	SDMH #10	22.0	12.0	0.013	132.86	132.42	0.020	5.04	1.90	2.42	37.7	138.00	134.37	138.00	134.43
CO-38	DI #19	SDMH #10	18.0	12.0	0.013	132.78	132.42	0.020	5.04	3.50	4.46	69.5	138.00	134.37	138.00	134.54
CO-29	SDMH #10	SDMH #9	44.0	18.0	0.013	132.42	131.98	0.010	10.50	13.60	7.70	129.5	138.00	133.63	138.00	134.37
CO-21	DI #13	DI #14	30.0	12.0	0.013	136.41	136.26	0.005	2.52	0.20	1.91	7.9	146.00	136.87	146.00	136.87
CO-22	DI #14	SDMH #8	19.0	12.0	0.013	136.26	135.90	0.019	4.90	0.20	3.06	4.1	146.00	136.87	148.50	136.87
CO-16	DI #9	DI #10	29.0	12.0	0.013	140.36	140.21	0.005	2.56	5.60	7.13	218.6	150.00	142.30	148.00	143.02
CO-17	DI #10	SDMH #5	18.0	12.0	0.013	140.21	139.85	0.020	5.04	5.60	7.13	111.1	148.00	141.86	149.00	142.30
CO-19	DI #12	DI #11	30.0	12.0	0.013	140.44	140.29	0.005	2.52	0.90	1.15	35.7	150.00	141.87	150.00	141.89
CO-20	DI #11	SDMH #5	22.0	12.0	0.013	140.29	139.85	0.020	5.04	0.90	1.15	17.9	150.00	141.86	149.00	141.87
CO-18	SDMH #5	SDMH #6	40.0	12.0	0.013	139.85	139.45	0.010	3.56	6.50	8.28	182.5	149.00	140.53	150.00	141.86
CO-1	DI #1	DI #2	33.0	12.0	0.013	143.50	143.33	0.005	2.56	1.60	3.44	62.6	153.00	143.87	152.00	144.07
CO-2	DI #2	SDMH #2	18.0	12.0	0.013	143.33	142.97	0.020	5.04	1.60	5.69	31.8	152.00	143.37	152.00	143.87
CO-3	SDMH #2	SDMH #1	42.0	12.0	0.013	142.97	142.55	0.010	3.56	1.60	4.41	44.9	152.00	143.02	153.00	143.51
CO-4	SDMH #1	SDMH #6	310.0	12.0	0.013	142.55	139.45	0.010	3.56	1.60	4.41	44.9	153.00	140.53	150.00	143.09
CO-5	SDMH #6	SDMH #7	314.0	18.0	0.013	139.45	136.31	0.010	10.50	7.70	6.49	73.3	150.00	137.26	150.00	140.53
CO-6	SDMH #7	SDMH #8	41.0	18.0	0.013	136.31	135.90	0.010	10.50	7.70	6.49	73.3	150.00	136.86	148.50	137.39
CO-7	SDMH #8	SDMH #9	392.0	24.0	0.013	135.90	131.98	0.010	22.62	7.50	6.47	33.2	148.50	133.63	138.00	136.87
CO-8	SDMH #9	SDMH #11	286.0	24.0	0.013	131.98	129.12	0.010	22.62	21.30	8.19	94.2	138.00	130.92	133.00	133.63
CO-9	SDMH #11	SDMH #14	193.0	36.0	0.013	129.12	127.19	0.010	66.69	30.80	9.25	46.2	133.00	129.68	131.00	130.92
CO-10	SDMH #14	SDMH #61	162.0	36.0	0.013	127.19	125.57	0.010	66.69	59.10	10.66	88.6	131.00	127.77	129.50	129.68
CO-11	SDMH #61	SDMH #16	168.0	36.0	0.013	125.57	123.89	0.010	66.69	32.10	9.35	48.1	129.50	125.78	129.00	127.41
CO-12	SDMH #16	SDMH #57	168.0	36.0	0.013	123.89	122.21	0.010	66.69	33.90	9.47	50.8	129.00	124.18	128.50	125.78
CO-13	SDMH #57	SDMH #58	106.0	36.0	0.013	122.21	121.15	0.010	66.69	36.50	9.65	54.7	128.50	122.76	136.00	124.18
CO-14	SDMH #58	SDMH #60	692.0	36.0	0.013	121.15	107.31	0.020	94.32	36.50	12.49	38.7	136.00	108.61	128.00	123.12
CO-15	SDMH #60	OUTFALL A	42.0	36.0	0.013	107.31	105.00	0.055	156.41	36.50	18.04	23.3	128.00	106.17	107.00	109.28

FlexTable: Outfall Table (2017-0214 Providence Park.stc)

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Hydraulic Grade Line (ft)	Boundary Condition Type	Elevation (Tailwater) (ft)	System Known Flow (ft^3/s)
OUTFALL A	107.00	105.00	105.00	Free Outfall	0.00	36.50
OUTFALL B	117.00	114.00	114.00	Free Outfall	0.00	45.20
OUTFALL C	109.00	106.00	106.00	Free Outfall	0.00	22.30

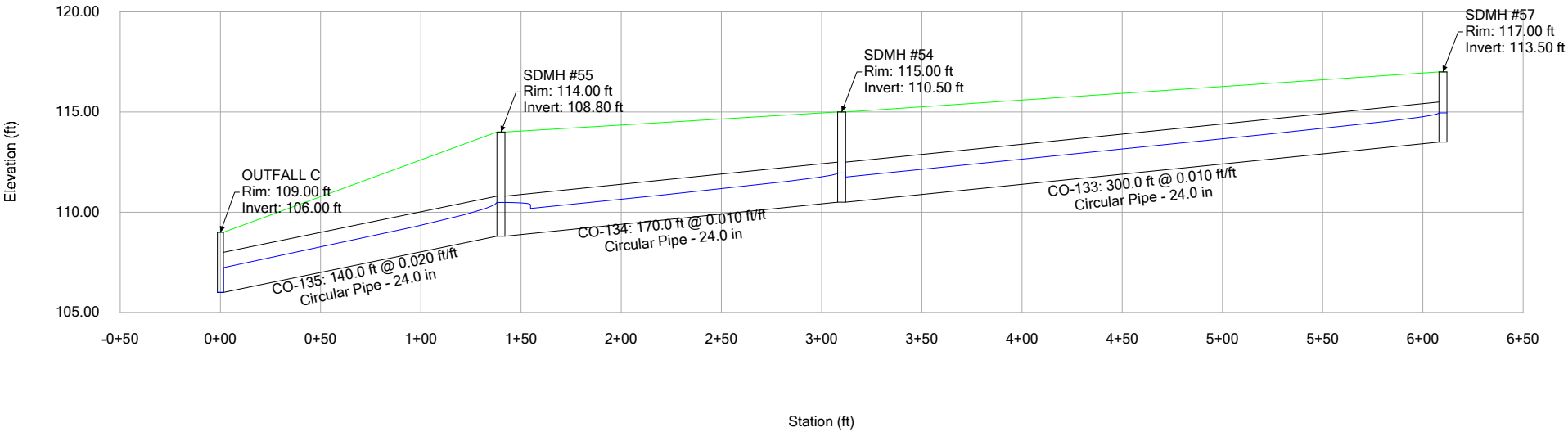
Profile Report

Engineering Profile - SDMH #9 to SDMH #18 (2017-0214 Providence Park.stc)



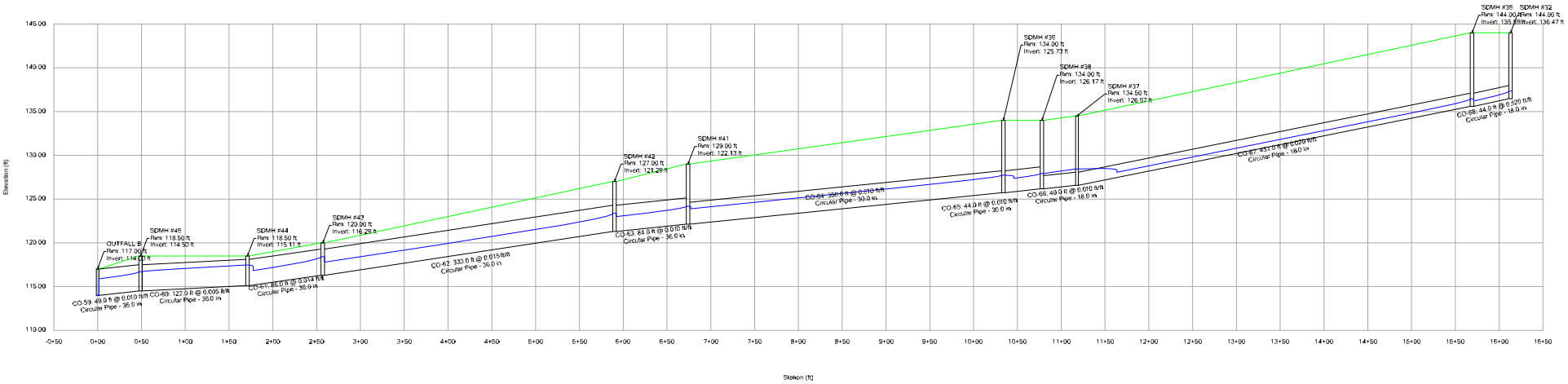
Profile Report

Engineering Profile - Outfall C to SDMH #57 (2017-0214 Providence Park.stc)



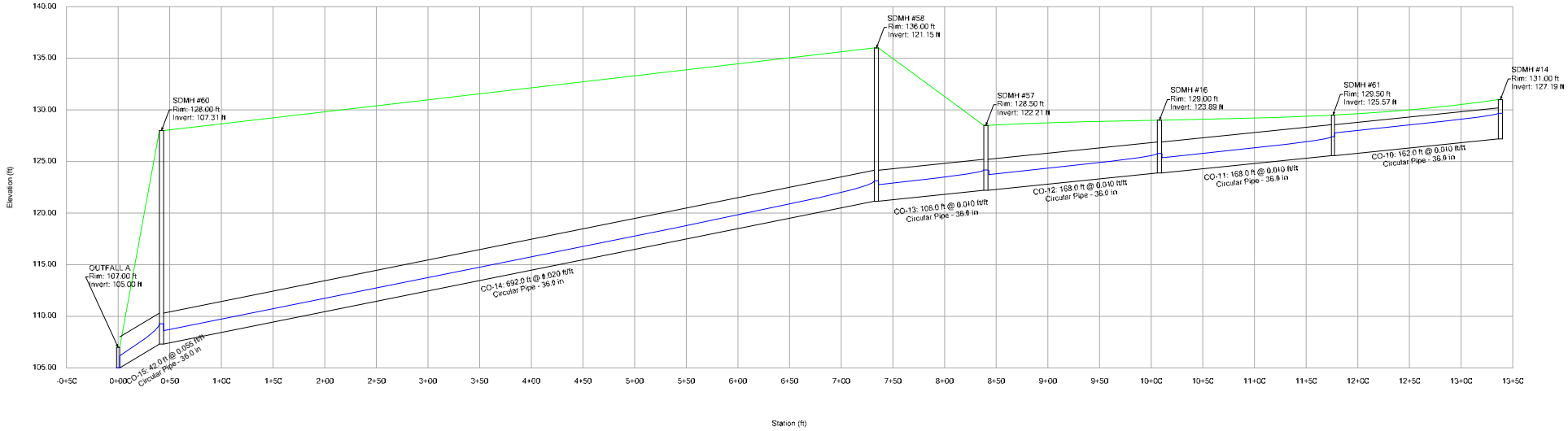
Profile Report

Engineering Profile - Outfall B to SDMH #32 (2017-0214 Providence Park.stc)



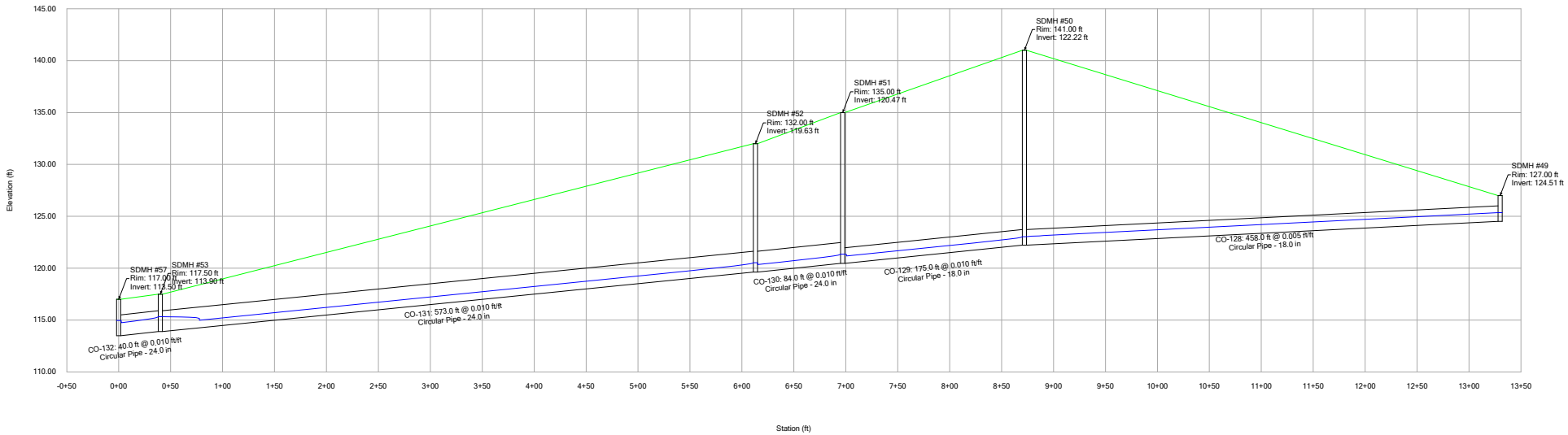
Profile Report

Engineering Profile - Outfall A to SDMH #14 (2017-0214 Providence Park.stc)



Profile Report

Engineering Profile - SDMH #57 to SDMH #49 (2017-0214 Providence Park.stc)



