OV #1901060
PERMIT #2402455

DRAINAGE REPORT FOR RIVERS EDGE

JN 4191B

July 30, 2019

RICK™
ENGINEERING COMPANY

DRAINAGE REPORT
FOR
RIVERS EDGE

Pima County Tax Code: TBD

OV 1901040, 1901060

Section 12, Township 12 South, Range 13 East
Gila and Salt River Meridian, Town of Oro Valley, Pima County, Arizona

Design and Analysis Based Upon Vertical Datum NAVD88

Prepared for:

MELCOR DEVELOPMENTS, ARIZONA, INC.
6930 E. Chauncy Lane, Ste 135
Phoenix, AZ 85054
(480) 699-4687
Attn: Ryan Mott
Email: RMott@Melcor.CA

Prepared by:

RICK ENGINEERING COMPANY, INC.
3945 East Fort Lowell Road, Suite 111
Tucson, Arizona 85712
(520) 795-1000

JN 4191B

July 30, 2019

TABLE OF CONTENTS

APPENDICES

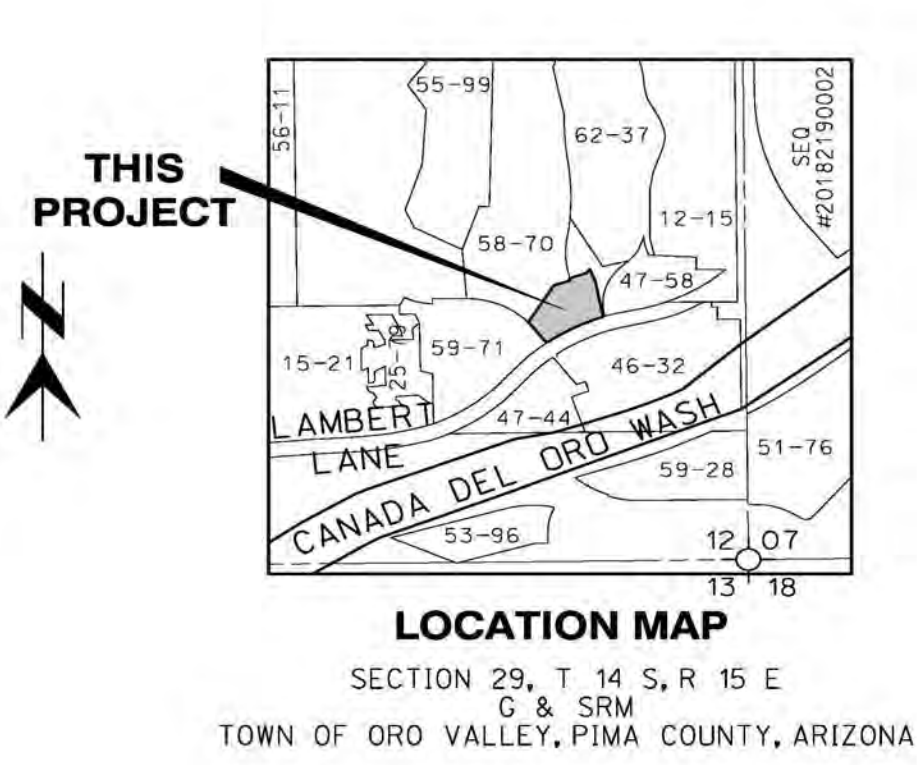
LIST OF FIGURES

1.0 INTRODUCTION

1.1 Site Location

Rivers Edge (the project site) is located within the southeast quarter of Section 12, Township 12 South, Range 13 East, Gila and Salt River Meridian, Town of Oro Valley, Pima County, Arizona. More specifically, the project site is located at the northeast corner of Lambert Lane and Shore Cliff Drive.

Figure 1 - Vicinity Map



1.2 Site Description

The project site has an area of 6.5 acres. As depicted on the aerial photo (Figure 2a), the site consists of undeveloped land covered with desert brush with an average cover density of 20%, and hydrologic soil groups consisting of 65% Type A soils, 25% Type C Soils and 10% Type D soils (per the Pima County Mapguide Hydrologic Soils group-NRCS layer and Figure 2b).

1.3 Project Description

The project site will consist of medium density residential development and associated roadway and landscape improvements with approximately 3.3 DU/AC. This project site is part of a larger Master Plan denoted as Rivers Edge. The project site is not located in any FEMA 100-year regulatory floodplains.

Per the Oro Valley drainage criteria manual, for the purposes of hydrologic analysis, all basins within the town of Oro Valley shall be considered as "Critical" basins. As a result, detention requirements are warranted in order to insure a 10% flow reduction of the pre-development 100-year peak discharge.

This Drainage Report was prepared in accordance with Oro Valley drainage standards. The report will address on-site and off-site stormwater runoff, stormwater detention, and the design of hydraulic structures for the conveyance of on-site and off-site stormwater runoff.

1.4 Purpose and Objectives

The purpose and objectives of this Drainage Report are to:

1. Provide supporting information required for the Development Plan drainage scheme, which meets or exceeds the Town of Oro Valley hydrologic/hydraulic criteria.
2. Determine the offsite and onsite peak discharges. The 100-year storm-event was calculated for design purposes.
3. Comply with Pima County/Oro Valley Stormwater Detention requirements.

4. Provide the onsite Federal Emergency Management Agency (FEMA) Special Flood Hazard Areas (SFHA).
5. Provide the existing and proposed regulatory floodplain limits, together with the associated Erosion Hazard Setback (EHS).
6. Determine the required onsite drainage improvements to convey the runoff through the project site.
7. Provide a Clean Water Act Section 404 Compliance Statement.

1.5 Previous Studies

Please note the following reports were used to obtain existing floodplain information as well as offsite storm runoff peak discharges affecting the project site.

Table 1: Offsite Drainage Reports

Acronym	Title Of Report/Project	Report Author	Report Date	Appendix
RE/CDOE 1-45	'Rivers Edge/Canada Del Oro Estates Lots 1-45 and Common Area "A" and "B" Hydrologic and Hydraulic Report'	Stantec Consulting, Inc.	January 25, 2006	B
RE/CDOE 70-102	'Rivers Edge/Canada Del Oro Estates – Final Drainage Support for the Improvement Plans Rivers Edge/Canada Del Oro Estates, Lots 70 through 102 and C.A. A & B and Canada Del Oro Estates: Lots 5, 6, 8, 11, 14, 17, 20, 21, 23, and 27 and Avenida Vallejo'	Stantec Consulting, Inc.	February 21, 2006	C

PRVII	'Hydrologic and Hydraulic Report for Pusch Ridge Vistas II'	Stantec Consulting, Inc.	September 19, 2003	D
RE/CDOE NDCC	'Rivers Edge/Canada Del Oro Estates Naranja Drive Culvert Crossing and Peak Discharge Reduction' Drainage Statement	Stantec Consulting, Inc.	February 4, 2004	E

1.6 Methodologies and Procedures

The drainage scheme for this project was determined in accordance with the existing topographic and drainage features. The drainage analyses were prepared using the following methodologies and procedures:

1. The offsite topographic information, offsite and onsite hydrologic soil types, and cover density were obtained from the Pima County Map Guide Website.
2. The onsite topographic information was taken from an aerial survey conducted by Cooper Aerial Company (February 9, 2017).
3. The offsite and onsite peak flows for the existing and proposed conditions were calculated following the methodologies presented within the Town of Oro Valley Drainage Criteria Manual (2010 edition) and within the Hydrology Manual for Engineering Design and Floodplain Management within Pima County, Arizona (September 1979). The PC-Hydro software program (version 5.4.3) developed for the Pima County Regional Flood Control District was utilized to calculate peak flows using the Rational Method and develop hydrographs.
4. The offsite and onsite hydrologic models for the existing and proposed conditions were prepared using the U.S. Army Corps of Engineers HEC-HMS software.
5. The provided retention and detention storages volumes were obtained from the HEC-HMS hydrologic models.

6. The proposed sidewalk concrete scuppers were modeled using Equation 10.16b of the COT SMDD Manual.
7. The proposed culverts and storm drains were modeled using the Haestad Methods CulvertMaster software.
8. The proposed storm drain system was modeled with StormCAD Hydraulics System program.

2.0 EXISTING CONDITIONS DRAINAGE

2.1 Offsite Conditions

Per the FEMA FIRM panel 04019C1089L the project site is located within a Clear Zone X (areas outside the 500-year floodplain). Figure 3 in Appendix A contains a portion of the FIRM map. Eight (8) off-site watersheds affect the project site. The easternmost of the two watersheds (herein referred to as 'Offsite Watershed OS7') conveys approximately 180 cubic feet per second (cfs) per the RE/CDOE 1-45 report. Offsite Watershed OS7 conveys south to the northeast corner of the property where, per the 'Existing Conditions' section of the RE/CDOE 1-45 report, a flow split occurs.

A Flow 2D analysis was performed with this report to determine what portion of the 180 cfs splits and conveys onto the project site in the existing condition. Three Flo-2D cross sections were placed in the model at the northeast corner of the property. It was determined that Cross Section 2 modeled the most accurate flow split onto the property. Cross section 2 is located at the proposed storm drain inlet (OS7) at the northeast corner of the project and resulted in a split flow of 47 cfs. The remaining 133 cfs split flow conveys east, into the existing Retention Basin included in the RE/CDOE 1-45 report. The Flow-2D model can be found in Appendix D. Flow-2D Cross Sections can be found on Figures 4 and 5. The hydrologic data sheets are included within Appendix B and the Offsite and Existing Drainage Map (Figure 4) depicts the associated concentration points (CPs).

OFFSITE WATERSHED PEAK FLOWS

WATERSHED CPs	AREA [ac]	Q100 [cfs]	CUMULATIVE CPs	CUMULATIVE AREA [ac]	CUMULATIVE Q2 [cfs]	CUMULATIVE Q10 [cfs]	CUMULATIVE Q25 [cfs]	CUMULATIVE Q100 [cfs]
OS1*	1.9	13	-	-	1	5	7	13
OS2*	2.8	19	-	-	2	7	11	19
OS3	0.3	2	-	-	0.2	1	1	2
OS4	1.2	8	OS2+OS4	4.0	3	10	14	27
OS5	4.8	35	OS1+OS5	6.7	7	17	28	48
OS6	0.1	1	-	-	0.1	0.2	0.3	1
OS7	37.0	179**	-	37.0	5	17	24	47***
OS8	0.7	5	-	-	1	2	2	5

* Per the 'Hydrologic and Hydraulic Report for Pusch Ridge Vistas II,' prepared by Stantec Consulting Inc. dated September 19, 2003 (applicable portions included in the Attachments to this memo)

** Per 'Rivers Edge/Canada Del Oro Estates Lots 1-45 and Common Area A and B', prepared by Stantec Consulting Inc, dated January 25, 2006 (applicable portions included in the Attachments to this memo).

***Split flow conveying onto project boundary, per Flow2D model.

2.2 Existing Onsite Conditions

There are two existing onsite watersheds, 1E and 2E. Existing Watershed 2E is approximately 0.6 acres of the southeast corner of the project and drains in a southeasterly direction to the existing offsite channel which conveys flows south under Lambert Lane. The remaining 5.9 acres of the site, watershed 1E, flows in a southwesterly direction to the existing double 36-inch Reinforced Concrete Pipe (RCP) culverts under Shore Cliff Drive. The hydrologic data sheets are included within Appendix B. The Existing Drainage Map (Figure 4) depicts the associated concentration points. The following table also includes the contributing

watersheds and cumulative 100-year design flow at the associated CP.

EXISTING WATERSHED PEAK FLOWS

WATERSHED CPs	AREA [ac]	Q100 [cfs]	CUMULATIVE CPs	CUMULATIVE Q2 [cfs]	CUMULATIVE Q10 [cfs]	CUMULATIVE Q25 [cfs]	CUMULATIVE Q100 [cfs]
1E	5.9	36	OS3+OS4+OS5+OS6+OS8+1E	15*	39*	53*	117*
2E	0.6	4	-	0.4	1	2	4

*Per HEC-HMS

3.0 PROPOSED CONDITIONS DRAINAGE DESIGN

The project site consists of residential properties along with the associated parking, recreational areas, and landscape improvements.

3.1 Proposed Onsite Conditions

The project site was divided into 4 proposed watersheds. The hydrologic data sheets are included within Appendix B and Figure 5 depicts the associated concentration points. The following table also includes the contributing watersheds and cumulative 100-year design flows at the associated CPs. The hydrologic model is presented within Appendix D.

PROPOSED WATERSHED DESIGN FLOWS

WATERSHED CPs	AREA [ac]	Q100 [cfs]	CUMULATIVE CPs	CUMULATIVE Q2 [cfs]	CUMULATIVE Q10 [cfs]	CUMULATIVE Q25 [cfs]	CUMULATIVE Q100 [cfs]
1P	2.0	15	OS3+OS4+OS5 +1P	13.0	33.0	49.0	92
2P	3.2	24	OS6+2P	5	9	11	25
3P	1.1	9	CP1P + CP2P + 3P + OS8	12	33	46	104*
4P	0.2	1	-	0.1	0.3	0.4	1

Update this section to match the proposed plan.

3.2 Proposed Drainage Structures

The proposed project site has been divided into 4 watersheds. Proposed Watershed 1P and associated Offsite Watersheds, convey to a proposed 48-inch culvert underneath Jasper Avenue. The 48-in culvert provides detention to proposed flow as a byproduct of inlet control. Watershed 2P conveys to Detention Basin 1 to provide the remaining detention requirements for the lower storm events.

3.3 Stormwater Detention

Per the Town of Oro Valley Drainage Criteria Manual (2010 edition) all basins within the Town of Oro Valley shall be considered as Critical Basins. As a result, detention requirements are warranted in order to insure a 10% flow reduction of the pre-development 100-year peak discharge.

The proposed 48-inch culvert underneath Jasper Avenue provides detention in the 100- year event as a byproduct of inlet control. The peak flows at concentration point 1P were routed through the 48-inch pipe via HEC-HMS to determine the

level of detention provided by the 48-inch pipe. Basin 1 South was proposed in order to meet the Town of Oro Valley and Pima County detention requirements for the 2-, 10-, 25- and 100- year storm events. The storage capacity is adequate to meet the Critical Basin design criteria. Figure 5 depicts the location of the basins. Appendix D contains the reservoir routing models and outflow structure details. The following table summarizes the basin parameters.

DETENTION/RETENTION BASIN SUMMARY TABLE

BASIN	Q100 In [cfs]	Q100 Out [cfs]	Volume Detained [ac-ft]	WSEL [ft]	Basin Bottom [ft]	Weir Elev. [ft]	Weir Length [ft]
48" Culvert Under Entrance Road (CP 1P)*	91	73	NA	NA	NA	NA	NA
BASIN 1 SOUTH	25	22	0.2	60.7	58	59.9	10

*Added to Basin summary to show 100-year detention that occurs as byproduct of inlet control on 48" Culvert under Jasper Avenue. Not a Detention Basin.

3.4 Pre-Developed and Post-Developed Runoff Comparison

The following table summarizes the existing and proposed runoff flows exiting the project site. As shown in the following table the proposed onsite peak flows exiting the project site are at a minimum 10% less than the existing onsite design flows, thus meeting the detention requirements for a Critical Basin.

EXISTING VS. PROPOSED PEAK FLOWS EXITING PROJECT SITE

WATERSHED /CP		**Q 2 Year [cfs]**		**Q 10 Year [cfs]**		**Q 25 Year [cfs]**		**Q 100 Year** [cfs]	
Existing	**Proposed**	**Existing**	**Proposed**	**Existing**	**Proposed**	**Existing**	**Proposed**	**Existing**	**Proposed**
1E*	**3P***	15	11	39	34	53	48	117	110
2E	**4P**	0	0.1	1	0.3	2	0.4	4	1

*Includes Offsite

3.5 First Flush

First Flush requirements are not warranted as no paved parking lots exist onsite.

4.0 SPECIAL CONDITIONS

No special conditions deviating from the procedures and requirements presented in the Town of Oro Valley Drainage Criteria Manual (2010 edition) and COT SMDD are anticipated for this project.

5.0 HYDROLOGIC AND HYDRAULIC ANALYSIS

5.1 Regulatory Floodplain Analysis

5.2.1 Existing Conditions

As stated in Section 2.1, the project is affected by one major offsite drainage watersheds from the north at the northeast corner of the project site (herein referred to as 'Offsite Watershed OS7). Offsite Watershed OS7 conveys approximately 180 cubic feet per second (cfs) per the RE/CDOE 1-45 report. Offsite Watershed OS7 conveys south to the northeast corner of the property where, per the 'Existing Conditions' section of the RE/CDOE 1-45 report, a flow split occurs. Per the Flo-2D model performed with this report the flow splits directly upstream of the northeast corner of the property where 47 cfs continues south and west and approximately 133 cfs flows east to an existing retention basin on the RE/CDOE 1-45 property. The 133 cfs split flow from Watershed OS7, ultimately conveys via weir outlet to the existing channel designed per the RE/CDOE 70-102 project. It should be noted that the existing channel was originally designed to convey a 100-year peak flow discharge of 1,638 cfs. Based on the RE/CDOE NDCC drainage statement, the 100-year peak discharge impacting the channel is now estimated to be 864 cfs. This discharge is a reduction from the original runoff estimate of 1,638 cfs and was determined in the Oro Valley Town Wide Drainage Study, by Kimley Horn and Associates, Inc., dated July 12, 2001, for the Town of Oro Valley, Arizona.

5.2.2 Proposed Conditions

Due to the reduced peak flows within the existing channel east of the project

within the RE/CDOE 1-45 property, the 47 cfs split flow originally conveying across the project site will be routed to the triple box culvert under Lambert Lane. This measure will alleviate flooding at the existing double 36-inch culverts located under Shore Cliff Drive.

Onsite regulatory flows are fully contained within armored channels as shown on Figure 5. The hydraulic cross-sections are depicted on Figure 5 and a summary of results can be found in Section 6.6. The hydraulic models are included within Appendix E.

5.2.4 Erosion Hazard Setback

All regulatory washes are contained within improved channels with grouted rip rap side slopes and channel bottoms; therefore, no Erosion Hazard Setbacks (EHS) exist onsite.

5.2.4 Scour Analysis

Scour analysis is not necessary as all regulatory flows are contained with armored channels. Armored channels are grouted rip rap along both sides lopes and channel bottom to the depth of flow plus freeboard.

