

Appendix F: **Hydrology and Water Quality Supporting Information**

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INITIAL HYDROLOGY AND HYDRAULICS STUDY

JUNE 28, 2021

SHILOH CROSSING

APN 163-171-039

295 SHILOH ROAD

WINDSOR, CA

Job Number: 2021017.00

PREPARED BY

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CIVIL ENGINEERS ▪ URBAN PLANNERS ▪ LAND SURVEYORS ▪ LANDSCAPE ARCHITECTS

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1 Introduction

The Shiloh Crossing (Project) located at 295 Shiloh Road will improve a six and one-tenth (6.10) acre vacant parcel into (i) a senior living facility, (ii) improve and dedicate the Project's frontage along Business Park Court and Shiloh Road to Town of Windsor Standards and, (iii) replace the northerly bordering parcel (Incubator) stormwater detention system with a new stormwater detention pond. Due to existing flooding issues within the public storm drain within Hembree Lane which serves this Project, the Project will be required to detain the difference between development and pre-development 100-year storm event for both the Project and Incubator site. The Project will also need to meter 100-year flow into the public storm drain to pre-developed conditions.

2 Existing Conditions

The Project site is bordered by Shiloh Road to the South, Hembree Lane to the southwest, Home Depot to the northwest, a commercial Incubator site to the north, and residential housing to the east. The private road Business Park Court, which connects the northerly commercial Incubator site to Shiloh Road, runs North-South along the Project's easterly border. The remaining Project site is undeveloped land with 340-ft of 36-inch storm drain extending into a storm water detention pond on the west side of the Project site. This existing storm drain and detention pond system on the Project site was designed to store the additional flows due to the development of the Incubator site within both the pond and 36-inch storm drain and release only predeveloped flow rates into the downstream public storm drain system on Hembree Lane. There is also existing storm drain and swales along the Project's Shiloh Road frontage, which carries the southerly half of the undeveloped Project to the public storm drain within Hembree Lane.

3 Proposed Conditions

The Project's drainage is divided into the tributary areas shown on the Proposed Hydrology Exhibit in Appendix A. These areas are designated based on the proposed grading and storm drain system. The Project will have three separate drainage tributaries. The northern and western tributaries will connect to the existing 30-inch public storm drain as it leaves the site on the west side of the property, and the eastern tributary will connect to the existing 36-inch public storm drain in Shiloh Road.

To satisfy the requirement of detaining the 100-year developed flows, there will be three separate detention systems. The detention for the existing Incubator site to the north of the Project will be achieved by a combination of a new detention pond along the northern boundary of the Project and a new 36-inch storm drain along the western boundary of the Project. Additionally, a

Contech ChamberMaxx detention chamber system will store the drainage from the westerly tributary, while a Contech Terrarch 26 detention chamber system will store the drainage from easterly tributary. Each Contech system will have a downstream manhole structure with an overflow weir set to the top of the Contech rock section to ensure full volume capture within the system. The weir will have a low flow orifice sized to release pre-development flow rates. The existing 36-inch storm drain and detention pond on site will be removed to increase developable area on site. The remaining portion of the existing 30-inch storm drain, leaving the site, will connect to the site drainage system downstream of the westerly Contech chamber system.

3.1 Detention Systems

In a rain event, runoff would be distributed to each of the two Contech chamber systems and collect until it would eventually overflow into the public storm drain. The analysis of this Project's drainage system was therefore divided into five pieces due to the function of the Contech systems. First, each of the existing storm drains which drain the detention systems were analyzed. Then, each of the three detention systems were analyzed individually. The hydraulic grade lines of the maximum storage water surface elevation of each Contech systems were also compared to the hydraulic grade line of the storm drain downstream of the overflow to ensure that the Contech chambers would sufficiently drain a 100-year rain event and avoid a backwater scenario.

3.1.1 Contech Chambers

Each of the two Contech Chamber systems were sized based on the difference between development and pre-development runoff, for a 100-year event with a fixed low flow outflow rate matching the undeveloped flow rate of the Project site. The westerly chambers were sized to handle the Project's north-westerly half of the Project's development. The easterly chambers were sized to handle the southeasterly half of the Project's development. The Contech sizing calculations have been included in Appendix C.

Each of the two Contech Chamber systems were analyzed separately starting at the individual system and working back up stream to verify the Project would not flood in the event of a 100-year rain event. To conservatively analyze the storm drain system, the low flow outflow orifice implemented due to hydromodification requirements was not included in analysis to simulate a situation where the low flow outflow structure had failed, and the hydraulic grade line was allowed to rise to the overflow elevation before being able to exit through the overflow. This scenario would set the starting HGL for each Contech Chamber system at the overflow elevation. The Terrarch 26 detention system is implemented on the eastern side of the Project's in order to provide sufficient cover for the chambers as the system is too shallow at this location to implement the ChamberMaxx system.

3.1.2 Detention Pond

The reference Hydrology report lacked sufficient supporting calculations for the sizing of the existing detention facilities, so the needed Incubator detention volume was sized conservatively by taking the difference between full impervious coverage ($C=0.9$) and zero impervious coverage ($C=0.35$) over the entire Incubator parcel which would be the maximum expected runoff.

A back check of the reference Hydrology report was completed by taking the volume of the detention pond and 36-inch Storm drain at the listed 120.35-foot water surface elevation, the volume of storage was determined to be 10,461 cubic feet, which is excessive. A headwater depth analysis was performed to determine a more reasonable water surface elevation for existing storage, which was determined to be 119.05-ft and equates to a detention volume of 5,840 cubic feet. The difference between the reference 5,840 cubic feet and the design 5,157 cubic feet can be attributed to the Project's northerly tributary, which is accounted for within the Project's westerly detention chamber calculations which adds 3,348 cubic feet of storage.

4 Storm Drain Design Criteria

The Shiloh Crossing Project will use the design criteria laid out in Table 4-1: Design Criteria is per the Sonoma County Water Agency's 2020 Flood Management Design Manual and the Town of Windsor's 2011 Design and Construction Standards. This criteria is for the 100-year storm.

Table 4-1: Design Criteria

Scenario	Design Criteria
Minimum Depth of Cover	2 ft
SD Pipe Type	Class III RCP
Minimum SD Size	18-inch
Manning's n-value	0.014 (RCP)
Minimum SD Flow Velocity	2.5 ft/s
Hydraulic Grade Line	1-ft below ground

5 Hydrology and Hydraulics Design Criteria

All hydrology and hydraulic calculations were performed in accordance with the Sonoma County Water Agency's (SCWA) Flood Control Design Criteria (FCDC) manual, and the City of Healdsburg's 2008 Storm Drain Collection System Standards. The rational method was used to calculate the hydraulics and hydrology for the storm drain system.

Storm drain system conduits were analyzed using Bentley's StormCAD.

5.1 Starting Hydraulic Grade Line

Separate starting HGLs were used to analyze the inlet and outlet of each of the three detention basins. Each detention basin has an outfall starting HGL, and an inlet starting HGL. The outfall HGLs were used at the detention basins outfall connection to the existing public storm drain system. While the inlet HGLs were used to analyze the private storm drains upstream of the detention basins.

5.1.1 Detention Outfall Starting HGL

Two separate starting 100-year Hydraulic Grade Lines (HGLs) were used to analyze the west and east detention basin outfalls. The starting HGL for the west detention basin was obtained from the *Shiloh Industrial Center Hydrology & Hydraulic Design* report, performed by Dale Roper & Associates, dated March 2001. While the starting HGL for the east detention basin was obtained from the *Drainage Analysis for the Windsor Redwoods*, performed by Adobe and Associates, dated July 2008. Both drainage reports can be found the Appendix E.

Table 5-1: Outlet Starting HGL

Detention Basin	100 – Year HGL (ft)		Location
	Reference	Adjusted	
West	117.45	120.35	Existing 30-in SD @ western boundary
East	117.7	118.9	Ex MH-6 @ Intersection of Shiloh & Hembree
Pond		120.50	Existing 30-in SD @ western boundary

The starting HGL for the detention pond and 36-inch storm drain along the western boundary of the Project was set such that the pond and basin achieve the needed volume to replace the existing 36-inch storm drain and detention pond.

5.1.2 Detention Inlet Starting HGL

The overflow weir exiting each of the two Contech Chambers is set equal to the water surface elevation at the top of the rock section of the Contech Chambers. The initial hydraulic grade line was set at the top of the overflow weir elevation.

Table 5-2: Inlet Starting HGL

Detention Basin	100 – Year HGL (ft)	Location
West	119.44	Upstream of west detention basin
East	120.50	Upstream of east detention basin
Pond	120.50	Upstream of northern detention pond

5.2 Hydrologic Design Criteria

The Shiloh Crossing Project will use the hydrologic design criteria laid out in Table 5-2: Hydrologic Design Criteria per the SCWA FCDC and the Town of Windsor's 2008 Storm Drain Collection System Standards. These criteria are for the 10- and 100-year storm.

Table 5-3: Hydrologic Design Criteria

Scenario	Design Criteria	Source
Starting Time of Concentration	7 minutes	SCWA for commercial or similar areas
	10 minutes	SCWA for residential or similar areas
	15 minutes	SCWA for undeveloped hillsides.

5.3 Coefficient of Runoff

The proposed composite runoff coefficients were calculated using the runoff coefficients in Table 5-3: Runoff Coefficients. The undeveloped or landscaped portions of the Project use the Parks and recreation runoff coefficients; while the proposed developed portions of the Project use a composite runoff coefficients calculated using the coefficients in Table 5-4.

Table 5-4: Runoff Coefficients

Surface	Runoff Coefficient 'C-Value'
Hardscape	0.90
Parks & Rec 0-2%	0.35

Composite runoff coefficient calculations for the proposed conditions can be found in Appendix B.

5.4 Energy Loss through Boxes

The HEC-22 Energy method was used to calculate the energy loss through boxes i.e. structures such as manholes and catch basins.

5.5 Design Storm

The design storm equations below were determined by fitting a power curve to the precipitation information from the Atlas 14 NOAA precipitation frequency data.

$$I_{10} = \frac{8.565}{(T_c)^{0.518}}$$

$$I_{100} = \frac{12.103}{(T_c)^{0.523}}$$

6 Conclusion

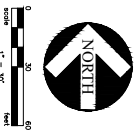
The proposed storm drain system is in conformance with the Sonoma County Water Agency's Flood Control Design Criteria. The underground storm drain system can convey the 100-year storm below ground, and an overflow route is available for runoff exceeding the 100-year storm. Any storm below a 100-year storm will be captured by one of the three proposed detention systems and metered to flows mimicking pre-existing site conditions.

Appendix A:

- **Proposed Hydrology Map**
- **Existing Hydrology Map**
- **Location Map**

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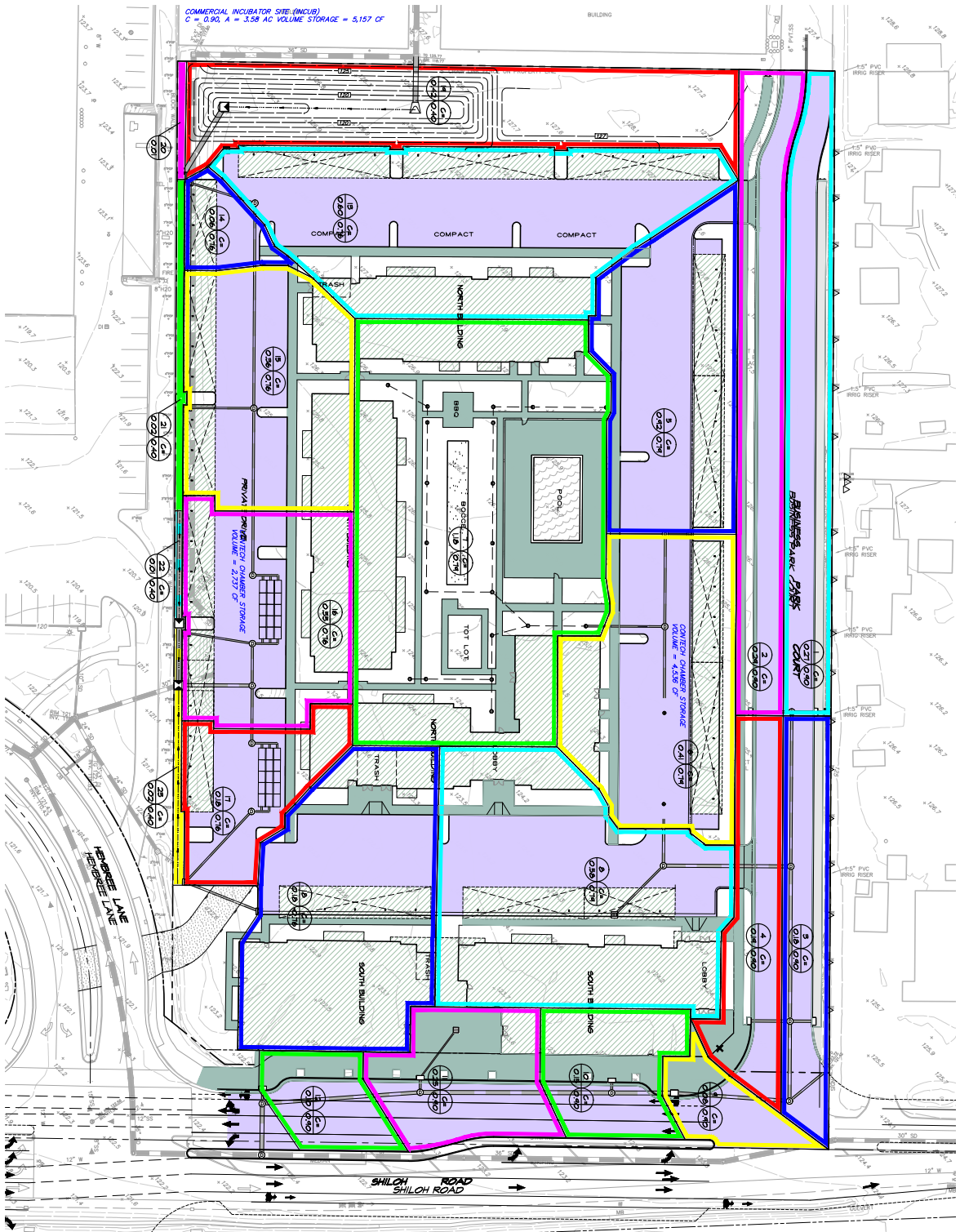


PRELIMINARY PROPOSED STORMWATER DETENTION SHILON CROSSING WINDSOR, CALIFORNIA

JUNE 25, 2021

PROJECT NO. 2021077

SHEET 1 OF 2
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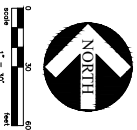
LEGEND

CONCRETE	- 0.85 AC
ROOFTOP	- 17.4 AC
ASPHALT	- 2.22 AC
GRASS PAVE	- 0.08 AC



EXISTING IMPERVIOUS SURFACE ONSITE	- 0.63 AC
PROPOSED IMPERVIOUS SURFACE ONSITE	- 4.81 AC
TOTAL SITE AREA	- 6.62 AC
IMPERVIOUSNESS BEFORE CONSTRUCTION	- 9.5%
IMPERVIOUSNESS AFTER CONSTRUCTION	- 72.7%
PROPOSED STORMWATER DETENTION	
VOLUME EAST - 5,157 CF (INCUB) + 2,737 CF - 7,894 CF	
VOLUME WEST - 5,157 CF (INCUB) + 2,737 CF - 7,894 CF	
TOTAL SITE DETENTION	- 12,430 CF

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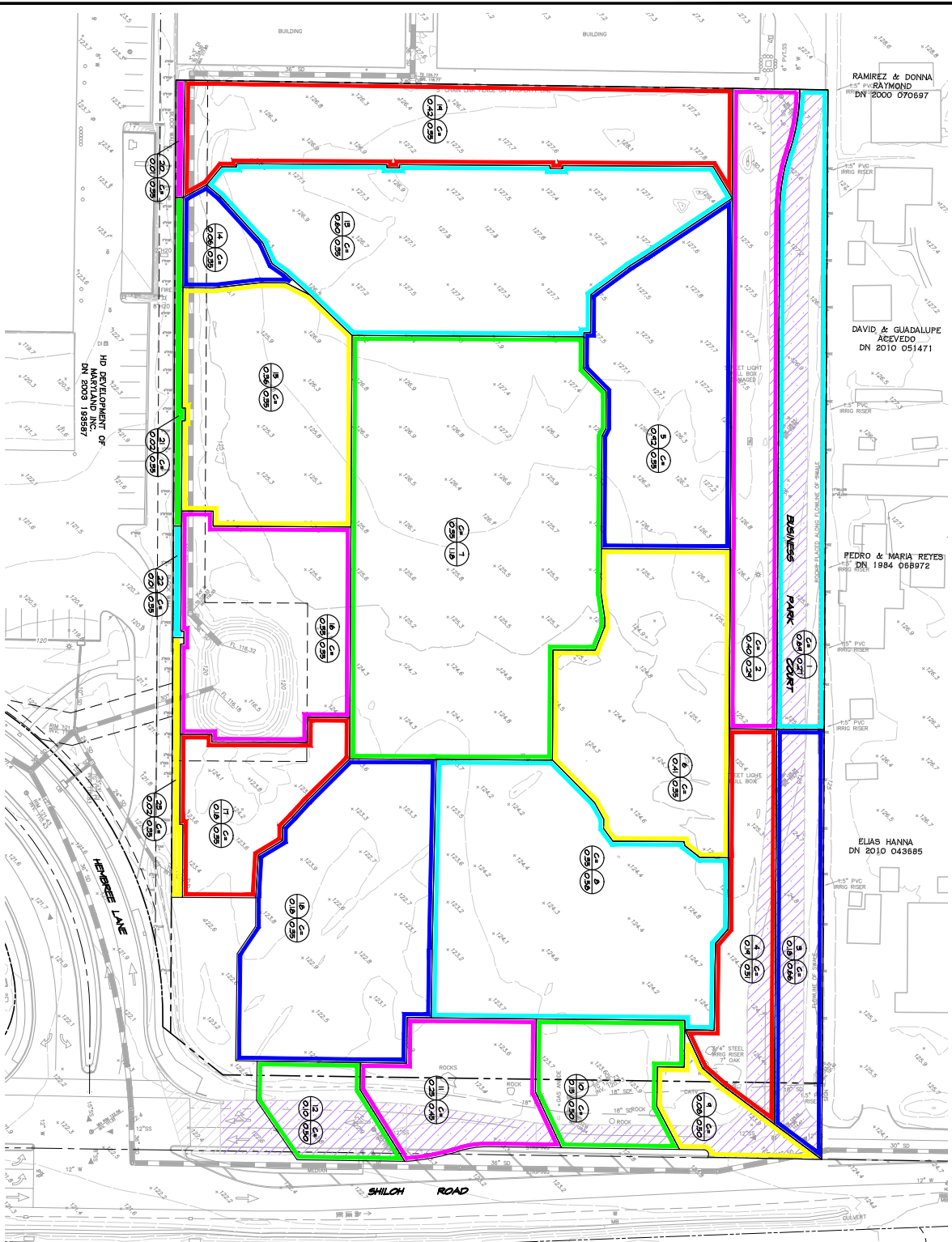


PRELIMINARY
EXISTING IMPERVIOUS + STORMWATER DETENTION
SHILOH CROSSING
WINDSOR, CALIFORNIA

JUNE 2021

PROJECT NO. 202007020

SHEET 2 OF 2
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RAMIREZ & DONNA
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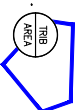
PEDRO & MARIA REYES
DN 1984 068972

ELIAS HANNA
DN 2010 045685

LEGEND

CONCRETE - 0.00 AC
ROOFTOP - 0.00 AC
ASPHALT - 0.63 AC
GRAVEL - 0.00 AC

TRIBUTARY AREA



EXISTING IMPERVIOUS SURFACE ONSITE - 0.63 AC
TOTAL SITE - 6.62 AC

IMPERVIOUSNESS BEFORE CONSTRUCTION - 9.6%

TOTAL EXISTING STORMWATER DETENTION VOLUME -
MAX VOLUME AVAILABLE -
2,601 CF + 7,860 CF = 10,461 CF
HEADWATER VOLUME (INCUB + PROU NORTH) -
1,736 CF + 4,077 CF = 5,813 CF •
DESIGN INCUBATOR VOL. (C-0.9 - 0.95) - 5,167 CF
• INCLUDES PORTION OF UNDEV PROU NORTH TRIB



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SHILOH CROSSING

LOCATION MAP

WINDSOR, CALIFORNIA

JUNE, 2021
PROJECT NO. 20210700

SHEET 1 OF 1

Appendix B:

Composite C-Value Calculations

Shiloh Crossing
 295 Shiloh Road, Windsor, CA 95492
 APN: 163-171-039

Surface Type	Roof	Asphalt	Concrete	Landscape
C-Value	0.90	0.90	0.90	0.40

Drainage Area	Roof <i>ft²</i>	Asphalt <i>ft²</i>	Concrete <i>ft²</i>	Landscape <i>ft²</i>	Total Area <i>ft²</i> <i>ac</i>		Composite C-Value
West	37,439	34,867	5,401	29,670	107,377	2.47	0.76
East	38,322	61,943	31,713	36,826	168,805	3.88	0.79
Total Site	75,761	96,810	37,114	66,496	276,181	6.34	0.78

Appendix C:

Detention Basin Calculations

Shiloh Crossing
295 Shiloh Road, Windsor, CA 95492
APN: 163-171-039

100-year Storm Detention Requirements: Proposed - Undeveloped
Project West

<u>Existing Conditions</u>	<u>Developed Conditions</u>
T _{C, pre} : 15 min	T _{C, post} : 7 min
C _{pre} : 0.35	Overall C_{post} : 0.76

Tributary Area : 2.47 acres

Storm Duration (min)	100-year Intensity X K (in/hr)	Design Release Rate, Q_{pre} (cfs)	Developed Peak Runoff Rate, Q_{post} (cfs)	Detention Rate to Storage (cfs)	Detention Volume (ft ³)
3.0	6.64	5.74	12.50	10.05	1,808
3.5	6.12	5.29	11.52	9.07	1,904
4.0	5.70	4.93	10.73	8.28	1,988
4.5	5.36	4.63	10.08	7.63	2,061
5.0	5.07	4.38	9.54	7.09	2,126
5.5	4.82	4.17	9.07	6.62	2,184
5.7	4.73	4.09	8.90	6.45	2,205
6.0	4.60	3.98	8.66	6.21	2,236
6.5	4.41	3.81	8.30	5.85	2,282
7.0	4.24	3.67	7.98	5.53	2,324
7.5	4.09	3.54	7.70	5.25	2,361
8.0	3.95	3.42	7.44	4.99	2,394
8.5	3.83	3.31	7.20	4.75	2,424
9.0	3.71	3.21	6.99	4.54	2,451
9.5	3.61	3.12	6.79	4.34	2,475
10.0	3.51	3.04	6.61	4.16	2,496
10.5	3.42	2.96	6.44	3.99	2,514
11.0	3.34	2.89	6.29	3.83	2,531
11.5	3.26	2.82	6.14	3.69	2,545
12.0	3.19	2.76	6.00	3.55	2,557
12.5	3.12	2.70	5.87	3.42	2,568
13.0	3.06	2.64	5.75	3.30	2,576
13.5	3.00	2.59	5.64	3.19	2,583
14.0	2.94	2.54	5.53	3.08	2,589
14.5	2.89	2.49	5.43	2.98	2,593
15.0	2.83	2.45	5.33	2.88	2,595
15.5	2.79	2.41	5.24	2.79	2,596
16.0	2.74	2.37	5.16	2.70	2,596
16.5	2.70	2.33	5.07	2.62	2,595
17.0	2.65	2.29	4.99	2.54	2,593
17.5	2.61	2.26	4.92	2.47	2,589
18.0	2.57	2.23	4.84	2.39	2,585
18.5	2.54	2.19	4.77	2.32	2,579
19.0	2.50	2.16	4.71	2.26	2,572
19.5	2.47	2.13	4.64	2.19	2,565
20.0	2.43	2.10	4.58	2.13	2,557

Notes:

- 1) $Q = C\text{-Value} \times \text{Intensity} \times \text{Tributary Area}$
- 2) Use design release rate of 3.61 cfs in correspondance with existing flow at time of concentration of 15 minutes
- 3) "Detention Rate to Storage" = "Developed Peak Runoff Rate" - "Design Release Rate"

Shiloh Crossing
295 Shiloh Road, Windsor, CA 95492
APN: 163-171-039

West

Contech Chamber Maxx

# columns	3	
# rows	6	
volume/chamber - middle	47.2	ft ³
volume/chamber - start	50.2	ft ³
volume/chamber - end	46.2	ft ³
in/outlet manifold volume		ft ³
Total chamber volume	1,428	ft ³

Detention Basin Dimensions

Basin footprint area	1,333	ft ²	
Stone depth	3.53	ft	
Backfill volume	4,700	ft ³	*40% porosity
Basin Storage Volume	1,309	ft ³	=(Backfill volume - Chamber volume)*40%

Total Detention Volume

Total Detention Volume	2,737	ft ³	=Total Chamber Volume + Basin storage volume
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Required Detention Volume	2,596	ft ³
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Design Elevations

Finished grade above chamber	125.73	ft
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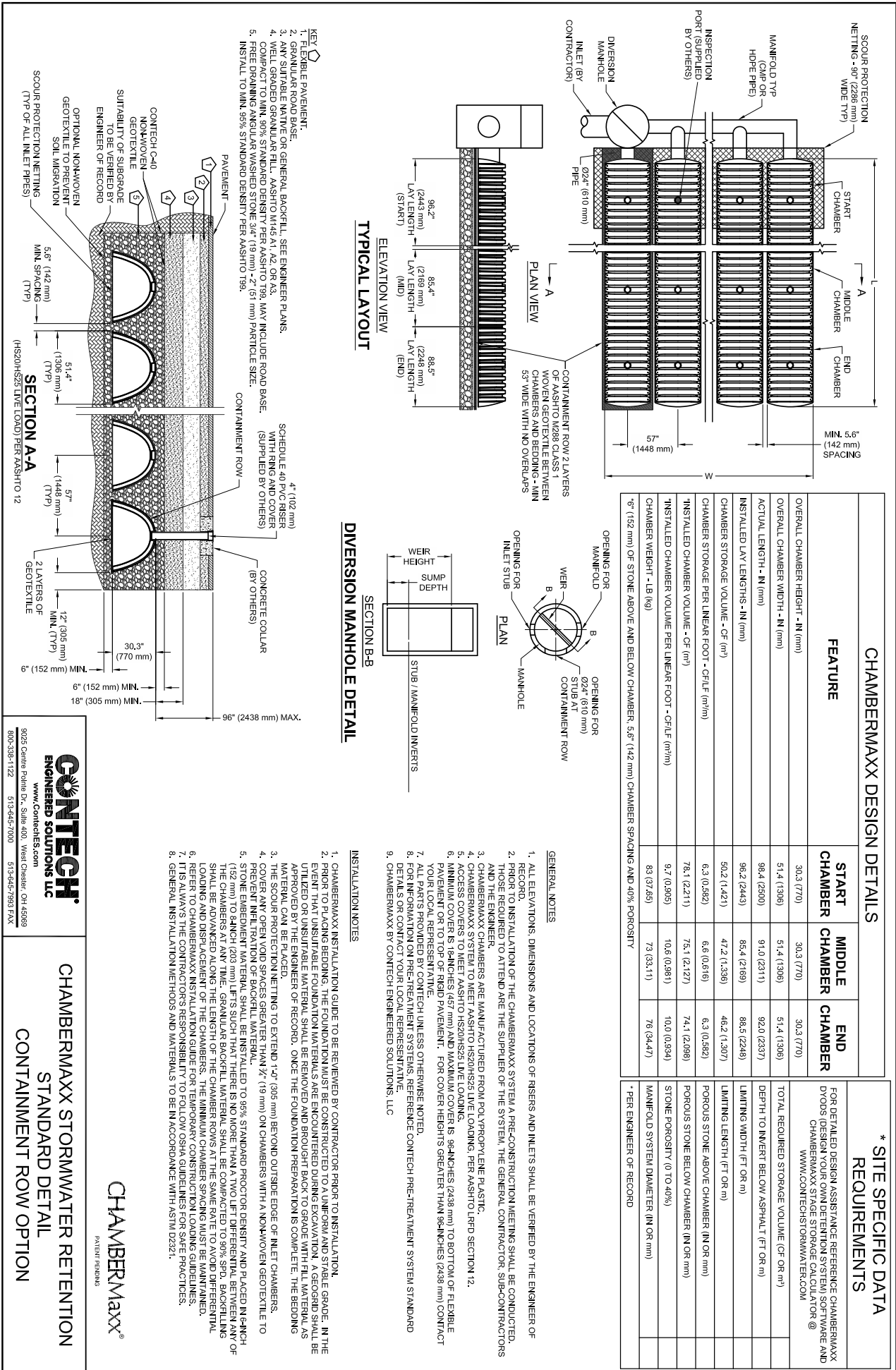
Inlet invert	117.32	ft
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Stone cover	6	in	4" minimum
Stone bedding depth	6	in	

Cover over top of stone	5.39	ft	8" Minimum
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Top of stone fill	120.35	ft	=Weir elevation
Top of chamber	119.85	ft	
Bottom of chamber	117.32	ft	
Bottom of stone bed	116.82	ft	

Stone depth	3.53	ft
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Shiloh Crossing
295 Shiloh Road, Windsor, CA 95492
APN: 163-171-039

100-year Storm Detention Requirements: Proposed - Undeveloped
EAST

Existing Conditions

$T_{C, \text{pre}}$: 15 min
 C_{pre} : 0.35

Developed Conditions

$T_{C, \text{post}}$: 7 min
Overall C_{post} : 0.79

Tributary Area : 3.88 acres

Storm Duration (min)	100-year Intensity X K (in/hr)	Design Release Rate, Q_{pre} (cfs)	Developed Peak Runoff Rate, Q_{post} (cfs)	Detention Rate to Storage (cfs)	Detention Volume (ft ³)
3.0	6.64	9.02	20.38	16.53	2,976
3.5	6.12	8.31	18.78	14.94	3,136
4.0	5.70	7.75	17.50	13.65	3,277
4.5	5.36	7.28	16.45	12.60	3,401
5.0	5.07	6.88	15.55	11.71	3,512
5.5	4.82	6.54	14.79	10.94	3,610
5.7	4.73	6.42	14.51	10.66	3,647
6.0	4.60	6.25	14.12	10.28	3,699
6.5	4.41	5.99	13.54	9.69	3,779
7.0	4.24	5.76	13.02	9.17	3,851
7.5	4.09	5.55	12.55	8.70	3,916
8.0	3.95	5.37	12.13	8.28	3,975
8.5	3.83	5.20	11.75	7.90	4,028
9.0	3.71	5.04	11.40	7.55	4,076
9.5	3.61	4.90	11.08	7.23	4,119
10.0	3.51	4.77	10.78	6.93	4,158
10.5	3.42	4.65	10.51	6.66	4,193
11.0	3.34	4.54	10.25	6.40	4,224
11.5	3.26	4.43	10.01	6.16	4,252
12.0	3.19	4.33	9.79	5.94	4,276
12.5	3.12	4.24	9.58	5.73	4,298
13.0	3.06	4.15	9.38	5.53	4,316
13.5	3.00	4.07	9.20	5.35	4,332
14.0	2.94	3.99	9.02	5.17	4,345
14.5	2.89	3.92	8.86	5.01	4,356
15.0	2.83	3.85	8.70	4.85	4,365
15.5	2.79	3.78	8.55	4.70	4,371
16.0	2.74	3.72	8.41	4.56	4,375
16.5	2.70	3.66	8.27	4.42	4,378
17.0	2.65	3.60	8.14	4.29	4,378
17.5	2.61	3.55	8.02	4.17	4,377
18.0	2.57	3.50	7.90	4.05	4,374
18.5	2.54	3.45	7.79	3.94	4,369
19.0	2.50	3.40	7.68	3.83	4,363
19.5	2.47	3.35	7.57	3.72	4,355
20.0	2.43	3.31	7.47	3.62	4,346

Notes:

- 1) $Q = C\text{-Value} \times \text{Intensity} \times \text{Tributary Area}$
- 2) Use design release rate of 2.96 cfs in correspondance with existing flow at time of concentration of 15 minutes
- 3) "Detention Rate to Storage" = "Developed Peak Runoff Rate" - "Design Release Rate"

Shiloh Crossing
295 Shiloh Road, Windsor, CA 95492
APN: 163-171-039

East

Contech Terre Arch 26

# chambers	12	
volume/chamber	319.0	<i>ft³</i>
distribution manifold volume	93	<i>ft³</i>
Total chamber volume	4,200	<i>ft³</i>

Stone Edge

Footprint area	210	<i>ft²</i>	
Stone depth	4.00	<i>ft</i>	
Edge volume	336	<i>ft³</i>	<i>*40% porosity</i>

Total Detention Volume

Total Detention Volume	4,536	<i>ft³</i>	=Total Chamber Volume + Edge Volume
------------------------	-------	-----------------------	-------------------------------------