Profile Report

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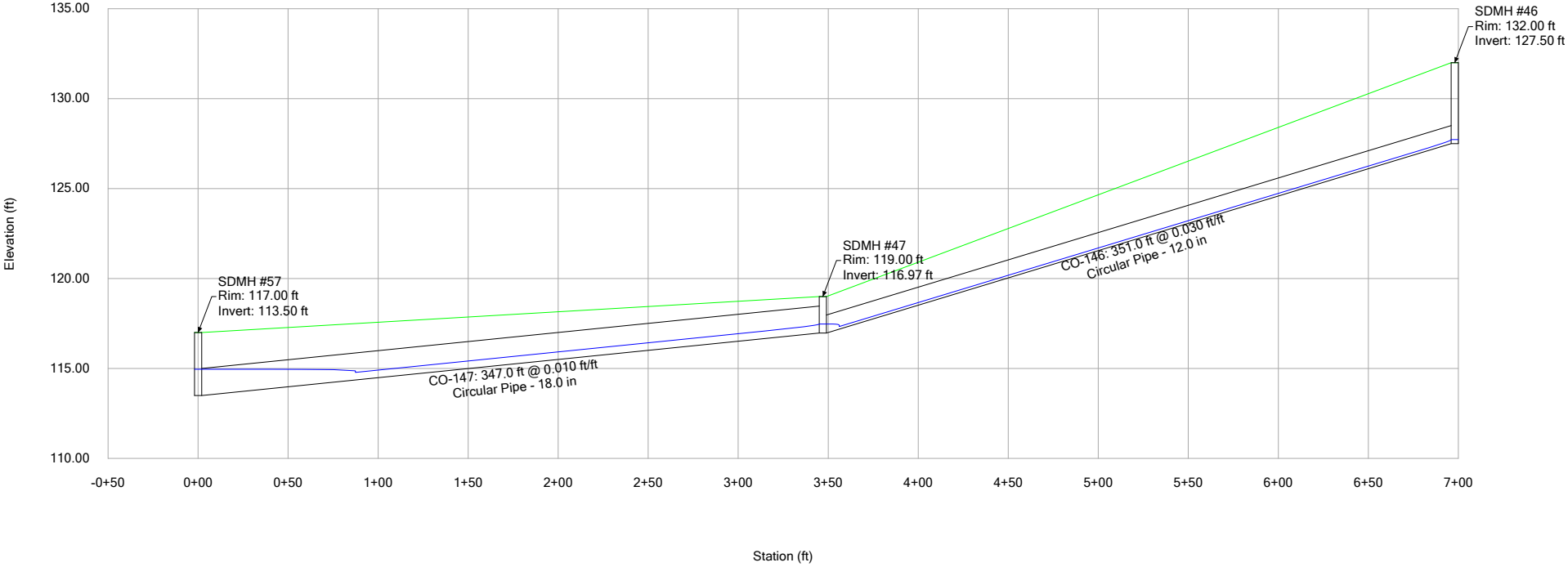
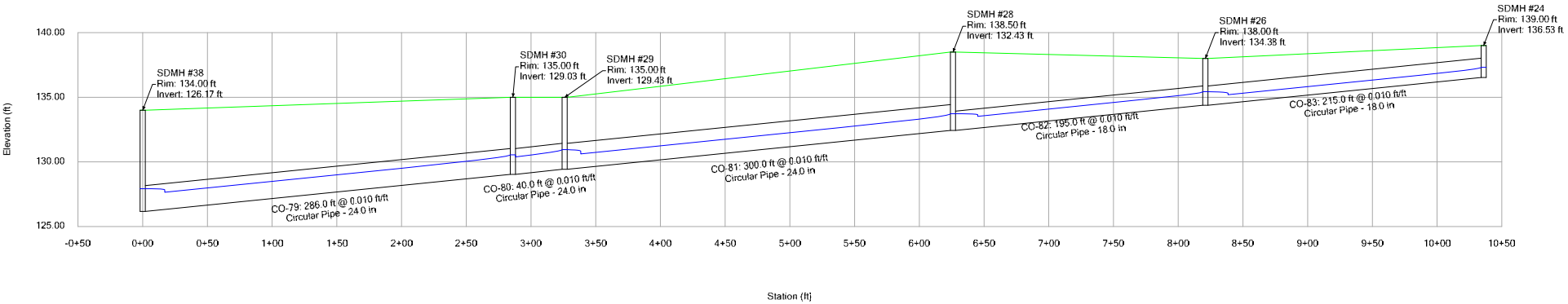


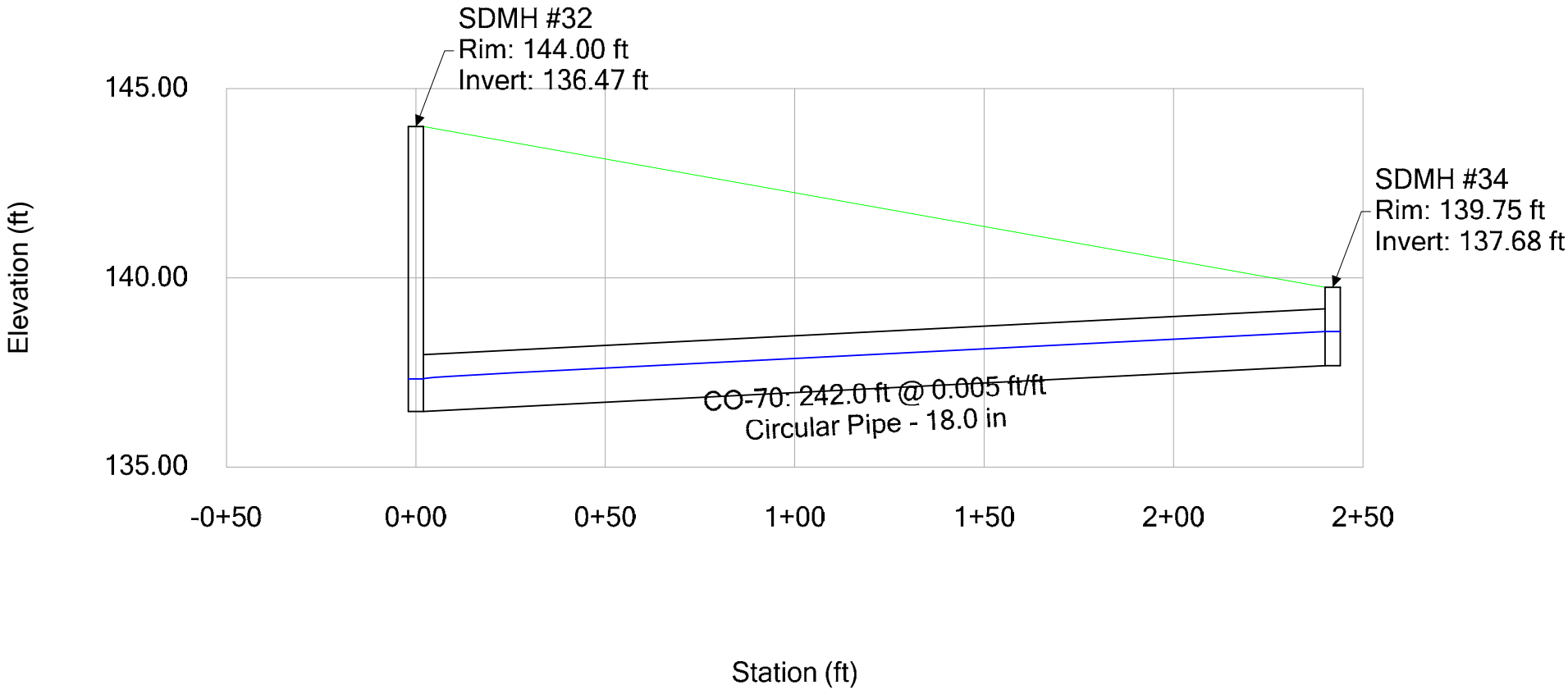
Profile Report

Engineering Profile - SDMH #38 to SDMH #24 (2017-0214 Providence Park.stc)



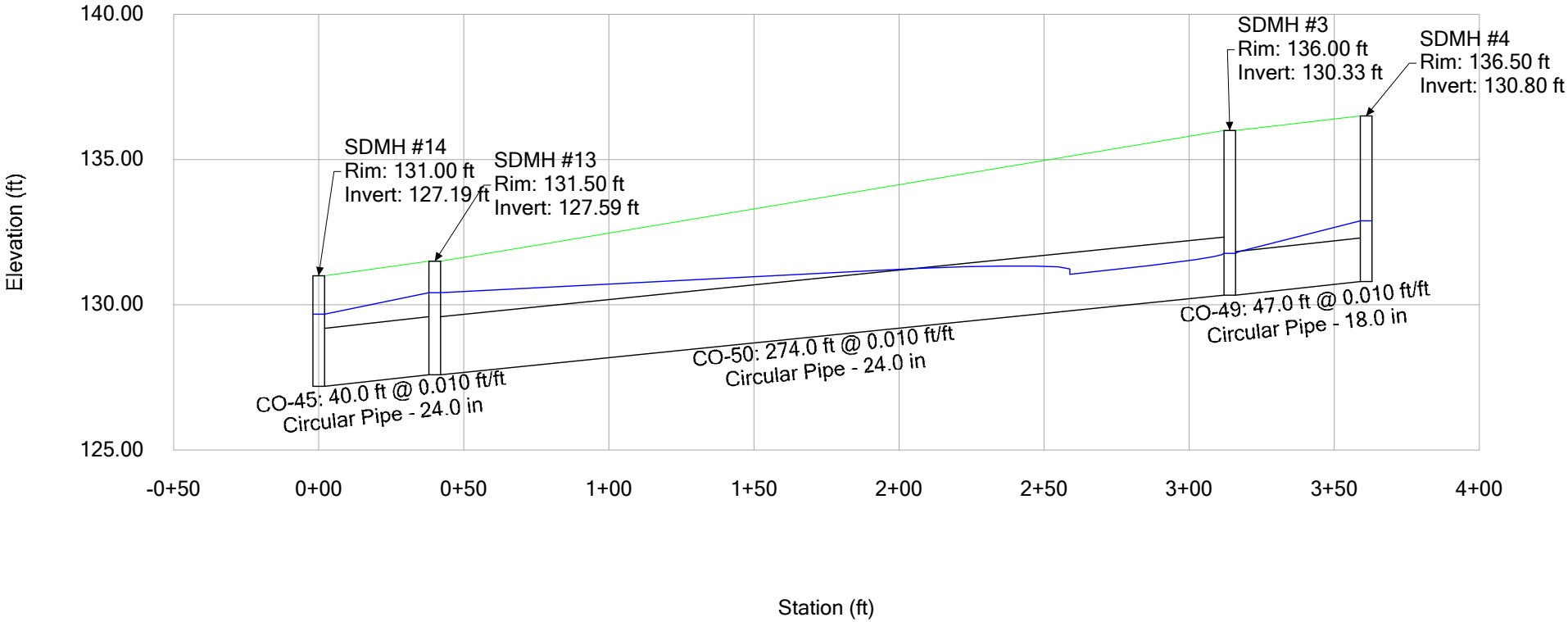
Profile Report

Engineering Profile - SDMH #32 to SDMH #34 (2017-0214 Providence Park.stc)



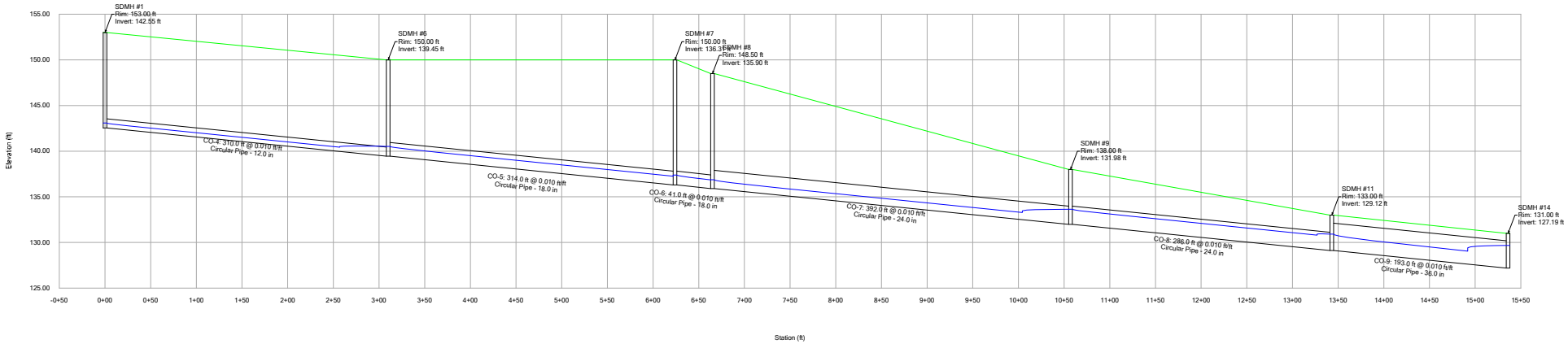
Profile Report

Engineering Profile - SDMH #14 to SDMH #4 (2017-0214 Providence Park.stc)



Profile Report

Engineering Profile - SDMH #14 to SDMH #1 (2017-0214 Providence Park.stc)



Worksheet for Providence Park (10-Yr)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00500	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Discharge	3.00	ft^3/s

Results

Normal Depth	0.75	ft
Flow Area	1.70	ft^2
Wetted Perimeter	4.76	ft
Hydraulic Radius	0.36	ft
Top Width	4.52	ft
Critical Depth	0.57	ft
Critical Slope	0.02134	ft/ft
Velocity	1.76	ft/s
Velocity Head	0.05	ft
Specific Energy	0.80	ft
Froude Number	0.51	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.75	ft
Critical Depth	0.57	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.02134	ft/ft

Cross Section for Providence Park (10-Yr)

