Mountain Meadows Gas Station
Drainage Study

26743 Mountain Meadow Rd.
Escondido, CA 92026
PDS2017-STP-17-028; PDS2017-BC-17-0069

Date Prepared:
August 13, 2019

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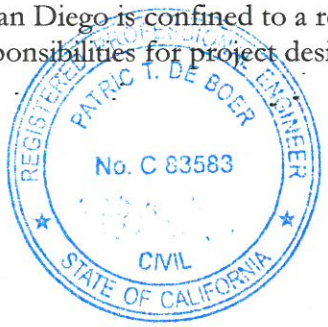
Declaration of Responsible Charge:
I hereby declare that I am the engineer of work for this project, that I have exercised responsible charge over the design of the project as defined in section 6703 of the business and professions code, and that the design is consistent with current standards. I understand that the check of the project drawings and specifications by the County of San Diego is confined to a review only and does not relieve me, as an engineer of work, of my responsibilities for project design.



Patric T. de Boer RCE 83583
Registration Expires 3-31-2021

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Appendices

Site & Project Description

This drainage study has been prepared for the redevelopment of the lot at 26743 Mountain Meadow Rd. The site is adjacent to the Interstate 15 at the intersection of Deer Springs Road & N. Center City Parkway.

The project will involve the demolition of an existing patio furniture business that currently covers the majority of the 1.61 acre site, and the construction of a retail fueling station. The proposed facility will be located on the north portion of the property, while the southerly portion will be used for a septic leech field. This analysis includes a portion of offsite tributary area. The total area of analysis is 1.74 acres.

The proposed construction will include 8 fuel pumps located under a fueling island canopy, and a convenience store with parking stalls. The proposed facility will be built with a private storm drain system including treatment BMPs. A biofiltration facility will be constructed for storm water treatment, as well as storage for flow attenuation. The 100-year flow attenuation aspect of this facility is detailed in the storage calculations section of this report. The treatment and hydromodification properties of the facility are detailed in the SWQMP report.

Methodology

This drainage report has been prepared in accordance with current county regulations and procedures. The Modified Rational Method was used to determine the peak flowrates generated by the existing and proposed site conditions. The flowrates generated by sub-basins were confluenced according to the junction equations as detailed on page 3-24 of the San Diego County Hydrology Manual.

The proposed storm drain pipes and channels were sized using Manning's Equation as specified for circular and trapezoidal channels on page 7-78 & 7-18 of *The Handbook of Hydraulics,* by Brater & King. The capacity of the inlets was determined using Autodesk's Hydraflow Express, a hydraulic modeling extension of AutoCad. Ponding analysis for storm water detention was performed using SWMM 5.1, with an input hydrograph generated by RatHydro, from Rick Engineering.

See the attached calculations for particulars. The following references have been used in preparation of this report:

(1) Handbook of Hydraulics, E.F. Brater & H.W. King, 6th Ed., 1976.
(2) County of San Diego Hydrology Manual, 2003

Existing Conditions

The existing site is the location of a patio furniture supply business. Ground cover consists of landscaping, bare dirt, concrete walkways and a single permanent structure at the northeast corner. There is no known onsite storm drain system. Runoff flows from the northeast corner of the site via surface flow to the southern tip of the site where it flows over the property line and into an

offsite concrete drainage ditch. The existing site slopes at an average of 5% and is underlain by type 'D' Soil.

Project receives runoff from a narrow offsite area between the easterly property line and the westerly right of way of N. Center City Parkway. The project is not located within a 100-year flood hazard zone according to FEMA Firm panel 0803G. The project is not located in an area that would expose people or structures to significant risk of loss, injury, or death involving flooding as a result of the failure of a levee or dam. See Existing Hydrology Exhibit for details.

Proposed Conditions

In the proposed conditions, the gas station and convenience store will be located on the north half of the project site. The south half will be cleared of all the existing paving and improvements, this area will be used for the septic system leech fields.

Runoff from the proposed gas station and surrounding improvements will be collected by a private storm drain system and conveyed to a brow ditch that runs to the south end of the project site and outlets to a rip-rap pad. From there, storm water will flow across the property line to enter the offsite concrete drainage ditch at the same location as in the existing conditions.

The surface of the covered fueling area will be hydraulically isolated from the storm drain system. This area will drain to a sand/oil separator and then to the septic system.

The majority of the proposed improvements will drain to a biofiltration BMP. This BMP is used to treat runoff and also to attenuate the anticipated increase in 100-year flowrates through storage and controlled release via an outlet control orifice and restricting weir.

Existing Rational Analysis

The existing area of site was modeled as a single basin, containing all onsite areas as well as the offsite areas that drain onto the site. This area, referred to in this report as E-1 slopes at an average of 3.5%. E-1 is 40% impervious, with a weighted C value of 0.57. The C-value was determined by taking the area weighted average of a value of 0.35 for natural D type soil, and 0.9 for impervious surfaces. See table 3-1 of the county hydrology manual, included as Appendix 5 of this report.

The initial time of concentration (Ti) and maximum overland flow length (Lm) were determined using Table 3-2 of the Hydrology Manual. A Ti of 5.7 mins and Lm value of 100 ft were chosen. This corresponds to medium density residential land use at 5% slope. These values are used rather than commercial values because the surface conditions are more similar to residential land use than a commercial use. The upper end of E-1 which contains the initial area contains steeper slopes between 5-10%.

The 100-yr, 6-hr storm depth (P_6) was determined using the isopluvial map included as Appendix 2 of this report.

The total time of concentration was determined by adding the Ti value to the travel time (Tt). Tt was determined via the Kirpich Formula as described in Figure 3-4 of the county hydrology manual.

$$\mathbf{Tc = Ti+Tt}$$
$$\mathbf{Tc = 5.7\ mins + 2.3\ mins}$$
$$\mathbf{Tc = 8.0\ mins}$$

The Tc and the P_6 values were entered into the peak intensity formula from page 3-7 of the hydrology manual to determine the intensity of the rainfall during the peak of the 100-year, 6-hr storm.

$$\mathbf{I = 7.44 \times P_6 \times Tc^{-0.645}}$$
$$\mathbf{I = 7.44 \times 3.6 \times 8.0^{-0.645}}$$
$$\mathbf{I = 6.98\ inches\ per\ minute}$$

The peak discharge rate was determine using the Rational Method Formula.

$$\mathbf{Q = C \times I \times A}$$

Below is a summary of the input data and the resulting flowrates for the 100-year, 6- hour storm.

Existing Rational Calculation Summary

Basin	Impervious %	C	I_{100} (in/hr)	Area (ac)	Q_{100} (cfs)
E-1	40.3%	0.57	6.98	1.74	6.94
-	-	-	-	-	-

The total peak runoff flowrate generated by the existing site is 6.94 cfs

Proposed Rational Analysis

The proposed site was modeled as 4 separate basins, containing all the onsite areas, as well as the offsite area that previously drained to the site. The proposed basins are referred to as P-1 through P-4 in this report. The average slopes of the basins varies from 1% to 8%. Weighted runoff coefficients vary from 0.37 to 0.87.

The initial time of concentration (Ti) and maximum overland flow length (Lm) were determined using Table 3-2 of the Hydrology Manual. Basins P-1 and P-3 use the Ti and Lm values associated with General Industrial at 1% slope. Basin P-2 uses the values associated with natural terrain at 10% slope. Basin P-4 uses the values associated with natural land at 3%.

The total time of concentration was determine by adding the Ti value to the travel time (Tt). Tt was determined for basin P-4 using the Kirpich Formula. The Tt for all other basins was found to be less than 0.5 minutes. As a conservative measure, these values were rounded down to 0 minutes travel time.

The time of concentration, peak intensity and the peak flowrate were determined using the same formulas and methods as in the existing conditions.

Below is a summary of the input data and resulting flowrates generated by each basin for the 100-year, 6-hr storm.

Proposed Rational Calculation Summary

Basin	Impervious %	C	I_{100} (in/hr)	Area (ac)	Unmitigated Q_{100} (cfs)	Mitigated Q_{100} (cfs)
P-1	94.7%	0.53	9.49	0.53	4.34	3.88*
P-2	0.0%	0.22	7.71	0.23	0.61	-
P-3	69.4%	0.29	9.49	0.29	1.98	-
P-4	4.4%	0.71	5.22	0.71	1.36	-

* The mitigated flow rate was determined as detailed in the 'Storage Calculations' section of this report

The peak flowrates determined for each basin were confluenced according to the junction equations from page 3-24 of the San Diego County Hydrology Manual.

Junction Equations:

$$T_1 < T_2 < T_3$$

$$Q_{T1} = Q_1 + \frac{T_1}{T_2} Q_2$$

$$Q_{T2} = Q_2 + \frac{I_1}{I_2} Q_1$$

Proposed Flow Junction Calculation Summary

Confluence Pt.	Tributary Flows	I_{100} (in/hr)	Tc (mins)	Q_{100} (cfs)	Confluenced Flow (cfs)
CP-1	P-1	9.49	5.0	3.88	4.37
	P-2	7.71	6.9	0.61	
CP-2	CP-1	9.49	5.0	4.37	6.35
	P-3	9.49	5.0	1.98	
CP-3	CP-2	5.0	5.0	6.35	6.89
	P-4	5.22	12.6	1.36	

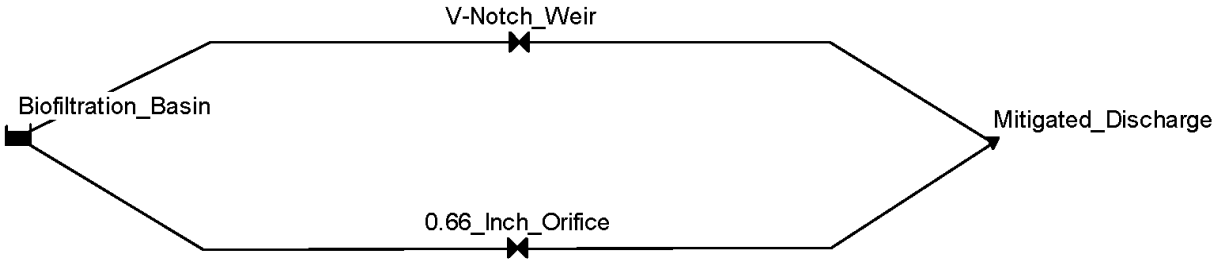
The confluenced peak runoff flowrate for the entire area of analysis is 6.89 cfs. This includes the mitigated flow from Basin P-1. See the attached calculations for details.