5.2.4 Sediment Transport

Sediment supply was calculated using the sediment transport calculation Equation 11.7 from Engineering Analysis of Fluvial Systems. Due to low offsite incoming channel velocities, sediment loads were generally low. Stable slope Equation 8-V from the Pima County Drainage and Channel Design Standards for Local Drainage manual was utilized to ensure the outgoing sediment in the channel was equal to the sediment supply. In all cases, the channel slope exceeds the calculated equilibrium slope thereby ensuring the sediment will convey through the channel system. For proposed storm drain, sediment movement was analyzed using Method A from Estimating Sediment Movement in Drainage Structures (Richards/Zeller, 19569) where pipe information was calculated with the FHWA

Hydraulic Toolbox to examine the sediment transport capability of the storm drain inlet at the entrance. In the case of Concentration Point OS7, the sediment movement (Qmax) was more than the calculated sediment supply (Qs), as a result it is anticipated that sediment will transport through the entrance of the storm drain successfully. It is anticipated that due to high velocities inside the storm drain reach, that sediment will continue to transport successfully. All proposed channels and storm drain have been designed to transport sediment at levels that match or exceed the existing condition. Refer to Appendix E for all Sediment Transport Calculations.

Upstream Existing XS/Proposed XS	Storm Event [yr]	Exist/ Prop Peak Q [cfs]	Qs* (cfs)	Calculated Stable Slope [ft/ft]	Lined Channel Slope [ft/ft]	Storm Pipe Qmax [cfs]	Channel Meets Sediment Transport Requirements?	Storm Pipe Entrance Meets Sediment Transport Requirements?
OS4/2A	2	3/10	0.0004	0.03	0.03	-	YES	-
OS4/2A	10	10/27	0.002	0.03	0.03	-	YES	-
OS4/2A	25	14/42	0.003	0.03	0.03	-	YES	-
OS4/2A	100	27/75	0.007	0.02	0.03	-	YES	-
OS5/1A	2	7/7	0.0005	0.004	0.025	-	YES	-
OS5/1A	10	17/17	0.002	0.004	0.025	-	YES	-
OS5/1A	25	28/28	0.004	0.004	0.025	-	YES	-
OS5/1A	100	48/48	0.008	0.004	0.025	-	YES	-
OS7/3A	2	5/5	0.001	0.002	0.40	0.562	YES	YES
OS7/3A	10	17/17	0.005	0.002	0.40	1.748	YES	YES
OS7/3A	25	24/24	0.008	0.002	0.40	2.870	YES	YES
OS7/3A	100	47/47	0.022	0.02	0.40	7.402	YES	YES

*Sediment Supply

6.0 LOCAL HYDROLOGY AND HYDRAULICS

Drainage structures will be required in order to convey the onsite and offsite flows through the project site. These structures consist of sidewalk scuppers, channels, and storm drain systems. Figure 5 depicts the local drainage structures together with the associated local contributing watersheds. Refer to Appendix B for the hydrologic data sheets for each local watershed. The following table summarizes the local watershed design peak flows for the 100-year storm event.

LOCAL WATERSHED DESIGN FLOWS

Watershed CP	Area [Ac]	Q100 [cfs]
2P.1	0.3	2

*CP for Local analysis only and is based on a unit peak flow of 7 cfs/acre

6.1 Scuppers

A scupper was calculated for the following concentration point (CP). Refer to Figure 5 for the location of the scupper and Appendix C for the hydraulic calculation and filter specs.

SCUPPERS*

CP	Q100 [cfs]	Scupper Type*	Cells Required [#]
2P.1	2	2	1

*Per Standard Details for Public Improvements, 2003 Edition.

6.2 Storm Drain Systems

A proposed 36-in. storm drain system along the east side of the property conveys the split flow from Offsite Watershed OS7 and connects to the existing triple 10x7 Box Culvert under Lambert Lane. Although Hydraulic calculations show the box is not flowing full, the starting downstream hydraulic grade-line elevation is

set to the soffit of the box culvert as a conservative measure. The following table summarizes the storm drain system. Refer to Figure 5 for the location of storm drain and to Appendix C for the models.

Sediment transport calculations were performed for the entrance of the 36-inch storm drain and the upstream inlet structure and are described in Section 5.2.4. As currently designed, it was determined that the proposed storm drain and associated inlet structure do not substantially reduce the flow of sediment. Sediment transport calculations are located in Appendix E.

STORM DRAIN SYSTEM

Upstream CP	Q100 [cfs]	Number, Size, Type	Slope [ft/ft]	Length [ft]	Computed Headwater [elev]	Tailwater [elev]
SD36-1	47	(1)-36" SRP	0.037	97.6	2582.6*	2577.5
SD36-2	47	(1)-36" SRP	0.030	364.4	2577.2	2570.6
SD36-3	47	(1)-36" SRP	0.040	51.5	2570.0	2569.7**

*Per Culvert Master

**Triple Box Culvert Soffit

6.3 Culverts

The following table summarizes the required culverts at the associated local CP. Appendix C contains the hydraulic models and Figure 5 depicts the location of roadway drainage crossings.

CULVERTS

CP	Q100 [cfs]	Number of Culverts	Size and Type	Head Water Elevation [ft]	Head Water Depth [ft]
1P	92	1	48" RCP & SRP	62.4*	5.0
2P	24	1	24" SRP	62.6	3.6
OS7	47	1	36" SRP	82.6	3.9

*Per Culvert Master for most conservative value

6.4 Culvert End Treatment

Riprap aprons are proposed at the outlet of all applicable storm drain and culvert outlets. The following table is a summary of the results. Rip rap apron calculations are included in Appendix C.

RIP RAP APRONS

CP	D50 Minimum [in]	Apron Length [ft]
CP 2P Outlet	8	11
48-in. Culvert Outlet	8	NA*
Outlet of Channel 2B**	20	7

*Pipe outlets to large rip rap area placed to an elevation of the maximum headwater elevation of the (2) Existing 36" Pipes under Shore Cliff Drive
**Rip rap pad is based on 2-year storm velocities as all higher storm events result in large tailwater depths

6.5 Grate Inlets

The following table summarizes the proposed Type 1 Catch Basin and transverse grate inlet. Negating the Type 1 Catch Basin, the Neenah Grate is anticipated to capture 97% of flows across the grate, approximately 24.3 cfs of the total 25 cfs. The capacity of the Type 1 Catch Basin on a grade is 3 cfs. Therefore, no bypass flows are anticipated to convey from the site into Shore Cliff Drive. Refer to

Figure 5 for the location of grate inlets and Appendix C for the hydraulic calculations.

GRATE INLETS

CP	Q100 [cfs]	No. Of Grates	Grate Type	Headwater [ft]
2P	3	1	1	0.5
2P	22*	22-ft Transverse Grate in 2-ft Sections	R-4999-L6 Neenah Bolted Transverse Drainage Structure	0.5

*Flow conveyed through Neenah Grate minus interception capacity of Type 1 Grated Inlet.

6.6 Channels

The channel locations are depicted on Figure 5 and Appendix E contains the hydraulic models and Sediment Transport Calculations.

CHANNELS

Channel Section	Q100 [cfs]	Bottom Width	Slope	Side Slopes	Flow Depth [ft]	Minimum Channel Depth [ft]	Freeboard
1A	48	10	0.025	1:1	0.7	2.4	1.7*
1D	14	TRIANGULAR	0.024	VARIES	0.8	5.0	1.0**
2A	75	10	0.025	2:1	0.9	1.9	1.0
2B	75	10	0.167	2:1	0.5	6.0	5.5
3A	47	NA	0.40	VARIES	0.6	2.4	1.8***

*Freeboard is taken at upstream end of channel to the adjacent pad elevation
**Minimum 1-ft of freeboard is provided throughout the onsite channel, flow depth and minimum channel depth is taken at most conservative location where peak flows converge.
***Calculated for Sediment Transport calculations. Minimal flow enters the upstream channel from the floodplain bank, majority of sediment in the channel will occur at the thalweg where cross section 3A is located. See 5.2.4 Sediment Transport section for additional information.

6.7 Street Flow

The allowable street flows during the 10-year and 100-year storm events are contained within the curb (6 inches) and right-of-way, respectively. The

following table summarizes the allowable and maximum street flows. Appendix C contains the hydraulic models.

STREET FLOW @ CP 2P

Storm Event	Street Capacity Q [cfs]	Design Q [cfs]
10-Year	28	9
100-Year	61	25

6.8 Long Term Maintenance

The proper functioning of the drainage systems described in this report is dependent on the owner providing, annual and continuous maintenance to the drainage improvements. The firm responsible for the ownership, operation, scheduled and unscheduled maintenance and liability of drainage improvements and common areas detailed on this report is:

Homeowner's Association for
Rivers Edge
In care of:

MELCOR DEVELOPMENTS, ARIZONA, INC.
6930 E. Chauncy Lane, Ste 135
Phoenix, AZ 85054
(480) 699-4687
Attn: Ryan Mott
Email: RMott@Melcor.CA

Maintenance guidelines and checklist are provided within Appendix C.

7.0 CLEAN WATER ACT

Based on the available aerial photographs and a site visit, characteristics of Jurisdictional U.S. Waters, such as high water marks or sandy bottom washes, were not observed within the project site.

8.0 RECOMMENDATIONS AND SUMMARY

8.1 Recommendations

- Detention shall be provided to mitigate the impact of this project on stormwater peak discharges and meet the Critical Basin design criteria.
- The proper functioning of the drainage systems described in this report is dependent on the owner providing, annual and continuous maintenance to the drainage improvements. Refer to Appendix C for details regarding recommended maintenance guidelines.

8.2 Summary

- The supporting information required for the Development Plan drainage scheme is being provided within the report.
- The offsite and onsite peak discharges for the 100-year storm event have been calculated.
- Town of Oro Valley and Pima County Stormwater Detention requirements have been met.
- The required onsite drainage improvements to convey the runoff through the project site have been calculated and are shown in the figures of the report.

9.0 ENGINEER'S STATEMENT

The drainage design concept presented in this Drainage Report assures that drainage affecting the project will be handled in a manner that does not conflict with any federal, state, county, and/or local regulations intended to protect adjacent properties and/or the project itself from adverse impacts during design storm events specified in the current regulations.

Disclaimer – ***Any deviations from the drainage scheme and hydraulic design presented herein, or any variations in climatic or watershed conditions may affect the functionality and other hydrologic or hydraulic characteristics of this project and nullify the results presented herein.***

10.0 REFERENCES

- Town of Oro Valley Department of Public Works, Drainage Criteria Manual. 2010.
- Pima County Department of Transportation and Flood Control District, Hydrology Manual for Engineering Design and Floodplain Management within Pima County, Arizona. September 1979.
- Pima County Department of Transportation and Flood Control District, Drainage and Channel Design Standards for Local Drainage. May 1984.
- Pima County Department of Transportation and Flood Control District, and City of Tucson, Stormwater Detention/Retention Manual. 1987.
- Simons, Li, & Associates and City of Tucson Department of Transportation, Standards Manual for Drainage Design and Floodplain Management in Tucson Arizona. December 1989 (Revised July 1998).
- Cooper Aerial Survey Co., Aerial Photo and Topographic Map. February 9, 2017.
- Pima County Department of Transportation – Geographic Information Services Division, Pima County Mapguide Maps. < http://www.dot.co.pima.az.us/gis/maps/mapguide/>.
- Federal Emergency Management Agency (FEMA), National Flood Insurance Program (NFIP); Flood Insurance Rate Map (FIRM) 04019C-1089L, dated June 16, 2011.
- Pima County Regional Flood Control District, PC-Hydro v. 5.4.2.
- Arroyo Engineering, LLC. and Pima County Regional Flood Control District, PC-HYDRO User Guide. March 2007.
- United States Army Corps of Engineers, Hydrologic Engineering Center – Hydrologic Modeling System (HEC-HMS) v. 4.3..
- Bentley, CulvertMaster v. 3.01. December 5, 2005.
- Bentley, FlowMaster v. 8.01. November 9, 2006.

F:\4191_RIVER'S_EDGE\HYDRO\4191B_OV_DR02.DOCX

APPENDIX A – FIGURES AND EXHIBITS

PimaMaps Print

Legend

Parcels

Notes:

400.0 0 200.00

Feet

Pima County GIS

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map are subject to Pima County's ITD GIS disclaimer and use restrictions.

Figure 2a - Rivers Edge Aerial Map 04/11/19

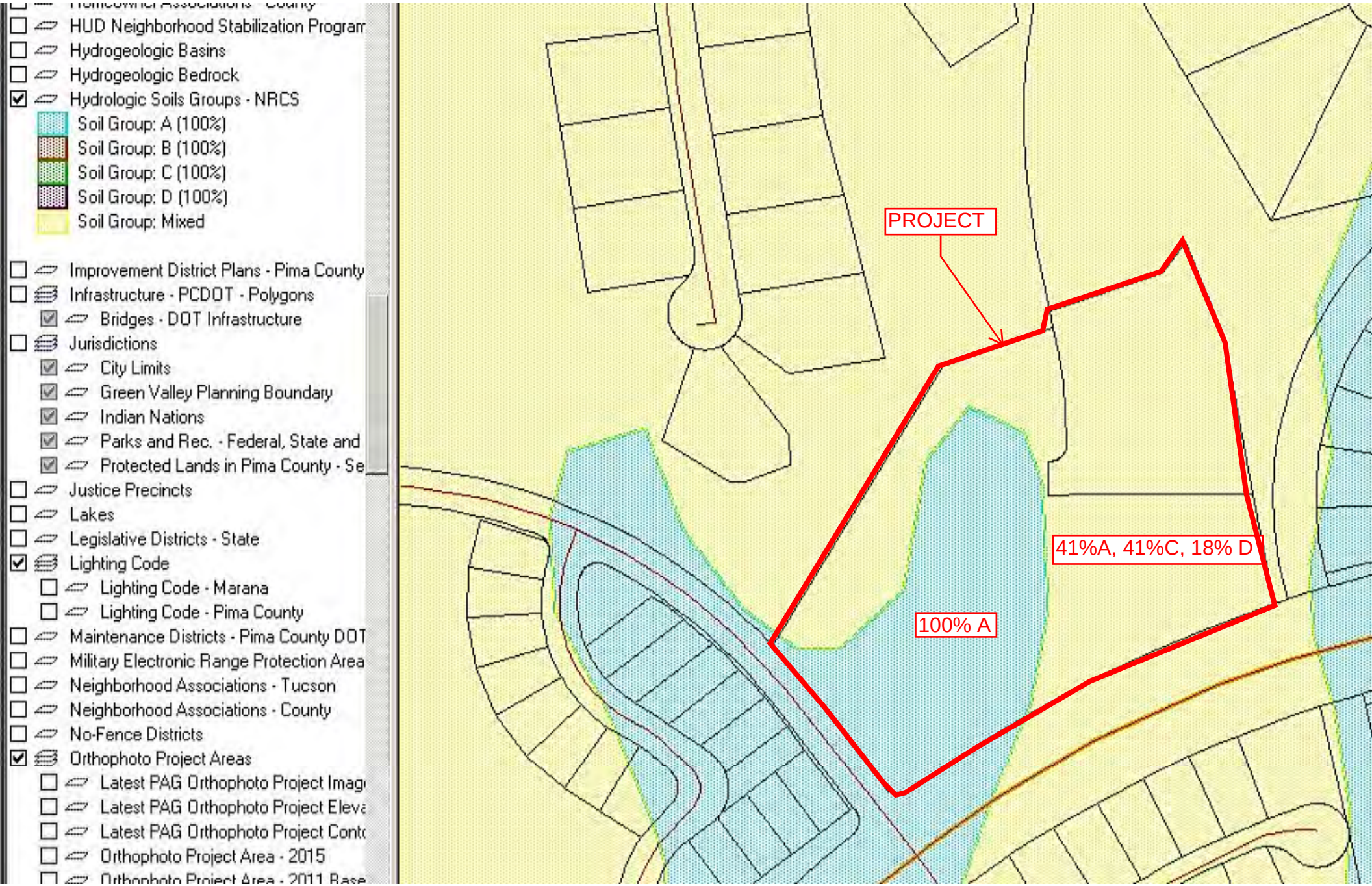
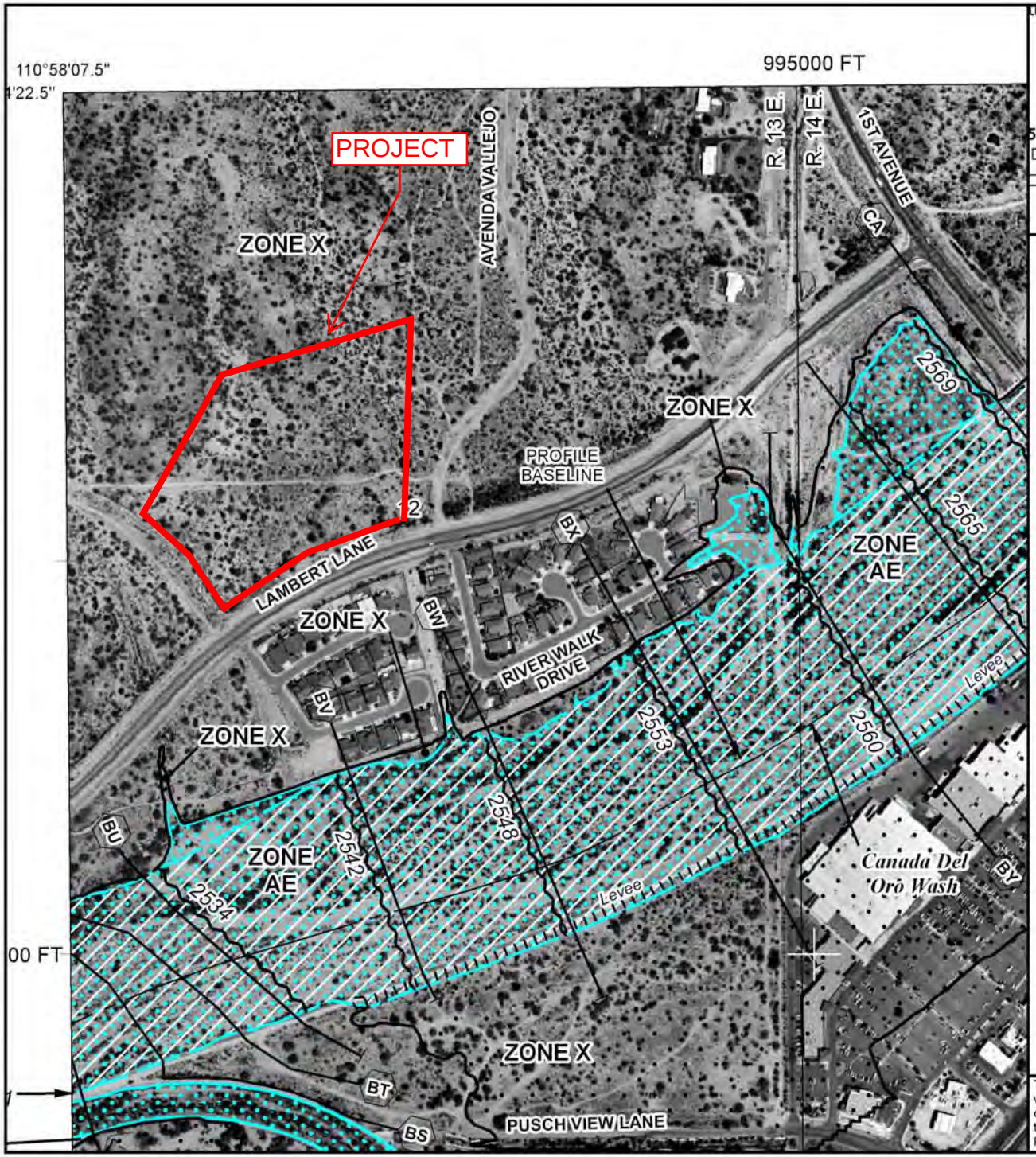