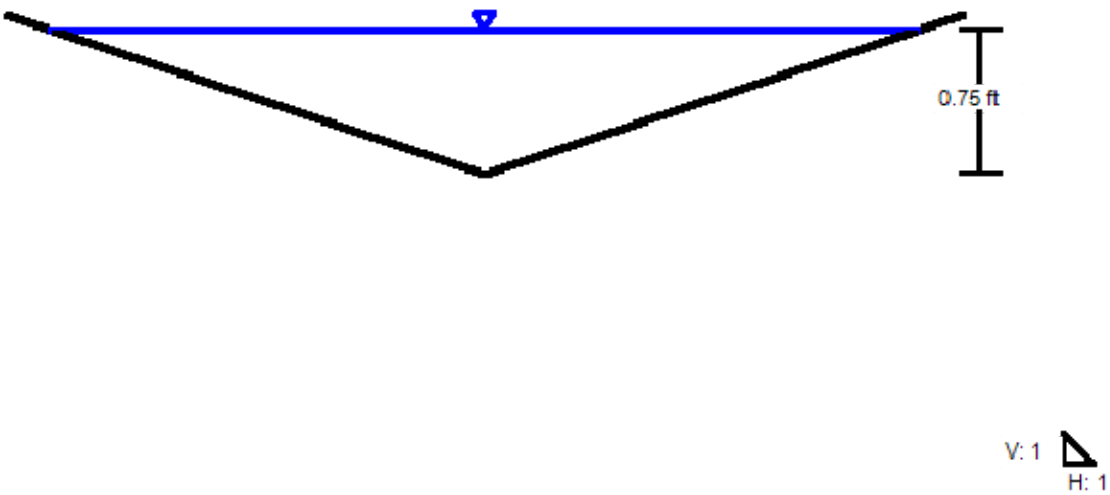
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00500	ft/ft
Normal Depth	0.75	ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Discharge	3.00	ft^3/s

Cross Section Image



Worksheet for Providence Park (100-Yr)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00500	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Discharge	5.80	ft^3/s

Results

Normal Depth	0.96	ft
Flow Area	2.79	ft^2
Wetted Perimeter	6.10	ft
Hydraulic Radius	0.46	ft
Top Width	5.79	ft
Critical Depth	0.75	ft
Critical Slope	0.01954	ft/ft
Velocity	2.08	ft/s
Velocity Head	0.07	ft
Specific Energy	1.03	ft
Froude Number	0.53	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.96	ft
Critical Depth	0.75	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.01954	ft/ft

Cross Section for Providence Park (100-Yr)

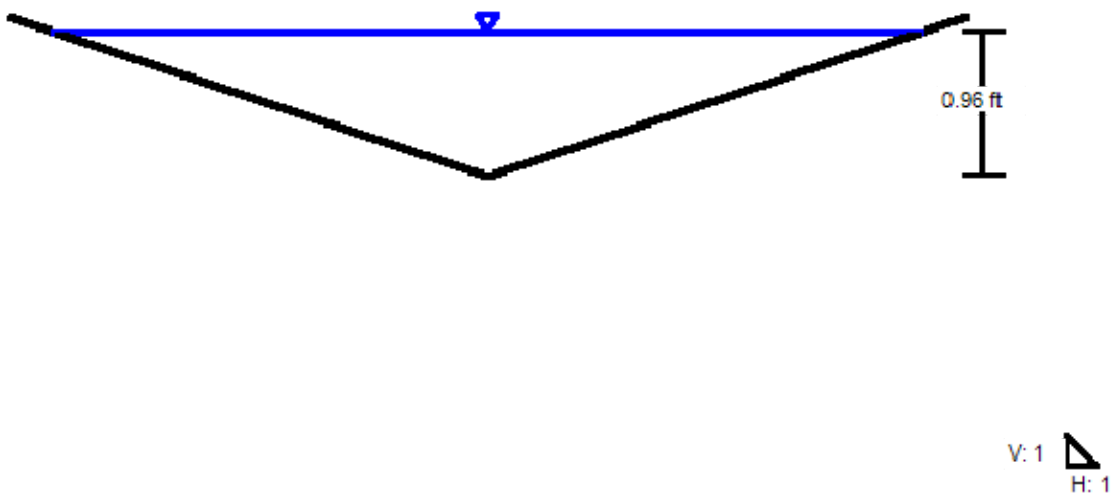
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00500	ft/ft
Normal Depth	0.96	ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Discharge	5.80	ft^3/s

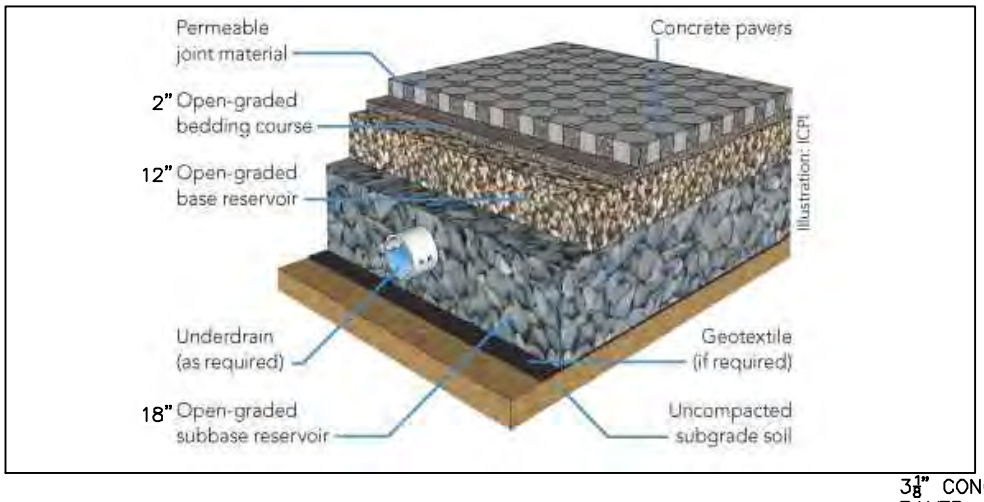
Cross Section Image

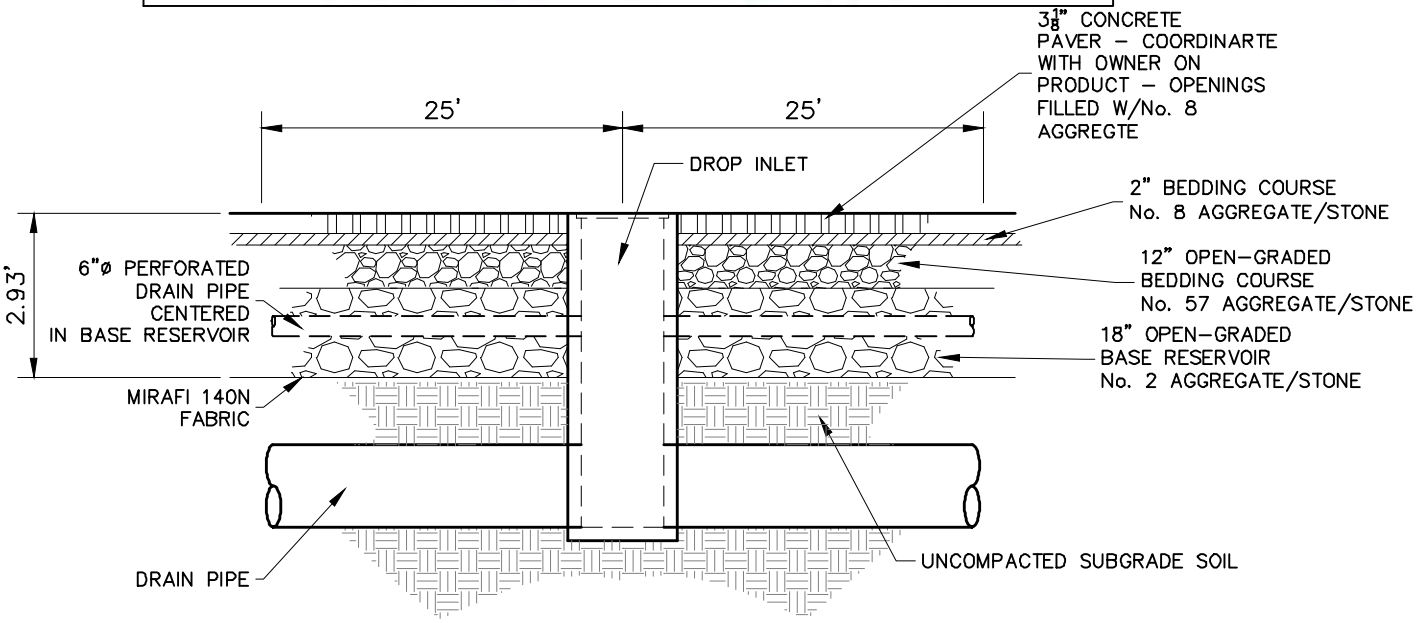


APPENDIX E- BEST MANAGEMENT PRACTICES

Permeable Pavement

Bio-Retention Basins





F

POROUS PAVEMENT

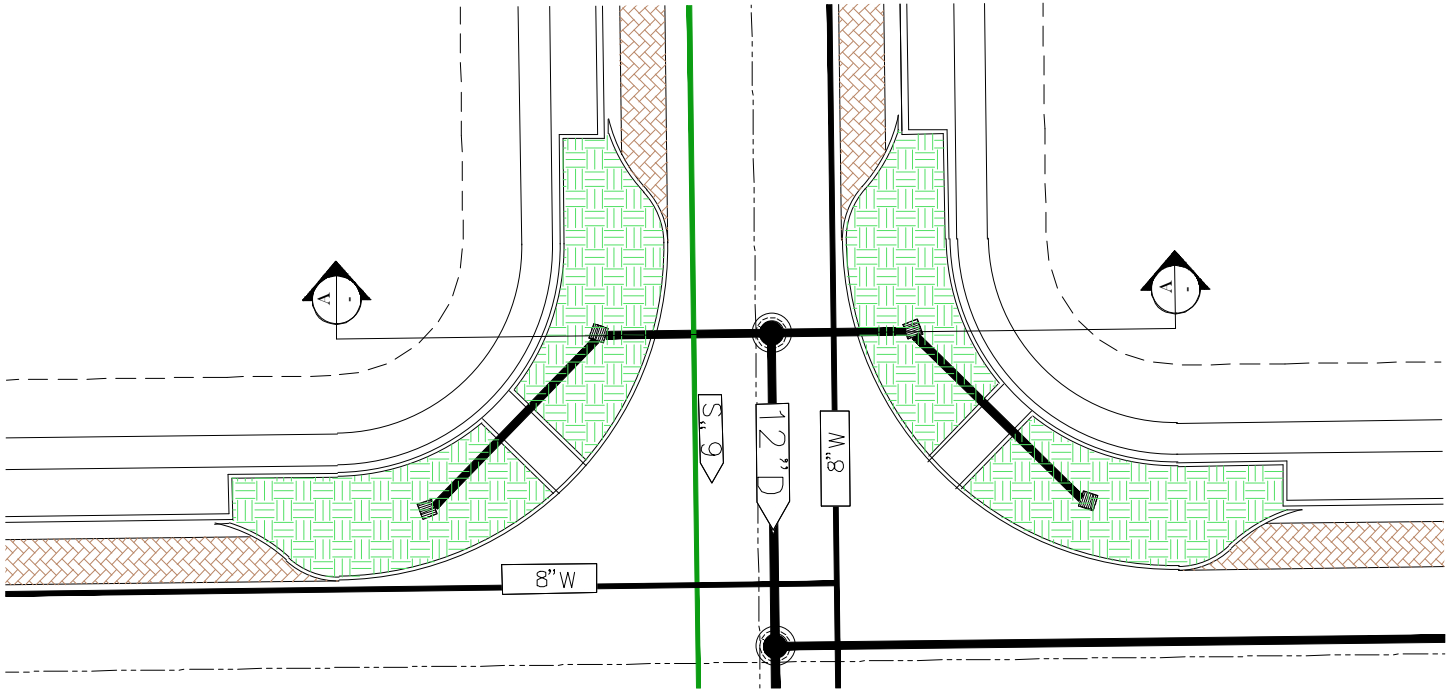
NOT TO SCALE

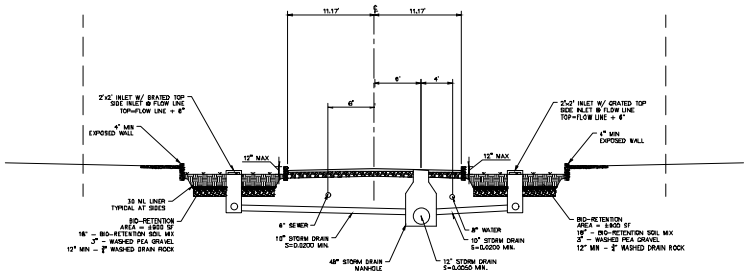
PRIVATE ONSITE USE ONLY

BIO-RETENTION BASIN SECTION

PROVIDENCE PARK

PLACER COUNTY, CA





A STREET SECTION

SEPTEMBER 14, 2016

TSD ENGINEERING, INC.
CIVIL ENGINEERS
91 Natoma Street, Suite #100
Folsom, CA 95630
Phone: (916) 608-6707
Fax: (916) 608-6701

APPENDIX F- 100-YEAR FLOOD PLAIN

Preliminary Hydrology and Hydraulics Study for Estimation of 100-Year Flood Boundaries and Elevations.

Michael S. Thomas, P.E.
235 Montgomery Street, Suite 706
San Francisco, California 94104
Phone: (415) 298-7403

June 6, 2016

TSD Engineering, Inc.
31 Natoma Street, Ste. 160
Folsom, California 95630
Attention: Mr. Casey Feickert

Re: Danbury Park – Preliminary Hydrology and Hydraulics Study for Estimation of 100-year flood Boundaries and Elevations

Dear Casey:

This letter report presents the findings of our review of hydrologic and hydraulic conditions at the Danbury Park project sites to estimate the limits of the 100-year floodplain. This report presents the analytical methods and results used to prepare a map that illustrates the estimated limits of the 100-year floodplain.

Hydrology

The Danbury Park project is proposed to be subdivided and developed as single-family residential parcels. It is currently undeveloped land located on the south side of PFE Road and between Antelope North Road and Antelope Oaks Road, as shown on Figure 1 in Attachment A. Danbury Park (Site) comprises approximately 45-acres of land with slopes ranging from flat to 20-percent.

The 2011 Update to the Dry Creek Watershed Flood Control Plan prepared by Civil Engineering Solutions, Inc. and RBF Consulting (CES 2011), reveals that the Danbury Park is part of a 1,500-acre watershed (DC80) that discharges into Dry Creek about 1.1-miles west of Atkinson Street, downstream of the City of Roseville Corporate Limits. The DC80 watershed extends from just north of Interstate 80 to Dry Creek and North of HWY 80.The majority of the Site is located in the watershed sub-basins DC80J and DC80A; a small portion of Site, located at its northwest corner, is located within sub-basin DC80C.