Storage Calculations

The excess volume generated by the 100-year storm is detained in the proposed biofiltration basin. To calculate the required storage volume, a hydrograph of the runoff produced by Basin P-1 was required. RatHydro, a hydrograph generating program was used to produce one. RatHydro uses the input and output data determined in the Rational Method calculations, and produces a hydrograph time series with a matching peak flowrate.

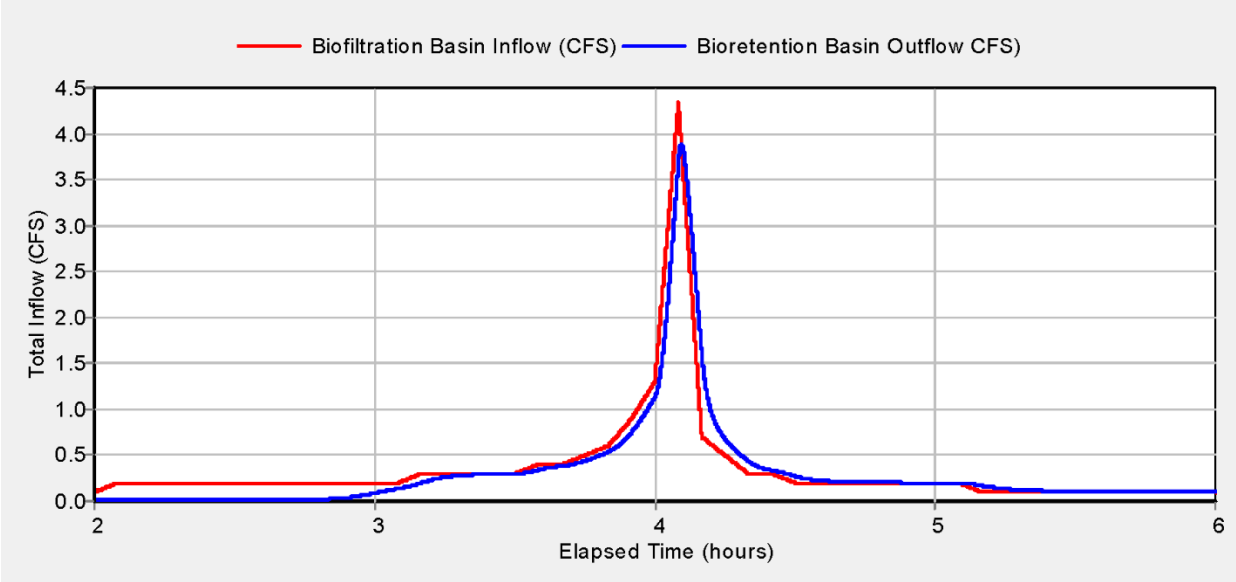
This hydrograph was input manually into SWMM 5.1 as a time series. The hydrograph time series was then routed through a modeled detention node with a low flow orifice and overflow weir.

Schematic of SWMM model



The biofiltration basin has V-notch weir 9" above the finished surface of the facility and a 0.66" low flow orifice on the perforated sub-drain in a subsurface gravel layer. The required storage volume is 1,650 cf when water is ponded to the 100-year stage.

Inflow vs. Outflow Hydrograph



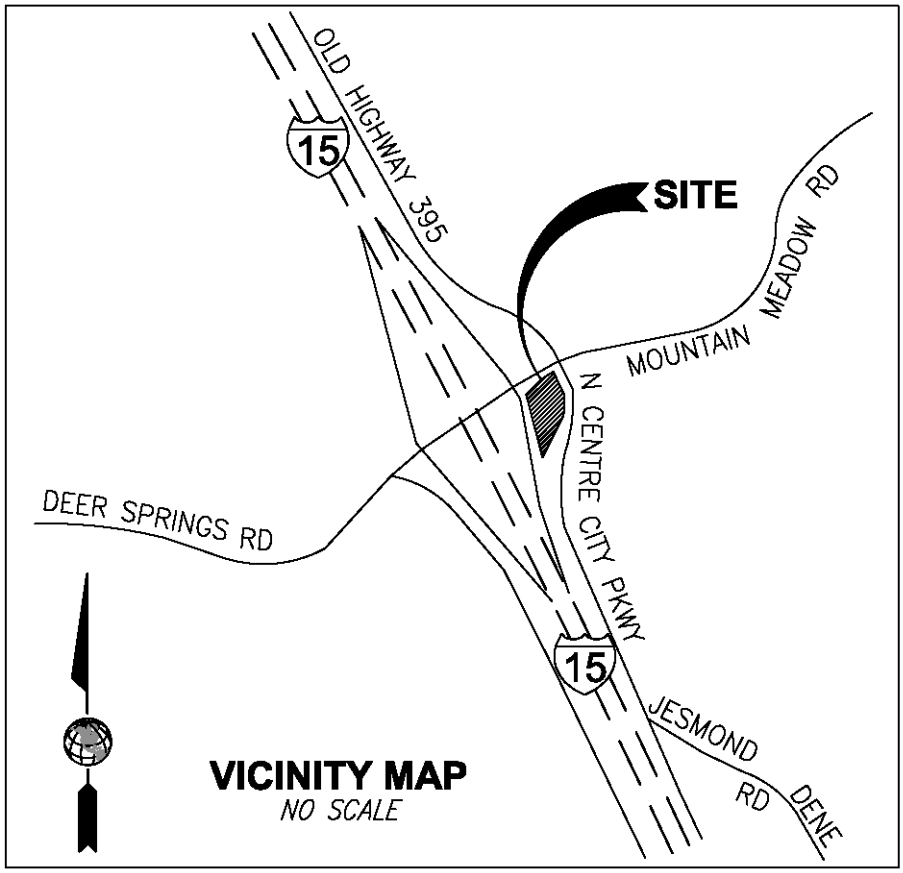
The peak mitigated outflow, represented in the chart above by the peak of the blue line, is 3.88 cfs vs the peak inflow of 4.34 cfs. This is a reduction in 0.46 cfs for the peak flow generated by basin P-1 vs the peak flow that is actually discharged from basin P-1.

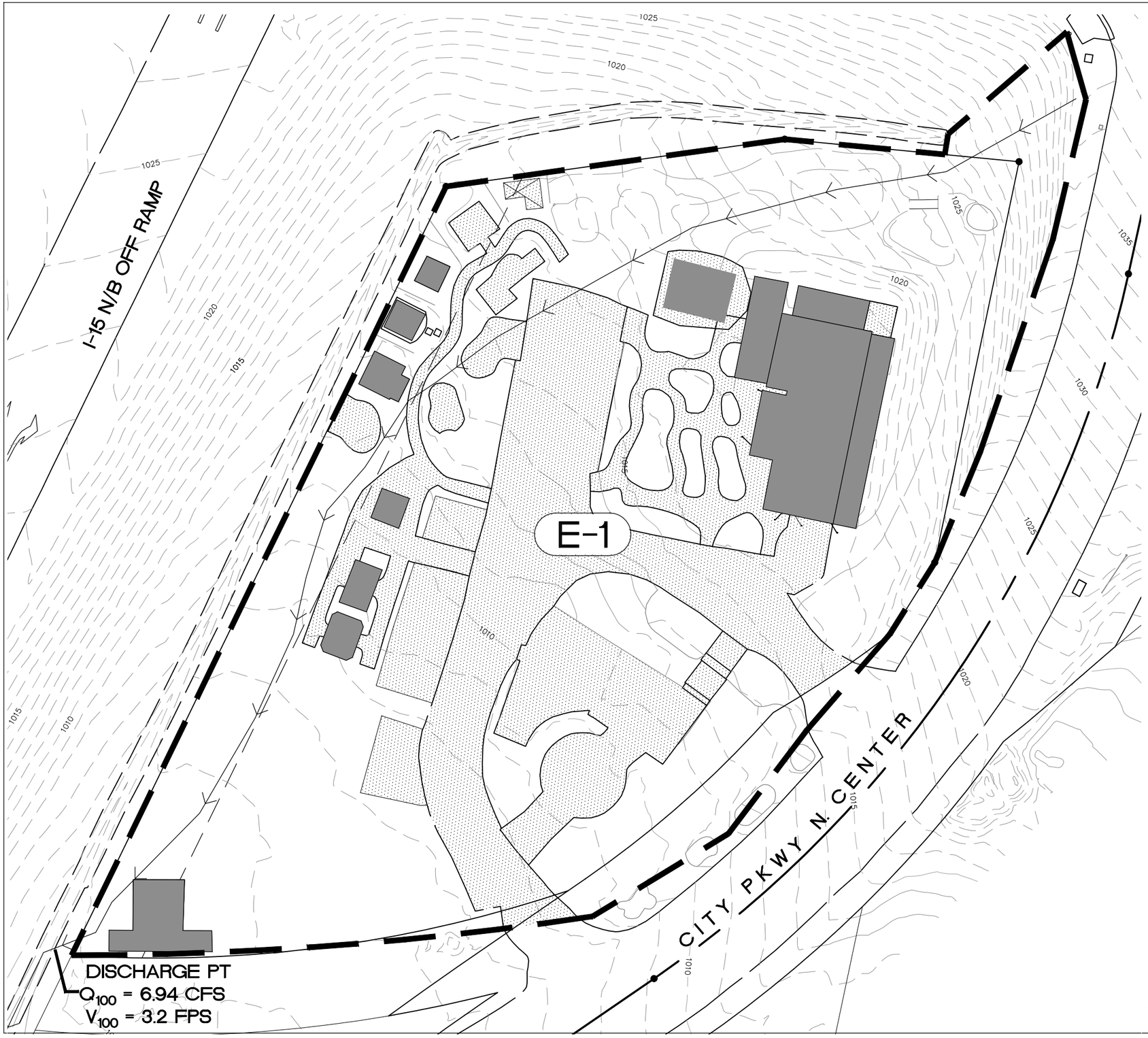
This attenuated value was entered back into the Rational Calculation worksheet and confluenced with flow from the rest of the site to determine the total mitigated peak discharge rate produced by the entire site. More details regarding the SWMM analysis can be found in the appendix of this report, including the SWMM input file.