Figure 2b - Rivers Edge - Soils Map
04/11/19



tional Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

50 0 500 1000

FEET

METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1089L

FIRM

FLOOD INSURANCE RATE MAP

PIMA COUNTY, ARIZONA
AND INCORPORATED AREAS

PANEL 1089 OF 4750

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

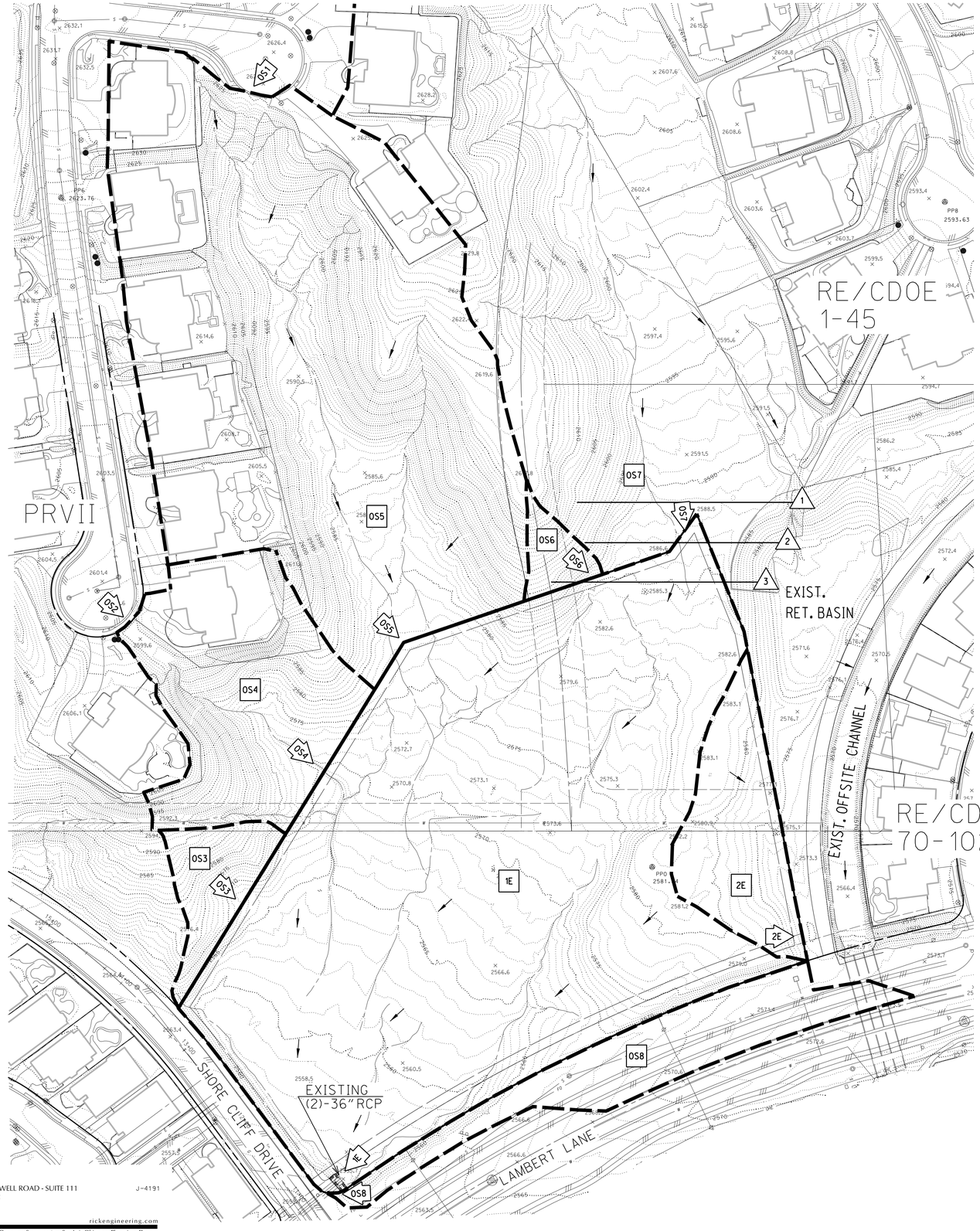
COMMUNITY	NUMBER	PANEL	SUFFIX
ORO VALLEY, TOWN OF	040109	1089	L
PIMA COUNTY	040073	1089	L

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

MAP NUMBER
04019C1089L

MAP REVISED
JUNE 16, 2011

Federal Emergency Management Agency



SCALE: 1"= 60'
CONTOUR INTERVAL: 1'

0' 30' 60' 120'

LEGEND

- 1 — WATERSHED
- 1 — CONCENTRATION POINT
- 1 — 1 — HYDRAULIC CROSS SECTIONS
- 1 — FLO-2D CROSS SECTIONS
- FLOW DIRECTION
- WATERSHED BOUNDARY

OFFSITE PEAK FLOWS								
WATERSHED CPs	AREA [ac]	Q100 [cfs]	CUMULATIVE CPs	CUMULATIVE AREA [ac]	CUMULATIVE Q2 [cfs]	CUMULATIVE Q10 [cfs]	CUMULATIVE Q25 [cfs]	CUMULATIVE Q100 [cfs]
OS1*	1.9	13	-	-	1	5	7	13
OS2*	2.8	19	-	-	2	7	11	19
OS3	0.3	2	-	-	0.2	1	1	2
OS4	1.2	8	OS2+OS4	4.0	3	10	14	27
OS5	4.8	35	OS1+OS5	6.7	7	17	28	48
OS6	0.1	1	-	-	0.1	0.2	0.3	1
OS7	37.0	179**	-	37.0	5.0	17	24	47***
OS8	0.7	5	-	-	1	2	2	5

* Per the 'Hydrologic and Hydraulic Report for Pusch Ridge Vistas II' prepared by Stantec Consulting Inc. dated September 19, 2003 (applicable portions included in the Attachments to this memo).

** Per 'Rivers Edge/Canada Del Oro Estates Lots 1-45 and Common Area A and B', prepared by Stantec Consulting Inc. dated January 25, 2006 (applicable portions included in the Attachments to this memo).

***Split flow conveying onto project boundary, per Flow2D model.

EXISTING PEAK FLOWS										
WATERSHED CPs	AREA [ac]	Q2 [cfs]	Q10 [cfs]	Q25 [cfs]	Q100 [cfs]	CUMULATIVE CPs	CUMULATIVE Q2 [cfs]	CUMULATIVE Q10 [cfs]	CUMULATIVE Q25 [cfs]	CUMULATIVE Q100 [cfs]
1E	5.9	4	11	14	36	OS3+OS4+OS5+OS6+ OS8+1E	15*	39*	53*	117*
2E	0.6	0.4	1	2	4	-	0.4	1	2	4

*Per HEC-HMS

FIGURE 4 - OFFSITE & EXISTING DRAINAGE MAP

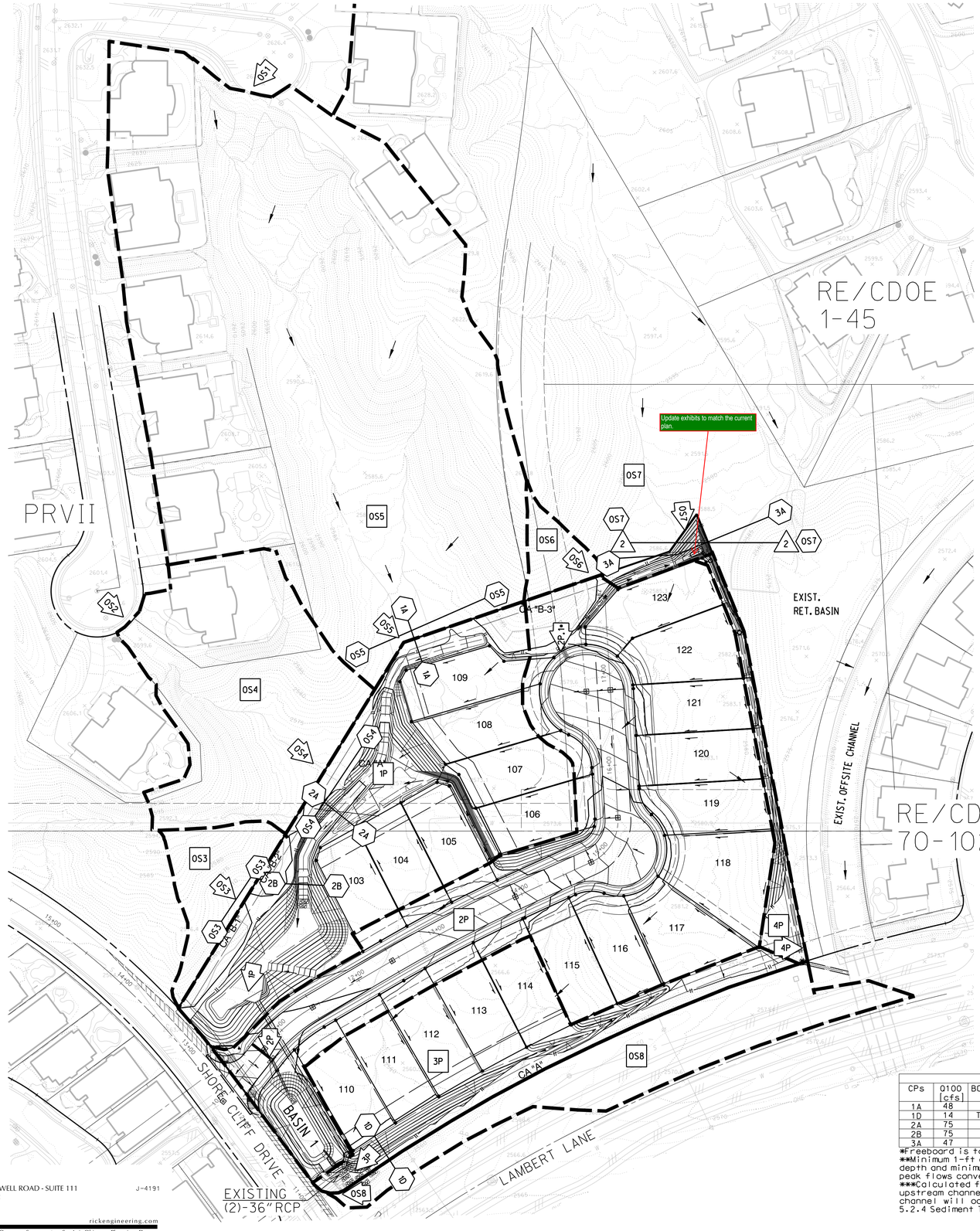
RIVERS EDGE

A PORTION OF SECTION 12, TOWNSHIP 12 SOUTH, RANGE 13 EAST, GILA & SALT RIVER MERIDIAN, TUCSON, PIMA COUNTY, ARIZONA.

SHEET 1 OF 1

RICK ENGINEERING COMPANY
Tucson
3945 EAST FORT LOWELL ROAD - SUITE 111
TUCSON, AZ 85712
520-795-1000
(FAX) 520-322-6956
J-4191
rickengineering.com
San Diego - Riverside - Orange - Sacramento - San Luis Obispo - Phoenix - Denver

July 30, 2019



LEGEND

- WATERSHED
- CONCENTRATION POINT
- HYDRAULIC CROSS SECTIONS
- FLO-2D CROSS SECTIONS
- FLOW DIRECTION
- WATERSHED BOUNDARY

SCALE: 1"= 60'
CONTOUR INTERVAL: 1'
0' 30' 60' 120'

OFFSITE PEAK FLOWS								
WATERSHED CPs	AREA [ac]	Q100 [cfs]	CUMULATIVE CPs	CUMULATIVE AREA [ac]	CUMULATIVE Q2 [cfs]	CUMULATIVE Q10 [cfs]	CUMULATIVE Q25 [cfs]	CUMULATIVE Q100 [cfs]
OS1*	1.9	13	-	-	1	5	7	13
OS2*	2.8	19	-	-	2	7	11	19
OS3	0.3	2	-	-	0.2	1	1	2
OS4	1.2	8	OS2+OS4	4.0	3	10	14	27
OS5	4.8	35	OS1+OS5	6.7	7	17	28	48
OS6	0.1	1	-	-	0.1	0.2	0.3	1
OS7	37.0	179**	-	37.0	5.0	17	24	47***
OS8	0.7	5	-	-	1	2	2	5

* Per the 'Hydrologic and Hydraulic Report for Pusch Ridge Vistas II' prepared by Stantec Consulting Inc. dated September 19, 2003 (applicable portions included in the Attachments to this memo).

** Per 'Rivers Edge/Canada Del Oro Estates Lots 1-45 and Common Area A and B', prepared by Stantec Consulting Inc. dated January 25, 2006 (applicable portions included in the Attachments to this memo).

***Split flow conveying onto project boundary, per Flow2D model.

PROPOSED PEAK FLOWS								
WATERSHED CPs	AREA [ac]	Q100 [cfs]	CUMULATIVE CPs	CUMULATIVE AREA [ac]	CUMULATIVE Q2 [cfs]	CUMULATIVE Q10 [cfs]	CUMULATIVE Q25 [cfs]	CUMULATIVE Q100 [cfs]
1P	2.0	15	OS3+OS4+OS5+1P	-	13.0	33.0	49.0	92
2P	3.2	24	OS6+2P	3.3	5	9	11	25
3P	1.1	9	CP1P + CP2P + 3P + OS8	-	12	33	46	104*
4P	0.2	1	-	-	0.1	0.3	0.4	1

*Per HEC-HMS

LOCALIZED PEAK FLOWS					
WATERSHED CPs	AREA [ac]	Q100 [cfs]	CUMULATIVE CPs	CUMULATIVE AREA [ac]	CUMULATIVE Q100 [cfs]
2P.1*	0.3	2	-	-	-

* CP for Local analysis only and is based on a unit peak flow of

EXISTING VS. PROPOSED RUNOFF EXITING PROJECT SITE									
WATERSHED CPs		2-YEAR DISCHARGE [cfs]		10-YEAR DISCHARGE [cfs]		25-YEAR DISCHARGE [cfs]		100-YEAR DISCHARGE [cfs]	
EXISTING	PROPOSED	EXISTING	PROPOSED	EXISTING	PROPOSED	EXISTING	PROPOSED	EXISTING	PROPOSED
1E*	3P*	15	11	39	34	53	48	117	110
2E	4P	0	0.1	1	0.3	2	0.4	4	1

*Includes offsite

DETENTION/RETENTION BASIN SUMMARY								
BASIN	Q100 IN [cfs]	Q100 OUT [cfs]	V100 [ac-ft]	WSEL Elev.	BASIN TOP Elev. (ft)	BASIN BOTTOM Elev. (ft)	WEIR Elev. (ft)	WEIR LENGTH [ft]
48" Culvert Under Entrance Road (CP	91	73	NA	NA	NA	NA	NA	NA
BASIN 1 SOUTH	25	22	0.2	60.7	61	58	59.9	10

*Added to Basin summary to show 100-year detention that occurs as byproduct of inlet control 48" Culvert under Entrance Road

SIDEWALK SCUPPERS SUMMARY			
LOCATION	Q100 [cfs]	# OF CELLS	TYPE*
CPs			
2P.1	2	1	2

*Per PC/COT Standard Details for Public Improvements

GRATE INLET SUMMARY				
CPs	Q100 [cfs]	# OF GRATES	GRATE TYPE	HEADWATER Elev.
2P	3	1	1	0.5
2P	22*	22-ft Transverse Grate in 2-ft	R-4999-L6 Neenah Bolted Transverse	0.5

*Bypass flow from Type 1 Catch Basin

CULVERT SUMMARY							
CPs	Q100 [cfs]	# OF PIPES	DIAMETER [in]	LENGTH [ft]	U.S. INVERT Elev.	D.S. INVERT Elev.	HEADWATER Elev.
1P	92	1	48	207	57.4	56	62.4
2P	24	1	24	41	59	58	62.6
OS7	47	1	36	NA	78.7	64.7	82.6

STORM DRAIN SUMMARY					
STORM DRAIN MEMBER	Q100 [cfs]	DIAMETER [in]	LENGTH [ft]	U.S. INVERT Elev.	D.S. INVERT Elev.
SD36-1	47	36	97.6	2578.7	2575
SD36-2	47	36	364.4	2575	2565
SD36-3	47	36	51.5	2564	2563

CHANNEL SUMMARY						
CPs	Q100 [cfs]	BOTTOM WIDTH [ft]	SLOPE [ft/ft]	FLOW DEPTH [ft]	FREEBOARD [ft]	(MIN) CHANNEL DEPTH [ft]
1A	48	10	0.025	0.7	1.7*	2.4
1D	14	TRIANGULAR	0.024	0.8	1.0**	5
2A	75	10	0.025	0.9	1	1.9
2B	75	10	0.167	0.5	5.5	6
3A	47	NA	0.4	0.6	1.8***	2.4

*Freeboard is taken at upstream end of channel to the adjacent pad elevation
**Minimum 1-ft of freeboard is provided throughout the onsite channel. flow depth and minimum channel depth is taken at most conservative location where peak flows converge.
***Calculated for Sediment Transport calculations. Minimal flow enters the upstream channel from the floodplain bank, majority of sediment in the channel will occur at the thalweg where cross section 3A is located. See 5.2.4 Sediment Transport section for additional information.

FIGURE 5 - OFFSITE & PROPOSED DRAINAGE MAP

RIVERS EDGE

A PORTION OF SECTION 12, TOWNSHIP 12 SOUTH, RANGE 13 EAST, GILA & SALT RIVER MERIDIAN, TUCSON, PIMA COUNTY, ARIZONA.