Required Detetnion Volume	4,378	<i>ft³</i>
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Design Elevations

Finished grade above chamber	123.00	<i>ft</i>
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Inlet invert	119.08	<i>ft</i>
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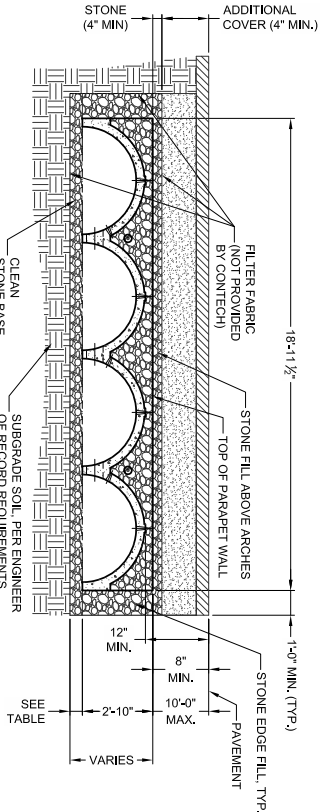
Stone cover	4	<i>in</i>	<i>4" minimum</i>
Stone bedding depth	8	<i>in</i>	

Cover over top of stone	1.75	<i>ft</i>	<i>8" Minimum</i>
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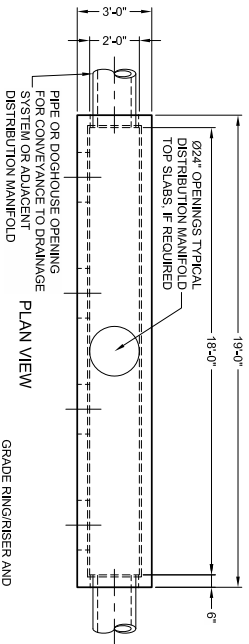
Min FG over chamber	121.58	<i>ft</i>
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Top of stone fill	121.25	<i>ft</i>	<i>=Weir elevation</i>
Top of chamber	120.75	<i>ft</i>	
Bottom of chamber	117.91	<i>ft</i>	
Bottom of stone bed	117.25	<i>ft</i>	

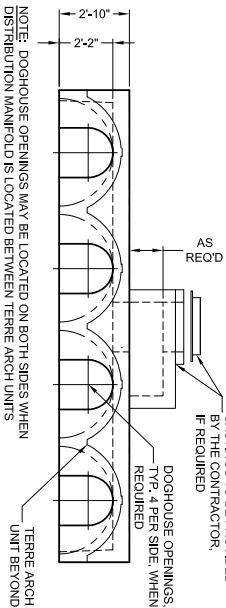
Stone depth	4.00	<i>ft</i>
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TYPICAL BACKFILL DETAIL
(STONE BASE)

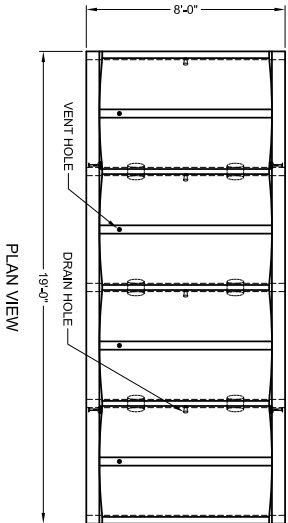


PLAN VIEW

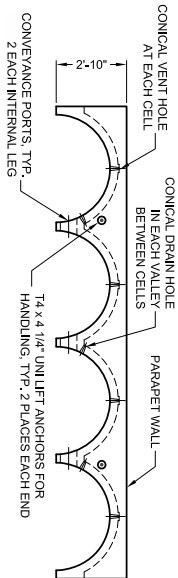


ELEVATION VIEW

TERRE ARCH 26 DISTRIBUTION MANIFOLD



PLAN VIEW



ELEVATION VIEW

TERRE ARCH 26 STRUCTURE

TERRE ARCH 26 DESIGN DETAILS

PART TYPE	*INSTALLED VOLUME	CHAMBER VOLUME	INFILTRATION AREA	WEIGHT	DIMENSIONS
DISTRIBUTION MANIFOLD	93 CF	78 CF	36 SF	11,500 LBS	3'-0" x 19'-0" x 2'-10"
ARCH	319 CF	234.9 CF	162 SF	13,500 LBS	8'-0" x 19'-0" x 2'-10"
CAPPING SLAB (2 REQUIRED PER ARCH)	0.6 CF	N/A	N/A	1,400 LBS	0'-4" x 9'-5" x 2'-10"

*INCLUDES VALLEYS BETWEEN ARCHES FILLED WITH STONE TO THE TOP OF THE PARAPET WALL. 6" COVER STONE ABOVE ARCH & 6" BASE STONE. (40% VOID SPACE TYPICAL WITH STONE)

TERRE ARCH CONFIGURATIONS SHALL BE SET ON A CLEAN ANGULAR STONE BASE. THE TOP 2 INCHES OF STONE BED SHALL BE #8 AASHTO (CLEAN 1 1/2" STONE). THE TOTAL STONE BED SHALL BE PER STONE BEDDING DEPTH TABLE BELOW. MINIMUM REQUIRED ALLOWABLE BEARING CAPACITY IS 3000 PSF. STANDARD WIDTH AND HEIGHT DIMENSIONS ARE SHOWN. TO ACCOMMODATE LARGER PIPE SIZES, CONTACT YOUR CONTECH REPRESENTATIVE.

TERRE ARCH 26 MINIMUM STONE BEDDING DEPTH

COVER DEPTH (FT.)	1	2	3	4	5	6	7	8	9	10
MINIMUM BEDDING DEPTH (IN.)	6	7	9	10	11	12	13	14	15	16

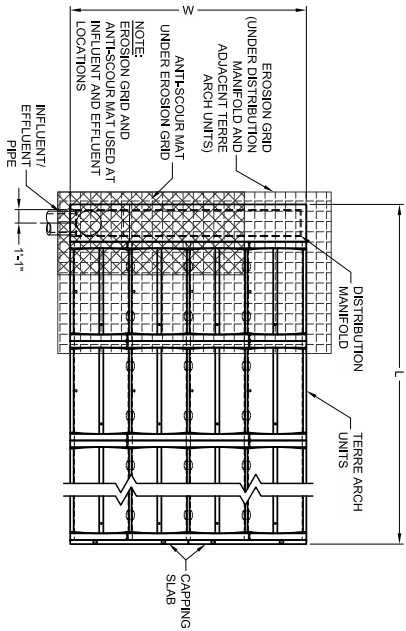
COVER DEPTH BASED ON AN ALLOWABLE BEARING CAPACITY OF 3000 PSF.
IF COVER DEPTH IS BETWEEN 2 VALUES, USE THE HIGHER VALUE.

SITE SPECIFIC DATA REQUIREMENTS*

TOTAL REQUIRED STORAGE VOLUME (CF or m³)	
LIMITING WIDTH (FT or m)	
LIMITING LENGTH (FT or m)	
STONE POROSITY (0 to 40%)	
POROUS STONE ABOVE ARCH (IN or mm)	
POROUS STONE BELOW ARCH (IN or mm) OR SLAB THICKNESS BELOW ARCH (IN or mm)	
NOTES/SPECIAL REQUIREMENTS:	
*PER ENGINEER OF RECORD	

GENERAL NOTES

1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
 2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
 3. TERRE ARCH WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
 4. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 1'-10" ABOVE TOP OF THE ARCH.
 5. FILTER FABRIC OR GEOTEXTILE IS RECOMMENDED WHERE SILT MIGRATION FROM THE SIDES OR TOP INTO THE VOID SPACE OF THE STONE IS POSSIBLE.
- INSTALLATION NOTES
- A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLUTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
 - B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE TERRE ARCH AND ASSOCIATED STRUCTURES (NO CHAINS ARE PERMITTED).
 - C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL TERRE ARCH STRUCTURES, DISTRIBUTION MANIFOLDS AND CAPPING SLAB SECTIONS.
 - D. CONTRACTOR TO INSTALL TWO STRAP CONNECTIONS (PROVIDED BY CONTECH) AT EACH CAPPING SLAB.
 - E. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH ALL PIPE INVERTS WITH FINAL CONTECH CONTRACT DRAWINGS.
 - F. 1" MINIMUM EARTH COVER ABOVE TOP OF ARCH. CONTECH RECOMMENDS STONE FOR THE FIRST 8" OF COVER.



TYPICAL LAYOUT

TERRE ARCH 26
STANDARD DETAIL

Shiloh Crossing
 295 Shiloh Road
 Prepared by Carlie Macy
 June 25, 2021

Incubator Pond Volume and Relocated Pond Volume

Storage Area	Bottom of Pond		100 Year Water Surface		Volume
	Elevation	Surface Area	Elevation	Surface Area	
Existing Incubator Pond	116.2	1515.0	120.5	2184.0	7860.4
Proposed Pond	118.0	472.0	121.5	4574.0	8830.5
Net Volume change-					970.1

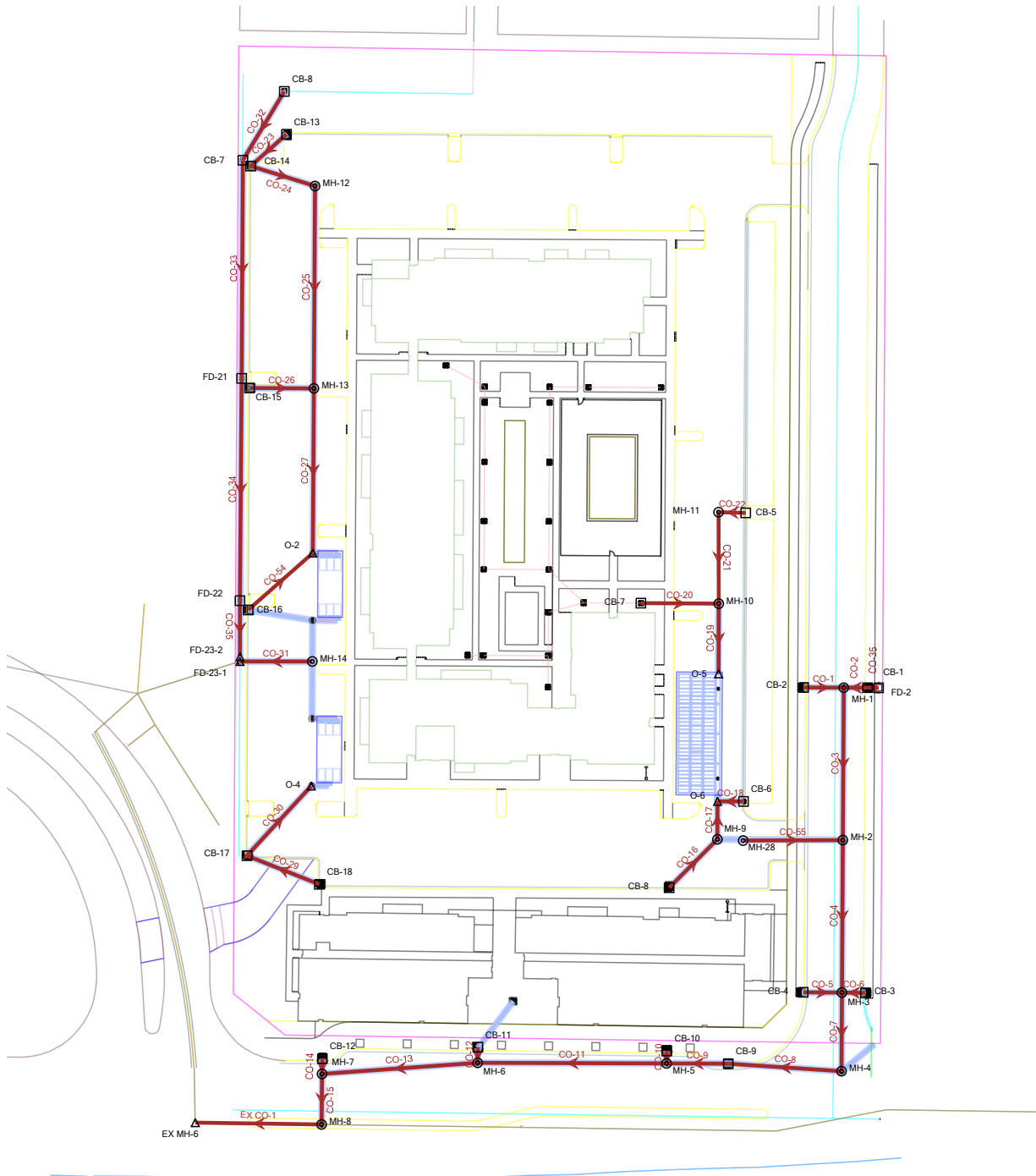
Existing and Proposed 36" Storm Drain Volume

Storage Area	Length (ft)	Cross-section Area (ft^2)	Volume (ft^3)
Existing 36" SD	507.0	7.1	3584.5
Proposed 36" SD	370.0	7.1	2615.9
Net Volume change-			-969

Appendix D:

100-Year Storm Hydrology and Hydraulics

Scenario: 100 year
Active Scenario: 100 year



West Detention Basin

Shiloh Crossing
Active Scenario: 100 year
Hydrology Report - Time: 0.00 hours

Label	Start Node	Stop Node	Diameter (in)	Length (ft)	Slope (ft/ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	System Flow Time (min)	System Intensity (in/h)	System Drainage Area (ft ²)	System CA (acres)	System Rational Flow (cfs)	Time (Pipe Flow) (min)
CO-23	CB-13	CB-14	12.0	120.0	0.001	124.24	124.13	7.000	4.374	26,136.0	0.456	2.01	0.781
CO-24	CB-14	MH-12	12.0	42.8	0.005	124.13	124.50	7.781	4.139	28,749.6	0.502	2.09	0.214
CO-25	MH-12	MH-13	15.0	128.6	0.005	124.50	124.40	7.995	4.081	28,749.6	0.502	2.06	0.625
CO-26	CB-15	MH-13	12.0	41.0	0.019	123.96	124.40	7.000	4.374	15,681.6	0.274	1.21	0.141
CO-27	MH-13	O-2	15.0	104.6	0.035	124.40	124.00	8.620	3.923	44,431.2	0.775	3.07	0.223
CO-29	CB-18	CB-17	12.0	49.4	0.005	122.90	123.30	7.000	4.374	7,840.8	0.137	0.60	0.275
CO-30	CB-17	O-4	12.0	60.3	0.031	123.30	123.00	8.072	4.060	15,681.6	0.274	1.12	0.136
CO-54	CB-16	O-2	12.0	54.8	0.054	123.96	124.00	7.000	4.374	14,374.8	0.251	1.11	0.131

Hydraulic Report - Time: 0.00 hours

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Dia. (in)	Length (ft)	Slope (ft/ft)	Flow (cfs)	Velocity (ft/s)	Hdloss (ft)	Elev. Ground (Start) (ft)	HGL (In) (ft)	EGL (In) (ft)	Elev. Ground (Stop) (ft)	HGL (Out) (ft)	EGL (Out) (ft)
CO-23	CB-13	122.00	CB-14	121.85	12.0	120.0	0.001	2.01	2.56	0.44	124.24	123.17	123.28	124.13	122.74	122.85
CO-24	CB-14	121.85	MH-12	121.64	12.0	42.8	0.005	2.09	3.34	0.24	124.13	122.59	122.76	124.50	122.35	122.54
CO-25	MH-12	121.64	MH-13	121.00	15.0	128.6	0.005	2.06	3.43	0.52	124.50	122.26	122.44	124.40	121.74	121.86
CO-26	CB-15	121.76	MH-13	121.00	12.0	41.0	0.019	1.21	4.86	0.47	123.96	122.22	122.40	124.40	121.75	121.81
CO-27	MH-13	121.00	O-2	117.32	15.0	104.6	0.035	3.07	7.81	1.35	124.40	121.70	121.99	124.00	120.35	120.45
CO-29	CB-18	119.43	CB-17	119.18	12.0	49.4	0.005	0.60	0.77	0.02	122.90	120.51	120.52	123.30	120.50	120.51
CO-30	CB-17	119.18	O-4	117.32	12.0	60.3	0.031	1.12	1.43	0.07	123.30	120.42	120.45	123.00	120.35	120.38
CO-54	CB-16	120.29	O-2	117.32	12.0	54.8	0.054	1.11	6.97	0.38	123.96	120.73	120.90	124.00	120.35	120.38

Manhole Report - Time: 0.00 hours

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	System CA (acres)	System Flow Time (min)	System Intensity (in/h)	System Rational Flow (cfs)	System Known Flow (cfs)	Flow (Known) (cfs)	Flow (Total Out) (cfs)	HGL (In) (ft)	HGL (Out) (ft)	Is Overflowing?
MH-12	124.50	121.64	0.502	7.995	4.081	2.06	0.00	0.00	2.06	122.35	122.26	False
MH-13	124.40	121.00	0.775	8.620	3.923	3.07	0.00	0.00	3.07	121.74	121.70	False

Shiloh Crossing **Active Scenario: 100 year** **Outfall Report - Time: 0.00 hours**

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	HGL (ft)	Depth (Node) (ft)	EGL (ft)	System Flow Time (min)	System CA (acres)	System Rational Flow (cfs)	Flow (Total Out) (cfs)	Notes
O-2	124.00	117.32	120.35	3.03	120.35	8.843	1.026	3.02	4.12	NW Inflow
O-4	123.00	117.32	120.35	3.03	120.35	8.777	0.274	1.07	1.07	SW Inflow

Catch Basin Detailed Report - Time: 0.00 hours

Label	Inlet	Inlet Location	Inlet Drainage Area (acres)	Total Rational Flow to Inlet (cfs)	Intercepted Rational Flow (cfs)	Bypassed Rational Flow (cfs)	Spread / Top Width (ft)	Depth (Gutter) (in)	Curb Opening Length (ft)	Capture Efficiency (Calculated) (%)	Is Overflowing?
CB-13	<None>	In Sag	0.600	2.01	2.01	0.00	0.0	(N/A)	0.0	100.0	False
CB-14	<None>	In Sag	0.060	0.20	0.20	0.00	0.0	(N/A)	0.0	100.0	False
CB-16	<None>	In Sag	0.330	1.11	1.11	0.00	0.0	(N/A)	0.0	100.0	False
CB-17	<None>	In Sag	0.180	0.60	0.60	0.00	0.0	(N/A)	0.0	100.0	False
CB-18	<None>	In Sag	0.180	0.60	0.60	0.00	0.0	(N/A)	0.0	100.0	False

Shiloh Crossing
Active Scenario: 100 year
Hydrology Report - Time: 0.00 hours

Label	Start Node	Stop Node	Diameter (in)	Length (ft)	Slope (ft/ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	System Flow Time (min)	System Intensity (in/h)	System Drainage Area (ft ²)	System CA (acres)	System Rational Flow (cfs)	Time (Pipe Flow) (min)
CO-31	MH-14	FD-23-1	24.0	46.1	0.006	123.80	121.50	15.000	2.936	86,248.8	0.693	2.05	0.153

Hydraulic Report - Time: 0.00 hours

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Dia. (in)	Length (ft)	Slope (ft/ft)	Flow (cfs)	Velocity (ft/s)	Hdloss (ft)	Elev. Ground (Start) (ft)	HGL (In) (ft)	EGL (In) (ft)	Elev. Ground (Stop) (ft)	HGL (Out) (ft)	EGL (Out) (ft)
CO-31	MH-14	116.23	FD-23-1	115.97	24.0	46.1	0.006	2.05	0.65	0.00	123.80	120.35	120.36	121.50	120.35	120.36

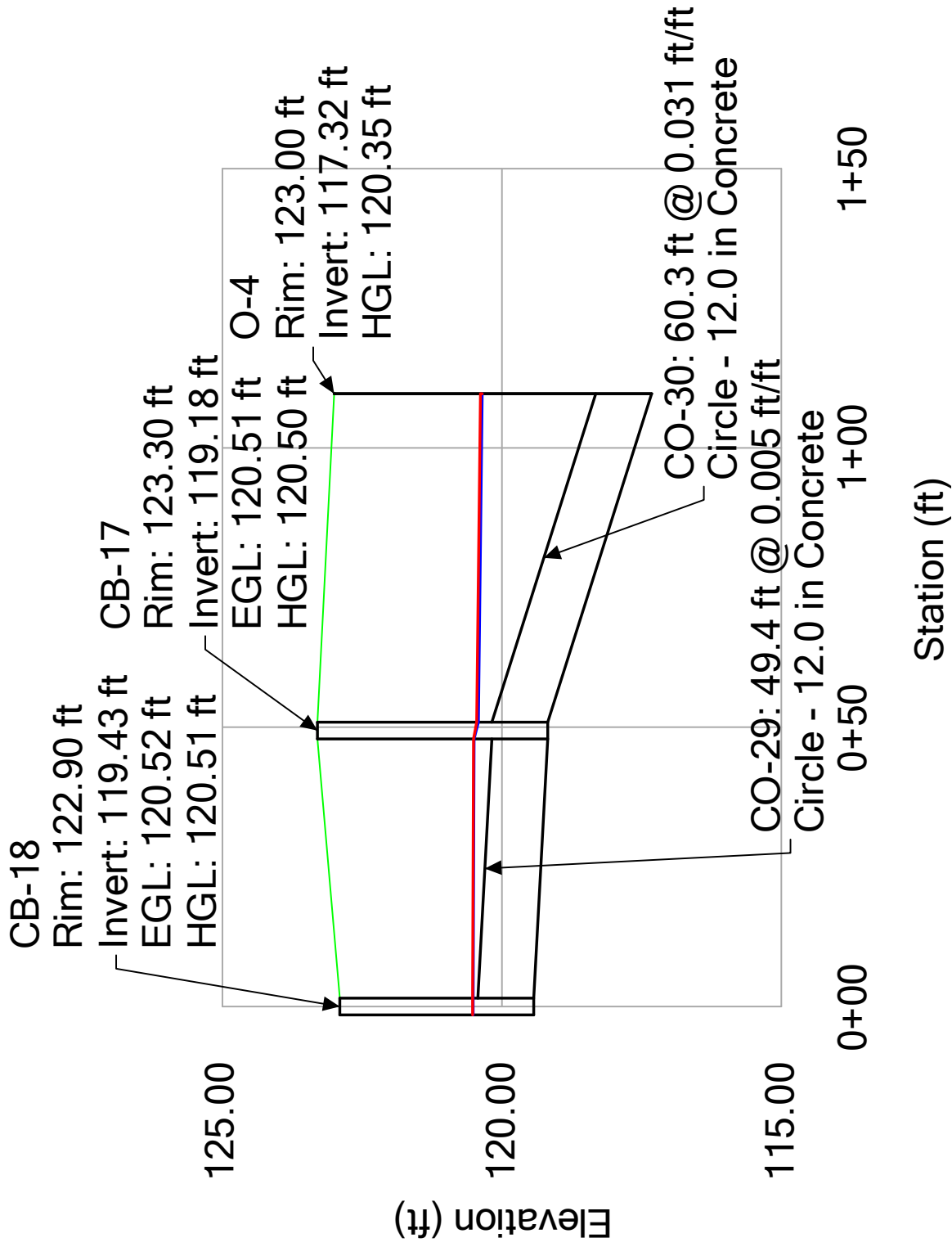
Manhole Report - Time: 0.00 hours

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	System CA (acres)	System Flow Time (min)	System Intensity (in/h)	System Rational Flow (cfs)	System Known Flow (cfs)	Flow (Known) (cfs)	Flow (Total Out) (cfs)	HGL (In) (ft)	HGL (Out) (ft)	Is Overflowing?
MH-14	123.80	116.23	0.693	15.000	2.936	2.05	0.00	0.00	2.05	120.35	120.35	False

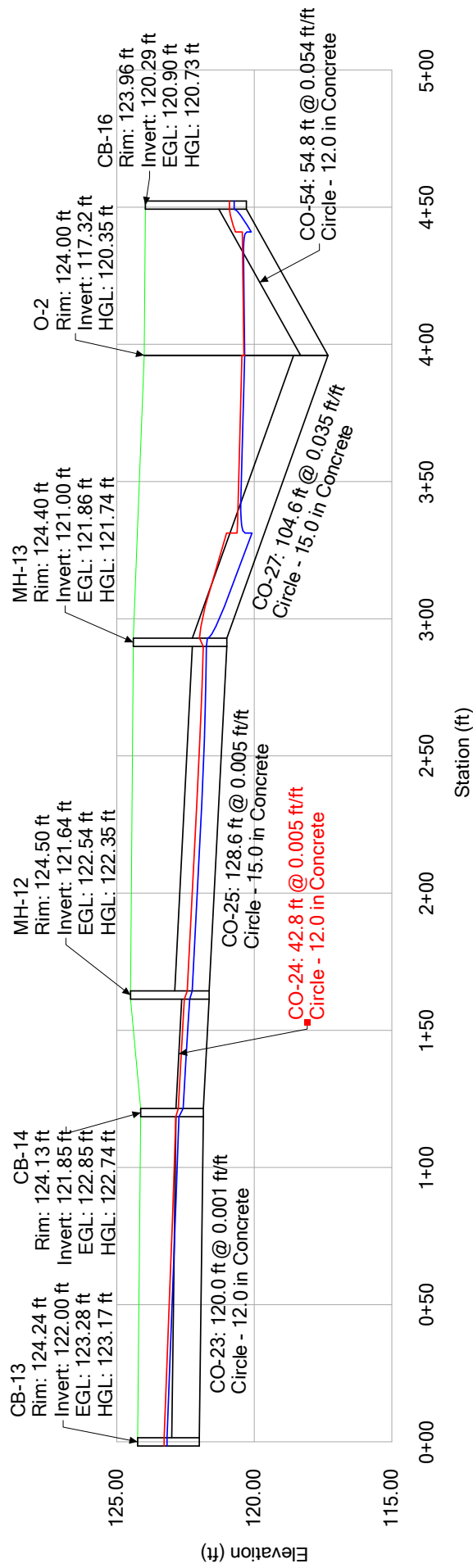
Outfall Report - Time: 0.00 hours

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	HGL (ft)	Depth (Node) (ft)	EGL (ft)	System Flow Time (min)	System CA (acres)	System Rational Flow (cfs)	Flow (Total Out) (cfs)	Notes
FD-23-1	121.50	115.97	120.35	4.38	120.35	16.176	0.700	1.99	1.97	

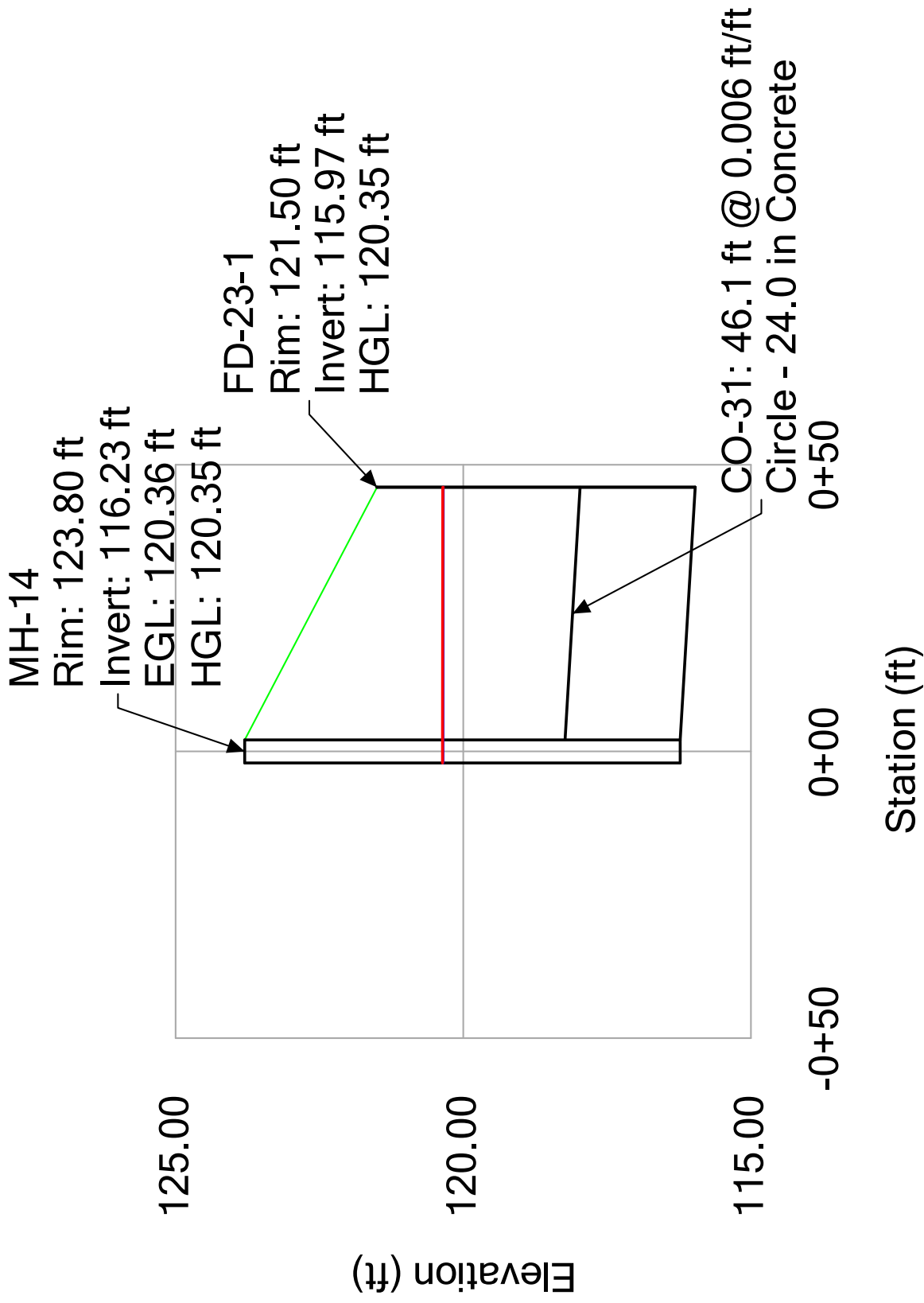
Profile Report **Engineering Profile - West-South Detention (21017-Shiloh Crossing.stsw)** **Active Scenario: 100 year**



Profile Report
Engineering Profile - West-North Detention (21017-Shiloh Crossing.stsw)
Active Scenario: 100 year



Profile Report
Engineering Profile - West Outfall (21017-Shiloh Crossing.stsw)
Active Scenario: 100 year



East Detention Basin

Shiloh Crossing

Active Scenario: 100 year

Hydrology Report - Time: 0.00 hours

Label	Start Node	Stop Node	Diameter (in)	Length (ft)	Slope (ft/ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	System Flow Time (min)	System Intensity (in/h)	System Drainage Area (ft²)	System CA (acres)	System Rational Flow (cfs)	Time (Pipe Flow) (min)
CO-16	CB-8	MH-9	12.0	43.4	0.009	122.92	123.65	7.000	4.374	25,264.8	0.458	2.02	0.179
CO-17	MH-9	O-6	12.0	24.1	0.017	123.65	123.79	7.281	4.285	25,264.8	0.458	1.98	0.072
CO-18	CB-6	O-6	24.0	16.5	0.044	122.80	123.79	7.000	4.374	17,859.6	0.324	1.43	0.043
CO-19	MH-10	O-5	15.0	44.6	0.009	123.42	123.80	10.297	3.575	91,476.0	1.659	5.98	0.156
CO-20	CB-7	MH-10	15.0	49.5	0.005	123.00	123.42	10.000	3.630	51,400.8	0.932	3.41	0.238
CO-21	MH-11	MH-10	15.0	58.1	0.020	124.00	123.42	7.070	4.351	40,075.2	0.727	3.19	0.140
CO-22	CB-5	MH-11	12.0	17.3	0.005	124.41	124.00	7.000	4.374	40,075.2	0.727	3.20	0.100

Hydraulic Report - Time: 0.00 hours

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Dia. (in)	Length (ft)	Slope (ft/ft)	Flow (cfs)	Velocity (ft/s)	Hdloss (ft)	Elev. Ground (Start) (ft)	HGL (In) (ft)	EGL (In) (ft)	Elev. Ground (Stop) (ft)	HGL (Out) (ft)	EGL (Out) (ft)
CO-16	CB-8	119.90	MH-9	119.50	12.0	43.4	0.009	2.02	2.57	0.16	122.92	121.59	121.69	123.65	121.43	121.53
CO-17	MH-9	119.50	O-6	119.08	12.0	24.1	0.017	1.98	2.52	0.09	123.65	121.34	121.43	123.79	121.25	121.35
CO-18	CB-6	119.80	O-6	119.08	24.0	16.5	0.044	1.43	6.40	0.00	122.80	121.25	121.25	123.79	121.25	121.25
CO-19	MH-10	119.50	O-5	119.08	15.0	44.6	0.009	5.98	4.87	0.44	123.42	121.69	122.06	123.80	121.25	121.62
CO-20	CB-7	119.75	MH-10	119.50	15.0	49.5	0.005	3.41	2.78	0.16	123.00	122.04	122.16	123.42	121.88	122.00
CO-21	MH-11	120.66	MH-10	119.50	15.0	58.1	0.020	3.19	2.60	0.16	124.00	121.96	122.06	123.42	121.79	121.90
CO-22	CB-5	120.74	MH-11	120.66	12.0	17.3	0.005	3.20	4.08	0.16	124.41	122.20	122.46	124.00	122.04	122.30