The hydrologic response of watershed DC80 was evaluated using the U.S. Army Corps of Engineers Hydrologic Engineering Center (HEC) Hydrologic Modeling System (HMS) computer program. Hydrologic parameters used in the HEC-HMS computer model generally include:

- meteorological data (precipitation data);
- watershed sub-basin data (area, infiltration losses, percent impervious, kinematic wave overland flow length, slope and roughness), and
- Reach routing data (runoff collector length, slope, roughness and channel type and geometry)

Key hydrologic parameters for the DC80 watershed sub-basins and reach routing segments were extracted from CES 2011. Figure 2 in Attachment A shows the watershed sub-basin boundaries used in the HEC-HMS model for the Danbury Park project; which are overlaid on a background map compiled from several plates extracted from CES 2011.

The HEC-HMS computer modeling program was used to estimating runoff rates entering and flowing through the site toward Dry Creek. Runoff estimates for the “full build-out” land use condition were developed using sub-basin characteristics presented in CES 2011, including initial precipitation losses of 0.1 inches and constant infiltration losses ranging from 0.07 to 0.19. Table 1 in Attachment B shows the sub-basin data extracted from CES 2011 and used in the HEC-HMS model for Danbury Park; the extracted data shown in Table 1 in attachment B follows the HEC-1 data format.

Meteorological data represents the design storm precipitation that drives runoff rate estimates. Design storm precipitation data was developed using the procedures and guidance provided in the Placer County Stormwater Management Manual (SWMM). The resulting precipitation amount and duration data used in the HEC-HMS model is presented in Table 2 in Attachment B. The data represent a balanced design storm of 10-days duration for a site with an average elevation of 120 feet and storm frequencies of 2-, 10-, 25-, 100- and 200-years.

The site is traversed from south to north by Antelope Road North - East Tributary, for a distance of approximately 2000-feet. Antelope Road North - East Tributary has a general slope of 0.4-percent as it crosses the site. An unnamed tributary also meanders through the site generally from southwest to northeast for a distance of approximately 1700-feet and merges with Antelope Road North - East Tributary.

The HEC-HMS model results are provided in Table 3 in Attachment B. The model results are similar to and within the range of values presented in CES 2011. The HEC-HMS model input and output files are on the CD provided in Attachment D.

Hydraulics

The U.S. Army Corps of Engineers HEC River Analysis System (HEC-RAS) computer model was used to analyze the water surface profiles along the Antelope Road North - East Tributary and the Unnamed tributary, as they cross the Site.

The starting water surface elevation for the 100-year and 10-year downstream water boundary condition was derived from the Federal Emergency Management Agency (FEMA) Effective Flood Insurance Study (FIS) which shows 100-year flood elevation on the downstream side of PFE Road of 112 feet (NGVD 1929) and 108 feet for the 10-year flood. The source information is provided in Attachment C. For the starting elevation for the 2- and 25-year events, data was interpolated as shown on Figure 3 in Attachment A. Roughness (Manning's n) values were based on the SWMM and are documented in Attachment C and are 0.065 for the natural channel and 0.08 for the floodplain.

Site aerial topography for the Danbury Park site was provided to MST by TSD Engineering, Inc. and is dated October, 2014 with supplemental spot elevations on January, 2016. HEC-RAS cross-section data was developed using the topographic survey. The bridge at PFE Road was modeled as a box culvert with a clear span of 14.5-feet and a height of 7.5 feet.

Flow rates as depicted on Table 3 in Attachment B were used to estimate the 100-year flood plain limits. Modeled flow rates and calculated water surface elevations are shown in Table 4 in Attachment B. Figure 4 in Attachment A shows the profile water surface elevations for 2-, 10-, 25-, and 100-year events for Antelope Road North - East Tributary reaches 1 and 2 and Unnamed Reach.

Figure 5 in Attachment A provides a map of the HEC-RAS model sections and the flood plain limits for the 100-year event.

The HEC-RAS model input and output files are provided on a CD in Attachment D.

Design Recommendations

The following preliminary design recommendations are provided with this report and conform to the requirements of the Placer County Stormwater Manual:

1. Site grading limits should terminate outside of the extents of the 100-year flood plain, as determined by this study;

2. We recommend that the limits of all lots fall outside the extents of the 100-year flood plain, as determined by this study.

2. We recommend that the limits of all lots fall outside the extents of the 100-year flood plain, as determined by this study.

3. The Placer County Stormwater Management Manual specifies that the 100-year water surface elevation should be a minimum of 1-foot below building pads. We recommend that the minimum pad elevation be set at 2-feet above the regulatory 100-year flood elevation, if the lot is next to a bridge.

If you have any questions or require any further information, please call me at the above number or e-mail me at michael.thomas.pe.@gmail.com.

Sincerely,

Michael S. Thomas, P.E.
Consulting Civil Engineer
Reg. No. C46957

Attachments:

Attachment A – Figures

Attachment B – Tables

Attachment C – Miscellaneous Supporting Information

Attachment D –Computer Model (HEC-HMS/HEC-RAS) Files (CD)

Attachment A – Figures

Figure 1. Danbury Park Site Location
Figure 2. CD80 Watershed Boundary Sub-Basins and HEC-HMS Model Schematic
Figure 3. Interpolation of downstream starting elevation Data
Figure 4. HEC-RAS Water Surface Profiles
Figure 5. HEC-RAS Model Schematic and Results

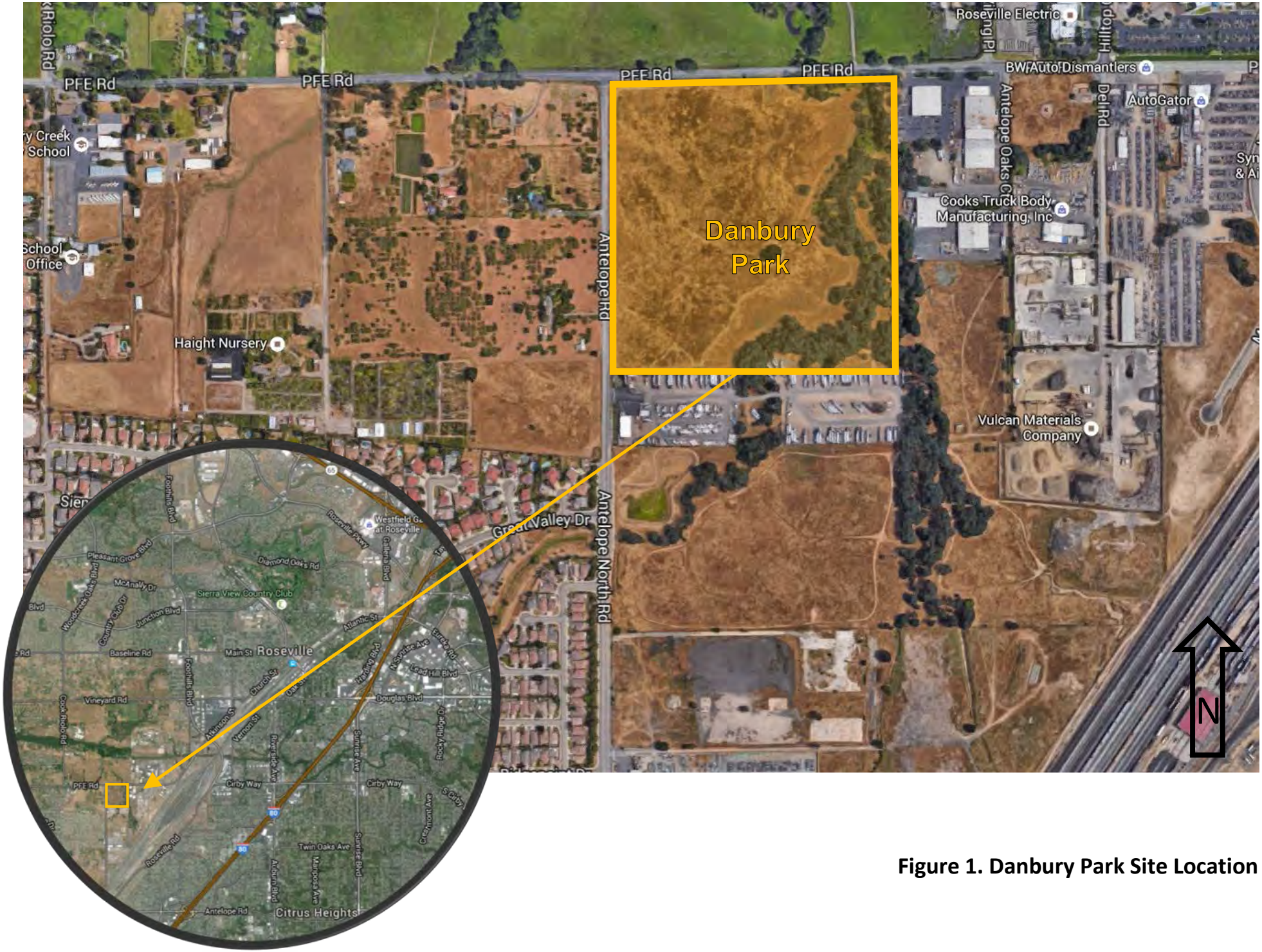
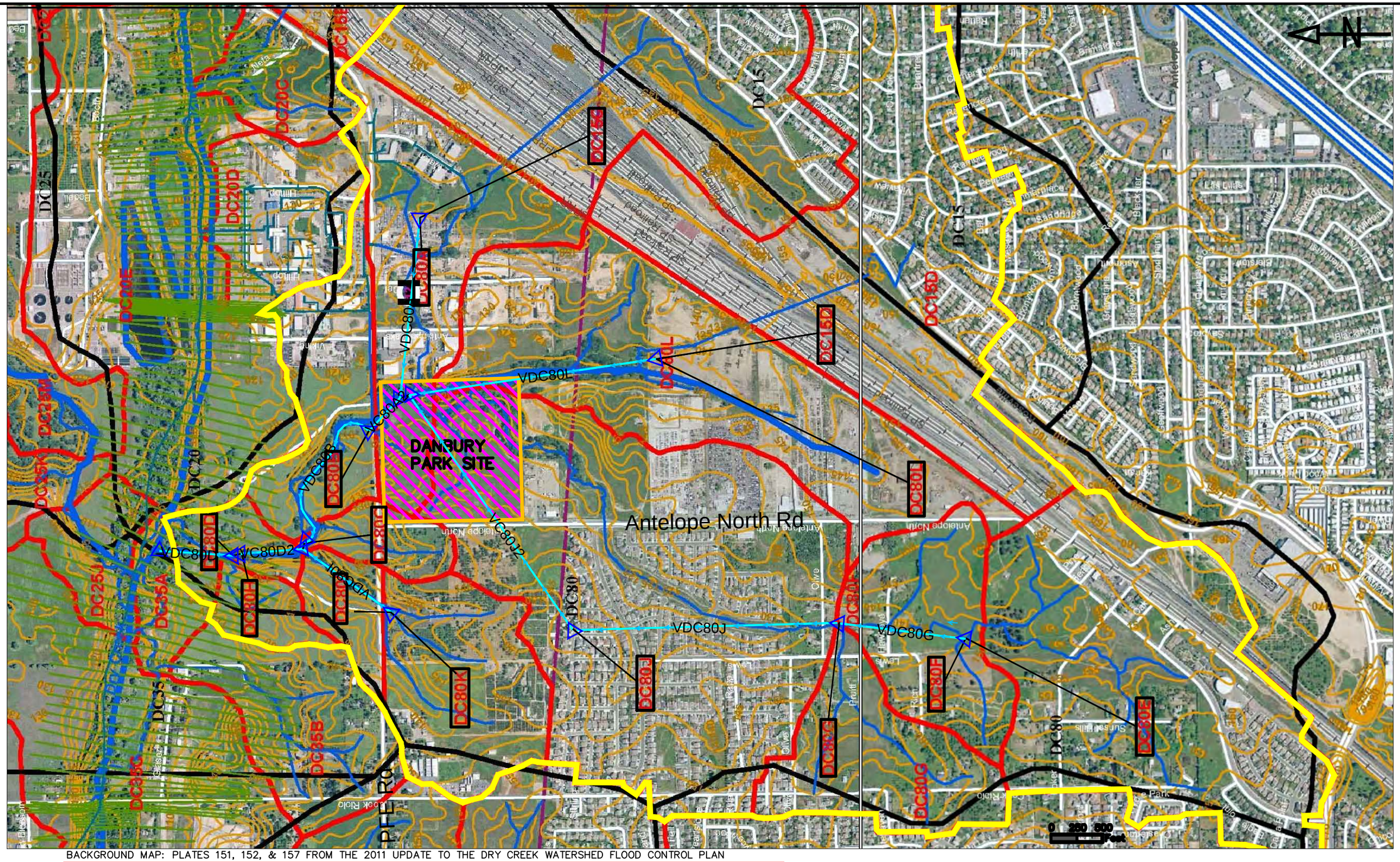


Figure 1. Danbury Park Site Location



BACKGROUND MAP: PLATES 151, 152, & 157 FROM THE 2011 UPDATE TO THE DRY CREEK WATERSHED FLOOD CONTROL PLAN

LEGEND

- 1992 PLAN WATERSHEDS BOUNDARIES
- WATERSHED BOUNDARY FROM 2011 UPDATE TO THE DRY CREEK WATERSHED FLOOD CONTROL PLAN
- DANBURY PARK HEC-HMS MODEL WATERSHED SUB-BASIN BOUNDARIES
- DANBURY PARK SITE LIMITS
- DC80J — SUB-BASIN LABEL
- VDC80J — REACH ROUTE LABEL