July 30, 2019

SHEET 1 OF 1

RICK ENGINEERING COMPANY
Tucson
3945 EAST FORT LOWELL ROAD - SUITE 111
TUCSON, AZ 85712
520-795-1000
(FAX) 520-322-6956
rickengineering.com
San Diego - Riverside - Orange - Sacramento - San Luis Obispo - Phoenix - Denver
J-4191

APPENDIX B – HYDROLOGIC DATA SHEETS

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by: LAV

Project Name: River's Edge | Date: 05/16/18

Concentration Point: OS3 | Job #: 4191

Watershed Area: 0.3 ac | Watershed Type: Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	27.0	144	0.1875	.035

Length of Watercourse (Lc): 144 feet | Mean Slope: 0.1875

Length to Cen. of Gravity (Lca): 72 feet | Weighted Basin Fac.: 0.035

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 2-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.25	0.68	0.84	1.25	1.26	1.37	1.45	1.62	1.80	1.92
Areal Values (in)	0.25	0.68	0.84	1.25	1.26	1.37	1.45	1.62	1.80	1.92

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	41	83.	80.43	0.148
C	41	88.	85.72	0.263
D	18	91.	88.97	0.361
Imp.	0	99.	99.	0.000

Weighted Runoff Coef. (Cw): 0.233

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 3.00 in/hr

Runoff Supply Rate (q) @ Tc: 0.70 in/hr

PEAK DISCHARGE: 0.2 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by: LAV

Project Name: River's Edge | Date: 05/16/18

Concentration Point: OS3 | Job #: 4191

Watershed Area: 0.3 ac | Watershed Type: Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	27.0	144	0.1875	.035

Length of Watercourse (Lc): 144 feet | Mean Slope: 0.1875

Length to Cen. of Gravity (Lca): 72 feet | Weighted Basin Fac.: 0.035

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 10-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.35	0.92	1.18	1.50	1.87	2.08	2.23	2.52	3.00	3.36
Areal Values (in)	0.35	0.92	1.18	1.50	1.87	2.08	2.23	2.52	3.00	3.36

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	41	83.	84.53	0.363
C	41	88.	88.91	0.490
D	18	91.	91.59	0.584
Imp.	0	99.	99.	0.000

Weighted Runoff Coef. (Cw): 0.455

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 4.20 in/hr

Runoff Supply Rate (q) @ Tc: 1.91 in/hr

PEAK DISCHARGE: 0.6 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by: LAV

Project Name: River's Edge | Date: 05/16/18

Concentration Point: OS3 | Job #: 4191

Watershed Area: 0.3 ac | Watershed Type: Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	27.0	144	0.1875	.035

Length of Watercourse (Lc): 144 feet | Mean Slope: 0.1875

Length to Cen. of Gravity (Lca): 72 feet | Weighted Basin Fac.: 0.035

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 25-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.40	1.08	1.38	1.68	2.22	2.49	2.67	3.00	3.42	3.96
Areal Values (in)	0.40	1.08	1.38	1.68	2.22	2.49	2.67	3.00	3.42	3.96

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	41	83.	85.86	0.455
C	41	88.	89.95	0.577
D	18	91.	92.44	0.663
Imp.	0	99.	99.	0.000

Weighted Runoff Coef. (Cw): 0.542

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 4.80 in/hr

Runoff Supply Rate (q) @ Tc: 2.60 in/hr

PEAK DISCHARGE: 0.8 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by: LAV

Project Name: River's Edge | Date: 05/16/18

Concentration Point: OS3 | Job #: 4191

Watershed Area: 0.3 ac | Watershed Type: Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	27.0	144	0.1875	.035

Length of Watercourse (Lc): 144 feet | Mean Slope: 0.1875

Length to Cen. of Gravity (Lca): 72 feet | Weighted Basin Fac.: 0.035

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 100-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.83	1.33	1.63	2.25	2.77	3.12	3.35	3.90	4.32	4.80
Areal Values (in)	0.83	1.33	1.63	2.25	2.77	3.12	3.35	3.90	4.32	4.80

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	41	83.	87.28	0.564
C	41	88.	91.05	0.672
D	18	91.	93.35	0.746
Imp.	0	99.	99.	0.000

Weighted Runoff Coef. (Cw): 0.641

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 9.96 in/hr

Runoff Supply Rate (q) @ Tc: 6.38 in/hr

PEAK DISCHARGE: 1.9 cfs

Lesser Return Periods

Return Period	Ratio	Qpeak
2-year	0.10	0.2
5-year	0.23	0.4
10-year	0.35	0.7
25-year	0.55	1.1
50-year	0.75	1.4

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by: LAV

Project Name: River's Edge | Date: 05/16/18

Concentration Point: OS4 | Job #: 4191

Watershed Area: 1.2 ac | Watershed Type: Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	42.0	270	0.1556	.032

Length of Watercourse (Lc): 270 feet | Mean Slope: 0.1556

Length to Cen. of Gravity (Lca): 135 feet | Weighted Basin Fac.: 0.032

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 2-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.25	0.68	0.84	1.25	1.26	1.37	1.45	1.62	1.80	1.92
Areal Values (in)	0.25	0.68	0.84	1.25	1.26	1.37	1.45	1.62	1.80	1.92

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	41	83.	80.43	0.148
C	41	88.	85.72	0.263
D	18	91.	88.97	0.361
Imp.	10	99.	99.	0.910

Weighted Runoff Coef. (Cw): 0.301

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 3.00 in/hr

Runoff Supply Rate (q) @ Tc: 0.90 in/hr

PEAK DISCHARGE: 1.1 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by: LAV

Project Name: River's Edge | Date: 05/16/18

Concentration Point: OS4 | Job #: 4191

Watershed Area: 1.2 ac | Watershed Type: Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	42.0	270	0.1556	.032

Length of Watercourse (Lc): 270 feet | Mean Slope: 0.1556

Length to Cen. of Gravity (Lca): 135 feet | Weighted Basin Fac.: 0.032

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 10-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.35	0.92	1.18	1.50	1.87	2.08	2.23	2.52	3.00	3.36
Areal Values (in)	0.35	0.92	1.18	1.50	1.87	2.08	2.23	2.52	3.00	3.36

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	41	83.	84.53	0.363
C	41	88.	88.91	0.490
D	18	91.	91.59	0.584
Imp.	10	99.	99.	0.938

Weighted Runoff Coef. (Cw): 0.503

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 4.20 in/hr

Runoff Supply Rate (q) @ Tc: 2.11 in/hr

PEAK DISCHARGE: 2.6 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by: LAV

Project Name: River's Edge | Date: 05/16/18

Concentration Point: OS4 | Job #: 4191

Watershed Area: 1.2 ac | Watershed Type: Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	42.0	270	0.1556	.032

Length of Watercourse (Lc): 270 feet | Mean Slope: 0.1556

Length to Cen. of Gravity (Lca): 135 feet | Weighted Basin Fac.: 0.032

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 25-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.40	1.08	1.38	1.68	2.22	2.49	2.67	3.00	3.42	3.96
Areal Values (in)	0.40	1.08	1.38	1.68	2.22	2.49	2.67	3.00	3.42	3.96

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	41	83.	85.86	0.455
C	41	88.	89.95	0.577
D	18	91.	92.44	0.663
Imp.	10	99.	99.	0.947

Weighted Runoff Coef. (Cw): 0.583

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 4.80 in/hr

Runoff Supply Rate (q) @ Tc: 2.80 in/hr

PEAK DISCHARGE: 3.4 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by: LAV

Project Name: River's Edge | Date: 05/16/18

Concentration Point: OS4 | Job #: 4191

Watershed Area: 1.2 ac | Watershed Type: Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	42.0	270	0.1556	.032

Length of Watercourse (Lc): 270 feet | Mean Slope: 0.1556

Length to Cen. of Gravity (Lca): 135 feet | Weighted Basin Fac.: 0.032

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 100-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.83	1.33	1.63	2.25	2.77	3.12	3.35	3.90	4.32	4.80
Areal Values (in)	0.83	1.33	1.63	2.25	2.77	3.12	3.35	3.90	4.32	4.80

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	41	83.	87.28	0.564
C	41	88.	91.05	0.672
D	18	91.	93.35	0.746
Imp.	10	99.	99.	0.958

Weighted Runoff Coef. (Cw): 0.673

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 9.96 in/hr

Runoff Supply Rate (q) @ Tc: 6.70 in/hr

PEAK DISCHARGE: 8.1 cfs

Lesser Return Periods

Return Period	Ratio	Qpeak
2-year	0.15	1.2
5-year	0.28	2.3
10-year	0.40	3.2
25-year	0.60	4.9
50-year	0.80	6.5

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by: LAV

Project Name: River's Edge | Date: 05/16/18

Concentration Point: OS5 | Job #: 4191

Watershed Area: 4.8 ac | Watershed Type: Suburban-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	53.0	700	0.0757	.032

Length of Watercourse (Lc): 700 feet | Mean Slope: 0.0757

Length to Cen. of Gravity (Lca): 350 feet | Weighted Basin Fac.: 0.032

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 2-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.25	0.68	0.84	1.25	1.26	1.37	1.45	1.62	1.80	1.92
Areal Values (in)	0.25	0.68	0.84	1.25	1.26	1.37	1.45	1.62	1.80	1.92

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	41	83.	80.43	0.148
C	41	88.	85.72	0.263
D	18	91.	88.97	0.361
Imp.	25	99.	99.	0.910

Weighted Runoff Coef. (Cw): 0.403

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 3.00 in/hr

Runoff Supply Rate (q) @ Tc: 1.21 in/hr

PEAK DISCHARGE: 5.8 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by: LAV

Project Name: River's Edge | Date: 05/16/18

Concentration Point: OS5 | Job #: 4191

Watershed Area: 4.8 ac | Watershed Type: Suburban-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	53.0	700	0.0757	.032

Length of Watercourse (Lc): 700 feet | Mean Slope: 0.0757

Length to Cen. of Gravity (Lca): 350 feet | Weighted Basin Fac.: 0.032

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 10-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.35	0.92	1.18	1.50	1.87	2.08	2.23	2.52	3.00	3.36
Areal Values (in)	0.35	0.92	1.18	1.50	1.87	2.08	2.23	2.52	3.00	3.36

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	41	83.	84.53	0.363
C	41	88.	88.91	0.490
D	18	91.	91.59	0.584
Imp.	25	99.	99.	0.938

Weighted Runoff Coef. (Cw): 0.575

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 4.20 in/hr

Runoff Supply Rate (q) @ Tc: 2.42 in/hr

PEAK DISCHARGE: 12 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by: LAV

Project Name: River's Edge | Date: 05/16/18

Concentration Point: OS5 | Job #: 4191

Watershed Area: 4.8 ac | Watershed Type: Suburban-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	53.0	700	0.0757	.032

Length of Watercourse (Lc): 700 feet | Mean Slope: 0.0757

Length to Cen. of Gravity (Lca): 350 feet | Weighted Basin Fac.: 0.032

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 25-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.40	1.08	1.38	1.68	2.22	2.49	2.67	3.00	3.42	3.96
Areal Values (in)	0.40	1.08	1.38	1.68	2.22	2.49	2.67	3.00	3.42	3.96

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	41	83.	85.86	0.455
C	41	88.	89.95	0.577
D	18	91.	92.44	0.663
Imp.	25	99.	99.	0.947

Weighted Runoff Coef. (Cw): 0.644

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 4.80 in/hr

Runoff Supply Rate (q) @ Tc: 3.09 in/hr

PEAK DISCHARGE: 15 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by: LAV

Project Name: River's Edge | Date: 05/16/18

Concentration Point: OS5 | Job #: 4191

Watershed Area: 4.8 ac | Watershed Type: Suburban-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	53.0	700	0.0757	.032

Length of Watercourse (Lc): 700 feet | Mean Slope: 0.0757

Length to Cen. of Gravity (Lca): 350 feet | Weighted Basin Fac.: 0.032

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 100-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.83	1.33	1.63	2.25	2.77	3.12	3.35	3.90	4.32	4.80
Areal Values (in)	0.83	1.33	1.63	2.25	2.77	3.12	3.35	3.90	4.32	4.80

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	41	83.	87.28	0.564
C	41	88.	91.05	0.672
D	18	91.	93.35	0.746
Imp.	25	99.	99.	0.958

Weighted Runoff Coef. (Cw): 0.720

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 9.96 in/hr

Runoff Supply Rate (q) @ Tc: 7.17 in/hr

PEAK DISCHARGE: 35 cfs

Lesser Return Periods

Return Period	Ratio	Qpeak
2-year	0.15	5.2
5-year	0.28	9.7
10-year	0.40	14
25-year	0.60	21
50-year	0.80	28

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by: LAV

Project Name: River's Edge | Date: 05/16/18

Concentration Point: OS6 | Job #: 4191

Watershed Area: 0.1 ac | Watershed Type: Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	30.0	126	0.2381	.035

Length of Watercourse (Lc): 126 feet | Mean Slope: 0.2381

Length to Cen. of Gravity (Lca): 63 feet | Weighted Basin Fac.: 0.035

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 2-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.25	0.68	0.84	1.25	1.26	1.37	1.45	1.62	1.80	1.92
Areal Values (in)	0.25	0.68	0.84	1.25	1.26	1.37	1.45	1.62	1.80	1.92

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	41	83.	80.43	0.148
C	41	88.	85.72	0.263
D	18	91.	88.97	0.361
Imp.	0	99.	99.	0.000

Weighted Runoff Coef. (Cw): 0.233

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 3.00 in/hr

Runoff Supply Rate (q) @ Tc: 0.70 in/hr

PEAK DISCHARGE: 0.1 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by: LAV

Project Name: River's Edge | Date: 05/16/18

Concentration Point: OS6 | Job #: 4191

Watershed Area: 0.1 ac | Watershed Type: Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	30.0	126	0.2381	.035

Length of Watercourse (Lc): 126 feet | Mean Slope: 0.2381

Length to Cen. of Gravity (Lca): 63 feet | Weighted Basin Fac.: 0.035

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 10-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.35	0.92	1.10	1.50	1.87	2.08	2.23	2.52	3.00	3.36
Areal Values (in)	0.35	0.92	1.10	1.50	1.87	2.08	2.23	2.52	3.00	3.36

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	41	83.	84.53	0.363
C	41	88.	88.91	0.490
D	18	91.	91.59	0.584
Imp.	0	99.	99.	0.000

Weighted Runoff Coef. (Cw): 0.455

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 4.20 in/hr

Runoff Supply Rate (q) @ Tc: 1.91 in/hr

PEAK DISCHARGE: 0.2 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by: LAV

Project Name: River's Edge | Date: 05/16/18

Concentration Point: OS6 | Job #: 4191

Watershed Area: 0.1 ac | Watershed Type: Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	30.0	126	0.2381	.035

Length of Watercourse (Lc): 126 feet | Mean Slope: 0.2381

Length to Cen. of Gravity (Lca): 63 feet | Weighted Basin Fac.: 0.035

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 25-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.40	1.08	1.38	1.68	2.22	2.49	2.67	3.00	3.42	3.96
Areal Values (in)	0.40	1.08	1.38	1.68	2.22	2.49	2.67	3.00	3.42	3.96

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	41	83.	85.86	0.455
C	41	88.	89.95	0.577
D	18	91.	92.44	0.663
Imp.	0	99.	99.	0.000

Weighted Runoff Coef. (Cw): 0.542

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 4.80 in/hr

Runoff Supply Rate (q) @ Tc: 2.60 in/hr

PEAK DISCHARGE: 0.3 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by: LAV

Project Name: River's Edge | Date: 05/16/18

Concentration Point: OS6 | Job #: 4191

Watershed Area: 0.1 ac | Watershed Type: Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	30.0	126	0.2381	.035

Length of Watercourse (Lc): 126 feet | Mean Slope: 0.2381

Length to Cen. of Gravity (Lca): 63 feet | Weighted Basin Fac.: 0.035

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 100-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.83	1.33	1.63	2.25	2.77	3.12	3.35	3.90	4.32	4.80
Areal Values (in)	0.83	1.33	1.63	2.25	2.77	3.12	3.35	3.90	4.32	4.80

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	41	83.	87.28	0.564
C	41	88.	91.05	0.672
D	18	91.	93.35	0.746
Imp.	0	99.	99.	0.000

Weighted Runoff Coef. (Cw): 0.641

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 9.96 in/hr

Runoff Supply Rate (q) @ Tc: 6.38 in/hr

PEAK DISCHARGE: 0.6 cfs

Lesser Return Periods

Return Period	Ratio	Qpeak
2-year	0.10	0.1
5-year	0.23	0.1
10-year	0.35	0.2
25-year	0.55	0.4
50-year	0.75	0.5

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by: LAV

Project Name: River's Edge | Date: 05/16/18

Concentration Point: OS8 | Job #: 4191

Watershed Area: 0.7 ac | Watershed Type: Mixed

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	18.0	660	0.0273	.028

Length of Watercourse (Lc): 660 feet | Mean Slope: 0.0273

Length to Cen. of Gravity (Lca): 330 feet | Weighted Basin Fac.: 0.028

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 2-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.25	0.68	0.84	1.25	1.26	1.37	1.45	1.62	1.80	1.92
Areal Values (in)	0.25	0.68	0.84	1.25	1.26	1.37	1.45	1.62	1.80	1.92

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	41	83.	80.43	0.148
C	41	88.	85.72	0.263
D	18	91.	88.97	0.361
Imp.	25	99.	99.	0.910

Weighted Runoff Coef. (Cw): 0.403

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 3.00 in/hr

Runoff Supply Rate (q) @ Tc: 1.21 in/hr

PEAK DISCHARGE: 0.9 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by: LAV

Project Name: River's Edge | Date: 05/16/18

Concentration Point: OS8 | Job #: 4191

Watershed Area: 0.7 ac | Watershed Type: Mixed

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	18.0	660	0.0273	.028

Length of Watercourse (Lc): 660 feet | Mean Slope: 0.0273

Length to Cen. of Gravity (Lca): 330 feet | Weighted Basin Fac.: 0.028

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 10-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.35	0.92	1.18	1.50	1.87	2.08	2.23	2.52	3.00	3.36
Areal Values (in)	0.35	0.92	1.18	1.50	1.87	2.08	2.23	2.52	3.00	3.36

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	41	83.	84.53	0.363
C	41	88.	88.91	0.490
D	18	91.	91.59	0.584
Imp.	25	99.	99.	0.938

Weighted Runoff Coef. (Cw): 0.575

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 4.20 in/hr

Runoff Supply Rate (q) @ Tc: 2.42 in/hr

PEAK DISCHARGE: 1.7 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by: LAV

Project Name: River's Edge | Date: 05/16/18

Concentration Point: OS8 | Job #: 4191

Watershed Area: 0.7 ac | Watershed Type: Mixed

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	18.0	660	0.0273	.028

Length of Watercourse (Lc): 660 feet | Mean Slope: 0.0273

Length to Cen. of Gravity (Lca): 330 feet | Weighted Basin Fac.: 0.028

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 25-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.40	1.08	1.38	1.68	2.22	2.49	2.67	3.00	3.42	3.96
Areal Values (in)	0.40	1.08	1.38	1.68	2.22	2.49	2.67	3.00	3.42	3.96