Manhole Report - Time: 0.00 hours

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	System CA (acres)	System Flow Time (min)	System Intensity (in/h)	System Rational Flow (cfs)	System Known Flow (cfs)	Flow (Known) (cfs)	Flow (Total Out) (cfs)	HGL (In) (ft)	HGL (Out) (ft)	Is Overflowing?
MH-9	123.65	119.50	0.458	7.281	4.285	1.98	0.00	0.00	1.98	121.43	121.34	False
MH-10	123.42	119.50	1.659	10.297	3.575	5.98	0.00	0.00	5.98	121.79	121.69	False
MH-11	124.00	120.66	0.727	7.070	4.351	3.19	0.00	0.00	3.19	122.04	121.96	False

Shiloh Crossing

Active Scenario: 100 year

Outfall Report - Time: 0.00 hours

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	HGL (ft)	Depth (Node) (ft)	EGL (ft)	System Flow Time (min)	System CA (acres)	System Rational Flow (cfs)	Flow (Total Out) (cfs)	Notes
O-5	123.80	119.08	121.25	2.17	121.25	10.449	1.659	5.93	5.93	NE Inflow
O-6	123.79	119.08	121.25	2.17	121.25	7.441	0.782	1.42	3.38	SE Inflow

Catch Basin Detailed Report - Time: 0.00 hours

Label	Inlet	Inlet Location	Inlet Drainage Area (acres)	Total Rational Flow to Inlet (cfs)	Intercepted Rational Flow (cfs)	Bypassed Rational Flow (cfs)	Spread / Top Width (ft)	Depth (Gutter) (in)	Curb Opening Length (ft)	Capture Efficiency (Calculated) (%)	Is Overflowing?
CB-5	<None>	In Sag	0.920	3.20	3.20	0.00	0.0	(N/A)	0.0	100.0	False
CB-6	<None>	In Sag	0.410	1.43	1.43	0.00	0.0	(N/A)	0.0	100.0	False
CB-7	<None>	In Sag	1.180	3.41	3.41	0.00	0.0	(N/A)	0.0	100.0	False
CB-8	<None>	In Sag	0.580	2.02	2.02	0.00	0.0	(N/A)	0.0	100.0	False

Shiloh Crossing **Active Scenario: 100 year** **Hydrology Report - Time: 0.00 hours**

Label	Start Node	Stop Node	Diameter (in)	Length (ft)	Slope (ft/ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	System Flow Time (min)	System Intensity (in/h)	System Drainage Area (ft²)	System CA (acres)	System Rational Flow (cfs)	Time (Pipe Flow) (min)
CO-1	CB-2	MH-1	15.0	25.6	0.014	124.00	124.00	7.000	4.374	12,632.4	0.232	1.02	0.072
CO-2	CB-1	MH-1	15.0	15.1	0.038	124.00	124.00	15.048	2.931	97,138.8	1.265	3.74	0.026
CO-3	MH-1	MH-2	18.0	96.8	0.003	124.00	123.50	15.130	2.923	109,771.2	1.497	4.41	0.534
CO-4	MH-2	MH-3	24.0	96.8	0.003	123.50	122.90	15.791	2.858	209,088.0	2.295	6.61	0.441
CO-5	CB-4	MH-3	15.0	24.7	0.002	122.97	122.90	7.000	4.374	8,276.4	0.165	0.73	0.171
CO-6	CB-3	MH-3	15.0	14.9	0.024	122.97	122.90	15.000	2.936	95,396.4	1.215	3.60	0.033
CO-7	MH-3	MH-4	24.0	50.0	0.003	122.90	123.70	16.558	2.788	312,760.8	3.676	10.33	0.227
CO-8	MH-4	CB-9	24.0	72.2	0.003	123.70	122.97	16.811	2.766	312,760.8	3.676	10.25	0.326
CO-9	CB-9	MH-5	24.0	39.3	0.003	122.97	123.22	17.180	2.735	319,730.4	3.820	10.53	0.185
CO-10	CB-10	MH-5	12.0	7.9	0.088	123.05	123.22	7.000	4.374	6,534.0	0.135	0.60	0.011
CO-11	MH-5	MH-6	24.0	120.1	0.003	123.22	123.50	17.375	2.719	326,264.4	3.955	10.84	0.547
CO-12	CB-11	MH-6	12.0	10.0	0.055	122.70	123.50	7.000	4.374	10,890.0	0.225	0.99	0.017
CO-13	MH-6	MH-7	24.0	99.2	0.003	123.50	123.17	17.955	2.673	337,154.4	4.180	11.26	0.450
CO-14	CB-12	MH-7	30.0	9.7	0.062	122.73	123.17	7.000	4.374	4,356.0	0.090	0.40	0.008
CO-15	MH-7	MH-8	30.0	32.1	0.003	123.17	123.10	18.416	2.637	341,510.4	4.270	11.35	0.130
CO-35	FD-2	CB-1	15.0	7.0	0.006	123.00	124.00	15.000	2.936	85,377.6	1.022	3.02	0.032
CO-55	MH-28	MH-2	18.0	63.4	0.022	123.00	123.50	15.000	2.936	99,316.8	0.798	2.36	0.128
EX CO-1	MH-8	EX MH-6	36.0	80.4	0.008	123.10	122.00	18.648	2.620	341,510.4	4.270	11.28	0.169

Shiloh Crossing
Active Scenario: 100 year
Hydraulic Report - Time: 0.00 hours

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Dia. (in)	Length (ft)	Slope (ft/ft)	Flow (cfs)	Velocity (ft/s)	Hdloss (ft)	Elev. Ground (Start) (ft)	HGL (In) (ft)	EGL (In) (ft)	Elev. Ground (Stop) (ft)	HGL (Out) (ft)	EGL (Out) (ft)
CO-1	CB-2	118.74	MH-1	118.37	15.0	25.6	0.014	1.02	0.83	0.01	124.00	121.43	121.44	124.00	121.42	121.43
CO-2	CB-1	118.95	MH-1	118.37	15.0	15.1	0.038	3.74	3.05	0.06	124.00	121.54	121.69	124.00	121.48	121.63
CO-3	MH-1	118.37	MH-2	118.08	18.0	96.8	0.003	4.41	2.50	0.20	124.00	121.40	121.49	123.50	121.20	121.30
CO-4	MH-2	118.08	MH-3	117.79	24.0	96.8	0.003	6.61	2.10	0.10	123.50	121.19	121.26	122.90	121.09	121.16
CO-5	CB-4	117.85	MH-3	117.79	15.0	24.7	0.002	0.73	0.59	0.00	122.97	121.08	121.09	122.90	121.08	121.08
CO-6	CB-3	118.15	MH-3	117.79	15.0	14.9	0.024	3.60	2.93	0.05	122.97	121.17	121.30	122.90	121.12	121.25
CO-7	MH-3	117.79	MH-4	117.64	24.0	50.0	0.003	10.33	3.29	0.12	122.90	121.07	121.24	123.70	120.95	121.12
CO-8	MH-4	117.64	CB-9	117.42	24.0	72.2	0.003	10.25	3.26	0.17	123.70	120.79	120.95	122.97	120.62	120.78
CO-9	CB-9	117.42	MH-5	117.31	24.0	39.3	0.003	10.53	3.35	0.10	122.97	120.57	120.75	123.22	120.47	120.65
CO-10	CB-10	118.00	MH-5	117.31	12.0	7.9	0.088	0.60	0.76	0.00	123.05	120.46	120.47	123.22	120.46	120.47
CO-11	MH-5	117.31	MH-6	116.95	24.0	120.1	0.003	10.84	3.45	0.32	123.22	120.45	120.64	123.50	120.13	120.32
CO-12	CB-11	117.50	MH-6	116.95	12.0	10.0	0.055	0.99	1.26	0.01	122.70	120.12	120.15	123.50	120.11	120.14
CO-13	MH-6	116.95	MH-7	116.65	24.0	99.2	0.003	11.26	3.58	0.29	123.50	120.10	120.30	123.17	119.81	120.01
CO-14	CB-12	116.75	MH-7	116.15	30.0	9.7	0.062	0.40	0.08	0.00	122.73	119.76	119.76	123.17	119.76	119.76
CO-15	MH-7	116.15	MH-8	116.06	30.0	32.1	0.003	11.35	2.31	0.03	123.17	119.74	119.83	123.10	119.71	119.80
CO-35	FD-2	118.99	CB-1	118.95	15.0	7.0	0.006	3.02	2.46	0.02	123.00	121.61	121.70	124.00	121.59	121.68
CO-55	MH-28	119.50	MH-2	118.08	18.0	63.4	0.022	2.36	1.34	0.04	123.00	121.25	121.27	123.50	121.21	121.24
EX CO-1	MH-8	115.56	EX MH-6	114.90	36.0	80.4	0.008	42.23	5.97	0.37	123.10	119.27	119.83	122.00	118.90	119.45

Shiloh Crossing
Active Scenario: 100 year
Manhole Report - Time: 0.00 hours

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	System CA (acres)	System Flow Time (min)	System Intensity (in/h)	System Rational Flow (cfs)	System Known Flow (cfs)	Flow (Known) (cfs)	Flow (Total Out) (cfs)	HGL (In) (ft)	HGL (Out) (ft)	Is Overflowing?
MH-1	124.00	118.37	1.497	15.130	2.923	4.41	0.00	0.00	4.41	121.42	121.40	False
MH-2	123.50	118.08	2.295	15.791	2.858	6.61	0.00	0.00	6.61	121.20	121.19	False
MH-3	122.90	117.79	3.676	16.558	2.788	10.33	0.00	0.00	10.33	121.08	121.07	False
MH-4	123.70	117.64	3.676	16.811	2.766	10.25	0.00	0.00	10.25	120.95	120.79	False
MH-5	123.22	117.31	3.955	17.375	2.719	10.84	0.00	0.00	10.84	120.46	120.45	False
MH-6	123.50	116.95	4.180	17.955	2.673	11.26	0.00	0.00	11.26	120.11	120.10	False
MH-7	123.17	116.15	4.270	18.416	2.637	11.35	0.00	0.00	11.35	119.76	119.74	False
MH-8	123.10	115.56	4.270	18.648	2.620	11.28	0.00	0.00	42.23	119.71	119.27	False
MH-28	123.00	119.50	0.798	15.000	2.936	2.36	0.00	0.00	2.36	121.25	121.25	False

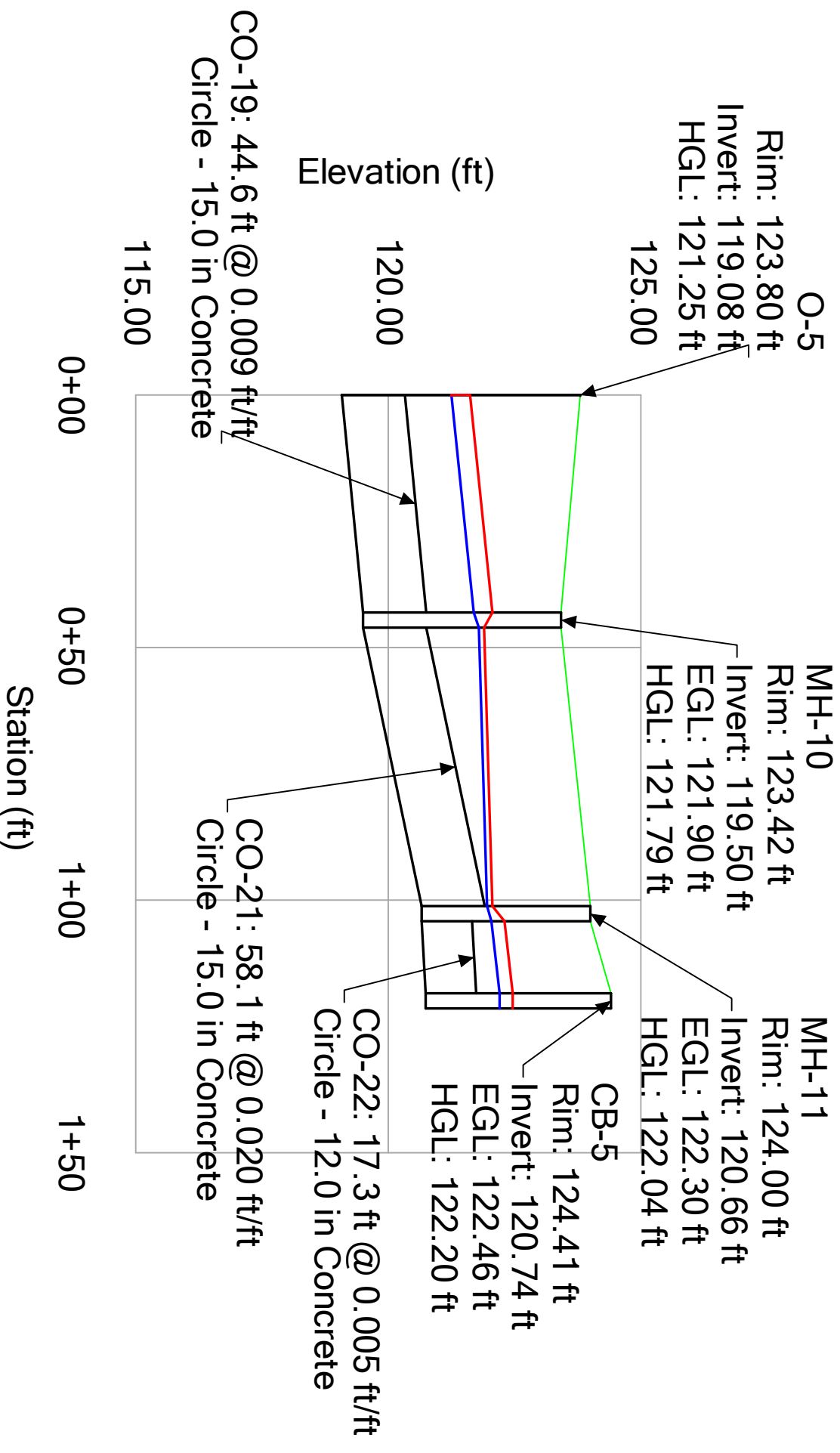
Shiloh Crossing **Active Scenario: 100 year** **Outfall Report - Time: 0.00 hours**

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	HGL (ft)	Depth (Node) (ft)	EGL (ft)	System Flow Time (min)	System CA (acres)	System Rational Flow (cfs)	Flow (Total Out) (cfs)	Notes
EX MH-6	122.00	114.90	118.90	4.00	118.90	18.872	4.270	11.21	42.16	

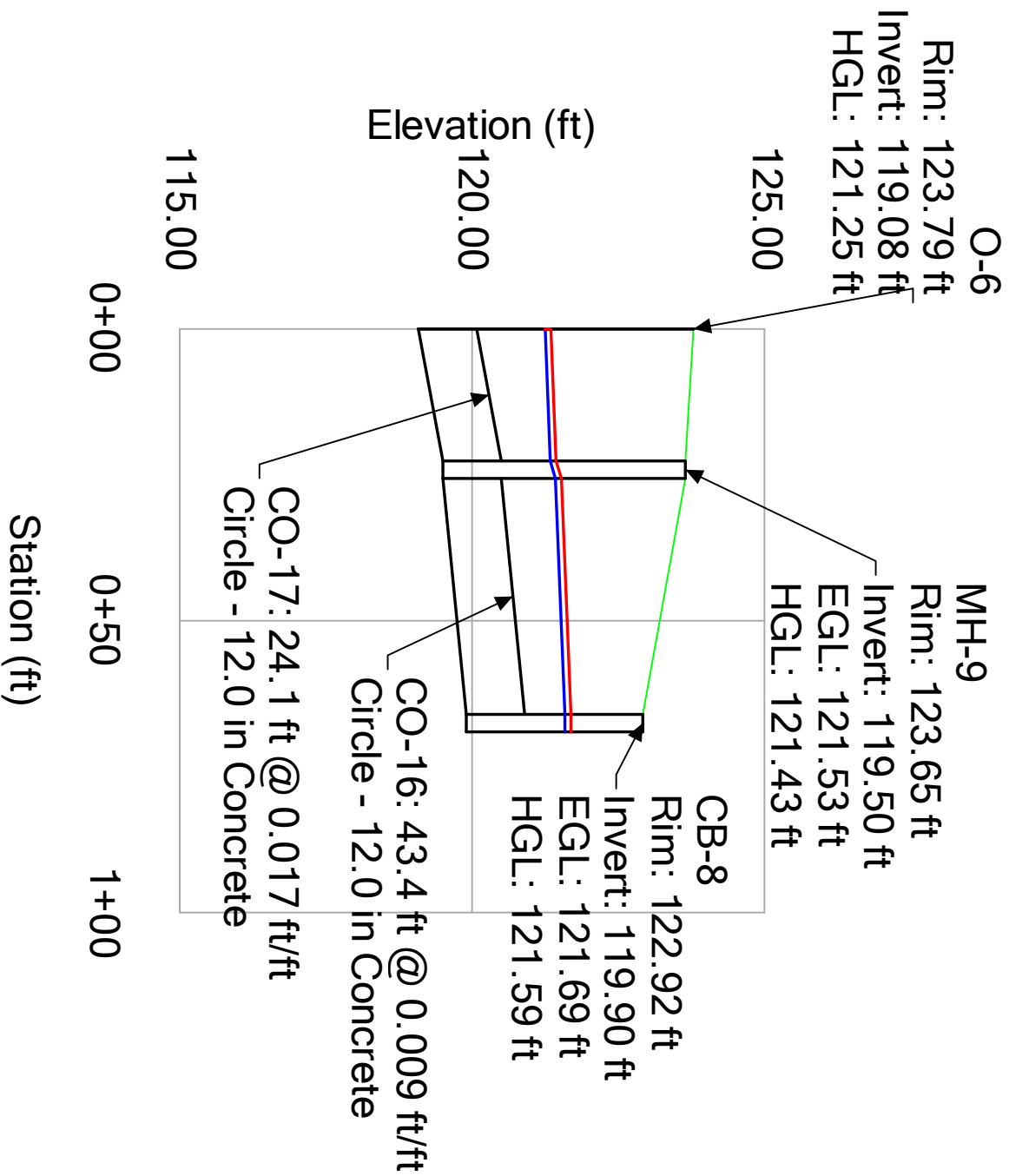
Catch Basin Detailed Report - Time: 0.00 hours

Label	Inlet	Inlet Location	Inlet Drainage Area (acres)	Total Rational Flow to Inlet (cfs)	Intercepted Rational Flow (cfs)	Bypassed Rational Flow (cfs)	Spread / Top Width (ft)	Depth (Gutter) (in)	Curb Opening Length (ft)	Capture Efficiency (Calculated) (%)	Is Overflowing?
CB-1	<None>	In Sag	0.270	1.07	1.07	0.00	0.0	(N/A)	0.0	100.0	False
CB-2	<None>	In Sag	0.290	1.02	1.02	0.00	0.0	(N/A)	0.0	100.0	False
CB-3	<None>	In Sag	2.190	3.60	3.60	0.00	0.0	(N/A)	0.0	100.0	False
CB-4	<None>	In Sag	0.190	0.73	0.73	0.00	0.0	(N/A)	0.0	100.0	False
CB-9	<None>	In Sag	0.160	0.63	0.63	0.00	0.0	(N/A)	0.0	100.0	False
CB-10	<None>	In Sag	0.150	0.60	0.60	0.00	0.0	(N/A)	0.0	100.0	False
CB-11	<None>	In Sag	0.250	0.99	0.99	0.00	0.0	(N/A)	0.0	100.0	False
CB-12	<None>	In Sag	0.100	0.40	0.40	0.00	0.0	(N/A)	0.0	100.0	False
FD-2	<None>	In Sag	1.960	3.02	3.02	0.00	0.0	(N/A)	0.0	100.0	False

Profile Report
Engineering Profile - East-North Detention (21017-Shiloh Crossing.stsw)
Active Scenario: 100 year



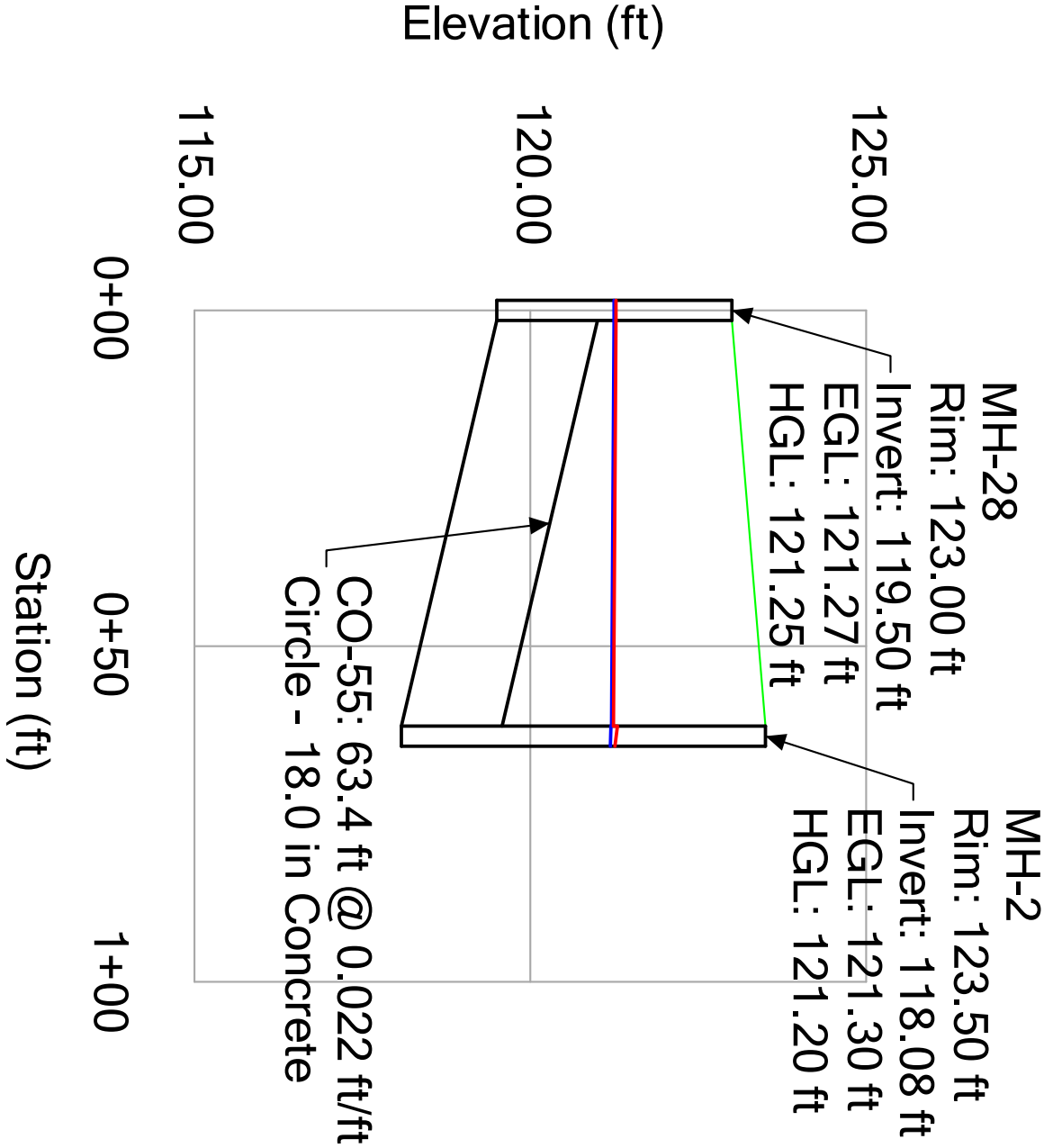
Profile Report
Engineering Profile - East-South Detention (21017-Shiloh Crossing.stsw)
Active Scenario: 100 year



Profile Report

Engineering Profile - East Outfall (21017-Shiloh Crossing.stsw)

Active Scenario: 100 year



North Detention Pond

Shiloh Crossing
Active Scenario: 100 year
Hydrology Report - Time: 0.00 hours

Label	Start Node	Stop Node	Diameter (in)	Length (ft)	Slope (ft/ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	System Flow Time (min)	System Intensity (in/h)	System Drainage Area (ft ²)	System CA (acres)	System Rational Flow (cfs)	Time (Pipe Flow) (min)
CO-32	CB-8	CB-7	36.0	51.0	0.004	121.50	123.25	15.000	2.936	387,248.4	5.332	15.78	0.148
CO-33	CB-7	FD-21	36.0	138.6	0.004	123.25	121.85	15.381	2.898	387,684.0	5.336	15.59	0.411
CO-34	FD-21	FD-22	36.0	141.3	0.004	121.85	121.90	16.428	2.800	388,555.2	5.343	15.08	0.419
CO-35	FD-22	FD-23-2	36.0	35.6	0.004	121.90	121.50	17.532	2.706	388,990.8	5.346	14.58	0.102

Hydraulic Report - Time: 0.00 hours

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Dia. (in)	Length (ft)	Slope (ft/ft)	Flow (cfs)	Velocity (ft/s)	Hdloss (ft)	Elev. Ground (Start) (ft)	HGL (In) (ft)	EGL (In) (ft)	Elev. Ground (Stop) (ft)	HGL (Out) (ft)	EGL (Out) (ft)
CO-32	CB-8	117.50	CB-7	117.28	36.0	51.0	0.004	15.78	2.23	0.03	121.50	120.77	120.85	123.25	120.74	120.81
CO-33	CB-7	117.28	FD-21	116.71	36.0	138.6	0.004	15.59	2.21	0.09	123.25	120.70	120.78	121.85	120.61	120.69
CO-34	FD-21	116.71	FD-22	116.13	36.0	141.3	0.004	15.08	2.13	0.08	121.85	120.61	120.68	121.90	120.52	120.60
CO-35	FD-22	116.13	FD-23-2	115.97	36.0	35.6	0.004	14.58	2.06	0.02	121.90	120.52	120.59	121.50	120.50	120.57

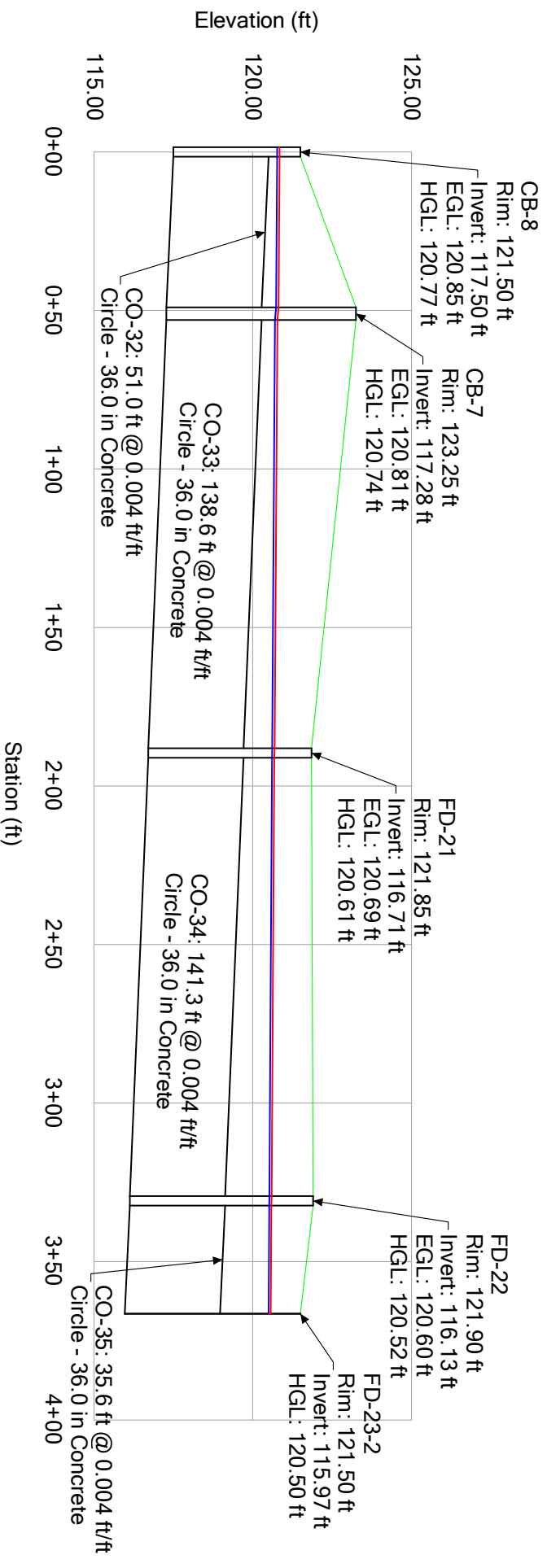
Outfall Report - Time: 0.00 hours

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	HGL (ft)	Depth (Node) (ft)	EGL (ft)	System Flow Time (min)	System CA (acres)	System Rational Flow (cfs)	Flow (Total Out) (cfs)	Notes
FD-23-2	121.50	115.97	120.50	4.53	120.50	17.820	5.346	14.46	14.46	

Shiloh Crossing **Active Scenario: 100 year** **Catch Basin Detailed Report - Time: 0.00 hours**

Label	Inlet	Inlet Location	Inlet Drainage Area (acres)	Total Rational Flow to Inlet (cfs)	Intercepted Rational Flow (cfs)	Bypassed Rational Flow (cfs)	Spread / Top Width (ft)	Depth (Gutter) (in)	Curb Opening Length (ft)	Capture Efficiency (Calculated) (%)	Is Overflowing?
CB-7	<None>	In Sag	0.010	0.01	0.01	0.00	0.0	(N/A)	0.0	100.0	False
CB-8	<None>	In Sag	8.890	15.78	15.78	0.00	0.0	(N/A)	0.0	100.0	False
FD-21	<None>	In Sag	0.020	0.02	0.02	0.00	0.0	(N/A)	0.0	100.0	False
FD-22	<None>	In Sag	0.010	0.01	0.01	0.00	0.0	(N/A)	0.0	100.0	False

Profile Report
Engineering Profile - Pond Outfall (21017-Shiloh Crossing.stsw)
Active Scenario: 100 year



Appendix E:

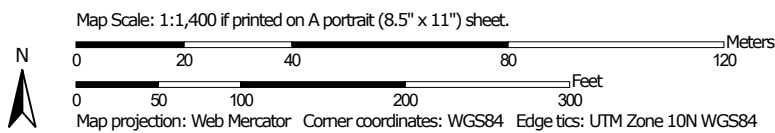
Reference Information

- Soil Map
- NOAA Precipitation Frequency Table
- Shiloh Industrial Center Drainage Report
 - Windsor Redwoods Drainage Report

Soil Map—Sonoma County, California (Shiloh Crossing)



Soil Map may not be valid at this scale.
