Results and Conclusions

The redevelopment of the project site will modify the onsite drainage patterns but the discharge point location will remain unchanged. The proposed improvements result in an increase in generated runoff during the peak of the 100-year, 6-hr storm. This increase will be mitigated through storage in the proposed biofiltration basin and controlled release via an outlet control structure. The result is a peak storm water flowrate that is less than the existing conditions by 0.05 cfs.

It is the opinion of Omega Engineering Consultants that the project will not cause adverse effects to the downstream facilities or receiving waters as a result of increased peak flowrate during the 100-yr, 6-hr storm. A separate Storm Water Quality Management Plan has been prepared to discuss the water quality impacts for the proposed development.


OLD HIGHWAY 395
15
SITE
MOUNTAIN MEADOW RD
N CENTRE CITY PKWY
DEER SPRINGS RD
15
JESMOND DENE RD
VICINITY MAP
NO SCALE



LEGEND

- BASIN NUMBER — E-#.#
- AREA LIMITS
- DRAINAGE FLOW PATH
- BUILDING AREA
- PAVEMENT AREA
- PERVIOUS AREA
- PERVIOUS PAVERS

DRAINAGE BASIN DATA

BASIN #	AREA (AC)	C-VALUE	T_C (MINS)	I_{100} (IN/HR)	Q_{100} (CFS)
E-1	1.74	0.57	8.0	6.98	6.94
–	–	–	–	–	–

MOUNTAIN MEADOWS GAS STATION EXISTING HYDROLOGY

GRAPHICAL SCALE: 1" = 40'

0 20 40 80

OMEGA

EX. HYDROLOGY EXHIBIT

LEGEND

- BASIN NUMBER ..... P-#
- AREA LIMITS .....
- DRAINAGE FLOW PATH .....
- BUILDING AREA .....
- PAVEMENT AREA .....
- PERVIOUS AREA .....

DRAINAGE BASIN DATA

BASIN #	AREA (AC)	C-VALUE	T_C (MINS)	I_{100} (IN/HR)	Q_{100} (CFS)
P-1	0.53	0.87	5.0	9.49	3.88
P-2	0.23	0.35	6.9	7.71	0.61
P-3	0.29	0.73	5.0	9.49	1.98
P-4	0.71	0.37	12.6	5.22	1.36

DRAINAGE CONVEYANCES

(X)	CONVEYANCE DESCRIPTION	DEPTH/ DIAMETER	Q_{100} (CFS)	V_{100} (FPS)
#1	8" DIA. PIPE @ 1% MIN	0.77	1.24	4.30
#2	12" DIA. PIPE @ 2% MIN	0.67	4.37	7.82
#3	12" DIA. PIPE @ 6% MIN	0.60	6.35	12.91
#4	8" DIA. PIPE @ 2% MIN	0.65	1.42	5.92
#5	8" DIA. PIPE @ 2% MIN	0.90	1.98	5.98
#6	24" BROWDITCH @ 3% MIN	0.09	0.61	4.36
#7	24" BROWDITCH @ 3% MIN	0.28	6.35	8.82

STORM DRAIN INLETS

◇1	INLET DESCRIPTION	Q_{100} (CFS)
#1	10' LONG 2" WIDE DRAIN	3.34
#2	42"W X 14"T V-WEIR	4.34

MOUNTAIN MEADOWS GAS STATION PROPOSED HYDROLOGY

OMEGA

PROP. HYDROLOGY EXHIBIT

MOUNTAIN MEADOWS GAS STATION
HYDROLOGY AND HYDRAULICS CALCS (Table No. 1)

3/14/2019

BASIN	AREA (SF)	AREA (AC)	% Imp	"C" Value
E-1	75,957	1.74	40.3%	0.57
EX. TOTAL	**75,957**	**1.74**		
A-1	22,922	0.53	94.7%	0.87
A-2	9,787	0.22	0.0%	0.30
A-3	12,461	0.29	69.4%	0.72
A-4	30,787	0.71	4.4%	0.33
PROP TOTAL	**75,957**	**1.74**		

Basin Confluence	Symbol
PROPOSED	
(A-1 & A-2)	CP-1
(CP-1 & A-3)	CP-2
(CP-2& A-4)	CP-3

(A) ECP # - Existing Confluence Point

(B) CP # - Proposed Confluence Point

(C) C value for bare ground is 0.35 (Table 3-1 County Hydrology Manual) (Type 'D' soil)

C value for impervious surfaces is 0.9

Basins with mixed surface type use a weighted average of these 2 values. (impervious % x 0.9)+(pervious % x 0.35)

MOUNTAIN MEADOWS GAS STATION 3/14/2019

HYDROLOGY AND HYDRAULICS CALCS (Table No. 2)

Sub-Basin	AREA Ac.	"C"	Overland flow length	Concentrated Flow Length, (ft)	S(%) (avg.)	Ti mins	Tt mins	T_c mins	I in/hr	Q cfs	Q tot cfs	NOTES 85TH
E-1	1.74	0.57	100.0	450.0	3.5%	5.7	2.34	8.0	0.20	0.20	0.20	
								Discharge Pt. 1			0.20	
P-1	0.53	0.87	60.0	130.0	1.0%	3.2	0.00	5.0	0.20	0.09	0.09	**Tt < 0.5 mins, rounded to 0**
P-2	0.23	0.35	100.0	170.0	8.0%	6.9	0.00	6.9	0.20	0.02	0.02	**Tt < 0.5 mins, rounded to 0**
								5.0	0.20		0.11	Confluence Pt.-1
P-3	0.29	0.73	60.0	90.0	1.0%	3.2	0.00	5.0	0.20	0.04	0.04	**Tt < 0.5 mins, rounded to 0**
								0.0	0.20		0.15	Confluence Pt. -2
P-4	0.71	0.37	100.0	470.0	4.0%	10.3	2.34	12.6	0.20	0.05	0.05	**Tt per Kirpich Formula**
								0.0	0.20		0.20	Confluence Pt.-3

MOUNTAIN MEADOWS GAS STATION 3/14/2019

HYDROLOGY AND HYDRAULICS CALCS (Table No. 4

Sub-Basin	AREA Ac.	"C"	Overland flow length	Concentrated Flow Length, (ft)	S(%) (avg.)	Ti mins	Tt mins	T_c mins	I in/hr	Q cfs	Q tot cfs	NOTES 100-year, 6 hr storm (mitigated)
												P(6) 3.6
E-1	1.74	0.57	100.0	450.0	3.5%	5.7	2.34	8.0	6.98	6.94	6.94	**T_t per Kirpich Formula**
										Existing Flow at Discharge Pt. 1	**6.94**	
P-1	0.53	0.87	60.0	130.0	1.0%	3.2	0.00	5.0	9.49	4.34	4.34	**Tt < 0.5 mins, rounded to 0**
P-2	0.23	0.35	100.0	170.0	8.0%	6.9	0.00	6.9	7.71	0.61	0.61	**Tt < 0.5 mins, rounded to 0**
								5.0	9.49		4.83	Confluence Pt. -1
P-3	0.29	0.73	60.0	90.0	1.0%	3.2	0.00	5.0	9.49	1.98	1.98	**Tt < 0.5 mins, rounded to 0**
								5.0	9.49		6.81	Confluence Pt.-2
P-4	0.71	0.37	100.0	470.0	4.0%	10.3	2.34	12.6	5.22	1.36	1.36	**Tt per Kirpich Formula**
								5.0	9.49		7.35	Confluence Pt.-3
										Proposed Flow at Discharge Pt. 1	**7.35**	

MOUNTAIN MEADOWS GAS STATION 3/14/2019

HYDROLOGY AND HYDRAULICS CALCS (Table No. 4

Sub-Basin	AREA Ac.	"C"	Overland flow length	Concentrated Flow Length, (ft)	S(%) (avg.)	Ti mins	Tt mins	T_c mins	I in/hr	Q cfs	Q tot cfs	NOTES 100-year, 6 hr storm (mitigated)
												P(6) 3.6
E-1	1.74	0.57	100.0	450.0	3.5%	5.7	2.34	8.0	6.98	6.94	6.94	**T_t per Kirpich Formula**
							Existing Flow at Discharge Pt. 1				**6.94**	
P-1	0.53	0.87	60.0	130.0	1.0%	3.2	0.00	5.0	9.49	4.34	3.88	**Tt < 0.5 mins, rounded to 0**
P-2	0.23	0.35	100.0	170.0	8.0%	6.9	0.00	6.9	7.71	0.61	0.61	**Tt < 0.5 mins, rounded to 0**
								5.0	9.49		4.37	Confluence Pt. -1
P-3	0.29	0.73	60.0	90.0	1.0%	3.2	0.00	5.0	9.49	1.98	1.98	**Tt < 0.5 mins, rounded to 0**
								5.0	9.49		6.35	Confluence Pt.-2
P-4	0.71	0.37	100.0	470.0	4.0%	10.3	2.34	12.6	5.22	1.36	1.36	**Tt per Kirpich Formula**
								5.0	9.49		6.89	Confluence Pt.-3
							Proposed Flow at Discharge Pt. 1				**6.89**	

CONDUIT SIZING CALCULATIONS

The following chart details the sizing parameters and for conduits that convey runoff on the site.
Flow parameters from *Handbook of Hydraulics, King & Brater* were used, see following page.