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DC80 WATERSHED
SUB-BASIN BOUNDARIES
AND HEC-HMS MODEL SCHEMATIC

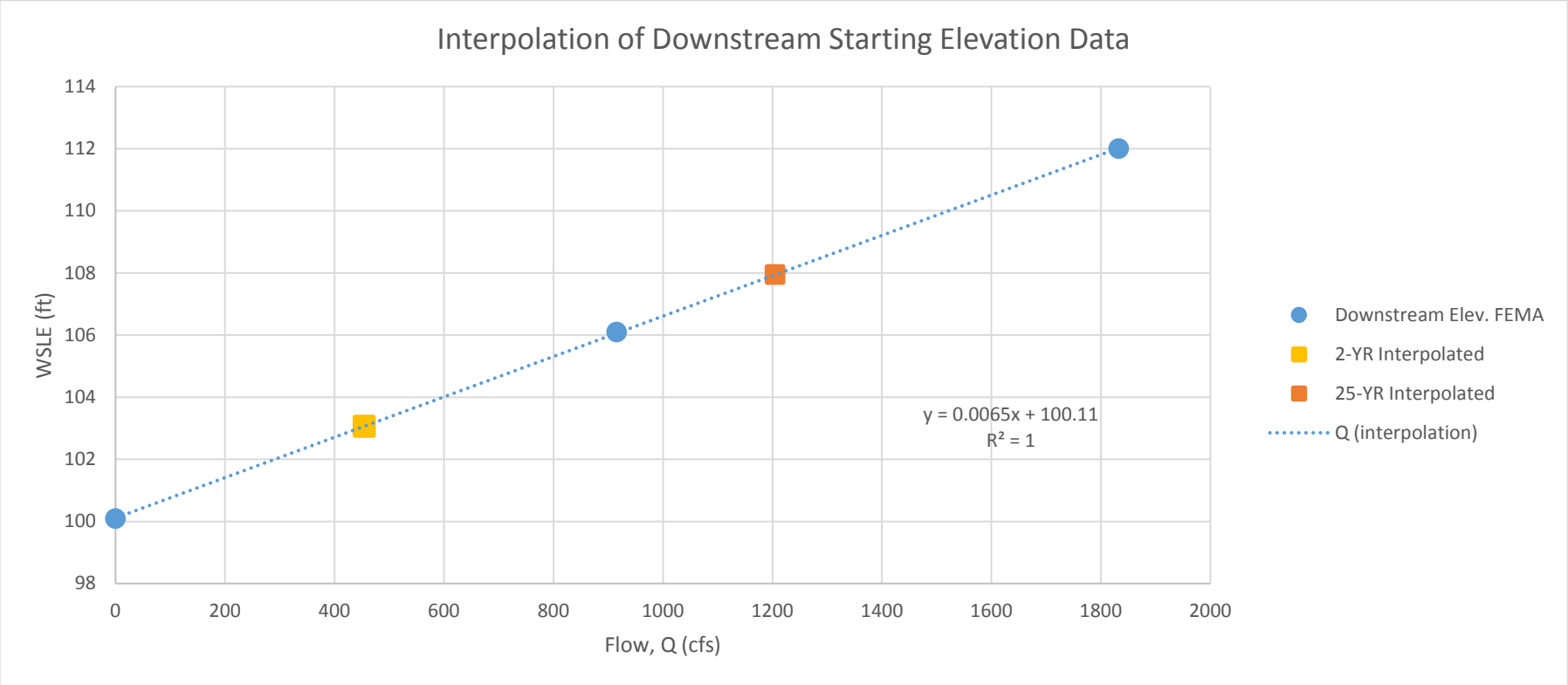
DATE 5/31/2015
SCALE 1" = 1000'
DRAWN --

SHEET
Figure 2

Figure 3. Interpolation of Downstream Starting Elevation Data

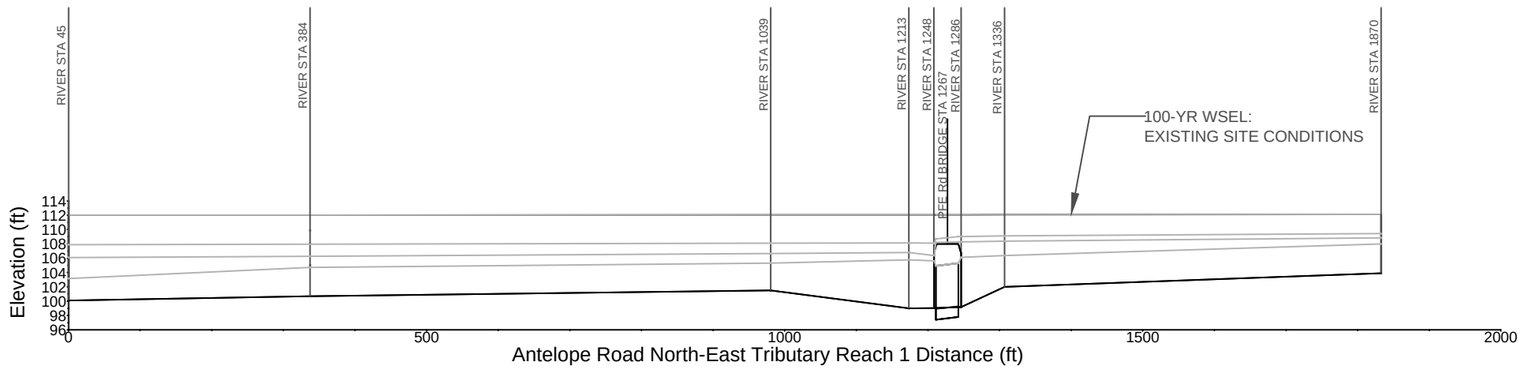
From FEMA-Flood Profiles		
YR-Event	**Q**	**Elev**
0	0	100.09
10	915.6	106.1
100	1832.6	112

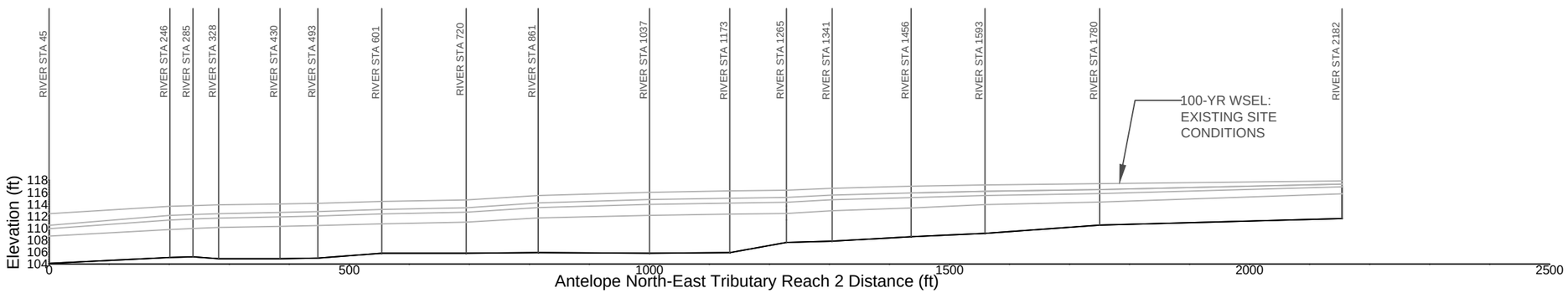
	Interpolation	
YR-Event	Elev	Q
0	100.11	0
2	103.06	454.3
10	106.06	915.6
25	107.94	1205.2
100	112.02	1832.6
200	112.38	1887

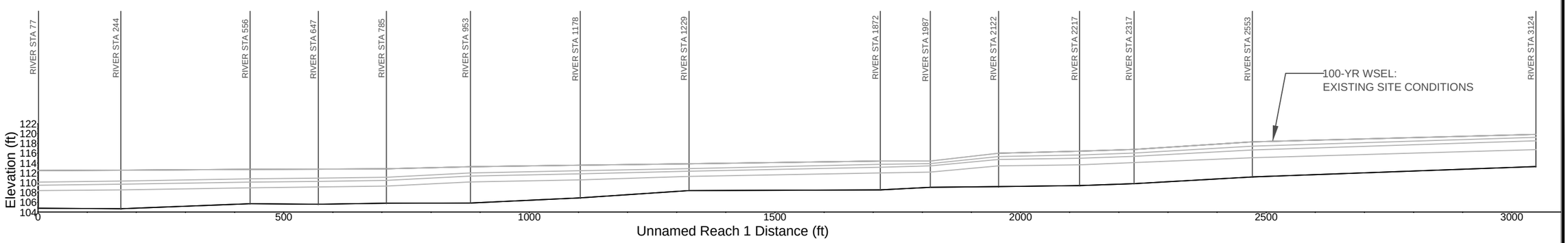


10- and 100-YR Water Surface Elevations Source: FEMA-Flood Insurance Study No. 06061CV002. Revised: Nov. 21, 2001

HEC-RAS Model PROFILE RESULTS







Legend

- WS 100-YR
- WS 25-YR
- WS 10-YR
- WS 2-YR
- Ground

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MST

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31 Natomas Street, Suite. 160
Folson, CA 95630

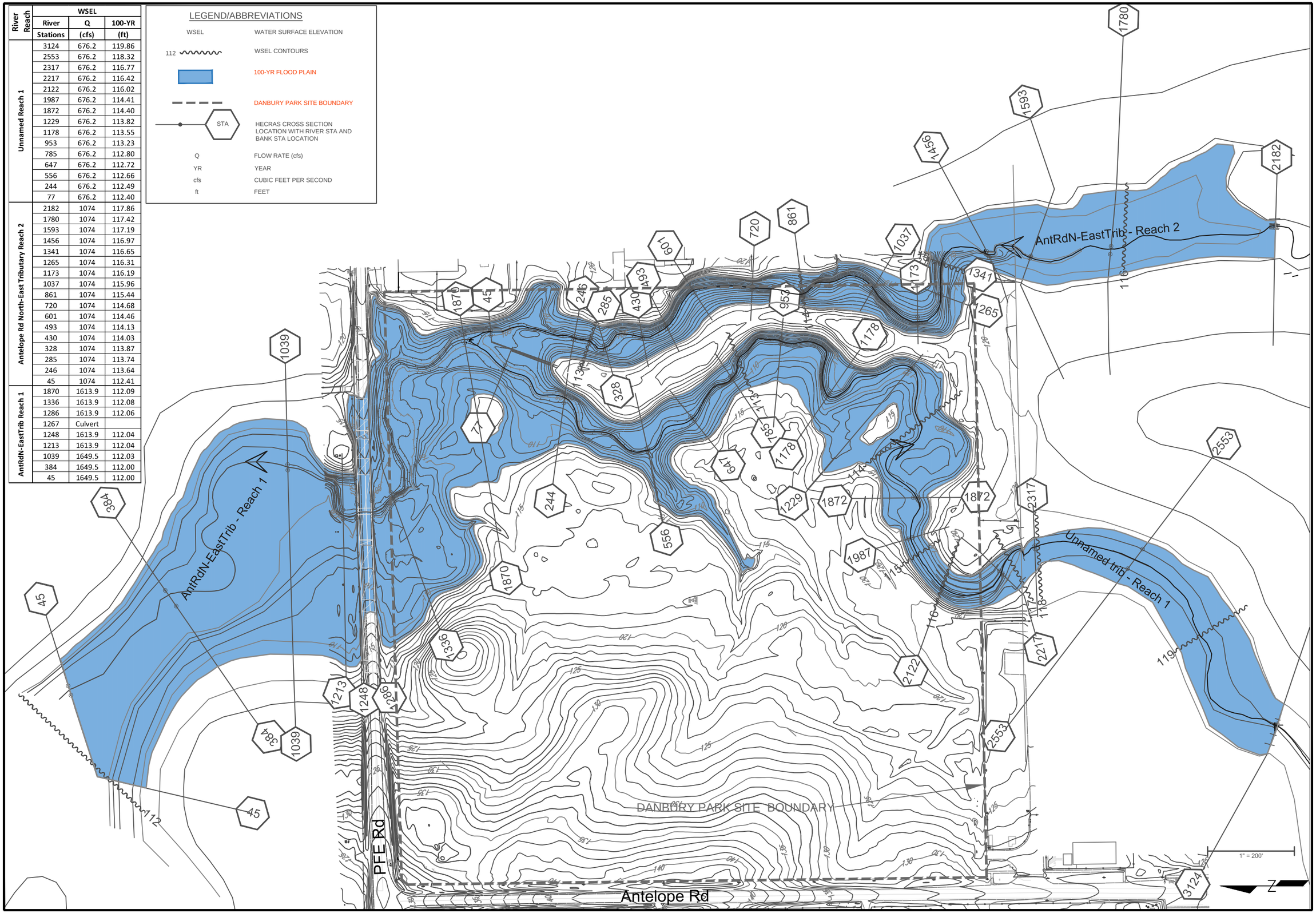
HEC-RAS
WATER SURFACE PROFILES

DATE 06-02-2016
SCALE --
DRAWN
--
SHEET
Figure 4

River Reach	WSEL River Stations	WSEL Q (cfs)	WSEL 100-YR (ft)
Unnamed Reach 1	3124	676.2	119.86
	2553	676.2	118.32
	2317	676.2	116.77
	2217	676.2	116.42
	2122	676.2	116.02
	1987	676.2	114.41
	1872	676.2	114.40
	1229	676.2	113.82
	1178	676.2	113.55
	953	676.2	113.23
	785	676.2	112.80
	647	676.2	112.72
	556	676.2	112.66
	244	676.2	112.49
	77	676.2	112.40
Antelope Rd North-East Tributary Reach 2	2182	1074	117.86
	1780	1074	117.42
	1593	1074	117.19
	1456	1074	116.97
	1341	1074	116.65
	1265	1074	116.31
	1173	1074	116.19
	1037	1074	115.96
	861	1074	115.44
	720	1074	114.68
	601	1074	114.46
	493	1074	114.13
	430	1074	114.03
	328	1074	113.87
	285	1074	113.74
	246	1074	113.64
	45	1074	112.41
AntRdN-EastTrib Reach 1	1870	1613.9	112.09
	1336	1613.9	112.08
	1286	1613.9	112.06
	1267	Culvert	
	1248	1613.9	112.04
	1213	1613.9	112.04
	1039	1649.5	112.03
	384	1649.5	112.00
	45	1649.5	112.00

LEGEND/ABBREVIATIONS

WSEL	WATER SURFACE ELEVATION
112	WSEL CONTOURS
	100-YR FLOOD PLAIN
	DANBURY PARK SITE BOUNDARY
STA	HECRAS CROSS SECTION LOCATION WITH RIVER STA AND BANK STA LOCATION
Q	FLOW RATE (cfs)
YR	YEAR
cfs	CUBIC FEET PER SECOND
ft	FEET