**Natural Resources
Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

6/25/2021
Page 1 of 3

MAP LEGEND

Area of Interest (AOI)		Area of Interest (AOI)		Spoil Area
Soils			Stony Spot	
	Soil Map Unit Polygons		Very Stony Spot	
	Soil Map Unit Lines		Wet Spot	
	Soil Map Unit Points		Other	
Special Point Features			Special Line Features	
	Blowout		Water Features	
	Borrow Pit			Streams and Canals
	Clay Spot		Transportation	
	Closed Depression			Rails
	Gravel Pit			Interstate Highways
	Gravelly Spot			US Routes
	Landfill			Major Roads
	Lava Flow			Local Roads
	Marsh or swamp		Background	
	Mine or Quarry			Aerial Photography
	Miscellaneous Water			
	Perennial Water			
	Rock Outcrop			
	Saline Spot			
	Sandy Spot			
	Severely Eroded Spot			
	Sinkhole			
	Slide or Slip			
	Sodic Spot			

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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

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

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

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

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

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

Soil Survey Area: Sonoma County, California
Survey Area Data: Version 14, May 29, 2020

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

Date(s) aerial images were photographed: Jun 1, 2020—Oct 30, 2020

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
CeA	Clear Lake clay, sandy substratum, drained, 0 to 2 percent slopes, MLRA 14	0.2	2.8%
HtA	Huichica loam, 0 to 2 percent slopes	6.9	79.8%
HwB	Huichica loam, shallow, ponded, 0 to 5 percent slopes	1.5	17.3%
Totals for Area of Interest		8.7	100.0%

Sonoma County, California

HtA—Huichica loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: hffk

Elevation: 100 to 300 feet

Mean annual precipitation: 30 inches

Mean annual air temperature: 61 degrees F

Frost-free period: 260 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Huichica and similar soils: 85 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Huichica

Setting

Landform: Terraces

Landform position (two-dimensional): Footslope

Landform position (three-dimensional): Base slope

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Alluvium derived from igneous, metamorphic and sedimentary rock

Typical profile

H1 - 0 to 14 inches: loam

H2 - 14 to 23 inches: sandy clay loam

H3 - 23 to 30 inches: clay

H4 - 30 to 57 inches: cemented

Properties and qualities

Slope: 0 to 2 percent

Depth to restrictive feature: More than 80 inches; 20 to 40 inches to duripan

Drainage class: Moderately well drained

Runoff class: High

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water capacity: Low (about 3.5 inches)

Interpretive groups

Land capability classification (irrigated): 3s

Land capability classification (nonirrigated): 3s

Hydrologic Soil Group: C

Hydric soil rating: No

Minor Components

Unnamed

Percent of map unit: 5 percent

Landform: Basin floors

Hydric soil rating: Yes

Wright

Percent of map unit: 3 percent

Hydric soil rating: No

Haire

Percent of map unit: 3 percent

Hydric soil rating: No

Clear lake

Percent of map unit: 2 percent

Landform: Depressions

Hydric soil rating: Yes

Zamora

Percent of map unit: 2 percent

Hydric soil rating: No

Data Source Information

Soil Survey Area: Sonoma County, California

Survey Area Data: Version 14, May 29, 2020



NOAA Atlas 14, Volume 6, Version 2
Location name: Windsor, California, USA*
Latitude: 38.5266°, Longitude: -122.7848°
Elevation: 125 ft**
 * source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

[PF_tabular](#) | [PF_graphical](#) | [Maps_&_aerials](#)

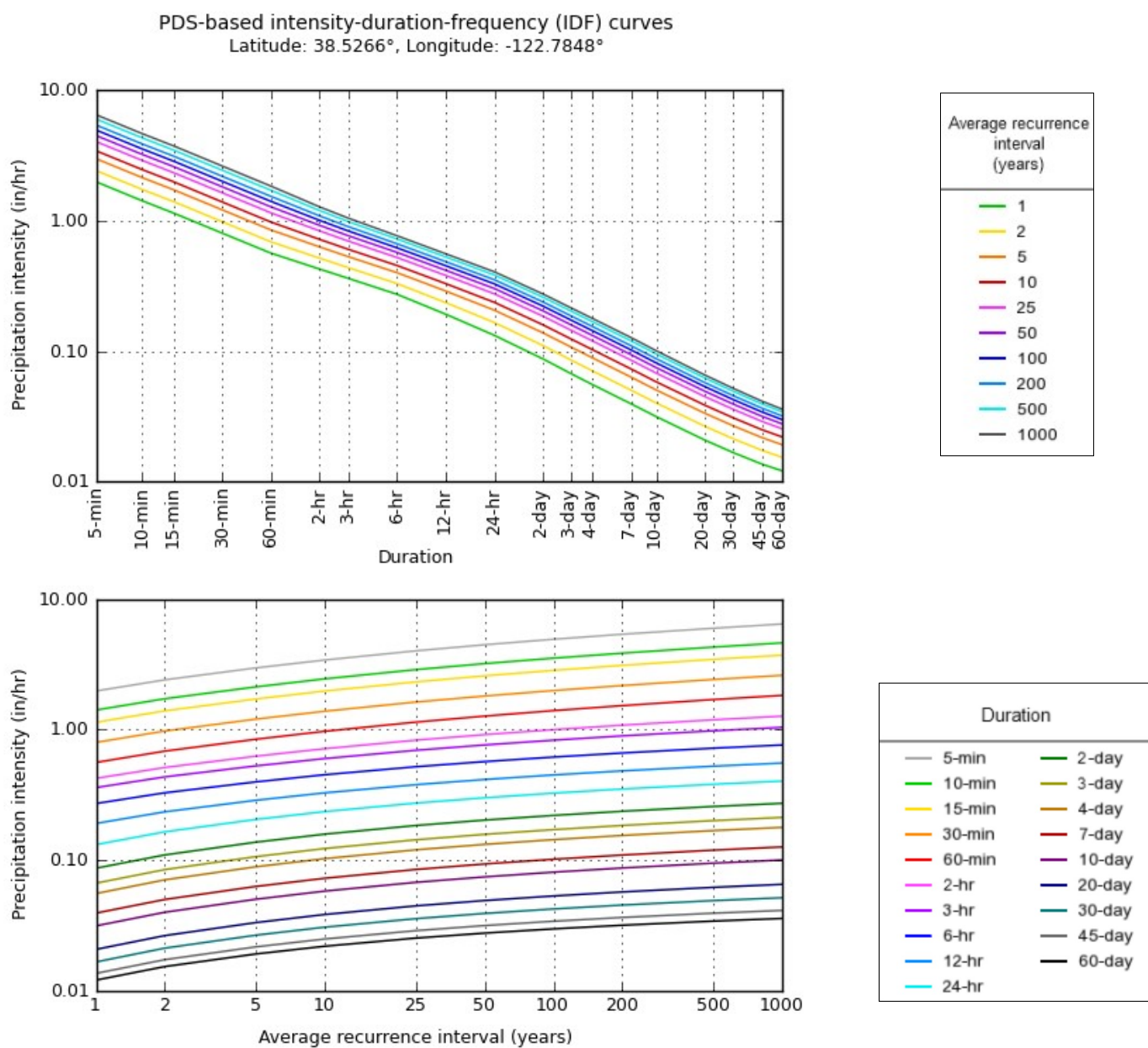
PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	1.98 (1.75-2.24)	2.41 (2.15-2.75)	2.98 (2.64-3.40)	3.42 (3.00-3.95)	4.02 (3.40-4.82)	4.48 (3.68-5.50)	4.93 (3.94-6.23)	5.39 (4.16-7.03)	5.99 (4.42-8.21)	6.46 (4.57-9.20)
10-min	1.42 (1.26-1.61)	1.73 (1.54-1.97)	2.13 (1.89-2.44)	2.45 (2.15-2.83)	2.89 (2.43-3.46)	3.21 (2.64-3.94)	3.53 (2.82-4.46)	3.86 (2.98-5.04)	4.30 (3.16-5.89)	4.63 (3.28-6.59)
15-min	1.14 (1.02-1.30)	1.40 (1.24-1.58)	1.72 (1.52-1.96)	1.98 (1.74-2.28)	2.32 (1.96-2.79)	2.59 (2.13-3.18)	2.85 (2.28-3.60)	3.11 (2.41-4.06)	3.46 (2.55-4.74)	3.73 (2.64-5.32)
30-min	0.800 (0.712-0.908)	0.978 (0.868-1.11)	1.21 (1.07-1.38)	1.39 (1.22-1.60)	1.63 (1.37-1.95)	1.81 (1.49-2.23)	2.00 (1.59-2.52)	2.18 (1.69-2.85)	2.43 (1.79-3.33)	2.61 (1.85-3.73)
60-min	0.562 (0.499-0.638)	0.686 (0.609-0.780)	0.846 (0.749-0.965)	0.973 (0.853-1.12)	1.14 (0.964-1.37)	1.27 (1.05-1.56)	1.40 (1.12-1.77)	1.53 (1.18-2.00)	1.70 (1.25-2.33)	1.83 (1.30-2.62)
2-hr	0.424 (0.378-0.482)	0.514 (0.456-0.585)	0.628 (0.556-0.716)	0.716 (0.628-0.825)	0.832 (0.701-0.997)	0.918 (0.754-1.13)	1.00 (0.800-1.27)	1.08 (0.838-1.42)	1.19 (0.878-1.63)	1.27 (0.900-1.81)
3-hr	0.361 (0.321-0.409)	0.436 (0.387-0.495)	0.529 (0.468-0.603)	0.602 (0.528-0.693)	0.696 (0.586-0.834)	0.765 (0.629-0.940)	0.832 (0.665-1.05)	0.898 (0.694-1.17)	0.982 (0.724-1.35)	1.04 (0.739-1.49)
6-hr	0.272 (0.242-0.309)	0.329 (0.292-0.374)	0.399 (0.353-0.455)	0.452 (0.397-0.521)	0.521 (0.439-0.624)	0.570 (0.469-0.701)	0.618 (0.493-0.781)	0.664 (0.513-0.867)	0.722 (0.532-0.990)	0.765 (0.541-1.09)
12-hr	0.192 (0.170-0.218)	0.235 (0.209-0.268)	0.288 (0.255-0.329)	0.329 (0.288-0.379)	0.380 (0.320-0.455)	0.416 (0.342-0.511)	0.451 (0.360-0.570)	0.484 (0.374-0.632)	0.526 (0.388-0.721)	0.556 (0.394-0.793)
24-hr	0.132 (0.119-0.150)	0.165 (0.148-0.188)	0.206 (0.184-0.234)	0.236 (0.210-0.271)	0.274 (0.237-0.324)	0.301 (0.256-0.363)	0.327 (0.271-0.402)	0.352 (0.285-0.443)	0.383 (0.299-0.500)	0.405 (0.306-0.545)
2-day	0.087 (0.078-0.099)	0.110 (0.099-0.125)	0.138 (0.123-0.157)	0.159 (0.141-0.182)	0.185 (0.160-0.218)	0.203 (0.172-0.245)	0.221 (0.183-0.271)	0.238 (0.192-0.299)	0.258 (0.202-0.338)	0.273 (0.207-0.369)
3-day	0.067 (0.060-0.076)	0.085 (0.076-0.097)	0.107 (0.096-0.122)	0.123 (0.110-0.141)	0.144 (0.124-0.170)	0.158 (0.134-0.190)	0.172 (0.143-0.211)	0.185 (0.150-0.233)	0.201 (0.157-0.263)	0.213 (0.161-0.287)
4-day	0.056 (0.050-0.063)	0.071 (0.064-0.081)	0.089 (0.080-0.102)	0.103 (0.092-0.118)	0.120 (0.104-0.142)	0.133 (0.112-0.159)	0.144 (0.120-0.177)	0.155 (0.126-0.195)	0.169 (0.132-0.221)	0.179 (0.135-0.241)
7-day	0.039 (0.035-0.045)	0.050 (0.045-0.057)	0.063 (0.057-0.072)	0.073 (0.065-0.084)	0.085 (0.074-0.101)	0.094 (0.080-0.113)	0.102 (0.085-0.125)	0.110 (0.089-0.138)	0.120 (0.093-0.156)	0.127 (0.096-0.171)
10-day	0.031 (0.028-0.036)	0.040 (0.036-0.046)	0.050 (0.045-0.057)	0.058 (0.052-0.067)	0.068 (0.059-0.080)	0.075 (0.063-0.090)	0.081 (0.067-0.100)	0.087 (0.071-0.110)	0.095 (0.074-0.124)	0.101 (0.076-0.136)
20-day	0.021 (0.019-0.024)	0.027 (0.024-0.030)	0.033 (0.030-0.038)	0.038 (0.034-0.044)	0.045 (0.039-0.053)	0.049 (0.042-0.059)	0.053 (0.044-0.066)	0.057 (0.046-0.072)	0.062 (0.048-0.081)	0.065 (0.050-0.088)
30-day	0.017 (0.015-0.019)	0.021 (0.019-0.024)	0.027 (0.024-0.030)	0.031 (0.027-0.035)	0.036 (0.031-0.042)	0.039 (0.033-0.047)	0.042 (0.035-0.052)	0.045 (0.037-0.057)	0.049 (0.038-0.064)	0.052 (0.039-0.070)
45-day	0.014 (0.012-0.015)	0.017 (0.016-0.020)	0.022 (0.019-0.025)	0.025 (0.022-0.029)	0.029 (0.025-0.034)	0.032 (0.027-0.038)	0.034 (0.028-0.042)	0.037 (0.030-0.046)	0.039 (0.031-0.051)	0.041 (0.031-0.056)
60-day	0.012 (0.011-0.014)	0.015 (0.014-0.017)	0.019 (0.017-0.022)	0.022 (0.020-0.025)	0.025 (0.022-0.030)	0.028 (0.024-0.033)	0.030 (0.025-0.037)	0.032 (0.026-0.040)	0.034 (0.027-0.045)	0.036 (0.027-0.048)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).
 Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.
 Please refer to NOAA Atlas 14 document for more information.

[Back to Top](#)

PF graphical



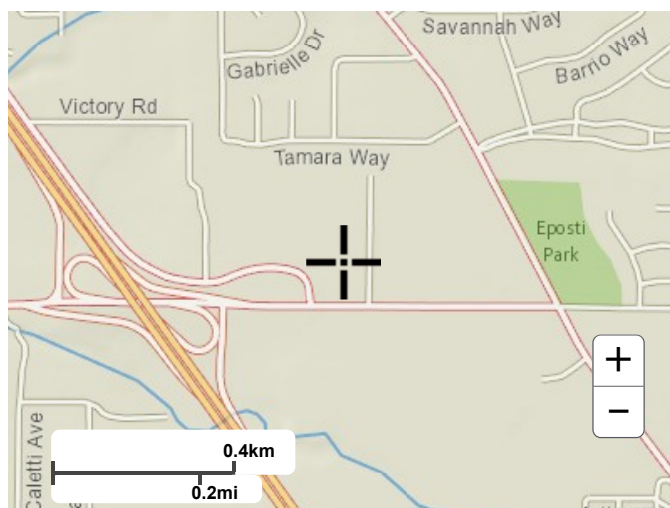
NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Thu Jun 17 15:38:17 2021

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Maps & aerials

Small scale terrain



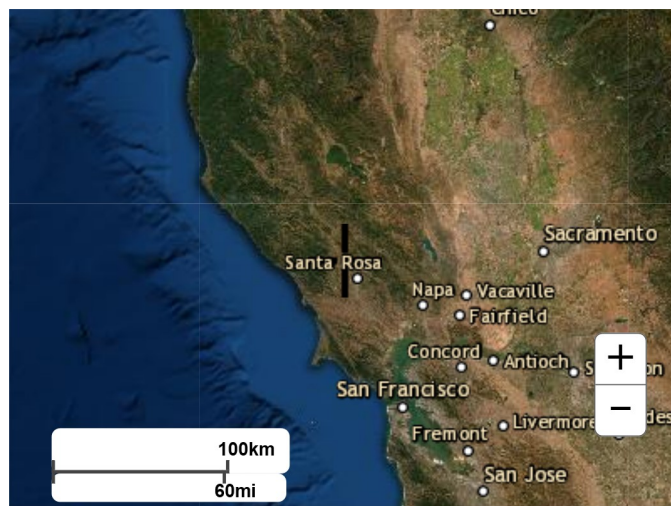
Large scale terrain



Large scale map



Large scale aerial

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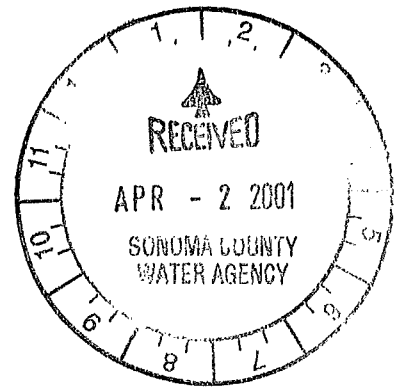
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SEP 27 2002

COASTLAND CIVIL
ENGINEERING, INC.



SHILOH INDUSTRIAL CENTER

Project No. 99-13

295 Shiloh Road
Windsor, California

A.P. No. 163-171-015,038

HYDROLOGY AND HYDRAULIC DESIGN

March 2001

WITH
\$ REVISIONS
RECEIVED
10/14/02

Prepared by:

DALE ROPER & ASSOCIATES

P.O. Box 2009
Healdsburg, CA 95448
(707) 431-1417

Dale Allen Roper
Dale Allen Roper, R.C.E. No. 35,379
Expires: 9/30/03



SHILOH INDUSTRIAL CENTER

WINDSOR, CALIFORNIA

SEE REVISIONS
AS OF 10/14/02
ATTACHED AS LAST

13 SHEETS

RMS

PARCEL 2 ONLY

INTRODUCTION:

The proposed project is a commercial incubator facility located on a 3.57 acre parcel of land located at 295 Shiloh Road, Windsor, California. The site is bordered on the east by rural residential properties, on the north by a residential subdivision, on the west by the Home Depot development that is currently under construction and on the south by Shiloh Road.

HYDROLOGY:

The hydrology calculations for the Empire Car Wash Project have been performed in accordance with the Sonoma County Water Agency "Flood Control Design Criteria" and the charts and graphs contained therein.

Mean seasonal precipitation in the project area is 35 inches, resulting in a "K" factor of 1.17. Initial time of concentration was assumed to be 7 minutes. Runoff coefficients of 0.95 for the paved areas, 0.45 for the off-site areas to the east. (Plate B-1) → runoff coeff.

CITY OF WINDSOR MASTER PLAN ESTIMATED

HYDRAULIC DESIGN:

The on-site storm drainage system was designed in accordance with Sonoma County Water Agency standards. Initial energy/hydraulic grade line information from the Home Depot project was utilized in the backwater analysis of the on-site system. Analysis of the Home Depot data indicates that the "siltation" pond being built as part of that project probably will not perform that function, as the flow line of the outlet pipe from the pond has been placed at the same elevation as the bottom of the pond. (Elev. = 113.3+/-) This will not allow for a stilling of the water that would allow settling of the sediment load in the storm water. The 30" diameter outlet pipe from the pond is under-sized to convey the 10-year flow calculated to be 45.8 cfs. {Q₍₁₀₎} This results in backwater situation until the water surface in the pond reaches an elevation of 117.45. This water surface elevation was utilized as the initial energy grade line for the backwater analysis.

BACKWATER
ELEVATION
USED AS
INITIAL
EGL

RESULTS & CONCLUSIONS:

The storm drainage system as designed is adequate to convey the 10-year design storm. Due to the water surface elevation in the Home Depot pond, it was necessary to significantly over-design the size of the storm drain from the pond outlet to D.I.# 2. While a 24" diameter pipe would have been sufficient under normal conditions, it was necessary to increase the diameter to 36" in order to keep the hydraulic grade line below the ground surface in the upper reaches of the system.

100 storm Runways

For storms in excess of the 10-year design storm, overflow outlets have been provided at several locations. For runoff entering the site from the east, excess stormwater can flow southerly along the roadside ditch to Shiloh Road, in accordance with the current drainage pattern. On-site overflows can release through the gap between Buildings A and B (See Site Plan, sheet C-4), out the emergency vehicle access between Buildings B and C, and through a path westerly from the northwest corner of the property at D.I.# 16.

Based on project review comments dated October 1, 2002 the following revisions were made to the drainage calculations prepared by Dale Roper & Associates:

1. Tributary Area 1 was increased in size from 4.5 acres to 7.39 acres. The area increase is based on a hydrology map used for the neighboring Wal-Mart development. See the attached portion of the revised Hydrology Map "A."
2. The runoff coefficient for tributary Area 1 has been revised from $C=0.45$ to $C=0.70$ to reflect the current zoning density for future development. The General Plan Map/zoning map indicates RV (Village Residential) and RH (High Density Residential) zoning for tributary Area 1. See the attached map and calculations for determining the revised runoff coefficient using a weighted average based on the area of each zoning category.

In addition, we analyzed the pre-development storm drainage run-off for this drainage system. It is our understanding that limiting the drainage system outlet to the pre-development discharge may be required. In order to accomplish this, we designed a structure with an orifice opening (16" diameter) within DI #1 to control the discharge to the pre-development flow ($Q=7.76$ c.f.s.). When the drainage flow exceeds the pre-development discharge rate, the water will overtop the structure within DI #1 and flow to the outlet of the structure. See the detail of DI #1 on revised sheet C-8, submitted on October 14, 2002.

DI #1
CONTROLS
DISCHARGE
TO PRE-Q

See the attached hydrology and hydraulic calculations for the revised drainage area and runoff coefficient for tributary Area 1.

SAILON INDUSTRIAL CENTER DRAINAGE DISCHARGE CALC.

10/14/02

PREF. DEVELOPMENT

$$A_1 + A_2 + A_3 = 10.94$$

FWD AREAS #1 to #3

$$K = 1.17$$

$$Q = KCIA$$

$$C = 0.45$$

$$Q = 7.76 \text{ cfs} \quad \checkmark$$

$$I' = 1.35$$

$$@ T_c = 22 \text{ min}$$

SUBMERGED ORIFICE OPENING

$$T_c = 407$$

$$I = 1$$

$$I' = 1.6?$$

TRY 12" DIA. ORIFICE

$$C = 0.60$$

$$A = \frac{\pi (11)^2}{4} = 0.785 \text{ ft}^2$$

$$h = 1' @ 12" \phi$$

$$Q = C A \sqrt{2gh}$$

$$= (0.6)(0.785)(64.4(1))^{1/2}$$

$$= 3.78 \text{ cfs} < 7.76 \text{ No Good} \quad \checkmark$$

TRY 15" DIA.

$$C = 0.60, h = 1.375'$$

$$A = \frac{\pi (1.25)^2}{4} = 1.22 \text{ ft}^2$$

$$Q = (0.6)(1.22)(64.4 \times 1.375)^{1/2}$$

$$Q = 6.89 \text{ cfs} < 7.76 \text{ No Good} \quad \checkmark$$

11/14/02 SHILON INDUSTRIAL CENTER
DRAINAGE DISCHARGE CALC.

(CONT.)

TRY 18" DIA.

$$h = 1.5', \quad a = \pi (1.5)^2 / 4 = 1.77 \text{ ft}^2$$

$$Q = C_d a \sqrt{2gh}$$

$$= (0.6)(1.77) \left(64.4 \times 1.5 \right)^{1/2}$$

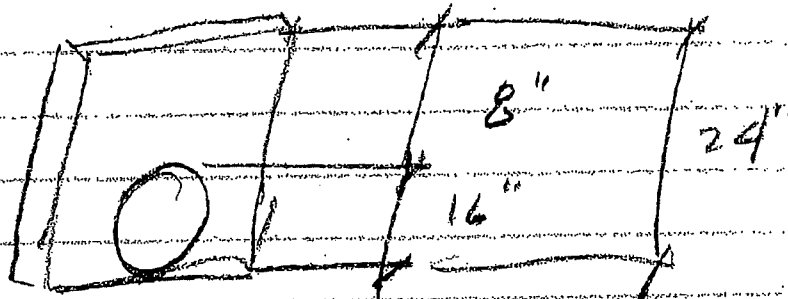
$$= 10.43 \text{ cfs} > 7.76 \text{ No Good}$$

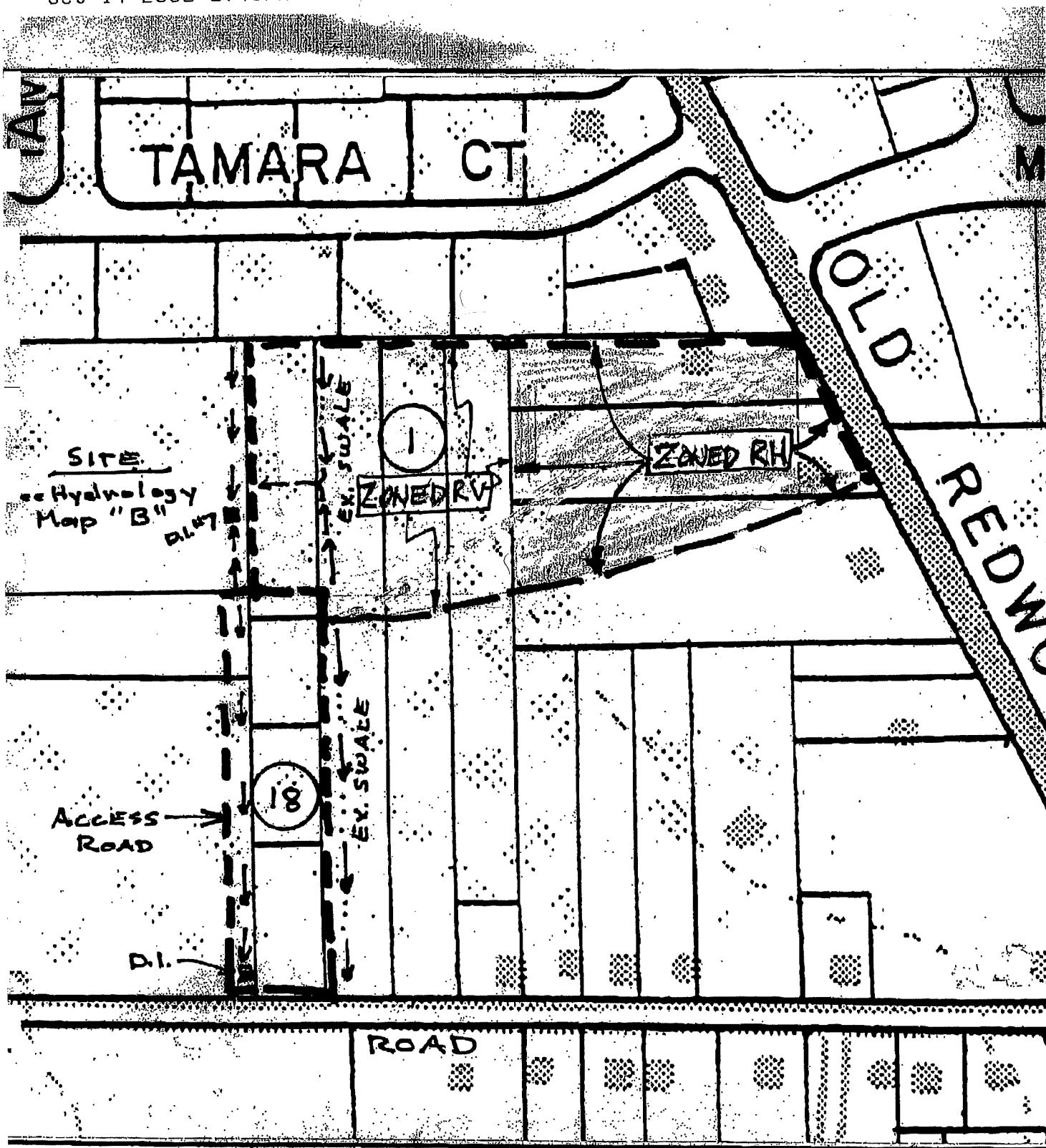
TRY 16" DIA. DRIFTER:

$$h = 1.33', \quad a = \pi (1.33)^2 / 4 = 1.396$$

$$Q = (0.6)(1.396) \left(64.4 \times 1.33 \right)^{1/2}$$

$$Q = 7.75 \text{ cfs} \approx 7.76 \text{ O.K.}$$





10/14/02

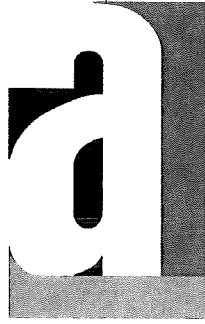
— REVISED —
HYDROLOGY MAP

SHILOH INDUSTRIAL CENTER
WINDSOR, CALIFORNIA

(707) 431-1417
Engineering Surveys

SCALE: 1"=200'

2005016.00
REF INFO



Drainage Analysis
For the
Windsor Redwoods
6065 Old Redwood Highway
Windsor, California
JN 05274

July, 2008

David R. Brown, RCE 41833
My license expires 3/31/2010

Prepared by:

Adobe Associates, Inc.
1220 N Dutton Avenue
Santa Rosa, CA 95401
Telephone: 707-541-2300
Fax: 707-541-2301

Windsor Redwoods

Drainage Narrative

The Windsor Redwoods Project is a proposed multi-unit apartment complex located between Shiloh Road and Old Redwood Highway in Windsor, California. The project site is approximately 2.29 acres and includes the construction of six multi-unit buildings, parking lots, frontage improvements to Kendall Way and Old Redwood Highway, and off-site drainage improvements in adjacent properties, Shiloh Road, and Hembree Lane.

This drainage analysis has been separated into three models, which include Off-Site Analysis, On-Site Analysis, and Detention Analysis. The off-site analysis includes pre vs. post-construction calculations of areas within the Hembree Lane public storm drain system watershed. Detention analysis includes calculations for the required storage volume and outlet structure orifice sizing. On-Site Analysis includes backwater calculations of the on-site storm drainage system for the post-construction condition, along with capacity calculations of runoff conveyance features.

Off-Site Analysis-

Off-Site Analysis includes drainage calculations of the proposed public storm drainage system. The existing watershed for the Hembree Lane public storm drain system is approximately 33 acres, which includes portions of properties north of Shiloh Road, east of Highway 101, and west of Old Redwood Highway. The existing watershed consists of commercial developments, vacant land, and single family residential properties, and slopes approximately 1-percent from Old Redwood Highway west to Hembree Lane. The existing public storm drain system in Hembree Lane connects with other drainage infrastructure, crosses underneath Highway 101 and releases runoff into Faught Creek.

The proposed off-site storm drain will convey storm runoff from the project site and two northerly properties through an adjacent southerly property, Shiloh Road, and connect into the existing public storm drain system in Hembree Lane. The off-site storm drainage system varies between a 24-inch and 48-inch storm drain. A drainage requirement placed on this project is to avoid affecting the HGL of the storm drain system in Hembree Lane by more than one-tenth of a foot between pre and post-construction conditions. Pre and post-construction analysis was performed using StormCad, a program developed by Haested Methods. StormCad doesn't allow for a rainfall distribution factor (K-factor) for varying rainfall intensities. The K-factor was 1.18 according to Sonoma County Water Agency (SCWA) Design Criteria and determined by the Mean Seasonal Precipitation and K-factor vs. Precipitation charts. To compensate for the additional factor the rainfall intensity equation: $i = 5.12xY^{0.1469}(t^{-0.528})$ was multiplied by 1.18 giving the equation: $i = 6.04xY^{0.1469}(t^{-0.528})$.

Previous drainage studies of the same watershed were used as reference in comparing the pre-construction runoff values. The Wal-Mart Drainage Report calculated runoff values and sized the public storm drain system in Hembree Lane. The referenced drainage report was attained from the Sonoma County Water Agency.

Analysis of the pre and post-construction conditions revealed that the combination of the Windsor Redwoods site and two northerly adjacent properties can release 5.00 cfs for the 10-year storm event and 7.30 cfs for the 100-year storm event without affecting the downstream hydraulic grade line more than one-tenth of a foot.

Detention Analysis-

Detention analysis includes calculations of the required storage volume to detain the difference between post-construction runoff and the release flow determined by Off-Site Analysis. Detention analysis was performed using Pond Pack, a program developed by Haested Methods. Pond Pack compares inflow and outflow hydrographs calculated by user input data, to determine the required amount of storage. Input includes the rainfall intensity equation adapted to include the K-factor, required outflows for different storm events, coefficients of runoff, tributary areas, and the approximate time of concentration. Post-construction runoff exceeds the allowable release rate determined by Off-Site Analysis, so detention is necessary. The required storage volume determined by Pond Pack is 0.089 ac-ft. The detention report provided by Pond Pack is included in this drainage analysis.

Detention analysis also includes calculations for sizing the orifices in the outlet control structure. Pond Pack was used to determine the orifice size and location to release the pre-determined release rate of storm runoff. A detail of the Outlet Structure is included in this drainage analysis.

On-Site Analysis-

On-Site Analysis includes backwater calculations of the proposed on-site storm drain system, along with capacity calculations, and overland flood route directions. The existing use of the project site is commercial with the majority of the site remaining undeveloped. The project site currently slopes at approximately 1-percent from Old Redwood Highway to the west towards Highway 101. The proposed on-site storm drain system has been designed to accept storm runoff from the project site, Kendall Way, and the two adjacent properties to the north, and convey it to the off-site storm drain system.

StormCad was used to calculate the HGL of the on-site storm drain system, and was used to compare to the finish floor elevations of on-site buildings. HGL information of the outlet structure determined by the Detention Analysis was used as outfall information for the On-Site Analysis. The minimum difference between HGL and Finish Floor elevations is 5.15, which far exceeds local standards. The comparison of finish

floor elevations vs. the hydraulic grade line of nearby drainage structures is included in this drainage analysis.

Flowmaster, a program developed by Haested Methods, was used to check capacity of drainage swales and valley gutters for the 100-year storm event. The worst case scenario was used for on-site bio-swales, valley gutters, and the off-site drainage swale adjacent to Kendall Way. Worst case scenario criteria, includes tributary area, slope and flow characteristics. The proposed swales and valley gutters have been designed to provide capacity for the 100-year storm. Cross-sections and a detailed report of the swales and valley gutters have been included in this drainage analysis. Inlet capacity calculations were used to size the grate of each on-site inlet to limit the depth of storm runoff above the grate. On-site drainage inlets were sized for a maximum depth of two-tenths of a foot during a 100-year storm event. An Overland Flood Routing Map is included to demonstrate how storm runoff will traverse the project site if portions of the storm drainage system are blocked. On-site grading has been designed to convey overland runoff away from on-site buildings.

Summary-

The existing public storm drain system in Hembree Lane was designed to accept storm runoff from the Windsor Redwoods project site per previous drainage reports. The on-site storm drainage system has been designed to store the difference between post-construction runoff values and the release rate determined by the Off-Site Analysis, which will affect the hydraulic grade line of the downstream system by less than one-tenth of a foot. The proposed off-site storm drain system has been designed to provide enough capacity for the required release rate of the Windsor Redwoods project and the pre-construction runoff rates off all other properties within the watershed. It is important to note that future development within the watershed shall release runoff at pre-construction values to ensure the proposed storm drain system and existing system in Hembree Lane maintain capacity.