K'= Discharge factor	=	$(Q*n)/(d^{8/3}*s^{1/2})$
n= Mannings coefficient	=	0.011 for PVC & HDPE
d=diameter of conduit (ft)	=	per chart
Q= Discharge	=	based off portions of basins tributary to outlet
s=Minimum Pipe Slope (ft/ft)	=	per chart
D=depth of flow	=	From table 7-4 of the *Handbook of Hydraulics, King & Brater* See right
C_a= Flow factor	=	From table 7-14 of the *Handbook of Hydraulics, King & Brater* See right
A=Cross sectional area of flow	=	C_a*d^2
V=Velocity	=	Q/A

Pipe	Tributary Areas	Q (cfs)	S (%)	d (in)	K'	D/d	C_a	A (sf)	V (fps)
1	fueling area roof	1.24	1	8	0.4387	0.77	0.649	0.288	4.30
2	Basins P-1 & P-2	4.37	2	12	0.3708	0.67	0.559	0.559	7.82
3	Basins P-1, P-2 & P-3	6.35	6	12	0.3111	0.60	0.492	0.492	12.91
4	Portions of Basin P-3	1.42	2	8	0.3553	0.65	0.54	0.240	5.92
5	Basin P-3	1.98	2	8	0.4954	0.90	0.745	0.331	5.98

See following pages for triangular browditch hydraulic calculations.

Table 7-4. For Determining the Area a of the Cross Section of a Circular Conduit Flowing Part Full

Let $\frac{\text{depth of water}}{\text{diameter of channel}} = \frac{D}{d}$ and C_a = the tabulated value. Then $a = C_a d^2$.

$\frac{D}{d}$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0	.0000	.0013	.0037	.0069	.0105	.0147	.0192	.0242	.0294	.0350
.1	.0409	.0470	.0534	.0600	.0668	.0739	.0811	.0885	.0961	.1039
.2	.1118	.1199	.1281	.1365	.1449	.1535	.1623	.1711	.1800	.1890
.3	.1982	.2074	.2167	.2260	.2355	.2450	.2546	.2642	.2739	.2836
.4	.2934	.3032	.3130	.3229	.3328	.3428	.3527	.3627	.3727	.3827
.5	.393	.403	.413	.423	.433	.443	.453	.462	.472	.482
.6	.492	.502	.512	.521	.531	.540	.550	.559	.569	.578
.7	.587	.596	.605	.614	.623	.632	.640	.649	.657	.666
.8	.674	.681	.689	.697	.704	.712	.719	.725	.732	.738
.9	.745	.750	.756	.761	.766	.771	.775	.779	.782	.784

Table 7-14. Values of K' for Circular Channels in the Formula

$$Q = \frac{K'}{n} d^{8/3} s^{1/2}$$

D = depth of water d = diameter of channel

$\frac{D}{d}$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0		.00007	.00031	.00074	.00138	.00222	.00328	.00455	.00604	.00775
.1	.00967	.0118	.0142	.0167	.0195	.0225	.0257	.0291	.0327	.0366
.2	.0406	.0448	.0492	.0537	.0585	.0634	.0686	.0738	.0793	.0849
.3	.0907	.0966	.1027	.1089	.1153	.1218	.1284	.1352	.1420	.1490
.4	.1561	.1633	.1705	.1779	.1854	.1929	.2005	.2082	.2160	.2238
.5	.232	.239	.247	.255	.263	.271	.279	.287	.295	.303
.6	.311	.319	.327	.335	.343	.350	.358	.366	.373	.380
.7	.388	.395	.402	.409	.416	.422	.429	.435	.441	.447
.8	.453	.458	.463	.468	.473	.477	.481	.485	.488	.491
.9	.494	.496	.497	.498	.498	.498	.496	.494	.489	.483
1.0	.463									

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Mar 14 2019

Brow Ditch (Conveyance #6)

Triangular

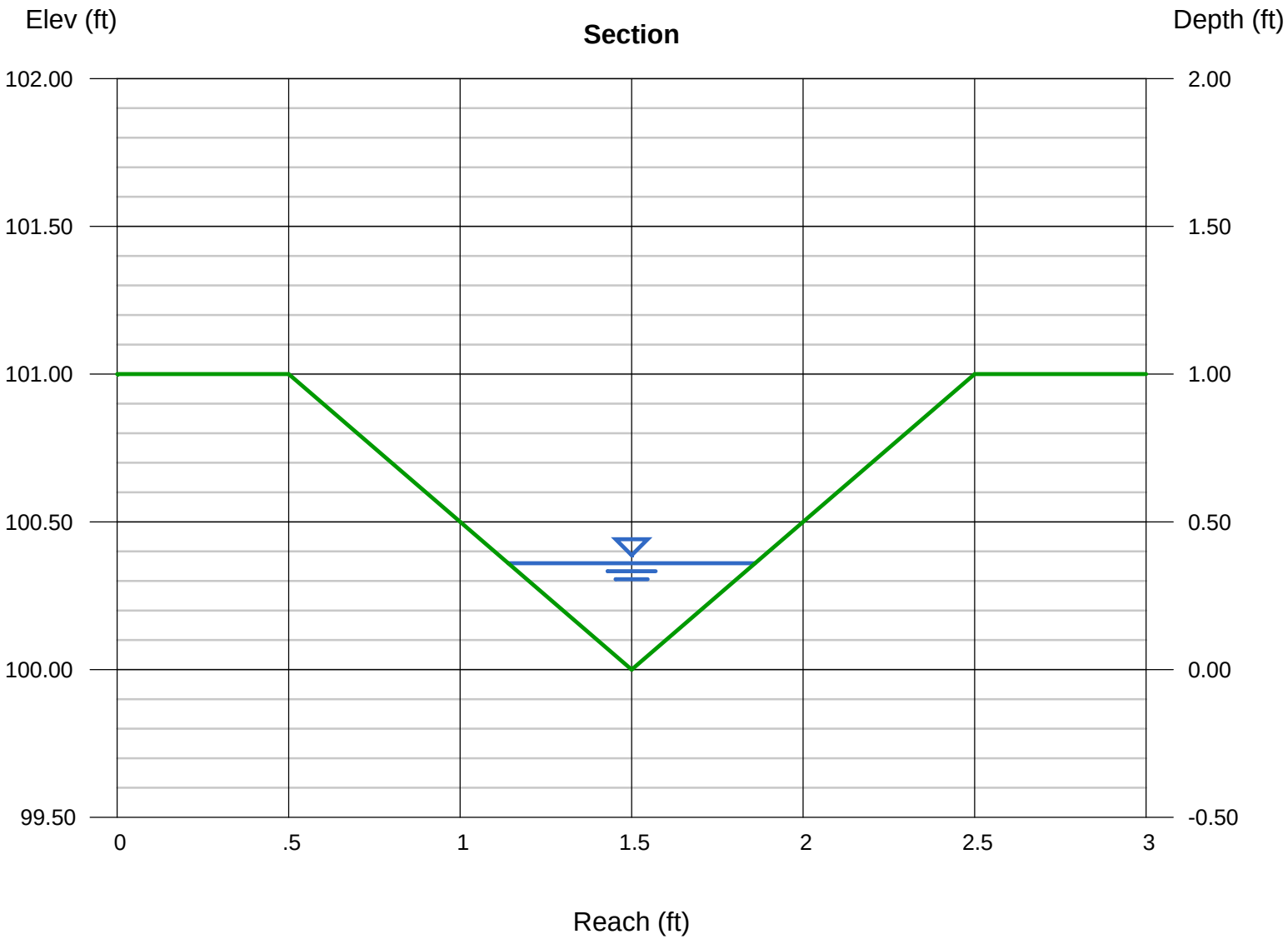
Side Slopes (z:1)	= 1.00, 1.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 100.00
Slope (%)	= 3.00
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.61

Highlighted

Depth (ft)	= 0.36
Q (cfs)	= 0.610
Area (sqft)	= 0.13
Velocity (ft/s)	= 4.71
Wetted Perim (ft)	= 1.02
Crit Depth, Yc (ft)	= 0.48
Top Width (ft)	= 0.72
EGL (ft)	= 0.70



Channel Report

Brow Ditch (Conveyance #7)