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	41	83.	85.86	0.455
C	41	88.	89.95	0.577
D	18	91.	92.44	0.663
Imp.	25	99.	99.	0.947

Weighted Runoff Coef. (Cw): 0.644

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 4.80 in/hr

Runoff Supply Rate (q) @ Tc: 3.09 in/hr

PEAK DISCHARGE: 2.2 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by: LAV

Project Name: River's Edge | Date: 05/16/18

Concentration Point: OS8 | Job #: 4191

Watershed Area: 0.7 ac | Watershed Type: Mixed

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	18.0	660	0.0273	.028

Length of Watercourse (Lc): 660 feet | Mean Slope: 0.0273

Length to Cen. of Gravity (Lca): 330 feet | Weighted Basin Fac.: 0.028

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 100-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.83	1.33	1.63	2.25	2.77	3.12	3.35	3.90	4.32	4.80
Areal Values (in)	0.83	1.33	1.63	2.25	2.77	3.12	3.35	3.90	4.32	4.80

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	41	83.	87.28	0.564
C	41	88.	91.05	0.672
D	18	91.	93.35	0.746
Imp.	25	99.	99.	0.958

Weighted Runoff Coef. (Cw): 0.720

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 9.96 in/hr

Runoff Supply Rate (q) @ Tc: 7.17 in/hr

PEAK DISCHARGE: 5.1 cfs

Lesser Return Periods

Return Period	Ratio	Qpeak
2-year	0.15	0.8
5-year	0.28	1.4
10-year	0.40	2.0
25-year	0.60	3.0
50-year	0.80	4.0

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by:

Project Name: River's Edge | Date: 05/16/18

Concentration Point: 1E | Job #: 4191

Watershed Area: 5.9 ac | Watershed Type: Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	32.0	854	0.0375	.035

Length of Watercourse (Lc): 854 feet | Mean Slope: 0.0375

Length to Cen. of Gravity (Lca): 427 feet | Weighted Basin Fac.: 0.035

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 2-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.25	0.68	0.84	1.25	1.26	1.37	1.45	1.62	1.80	1.92
Areal Values (in)	0.25	0.68	0.84	1.25	1.26	1.37	1.45	1.62	1.80	1.92

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	71	83.	80.43	0.148
C	20	88.	85.72	0.263
D	9	91.	88.97	0.361
Imp.	0	99.	99.	0.000

Weighted Runoff Coef. (Cw): 0.190

Time of Concentration: 8.2 min

Rainfall Intensity (i) @ Tc: 3.85 in/hr

Runoff Supply Rate (q) @ Tc: 0.73 in/hr

PEAK DISCHARGE: 4.3 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by:

Project Name: River's Edge | Date: 05/16/18

Concentration Point: 1E | Job #: 4191

Watershed Area: 5.9 ac | Watershed Type: Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	32.0	854	0.0375	.035

Length of Watercourse (Lc): 854 feet | Mean Slope: 0.0375

Length to Cen. of Gravity (Lca): 427 feet | Weighted Basin Fac.: 0.035

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 10-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.35	0.92	1.18	1.50	1.87	2.08	2.23	2.52	3.00	3.36
Areal Values (in)	0.35	0.92	1.18	1.50	1.87	2.08	2.23	2.52	3.00	3.36

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	71	83.	84.53	0.363
C	20	88.	88.91	0.490
D	9	91.	91.59	0.584
Imp.	0	99.	99.	0.000

Weighted Runoff Coef. (Cw): 0.408

Time of Concentration: 5.7 min

Rainfall Intensity (i) @ Tc: 4.52 in/hr

Runoff Supply Rate (q) @ Tc: 1.84 in/hr

PEAK DISCHARGE: 11 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by:

Project Name: River's Edge | Date: 05/16/18

Concentration Point: 1E | Job #: 4191

Watershed Area: 5.9 ac | Watershed Type: Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	32.0	854	0.0375	.035

Length of Watercourse (Lc): 854 feet | Mean Slope: 0.0375

Length to Cen. of Gravity (Lca): 427 feet | Weighted Basin Fac.: 0.035

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 25-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.40	1.08	1.38	1.68	2.22	2.49	2.67	3.00	3.42	3.96
Areal Values (in)	0.40	1.08	1.38	1.68	2.22	2.49	2.67	3.00	3.42	3.96

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	71	83.	85.86	0.455
C	20	88.	89.95	0.577
D	9	91.	92.44	0.663
Imp.	0	99.	99.	0.000

Weighted Runoff Coef. (Cw): 0.498

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 4.80 in/hr

Runoff Supply Rate (q) @ Tc: 2.39 in/hr

PEAK DISCHARGE: 14 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by:

Project Name: River's Edge | Date: 05/16/18

Concentration Point: 1E | Job #: 4191

Watershed Area: 5.9 ac | Watershed Type: Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	32.0	854	0.0375	.035

Length of Watercourse (Lc): 854 feet | Mean Slope: 0.0375

Length to Cen. of Gravity (Lca): 427 feet | Weighted Basin Fac.: 0.035

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 100-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.83	1.33	1.63	2.25	2.77	3.12	3.35	3.90	4.32	4.80
Areal Values (in)	0.83	1.33	1.63	2.25	2.77	3.12	3.35	3.90	4.32	4.80

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	71	83.	87.28	0.564
C	20	88.	91.05	0.672
D	9	91.	93.35	0.746
Imp.	0	99.	99.	0.000

Weighted Runoff Coef. (Cw): 0.602

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 9.96 in/hr

Runoff Supply Rate (q) @ Tc: 5.99 in/hr

PEAK DISCHARGE: 36 cfs

Lesser Return Periods

Return Period	Ratio	Qpeak
2-year	0.10	3.6
5-year	0.23	8.2
10-year	0.35	12
25-year	0.55	20
50-year	0.75	27

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by:

Project Name: River's Edge | Date: 05/16/18

Concentration Point: 2E | Job #: 4191

Watershed Area: 0.6 ac | Watershed Type: Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	10.0	326	0.0307	.035

Length of Watercourse (Lc): 326 feet | Mean Slope: 0.0307

Length to Cen. of Gravity (Lca): 163 feet | Weighted Basin Fac.: 0.035

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 2-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.25	0.68	0.84	1.25	1.26	1.37	1.45	1.62	1.80	1.92
Areal Values (in)	0.25	0.68	0.84	1.25	1.26	1.37	1.45	1.62	1.80	1.92

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	41	83.	80.43	0.148
C	41	88.	85.72	0.263
D	18	91.	88.97	0.361
Imp.	0	99.	99.	0.000

Weighted Runoff Coef. (Cw): 0.233

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 3.00 in/hr

Runoff Supply Rate (q) @ Tc: 0.70 in/hr

PEAK DISCHARGE: 0.4 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by:

Project Name: River's Edge | Date: 05/16/18

Concentration Point: 2E | Job #: 4191

Watershed Area: 0.6 ac | Watershed Type: Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	10.0	326	0.0307	.035

Length of Watercourse (Lc): 326 feet | Mean Slope: 0.0307

Length to Cen. of Gravity (Lca): 163 feet | Weighted Basin Fac.: 0.035

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 10-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.35	0.92	1.18	1.50	1.87	2.08	2.23	2.52	3.00	3.36
Areal Values (in)	0.35	0.92	1.18	1.50	1.87	2.08	2.23	2.52	3.00	3.36

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	41	83.	84.53	0.363
C	41	88.	88.91	0.490
D	18	91.	91.59	0.584
Imp.	0	99.	99.	0.000

Weighted Runoff Coef. (Cw): 0.455

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 4.20 in/hr

Runoff Supply Rate (q) @ Tc: 1.91 in/hr

PEAK DISCHARGE: 1.2 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by:

Project Name: River's Edge | Date: 05/16/18

Concentration Point: 2E | Job #: 4191

Watershed Area: 0.6 ac | Watershed Type: Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	10.0	326	0.0307	.035

Length of Watercourse (Lc): 326 feet | Mean Slope: 0.0307

Length to Cen. of Gravity (Lca): 163 feet | Weighted Basin Fac.: 0.035

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 25-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.40	1.08	1.38	1.68	2.22	2.49	2.67	3.00	3.42	3.96
Areal Values (in)	0.40	1.08	1.38	1.68	2.22	2.49	2.67	3.00	3.42	3.96

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	41	83.	85.86	0.455
C	41	88.	89.95	0.577
D	18	91.	92.44	0.663
Imp.	0	99.	99.	0.000

Weighted Runoff Coef. (Cw): 0.542

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 4.80 in/hr

Runoff Supply Rate (q) @ Tc: 2.60 in/hr

PEAK DISCHARGE: 1.6 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by:

Project Name: River's Edge | Date: 05/16/18

Concentration Point: 2E | Job #: 4191

Watershed Area: 0.6 ac | Watershed Type: Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	10.0	326	0.0307	.035

Length of Watercourse (Lc): 326 feet | Mean Slope: 0.0307

Length to Cen. of Gravity (Lca): 163 feet | Weighted Basin Fac.: 0.035

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 100-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.83	1.33	1.63	2.25	2.77	3.12	3.35	3.90	4.32	4.80
Areal Values (in)	0.83	1.33	1.63	2.25	2.77	3.12	3.35	3.90	4.32	4.80

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	41	83.	87.28	0.564
C	41	88.	91.05	0.672
D	18	91.	93.35	0.746
Imp.	0	99.	99.	0.000

Weighted Runoff Coef. (Cw): 0.641

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 9.96 in/hr

Runoff Supply Rate (q) @ Tc: 6.38 in/hr

PEAK DISCHARGE: 3.9 cfs

Lesser Return Periods

Return Period	Ratio	Qpeak
2-year	0.10	0.4
5-year	0.23	0.9
10-year	0.35	1.4
25-year	0.55	2.1
50-year	0.75	2.9

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by:

Project Name: River's Edge | Date: 5/16/18

Concentration Point: 1P | Job #: 4191

Watershed Area: 2.0 ac | Watershed Type: Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	35.0	560	0.0625	.022

Length of Watercourse (Lc): 560 feet | Mean Slope: 0.0625

Length to Cen. of Gravity (Lca): 280 feet | Weighted Basin Fac.: 0.022

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 100-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.25	0.68	0.84	1.25	1.26	1.37	1.45	1.62	1.80	1.92
Areal Values (in)	0.25	0.68	0.84	1.25	1.26	1.37	1.45	1.62	1.80	1.92

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	71	83.	80.43	0.148
C	20	88.	85.72	0.263
D	9	91.	88.97	0.361
Imp.	35	99.	99.	0.910

Weighted Runoff Coef. (Cw): 0.442

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 3.00 in/hr

Runoff Supply Rate (q) @ Tc: 1.33 in/hr

PEAK DISCHARGE: 2.7 cfs

Lesser Return Periods

Return Period	Ratio	Qpeak
2-year	0.20	0.5
5-year	0.30	0.8
10-year	0.45	1.2
25-year	0.65	1.7
50-year	0.85	2.3

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by:

Project Name: River's Edge | Date: 5/16/18

Concentration Point: 1P | Job #: 4191

Watershed Area: 2.0 ac | Watershed Type: Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	35.0	560	0.0625	.022

Length of Watercourse (Lc): 560 feet | Mean Slope: 0.0625

Length to Cen. of Gravity (Lca): 280 feet | Weighted Basin Fac.: 0.022

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 10-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.35	0.92	1.18	1.50	1.87	2.08	2.23	2.52	3.00	3.36
Areal Values (in)	0.35	0.92	1.18	1.50	1.87	2.08	2.23	2.52	3.00	3.36

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	71	83.	84.53	0.363
C	20	88.	88.91	0.490
D	9	91.	91.59	0.584
Imp.	35	99.	99.	0.938

Weighted Runoff Coef. (Cw): 0.594

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 4.20 in/hr

Runoff Supply Rate (q) @ Tc: 2.49 in/hr

PEAK DISCHARGE: 5.0 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by:

Project Name: River's Edge | Date: 5/16/18

Concentration Point: 1P | Job #: 4191

Watershed Area: 2.0 ac | Watershed Type: Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	35.0	560	0.0625	.022

Length of Watercourse (Lc): 560 feet | Mean Slope: 0.0625

Length to Cen. of Gravity (Lca): 280 feet | Weighted Basin Fac.: 0.022

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 25-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.40	1.08	1.38	1.68	2.22	2.49	2.67	3.00	3.42	3.96
Areal Values (in)	0.40	1.08	1.38	1.68	2.22	2.49	2.67	3.00	3.42	3.96

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	71	83.	85.86	0.455
C	20	88.	89.95	0.577
D	9	91.	92.44	0.663
Imp.	35	99.	99.	0.947

Weighted Runoff Coef. (Cw): 0.655

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 4.80 in/hr

Runoff Supply Rate (q) @ Tc: 3.15 in/hr

PEAK DISCHARGE: 6.3 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by:

Project Name: River's Edge | Date: 5/16/18

Concentration Point: 1P | Job #: 4191

Watershed Area: 2.0 ac | Watershed Type: Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	35.0	560	0.0625	.022

Length of Watercourse (Lc): 560 feet | Mean Slope: 0.0625

Length to Cen. of Gravity (Lca): 280 feet | Weighted Basin Fac.: 0.022

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 100-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.83	1.33	1.63	2.25	2.77	3.12	3.35	3.90	4.32	4.80
Areal Values (in)	0.83	1.33	1.63	2.25	2.77	3.12	3.35	3.90	4.32	4.80

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	71	83.	87.28	0.564
C	20	88.	91.05	0.672
D	9	91.	93.35	0.746
Imp.	35	99.	99.	0.958

Weighted Runoff Coef. (Cw): 0.726

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 9.96 in/hr

Runoff Supply Rate (q) @ Tc: 7.23 in/hr

PEAK DISCHARGE: 15 cfs

Lesser Return Periods

Return Period	Ratio	Qpeak
2-year	0.20	2.9
5-year	0.30	4.4
10-year	0.45	6.6
25-year	0.65	9.5
50-year	0.85	12

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by:

Project Name: River's Edge | Date: 5/16/18

Concentration Point: 2P | Job #: 4191

Watershed Area: 3.2 ac | Watershed Type: Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	23.0	720	0.0319	.022

Length of Watercourse (Lc): 720 feet | Mean Slope: 0.0319

Length to Cen. of Gravity (Lca): 360 feet | Weighted Basin Fac.: 0.022

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 2-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.25	0.68	0.84	1.25	1.26	1.37	1.45	1.62	1.80	1.92
Areal Values (in)	0.25	0.68	0.84	1.25	1.26	1.37	1.45	1.62	1.80	1.92

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	71	83.	80.43	0.148
C	20	88.	85.72	0.263
D	9	91.	88.97	0.361
Imp.	45	99.	99.	0.910

Weighted Runoff Coef. (Cw): 0.514

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 3.00 in/hr

Runoff Supply Rate (q) @ Tc: 1.54 in/hr

PEAK DISCHARGE: 5.0 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by:

Project Name: River's Edge | Date: 5/16/18

Concentration Point: 2P | Job #: 4191

Watershed Area: 3.2 ac | Watershed Type: Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	23.0	720	0.0319	.022

Length of Watercourse (Lc): 720 feet | Mean Slope: 0.0319

Length to Cen. of Gravity (Lca): 360 feet | Weighted Basin Fac.: 0.022

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 10-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.35	0.92	1.18	1.50	1.87	2.08	2.23	2.52	3.00	3.36
Areal Values (in)	0.35	0.92	1.18	1.50	1.87	2.08	2.23	2.52	3.00	3.36

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	71	83.	84.53	0.363
C	20	88.	88.91	0.490
D	9	91.	91.59	0.584
Imp.	45	99.	99.	0.938

Weighted Runoff Coef. (Cw): 0.647

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 4.20 in/hr

Runoff Supply Rate (q) @ Tc: 2.72 in/hr

PEAK DISCHARGE: 8.8 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by:

Project Name: River's Edge | Date: 5/16/18

Concentration Point: 2P | Job #: 4191

Watershed Area: 3.2 ac | Watershed Type: Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	23.0	720	0.0319	.022

Length of Watercourse (Lc): 720 feet | Mean Slope: 0.0319

Length to Cen. of Gravity (Lca): 360 feet | Weighted Basin Fac.: 0.022

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 25-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.40	1.08	1.38	1.68	2.22	2.49	2.67	3.00	3.42	3.96
Areal Values (in)	0.40	1.08	1.38	1.68	2.22	2.49	2.67	3.00	3.42	3.96

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	71	83.	85.86	0.455
C	20	88.	89.95	0.577
D	9	91.	92.44	0.663
Imp.	45	99.	99.	0.947

Weighted Runoff Coef. (Cw): 0.700

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 4.80 in/hr

Runoff Supply Rate (q) @ Tc: 3.36 in/hr

PEAK DISCHARGE: 11 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by:

Project Name: River's Edge | Date: 5/16/18

Concentration Point: 2P | Job #: 4191

Watershed Area: 3.2 ac | Watershed Type: Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	23.0	720	0.0319	.022

Length of Watercourse (Lc): 720 feet | Mean Slope: 0.0319

Length to Cen. of Gravity (Lca): 360 feet | Weighted Basin Fac.: 0.022

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 100-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.83	1.33	1.63	2.25	2.77	3.12	3.35	3.90	4.32	4.80
Areal Values (in)	0.83	1.33	1.63	2.25	2.77	3.12	3.35	3.90	4.32	4.80

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	71	83.	87.28	0.564
C	20	88.	91.05	0.672
D	9	91.	93.35	0.746
Imp.	45	99.	99.	0.958

Weighted Runoff Coef. (Cw): 0.762

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 9.96 in/hr

Runoff Supply Rate (q) @ Tc: 7.59 in/hr

PEAK DISCHARGE: 24 cfs

Lesser Return Periods

Return Period	Ratio	Qpeak
2-year	0.20	4.9
5-year	0.30	7.3
10-year	0.45	11
25-year	0.65	16
50-year	0.85	21

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by:

Project Name: River's Edge | Date: 5/16/18

Concentration Point: 3P | Job #: 4191

Watershed Area: 1.1 ac | Watershed Type: Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	10.0	420	0.0238	.022

Length of Watercourse (Lc): 420 feet | Mean Slope: 0.0238

Length to Cen. of Gravity (Lca): 210 feet | Weighted Basin Fac.: 0.022

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 2-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.25	0.68	0.84	1.25	1.26	1.37	1.45	1.62	1.80	1.92
Areal Values (in)	0.25	0.68	0.84	1.25	1.26	1.37	1.45	1.62	1.80	1.92

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	71	83.	80.43	0.148
C	20	88.	85.72	0.263
D	9	91.	88.97	0.361
Imp.	50	99.	99.	0.910