10 and 100-Year Calculations

Post-Construction

Post-con 100-yr

FlexTable: Conduit Table (05274 offsite hydrology map post-construction.stc)

Current Time: 0.000 min

Label	Start Node	Invert (Upstream) (ft)	Stop Node	Invert (Downstream) (ft)	Manning's n	Section Size	Upstream CA (acres)
CO-1	MH-1	108.19	OF-1	106.25	0.014	48" SD	24.477
CO-2	MH-2	109.82	MH-1	108.19	0.014	42" SD	22.17
CO-3	MH-3	110.43	MH-2	109.82	0.014	42" SD	21.243
CO-4	MH-4	112.09	MH-3	110.43	0.014	42" SD	18.714
CO-5	MH-5	112.44	MH-4	112.09	0.014	42" SD	15.792
CO-6	CB-1	113.5	MH-5	112.54	0.014	42" SD	5.814
CO-7	CB-2	114.5	CB-1	113.5	0.014	36" SD	5.814
CO-8	CB-3	115.8	CB-2	114.5	0.014	36" SD	3.626
CO-9	MH-6	113.47	MH-5	112.54	0.014	36" SD	9.977
CO-10	MH-7	114.4	MH-6	113.57	0.014	36" SD	9.977
CO-11	MH-8	115.38	MH-7	114.5	0.014	36" SD	9.977
CO-12	MH-9	116.23	MH-8	115.48	0.014	30" SD	8.118
CO-13	MH-10	117.21	MH-9	116.33	0.014	30" SD	4.37
CO-14	MH-11	118.62	MH-10	117.31	0.014	24" SD	2.88
CO-15	CB-4	118.75	MH-11	118.72	0.014	24" SD	2.88
CO-16	MH-12	119.68	CB-4	118.75	0.014	24" SD	1.657
CO-17	CB-5	120.98	MH-12	119.78	0.014	24" SD	0

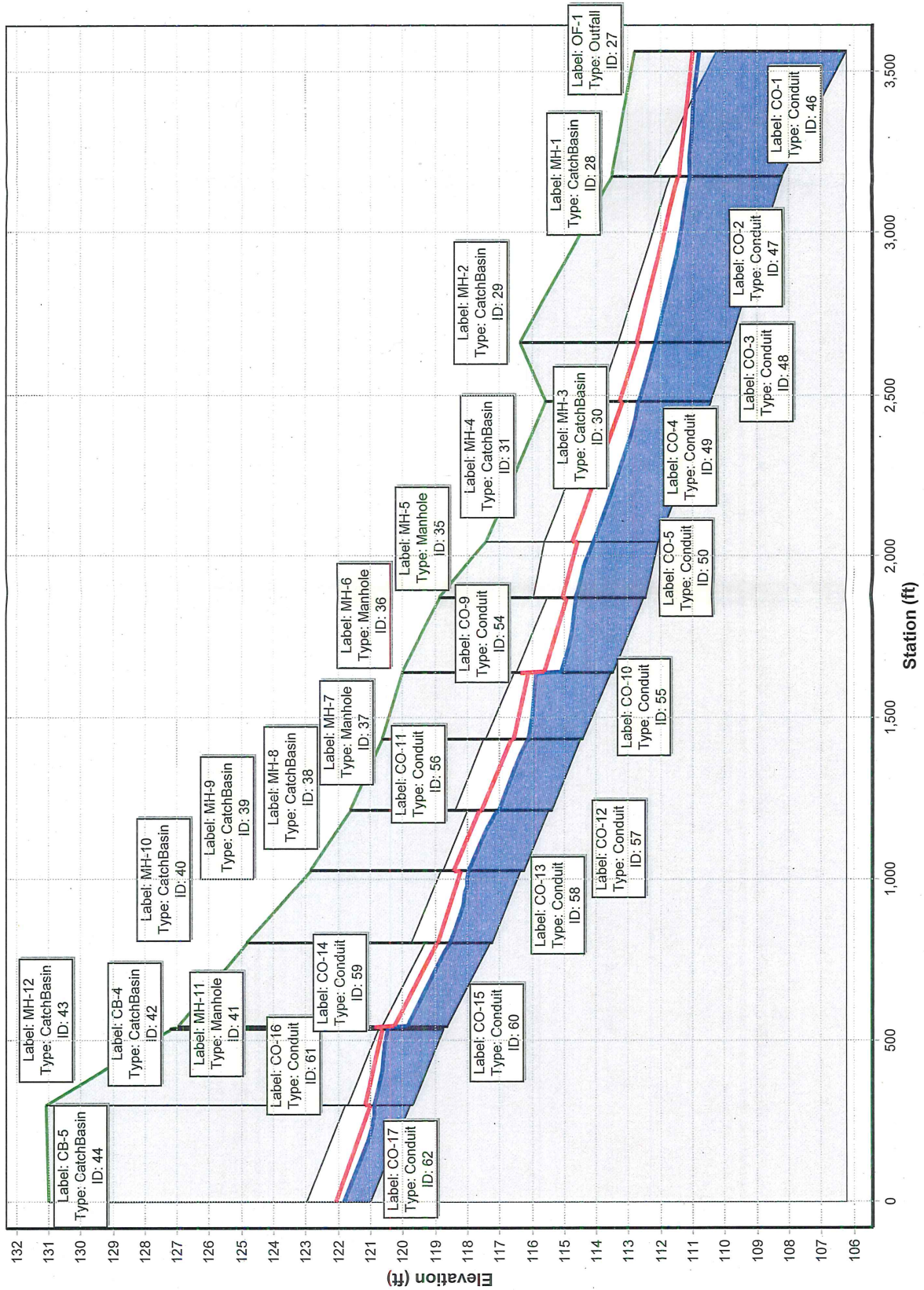
System Flow Time (min)	System Intensity (in/hr)	Flow (ft ³ /s)	Length (ft)	Slope (Calculated) (ft/ft)	Capacity (Full) Flow (ft ³ /s)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)
27.312	2.074	58.47	389	0.005	94.19	113.52	112.82
25.824	2.136	55.04	511	0.003	52.76	116.35	113.52
25.273	2.161	53.57	184	0.003	53.79	115.58	116.35
23.855	2.227	49.32	436	0.004	57.64	117.41	115.58
23.221	2.259	43.26	171	0.002	42.26	118.85	117.41
16.835	2.678	15.69	36	0.027	152.55	188.81	118.85
16.667	2.692	15.78	80	0.013	69.24	122	188.81
15	2.846	10.4	425	0.003	34.25	121.5	122
22.321	2.307	30.5	233	0.004	39.13	120.02	118.85
21.533	2.351	30.95	207	0.004	39.22	120.61	120.02
20.716	2.4	31.43	218	0.004	39.35	121.61	120.61
20.154	2.435	27.22	187	0.004	24.12	122.84	121.61
19.158	2.501	18.32	223	0.004	23.92	124.84	122.84
18.229	2.567	14.75	262	0.005	14.85	126.97	124.84
18.204	2.569	14.76	7	0.004	13.75	127.21	126.97
17.159	2.651	11.73	234	0.004	13.24	131.1	127.21
15	2.846	7.3	301	0.004	13.26	131	131.1

Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Velocity (Average) (ft/s)	Design Conduit?	Design Start Invert?	Design Stop Invert?	Conduit Type
113.48	112.73	4.65	FALSE	FALSE	FALSE	Catalog Conduit
115.25	113.48	5.72	FALSE	FALSE	FALSE	Catalog Conduit
115.86	115.25	5.57	FALSE	FALSE	FALSE	Catalog Conduit
116.8	115.58	5.13	FALSE	FALSE	FALSE	Catalog Conduit
117.16	116.8	4.5	FALSE	FALSE	FALSE	Catalog Conduit
117.17	117.16	1.63	FALSE	FALSE	FALSE	Catalog Conduit
117.22	117.17	7.93	FALSE	FALSE	FALSE	Catalog Conduit
117.33	117.22	4.25	FALSE	FALSE	FALSE	Catalog Conduit

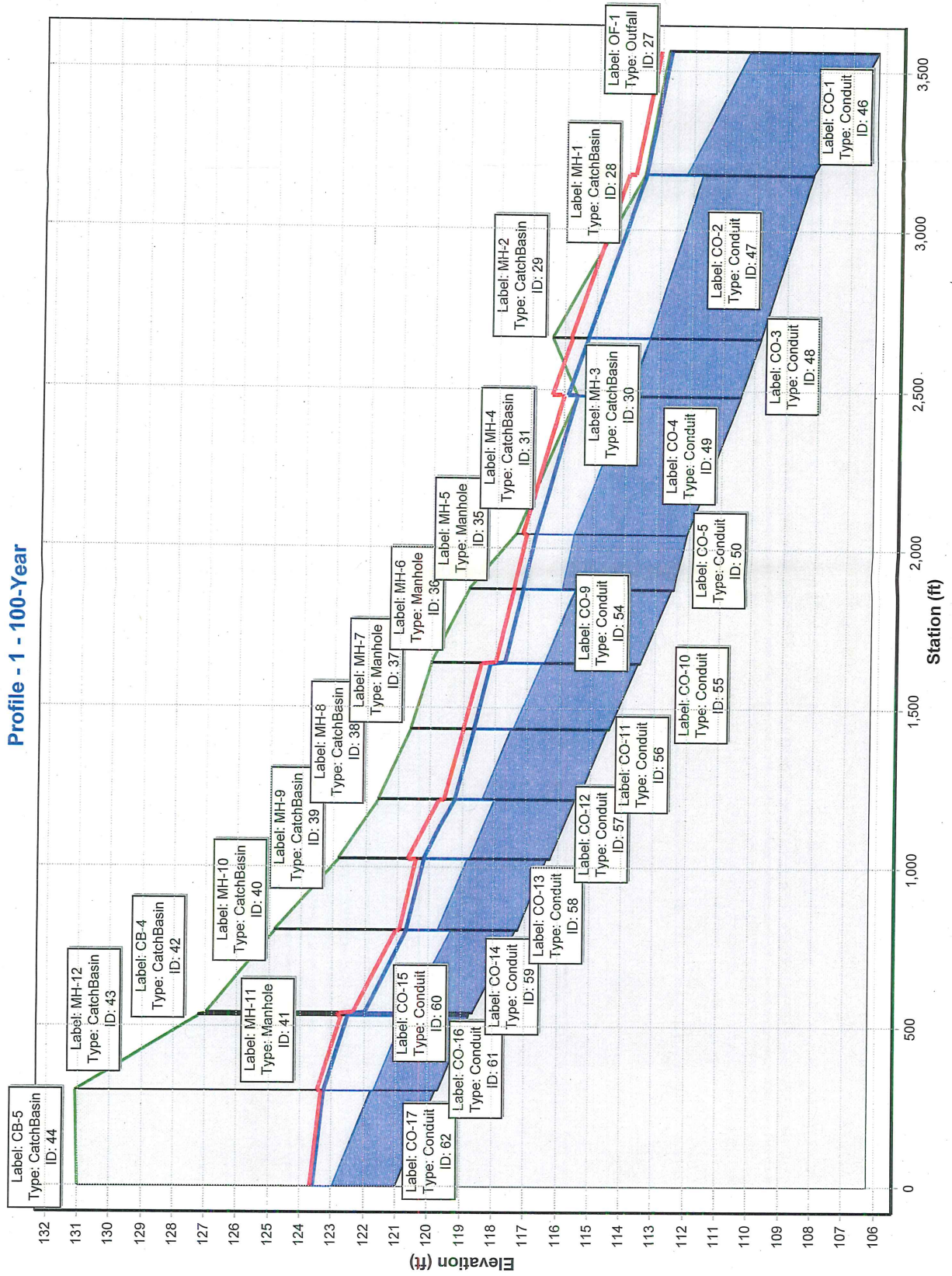
117.73	117.16	4.32	FALSE	FALSE	FALSE	Catalog Conduit
118.67	118.16	4.38	FALSE	FALSE	FALSE	Catalog Conduit
119.24	118.67	4.45	FALSE	FALSE	FALSE	Catalog Conduit
120.19	119.24	5.55	FALSE	FALSE	FALSE	Catalog Conduit
120.71	120.19	3.73	FALSE	FALSE	FALSE	Catalog Conduit
122	120.71	4.7	FALSE	FALSE	FALSE	Catalog Conduit
122.51	122.48	4.7	FALSE	FALSE	FALSE	Catalog Conduit
123.24	122.51	3.73	FALSE	FALSE	FALSE	Catalog Conduit
123.61	123.24	2.32	FALSE	FALSE	FALSE	Catalog Conduit

**10 and 100-Year HGL/EGL Profiles
Post-Construction**

Profile - 1 - 10-Year



Profile - 1 - 100-Year



Project Name: Shiloh Crossing

Date: 6/25/2021



Storm Water Low Impact Development Submittal Coversheet

To be submitted with all SW LID submittals

1. **Submittal Information:**

Submittal Date: June 25, 2021

Initial SW LIDS ☒ Final SW LIDS ☐

Design Manual Used for design:

- ☐ 2005 Standard Urban Storm Water Mitigation Plan
- ☐ 2011 Storm Water Low Impact Development Technical Design Manual
- ☒ 2017 Storm Water Low Impact Development Technical Design Manual

2. **Applicant Information:**

Applicant Name (Owner or Developer): Integrated Community Development

Mailing Address: 20750 Ventura Boulevard., Suite 155

City/State/Zip: Windsor, CA 95492

Phone/Email/Fax: 818-974-2966

Project Name: Shiloh Crossing

Date: 6/25/2021



Storm Water Low Impact Development Submittal Coversheet

To be submitted with all SW LID submittals

3. Project Information:

Project Name: Shiloh Crossing

Site Address: 295 Shiloh Road

City/State/Zip: Windsor, CA 95492

APN (s): 163-171-039

Permit # (s):

Subdivision ☐ Grading Permit ☐ Building Permit ☐ Design Review ☒

Use Permit ☐ Hillside Development ☐ Encroachment ☐ Time Extension ☐

Other:

Project Name: Shiloh Crossing

Date: 6/25/2021



Storm Water Low Impact Development Submittal Coversheet

To be submitted with all SW LID submittals

4. Design Information:

Narrative:

Project Description

- ☒ Description of proposed project type, size, location, and any specific uses or features.
- ☒ Description of any sensitive features (creeks, wetlands, trees, etc.) and whether they are going to be preserved, removed or altered.
- ☒ Description of the existing site.
- ☒ Description of how this project triggers these requirements (impervious area, CALGreen, 401 Permit, etc.).
- ☒ Describe any "on-site offset" used.

Pollution Prevention and Runoff Reduction Measures

- ☒ Description of all proposed pollution prevention measures (street sweeping, covered trash enclosures, indoor uses, etc).
- ☒ Description of all Runoff Reduction Measures (Interceptor Trees, Impervious Area Disconnection, and/or Alternative Driveway Design).

Type of BMPs Proposed

- ☒ Description of the types of BMPs selected including priority group that each is in.
- ☒ Description of level of treatment and volume capture achieved for each BMP.

Maintenance

- ☒ Description of maintenance for each type of BMP.
- ☒ Description of funding mechanism.
- ☒ Designation of Responsible Party.



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To be submitted with all SW LID submittals

Exhibits:

Proposed SW LID Exhibit:

- ☒ Exhibit should include: street names, property lines, storm drainage system, waterways, title block, scale and north arrow.
- ☒ Tributary areas shown for all inlets (including off-site drainage areas).
- ☒ C value for each tributary area.
- ☒ Soil Type of existing site.
- ☒ New or replaced impervious area shown.
- ☒ All inlets and BMP, shown (including unique identifier).
- ☒ All interceptor trees shown.
- ☒ All proposed BMPs shown including dimensions.

Existing Condition Exhibit

- ☒ Exhibit should include: street names, property lines, proposed storm drainage system, waterways, title block, scale, and north arrow.
- ☒ Soil Type of existing site.
- ☒ Proposed tributary areas shown for all proposed inlets (including offsite drainage areas). Existing impervious areas.
- ☒ Existing impervious area.

BMP Details:

- ☒ Detail for each type of BMP selected- provide a preliminary 8.5"x11" detail for each BMP type or include on submitted drawings. These can be taken straight from the Fact Sheets if no significant changes are proposed.

On Plans:

- ☒ Show all applicable elements of the selected BMPs on the appropriate plan sheets.

Calculations:

- ☒ Calculations, for each inlet, and summary sheet using the Storm Water Calculator found at www.srcity.org/stormwaterLID
- ☒ Supplemental or supporting calculation if applicable.

**INITIAL
STORM WATER
LOW IMPACT DEVELOPMENT PLAN**

JUNE 25, 2021

SHILOH CROSSING

**APN 163-171-039
295 SHILOH ROAD
WINDSOR, CA**

PROJECT #: 2021017.00

CARLILE • MACY

*15 Third Street, Santa Rosa, CA 95401
Tel: 707 542 6451 Fax: 707 542 5212*

CIVIL ENGINEERS • URBAN PLANNERS • LAND SURVEYORS • LANDSCAPE ARCHITECTS

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PROJECT DESCRIPTION

Project Name: Shiloh Crossing
Assessor's Parcel Number: 163-171-039
Total Area of Site: 6.36 acres

Proposed Development:

The project located at 295 Shiloh Road will develop the existing property into affordable housing in the center of the property via 3 connected buildings which form a C shape, surrounded by parking. Two commercial buildings will be constructed along the Shiloh Road frontage. The northerly half of Shiloh Road and Business Park Court will be improved to Town of Windsor standards with curb gutter and sidewalk and be dedicated to the Town of Windsor.

The drainage of the project is divided into sub-drainage areas as shown on the Proposed Improvements, Drainage Sub-areas and BMP Exhibit. The areas are designated based on the proposed grading plan. The proposed storm drain system will tie into the existing system located at the west end of the property on the east side of Hembree Road and into the existing 36" storm drain within Shiloh Road.

Existing Conditions:

The project site is bordered by Shiloh Road to the South, Hembree Road to the southwest, Home Depot to the Northwest, a commercial Incubator site to the North, and residential housing to the east. The private road Business Park Court, which connects the northerly commercial incubator site to Shiloh Road, runs North-South within the projects easterly border. The remaining project site is undeveloped land with 340' of 36" storm drain extending into a storm water detention pond on the west side of the project site. This existing storm drain and detention pond system on the project site was designed to store the additional flows due to the development of the Incubator project within both the pond and storm drain and release only predeveloped flow rates into the downstream public storm drain system on Hembree Road. There are also existing storm drain and swales along the project frontage bordering Shiloh Road which carry the southerly half of the undeveloped property to the public storm drain within Hembree Road. The USGS soil map for the project indicates that the site is under laid with Hydrologic Soil Group C soils (see Appendix I). Group C soils have low infiltration rates ranging between 0.05 to 0.15 in/hr.

Water Bodies Receiving Storm Water from the Project site include, in order of reception: Public Storm Drain; Pool Creek; Windsor Creek; Mark West Creek; and Russian River.

Project Triggers:

The Project will create more than one (1) acre of impervious surface and will therefore be conditioned to meet treatment and hydromodification control requirements. The hydromodification control design goal requires the project to capture and/or infiltrate and/or reuse one hundred percent (100%) of the post project volume. This Project is designed to implement permanent water quality treatment and hydro-modification control BMPs set forth in the 2017 City of Santa Rosa's Storm Water Low Impact Development Technical Manual (SWLID); such Manual requires (i) treatment of all runoff generated by a one inch (1") rainfall

event in a twenty-four (24) hour time period falling on all impermeable surfaces, and (ii) the exit off the Project site of all such storm water at flow rates similar to pre-development conditions.

POLLUTION PREVENTION AND RUNOFF REDUCTION MEASURES

Within the Project, (i) interceptor trees will be planted along Business Park Court and within parking lots, and (ii) runoff from Project rooftops will be disconnected from storm drain inlets and directed to infiltration areas, and (iii) permeable pavements will be used within the westerly EVA to be built to allow emergency vehicles to access the project via Hembree Road. The total tributary area used for treatment calculations has been reduced by these measures. Runoff will be treated by bioretention measures and trash removed by trash baskets within each inlet structure to reduce pollution prior to being discharged from the Project.

TYPES OF BMPs

Storm water generated by the Project will be captured and treated in a treatment train installed in the following order. Storm water runoff on the streets will be treated using either roadside bioretention basins installed similar to detail P2 “Roadside Bioretention – Contiguous Sidewalk”, basins in compliance with detail P2 “Roadside Bioretention – Flush Design.” Storm water runoff collected in the communal areas between buildings will be treated with bioretention basins installed similar to P1 “Roadside Bioretention – No curb and gutter.”

All bioretention areas are sized for one hundred percent (100%) treatment. This project will be required to detain the 100-year probability storm within Detention Chambers, this volume will satisfy the 2 year project volume capture goals for the project site. Stormwater leaving each detention chamber system will be metered to mimic pre-development flows off the site. Each BMP along Business Park Court and Shiloh Road will not distribute to a detention chamber and were therefore sized to retain the delta volume of development from a 1 in - 24 hr storm rate for the tributary areas shown in the Initial SW LID Exhibits per City of Santa Rosa Standard. In all cases, higher flows will bypass the permeable gutter and flow into the storm drain system. As it is infeasible to limit flows off the public streets of Business Park Circle and Shiloh Road, the onsite detention chambers were over-sized to compensate for these areas.

Level of Treatment:

The Project will achieve the Design Goal of one hundred percent (100%) volume capture and one hundred percent (100%) of the runoff generated by the developed Project will be treated. Flows leaving the project site will meet the Hydromodification requirement.

ASSIGNING LONG TERM BMPs MAINTENANCE

The long-term maintenance of the Roadside Bioretention, Vegetated Swales, and Impervious Area Disconnections will be the responsibility of the Property Owner. The required maintenance is described in detail in the BMP Inspection and Maintenance Checklists section of this report. Funding for this maintenance will be provided by the Property Owner.

APPENDIX A

DETERMINATION WORKSHEET



2017 Storm Water LID Determination Worksheet



PURPOSE AND APPLICABILITY: This determination worksheet is intended to satisfy the specific requirements of "ORDER NO. R1-2015-0030, NPDES NO. CA0025054 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT AND WASTE DISCHARGE REQUIREMENTS FOR DISCHARGES FROM THE MUNICIPAL SEPARATE STORM SEWER SYSTEMS." Additional design requirements imposed by Governing Agencies, such as local grading ordinances, CAL Green, CEQA, 401 permitting, and hydraulic design for flood control still apply as appropriate. Additionally, coverage under another regulation may trigger the requirement to design in accordance with the Storm Water LID Technical Design Manual.

Part 1: Project Information

Shiloh Crossing

Project Name

295 Shiloh Road

Project Site Address

Windsor, CA 95492

Project City/State/Zip

Permit Number(s) - (if applicable)

Carlile-Macy

Designer Name

Santa Rosa, CA 95401

Designer City/State/Zip

Integrated Community Development

Applicant (owner or developer) Name

20750 Ventura Boulevard, Suite 155

Applicant Mailing Address

Woodland Hills, CA 91364

Applicant City/State/Zip

jlingo@icdemail.com

Applicant Phone/Email/Fax

15 3rd Street

Designer Mailing Address

707-542-6451

Designer Phone/Email

Type of Application/Project:

- ☐ Subdivision ☐ Grading Permit ☐ Building Permit ☐ Hillside Development
☒ Design Review ☐ Use Permit ☐ Encroachment ☐ Time Extensions ☐ Other : _____

PART 2: Project Exemptions

1. Is this a project that creates or replaces *less than* 10,000 square feet of impervious surface¹, including all project phases and off-site improvements?

☐ Yes ☒ No

¹ Impervious surface replacement, such as the reconstruction of parking lots or excavation to roadway subgrades, is not a routine maintenance activity. Reconstruction is defined as work that replaces surfaces down to the subgrade. Overlays, resurfacing, trenching and patching are defined as maintenance activities per section VI.D.2.b.

2. Is this project a routine maintenance activity² that is being conducted to maintain original line and grade, hydraulic capacity, and original purpose of facility such as resurfacing existing roads and parking lots?

☐ Yes ☒ No

3. Is this project a stand alone pedestrian pathway, trail or off-street bike lane?

☐ Yes ☒ No

4. Did you answer "YES" to any of the questions in Part 2?

☐ **YES:** This project will *not* need to incorporate permanent Storm Water BMP's as required by the NPDES MS4 Permit. **Please complete the "Exemption Signature Section" on Page 4.**

☒ **NO:** Please complete the remainder of this worksheet.

Part 3: Project Triggers

Projects that Trigger Requirements:

Please answer the following questions to determine whether this project requires permanent Storm Water BMP's and the submittal of a SW LIDs as required by the NPDES MS4 Permit order No. R1-2015-0030.

1. Does this project create or replace a combined total of 10,000 square feet or more of impervious surface¹ including all project phases and off-site improvements?

☒ Yes ☐ No

2. Does this project create or replace a combined total or 10,000 square feet or more of impervious streets, roads, highways, or freeway construction or reconstruction³? ☒ Yes ☐ No

3. Does this project create or replace a combined total of 1.0 acre or more of impervious surface¹ including all project phases and off-site improvements? ☒ Yes ☐ No

4. Did you answer "YES" to any of the above questions in Part 3?

☒ **YES:** This project will need to incorporate permanent Storm Water BMP's as required by the NPDES MS4 Permit. **Please complete remainder of worksheet and sign the "Acknowledgement Signature Section" on Page 4.**

☐ **NO:** This project will *not* need to incorporate permanent Storm Water BMP's as required by the NPDES MS4 permit. **Please complete the "Exemption Signature Section" on Page 4.**

¹ Impervious surface replacement, such as the reconstruction of parking lots or excavation to roadway subgrades, is not a routine maintenance activity. Reconstruction is defined as work that replaces surfaces down to the subgrade. Overlays, resurfacing, trenching and patching are defined as maintenance activities per section VI.D.2.b.

² "Routine Maintenance Activity" includes activities such as overlays and/or resurfacing of existing roads or parking lots as well as trenching and patching activities and reroofing activities per section VI.D.2.b.

³ "Reconstruction" is defined as work that extends into the subgrade of a pavement per section VI.D.2.b.

Part 4: Project Description

1. Total Project area: 6.36

☐ square feet
☒ acres

2. Existing land use(s): (check all that apply)

☐ Commercial ☐ Industrial ☐ Residential ☐ Public ☒ Other

Description of buildings, significant site features (creeks, wetlands, heritage trees), etc.:

Vacant undeveloped lot with private driveway along east side of lot, existing storm drain and detention pond on the west side of the property.

3. Existing impervious surface area: 0.64

☐ square feet
☒ acres

4. Proposed Land Use(s): (check all that apply)

☒ Commercial ☐ Industrial ☒ Residential ☐ Public ☐ Other

Description of buildings, significant site features (creeks, wetlands, heritage trees), etc.:

Development of the vacant lot into affordable housing in the center of the property, improvement of the private driveway to Town standards and dedicated to the Town. Commercial buildings along Shiloh road frontage. Relocation of existing pond to north side of property.

Proposed

5. ~~Existing~~ impervious surface area: 4.93☐ square feet
☒ acres

Acknowledgment Signature Section:

As the property owner or developer, I understand that this project is required to implement permanent Storm Water Best Management Practices and provide a Storm Water Low Impact Development Submittal (SW LIDS) as required by the City's National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer Systems (MS4) Permit Order No. R1-2015-0030. *Any unknown responses must be resolved to determine if the project is subject to these requirements.

Applicant Signature

6/25/2021

Date**Exemption Signature Section:**

As the property owner or developer, I understand that this project as currently designed does not require permanent Storm Water BMP's nor the submittal of a Storm Water Low Impact Development Submittal (SW LIDS) as required by the City's National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer Systems (MS4) Permit*. I understand that redesign may require submittal of a new Determination Worksheet and may require permanent Storm Water BMP's.

Applicant Signature_____
Date

* This determination worksheet is intended to satisfy the specific requirements of "ORDER NO. R1-2015-0030, NPDES NO. CA0025054 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT AND WASTE DISCHARGE REQUIREMENTS FOR DISCHARGES FROM THE MUNICIPAL SEPARATE STORM SEWER SYSTEMS." Additional design requirements imposed by Governing Agencies, such as local grading ordinances, CAL Green, CEQA, 401 permitting, and hydraulic design for flood control still apply as appropriate. Additionally, coverage under another regulation may trigger the requirement to design in accordance with the Storm Water LID Technical Design Manual.

Implementation Requirements: All calculations shall be completed using the "Storm Water Calculator" available at: www.srcity.org/stormwaterLID

Hydromodification Control/100% Volume Capture: Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by a 1.0" 24-hour storm event, as calculated using the "Urban Hydrology for Small Watersheds" TR-55 Manual method. This is a retention requirement.

Treatment Requirement: Treatment of 100% of the flow calculated using the modified Rational Method and a known intensity of 0.20 inches per hour.

Delta Volume Capture Requirement: Capture (infiltration and/or reuse) of the increase in volume of storm water due to development generated by a 1.0" 24-hour storm event, as calculated using the "Urban Hydrology for Small Watersheds" TR-55 Manual method. This is a retention requirement.