Triangular

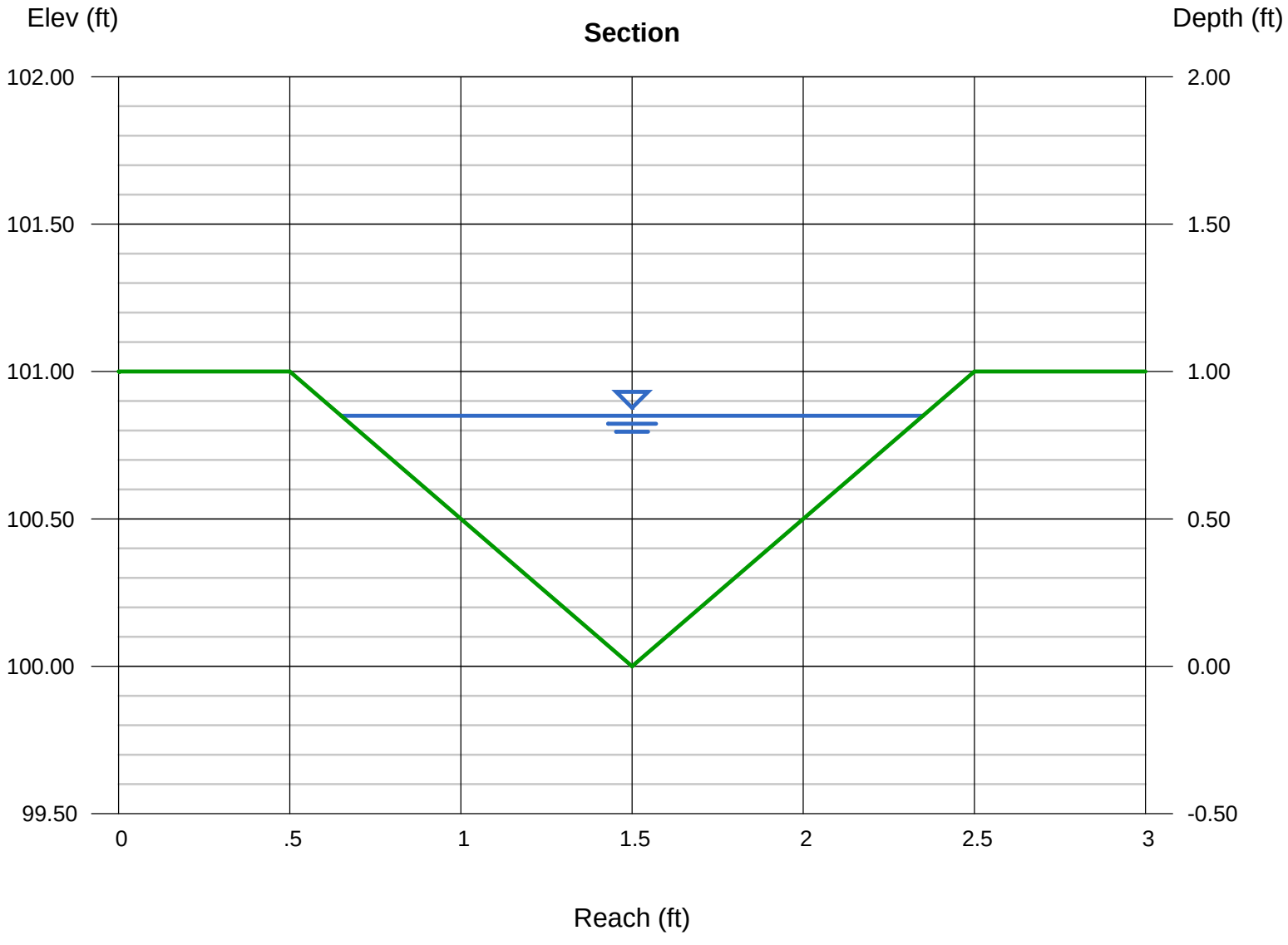
Side Slopes (z:1)	= 1.00, 1.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 100.00
Slope (%)	= 3.00
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 6.35

Highlighted

Depth (ft)	= 0.85
Q (cfs)	= 6.350
Area (sqft)	= 0.72
Velocity (ft/s)	= 8.79
Wetted Perim (ft)	= 2.40
Crit Depth, Yc (ft)	= 1.00
Top Width (ft)	= 1.70
EGL (ft)	= 2.05



Inlet Report

Slot Drain South of Driveway

Slotted Inlet

Location	=	On grade
Curb Length (ft)	=	-0-
Throat Height (in)	=	-0-
Grate Area (sqft)	=	-0-
Grate Width (ft)	=	0.17
Grate Length (ft)	=	10.00

Gutter

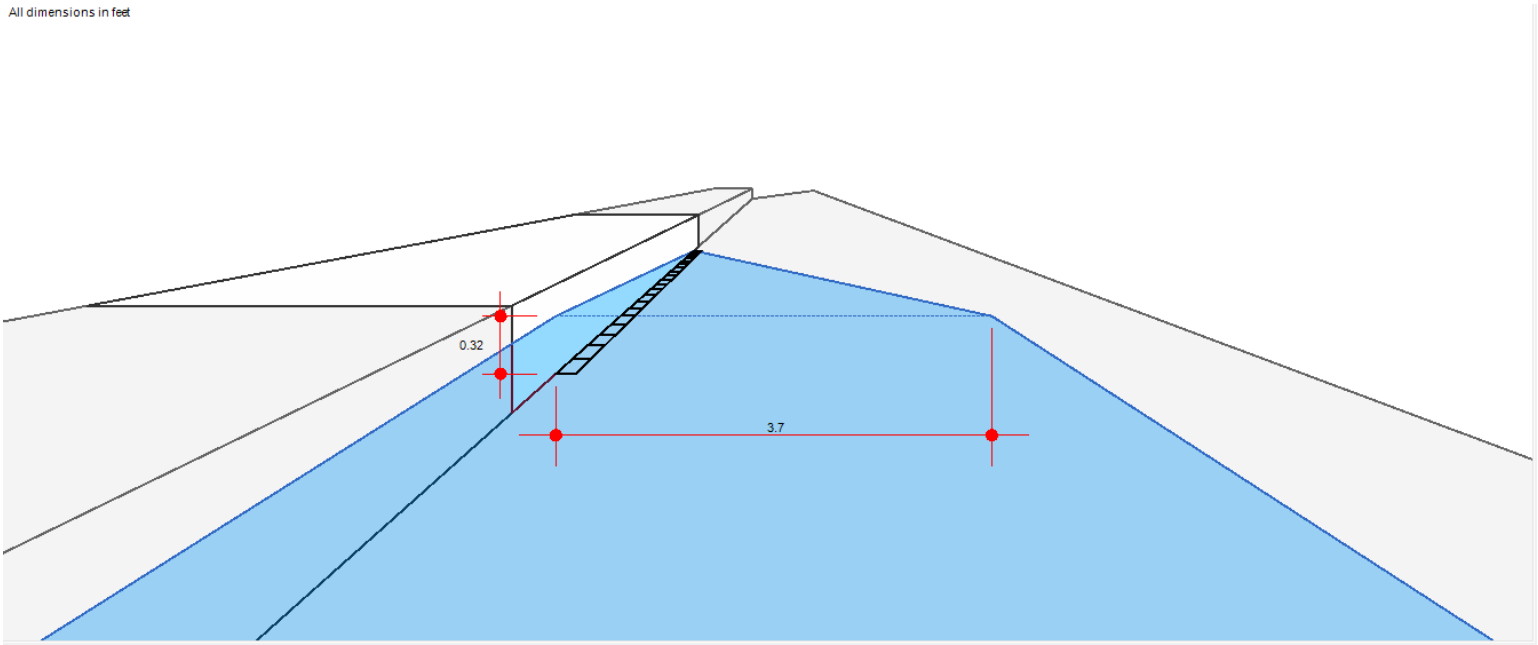
Slope, Sw (ft/ft)	=	0.087
Slope, Sx (ft/ft)	=	0.087
Local Depr (in)	=	1.00
Gutter Width (ft)	=	-0-
Gutter Slope (%)	=	0.50
Gutter n-value	=	0.016

Calculations

Compute by:		Known Q
Q (cfs)	=	1.37

Highlighted

Q Total (cfs)	=	1.37
Q Capt (cfs)	=	-1.#J
Q Bypass (cfs)	=	-0-
Depth at Inlet (in)	=	3.86
Efficiency (%)	=	-1
Gutter Spread (ft)	=	3.70
Gutter Vel (ft/s)	=	2.30
Bypass Spread (ft)	=	-0-
Bypass Depth (in)	=	-0-



Weir Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Aug 1 2019

Biofiltration Basin Overflow Weir

V-Notch Weir

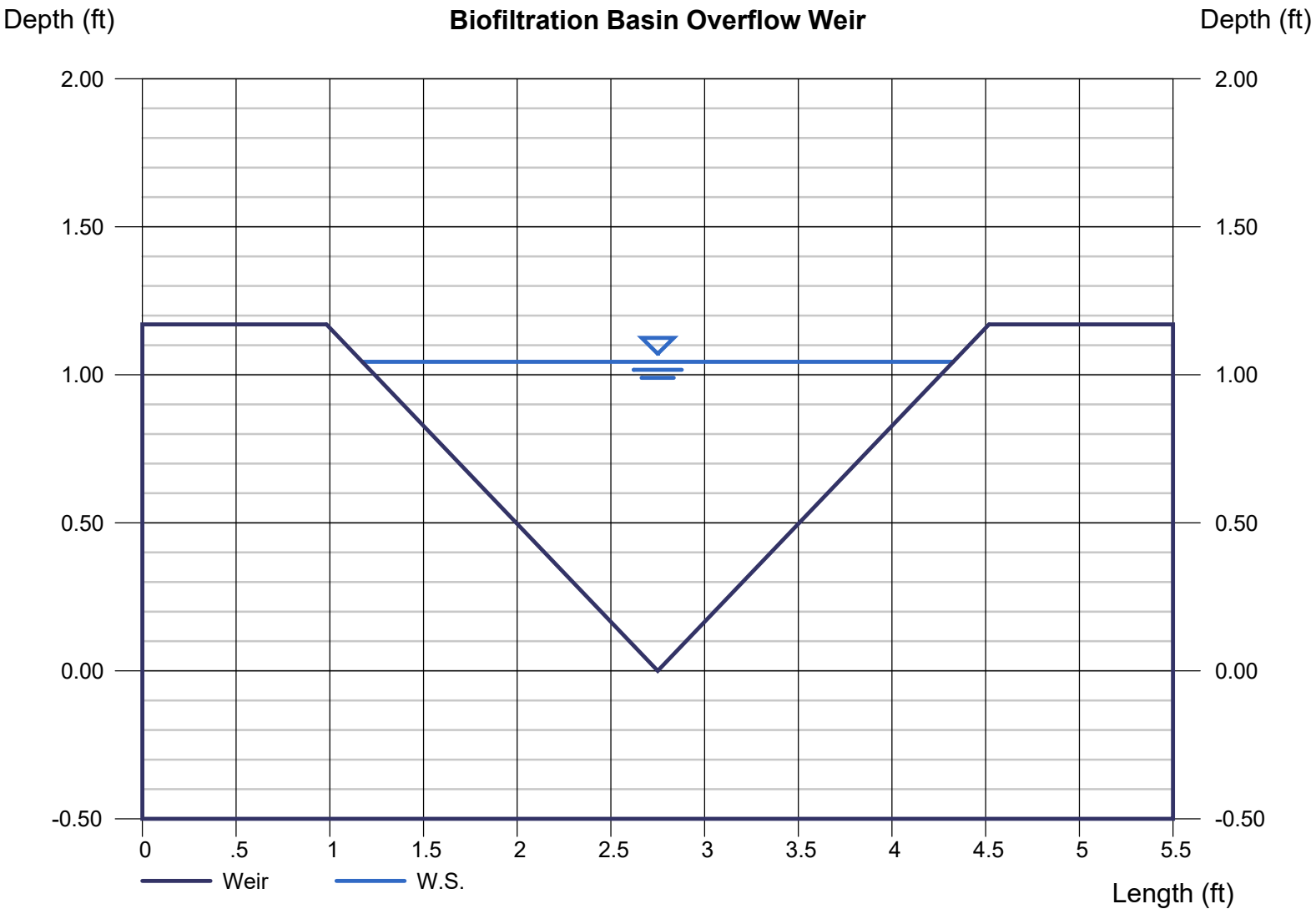
Crest	= Sharp
Angle (Deg)	= 113
Total Depth (ft)	= 1.17