Weighted Runoff Coef. (Cw): 0.550

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 3.00 in/hr

Runoff Supply Rate (q) @ Tc: 1.65 in/hr

PEAK DISCHARGE: 1.8 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by:

Project Name: River's Edge | Date: 5/16/18

Concentration Point: 3P | Job #: 4191

Watershed Area: 1.1 ac | Watershed Type: Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	10.0	420	0.0238	.022

Length of Watercourse (Lc): 420 feet | Mean Slope: 0.0238

Length to Cen. of Gravity (Lca): 210 feet | Weighted Basin Fac.: 0.022

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 10-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.35	0.92	1.18	1.50	1.87	2.08	2.23	2.52	3.00	3.36
Areal Values (in)	0.35	0.92	1.18	1.50	1.87	2.08	2.23	2.52	3.00	3.36

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	71	83.	84.53	0.363
C	20	88.	88.91	0.490
D	9	91.	91.59	0.584
Imp.	50	99.	99.	0.938

Weighted Runoff Coef. (Cw): 0.673

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 4.20 in/hr

Runoff Supply Rate (q) @ Tc: 2.83 in/hr

PEAK DISCHARGE: 3.1 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by:

Project Name: River's Edge | Date: 5/16/18

Concentration Point: 3P | Job #: 4191

Watershed Area: 1.1 ac | Watershed Type: Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	10.0	420	0.0238	.022

Length of Watercourse (Lc): 420 feet | Mean Slope: 0.0238

Length to Cen. of Gravity (Lca): 210 feet | Weighted Basin Fac.: 0.022

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 25-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.40	1.08	1.38	1.68	2.22	2.49	2.67	3.00	3.42	3.96
Areal Values (in)	0.40	1.08	1.38	1.68	2.22	2.49	2.67	3.00	3.42	3.96

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	71	83.	85.86	0.455
C	20	88.	89.95	0.577
D	9	91.	92.44	0.663
Imp.	50	99.	99.	0.947

Weighted Runoff Coef. (Cw): 0.723

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 4.80 in/hr

Runoff Supply Rate (q) @ Tc: 3.47 in/hr

PEAK DISCHARGE: 3.8 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by:

Project Name: River's Edge | Date: 5/16/18

Concentration Point: 3P | Job #: 4191

Watershed Area: 1.1 ac | Watershed Type: Medium Density Urbanized

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	10.0	420	0.0238	.022

Length of Watercourse (Lc): 420 feet | Mean Slope: 0.0238

Length to Cen. of Gravity (Lca): 210 feet | Weighted Basin Fac.: 0.022

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 100-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.83	1.33	1.63	2.25	2.77	3.12	3.35	3.90	4.32	4.80
Areal Values (in)	0.83	1.33	1.63	2.25	2.77	3.12	3.35	3.90	4.32	4.80

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	71	83.	87.28	0.564
C	20	88.	91.05	0.672
D	9	91.	93.35	0.746
Imp.	50	99.	99.	0.958

Weighted Runoff Coef. (Cw): 0.780

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 9.96 in/hr

Runoff Supply Rate (q) @ Tc: 7.76 in/hr

PEAK DISCHARGE: 8.6 cfs

Lesser Return Periods

Return Period	Ratio	Qpeak
2-year	0.20	1.7
5-year	0.30	2.6
10-year	0.45	3.9
25-year	0.65	5.6
50-year	0.85	7.3

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by:

Project Name: River's Edge | Date: 5/16/18

Concentration Point: 4P | Job #: 4191

Watershed Area: 0.2 ac | Watershed Type: Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	6.0	50	0.1200	.035

Length of Watercourse (Lc): 50 feet | Mean Slope: 0.1200

Length to Cen. of Gravity (Lca): 25 feet | Weighted Basin Fac.: 0.035

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 2-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.25	0.68	0.84	1.25	1.26	1.37	1.45	1.62	1.80	1.92
Areal Values (in)	0.25	0.68	0.84	1.25	1.26	1.37	1.45	1.62	1.80	1.92

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	71	83.	80.43	0.148
C	20	88.	85.72	0.263
D	9	91.	88.97	0.361
Imp.	0	99.	99.	0.000

Weighted Runoff Coef. (Cw): 0.190

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 3.00 in/hr

Runoff Supply Rate (q) @ Tc: 0.57 in/hr

PEAK DISCHARGE: 0.1 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by:

Project Name: River's Edge | Date: 5/16/18

Concentration Point: 4P | Job #: 4191

Watershed Area: 0.2 ac | Watershed Type: Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	6.0	50	0.1200	.035

Length of Watercourse (Lc): 50 feet | Mean Slope: 0.1200

Length to Cen. of Gravity (Lca): 25 feet | Weighted Basin Fac.: 0.035

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 10-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.35	0.92	1.18	1.50	1.87	2.08	2.23	2.52	3.00	3.36
Areal Values (in)	0.35	0.92	1.18	1.50	1.87	2.08	2.23	2.52	3.00	3.36

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	71	83.	84.53	0.363
C	20	88.	88.91	0.490
D	9	91.	91.59	0.584
Imp.	0	99.	99.	0.000

Weighted Runoff Coef. (Cw): 0.408

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 4.20 in/hr

Runoff Supply Rate (q) @ Tc: 1.71 in/hr

PEAK DISCHARGE: 0.3 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by:

Project Name: River's Edge | Date: 5/16/18

Concentration Point: 4P | Job #: 4191

Watershed Area: 0.2 ac | Watershed Type: Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	6.0	50	0.1200	.035

Length of Watercourse (Lc): 50 feet | Mean Slope: 0.1200

Length to Cen. of Gravity (Lca): 25 feet | Weighted Basin Fac.: 0.035

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 25-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.40	1.08	1.38	1.68	2.22	2.49	2.67	3.00	3.42	3.96
Areal Values (in)	0.40	1.08	1.38	1.68	2.22	2.49	2.67	3.00	3.42	3.96

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	71	83.	85.86	0.455
C	20	88.	89.95	0.577
D	9	91.	92.44	0.663
Imp.	0	99.	99.	0.000

Weighted Runoff Coef. (Cw): 0.498

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 4.80 in/hr

Runoff Supply Rate (q) @ Tc: 2.39 in/hr

PEAK DISCHARGE: 0.4 cfs

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Melcor | Prepared by:

Project Name: River's Edge | Date: 5/16/18

Concentration Point: 4P | Job #: 4191

Watershed Area: 0.2 ac | Watershed Type: Undeveloped-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	6.0	50	0.1200	.035

Length of Watercourse (Lc): 50 feet | Mean Slope: 0.1200

Length to Cen. of Gravity (Lca): 25 feet | Weighted Basin Fac.: 0.035

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 20 %

RETURN PERIOD: 100-years

Rainfall Depths: Manual Input of Rainfal Depths by User

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.83	1.33	1.63	2.25	2.77	3.12	3.35	3.90	4.32	4.80
Areal Values (in)	0.83	1.33	1.63	2.25	2.77	3.12	3.35	3.90	4.32	4.80

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	71	83.	87.28	0.564
C	20	88.	91.05	0.672
D	9	91.	93.35	0.746
Imp.	0	99.	99.	0.000

Weighted Runoff Coef. (Cw): 0.602

Time of Concentration: 5.0 min

Rainfall Intensity (i) @ Tc: 9.96 in/hr

Runoff Supply Rate (q) @ Tc: 5.99 in/hr

PEAK DISCHARGE: 1.0 cfs

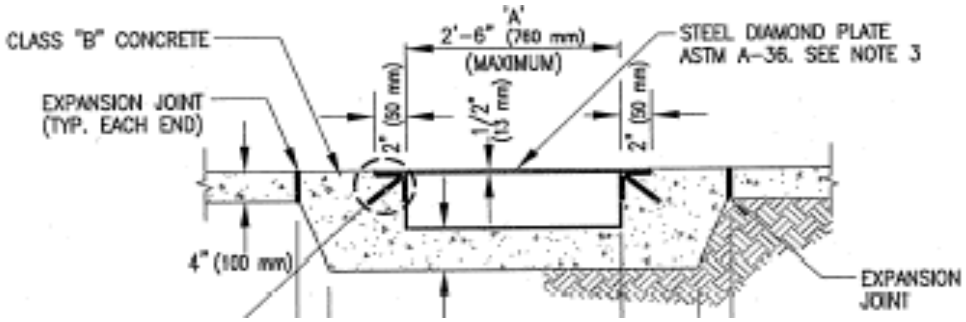
Lesser Return Periods

Return Period	Ratio	Qpeak
2-year	0.10	0.1
5-year	0.23	0.2
10-year	0.35	0.4
25-year	0.55	0.6
50-year	0.75	0.8

APPENDIX C – HYDRAULIC CALCULATIONS

Type 2 Scupper Calculations

Project Name:	River's Edge
Job Number:	4191B
Page:	1 of 1



$Q = CLH^{3/2}$ WEIR FLOW

C= 2.3
H= 0.5 ft

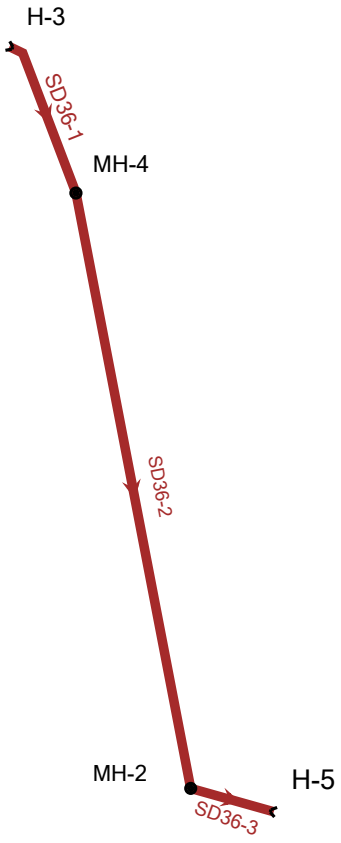
$$L = \frac{Q}{C \times H^{3/2}}$$

CP	Q100*	Length	# Cells Rq'd	Opening Length
	(cfs)	(ft)		(ft)
2P.1	2	2.5	1	2.5

*Estimated

Prepared by: LAV Checked by: _____ Company: Rick Engineering Date: 4/11/2019

Scenario: Base



FlexTable: Conduit Table

ID	Label	Start Node	Set Invert to Start?	Invert (Start) (ft)
44	SD36-1	H-3	True	2,578.70
61	SD36-2	MH-4	True	2,575.00
54	SD36-3	MH-2	True	2,564.00

Stop Node	Set Invert to Stop?	Invert (Stop) (ft)	Has User Defined Length?	Length (User Defined) (ft)
MH-4	False	2,575.10	True	97.6
MH-2	False	2,564.10	True	364.4
H-5	True	2,563.81	True	51.5

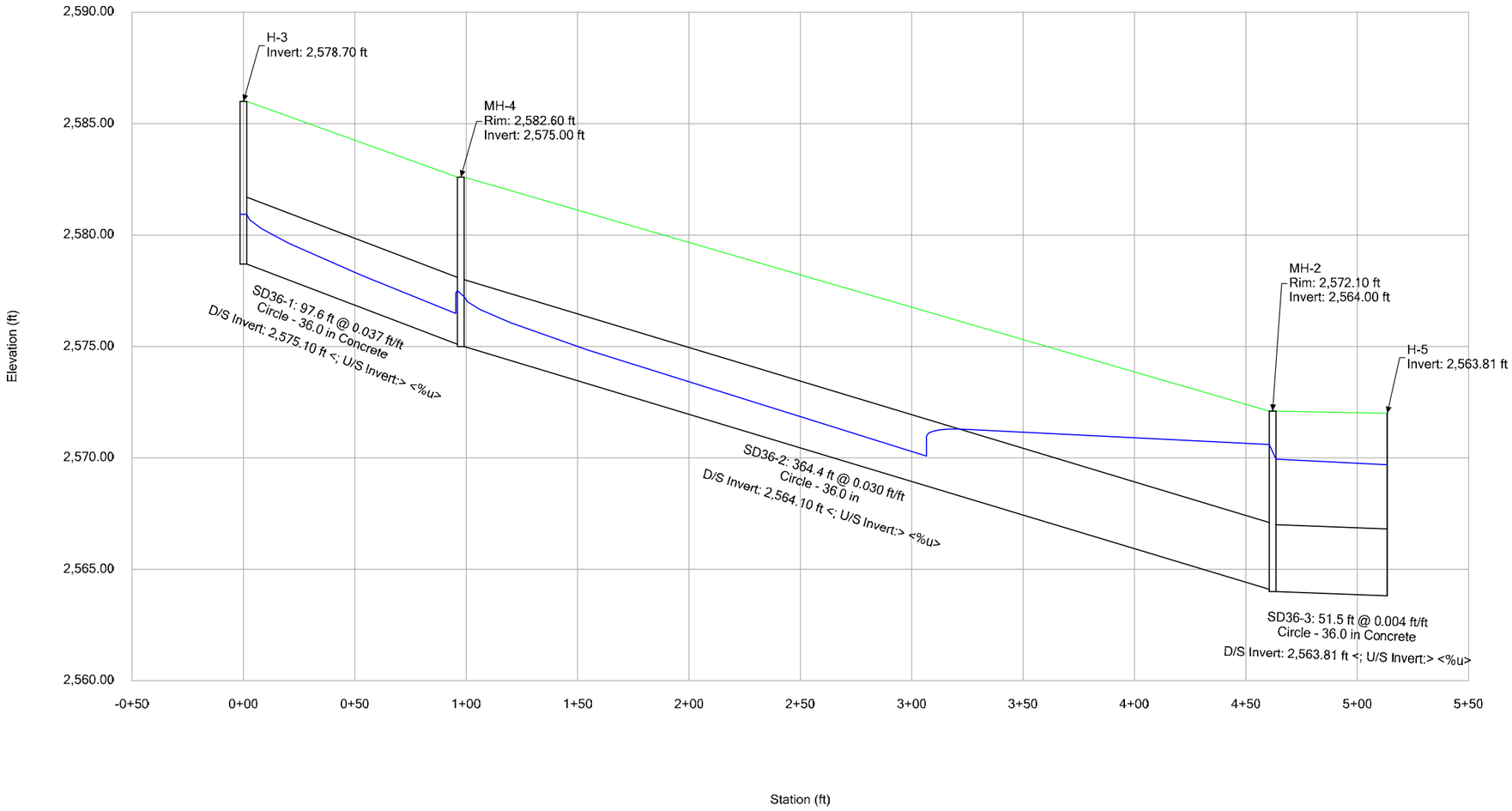
Length (Scaled) (ft)	Slope (Calculated) (ft/ft)	Section Type	Diameter (in)	Manning's n
99.0	0.037	Circle	36.0	0.013
364.6	0.030	Circle	36.0	0.013
51.9	0.004	Circle	36.0	0.013

Flow (cfs)	Velocity (ft/s)	Depth (Out) (ft)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)
47.00	16.72	2.40	128.11	36.7
47.00	15.48	6.50	115.34	40.7
47.00	6.65	5.88	40.53	116.0

Depth (Normal) / Rise (%)	Notes	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
41.9		2,580.93	2,577.50
44.4		2,577.23	2,570.60
(N/A)		2,569.95	2,569.69

Profile Report

Engineering Profile - Profile - 1 (4191B.stsw)



Culvert Calculator Report
2P_Culvert

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	63.40	ft	Headwater Depth/Height	1.82	
Computed Headwater Elev	62.64	ft	Discharge	24.00	cfs
Inlet Control HW Elev.	62.64	ft	Tailwater Elevation	60.70	ft
Outlet Control HW Elev.	62.45	ft	Control Type	Inlet Control	

Grades					
Upstream Invert	59.00	ft	Downstream Invert	58.00	ft
Length	40.50	ft	Constructed Slope	0.024691	ft/ft

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	1.29	ft
Slope Type	N/A		Normal Depth	1.14	ft
Flow Regime	N/A		Critical Depth	1.74	ft
Velocity Downstream	11.21	ft/s	Critical Slope	0.008779	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.012	
Section Material	HDPE (Smooth Interior)		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	62.45	ft	Upstream Velocity Head	1.07	ft
Ke	0.50		Entrance Loss	0.45	ft

Inlet Control Properties					
Inlet Control HW Elev.	62.64	ft	Flow Control	N/A	
Inlet Type	Square edge w/headwall		Area Full	3.1	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Culvert Calculator Report
36" Pipe Connection to Culvert_Final-Design

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	86.00	ft	Headwater Depth/Height	1.28	
Computed Headwater Elev	82.55	ft	Discharge	47.00	cfs
Inlet Control HW Elev.	82.44	ft	Tailwater Elevation	68.60	ft
Outlet Control HW Elev.	82.55	ft	Control Type	Entrance Control	

Grades					
Upstream Invert	78.70	ft	Downstream Invert	64.70	ft
Length	481.00	ft	Constructed Slope	0.029106	ft/ft

Hydraulic Profile					
Profile	CompositePressureProfileS1S2		Depth, Downstream	3.90	ft
Slope Type	N/A		Normal Depth	1.28	ft
Flow Regime	N/A		Critical Depth	2.23	ft
Velocity Downstream	6.65	ft/s	Critical Slope	0.005180	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.012	
Section Material	Corrugated HDPE (Smooth Interior)		Span	3.00	ft
Section Size	36 inch		Rise	3.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	82.55	ft	Upstream Velocity Head	1.08	ft
Ke	0.50		Entrance Loss	0.54	ft

Inlet Control Properties					
Inlet Control HW Elev.	82.44	ft	Flow Control	Transition	
Inlet Type	Square edge w/headwall		Area Full	7.1	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Culvert Calculator Report
Existing-Triple 10x7

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	2,569.00	ft	Headwater Depth/Height	0.74	
Computed Headwater Eleva	2,567.66	ft	Discharge	864.00	cfs
Inlet Control HW Elev.	2,567.18	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	2,567.66	ft	Control Type	Entrance Control	

Grades					
Upstream Invert	2,562.49	ft	Downstream Invert	2,561.58	ft
Length	136.00	ft	Constructed Slope	0.006691	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	2.38	ft
Slope Type	Steep		Normal Depth	2.28	ft
Flow Regime	Supercritical		Critical Depth	2.95	ft
Velocity Downstream	12.08	ft/s	Critical Slope	0.003187	ft/ft

Section					
Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	10.00	ft
Section Size	10 x 7 ft		Rise	7.00	ft
Number Sections	3				

Outlet Control Properties					
Outlet Control HW Elev.	2,567.66	ft	Upstream Velocity Head	1.48	ft
Ke	0.50		Entrance Loss	0.74	ft

Inlet Control Properties					
Inlet Control HW Elev.	2,567.18	ft	Flow Control	N/A	
Inlet Type	30 to 75° wingwall flares		Area Full	210.0	ft²
K	0.02600		HDS 5 Chart	8	
M	1.00000		HDS 5 Scale	1	
C	0.03470		Equation Form	1	
Y	0.86000				