APPENDIX B

BMP SELECTION TABLES



BMP Selection Table

APPENDIX B

SHILOH CROSSING

ROADSIDE BIORETENTION

Project Name:

Best Management Practice (BMP)	Detail Sheet	Detail Title	Can be used with:					Achieves:			Runoff Reduction Measure		BMP in priority selected?	No	Unique Identifier of BMP per Planes	Explanation of selection	Other notes:
			High Ground Water	Contamination	Slope Constraints	Treatment	Volume Capture	Runoff Reduction Measure	Runoff Reduction Measure	Runoff Reduction Measure	Runoff Reduction Measure	Runoff Reduction Measure					
Universal BMP- to be considered on all projects.	Living Roof	N/A	N/A	X	X	X	X	X	X	X	X	X	X				
	Rainwater Harvesting	N/A	N/A	X	X	X	X	X	X	X	X	X	X				

Runoff Reduction Measures	Interceptor Trees	N/A	N/A	X	X	X	X	X	X	X	X	X	X				
	Bovine Terrace	RRM-01	Bovine Terrace	X													
	Vegetated Buffer Strip	RRM-02	Vegetated Buffer Strip														
	Impervious Area Disconnection	N/A	N/A	X	X	X	X	X	X	X	X	X	X				

Priority 1- to be installed with no underdrains or liners. Must drain all stading water within 72 hours.	Bioretention	P1-02	Roadside Bioretention - no C & G				X	X					X				
	Vegetated Swale with Bioretention	P1-06	Swale with Bioretention				X	X					X				
	Constructed Wetlands	N/A	N/A				X	X					X				

Priority 2 BMPs- with subsurface drains installed above the capture volume.	Bioretention	P2-02	Roadside Bioretention - Flush Design Roadside				X	X					X				
		P2-03	Roadside Bioretention- Contiguous SW				X	X					X				
		P2-04	Roadside Bioretention- Curb Opening				X	X					X				
		P2-05	Roadside Bioretention- No C & G				X	X					X				
		N/A	N/A				X	X					X				

Date: JUNE 2021

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BMP Selection Table

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Best Management Practice (BMP)	Detail Sheet	Detail Title	Can be used with:				Achieves:				BMP In priority selected?		Explanation of BMP per	Other notes:
			High Ground Water	Contamination	Slope Constraints	Treatment	Volume Capture	Runoff Reduction	Runoff Reduction Measure	Runoff Reduction Measure	Yes	No		
Priority 3 BMPs- installed with subdrains and/or impermeable liner. Does not achieve volume capture and must be used as part of a treatment train.	Bioretention	P3-02	X	X	X	X	X	X	X	X	X			
		P3-03	X	X	X	X	X	X	X	X	X			
		P3-04	X	X	X	X	X	X	X	X	X			
	Flow Through Planters	P3-05	X	X	X	X	X	X	X	X	X			
		P3-06	X	X	X	X	X	X	X	X	X			
	Vegetated Swale	P3-07	X	X	X	X	X	X	X	X	X			
			X	X	X	X	X	X	X	X	X			
Priority 4 BMPs- does not achieve volume capture and must be used as part of a	Tree Filter Unit		X	X	X	X	X	X	X	X	X			
	Modular Bioretention		X	X	X	X	X	X	X	X	X			
Priority 5 BMPs- does not achieve volume capture and must be used as part of a treatment train.	Chambered Separator Units		X	X	X	X	X	X	X	X	X			
	Centrifugal Separator Units		X	X	X	X	X	X	X	X	X			
	Trash Excluders		X	X	X	X	X	X	X	X	X			
	Filter Inserts		X	X	X	X	X	X	X	X	X			
Priority 6 BMPs- see the "Offset Program" chapter for details.	Offset Program						N/A	N/A	N/A	N/A	X			
Other	Detention		X								X			



BMP Selection Table

APPENDIX B

SHILOH CROSSING

GG / VALLEY GUTTER TREATMENT

Project Name:

Universal BMP- to be considered on all projects.	Best Management Practice (BMP)	Detail Sheet	Detail Title	Can be used with:				Achieves:				BMP in priority selected?	Unique Identifier of BMP per Planes	Explanation of selection	Other notes:
				High Ground Water	Contamination	Slope Constraints	Treatment	Volume Capture	Runoff Reduction Measure	No	Yes				
	Living Roof	N/A	N/A	X	X	X	X	X	X	X	X	X			
	Rainwater Harvesting	N/A	N/A	X	X	X	X	X	X	X	X	X			

Runoff Reduction Measures	Interceptor Trees	N/A	N/A	X	X	X			X		X				
	Bovine Terrace	RRM-01	Bovine Terrace	X					X						
	Vegetated Buffer Strip	RRM-02	Vegetated Buffer Strip						X						
	Impervious Area Disconnection	N/A	N/A	X	X	X			X						

Priority 1- to be installed with no underdrains or liners. Must drain all standing water within 72 hours.	Bioretention	P1-02	Roadside Bioretention - no C & G				X					X			
	Vegetated Swale with Bioretention	P1-06	Swale with Bioretention				X					X			
	Constructed Wetlands	N/A	N/A				X					X			

Priority 2 BMPs- with subsurface drains installed above the capture volume.	Bioretention	P2-02	Roadside Bioretention- Flush Design Roadside				X					X			
		P2-03	Roadside Bioretention- Contiguous SW				X					X			
		P2-04	Roadside Bioretention- Curb Opening				X					X			
		P2-05	Roadside Bioretention- No C & G				X					X			
		N/A	N/A				X					X			

Date: JUNE 2021

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BMP Selection Table

APPENDIX B

Best Management Practice (BMP)	Detail Sheet	Detail Title	Can be used with:				Achieves:		BMP in priority selected?		Explanation of selection	Other notes:		
			High Ground Water Contamination	Slope Constraints	Treatment	Volume Capture	Runoff Reduction Measure	Yes	No	Unique Identifier of BMP per Planes				
Priority 3 BMPs- installed with subdrains and/or impermeable liner. Does not achieve volume capture and must be used as part of a treatment train.	Bioretention	P3-02	Roadside	X	X	X	X							
			Bioretention- Flush Design Roadside											
		P3-03	Roadside	X	X	X	X							
			Bioretention- Contiguous SW											
	Flow Through Planters	P3-04	Roadside	X	X	X	X							
		Bioretention- Curb Opening												
	Vegetated Swale	P3-05	Flow Through Planters	X	X	X	X							
P3-06		With	X	X	X	X								
		Bioretention Vegetated Swale	X	X	X	X								
Priority 4 BMPs- does not achieve volume capture and must be used as part of a	Tree Filter Unit		X	X	X	X	X							
	Modular Bioretention		X	X	X	X	X							
Priority 5 BMPs- does not achieve volume capture and must be used as part of a treatment train.	Chambered Separator Units		X	X	X	X	X							
	Centrifugal Separator Units		X	X	X	X	X							
	Trash Excluders		X	X	X	X	X							
	Filter Inserts		X	X	X	X	X							
Priority 6 BMPs- see the "Offset Program" chapter for details.	Offset Program						N/A	N/A	N/A					
Other	Detention		X											



BMP Selection Table

APPENDIX B

Project Name: SHILOH CROSSING

RAW GARDEN

Best Management Practice (BMP)	Detail Sheet	Detail Title	Can be used with:					Achieves:			BMP in priority selected?			Unique Identifier of BMP per Planes		Other notes:
			High Ground Water Contamination	Slope Constraints	Treatment	Volume Capture	Runoff Reduction Measure	Yes	No	Explanation of selection						
Universal BMP- to be considered on all projects.	Living Roof	N/A	X	X	X	X	X	X			X					
	Rainwater Harvesting	N/A	X	X	X	X	X	X			X					
Runoff Reduction Measures	Interceptor Trees	N/A	X	X	X		X				X					
	Bovine Terrace	RRM-01	X				X				X					
	Vegetated Buffer Strip	RRM-02					X				X					
	Impervious Area Disconnection	N/A	X	X	X		X				X					
Priority 1- to be installed with no underdrains or liners. Must drain all standing water within 72 hours.	Bioretention	P1-02			X		X				X					
	Vegetated Swale- with Bioretention	P1-06			X		X				X					
	Constructed Wetlands	N/A			X		X				X					
Priority 2 BMPs- with subsurface drains installed above the capture volume.	Bioretention - Flush Design	P2-02			X		X				X					
	Bioretention- Contiguous SW	P2-03			X		X				X					
	Bioretention- Curb Opening	P2-04			X		X				X					
	Bioretention- No C & G	P2-05			X		X				X					
	Constructed Wetlands	N/A			X		X				X					

Date: JUNE 2021

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BMP Selection Table

APPENDIX B

Best Management Practice (BMP)	Detail Sheet	Detail Title	Can be used with:				Achieves:		BMP in priority selected?		Unique Identifier of BMP per Plan	Explanation of selection	Other notes:	
			High Ground Water	Slope Contamination	Contaminant	Runoff Reduction Measure	Treatment	Volume Capture	Yes	No				
Priority 3 BMPs- installed with subdrains and/or impermeable liner. Does not achieve volume capture and must be used as part of a treatment train.	Bioretention	P3-02	Roadside Bioretention - Flush Design Roadside	X	X	X	X	X	X	X				
		P3-03	Roadside Bioretention- Contiguous SW	X	X	X	X	X	X	X	X			
		P3-04	Roadside Bioretention- Curb Opening	X	X	X	X	X	X	X	X			
	Flow Through Planters	P3-05	Flow Through Planters	X	X	X	X	X	X	X	X			
		P3-06	With Vegetated Swale	X	X	X	X	X	X	X	X			
	Vegetated Swale	P3-07		X	X	X	X	X	X	X	X			
				X	X	X	X	X	X	X	X			
Priority 4 BMPs- does not achieve volume capture and must be used as part of a	Tree Filter Unit		X	X	X	X	X	X	X	X				
	Modular Bioretention		X	X	X	X	X	X	X	X				
Priority 5 BMPs- does not achieve volume capture and must be used as part of a treatment train.	Chambered Separator Units		X	X	X	X	X	X	X	X				
	Centrifugal Separator Units		X	X	X	X	X	X	X	X				
	Trash Excluders		X	X	X	X	X	X	X	X				
	Filter Inserts		X	X	X	X	X	X	X	X				
Priority 6 BMPs- see the "Offset Program" chapter for details.	Offset Program						N/A	N/A	N/A	X				
Other	Detention		X							X				

APPENDIX C

DRAINAGE AREA C-VALUE AND CURVE NUMBER CALCULATIONS

Shiloh Crossing
 295 Shiloh Road
 Prepared by Carille Macy
 June 25, 2021

C-Values and Curve Numbers for Preliminary Drainage Areas

Surface Type	Permeable				
	Asphalt	Concrete	Pavement	Rooftop	Landscape
C-Value	0.70	0.80	0.60	0.90	0.10
Curve Number	98	98	89	98	80

K = 1.17
 P = 1.00 in
 Intensity = 0.2 in/hr
 Average Rainfall = 35 in

Proposed

Drainage Area	Treatment Type	Asphalt					Total Area ft ²	Total Area acres	C-Value	Curve Number
		ft ²	Concrete ft ²	Pavers ft ²	Rooftop ft ²	Landscape ft ²				
1	Bioretention-Flush	9,023	2,454	0	0	99	11,576	0.27	0.72	97.8
2	Bioretention-Flush	4,351	830	0	0	0	5,181	0.12	0.72	98.0
3	Bioretention-Flush	8,930	3,009	0	0	2,274	14,213	0.33	0.63	95.1
4	Bioretention-Flush	3,751	1,588	0	0	625	5,964	0.14	0.66	96.1
5	Bioretention-Flush	2,053	1,130	0	0	0	3,183	0.07	0.74	98.0
6	Bioretention-Flush	2,597	1,310	0	0	49	3,956	0.09	0.73	97.8
7	Bioretention-Flush	4,453	1,821	0	0	77	6,351	0.15	0.72	97.8
8	Bioretention-Flush	3,663	1,462	0	0	144	5,269	0.12	0.71	97.5
9	Bioretention Rain Garden	1,329	537	1,266	0	4,631	7,763	0.18	0.33	85.8
10	Detention Pond	0	0	0	0	19,364	19,364	0.44	0.10	80.0
11	Bioretention-Flush	11,247	1,742	0	9,779	2,551	25,319	0.58	0.72	96.2
12	Bioretention-Flush	1,175	119	0	1,071	469	2,834	0.07	0.68	95.0
13	Bioretention-Flush	6,787	1,558	0	5,843	2,330	16,518	0.38	0.70	95.5
14	Bioretention-Flush	5,898	1,298	0	5,828	2,409	15,433	0.35	0.69	95.2
15	Bioretention-Flush	9,756	2,467	425	14,660	3,269	30,577	0.70	0.74	96.0
16	Bioretention-Flush	6,507	2,216	0	16,219	2,654	27,596	0.63	0.77	96.3
17	Bioretention-Flush	9,430	1,220	0	4,829	2,640	18,119	0.42	0.67	95.4
18	Bioretention-Flush	9,219	1,298	0	3,854	2,640	17,011	0.39	0.66	95.2
19	Bioretention Rain Garden	0	12,351	0	12,943	15,592	40,886	0.94	0.56	91.1
Overall		100,169	38,410	1,691	75,026	61,817	277,113	6.36	0.63	93.9

APPENDIX D

DRAINAGE AREA CALCULATIONS

STORM WATER CALCULATOR

LID BMP Summary Page & Site Global Values

Project Information:

Project Name: **Shiloh Crossing**
 Address/Location: **295 Shiloh Road, Windsor, CA 95492**
 Designer: **Carlie-Macy - Alan Furste**
 Date: **6/25/2021**

Site Information:

Mean Seasonal Precipitation (MSP) of Project Site: **35.00 (inches)**
 $K = \text{MSP} / 30 = 1.17$
 Impervious area - pre development: **27,878.0 ft²**
 Impervious area - post development: **214,750.0 ft²**

Based upon the pre and post development impervious area, the post construction BMP requirement is:

100% Capture & Treatment

Summary of Saved BMP Results:

BMP ID:	Tributary Area	Runoff Reduction Measures (Y/N)	Type of Requirement Met	Requirements	Type of BMP Design	BMP Design Results					
						Hydromodification Control	Flow Base Treatment	Delta Volume Capture			
						Required Hydromod (ft³)	Achieved (ft³)	Required Q Treatment (cfs)	Achieved (ft³)	Required Ydelta (ft³)	Achieved (ft³)
1	11,576	Yes	Hydromod Volume Capture	Priority 2: P2-02 Roadside Bioretention - Flush Design	100.8	885,6216	892,8000				
2	5,181	No	Hydromod Volume Capture	Priority 2: P2-02 Roadside Bioretention - Flush Design	101.5	411,5268	417,6000				
3	14,213	No	Hydromod Volume Capture	Priority 2: P2-02 Roadside Bioretention - Flush Design	100.9	848,8004	856,8000				
4	5,964	No	Hydromod Volume Capture	Priority 2: P2-02 Roadside Bioretention - Flush Design	100.6	392,6101	394,8000				
5	3,183	No	Hydromod Volume Capture	Priority 2: P2-02 Roadside Bioretention - Flush Design	101.9	252,8257	257,6000				
6	3,956	Yes	Hydromod Volume Capture	Priority 2: P2-02 Roadside Bioretention - Flush Design	101.2	284,6196	288,0000				
7	6,351	Yes	Hydromod Volume Capture	Priority 2: P2-02 Roadside Bioretention - Flush Design	100.3	471,0703	472,3200				
8	5,269	Yes	Hydromod Volume Capture	Priority 2: P2-02 Roadside Bioretention - Flush Design	107.0	394,6877	422,4000				
9	7,763	Yes	Hydromod Volume Capture	Priority 1: P1-02 Roadside Bioretention - No Curb and Gutter	101.8	174,4103	177,6000				
10	19,364	No	Hydromod Volume Capture	Priority 1: P1-02 Roadside Bioretention - No Curb and Gutter	696.1	226,5588	#####				
11	25,319	No	100% Vertical Flow Treatment	Priority 3: P3-03 Roadside Bioretention - Contiguous Sidewalk	102.4			0.0976	0.1000		
12	2,834	No	100% Vertical Flow Treatment	Priority 3: P3-03 Roadside Bioretention - Contiguous Sidewalk	107.6			0.0103	0.0111		
13	16,518	No	100% Vertical Flow Treatment	Priority 3: P3-03 Roadside Bioretention - Contiguous Sidewalk	100.5			0.0619	0.0622		
14	15,433	No	100% Vertical Flow Treatment	Priority 3: P3-03 Roadside Bioretention - Contiguous Sidewalk	101.3			0.0670	0.0578		
15	30,577	No	100% Vertical Flow Treatment	Priority 3: P3-03 Roadside Bioretention - Contiguous Sidewalk	100.0			0.1212	0.1212		
16	27,596	No	100% Vertical Flow Treatment	Priority 3: P3-03 Roadside Bioretention - Contiguous Sidewalk	100.0			0.1138	0.1138		
17	18,119	No	100% Vertical Flow Treatment	Priority 3: P3-03 Roadside Bioretention - Contiguous Sidewalk	100.8			0.0650	0.0656		
18	17,011	No	100% Vertical Flow Treatment	Priority 3: P3-03 Roadside Bioretention - Contiguous Sidewalk	100.0			0.0601	0.0601		
19	40,886	No	100% Vertical Flow Treatment	Priority 3: P3-03 Roadside Bioretention - Contiguous Sidewalk	101.5			0.1226	0.1244		
20											
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											

STORM WATER CALCULATOR

BMP Tributary Parameters

BMP ID:	1	Project Name:	Shiloh Crossing
BMP Design Criteria:	100% Capture & Treatment		
Type of BMP Design:	Priority 2: P2-02 Roadside Bioretention - Flush Design		
BMP's Physical Tributary Area:	11,576.0 ft ²		
Description/Notes:			

Runoff Reduction Measures

Resulting reduced Tributary Area used for BMP sizing = 11,376.0 ft²
Total Runoff Reduction Measures = 200.0 ft²

Interceptor Trees

Number of new interceptor *Evergreen Trees*: 0
Number of new interceptor *Deciduous Trees*: 2
Square footage of qualifying existing tree canopy: 0.0 ft²
Total Number of New trees in BMP Tributary Area: 2

Disconnected Roof Drains

Select disconnection condition: Select disconnection condition

Disconnected Roof Drains Method 1

Roof area of disconnected downspouts: 0 ft²
Disconnected Roof Drains Method 2
Percent of rooftop area: 0 %
Select Density: 1 Units per Acre

Paved Area Disconnection

Paved Area Type: Select paved area type
Alternatively designed paved area: 0.0 ft²

Buffer Strips & Bovine Terraces

Area draining to a Buffer Strip or Bovine Terrace: 0.0 ft²

Hydromodification Requirement: 100% Volume Capture; V_{HYDROMOD}

V_{HYDROMOD} = 885.62 ft³

Post development hydrologic soil type within tributary area: C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Post development ground cover description: Impervious - Paved Parking, Rooftop, Driveways

CN_{POST}:
User Composite post development CN: 98.0

BMP Sizing Tool: Hydromodification Requirement

Percent of Goal Achieved = 100.81 %

BMP Volume		Ponded Water Above Ground	
Below Ground	Porosity: 0.40	Depth: 0.00 ft	
	Width: 12.00 ft	Width: 0.00 ft	
	Length: 62.00 ft	Length: 0.00 ft	
	Area: 0.00 ft ²	Area: 0.00 ft ²	

STORM WATER CALCULATOR

BMP Tributary Parameters

BMP ID:	2	Project Name:	Shiloh Crossing
BMP Design Criteria:	100% Capture & Treatment		
Type of BMP Design:	Priority 2: P2-02 Roadside Bioretention - Flush Design		
BMP's Physical Tributary Area:	5,181.0	ft ²	
Description/Notes:			

Hydromodification Requirement: 100% Volume Capture; V_{HYDROMOD}

V_{HYDROMOD} = 411.53 ft³

Post development hydrologic soil type within tributary area:

C: 0.05 - 0.15 in/hr infiltration (transmission) rate

Post development ground cover description:

Impervious - Paved Parking, Rooftop, Driveways

CN_{post}:

98

User Composite post development CN:

0.0

BMP Sizing Tool: Hydromodification Requirement

BMP Volume		Percent of Goal Achieved = 101.48 %	
Below Ground		Ponded Water Above Ground	
Porosity:	0.40	Depth:	0.00 ft
Depth below perforated pipe if present:	3.00 ft	Width:	0.00 ft
Width:	12.00 ft	Length:	0.00 ft
Length:	29.00 ft	Area:	0.00 ft ²
Area:	0.00 ft ²		

STORM WATER CALCULATOR

BMP Tributary Parameters

BMP ID: **3**

Project Name: **Shiloh Crossing**

BMP Design Criteria: **100% Capture & Treatment**

Type of BMP Design: **Priority 2: P2-02 Roadside Bioretention - Flush Design**

BMP's Physical Tributary Area:

14,213.0 ft²

Description/Notes:

Hydromodification Requirement: 100% Volume Capture; V_{HYDROMOD}

V_{HYDROMOD} = **848.80** ft³

Post development hydrologic soil type within tributary area:

C: 0.05 - 0.15 in/hr infiltration (transmission) rate

Post development ground cover description:

Impervious - Paved Parking, Rooftop, Driveways

CN_{POST}:

User Composite post development CN: **95.0**

BMP Sizing Tool: Hydromodification Requirement

Percent of Goal Achieved = **100.94** %

BMP Volume Below Ground	
Porosity:	0.40
Depth below perforated pipe if present:	3.00 ft
Width:	7.00 ft
Length:	102.00 ft
Area:	0.00 ft ²

Ponded Water Above Ground	
Depth:	0.00 ft
Width:	0.00 ft
Length:	0.00 ft
Area:	0.00 ft ²



STORM WATER CALCULATOR

BMP Tributary Parameters

BMP ID: 4

Project Name: Shiloh Crossing

BMP Design Criteria: 100% Capture & Treatment

Type of BMP Design: Priority 2: P2-02 Roadside Bioretention - Flush Design

BMP's Physical Tributary Area:

5,964.0 ft²

Description/Notes:

Hydromodification Requirement: 100% Volume Capture; V_{HYDROMOD}

V_{HYDROMOD} = 392.61 ft³

Post development hydrologic soil type within tributary area:

C: 0.05 - 0.15 in/hr infiltration (transmission) rate

Post development ground cover description:

Impervious - Paved Parking, Rooftop, Driveways

CN_{POST}:

User Composite post development CN: 96.0

BMP Sizing Tool: Hydromodification Requirement

Percent of Goal Achieved = 100.56 %

BMP Volume	
Below Ground	
Porosity:	0.40
Depth below perforated pipe if present:	3.00 ft
Width:	7.00 ft
Length:	47.00 ft
Area:	0.00 ft ²

Ponded Water	
Above Ground	
Depth:	0.00 ft
Width:	0.00 ft
Length:	0.00 ft
Area:	0.00 ft ²

STORM WATER CALCULATOR

BMP Tributary Parameters

BMP ID:	5	Project Name:	Shiloh Crossing
BMP Design Criteria:	100% Capture & Treatment		
Type of BMP Design:	Priority 2: P2-02 Roadside Bioretention - Flush Design		
BMP's Physical Tributary Area:	3,183.0 ft ²		
Description/Notes:			

Hydromodification Requirement: 100% Volume Capture; V_{HYDROMOD}

V_{HYDROMOD} = 252.83 ft³

Post development hydrologic soil type within tributary area:

C: 0.05 - 0.15 in/hr infiltration (transmission) rate

Post development ground cover description:

Impervious - Paved Parking, Rooftop, Driveways

CN_{Post}:

User Composite post development CN: 98.0

BMP Sizing Tool: Hydromodification Requirement

BMP Volume		Percent of Goal Achieved = 101.89 %	
Below Ground		Ponded Water Above Ground	
Porosity:	0.40	Depth:	0.00 ft
Depth below perforated pipe if present:	4.00 ft	Width:	0.00 ft
Width:	7.00 ft	Length:	0.00 ft
Length:	23.00 ft	Area:	0.00 ft ²
Area:	0.00 ft ²		

STORM WATER CALCULATOR

BMP Tributary Parameters

BMP ID:	6	Project Name:	Shiloh Crossing
BMP Design Criteria:	100% Capture & Treatment		
Type of BMP Design:	Priority 2: P2-02 Roadside Bioretention - Flush Design		
BMP's Physical Tributary Area:	3,956.0 ft ²		
Description/Notes:			

Runoff Reduction Measures

Resulting reduced Tributary Area used for BMP sizing = 3,656.0 ft²
Total Runoff Reduction Measures = 300.0 ft²

Interceptor Trees

Number of new interceptor <i>Evergreen Trees</i> :	0	Total Number of New trees in BMP Tributary Area:	3
Number of new interceptor <i>Deciduous Trees</i> :	3		
Square footage of qualifying existing tree canopy:	0.0 ft ²		

Disconnected Roof Drains

Select disconnection condition: **Select disconnection condition**

Disconnected Roof Drains Method 1		Disconnected Roof Drains Method 2	
Roof area of disconnected downspouts:	0 ft ²	Percent of rooftop area:	0 %
		Select Density:	1 Units per Acre

Paved Area Disconnection

Paved Area Type: **Select paved area type**
Alternatively designed paved area: 0.0 ft²

Buffer Strips & Bovine Terraces

Area draining to a Buffer Strip or Bovine Terrace: 0.0 ft²

Hydromodification Requirement: 100% Volume Capture; V_{HYDROMOD}

V_{HYDROMOD} = 284.62 ft³

Post development hydrologic soil type within tributary area: C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Post development ground cover description: Impervious - Paved Parking, Rooftop, Driveways

CN_{post}:
User Composite post development CN: 98.0

BMP Sizing Tool: Hydromodification Requirement

BMP Volume		Percent of Goal Achieved = 101.19 %	
Below Ground		Ponded Water Above Ground	
Porosity:	0.40	Depth:	0.00 ft
Depth below perforated pipe if present:	4.00 ft	Width:	0.00 ft
Width:	6.00 ft	Length:	0.00 ft
Length:	30.00 ft	Area:	0.00 ft ²
Area:	0.00 ft ²		

STORM WATER CALCULATOR

BMP Tributary Parameters

BMP ID:	7	Project Name:	Shiloh Crossing
BMP Design Criteria:	100% Capture & Treatment		
Type of BMP Design:	Priority 2: P2-02 Roadside Bioretention - Flush Design		
BMP's Physical Tributary Area:	6,351.0	ft ²	
Description/Notes:			

Runoff Reduction Measures

Resulting reduced Tributary Area used for BMP sizing =	6,051.0	ft ²
Total Runoff Reduction Measures =	300.0	ft ²

Interceptor Trees

Number of new interceptor <i>Evergreen Trees</i> :	0	Total Number of New trees in BMP Tributary Area:	3
Number of new interceptor <i>Deciduous Trees</i> :	3		
Square footage of qualifying existing tree canopy:	0.0	ft ²	

Disconnected Roof Drains

Select disconnection condition:

Select disconnection condition

Disconnected Roof Drains Method 1

Roof area of disconnected downspouts: 0 ft²

Disconnected Roof Drains Method 2

Percent of rooftop area: 0 %
Select Density: 1 Units per Acre

Paved Area Disconnection

Paved Area Type: Select paved area type

Alternatively designed paved area: 0.0 ft²

Buffer Strips & Bovine Terraces

Area draining to a Buffer Strip or Bovine Terrace: 0.0 ft²

Hydromodification Requirement: 100% Volume Capture; V_{HYDROMOD}

V_{HYDROMOD} = 471.07 ft³

Post development hydrologic soil type within tributary area:

C: 0.05 - 0.15 in/hr infiltration (transmission) rate

Post development ground cover description:

Impervious - Paved Parking, Rooftop, Driveways

CN_{Post}:

98.0

User Composite post development CN:

98.0

BMP Sizing Tool: Hydromodification Requirement

Percent of Goal Achieved = 100.27 %

BMP Volume		Ponded Water Above Ground	
Below Ground		Ground	
Porosity:	0.40	Depth:	0.00 ft
Depth below perforated pipe if present:	4.00 ft	Width:	0.00 ft
Width:	6.00 ft	Length:	0.00 ft
Length:	49.20 ft	Area:	0.00 ft ²
Area:	0.00 ft ²		

STORM WATER CALCULATOR

BMP Tributary Parameters

BMP ID: **8** Project Name: **Shiloh Crossing**

BMP Design Criteria: **100% Capture & Treatment**

Type of BMP Design: **Priority 2: P2-02 Roadside Bioretention - Flush Design**

BMP's Physical Tributary Area: **5,269.0 ft²**

Description/Notes:

Runoff Reduction Measures

Resulting reduced Tributary Area used for BMP sizing = **4,969.0 ft²**

Total Runoff Reduction Measures = **300.0 ft²**

Interceptor Trees

Number of new interceptor *Evergreen Trees*: **0** Total Number of New trees in BMP Tributary Area: **3**

Number of new interceptor *Deciduous Trees*: **3**

Square footage of qualifying existing tree canopy: **0.0 ft²**

Disconnected Roof Drains

Select disconnection condition: **Select disconnection condition**

Disconnected Roof Drains Method 1

Roof area of disconnected downspouts: **0 ft²**

Disconnected Roof Drains Method 2

Percent of rooftop area: **0 %**

Select Density: **1 Units per Acre**

Paved Area Disconnection

Paved Area Type: **Select paved area type**

Alternatively designed paved area: **0.0 ft²**

Buffer Strips & Bovine Terraces

Area draining to a Buffer Strip or Bovine Terrace: **0.0 ft²**

Hydromodification Requirement: 100% Volume Capture; V_{HYDROMOD}

V_{HYDROMOD} = **394.69 ft³**

Post development hydrologic soil type within tributary area:

C: 0.05 - 0.15 in/hr infiltration (transmission) rate

Post development ground cover description: **Impervious - Paved Parking, Rooftop, Driveways**

CN_{post}:

User Composite post development CN: **98.0**

BMP Sizing Tool: Hydromodification Requirement

Percent of Goal Achieved = **107.02 %**

BMP Volume		Ponded Water Above Ground	
	Below Ground		
Porosity:	0.40	Depth:	0.00 ft
Depth below perforated pipe if present:	4.00 ft	Width:	0.00 ft
Width:	6.00 ft	Length:	0.00 ft
Length:	44.00 ft	Area:	0.00 ft²
Area:	0.00 ft²		

STORM WATER CALCULATOR

BMP Tributary Parameters

BMP ID:	9	Project Name:	Shiloh Crossing
BMP Design Criteria:	100% Capture & Treatment		
Type of BMP Design:	Priority 1: P1-02 Roadside Bioretention - No Curb and Gutter		
BMP's Physical Tributary Area:	7,763.0 ft ²		
Description/Notes:			

Runoff Reduction Measures

Resulting reduced Tributary Area used for BMP sizing = 7,463.0 ft²
Total Runoff Reduction Measures = 300.0 ft²

Interceptor Trees

Number of new interceptor <i>Evergreen Trees</i> :	0	Total Number of New trees in BMP Tributary Area:	3
Number of new interceptor <i>Deciduous Trees</i> :	3		
Square footage of qualifying existing tree canopy:	0.0 ft ²		

Disconnected Roof Drains

Select disconnection condition: Select disconnection condition

Disconnected Roof Drains Method 1

Roof area of disconnected downspouts: 0 ft²

Disconnected Roof Drains Method 2

Percent of rooftop area: 0 %
Select Density: 1 Units per Acre

Paved Area Disconnection

Paved Area Type: Select paved area type

Alternatively designed paved area: 0.0 ft²

Buffer Strips & Bovine Terraces

Area draining to a Buffer Strip or Bovine Terrace: 0.0 ft²

Hydromodification Requirement: 100% Volume Capture; V_{HYDROMOD}

V_{HYDROMOD} = 174.41 ft³

Post development hydrologic soil type within tributary area: C: 0.05 - 0.15 in/hr Infiltration (transmission) rate
Post development ground cover description: Impervious - Paved Parking, Rooftop, Driveways

CN_{POST}:
User Composite post development CN: 86.0

BMP Sizing Tool: Hydromodification Requirement

Percent of Goal Achieved = 101.83 %

BMP Volume		Percent of Goal Achieved =	
	Below Ground		Ponded Water Above Ground
Porosity:	0.40	Depth:	0.00 ft
Depth below perforated pipe if present:	3.00 ft	Width:	0.00 ft
Width:	8.00 ft	Length:	0.00 ft
Length:	18.50 ft	Area:	0.00 ft ²
Area:	0.00 ft ²		



STORM WATER CALCULATOR

BMP Tributary Parameters

BMP ID:	10	Project Name:	Shiloh Crossing
BMP Design Criteria:	100% Capture & Treatment		
Type of BMP Design:	Priority 1: P-1-02 Roadside Bioretention - No Curb and Gutter		
BMP's Physical Tributary Area:	19,364.0	ft ²	
Description/Notes:	Detention Pond for Incubator site to the North.		

Hydromodification Requirement: 100% Volume Capture; V_{HYDROMOD}

V_{HYDROMOD} = 226.56 ft³

Post development hydrologic soil type within tributary area:

C: 0.05 - 0.15 in/hr infiltration (transmission) rate

Post development ground cover description:

Impervious - Paved Parking, Rooftop, Driveways

CN_{Post}:

User Composite post development CN: 80.0

BMP Sizing Tool: Hydromodification Requirement

BMP Volume Below Ground		Percent of Goal Achieved = 696.07 %	
Porosity:	0.40	Ponded Water Above Ground	
Depth below perforated pipe if present:	0.00 ft	Depth:	0.50 ft
Width:	0.00 ft	Width:	0.00 ft
Length:	0.00 ft	Length:	0.00 ft
Area:	0.00 ft ²	Area:	3,154.00 ft ²

STORM WATER CALCULATOR

BMP Tributary Parameters

BMP ID: **11**

Project Name: **Shiloh Crossing**

BMP Design Criteria: **100% Capture & Treatment**

Type of BMP Design: **Priority 3: P-3-03 Roadside Bioretention - Contiguous Sidewalk**

BMP's Physical Tributary Area: **25,319.0 ft²**

Description/Notes: Volume Capture achieved via detention chambers sized for 100 year storm. See detention volume portion of this report.

100% Treatment

Post surface type: **Concrete**

$Q_{TREATMENT} =$ **0.0976** cfs

User Composite post development C_{Post} : **0.72**

Treatment Factor (Tf): **1**

User Input $I_{Historical}$: **0.00** in./hr.

Design Storm: **0.20** in./hr.

BMP Sizing 100% Treatment Vertical

Infiltration rate of the specified BMP soil: **24.00** in./hr.

Percent of Goal Achieved = **102.41** %

Depth of drainage pipe: **1.50** ft
BMP Length: **90.00** ft
BMP Width: **2.00** ft

STORM WATER CALCULATOR

BMP Tributary Parameters

BMP ID:	12	Project Name:	Shiloh Crossing
BMP Design Criteria:	100% Capture & Treatment		
Type of BMP Design:	Priority 3: P3-03 Roadside Bioretention - Contiguous Sidewalk		
BMP's Physical Tributary Area:	2,834.0	ft ²	
Description/Notes:	Volume Capture achieved via detention chambers sized for 100 year storm. See detention volume portion of this report.		

100% Treatment

Post surface type:	Concrete	Q _{TREATMENT} =	0.0103	cfs
User Composite post development C _{post} :	0.68	Treatment Factor (Tf):	1	Calculated
User Input I _{historical} :	0.00	I _{Design Storm} :	0.20	in./hr.

BMP Sizing 100% Treatment Vertical

Infiltration rate of the specified BMP soil:	24.00	in./hr.	Percent of Goal Achieved =	107.64	%
Depth of drainage pipe:	1.50	ft			
BMP Length:	10.00	ft			
BMP Width:	2.00	ft			

STORM WATER CALCULATOR

BMP Tributary Parameters

BMP ID: **13**

Project Name: **Shiloh Crossing**

BMP Design Criteria: **100% Capture & Treatment**

Type of BMP Design: **Priority 3: P3-03 Roadside Bioretention - Contiguous Sidewalk**

BMP's Physical Tributary Area: **16,518.0 ft²**

Description/Notes: Volume Capture achieved via detention chambers sized for 100 year storm. See detention volume portion of this report.

100% Treatment

Post surface type: **Concrete**

$Q_{TREATMENT} =$ **0.0619** cfs

User Composite post development C_{Post} : **0.70**

Treatment Factor (TF): **1** Calculated

User Input $I_{Historical}$: **0.00** in./hr.

Design Storm: **0.20** in./hr.

BMP Sizing 100% Treatment Vertical

Infiltration rate of the specified BMP soil: **24.00** in./hr.

Percent of Goal Achieved = **100.46** %

Depth of drainage pipe: **1.50** ft

BMP Length: **56.00** ft

BMP Width: **2.00** ft

STORM WATER CALCULATOR

BMP Tributary Parameters

BMP ID:	14	Project Name:	Shiloh Crossing
BMP Design Criteria:	100% Capture & Treatment		
Type of BMP Design:	Priority 3: P-3-03 Roadside Bioretention - Contiguous Sidewalk		
BMP's Physical Tributary Area:	15,433.0	ft ²	
Description/Notes:	Volume Capture achieved via detention chambers sized for 100 year storm. See detention volume portion of this report.		