Calculations

Weir Coeff. Cw	= 3.90
Compute by:	Known Q
Known Q (cfs)	= 4.34

Highlighted

Depth (ft)	= 1.04
Q (cfs)	= 4.340
Area (sqft)	= 1.65
Velocity (ft/s)	= 2.64
Top Width (ft)	= 3.15

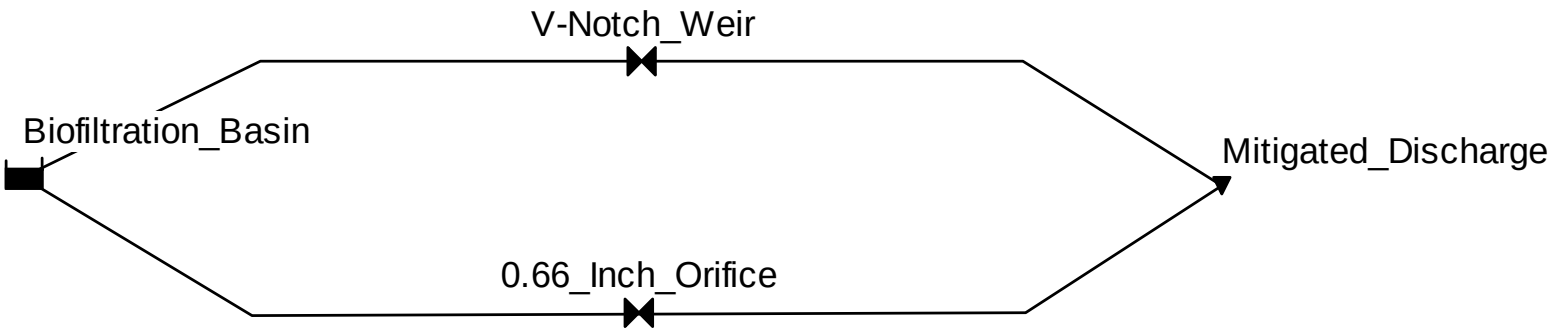


100 year storage
SWMM input file

```
[TITLE]
;;Project Title/Notes

[OPTIONS]
;;Option             Value
FLOW_UNITS           CFS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         KINWAVE
LINK_OFFSETS         DEPTH
MIN_SLOPE            0
ALLOW_PONDING        NO
SKIP_STEADY_STATE    NO

START_DATE           09/24/1964
START_TIME           00:00:00
REPORT_START_DATE    09/24/1964
REPORT_START_TIME    00:00:00
END_DATE             09/25/1964
END_TIME             00:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          00:00:01
WET_STEP             00:00:01
DRY_STEP             00:00:01
ROUTING_STEP         0:00:01

INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  H-W
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         12.557
MAX_TRIALS           8
HEAD_TOLERANCE       0.005
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
THREADS              1

[EVAPORATION]
;;Data Source    Parameters
;;-------------- ----------------
MONTHLY          0.06   0.08   0.11   0.16   0.18   0.21   0.21   0.20   0.16   0.12   0.08   0.06
DRY_ONLY         NO

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route To
;;-------------- ---------- ---------- ---------------- -------- ----------------
Mitigated_Discharge 0          FREE                        NO

[STORAGE]
;;Name           Elev.    MaxDepth   InitDepth  Shape      Curve Name/Params            N/A      Fevap    Psi      Ksat     IMD
;;-------------- -------- ---------- ---------- ---------- ---------------------------- -------- --------          -------- --------
Biofiltration_Basin 0        5.5        0          TABULAR    BMP-1                        0        0

[ORIFICES]
;;Name           From Node        To Node          Type         Offset     Qcoeff     Gated    CloseTime
;;-------------- ---------------- ---------------- ------------ ---------- ---------- -------- ----------
0.66_Inch_Orifice Biofiltration_Basin Mitigated_Discharge SIDE         0          0.65       NO       0

[WEIRS]
;;Name           From Node        To Node          Type         CrestHt    Qcoeff     Gated    EndCon   EndCoeff   Surcharge  RoadWidth  RoadSurf
;;-------------- ---------------- ---------------- ------------ ---------- ---------- -------- -------- ---------- ---------- ---------- ----------
V-Notch_Weir     Biofiltration_Basin Mitigated_Discharge V-NOTCH      4.25       3.33       NO       2        0          YES

[XSECTIONS]
;;Link           Shape        Geom1            Geom2      Geom3      Geom4      Barrels    Culvert
;;-------------- ------------ ---------------- ---------- ---------- ---------- ---------- ----------
0.66_Inch_Orifice CIRCULAR     0.055            0          0          0
V-Notch_Weir     TRIANGULAR   1                3          0.0        0.0

[INFLOWS]
```

```
;;Node           Constituent      Time Series      Type     Mfactor  Sfactor  Baseline Pattern
;;-------------- ---------------- ---------------- -------- -------- -------- -------- --------
Biofiltration_Basin FLOW             Inflow_to_BMP    FLOW     1.0      1.0

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
BMP-1            Storage    0          240
BMP-1                       2          240
BMP-1                       2.01       120
BMP-1                       3.5        120
BMP-1                       3.51       600
BMP-1                       5.5        600

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
Inflow_to_BMP                0:00       0
Inflow_to_BMP                0:05       0.1
Inflow_to_BMP                0:10       0.1
Inflow_to_BMP                0:15       0.1
Inflow_to_BMP                0:20       0.1
Inflow_to_BMP                0:25       0.1
Inflow_to_BMP                0:30       0.1
Inflow_to_BMP                0:35       0.1
Inflow_to_BMP                0:40       0.1
Inflow_to_BMP                0:45       0.1
Inflow_to_BMP                0:50       0.1
Inflow_to_BMP                0:55       0.1
Inflow_to_BMP                1:00       0.1
Inflow_to_BMP                1:05       0.1
Inflow_to_BMP                1:10       0.1
Inflow_to_BMP                1:15       0.1
Inflow_to_BMP                1:20       0.1
Inflow_to_BMP                1:25       0.1
Inflow_to_BMP                1:30       0.1
Inflow_to_BMP                1:35       0.1
Inflow_to_BMP                1:40       0.1
Inflow_to_BMP                1:45       0.1
Inflow_to_BMP                1:50       0.1
Inflow_to_BMP                1:55       0.1
Inflow_to_BMP                2:00       0.1
Inflow_to_BMP                2:05       0.2
Inflow_to_BMP                2:10       0.2
Inflow_to_BMP                2:15       0.2
Inflow_to_BMP                2:20       0.2
Inflow_to_BMP                2:25       0.2
Inflow_to_BMP                2:30       0.2
Inflow_to_BMP                2:35       0.2
Inflow_to_BMP                2:40       0.2
Inflow_to_BMP                2:45       0.2
Inflow_to_BMP                2:50       0.2
Inflow_to_BMP                2:55       0.2
Inflow_to_BMP                3:00       0.2
Inflow_to_BMP                3:05       0.2
Inflow_to_BMP                3:10       0.3
Inflow_to_BMP                3:15       0.3
Inflow_to_BMP                3:20       0.3
Inflow_to_BMP                3:25       0.3
Inflow_to_BMP                3:30       0.3
Inflow_to_BMP                3:35       0.4
Inflow_to_BMP                3:40       0.4
Inflow_to_BMP                3:45       0.5
Inflow_to_BMP                3:50       0.6
Inflow_to_BMP                3:55       0.9
Inflow_to_BMP                4:00       1.3
Inflow_to_BMP                4:05       4.34
Inflow_to_BMP                4:10       0.7
Inflow_to_BMP                4:15       0.5
Inflow_to_BMP                4:20       0.3
Inflow_to_BMP                4:25       0.3
Inflow_to_BMP                4:30       0.2
Inflow_to_BMP                4:35       0.2
```