Culvert Calculator Report
48" Culvert Under Entrance

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	63.00	ft	Headwater Depth/Height	1.24	
Computed Headwater Elev	62.37	ft	Discharge	92.00	cfs
Inlet Control HW Elev.	62.14	ft	Tailwater Elevation	59.55	ft
Outlet Control HW Elev.	62.37	ft	Control Type	Entrance Control	

Grades					
Upstream Invert	57.40	ft	Downstream Invert	56.00	ft
Length	207.00	ft	Constructed Slope	0.006763	ft/ft

Hydraulic Profile					
Profile	CompositeS1S2		Depth, Downstream	3.55	ft
Slope Type	Steep		Normal Depth	2.65	ft
Flow Regime	N/A		Critical Depth	2.91	ft
Velocity Downstream	7.80	ft/s	Critical Slope	0.005315	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	CMP		Span	4.00	ft
Section Size	48 inch		Rise	4.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	62.37	ft	Upstream Velocity Head	1.37	ft
Ke	0.50		Entrance Loss	0.69	ft

Inlet Control Properties					
Inlet Control HW Elev.	62.14	ft	Flow Control	N/A	
Inlet Type	Headwall		Area Full	12.6	ft²
K	0.00780		HDS 5 Chart	2	
M	2.00000		HDS 5 Scale	1	
C	0.03790		Equation Form	1	
Y	0.69000				

Culvert Calculator Report
(2) 36" RCP 100yr Proposed Condition

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	60.85	ft	Headwater Depth/Height	1.26	
Computed Headwater Elev	59.55	ft	Discharge	104.00	cfs
Inlet Control HW Elev.	59.54	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	59.55	ft	Control Type	Entrance Control	

Grades					
Upstream Invert	55.77	ft	Downstream Invert	55.00	ft
Length	97.00	ft	Constructed Slope	0.007938	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	2.18	ft
Slope Type	Steep		Normal Depth	2.17	ft
Flow Regime	Supercritical		Critical Depth	2.35	ft
Velocity Downstream	9.47	ft/s	Critical Slope	0.006670	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	3.00	ft
Section Size	36 inch		Rise	3.00	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	59.55	ft	Upstream Velocity Head	1.20	ft
Ke	0.20		Entrance Loss	0.24	ft

Inlet Control Properties					
Inlet Control HW Elev.	59.54	ft	Flow Control	Submerged	
Inlet Type	Groove end projecting		Area Full	14.1	ft²
K	0.00450		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	3	
C	0.03170		Equation Form	1	
Y	0.69000				

Worksheet for 2B_Prop_100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.025	
Channel Slope	0.16700	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	75.00	ft³/s

Results

Normal Depth	0.49	ft
Flow Area	5.35	ft²
Wetted Perimeter	12.18	ft
Hydraulic Radius	0.44	ft
Top Width	11.95	ft
Critical Depth	1.11	ft
Critical Slope	0.00974	ft/ft
Velocity	14.02	ft/s
Velocity Head	3.06	ft
Specific Energy	3.54	ft
Froude Number	3.70	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.49	ft
Critical Depth	1.11	ft
Channel Slope	0.16700	ft/ft

Worksheet for 2B_Prop_100

GVF Output Data

Critical Slope	0.00974	ft/ft

RIPRAP APRON CALCULATION

PIMA COUNTY DRAINAGE & CHANNEL DESIGN STANDARDS (Pg VI-14)

PROJECT NAME: 4191B- River's Edge

IF Froude Number is greater than 1 (F>1)

$L_{sb} = D_c (8 + 17 \log F)$ for minimum tailwater (Equation 4-VI)

$L_{sb} = D_c (8 + 55 \log F)$ for maximum tailwater (Equation 5-VI)

Where:

L_{sb} = Length of scour basin, ft.

F = Froude number of flow at the culvert outlet

D_c = Culvert diameter or depth of flow, ft

W_c = Culvert width, ft

IF Froude Number is less than or equal to 1 (F<=1)

$Lsb = 8\ D_c$

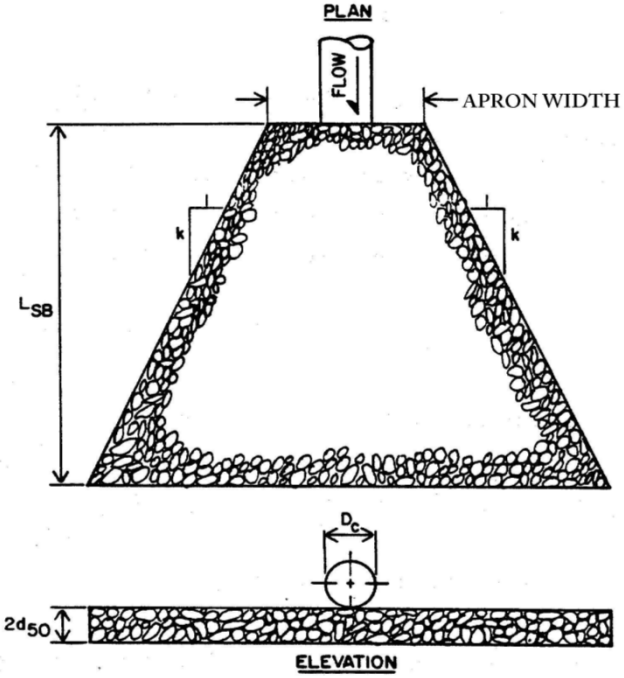
$W = 3\ D_c$

k = 2 for minimum tailwater

k = 5 for maximum tailwater

$$d_{50} = 0.02 \left[\frac{D_c^{\,2}}{TW} \right] (R)^{1.33}$$ (Equation 6-VI)

$t = 2\ d_{50}$



CP or X-Section/Wash	Q100 (cfs)	No. of Barrels -	Froude Number -	Wc (ft)	Dc (ft)	TW (ft)	Tailwater Condition -	R -	Apron Length (L_{sb}) (ft)	Apron Width (ft)	Taper Coefficient (*k*) -	Size d_{50} (in)	Apron Thickness (in)
CP2P Outlet	24	1	1.00	2.0	1.3	2.70	MAXIMUM	11.99	11	6.0	5.0	8	16
48" Outlet	92	1	1.00	4.0	3.6	3.60	MAXIMUM	3.74	29	12.0	5.0	8	16
2B Channel Outlet	10	1	3.00	10.0	0.2	2.20	MAXIMUM	559.02	7	30.0	5.0	20	40

Worksheet for Street Section @ 2P 2%

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01250	ft/ft
Discharge	25.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	0.68
0+09	0.50
0+11	0.00
0+39	0.56
0+41	1.06
0+50	1.24

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 0.68)	(0+09, 0.50)	0.018
(0+09, 0.50)	(0+11, 0.00)	0.015
(0+11, 0.00)	(0+39, 0.56)	0.016
(0+39, 0.56)	(0+41, 1.06)	0.015
(0+41, 1.06)	(0+50, 1.24)	0.018

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.48	ft
Elevation Range	0.00 to 1.24 ft	
Flow Area	6.22	ft²

Worksheet for Street Section @ 2P 2%

Results

Wetted Perimeter		25.98	ft
Hydraulic Radius		0.24	ft
Top Width		25.92	ft
Normal Depth		0.48	ft
Critical Depth		0.56	ft
Critical Slope		0.00580	ft/ft
Velocity		4.02	ft/s
Velocity Head		0.25	ft
Specific Energy		0.73	ft
Froude Number		1.45	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.48	ft
Critical Depth	0.56	ft
Channel Slope	0.01250	ft/ft
Critical Slope	0.00580	ft/ft

Cross Section for Street Section @ 2P 2%

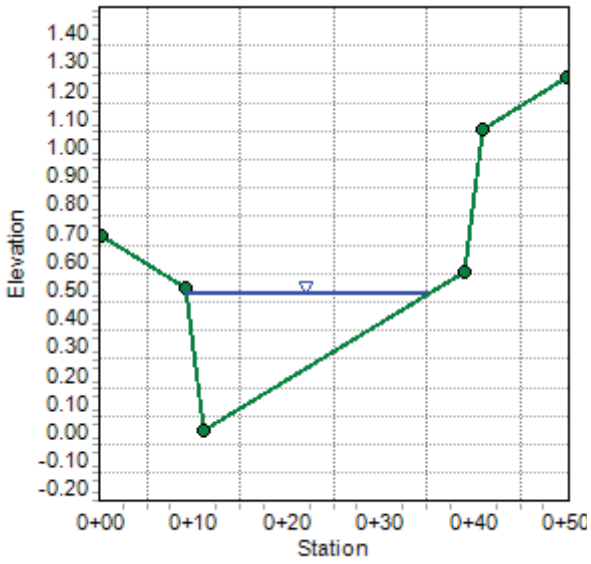
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01250	ft/ft
Normal Depth	0.48	ft
Discharge	25.00	ft³/s

Cross Section Image



Street Flow depth at 2P = 0.5'. At deepest 1' section, the peak flow over the grate is 2.6 cfs. See Neenah Grate Charts for Capacity of Neenah Grate

TRENCH CASTINGS: VANED

Neenah Foundry offers a variety of cast iron vaned L Series trench castings. Select from the list below to find the vaned L Series trench castings that fit your needs.

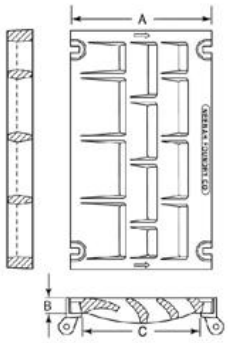
R-4999 Vaned Type L Series -

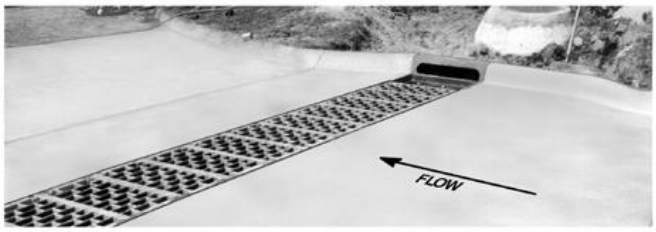
R-4999 Vaned Type L Series

Bolted Transverse Drainage Structure

Heavy Duty

This trench grate series represents Neenah's best hydraulic performance.





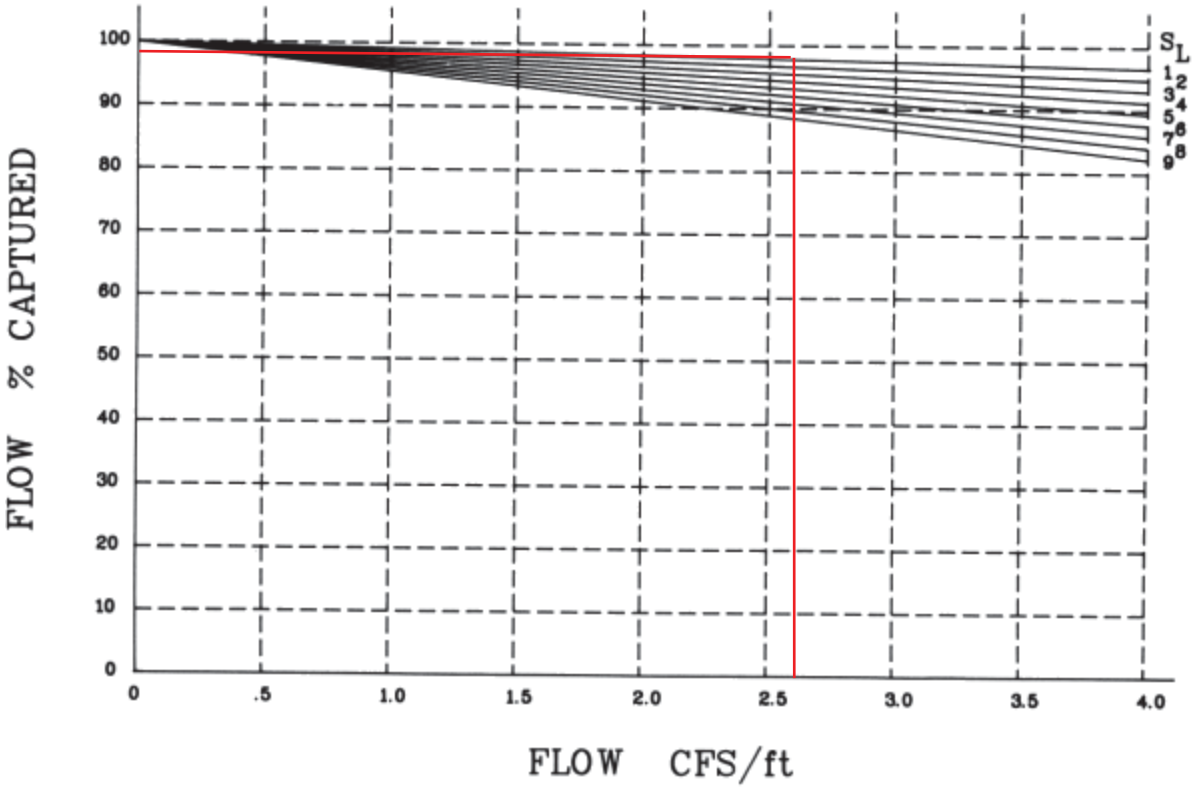
Catalog Number	A	B	C
R-4999-L2 ***	12	1-1/2	10
R-4999-L3 *	14	1-1/2	12
R-4999-L6 **	23-7/8	2	21-7/8
R-4999-L7 *	26-5/8	2	24-5/8
R-4999-L9 ***	29-3/4	2-1/2	26-3/4

* Furnished in 24" Sections
** Furnished in 12" or 24" sections
*** Furnished in 18" or 36" sections

- Type "L" vane shaped grates have the ability to remove significant amounts of sheet flow from streets, parking lots, and industrial lots.
- For detailed hydraulic information, contact Neenah Product Engineering.

Back to Top

R-4999-L6



Capacity of Neenah Grate at Maximum 2.6 cfs over deepest 1' of width = 97% of 21 cfs, or 20.4 cfs.

Capacity above ignores the Type 1 Catch Basin which, on a grade, has a capacity of 3 cfs. Therefore, no bypass is anticipated across the Neenah Grate.

Capacity of a Grate Inlet on a Continuous Grade

Section 10.6.5 of the City of Tucson Standards Manual for Drainage Design and Floodplain Management

Project Name	River's Edge
REC Project No.	4438A
Grate inlet (CP)	2P -Type 1 Calculated as Type 4, curb opening ignored per SMDD

Grate =	**EF-1**	**PER SD 311**		
Design Flow =	**24.0**	**(cfs)**		
No. of Grates =	**1**			
Spread =	**25.5**	**(ft)**		
Flow Velocity =	**4.0**	**(fps)**		
Cross-Slope =	**0.020**	**(ft/ft)**		
Splash Over Vel =	**6.0**	**(fps)**	Per Figure 10.5	**Clogging**

3.33 = actual grate opening length (ft)
1.67 = grate opening length (ft) / F.S.
1.97 = actual grate opening width (ft)
0.98 = grate opening width (ft) / F.S.

Clogging Factors (SMDD Sec. 10.6.9)
2.00 = Clogging FS

Frontal Flow =	**2.4**	**(cfs)**
Frontal Ratio =	**1.0**	
Side Flow =	**21.6**	**(cfs)**
Side Flow Ratio =	**0.03**	

Interception Capacity = 3.1 (cfs)

Bypass Flow = 20.9 (cfs)====>>> Bypass enters Neenah Grate

The amount of frontal flow, Q_f, should be computed with the following equation:

$$\frac{Q_f}{Q_T} = E_o = 1 - (1 - W/T)^{8/3}$$

Where:
Q_f = Frontal flow at width W, in cubic feet per second;
Q_T = Total gutter flow, in cubic feet per second;
W = Width of grate, in feet;
T = Total spread of water at the gutter, in feet; and,
E_o = Ratio of frontal flow to total gutter flow.

The ratio, R_f, of frontal flow intercepted, Q_{fi}, to total frontal flow, Q_f, is expressed by:

$$\frac{Q_{fi}}{Q_f} = R_f = 1 - 0.09\,(V - V_o) \qquad (10.19)$$

Where:
V = Velocity of flow in the gutter, in feet per second; and,
V_o = Gutter velocity at which splash-over first occurs, in feet per second.

The ratio, R_{sf}, of side flow intercepted, Q_{si}, to total side flow, Q_s, is given by:

$$\frac{Q_{si}}{Q_s} = R_{sf} = \left[1 + \frac{0.15\,V^{1.8}}{S_x\,L^{2.3}}\right]^{-1.0} \qquad (10.20)$$

Where:
L = Length of the grate, in feet, and the other terms are as previously defined.

The total interception capacity (Q_i) of a grate inlet on a continuous grade is therefore equal to:

$$Q_i = R_f Q_f + R_{sf} Q_s \qquad (10.21)$$

Designer : LAV **Checker :** _____ **Company :** Rick Engineering

LONG TERM STORMWATER FACILITY INSPECTION AND MAINTENANCE PROTOCAL

Project Name: River's Edge
Prepared By: REC J-4191B

(In accordance with section 7 of the Design Standards for Stormwater Detention and Retention for Pima County (DSSDR), dated June 2014)

A. Basin Inspection and Maintenance General Requirements

1. Inspection and maintenance are required for all basins. An inspection and maintenance protocol including frequency of inspection, a checklist of items to be inspected and recommended maintenance when an inspection identifies a maintenance requirement shall be prepared by an Arizona registrant.

2. Upon completion of construction of all basins, an As-built Certification shall be prepared by an Arizona registrant and submitted to the Floodplain Administrator and entity responsible for basin maintenance. The plan associated with the As-built Certification shall be used by the responsible party when performing periodic inspections and when restoring the basin to design specifications, if required. The Floodplain Administrator may utilize the certification during enforcement actions.

3. The periodic maintenance described in this protocol does not require a Floodplain Use Permit.

4. Periodic inspections shall occur a minimum of once per year. If significant storm events occur between annual inspections, additional inspections are required following each of the significant events.

5. During an inspection, conditions shall be checked for proper functioning and compared to design specifications. If function impairment or deviation from design specifications is observed, maintenance shall be performed as described below or as directed by the inspector.

B. Inspection and Maintenance Requirements for <u>All Basins</u>

<u>Basin Location and Collection</u>

1. Verify that drainage system conveying flows to basin(s) is in accordance with design specifications and maintained free of leaves, debris, or other obstructions.

2. Flow paths and structures delivering flow to basins shall not be altered. If necessary, obstruction of flow paths or structures, alteration of basin location or modification of

flow direction shall be remedied, and the basin functioning shall be restored to design specifications.