100% Treatment

Post surface type:	Concrete	Q _{TREATMENT} =	0.0570	cfs
User Composite post development C _{Post} :	0.69	Treatment Factor (Tf):	1	Calculated
User Input I _{Historical} :	0.00	I _{Design Storm} :	0.20	in./hr.

BMP Sizing 100% Treatment Vertical

Infiltration rate of the specified BMP soil:	24.00	in./hr.	Percent of Goal Achieved =	101.29	%
Depth of drainage pipe:	1.50	ft			
BMP Length:	52.00	ft			
BMP Width:	2.00	ft			

STORM WATER CALCULATOR

BMP Tributary Parameters

BMP ID:	15	Project Name:	Snihon Crossing
BMP Design Criteria:	100% Capture & Treatment		
Type of BMP Design:	Priority 3: P3-03 Roadside Bioretention - Contiguous Sidewalk		
BMP's Physical Tributary Area:	30,577.0	ft ²	
Description/Notes:	Volume Capture achieved via detention chambers sized for 100 year storm. See detention volume portion of this report.		

100% Treatment

Post surface type:	Concrete	Q _{TREATMENT} =	0.1212	cfs
User Composite post development C _{Post} :	0.74	Treatment Factor (TF):	1	Calculated
User Input I _{Historical} :	0.00	Design Storm:	0.20	in./hr.

BMP Sizing 100% Treatment Vertical

Infiltration rate of the specified BMP soil:	24.00	in./hr.	Percent of Goal Achieved =	100.02	%
Depth of drainage pipe:	1.50	ft			
BMP Length:	109.10	ft			
BMP Width:	2.00	ft			

STORM WATER CALCULATOR

BMP Tributary Parameters

BMP ID:	16	Project Name:	Shiloh Crossing
BMP Design Criteria:	100% Capture & Treatment		
Type of BMP Design:	Priority 3: P-3-03 Roadside Bioretention - Contiguous Sidewalk		
BMP's Physical Tributary Area:	27,596.0	ft²	
Description/Notes:	Volume Capture achieved via detention chambers sized for 100 year storm. See detention volume portion of this report.		

100% Treatment

Post surface type:	Concrete	$Q_{TREATMENT} =$	0.1138	cfs
User Composite post development C_{Post} :	0.77	Treatment Factor (Tf):	1	Calculated
User Input Historical:	0.00	Design Storm:	0.20	in./hr.

BMP Sizing 100% Treatment Vertical

Infiltration rate of the specified BMP soil:	24.00	Percent of Goal Achieved =	99.96	%
Depth of drainage pipe:	1.50			ft
BMP Length:	102.40			ft
BMP Width:	2.00			ft

STORM WATER CALCULATOR

BMP Tributary Parameters

BMP ID: **17**

Project Name: **Shiloh Crossing**

BMP Design Criteria: **100% Capture & Treatment**

Type of BMP Design: **Priority 3: P3-03 Roadside Bioretention - Contiguous Sidewalk**

BMP's Physical Tributary Area: **18,119.0** ft²

Description/Notes: Volume Capture achieved via detention chambers sized for 100 year storm. See detention volume portion of this report.

100% Treatment

Post surface type: **Concrete**

Q_{TREATMENT} = **0.0650** cfs

C_{POST}:

User Composite post development C_{POST}:

0.67

Treatment Factor (Tf):

1

Calculated

User Input I_{Historical}:

0.00

I_{Design Storm}:

0.20

in./hr.

BMP Sizing 100% Treatment Vertical

Infiltration rate of the specified BMP soil: **24.00** in./hr.

Percent of Goal Achieved = **100.81** %

Depth of drainage pipe: **1.50** ft

BMP Length: **59.00** ft

BMP Width: **2.00** ft

STORM WATER CALCULATOR

BMP Tributary Parameters

BMP ID:	18	Project Name:	Shiloh Crossing
BMP Design Criteria:	100% Capture & Treatment		
Type of BMP Design:	Priority 3: P3-03 Roadside Bioretention - Contiguous Sidewalk		
BMP's Physical Tributary Area:	17,011.0	ft ²	
Description/Notes:	Volume Capture achieved via detention chambers sized for 100 year storm. See detention volume portion of this report.		

100% Treatment

Post surface type:	Concrete	Q _{TREATMENT} =	0.0601	cfs
User Composite post development C _{Post} :	0.66	Treatment Factor (Tf):	1	Calculated
User Input Historical:	0.00	Design Storm:	0.20	in./hr.

BMP Sizing 100% Treatment Vertical

Infiltration rate of the specified BMP soil:	24.00	in./hr.	Percent of Goal Achieved =	99.95	%
Depth of drainage pipe:	1.50	ft			
BMP Length:	54.10	ft			
BMP Width:	2.00	ft			

STORM WATER CALCULATOR

BMP Tributary Parameters

BMP ID:	19	Project Name:	Shiloh Crossing
BMP Design Criteria:	100% Capture & Treatment		
Type of BMP Design:	Priority 3: P3-03 Roadside Bioretention - Contiguous Sidewalk		
BMP's Physical Tributary Area:	40,886.0	ft²	
Description/Notes:	Volume Capture achieved via detention chambers sized for 100 year storm. See detention volume portion of this report.		

100% Treatment

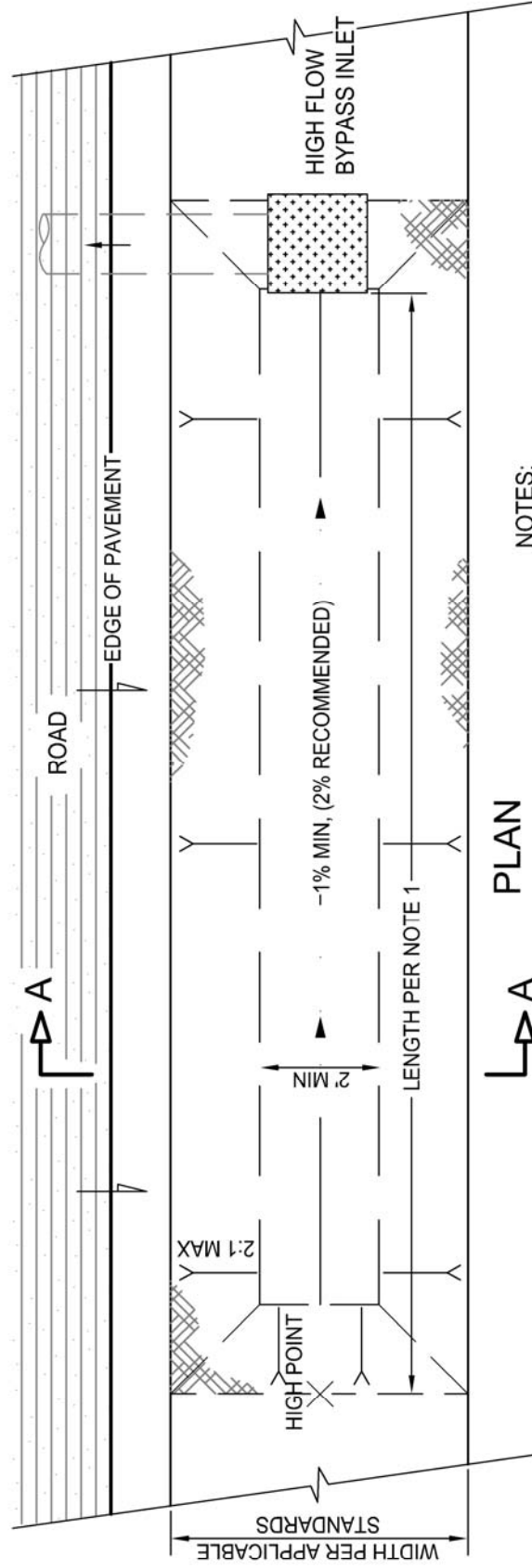
Post surface type:	Concrete	$Q_{TREATMENT} =$	0.1226	cfs
User Composite post development C_{POST} :	0.56	Treatment Factor (TF):	1	Calculated
User Input Historical:	0.00	Design Storm:	0.20	in./hr.

BMP Sizing 100% Treatment Vertical

Infiltration rate of the specified BMP soil:	24.00	Percent of Goal Achieved =	101.47	%
Depth of drainage pipe:	1.50			ft
BMP Length:	28.00			ft
BMP Width:	8.00			ft

APPENDIX E

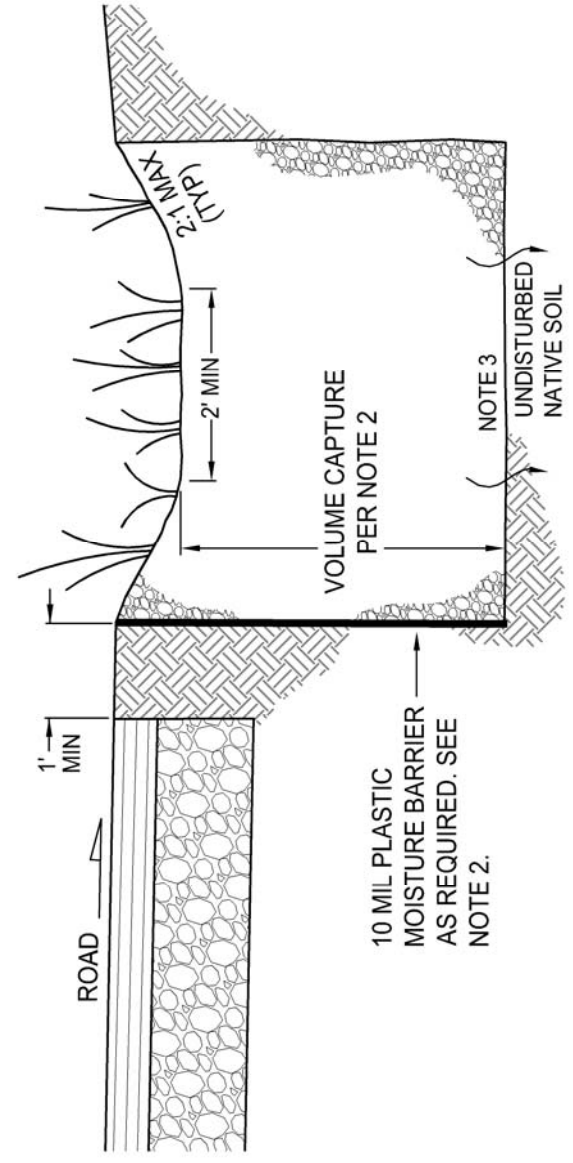
BMP DETAILS



PLAN

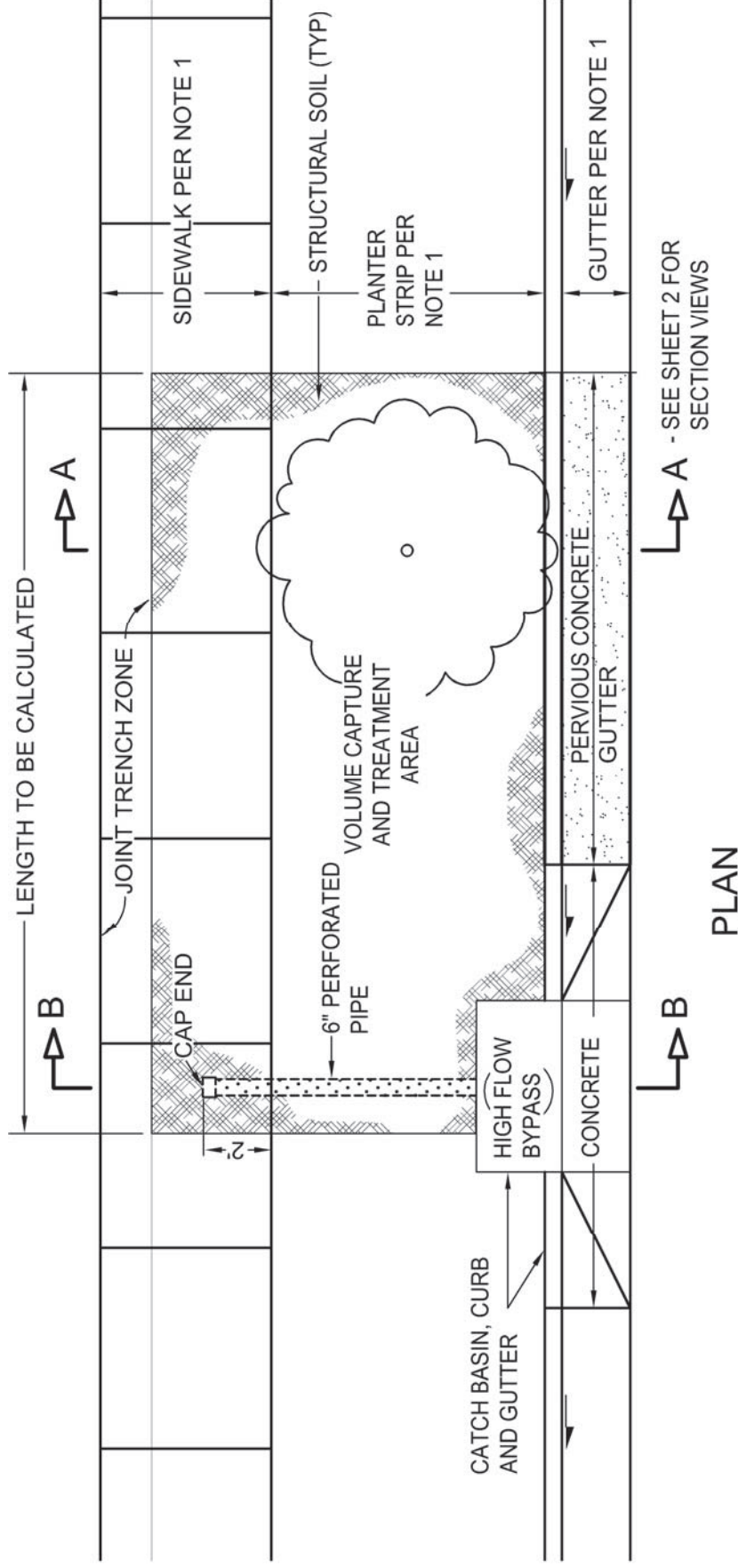
NOTES:

1. IF SWALE PROVIDES TREATMENT, LENGTH SHALL BE DESIGNED TO PROVIDE 12 MINUTES OF CONTACT TIME IF FLOW ENTERS UNIFORMLY ALONG LENGTH. LENGTH SHALL PROVIDE 5 MINUTES OF CONTACT TIME IF 90% OR MORE OF THE FLOW ENTERS AT THE UPSTREAM END.
2. SOIL TO BE SPECIFIED BY DESIGN ENGINEER TO MEET VOLUME CAPTURE AND GOVERNING AGENCY REQUIREMENTS. IF NON-STRUCTURAL SOIL IS SELECTED, A CUTOFF WALL IS REQUIRED IN PLACE OF A MOISTURE BARRIER.
3. SWALE MUST CONVEY HIGH FLOWS PER GOVERNING AGENCY DESIGN STANDARDS.



SECTION A-A

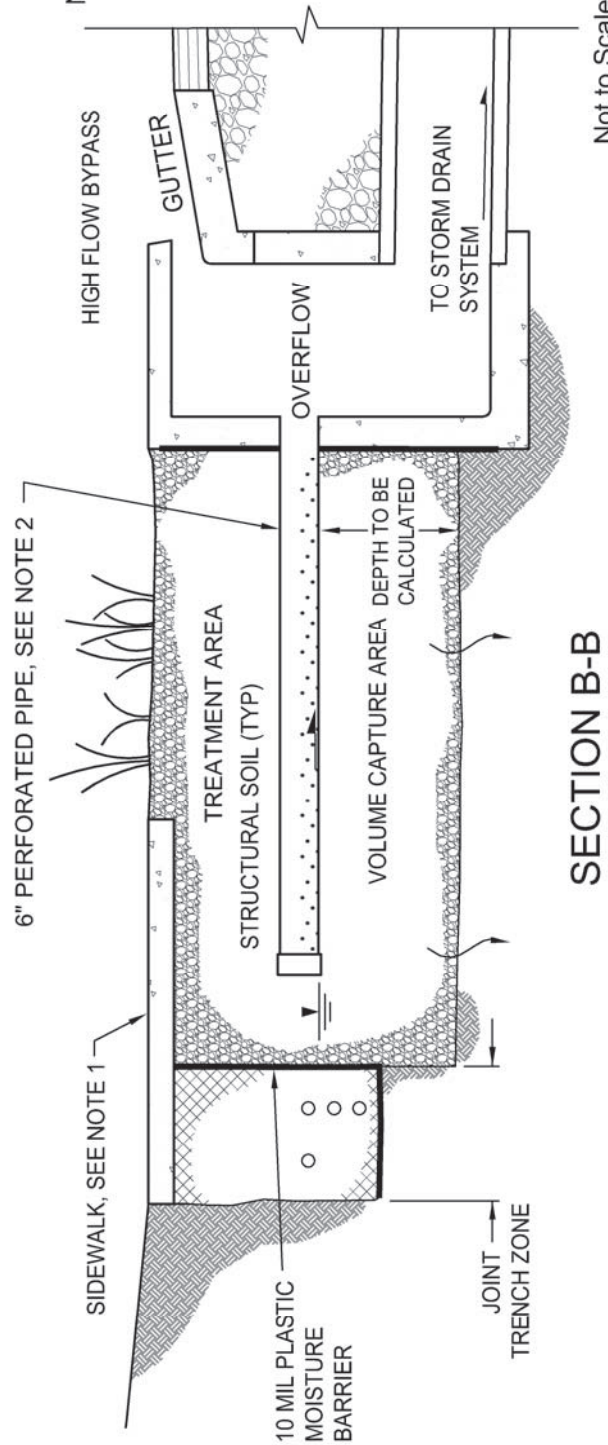
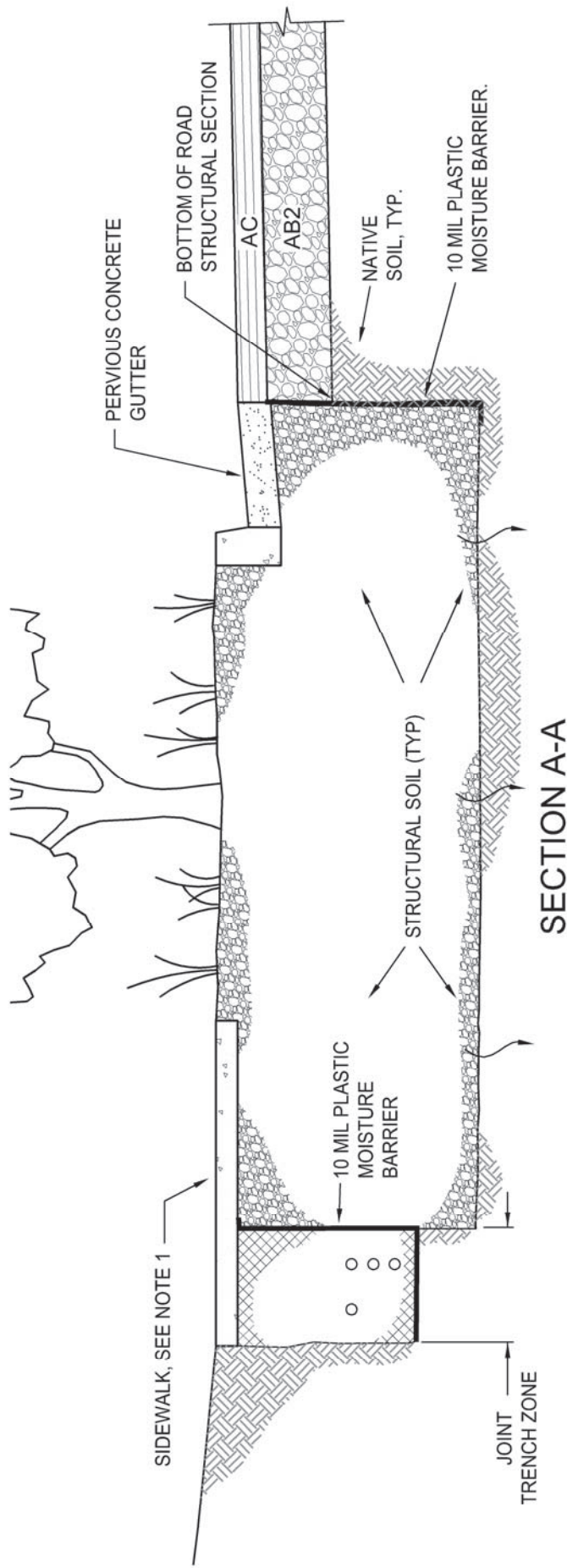
PRIORITY 1			
ROADSIDE BIORETENTION			
- NO CURB AND GUTTER			
SCALE: NONE	DATE: 03/29/17		
DWN. D/T	CHK. HM		
Not to Scale		P1-02	



- NOTES:
1. SIDEWALK, GUTTER AND PLANTER WIDTHS PER APPLICABLE GOVERNING AGENCY STANDARDS (TYP).

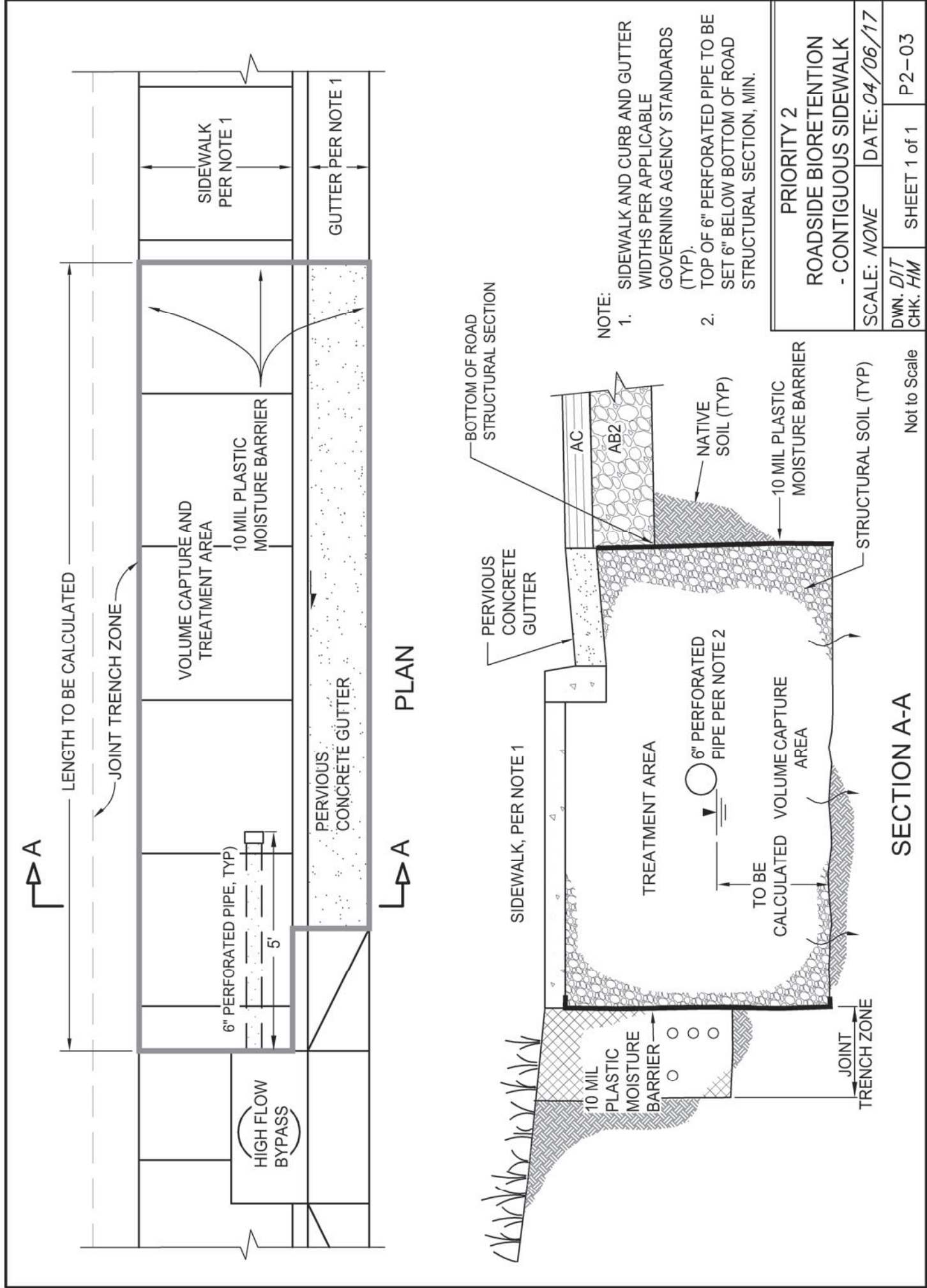
PRIORITY 2		
ROADSIDE BIORETENTION		
- FLUSH DESIGN		
SCALE: NONE	DATE: 04/06/17	
DWN. D/T	SHEET 1 of 2	P2-02
CHK. HM		

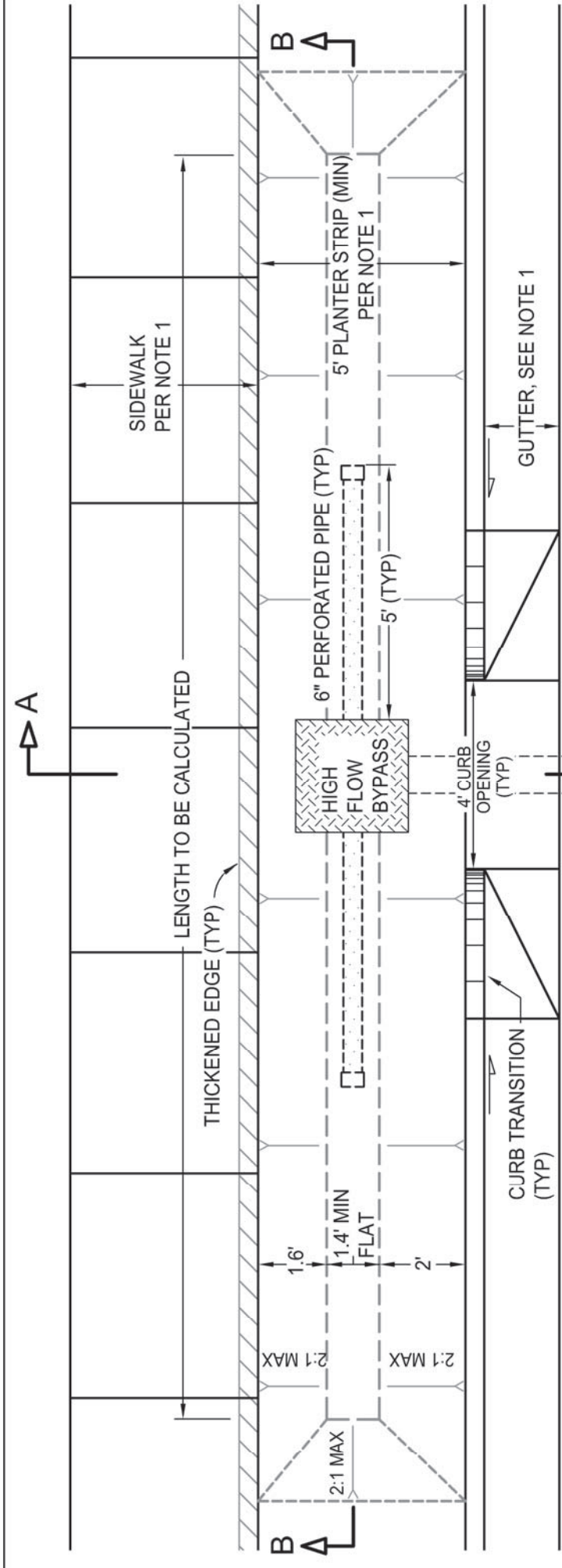
Not to Scale



- NOTES:
1. SIDEWALK, GUTTER AND PLANTER WIDTHS PER APPLICABLE GOVERNING AGENCY STANDARDS (TYP).
 2. TOP OF 6" PERFORATED PIPE TO BE SET 6" BELOW BOTTOM OF ROAD STRUCTURAL SECTION, MIN.

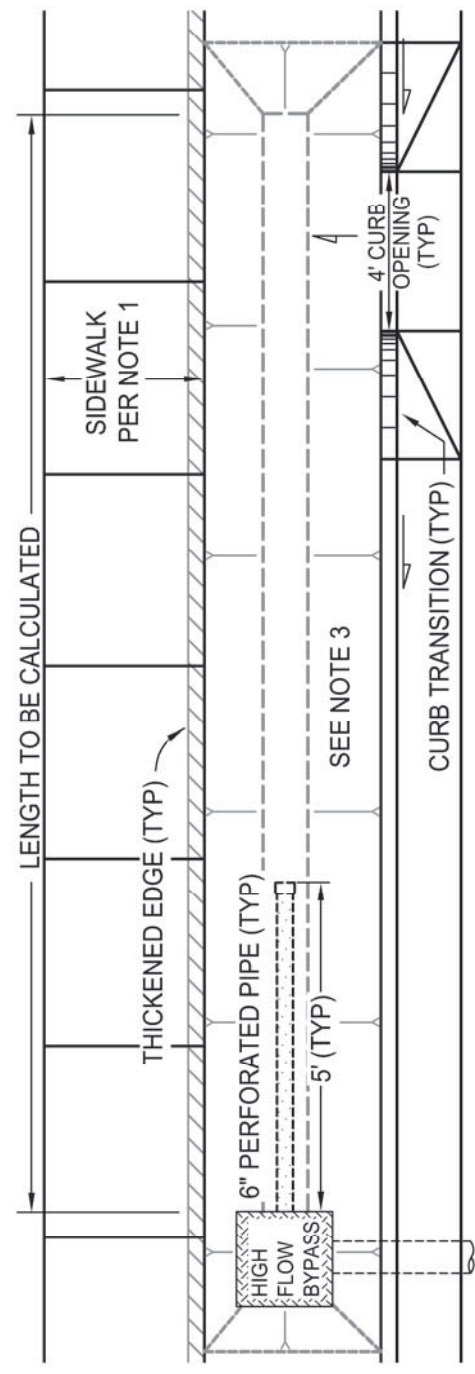
PRIORITY 2		
ROADSIDE BIORETENTION		
- FLUSH DESIGN		
SCALE: NONE	DATE: 04/06/17	
DWN. D/T	SHEET 2 of 2	P2-02
CHK. HM		





PLAN
TYPE A - CURB OPENING AT LOW POINT

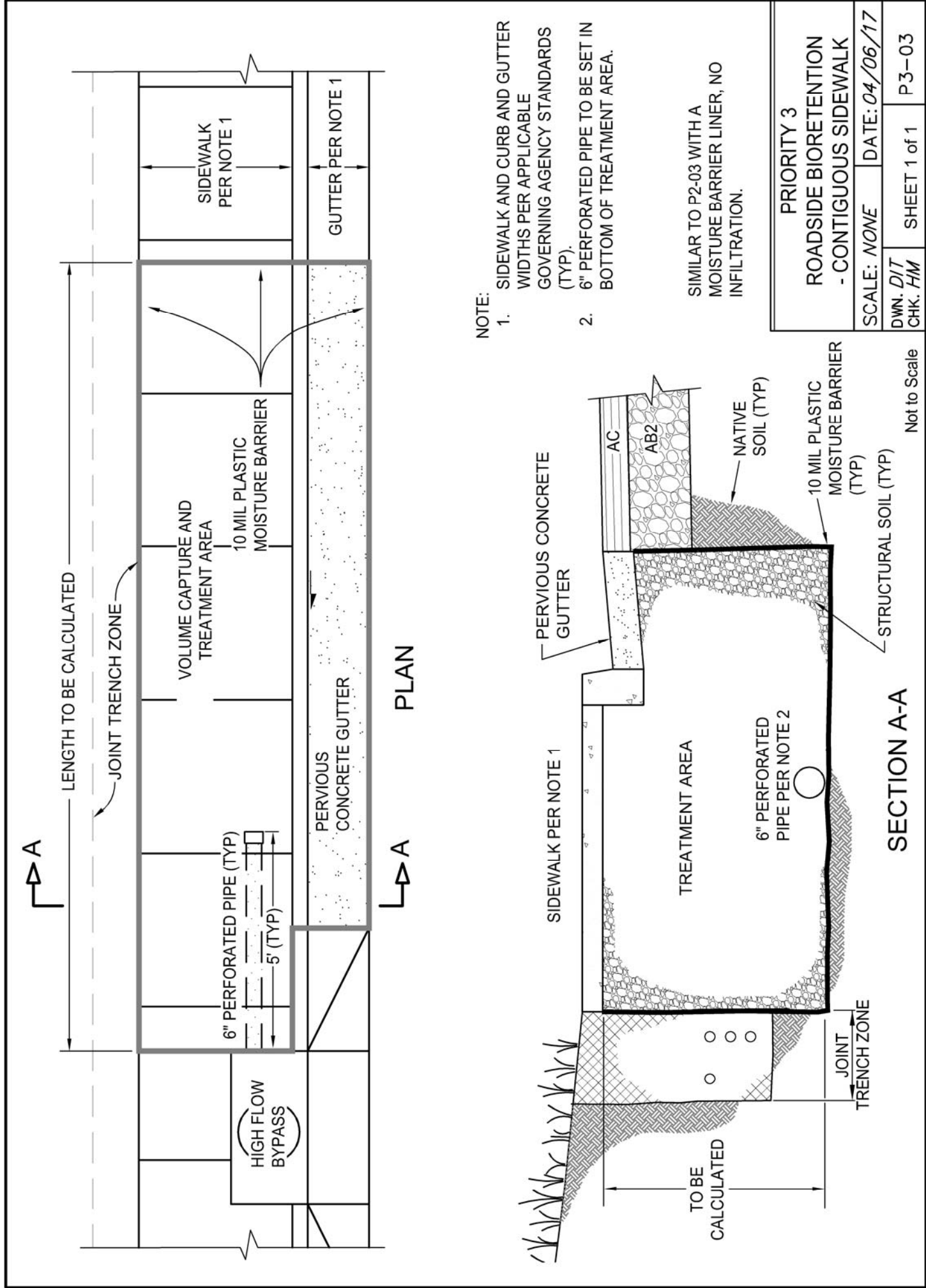
- NOTE:
1. SIDEWALK, GUTTER AND PLANTER WIDTHS PER APPLICABLE MUNICIPAL STANDARDS (TYP).
 2. TOP OF 6" PERFORATED PIPE TO BE SET 6" BELOW ROAD STRUCTURAL SECTION, MIN.
 3. TYPE A MINIMUM DIMENSIONS AND GRADES APPLY TO TYPE B.