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HEC-RAS MODEL
SCHEMATIC AND RESULTS

DATE 06-02-2016
SCALE 1" = 200'
DRAWN
SHEET

Figure 5

Attachment B – Tables

Table 1. Extracted Hydraulic Parameters for DC80 Watershed Sub-Basins
Table 2. Precipitation Amount and Duration Data Used
Table 3. Summary of HEC-HMS Results
Table 4. Summary of HEC-RAS Model Results

WATERSHED

			LU CARDS						UK CARDS											RD1 CARD ITEMS		
	BA		PLANE 1	0.3212572		PLANE 2	0.48		PLANE 1	0.005	0.4		PLANE 2						0.08			20
shed	KM (DO NOT USE COMMA CHARACTER IN DESCRIPTIONS)	AREA MI^2	Init Abs	Const Infilt	% Imp	Init Abs	Const Infilt	% Imp	Length	Slope	'n' Value	% of Shed	Length	Slope	'n' Value	% of Shed	Length	Slope	'n' Value	TYPE	BW	SS
DC15C	DC15C 252.8 ac	0.39500469	0.1	0.070	2.0	0.1	0.09	61.94	409.6	0.001	0.4	0	89	0.0122	0.24	100	3798.9	0.006	0.08	TRAP	2	20
DC15D	DC15D 238.0 ac	0.37182344	0.1	0.070	2.0	0.1	0.10	56.96	484.0	0.001	0.4	0	94	0.0112	0.24	100	5925.0	0.004	0.08	TRAP	2	20
DC80A	DC80A 94.8 ac	0.14814063	0.1	0.080	2.0	0.1	0.08	77.01	350.3	0.001	0.4	6.91066343	73	0.01567	0.24	93.1	1362.4	0.011	0.08	TRAP	2	20
DC80B	DC80B 54.1 ac	0.08457969	0.1	0.081	2.0	0.1	0.09	71.15	291.8	0.001	0.4	23.3489128	79	0.0142	0.24	76.7	1812.8	0.015	0.08	TRAP	2	20
DC80C	DC80C 17.0 ac	0.02656406	0.1	0.083	2.0	0.1	0.12	76.49	440.5	0.001	0.4	6.9344783	74	0.01533	0.24	93.1	1570.0	0.025	0.08	TRAP	2	20
DC80D	DC80D 18.5 ac	0.02884844	0.1	0.197	2.0	0.1	0.27	44.18	379.0	0.001	0.4	55.4051127	118	0.01	0.24	44.6	369.5	0.048	0.08	TRAP	2	20
DC80E	DC80E 180.4 ac	0.28179844	0.1	0.070	5.0	0.1	0.08	73.83	603.7	0.005	0.4	52.1760345	77	0.0146	0.24	47.8	4420.8	0.007	0.08	TRAP	2	20
DC80F	DC80F 61.3 ac	0.09580625	0.1	0.070	5.0	0.1	0.07	80.00	394.2	0.005	0.4	97.3383348	70	0.01667	0.24	2.7	1126.5	0.023	0.08	TRAP	2	20
DC80G	DC80G 60.7 ac	0.09478438	0.1	0.070	5.0	0.1	0.12	40.00	545.3	0.005	0.4	72.029805	130	0.01	0.24	28.0	2418.0	0.013	0.08	TRAP	2	20
DC80H	DC80H 14.3 ac	0.02237344	0.1	0.098	2.0	0.1	0.20	35.00	216.4	0.001	0.4	1.32681564	140	0.01	0.24	98.7	1327.9	0.022	0.08	TRAP	2	20
DC80I	DC80I 18.0 ac	0.02811563	0.1	0.082	2.0	0.1	0.12	37.64	343.2	0.001	0.4	23.6454571	136	0.01	0.24	76.4	624.5	0.029	0.08	TRAP	2	20
DC80J	DC80J 262.6 ac	0.41027031	0.1	0.075	3.7	0.1	0.11	54.68	481.2	0.0023	0.4	9.05282241	96	0.0108	0.24	90.9	2072.1	0.013	0.08	TRAP	2	20
DC80K	DC80K 65.7 ac	0.10268281	0.1	0.075	2.0	0.1	0.12	37.53	312.4	0.001	0.4	0.10499566	136	0.01	0.24	99.9	2335.3	0.012	0.08	TRAP	2	20
DC80L	DC80L 161.4 ac	0.25223594	0.1	0.076	3.4	0.1	0.07	79.93	600.0	0.0023	0.4	4.97636644	71	0.01633	0.24	95.0	800.0	0.020	0.08	TRAP	2	20

sum= 2.343028125

ROUTING

ALIAS	KK	KM (DO NOT USE COMMA CHARACTER IN DESCRIPTIONS)	Length	Slope	'n' Value	Portion	TYPE	BW	SS
Text_for_B7_formula									
	VDC80A	Routing Fr/Thru DC80A	1723.863	0.0094	0.04		TRAP	10	10
	VC80A2	Routing Fr/Thru DC80A	438.401	0.0041	0.04		TRAP	10	10
	VDC80B	Routing Fr/Thru DC80B	1609.685	0.0037	0.04		TRAP	10	10
	VDC80D	Routing Fr/Thru DC80D	708.191	0.0103	0.04		TRAP	10	10
	VC80D2	Routing Fr/Thru DC80D	601.287	0.0032	0.04		TRAP	10	10
	VDC80F	Routing Fr/Thru DC80F	1225.6	0.0038	0.04		TRAP	10	10
	VDC80I	Routing Fr/Thru DC80I	1058.876	0.0167	0.04		TRAP	10	10
	VDC80J	Routing Fr/Thru DC80J	2505.209	0.0055	0.04		TRAP	10	10
	VC80J2	Routing Fr/Thru DC80J	2751.075	0.0043	0.04		TRAP	10	10
	VDC80L	Routing Fr/Thru DC80L	2400.122	0.0052	0.04		TRAP	10	10

Source:2011 Update to the Dry Creek Watershed Flood Control Plan (CES 2011).

Table 1. Extracted Hydraulic Parameters for DC80 Watershed Sub-Basins

Danbury Park Subdivision
Placer County, CA
25-Mar-16

Precipitation

Precipitation Depth (D) = mE+b where: E = Elevation (ft)
m and b from Table 5-A-1, Appendix V-A

Precipitation Depth at 150 feet elevation (b)

Duration	2-yr	10-yr	25-yr	100-yr	200-yr
5	0.130	0.250	0.320	0.440	0.490
10	0.190	0.360	0.460	0.620	0.700
15	0.230	0.430	0.550	0.730	0.820
30	0.320	0.570	0.720	0.940	1.040
1h	0.450	0.770	0.940	1.210	1.330
2h	0.640	1.040	1.260	1.590	1.760
3h	0.770	1.230	1.470	1.850	2.030
6h	1.060	1.650	1.950	2.230	2.750
12h	1.430	2.240	2.670	3.300	3.600
1d	1.900	2.980	3.460	4.250	4.600
2d	2.510	3.950	4.650	5.700	6.200
3d	3.000	4.650	5.500	6.800	7.500
5d	3.610	5.760	6.850	8.420	9.200
10d	4.730	7.540	8.960	11.010	11.950

Change in Depth (m) per 1000 Feet of Elevation

Duration	2-yr	10-yr	25-yr	100-yr	200-yr
5	0.0070	-0.0030	-0.0070	-0.0230	-0.0270
10	0.0070	0.0000	-0.0100	-0.0270	-0.0370
15	0.0170	0.0130	0.0030	-0.0100	-0.0130
30	0.0300	0.0400	0.0400	0.0400	0.0400
1h	0.0630	0.1000	0.1200	0.1370	0.1570
2h	0.1070	0.1930	0.2300	0.2870	0.3130
3h	0.1430	0.2630	0.3270	0.4130	0.4570
6h	0.2300	0.4330	0.5400	0.7330	0.7570
12h	0.4530	0.8200	0.9770	1.2500	1.4000
1d	0.7000	1.2400	1.5470	1.9830	2.2000
2d	1.1630	2.0170	2.4830	3.1670	3.5330
3d	1.6470	2.8500	3.5000	4.3830	4.8330
5d	2.2870	3.9130	4.7170	5.9600	6.6000
10d	3.4900	5.9870	7.1800	8.9970	10.3500

Average site elevation = 120 feet (E)
Factor is 0.12

Precipitation Depth at Site D = Em+B

Duration	2-yr	10-yr	25-yr	100-yr	125% of 100-yr	200-yr
5	0.13	0.25	0.32	0.44	0.55	0.49
10	0.19	0.36	0.46	0.62	0.77	0.70
15	0.23	0.43	0.55	0.73	0.91	0.82
30	0.32	0.57	0.72	0.94	1.18	1.04
1h	0.46	0.78	0.95	1.23	1.53	1.35
2h	0.65	1.06	1.29	1.62	2.03	1.80
3h	0.79	1.26	1.51	1.90	2.37	2.08
6h	1.09	1.70	2.01	2.32	2.90	2.84
12h	1.48	2.34	2.79	3.45	4.31	3.77
1d	1.98	3.13	3.65	4.49	5.61	4.86
2d	2.65	4.19	4.95	6.08	7.60	6.62
3d	3.20	4.99	5.92	7.33	9.16	8.08
5d	3.88	6.23	7.42	9.14	11.42	9.99
10d	5.15	8.26	9.82	12.09	15.11	13.19

Table 5-A-1
Depth-Duration-Frequency Coefficients

150 - 3000 feet elevation
West of Sierra Nevada Crest

Depths in inches at 150 feet

Duration	2yr	5yr	10yr	25yr	50yr	100yr	200yr	500yr
5m	0.13	0.20	0.25	0.32	0.38	0.44	0.49	0.58
10m	0.19	0.29	0.36	0.46	0.54	0.62	0.70	0.82
15m	0.23	0.35	0.43	0.55	0.64	0.73	0.82	0.96
30m	0.32	0.47	0.57	0.72	0.83	0.94	1.04	1.22
1h	0.45	0.64	0.77	0.94	1.07	1.21	1.33	1.53
2h	0.64	0.88	1.04	1.26	1.42	1.59	1.76	2.00
3h	0.77	1.04	1.23	1.47	1.66	1.85	2.03	2.31
6h	1.06	1.40	1.65	1.95	2.22	2.23	2.75	3.10
12h	1.43	1.91	2.24	2.67	3.00	3.30	3.60	4.00
1d	1.90	2.50	2.98	3.46	3.85	4.25	4.60	5.20
2d	2.51	3.40	3.95	4.65	5.15	5.70	6.20	7.00
3d	3.00	4.07	4.65	5.50	6.20	6.80	7.50	8.40
5d	3.61	4.91	5.76	6.85	7.63	8.42	9.20	10.29
10d	4.73	6.44	7.54	8.96	9.97	11.01	11.95	13.45

Change in depth, inches per 1000 feet

Duration	2yr	5yr	10yr	25yr	50yr	100yr	200yr	500yr
5m	0.007	0.000	-0.003	-0.007	-0.017	-0.023	-0.027	-0.037
10m	0.007	0.003	0.000	-0.010	-0.020	-0.027	-0.037	-0.050
15m	0.017	0.013	0.013	0.003	0.000	-0.007	-0.013	-0.027
30m	0.030	0.040	0.040	0.040	0.040	0.040	0.040	0.030
1h	0.063	0.087	0.100	0.120	0.133	0.137	0.157	0.173
2h	0.107	0.157	0.193	0.230	0.260	0.287	0.313	0.350
3h	0.143	0.220	0.263	0.327	0.373	0.413	0.457	0.513
6h	0.230	0.357	0.433	0.540	0.593	0.733	0.757	0.850
12h	0.453	0.663	0.820	0.977	1.127	1.250	1.400	1.600
1d	0.700	1.037	1.240	1.547	1.783	1.983	2.200	2.500
2d	1.163	1.667	2.017	2.483	2.850	3.167	3.533	4.000
3d	1.647	2.343	2.850	3.500	3.933	4.383	4.833	5.533
5d	2.287	3.230	3.913	4.717	5.390	5.960	6.600	7.570
10d	3.490	4.920	5.987	7.180	8.177	8.997	10.350	11.683