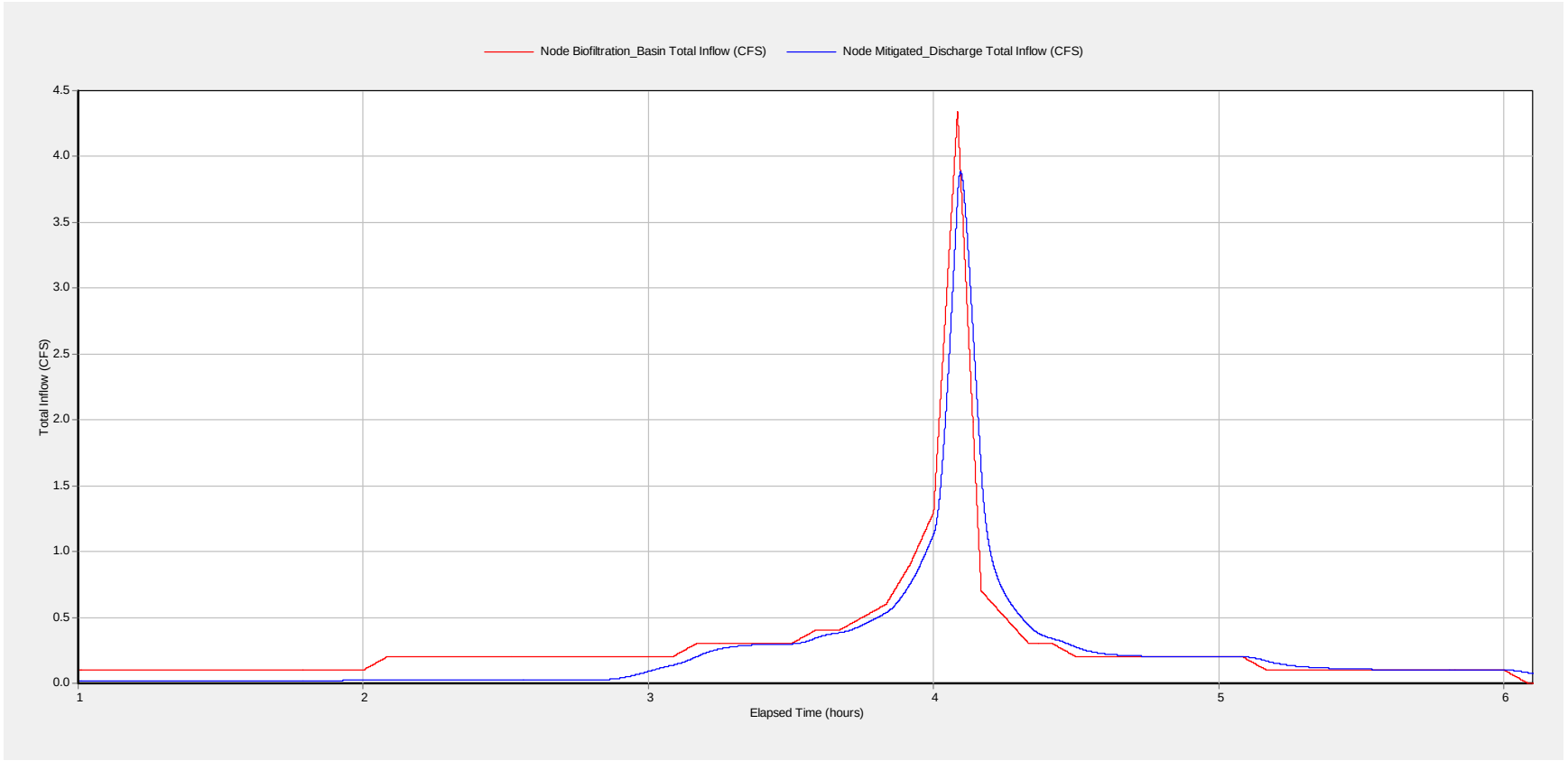
```
Inflow_to_BMP               4:40       0.2
Inflow_to_BMP               4:45       0.2
Inflow_to_BMP               4:50       0.2
Inflow_to_BMP               4:55       0.2
Inflow_to_BMP               5:00       0.2
Inflow_to_BMP               5:05       0.2
Inflow_to_BMP               5:10       0.1
Inflow_to_BMP               5:15       0.1
Inflow_to_BMP               5:20       0.1
Inflow_to_BMP               5:25       0.1
Inflow_to_BMP               5:30       0.1
Inflow_to_BMP               5:35       0.1
Inflow_to_BMP               5:40       0.1
Inflow_to_BMP               5:45       0.1
Inflow_to_BMP               5:50       0.1
Inflow_to_BMP               5:55       0.1
Inflow_to_BMP               6:00       0.1
Inflow_to_BMP               6:05       0

[REPORT]
;;Reporting Options
INPUT      NO
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS 0.000 0.000 10000.000 10000.000
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
Mitigated_Discharge 5232.692           8378.931
Biofiltration_Basin 4826.139           8381.588

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
0.66_Inch_Orifice 4903.957            8334.426
0.66_Inch_Orifice 5165.708            8335.605
V-Notch_Weir     4906.698           8420.745
V-Notch_Weir     5164.551           8420.745
```


V-Notch_Weir
Biofiltration_Basin
Mitigated_Discharge
0.66_Inch_Orifice

RATIONAL METHOD HYDROGRAPH PROGRAM

RUN DATE 3/12/2019
TIME OF CONCENTRATION 5 MIN.
6 HOUR RAINFALL 3.6 INCHES BASIN AREA 0.53 ACRES RUNOFF COEFFICIENT 0.87
PEAK DISCHARGE 4.34 CFS

Minutes	Flow (cfs)
0	0
5	0.1
10	0.1
15	0.1
20	0.1
25	0.1
30	0.1
35	0.1
40	0.1
45	0.1
50	0.1
55	0.1
60	0.1
65	0.1
70	0.1
75	0.1
80	0.1
85	0.1
90	0.1
95	0.1
100	0.1
105	0.1
110	0.1
115	0.1
120	0.1
125	0.2
130	0.2
135	0.2
140	0.2
145	0.2
150	0.2
155	0.2
160	0.2
165	0.2
170	0.2
175	0.2
180	0.2
185	0.2
190	0.3
195	0.3
200	0.3
205	0.3
210	0.3
215	0.4
220	0.4
225	0.5
230	0.6
235	0.9
240	1.3
245	4.34
250	0.7
255	0.5
260	0.3
265	0.3
270	0.2
275	0.2
280	0.2
285	0.2
290	0.2
295	0.2
300	0.2
305	0.2
310	0.1
315	0.1
320	0.1
325	0.1
330	0.1
335	0.1
340	0.1
345	0.1
350	0.1
355	0.1
360	0.1
365	0


Node Biofiltration_Basin Total Inflow (CFS)
Node Mitigated_Discharge Total Inflow (CFS)
Total Inflow (CFS)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
Elapsed Time (hours)

Appendix 1

County of San Diego Hydrology Manual

Soil Hydrologic Groups

Orange County

Riverside County

Imperial County

Pacific Ocean

Mexico

PROJECT SITE
GROUP 'D'

OCEANSIDE
VISTA
CARLSBAD
ESCONDIDO
ENCINITAS
SOLANA BEACH
DEL MAR
POWAY
S.D. COUNTY
SANTEE
SAN DIEGO
EL CAJON
LA MESA
LEMON GROVE
CORONADO
CHULA VISTA
IMPERIAL BEACH

117°30' 117°15' 117°00' 116°45' 116°30' 116°15'

33°30' 33°15' 33°00' 32°45' 32°30'

Legend

Soil Groups

- Group A
- Group B
- Group C
- Group D
- Undetermined
- Data Unavailable

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Department of Public Works
Geographic Information Services