TYPE B - CURB OPENING ALONG A SLOPE

PRIORITY 2		
ROADSIDE BIORETENTION - CURB OPENING		
SCALE: <i>NONE</i>	DATE: <i>04/06/17</i>	
DWN. <i>DIT</i>	SHEET 1 of 2	P2-04
CHK. <i>HM</i>		

Not to Scale



APPENDIX F

BMP INSPECTION AND MAINTENANCE CHECKLISTS

Form A
Storm Water Quality Feature Maintenance Check List
- Standard Conditions -

Date: _____ Inspector: _____
Start Time: _____ Project: _____
Stop Time: _____ Address: _____

Inspection Status Codes:

S = Satisfactory * = Refer to Form B (Specials)
D = Deficient and/or Form C (Notes).

Are there any special conditions and/or maintenance requirements noted for BMP(s)? **Y** **N** (circle one)
If Yes, attach Form B for Project.

Drainage				
Drawdown - Drainage - Vector Risk - Pump Out-Blockage				
Reference code	D1	D2	D3	D4
BMP ID:	Evidence of standing or ponding of water in the BMP area after 72 hours of dry weather?	Does the high flow bypass function as designed?	Is there sediment accumulation in or around BMP?	Has water been observed flowing in the pervious concrete section during a low intensity storm?

Erosion						
Hydraulic Function - Failure - Sediment Clogging						
E1	E2	E3	E4	E5	E6	
Is there under cutting or washouts along the sidewalks and/or curbs abutting the planter area?	Is there channelization (gully) forming along the length of the planter area?	Is there accumulation of sediment (sand, dirt, mud) in the planter area?	Observed or potential transport of mulch to drainage system?	Are there voids or holes present in the BMP?	Is there evidence of animal activity?	

Vegetation				
Excessive Mowing - Herbicide Overuse - Health of Desired Vegetation -				
V1	V2	V3	V4	
Is the vegetation clogging the inlet or flow path?	Evidence of Excessive Mowing and/or Herbicide Overuse?	Are there dead or dry plants or excessive weeds?	Is there an absence of correct vegetation?	

General		Special Features	
Trash and Debris - Improper Modifications - Damage			
G1	G2	G4	S
Is there debris/trash accumulation in the BMP or high flow by pass?	Missing or damage structural features? (Grates, pipes, walls, curbs, etc.)	Evidence of improper modifications or removal of BMP?	See Additional Special Conditions or Form B

Office Use: _____
Complete: _____

Issues Corrective Action: _____

Re-Inspection Required: _____

Storm Water Quality Special Feature Maintenance Check List

Date: _____

Start Time: _____

Stop Time: _____

Inspector: _____

Project: _____

Address: _____

Inspection Status Codes:

S = Satisfactory

D = Deficient

* - See Notes on Form C

Special Feature or Conditions

[illegible]

Office Use:	
Complete:	
Issues Corrective Action:	Re-Inspection Required:

Form C

Inspector: _____

Project:

Address:

[illegible]

APPENDIX G

SUSMP EXHIBITS

CIVIL ENGINEERS • URBAN PLANNERS • LAND SURVEYORS • LANDSCAPE ARCHITECTS
15 Third Street, Santa Rosa, CA 95401
Tel: (707) 542-6451 Fax: (707) 542-5212



0 10 20
SCALE
1" = 30'

PRELIMINARY
EXISTING IMPERVIOUS + STORMWATER DETENTION

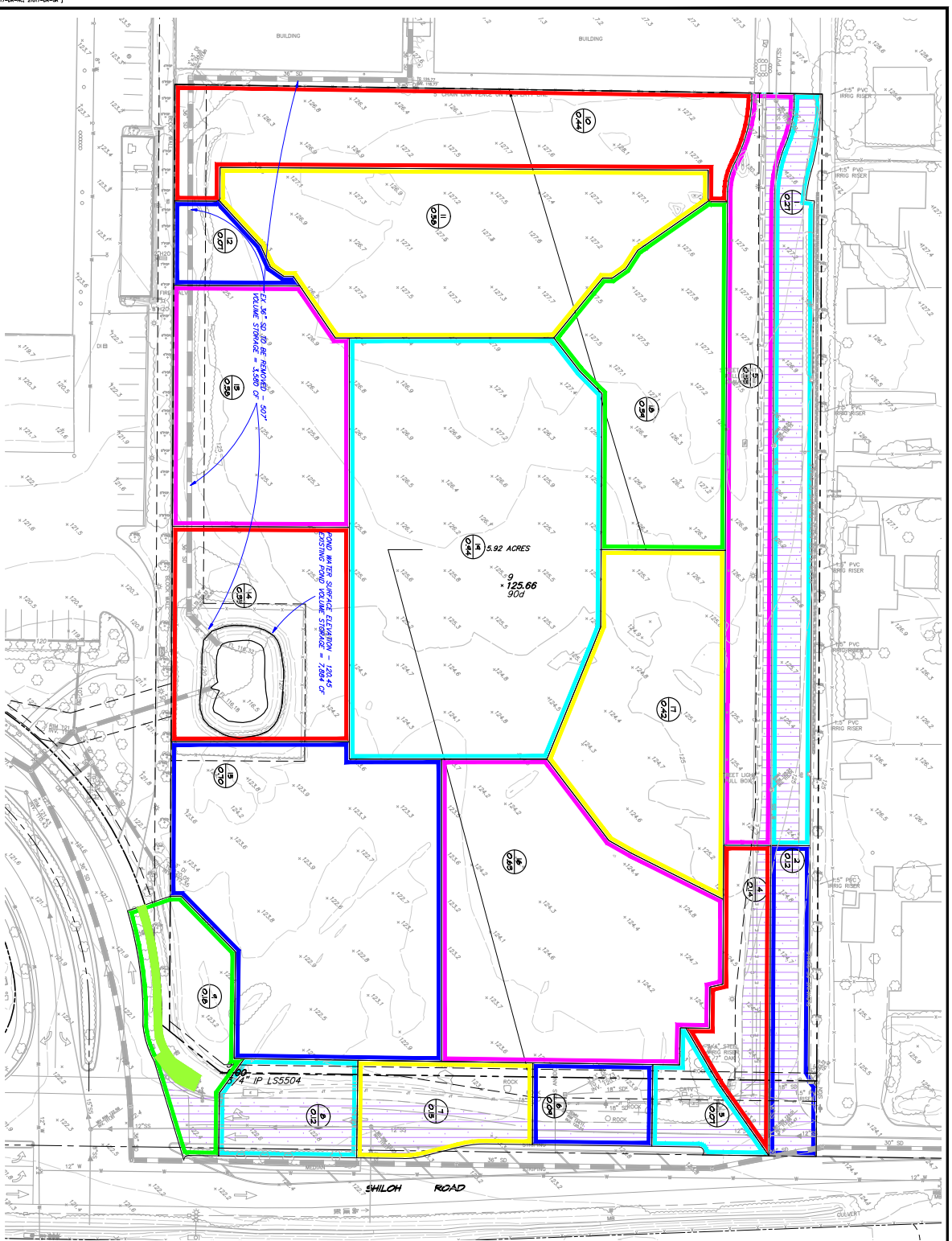
SHILOH CROSSING

WINDSOR, CALIFORNIA

JUNE 2021

PROJECT NO. 202001262

SHEET 2 OF 2
Copyright © 2021, Alan Furea



LEGEND

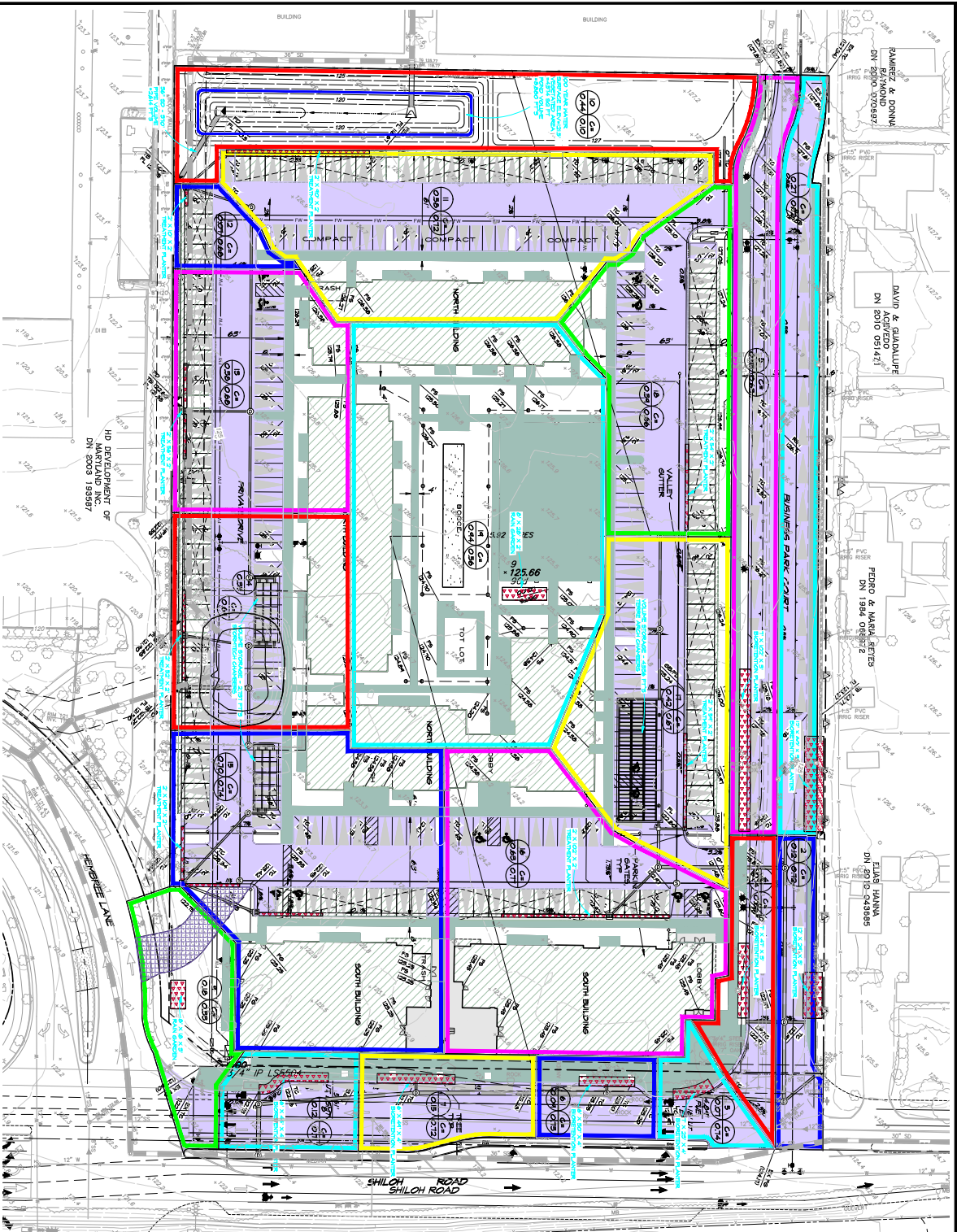
- CONCRETE - 0.00 AC
- ROOFTOP - 0.00 AC
- ASPHALT - 0.04 AC
- GRAVEL - 0.00 AC

TRIBUTARY AREA TRB AREA

EXISTING IMPERVIOUS SURFACE ONSITE - 0.04 AC
TOTAL SITE - 6.96 AC

IMPERVIOUSNESS BEFORE CONSTRUCTION - 10%

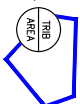
TOTAL EXISTING STORMWATER DETENTION VOLUME -
11,464 CF



LEGEND

CONCRETE	- 0.88 AC
ROOFTOP	- 172 AC
ASPHALT	- 230 AC
GRASS PAVE	- 0.04 AC

TRIBUTARY AREA



EXISTING IMPERVIOUS SURFACE ONSITE	- 0.64 AC
PROPOSED IMPERVIOUS SURFACE ONSITE	- 4.83 AC
TOTAL SITE AREA	- 6.36 AC
IMPERVIOUSNESS BEFORE CONSTRUCTION	- 6.5%
IMPERVIOUSNESS AFTER CONSTRUCTION	- 77.5%
TOTAL PROPOSED STORMWATER DETENTION	
VOLUME EX POND - 7,884 CF	
VOLUME EX 36" SD - 5,580 CF	
VOLUME PROPOSED POND - 8,880 CF	
VOLUME PROPOSED 36" SD - 2,614 CF	
VOLUME PROJECT WEST - 2,737 CF	
VOLUME PROJECT EAST - 4,636 CF	
TOTAL SITE DETENTION	- 7,273 CF

PRELIMINARY
STORMWATER DETENTION AND TREATMENT BMP'S

SHILOAH CROSSING

WINDSOR, CALIFORNIA

JUNE 2021

PROJECT NO. 202000020

SHEET 2 OF 2
DRAWN BY: J. L. L. L.

CIVIL ENGINEERS • URBAN PLANNERS • LAND SURVEYORS • LANDSCAPE ARCHITECTS

15 Third Street, Santa Rosa, CA 95401
Tel: (707) 542-6451 Fax: (707) 542-5212



APPENDIX H

100 YEAR STORMWATER DETENTION

Shiloh Crossing
 295 Shiloh Road, Windsor, CA 95492
 APN: 163-171-039

Surface Type	Roof	Asphalt	Concrete	Landscape
C-Value	0.90	0.90	0.90	0.40

Drainage Area	Roof <i>ft²</i>	Asphalt <i>ft²</i>	Concrete <i>ft²</i>	Landscape <i>ft²</i>	Total Area <i>ft²</i> <i>ac</i>		Composite C-Value
West	37,439	34,867	5,401	29,670	107,377	2.47	0.76
East	38,322	61,943	31,713	36,826	168,805	3.88	0.79
Total Site	75,761	96,810	37,114	66,496	276,181	6.34	0.78
	1.74	2.22	0.85	1.53	6.34		

4.81

Shiloh Crossing
295 Shiloh Road, Windsor, CA 95492
APN: 163-171-039

100-year Storm Detention Requirements: Proposed - Undeveloped
Project West

<u>Existing Conditions</u>	<u>Developed Conditions</u>
T _{C, pre} : 15 min C _{pre} : 0.35	T _{C, post} : 7 min Overall C_{post} : 0.76

Tributary Area : 2.47 acres

Storm Duration (min)	100-year Intensity X K (in/hr)	Design Release Rate, Q_{pre} (cfs)	Developed Peak Runoff Rate, Q_{post} (cfs)	Detention Rate to Storage (cfs)	Detention Volume (ft ³)
3.0	6.64	5.74	12.50	10.05	1,808
3.5	6.12	5.29	11.52	9.07	1,904
4.0	5.70	4.93	10.73	8.28	1,988
4.5	5.36	4.63	10.08	7.63	2,061
5.0	5.07	4.38	9.54	7.09	2,126
5.5	4.82	4.17	9.07	6.62	2,184
5.7	4.73	4.09	8.90	6.45	2,205
6.0	4.60	3.98	8.66	6.21	2,236
6.5	4.41	3.81	8.30	5.85	2,282
7.0	4.24	3.67	7.98	5.53	2,324
7.5	4.09	3.54	7.70	5.25	2,361
8.0	3.95	3.42	7.44	4.99	2,394
8.5	3.83	3.31	7.20	4.75	2,424
9.0	3.71	3.21	6.99	4.54	2,451
9.5	3.61	3.12	6.79	4.34	2,475
10.0	3.51	3.04	6.61	4.16	2,496
10.5	3.42	2.96	6.44	3.99	2,514
11.0	3.34	2.89	6.29	3.83	2,531
11.5	3.26	2.82	6.14	3.69	2,545
12.0	3.19	2.76	6.00	3.55	2,557
12.5	3.12	2.70	5.87	3.42	2,568
13.0	3.06	2.64	5.75	3.30	2,576
13.5	3.00	2.59	5.64	3.19	2,583
14.0	2.94	2.54	5.53	3.08	2,589
14.5	2.89	2.49	5.43	2.98	2,593
15.0	2.83	2.45	5.33	2.88	2,595
15.5	2.79	2.41	5.24	2.79	2,596
16.0	2.74	2.37	5.16	2.70	2,596
16.5	2.70	2.33	5.07	2.62	2,595
17.0	2.65	2.29	4.99	2.54	2,593
17.5	2.61	2.26	4.92	2.47	2,589
18.0	2.57	2.23	4.84	2.39	2,585
18.5	2.54	2.19	4.77	2.32	2,579
19.0	2.50	2.16	4.71	2.26	2,572
19.5	2.47	2.13	4.64	2.19	2,565
20.0	2.43	2.10	4.58	2.13	2,557

Notes:

- 1) $Q = C\text{-Value} \times \text{Intensity} \times \text{Tributary Area}$
- 2) Use design release rate of 3.61 cfs in correspondance with existing flow at time of concentration of 15 minutes
- 3) "Detention Rate to Storage" = "Developed Peak Runoff Rate" - "Design Release Rate"

Shiloh Crossing
295 Shiloh Road, Windsor, CA 95492
APN: 163-171-039

West

Contech Chamber Maxx

# columns	3
# rows	6
volume/chamber - middle	47.2 ft^3
volume/chamber - start	50.2 ft^3
volume/chamber - end	46.2 ft^3
in/outlet manifold volume	ft^3
Total chamber volume	1,428 ft^3

Detention Basin Dimensions

Basin footprint area	1,333 ft^2	
Stone depth	3.53 ft	
Backfill volume	4,700 ft^3	*40% porosity
Basin Storage Volume	1,309 ft^3	=(Backfill volume - Chamber volume)*40%

Total Detention Volume

Total Detention Volume	2,737 ft^3	=Total Chamber Volume + Basin storage volume
------------------------	--------------	--

Required Detention Volume	2,596 ft^3
---------------------------	--------------

Design Elevations

Finished grade above chamber	125.73 ft	
Inlet invert	116.41 ft	
Stone cover	6 in	4" minimum
Stone bedding depth	6 in	
Cover over top of stone	6.30 ft	8" Minimum
Top of stone fill	119.44 ft	=Weir elevation
Top of chamber	118.94 ft	
Bottom of chamber	116.41 ft	
Bottom of stone bed	115.91 ft	
Stone depth	3.53 ft	

Shiloh Crossing
295 Shiloh Road, Windsor, CA 95492
APN: 163-171-039

100-year Storm Detention Requirements: Proposed - Undeveloped

EAST

Existing Conditions

$T_{C, \text{pre}}$: 15 min
 C_{pre} : 0.35

Developed Conditions

$T_{C, \text{post}}$: 7 min
Overall C_{post} : 0.79

Tributary Area : 3.88 acres

Storm Duration (min)	100-year Intensity X K (in/hr)	Design Release Rate, Q_{pre} (cfs)	Developed Peak Runoff Rate, Q_{post} (cfs)	Detention Rate to Storage (cfs)	Detention Volume (ft ³)
3.0	6.64	9.02	20.38	16.53	2,976
3.5	6.12	8.31	18.78	14.94	3,136
4.0	5.70	7.75	17.50	13.65	3,277
4.5	5.36	7.28	16.45	12.60	3,401
5.0	5.07	6.88	15.55	11.71	3,512
5.5	4.82	6.54	14.79	10.94	3,610
5.7	4.73	6.42	14.51	10.66	3,647
6.0	4.60	6.25	14.12	10.28	3,699
6.5	4.41	5.99	13.54	9.69	3,779
7.0	4.24	5.76	13.02	9.17	3,851
7.5	4.09	5.55	12.55	8.70	3,916
8.0	3.95	5.37	12.13	8.28	3,975
8.5	3.83	5.20	11.75	7.90	4,028
9.0	3.71	5.04	11.40	7.55	4,076
9.5	3.61	4.90	11.08	7.23	4,119
10.0	3.51	4.77	10.78	6.93	4,158
10.5	3.42	4.65	10.51	6.66	4,193
11.0	3.34	4.54	10.25	6.40	4,224
11.5	3.26	4.43	10.01	6.16	4,252
12.0	3.19	4.33	9.79	5.94	4,276
12.5	3.12	4.24	9.58	5.73	4,298
13.0	3.06	4.15	9.38	5.53	4,316
13.5	3.00	4.07	9.20	5.35	4,332
14.0	2.94	3.99	9.02	5.17	4,345
14.5	2.89	3.92	8.86	5.01	4,356
15.0	2.83	3.85	8.70	4.85	4,365
15.5	2.79	3.78	8.55	4.70	4,371
16.0	2.74	3.72	8.41	4.56	4,375
16.5	2.70	3.66	8.27	4.42	4,378
17.0	2.65	3.60	8.14	4.29	4,378
17.5	2.61	3.55	8.02	4.17	4,377
18.0	2.57	3.50	7.90	4.05	4,374
18.5	2.54	3.45	7.79	3.94	4,369
19.0	2.50	3.40	7.68	3.83	4,363
19.5	2.47	3.35	7.57	3.72	4,355
20.0	2.43	3.31	7.47	3.62	4,346

Notes:

- 1) $Q = C\text{-Value} \times \text{Intensity} \times \text{Tributary Area}$
- 2) Use design release rate of 2.96 cfs in correspondance with existing flow at time of concentration of 15 minutes
- 3) "Detention Rate to Storage" = "Developed Peak Runoff Rate" - "Design Release Rate"

Shiloh Crossing
295 Shiloh Road, Windsor, CA 95492
APN: 163-171-039

East

Contech Terre Arch 26

# chambers	12	
volume/chamber	319.0	<i>ft</i> ³
distribution manifold volume	93	<i>ft</i> ³
Total chamber volume	4,200	<i>ft</i> ³

Stone Edge

Footprint area	210	<i>ft</i> ²	
Stone depth	4.00	<i>ft</i>	
Edge volume	336	<i>ft</i> ³	*40% porosity

Total Detention Volume

Total Detention Volume	4,536	<i>ft</i> ³	=Total Chamber Volume + Edge Volume
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Required Detention Volume	4,378	<i>ft</i> ³
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Design Elevations

Finished grade above chamber	123.00	<i>ft</i>	
Inlet invert	118.33	<i>ft</i>	
Stone cover	4	<i>in</i>	4" minimum
Stone bedding depth	8	<i>in</i>	
Cover over top of stone	2.50	<i>ft</i>	8" Minimum
Min FG over chamber	120.83	<i>ft</i>	
Top of stone fill	120.50	<i>ft</i>	=Weir elevation
Top of chamber	120.00	<i>ft</i>	
Bottom of chamber	117.16	<i>ft</i>	
Bottom of stone bed	116.50	<i>ft</i>	
Stone depth	4.00	<i>ft</i>	

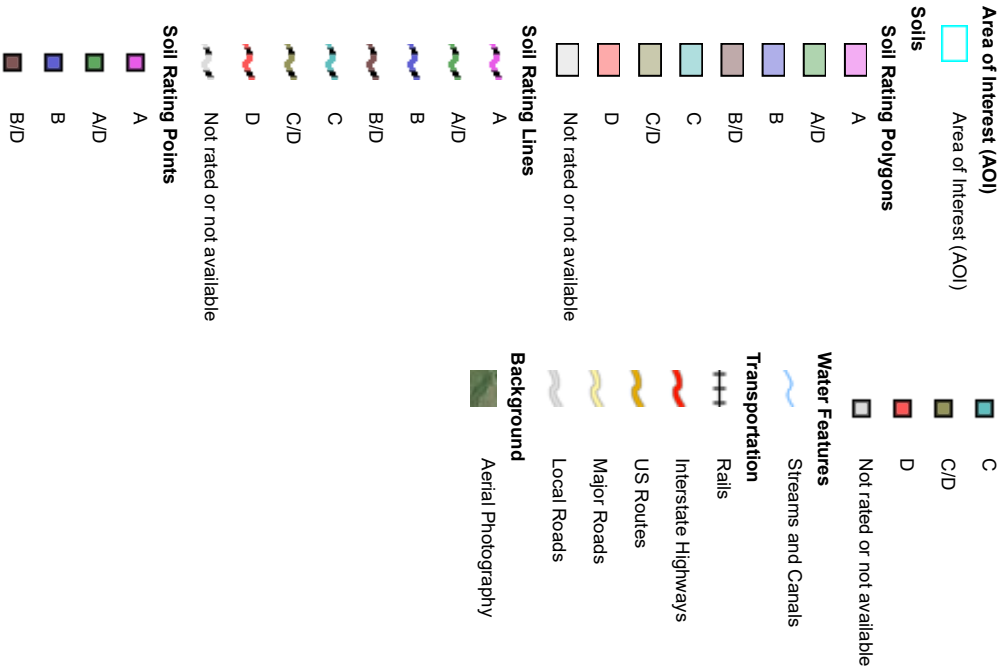
APPENDIX I

SOIL TYPE

Hydrologic Soil Group—Sonoma County, California



MAP LEGEND



MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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

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

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

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

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

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

Soil Survey Area: Sonoma County, California
Survey Area Data: Version 12, Sep 13, 2018

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

Date(s) aerial images were photographed: Jul 1, 2018—Jul 31, 2018

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
CeA	Clear Lake clay, sandy substratum, drained, 0 to 2 percent slopes, MLRA 14	D	0.7	6.8%
HtA	Huichica loam, 0 to 2 percent slopes	C	7.8	76.1%
HwB	Huichica loam, shallow, ponded, 0 to 5 percent slopes	D	1.8	17.1%
Totals for Area of Interest			10.3	100.0%

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher



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Whether you are in a high risk zone or not, you may need [flood insurance \(https://www.fema.gov/national-flood-insurance-program\)](https://www.fema.gov/national-flood-insurance-program) because most homeowners insurance doesn't cover flood damage. If you live in an area with low or moderate flood risk, you are 5 times more likely to experience flood than a fire in your home over the next 30 years. For many, a National Flood Insurance Program's flood insurance policy could cost less than \$400 per year. Call your insurance agent today and protect what you've built.

Learn more about [steps you can take \(https://www.fema.gov/what-mitigation\)](https://www.fema.gov/what-mitigation) to reduce flood risk damage.

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Show ALL Products » (<https://msc.fema.gov/portal/availabilitySearch?addcommunity=060761&communityName=WINDSOR>)

The flood map for the selected area is number **06097C0568E**, effective on **12/02/2008** ?

DYNAMIC MAP



MAP IMAGE



([https://msc.fema.gov/portal/downloadProduct?](https://msc.fema.gov/portal/downloadProduct?filepath=/06/P/Firm/06097C0568E.png&productTypeID=FINAL_PRODUCT&productSubTypeID=FIRM_PANEL)

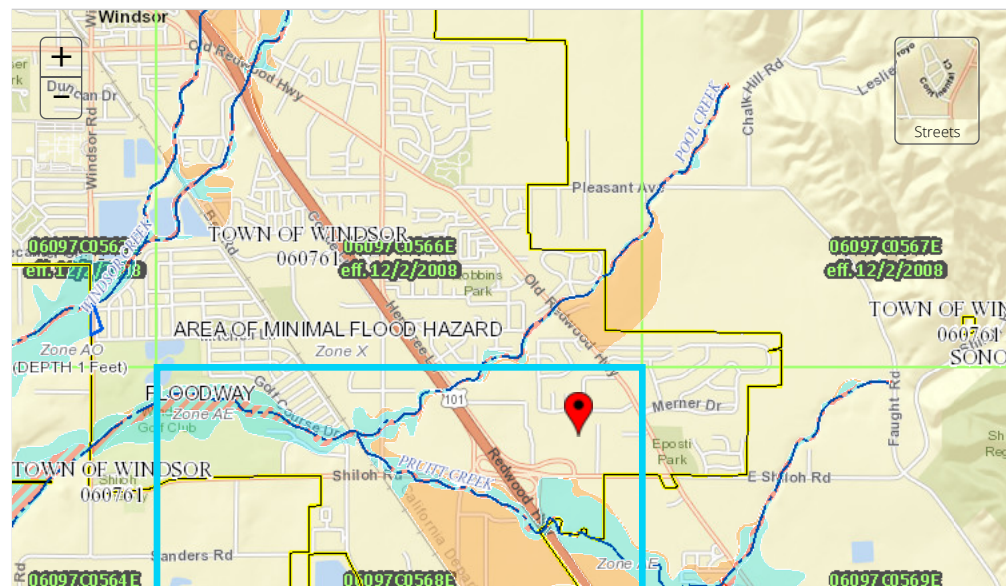
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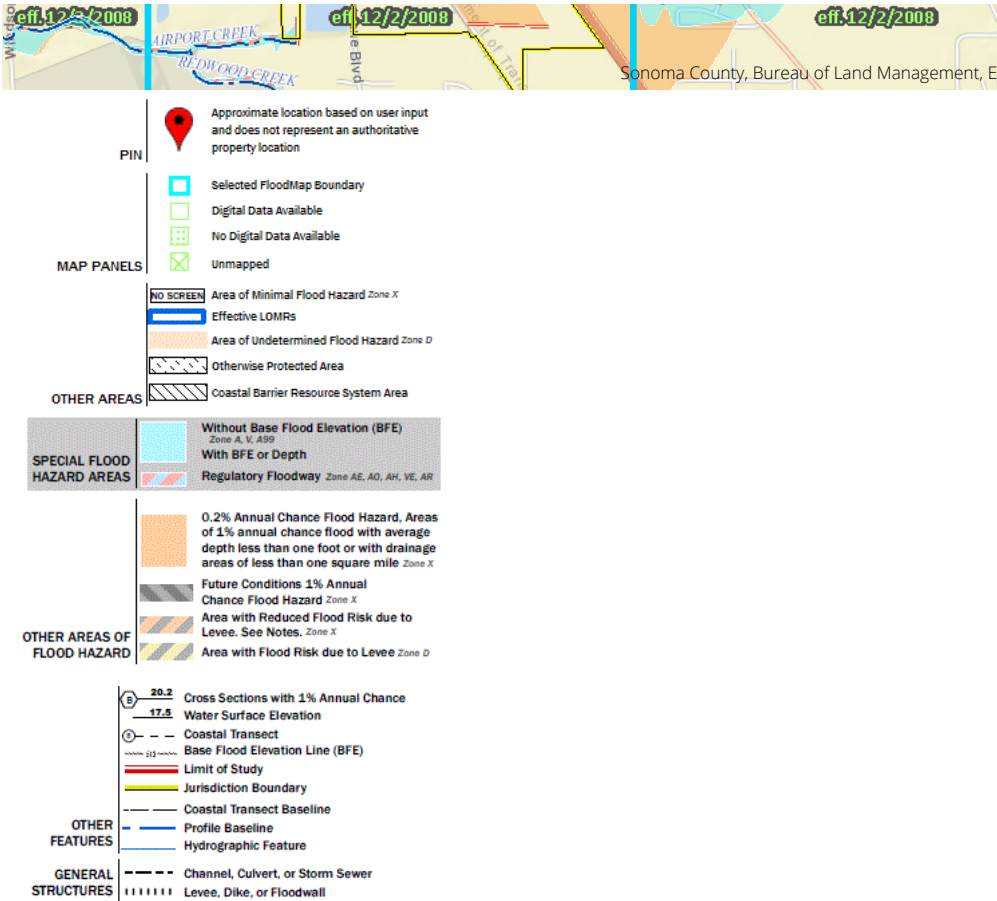
Changes to this FIRM ?


Revisions (0)
Amendments (4)
Revalidations (2)

You can choose a new flood map or move the location pin by selecting a different location on the locator map below or by entering a new location in the search field above. It may take a minute or more during peak hours to generate a dynamic FIRMette.

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