Table 2. Precipitation Amount and Duration Data Used

			Model Scenarios									
			2-YR Full Built-Out		10-YR Full Built-Out		25-YR Full Built-Out		100-YR Full Built-Out		200-YR Full Built-Out	
	Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Volume (IN)	Peak Discharge (CFS)	Volume (IN)	Peak Discharge (CFS)	Volume (IN)	Peak Discharge (CFS)	Volume (IN)	Peak Discharge (CFS)	Volume (IN)
	DC80E	0.28180	45.4	2.36	97.2	4.01	128.6	4.92	176.8	6.53	204.5	6.95
	DC80F	0.09581	12.6	0.98	28.8	1.97	38.6	2.52	55.2	3.6	63.8	3.96
	YDC80F	0.37761	56.8	2.01	125.8	3.49	166.9	4.31	231.8	5.79	268.3	6.19
	VDC80F	0.37761	56.7	2.01	125.3	3.49	166.2	4.31	231.0	5.78	266.9	6.19
	DC80G	0.09478	12.2	1.28	30.3	2.38	40.7	3.01	58.2	4.18	68.3	4.54
	YDC80G	0.47239	67.7	1.86	151.8	3.27	202.4	4.05	280.5	5.46	326.3	5.86
	VDC80J	0.47239	67.5	1.86	151.6	3.26	201.9	4.04	280.0	5.45	325.3	5.85
	DC80J	0.41027	149.2	2.83	318.9	4.66	438.2	5.7	624.8	7.45	712.6	7.86
	YDC80J	0.88266	168.3	2.31	362.7	3.91	499	4.82	709.8	6.38	819.1	6.78
Unnamed Trib-Reach1	**VC80J2**	0.88266	165.9	2.3	356.6	3.9	491.7	4.81	676.2	6.37	778.9	6.78
	DC15D	0.37182	82.1	3.14	159.9	5.14	206.2	6.27	282.9	8.13	316.5	8.56
	DC80L	0.25224	128.3	4.09	282.1	6.59	378.5	7.94	522.0	10.25	593.3	10.74
	YDC80L	0.62406	291.1	2.81	592.2	4.66	803.3	5.69	1090.1	7.45	1237.2	7.88
AntRd-EastTrib-Reach 2	**VCD80L**	0.62406	288	2.81	591.2	4.65	772.3	5.69	1074.0	7.45	1230.7	7.87
	YC80L2	1.50672	288	2.81	591.2	4.65	772.3	5.69	1074.0	7.45	1230.7	7.87
	DC15C	0.39500	124	3.4	246.5	5.54	325.7	6.73	449.5	8.7	505.7	9.14
	DC80A	0.14814	66.5	3.88	139.8	6.27	180.1	7.58	256.8	9.78	299.5	10.25
	YDC80A	0.54314	169.5	3.53	339.2	5.74	451.6	6.96	629.7	8.99	715.8	9.44
	VDC80A	0.54314	169	3.53	337.8	5.74	447.3	6.96	622.6	8.98	706.2	9.44
	YC80A2	2.04986	169	3.53	337.8	5.74	447.3	6.96	622.6	8.98	706.2	9.44
PFE Road Crossing	**VC80A2**	2.04986	440.5	3	890.9	4.94	1164.4	6.02	1613.9	7.85	1837.4	8.29
	DC80B	0.08458	28.1	3.08	57.9	5.07	79.4	6.17	113.0	8.02	130.5	8.44
	YDC80B	2.13444	456.7	3	920.5	4.95	1207.6	6.03	1666.4	7.86	1893.9	8.29
D.S. of PFE Road	**VDC80B**	2.13444	454.3	3	915.6	4.94	1205.2	6.03	1649.5	7.86	1887	8.29
	DC80C	0.02656	10.9	3.81	22.7	6.15	30.6	7.43	42.6	9.59	48.1	10.06
	YDC80C	2.16100	458.6	3.01	923.6	4.96	1216.2	6.04	1662.7	7.88	1904.5	8.31
	DC80K	0.10268	30.7	2.18	66.7	3.66	88.5	4.5	128.6	5.97	147.1	6.34
	DC80I	0.02812	7.4	1.84	17.3	3.15	23.7	3.91	34.1	5.24	38.8	5.58
	YDC80I	0.13080	37	2.11	80	3.55	108.7	4.37	155.4	5.82	176.6	6.18
	VDC80I	0.13080	36.6	2.11	79.5	3.55	107.3	4.37	149.3	5.81	171.8	6.17
	YD80I2	2.29180	489.9	2.96	983.3	4.88	1301.2	5.95	1781.9	7.76	2044.8	8.19
	VC80D2	2.29180	488	2.95	981.8	4.88	1292.1	5.95	1771.6	7.76	2031.2	8.19
	DC80H	0.02237	5.9	1.95	14.7	3.27	20.5	4	29.5	5.21	34.5	5.61
	YDC80H	2.31417	491.4	2.94	989.5	4.86	1303.2	5.93	1784.9	7.73	2049.7	8.16
	DC80D	0.02885	4	1.26	10.5	2.2	14.6	2.73	22.4	3.62	26.9	3.96
	YDC80D	2.34302	493	2.92	993.8	4.83	1309.4	5.89	1793.7	7.68	2060.6	8.11
	VDC80D	2.34302	492.4	2.92	991.5	4.83	1302.1	5.89	1793.4	7.68	2042.2	8.11
	YC80D2	2.34302	492.4	2.92	991.5	4.83	1302.1	5.89	1793.4	7.68	2042.2	8.11

Flows used for HEC-RAS Modeling

D. S.= Down Stream

Table 3. Summary of HEC-HMS Results

Table 4. Summary of HEC-RAS Model Results

River Reach	River Stations	WSEL							
		100-YR		25-YR		10-YR		2-YR	
		Q (cfs)	WSEL (ft)	Q (cfs)	WSEL (ft)	Q (cfs)	WSEL (ft)	Q (cfs)	WSEL (ft)
Unnamed Reach 1	3124	676.2	119.86	491.7	119.24	356.6	118.53	165.9	116.76
	2553	676.2	118.32	491.7	117.44	356.6	116.68	165.9	115.09
	2317	676.2	116.77	491.7	116.04	356.6	115.38	165.9	114.11
	2217	676.2	116.42	491.7	115.67	356.6	115.00	165.9	113.65
	2122	676.2	116.02	491.7	115.34	356.6	114.72	165.9	113.43
	1987	676.2	114.41	491.7	113.90	356.6	113.42	165.9	112.16
	1872	676.2	114.40	491.7	113.76	356.6	113.16	165.9	111.99
	1229	676.2	113.82	491.7	112.88	356.6	112.32	165.9	111.29
	1178	676.2	113.55	491.7	112.43	356.6	111.80	165.9	110.58
	953	676.2	113.23	491.7	111.97	356.6	111.34	165.9	110.15
	785	676.2	112.80	491.7	111.12	356.6	110.47	165.9	109.32
	647	676.2	112.72	491.7	110.92	356.6	110.27	165.9	109.13
	556	676.2	112.66	491.7	110.78	356.6	110.12	165.9	108.97
	244	676.2	112.49	491.7	110.34	356.6	109.69	165.9	108.54
	77	676.2	112.40	491.7	110.10	356.6	109.47	165.9	108.37
Antelope Rd North-East Tributary Reach 2	2182	607.7	117.86	772.3	117.32	591.2	116.87	288.0	115.73
	1780	607.7	117.42	772.3	116.41	591.2	115.75	288.0	114.33
	1593	607.7	117.19	772.3	116.14	591.2	115.44	288.0	113.91
	1456	607.7	116.97	772.3	115.86	591.2	115.09	288.0	113.36
	1341	607.7	116.65	772.3	115.51	591.2	114.73	288.0	112.9
	1265	607.7	116.31	772.3	115.12	591.2	114.30	288.0	112.44
	1173	607.7	116.19	772.3	114.98	591.2	114.17	288.0	112.31
	1037	607.7	115.96	772.3	114.76	591.2	113.96	288.0	112.13
	861	607.7	115.44	772.3	114.21	591.2	113.43	288.0	111.68
	720	607.7	114.68	772.3	113.40	591.2	112.65	288.0	111
	601	607.7	114.46	772.3	113.11	591.2	112.35	288.0	110.69
	493	607.7	114.13	772.3	112.76	591.2	112.02	288.0	110.44
	430	607.7	114.03	772.3	112.62	591.2	111.88	288.0	110.3
	328	607.7	113.87	772.3	112.41	591.2	111.67	288.0	110.09
	285	607.7	113.74	772.3	112.25	591.2	111.51	288.0	109.95
	246	607.7	113.64	772.3	112.10	591.2	111.35	288.0	109.75
	45	607.7	112.41	772.3	110.47	591.2	109.88	288.0	108.65
AntRdN-EastTrib Reach 1	1870	1775.1	112.09	1164.4	109.43	890.9	108.83	440.5	107.99
	1336	1775.1	112.08	1164.4	109.12	890.9	108.40	440.5	106.36
	1286	1775.1	112.06	1164.4	109.03	890.9	108.28	440.5	106.12
	1267	Culvert							
	1248	1775.1	112.04	1164.4	108.09	890.9	106.36	440.5	105.62
	1213	1775.1	112.04	1164.4	108.14	890.9	106.80	440.5	105.79
	1039	1832.6	112.03	1205.2	108.10	915.6	106.65	454.3	105.33
	384	1832.6	112.00	1205.2	107.94	915.6	106.26	454.3	104.7
	45	1832.6	112.00	1205.2	107.90	915.6	106.10	454.3	103.16

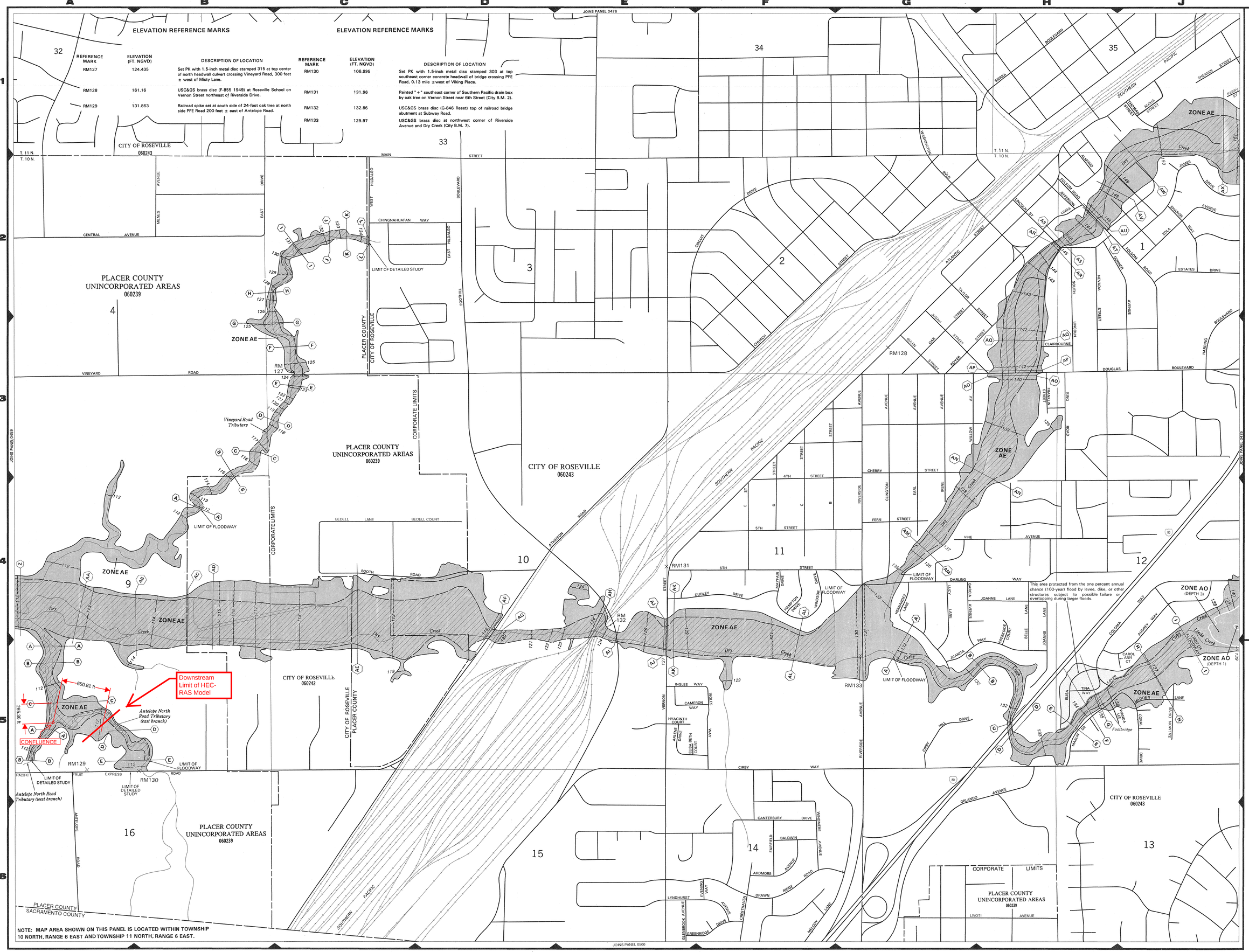
WSEL= WaterSurface Elevation, Q= Flow Rate, cfs=Cubic Feet per Second, ft=Feet

Attachment C – Miscellaneous Supporting Information

FIRM-Flood Insurance Rate Map No. 06061C0478F
2001 FIS Table 5 Summary of Discharges
Channel Mannings “n” from Placer County SWMM
Flood Plain Mannings “n” from Placer County SWMM
Profile Antelope Road North-East Tributary from 06061CV002
Profile Antelope Road North-West Tributary from 06061CV002-2

ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION (FT. NGVD)	DESCRIPTION OF LOCATION
RM127	124.435	Set PK with 1.5-inch metal disc stamped 315 at top center of north headwall culvert crossing Vineyard Road, 300 feet ± west of Misty Lane.
RM128	161.16	USC&GS brass disc (F-855 1949) at Roseville School on Vernon Street northeast of Riverside Drive.
RM129	131.863	Railroad spike set at south side of 24-foot oak tree at north side PFE Road 200 feet ± east of Antelope Road.
RM130	106.995	Set PK with 1.5-inch metal disc stamped 303 at top southeast corner concrete headwall of bridge crossing PFE Road, 0.13 mile ± west of Viking Place.
RM131	131.96	Painted "+" southeast corner of Southern Pacific drain box by oak tree on Vernon Street near 6th Street (City B.M. 2).
RM132	132.86	USC&GS brass disc (G-846 Reset) top of railroad bridge abutment at Subway Road.
RM133	129.97	USC&GS brass disc at northwest corner of Riverside Avenue and Dry Creek (City B.M. 7).



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 10 NORTH, RANGE 6 EAST AND TOWNSHIP 11 NORTH, RANGE 6 EAST.

LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

- **ZONE A** No base flood elevations determined.
- **ZONE AE** Base flood elevations determined.
- **ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
- **ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding; velocities also determined.
- **ZONE A99** To be protected from 100-year flood by federal flood protection system under construction; no base flood elevations determined.
- **ZONE V** Coastal flood with velocity hazard (wave action); no base flood elevations determined.
- **ZONE VE** Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

- **ZONE X** Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

- **ZONE X** Areas determined to be outside 500-year floodplain.
- **ZONE D** Areas in which flood hazards are undetermined.

UNDEVELOPED COASTAL BARRIERS†

Identified 1983 | Identified 1990 | Otherwise Protected Areas

†Coastal barrier areas are normally located within or adjacent to special flood hazard areas.

Floodplain Boundary

Floodway Boundary

Zone D Boundary

Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.

513 — Base Flood Elevation Line; Elevation in Feet*

D — D Cross Section Line

(EL 987) Base Flood Elevation in Feet Where Uniform Within Zone*

RM7x Elevation Reference Mark

•M1.5 River Mile

*Referenced to the National Geodetic Vertical Datum of 1929

NOTES

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas. The community map repository should be consulted for more detailed data on BFEs, and for any information on floodway delineations, prior to use of this map for property purchase or construction purposes.