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N W E S

3 0 3 Miles

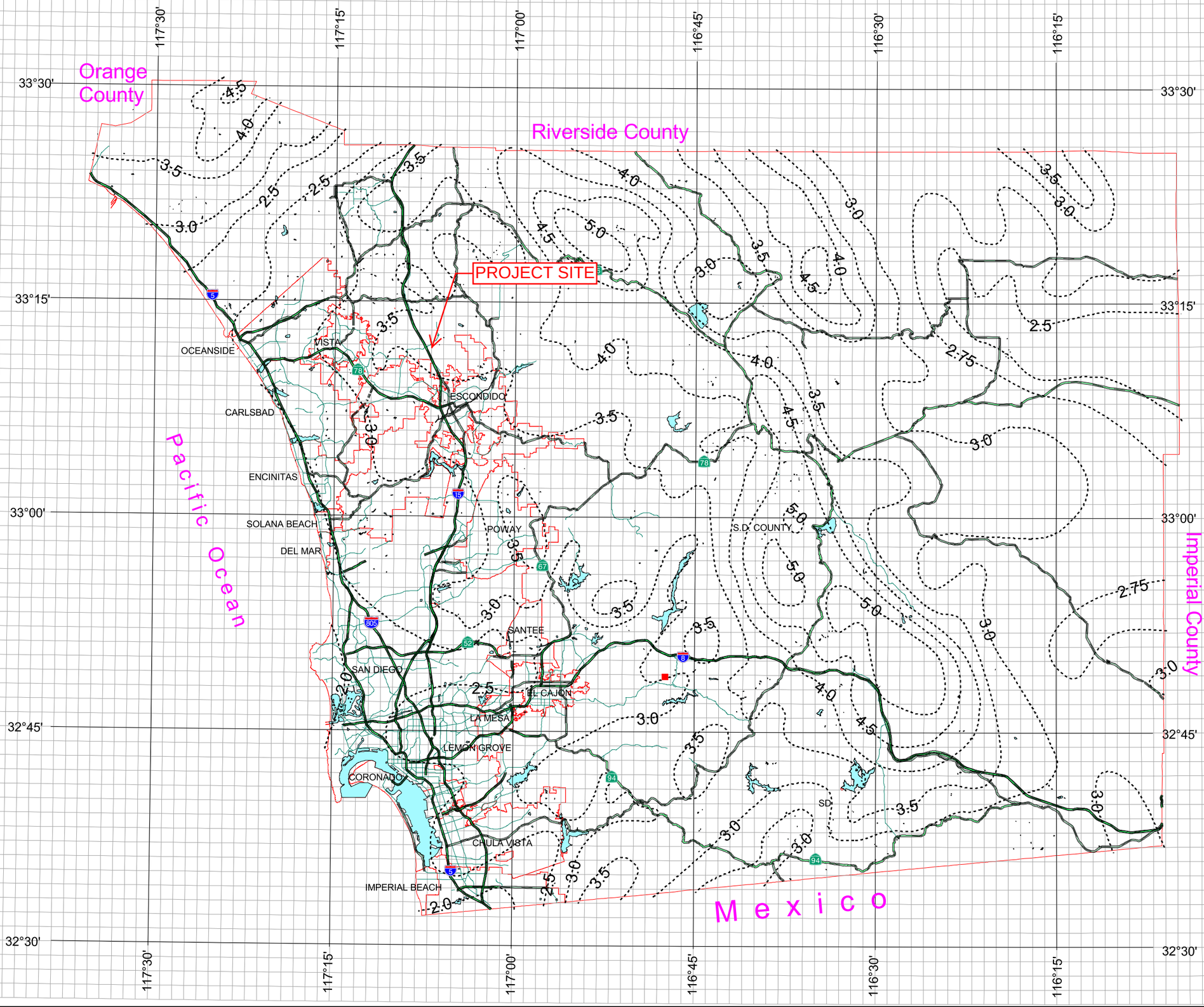
Appendix 2

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)



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N
W E
S

3 0 3 Miles

Appendix 3

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

Orange County

Riverside County

Imperial County

Pacific Ocean

Mexico

PROJECT SITE

OCEANSIDE
VISTA
CARLSBAD
ESCONDIDO
ENCINITAS
SOLANA BEACH
DEL MAR
POWAY
S.D. COUNTY
SANTEE
SAN DIEGO
EL CAJON
LA MESA
LEMON GROVE
CORONADO
SD
CHULA VISTA
IMPERIAL BEACH

117°30' 117°15' 117°00' 116°45' 116°30' 116°15'
33°30' 33°15' 33°00' 32°45' 32°30'

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Department of Public Works
Geographic Information Services

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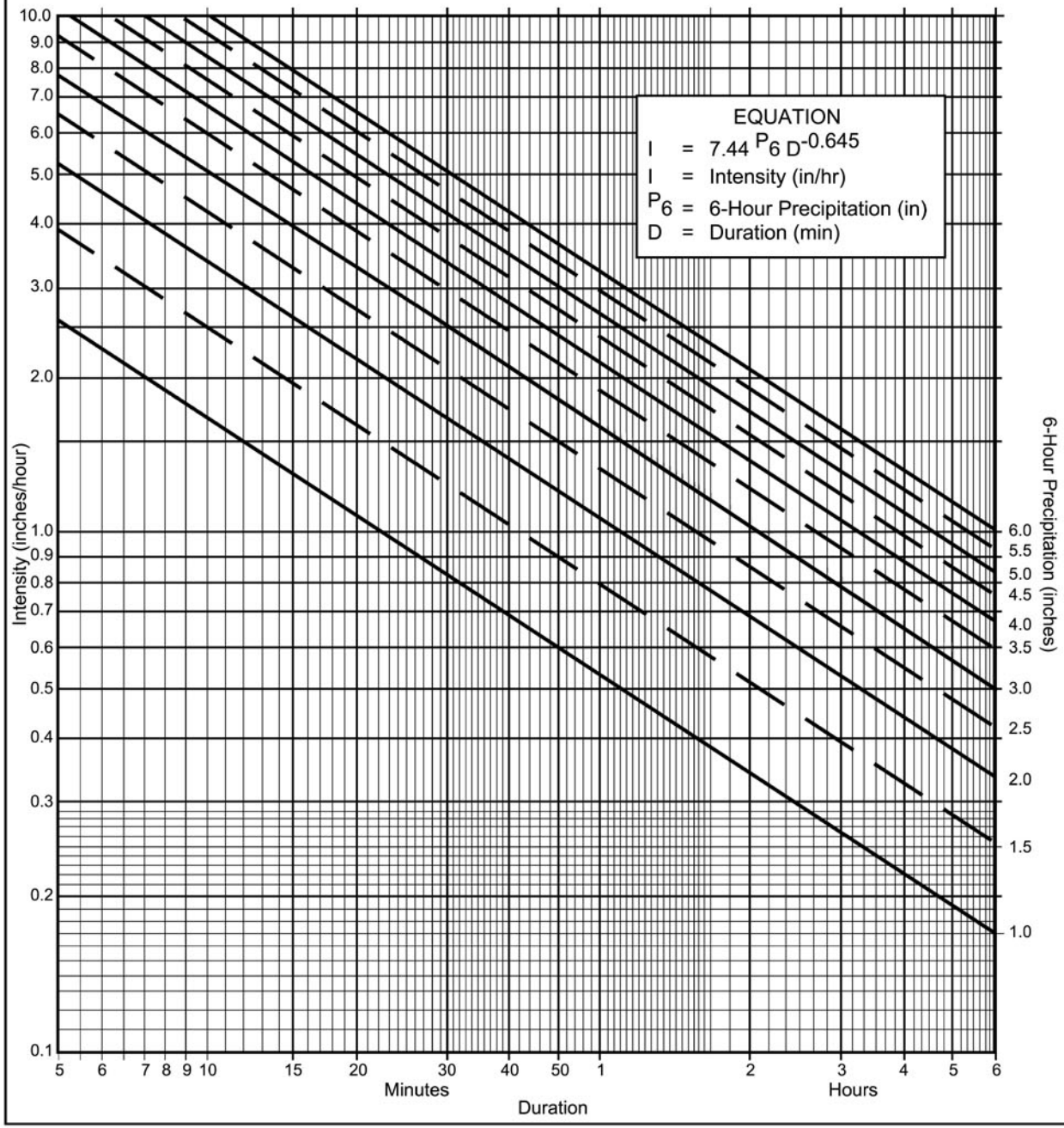
N
W E
S

3 0 3 Miles

Appendix 4



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 3.6 in., P_{24} = 8.0, $\frac{P_6}{P_{24}}$ = 4.5 %(2)

(c) Adjusted P_6(2) = n/a in.

(d) t_x = _____ min. **T & I per Rational**

(e) I = _____ in./hr. **Calc sheet**

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE 3-1

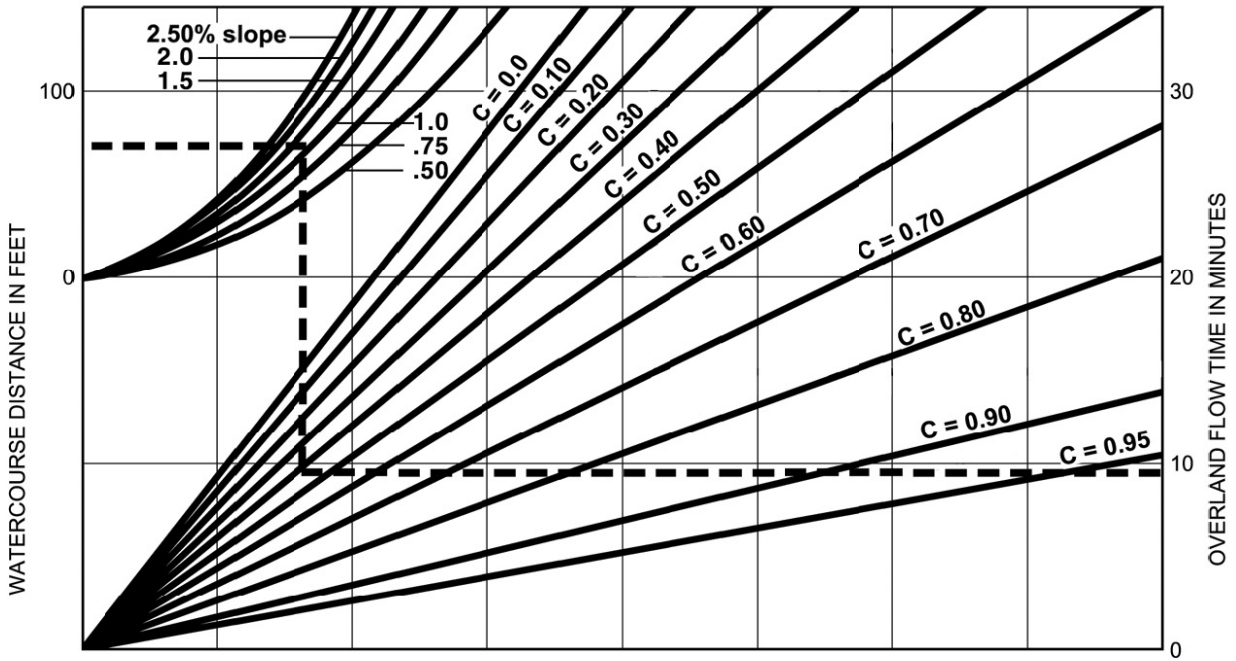
Appendix 5

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service

Appendix 6



EXAMPLE:

Given: Watercourse Distance (D) = 70 Feet
Slope (s) = 1.3%
Runoff Coefficient (C) = 0.41
Overland Flow Time (T) = 9.5 Minutes

$$T = \frac{1.8\,(1.1-C)\sqrt{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

Rational Formula - Overland Time of Flow Nomograph

FIGURE 3-3

Appendix 7

Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the "Regulating Agency" when submitted with a detailed study.

Table 3-2

MAXIMUM OVERLAND FLOW LENGTH (L_M) & INITIAL TIME OF CONCENTRATION (T_i)

Element*	DU/ Acre	.5%		1%		2%		3%		5%		10%	
		L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

*See Table 3-1 for more detailed description