Areas of Special Flood Hazard (100-year flood) include Zones A, AE, A1-A30, AH, AO, A99, V, VE and V1-V30.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Refer to Floodway Data Table where floodway width is shown at 1/20 inch.

Coastal base flood elevations apply only landward of 0.0 NGVD, and include the effects of wave action; these elevations may also differ significantly from those developed by the National Weather Service for hurricane evacuation planning.

Corporate limits shown are current as of the date of this map. The user should contact appropriate community officials to determine if corporate limits have changed subsequent to the issuance of this map.

For community map revision history prior to countywide mapping, see section 6.0 of the Flood Insurance Study Report.

For adjoining panels, see separately printed Map Index.

MAP REPOSITORY
Refer to Repository Listing on Index Map

EFFECTIVE DATE OF
COUNTYWIDE FLOOD INSURANCE RATE MAP:
JUNE 8, 1998

EFFECTIVE DATE (S) OF REVISION (S) TO THIS PANEL:

Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE DATE shown on this map to determine when actuarial rates apply to structures in the zones where elevations or depths have been established.

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 638-6620.

APPROXIMATE SCALE IN FEET
500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

PLACER COUNTY,
CALIFORNIA AND
INCORPORATED AREAS

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
PLACER COUNTY UNINCORPORATED AREAS	060239	0478	F
ROSEVILLE, CITY OF	060243	0478	F

MAP NUMBER
06061C0478 F

EFFECTIVE DATE:
JUNE 8, 1998

Federal Emergency Management Agency

Table 5. Summary of Discharges (Cont'd)

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cubic feet per second) 10-Year	50-Year	100-Year	500-Year
Dry Creek (Near Auburn)					
End of Study to Haines Road	4.5	680	1,100	1,350	2,300
Haines Road at Red Hawk Ranch Reservoir	6.5	970	1,550	1,900	3,300
At Limit of Detailed Study	7.3	1,130	1,770	2,160	3,630
Dry Creek - Antelope North Road Tributary					
At Dry Creek	2.0	775	1,190	1,350	*
Dry Creek - Billy Mitchell Road Tributary					
At Dry Creek	0.7	215	350	390	*
Dry Creek - Vineyard Road Tributary					
At Dry Creek	1.7	525	845	960	*
Dry Creek - Walerga Road Tributary					
At Dry Creek	1.3	250	450	485	*
Linda Creek					
At Champion Oaks Drive	11.3	1,570	2,900	3,300	*
At Rocky Ridge Road	16.2	2,010	3,510	4,160	*
At Mouth	16.3	1,620	1,840	1,930	*
Markham Ravine					
Fruitvale Road	2.0	670	1,090	1,520	*
Lakeside Drive	5.22	380	760	1,070	*
Nelson Lane	8.36	600	1,200	1,720	*

*Data Not Determined

Reference: FEMA. Flood Insurance Study No. 06061CV001. Placer County, CA. Nov. 21, 2001.

TABLE 8-1

MANNING N FOR STREAMS AND CHANNELS (24)

UNIFORM CHANNELS

Description	n
Concrete	0.012 - 0.016
Earth	0.017 - 0.022
Grass	0.020 - 0.025
Rock, Rubble	0.025 - 0.045

NATURAL STREAMS-CHANNELS

Channel n is a composite computed from the component n and k values in the table as follows:

$$n = k\,(n_1+n_2+n_3+n_4)$$

Component	Condition	n
Material involved (n_1)	Earth	0.020
	Rock Cut	0.025
	Fine Gravel	0.024
	Course Gravel	0.028
Degree of Irregularity (n_2)	Smooth	0.000
	Minor	0.005
	Moderate	0.010
	Severe	0.020
Relative effect of Obstructions (n_3)	Negligible	0.000
	Minor	0.010 - 0.015
	Appreciable	0.020 - 0.030
	Severe	0.040 - 0.060
Vegetation (n_4)	Low	0.005 - 0.010
	Medium	0.010 - 0.025
	High	0.025 - 0.050
	Very High	0.050 - 0.100
Degree of Meandering (k)	Minor	1.000
	Appreciable	1.150
	Severe	1.300

(1.075) x (0.026 + 0.005 + 0.0125 + 0.0175) = n
0.065

TABLE 8-1 (CONTINUED)
MANNING N FOR NATURAL STREAMS - FLOODPLAIN

Description	Condition	n
Pasture	Short Grass	0.025 - 0.035
	High Grass	0.030 - 0.050
Cultivated Areas	No Crop	0.020 - 0.040
	Mature Row Crops	0.025 - 0.045
	Mature Field Crops	0.030 - 0.050
Brush	Scattered brush, heavy weeds	0.035 - 0.070
	Light brush/trees, winter	0.035 - 0.060
	Light brush/trees, summer	0.040 - 0.080
	Medium to dense brush, winter	0.045 - 0.110
	Medium to dense brush, summer	0.070 - 0.160
Trees	Dense willows, summer, straight	0.110 - 0.200
	Cleared land with tree stumps, no sprouts	0.030 - 0.050
	Same as above, but with heavy growth of sprouts	0.050 - 0.080
	Heavy stand of timber a few down trees, little undergrowth, flood stage below branches	0.080 - 0.120
	As above, but with flood stage reaching branches	0.100 - 0.160

The effect of channel work on existing culverts, bridges, buried cables, pipelines, irrigation flumes, and inlet structures shall be evaluated to determine the need for modification or replacement.

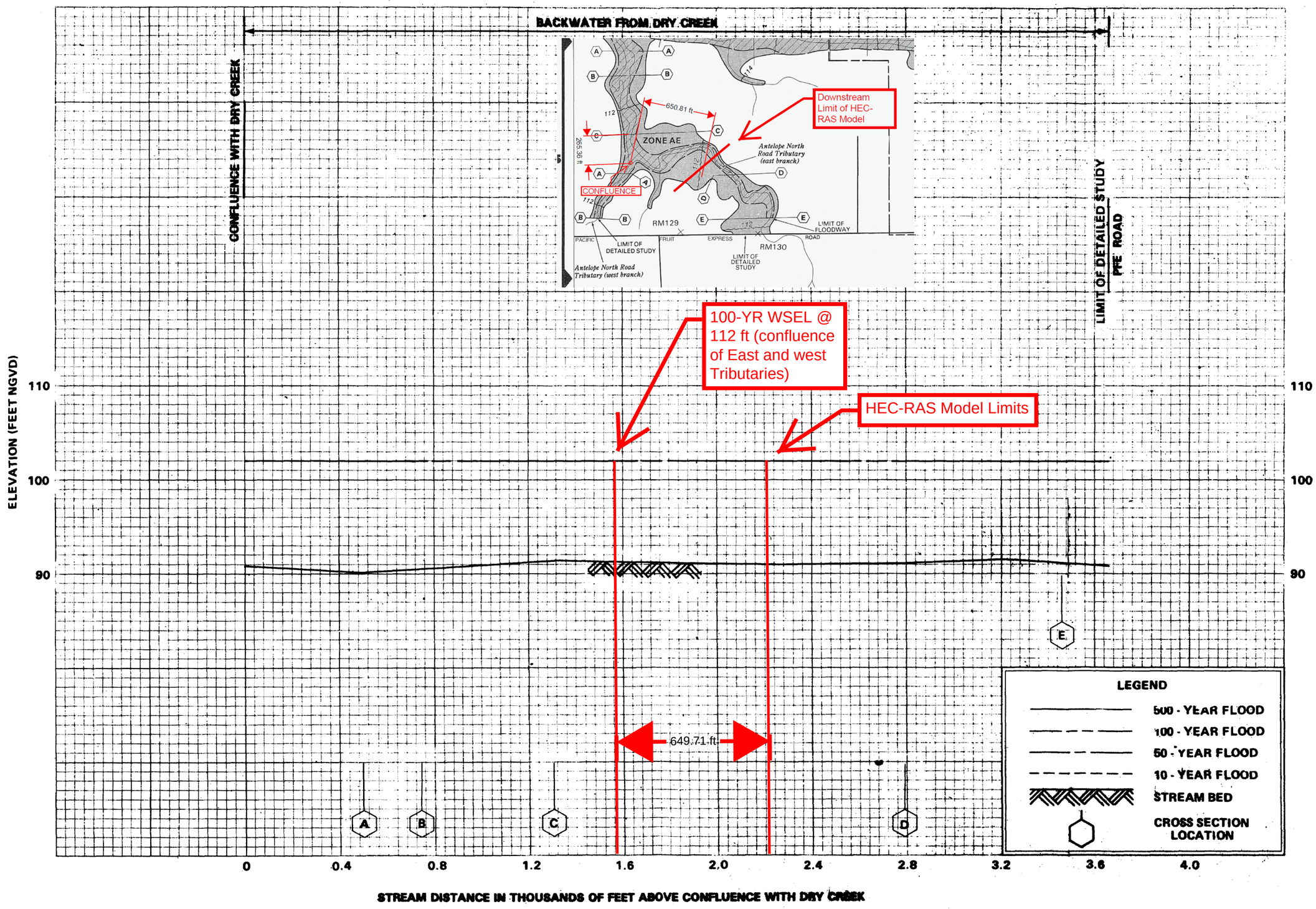
f. Culverts and Brides Culverts and bridges that are modified or added as part of channel projects shall meet reasonable standards for the type of structure and shall have a minimum capacity equal to the design discharge or state agency design requirements, whichever is greater. Capacity of some culverts and bridges may need to be increased above the design discharge.

g. Disposition of spoil Spoil material from clearing, grubbing, and channel excavation shall be disposed of in a manner that will:

- Not confine or direct flows so as to cause instability when the discharge is greater than the bankfull flow.

- Provide for the free flow of water between the channel and flood plain unless the valley routing and water surface profile are based on continuous dikes being installed.

2. Natural Channels Natural waterways are important in conveying storm runoff in Placer County. The objectives of the

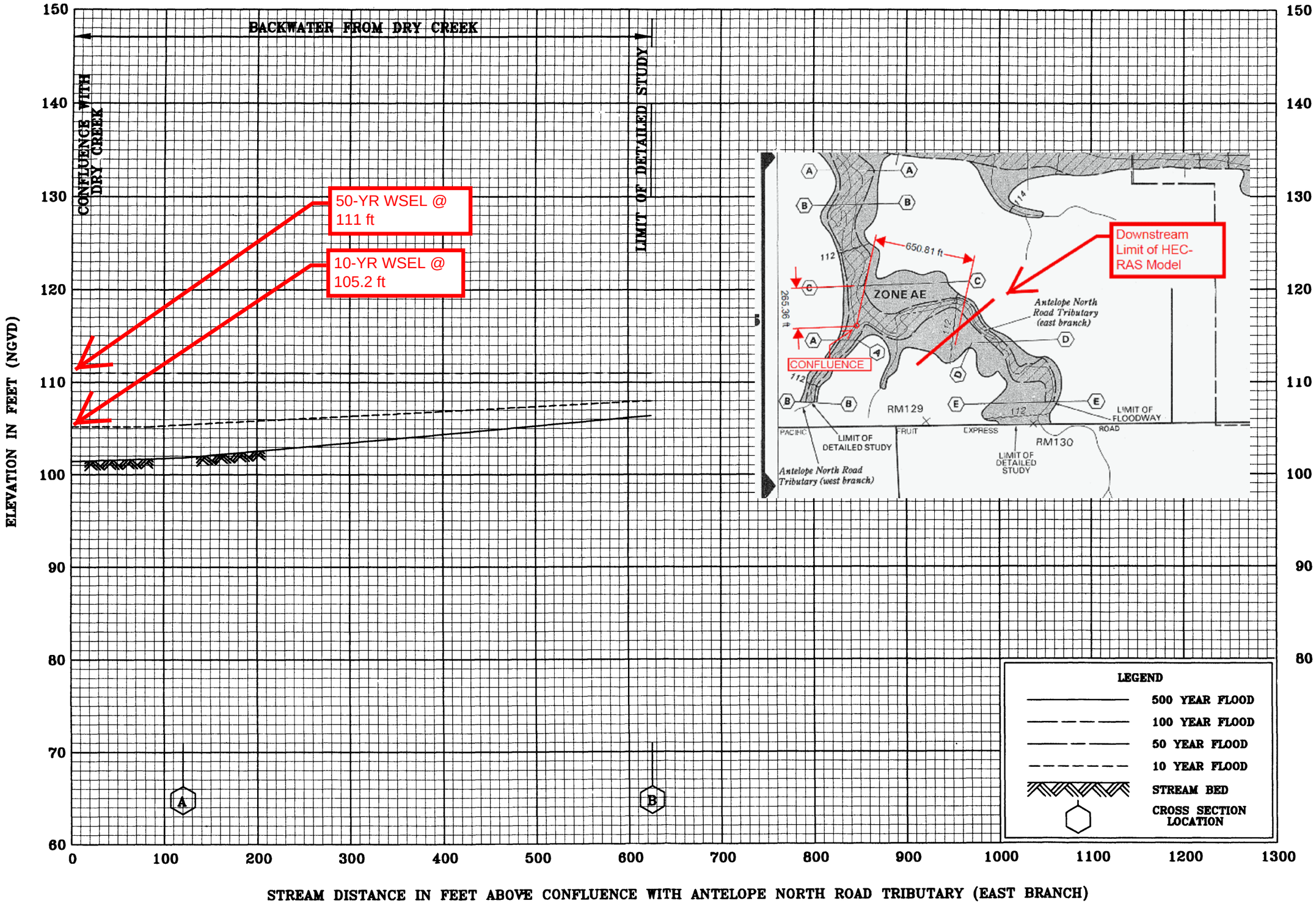


FLOOD PROFILES

DRY CREEK-ANTELOPE NORTH ROAD TRIBUTARY (EAST BRANCH)

FEDERAL EMERGENCY MANAGEMENT AGENCY

PLACER COUNTY, CA AND INCORPORATED AREAS



FLOOD PROFILES

DRY CREEK – ANTELOPE NORTH ROAD TRIBUTARY (WEST BRANCH)

FEDERAL EMERGENCY MANAGEMENT AGENCY

PLACER COUNTY, CA

AND INCORPORATED AREAS

Attachment D – HEC-HMS and HEC-RAS Model Files (CD)

HEC-HMS Data

HEC-RAS Model Data