Basin Depth and Freeboard

1. The depth of the basin shall be inspected to ensure the design volume, depth and freeboard are maintained.

2. For detention basins, the design depth shall be restored when the depth of sediment exceeds 6 inches above the lowest bottom floor elevation shown on the basin as-built plans. For stormwater harvesting basins, the design depth shall be restored when the design depth of the basin is reduced by more than 1 inch.

3. Slopes shall be maintained to the original design configuration.

4. Trash and debris shall be removed.

Basin Storage Time

1. Basin bottoms shall be inspected for evidence of ponding lasting longer than 12 hours for contributing watersheds up to 10 acres or 24 hours for contributing watersheds greater than 10 acres for Detention Basins (per Section 4.5.1 of the Design Standards for Stormwater Detention and Retention for Pima County) and longer than 24 hours for stormwater harvesting basins.
2. If an inspection identifies evidence of ponding exceeding these limits, the following maintenance shall be performed:
    a. Areas of ponding shall be graded to drain to the outlet for basins with no retention;
    b. Compacted soil shall be scarified to promote infiltration;
    c. Basin outlets shall be maintained to function as designed; and
    d. Obstructions at the outlet shall be removed.
    e. Additional design remedies may be required, if problems persist.

Basin Floor

1. The basin floor shall be inspected to ensure that the design slope is maintained, that infiltration has not been significantly reduced and that vegetation or other obstructions do not alter slope, infiltration or basin volume.

2. Maintenance shall be performed when accumulated sediment and debris alter the design slope to the basin outlet or infiltration potential.

3. Invasive non-native plants shall be removed. A list of invasive non-native plants can be found in Appendix E of the Pima County Regulated Riparian Habitat Mitigation Standards and Implementation Requirements available on the Rules and Procedures Page of the District's web page.

4. Soil with evidence of oil, grease or other chemicals shall be removed and disposed of properly.

Basin Side Slope

1. Inspections shall occur to ensure that slope treatment has not been damaged by settling, vegetation, erosion, or other causes.

2. Should damage be observed, basin side slopes shall be restored to design specifications.

3. When slope treatment is dumped riprap, the treatment shall be repaired when foundation soil is lost or filter fabric is exposed.

4. Filter fabric that has migrated under a dumped rock riprap layer or has tears or holes shall be restored to design specifications.

5. Grouted riprap side slopes shall be restored to design specifications when foundation soil is lost or grout beds become damaged.

6. Retaining walls shall be restored to design specifications when signs of tipping, clogged weep holes or soil subsidence are observed.

Basin Inlet Structure

1. Inspections shall occur to ensure the inlet is free of obstructions and not damaged.

2. Should obstructions or damage be observed, inlets shall be restored to design specifications.

3. When an inlet includes a sediment trap, sediment shall be removed to the design elevation.

Basin Outlet Structure

1. Inspections shall occur to ensure the outlet and all components are free of obstructions and not damaged.

2. Should obstructions or damage be observed, outlets shall be restored to design specifications.

Basin Maintenance Access

1. Inspections shall be conducted to ensure access to the basin is not compromised.

2. Conditions which compromise the design access shall be repaired.

Basin Landscaping

1. Inspections shall occur to ensure that landscaping has not impacted basin function.
2. If damage is observed, the basin shall be restored to design specifications.
3. Invasive non-native plants shall be removed. A list of the invasive non-native plants can be found in Appendix E of the Pima County Regulated Riparian Habitat Mitigation Standards and Implementation Requirements available on the Rules and Procedures Page of the District's web page.
4. Any vegetation or debris within the 20-foot radius of the basin inlet, outlet, or maintenance access ramp shall be removed.

C. Additional Inspection and Maintenance Requirements for Detention Basins

Detention Basin Embankment

1. Inspections shall be conducted to ensure the embankment is not damaged due to erosion, piping, sliding, settling or other causes.
2. If damage to an embankment is observed, the embankment shall be restored to design specifications.

D. Inspection and Maintenance Requirements for additional Storm Water Facilities

1. The following inspections and corrective measure should occur annually and after significant storm events.
    a) Inspect easement and common area drainage facilities.
    b) Remove debris and other obstructions that could divert flow out of the area designated for drainage or cause overtopping of facilities.
    c) Remove debris, obstructions and invasive plants in natural open space.
    d) Correct drainage slopes that result in extended ponding.
    e) Restore soils and remove residues that can result from extended ponding.
    f) Repair concrete and grouted rip rap that exhibits cracks, damage or stress due to settling.

g) Restore rip rap or other non-grouted rock erosion protection that have developed gaps or lost subsurface soil over time.

h) Add or fill to correct undermined or exposed ends of edges or erosion protection.

i) Remove sediment that reduces water volume in basins or reduces conveyance capacity of infrastructure such as pipes and channels

j) Removal of obstructions such as sediment, plants, and trash from culverts under private roads.

F. Additional Project Specific Inspection and Maintenance Requirements

1. All onsite channels and rip rap pads should be inspected and maintained annually and after significant storm events. Channels and rip rap pads should be inspected and maintained for the following problems:

    a. Trash and debris buildup:

        i. Channels and rip rap pads should be cleared of all dumping of yard wastes and accumulation of non-biodegradable materials

    b. Over vegetation:

        i. Channel bottoms and rip rap pads should be cleared of trees or heavy desert brush vegetation that decreases flow

    c. Sedimentation:

        i. Channels and rip rap pads should be inspected for accumulated sediment. Sediment accumulated in rip rap pads, and sediment believed to decrease channel capacity, should be removed.

Detention Basin Inspection and Maintenance Checklist

Date:	Basin Name/Location:	
Inspector:	Title:	Affiliation:
Type of Inspection: ☐ Annual ☐ After a Significant Storm Event		

General Requirements

- Basins shall be maintained to perform as designed for the life of the project and shall not be converted to a different use without a Floodplain Use Permit. A Floodplain Use Permit is not required for maintenance activities.
- Basins shall be inspected annually and after significant storm events.
- The purpose of the inspection is to evaluate whether as-built characteristics are maintained.

Basin Component	Inspection Item	Requires Maintenance	If maintenance is required, describe corrective action
Inlet	As-built grades and elevations	☐	
	Presence of obstructions	☐	
	Evidence of material damage	☐	
Outlet	As-built grades and elevations	☐	
	Presence of obstructions	☐	
	Evidence of material damage	☐	
Slopes	As-built grades and elevations	☐	
	Invasive non-native plants	☐	
	Slope treatment	☐	
Retaining walls	As-built grades and elevations	☐	
	Presence of damage or instability	☐	
	Drainage function	☐	
Depth	As-built grades and elevations	☐	
	Sediment accumulation >10% of design volume	☐	
Floor	As-built grades and elevations	☐	
	Presence of ponding	☐	
	Evidence of oil, grease, chemicals or trash	☐	
	Presence of invasive non-native plants	☐	

Detention Basin Inspection and Maintenance Checklist (Continued)

Date:	Basin Name/Location:

Basin Component	Inspection Item	Requires Maintenance	If maintenance is required, describe corrective action
Perimeter Wall	As-built grades and elevations	☐	
	Presence of damage or instability	☐	
	Drainage function	☐	
Security Barrier	Presence of damage or instability	☐	
Access	Presence of obstruction	☐	
Landscaping	Presence of overgrown vegetation	☐	
	Presence of invasive non-native plants	☐	
	Damage to basin due to landscape elements	☐	
Pump	Alarm System	☐	
	Presence of obstruction	☐	
	As-built specifications	☐	
Other			

APPENDIX D – FLOW AND FLOOD ROUTING MODELS

4191 INFLOW.DAT
07/26/19

```
 0              303
F               0              303
H             0.0            0.0
H             0.3            180.0
H             1.0            180.0
```

4191 TOLER.DAT 07/26/19

```
 0.1            0              0
C               0.6
T               0.1
```

4191 CONT.DAT
07/26/19

```
 1              0.1            2              0              0              Pro Model -
Build No. 16.06.16
 0              0              0              0              0
 0              0              0              0              0              0
 0
 0              0              0
 0              0              0              0              1              0.2
 2              0
 0              0
 0.1
```

THE MAXIMUM DISCHARGE FROM CROSS SECTION 1 IS: 51.20 CFS AT TIME: 0.46 HOURS
THE TOTAL VOLUME OF DISCHARGE IS: 0.99 AF

HYDROGRAPH AND AVERAGE FLOODPLAIN HYDRAULICS FOR CROSS SECTION NO: 1

VELOCITY = AVERAGE CROSS SECTION VELOCITY = DISCHARGE DIVIDED BY AVERAGE DEPTH AND TOTAL WIDTH
RESOLVED VEL = AVERAGE OF THE SUM OF THE MAGNITUDE OF THE RESOLVED VELOCITY VECTORS FOR EACH CROSS SECTION ELEMENT
(FOR ONLY ONE CELL = RESOLVED VELOCITY VECTOR AND ALWAYS POSITIVE)

TIME (HRS)	TOPWID (FT)	DEPTH (FT)	WS ELEV (FT/FT)	VELOCITY (FPS)	RESOLVED VEL (FPS)	DISCHARGE (CFS)
0.10	0.00	0.00	0.00	0.00	0.00	0.00
0.20	0.00	0.00	0.00	0.00	0.00	0.00
0.30	142.90	0.26	2585.76	1.11	0.81	40.71
0.40	136.69	0.27	2585.83	1.34	0.91	49.78
0.50	147.05	0.26	2585.86	1.31	0.90	50.98

THE MAXIMUM DISCHARGE FROM CROSS SECTION 2 IS: 47.30 CFS AT TIME: 0.50 HOURS
THE TOTAL VOLUME OF DISCHARGE IS: 0.91 AF

HYDROGRAPH AND AVERAGE FLOODPLAIN HYDRAULICS FOR CROSS SECTION NO: 2

VELOCITY = AVERAGE CROSS SECTION VELOCITY = DISCHARGE DIVIDED BY AVERAGE DEPTH AND TOTAL WIDTH
RESOLVED VEL = AVERAGE OF THE SUM OF THE MAGNITUDE OF THE RESOLVED VELOCITY VECTORS FOR EACH CROSS SECTION ELEMENT
(FOR ONLY ONE CELL = RESOLVED VELOCITY VECTOR AND ALWAYS POSITIVE)

TIME (HRS)	TOPWID (FT)	DEPTH (FT)	WS ELEV (FT/FT)	VELOCITY (FPS)	RESOLVED VEL (FPS)	DISCHARGE (CFS)

0.10	0.00	0.00	0.00	0.00	0.00	0.00
0.20	0.00	0.00	0.00	0.00	0.00	0.00
0.30	136.69	0.27	2585.29	1.01	0.65	36.84
0.40	142.90	0.29	2585.33	1.14	0.70	47.19
0.50	136.69	0.29	2585.33	1.18	0.72	47.09

THE MAXIMUM DISCHARGE FROM CROSS SECTION 3 IS: 68.58 CFS AT TIME: 0.45 HOURS
THE TOTAL VOLUME OF DISCHARGE IS: 1.34 AF

HYDROGRAPH AND AVERAGE FLOODPLAIN HYDRAULICS FOR CROSS SECTION NO: 3

VELOCITY = AVERAGE CROSS SECTION VELOCITY = DISCHARGE DIVIDED BY AVERAGE DEPTH AND TOTAL WIDTH
RESOLVED VEL = AVERAGE OF THE SUM OF THE MAGNITUDE OF THE RESOLVED VELOCITY VECTORS FOR EACH CROSS SECTION ELEMENT
(FOR ONLY ONE CELL = RESOLVED VELOCITY VECTOR AND ALWAYS POSITIVE)

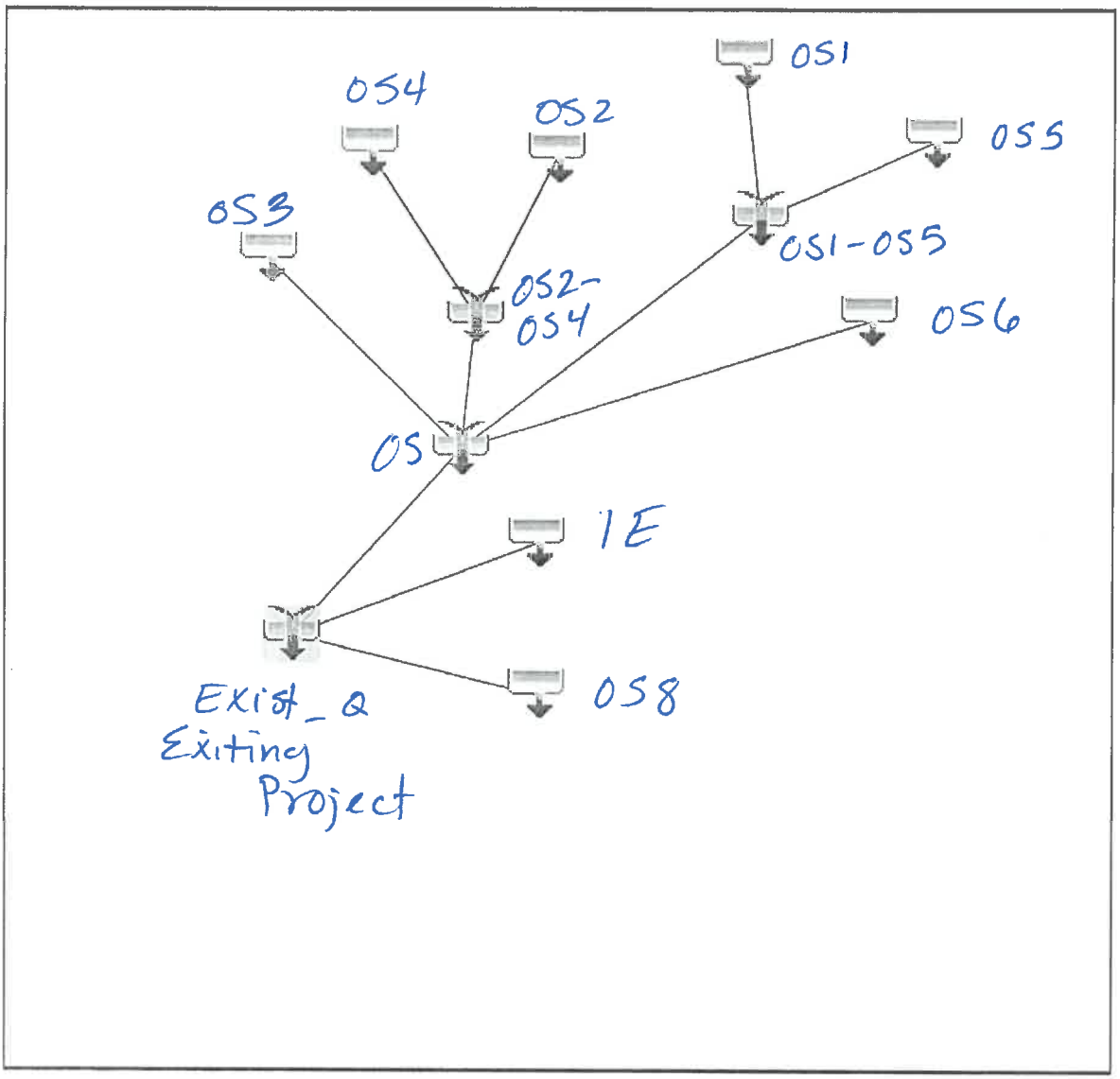
TIME (HRS)	TOPWID (FT)	DEPTH (FT)	WS ELEV (FT/FT)	VELOCITY (FPS)	RESOLVED VEL (FPS)	DISCHARGE (CFS)
0.10	0.00	0.00	0.00	0.00	0.00	0.00
0.20	0.00	0.00	0.00	0.00	0.00	0.00
0.30	173.97	0.27	2588.16	1.09	0.84	51.55
0.40	186.40	0.30	2588.19	1.22	0.91	67.67
0.50	173.97	0.30	2588.19	1.28	0.95	66.49

HEC-HMS

Project : 4191_HEC-HMS

Basin Model : 100-YEAR_EXIST

Apr 11 13:30:49 MST 2019



Project: 4191_HEC-HMS Simulation Run: Exist_2yr

Start of Run: 01Jan2001, 00:00 Basin Model: 2_YEAR_EXIST
End of Run: 01Jan2001, 03:00 Meteorologic Model: Met 1
Compute Time: 11Apr2019, 13:34:09 Control Specifications: Control 1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1E	Not Specified	4.3	01Jan2001, 00:16	n/a
OS8	Not Specified	0.8	01Jan2001, 00:13	n/a
OS3	Not Specified	0.2	01Jan2001, 00:11	n/a
OS4	Not Specified	1.1	01Jan2001, 00:14	n/a
OS2	Not Specified	2.0	01Jan2001, 00:00	n/a
OS2-OS4	Not Specified	3.1	01Jan2001, 00:14	n/a
OS1	Not Specified	1.0	01Jan2001, 00:00	n/a
OS5	Not Specified	5.7	01Jan2001, 00:14	n/a
OS1-OS5	Not Specified	6.7	01Jan2001, 00:14	n/a
OS6	Not Specified	0.1	01Jan2001, 00:11	n/a
OS	Not Specified	10.1	01Jan2001, 00:14	n/a
Exist-Q_Exiting_Project	Not Specified	14.6	01Jan2001, 00:14	n/a

Project: 4191_HEC-HMS Simulation Run: EXIST_10yr

Start of Run: 01Jan2001, 00:00 Basin Model: 10_YEAR_EXIST
End of Run: 01Jan2001, 03:00 Meteorologic Model: Met 1
Compute Time: 11Apr2019, 13:34:02 Control Specifications: Control 1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
1E	Not Specified	11.0	01Jan2001, 00:14	0.3
OS8	Not Specified	1.7	01Jan2001, 00:14	0.0
OS3	Not Specified	0.6	01Jan2001, 00:14	0.0
OS4	Not Specified	2.5	01Jan2001, 00:14	0.1
OS2	Not Specified	7.0	01Jan2001, 00:00	1.7
OS2-OS4	Not Specified	9.5	01Jan2001, 00:14	1.8
OS1	Not Specified	5.0	01Jan2001, 00:00	1.2
OS5	Not Specified	11.4	01Jan2001, 00:14	0.3
OS1-OS5	Not Specified	16.4	01Jan2001, 00:14	1.5
OS6	Not Specified	0.2	01Jan2001, 00:12	0.0
OS	Not Specified	26.7	01Jan2001, 00:14	3.3
Exist-Q_Exiting_Project	Not Specified	39.4	01Jan2001, 00:14	3.6

Project: 4191_HEC-HMS Simulation Run: Exist_25yr

Start of Run: 01Jan2001, 00:00 Basin Model: 25_YEAR_EXIST
End of Run: 01Jan2001, 03:00 Meteorologic Model: Met 1
Compute Time: 11Apr2019, 13:34:11 Control Specifications: Control 1

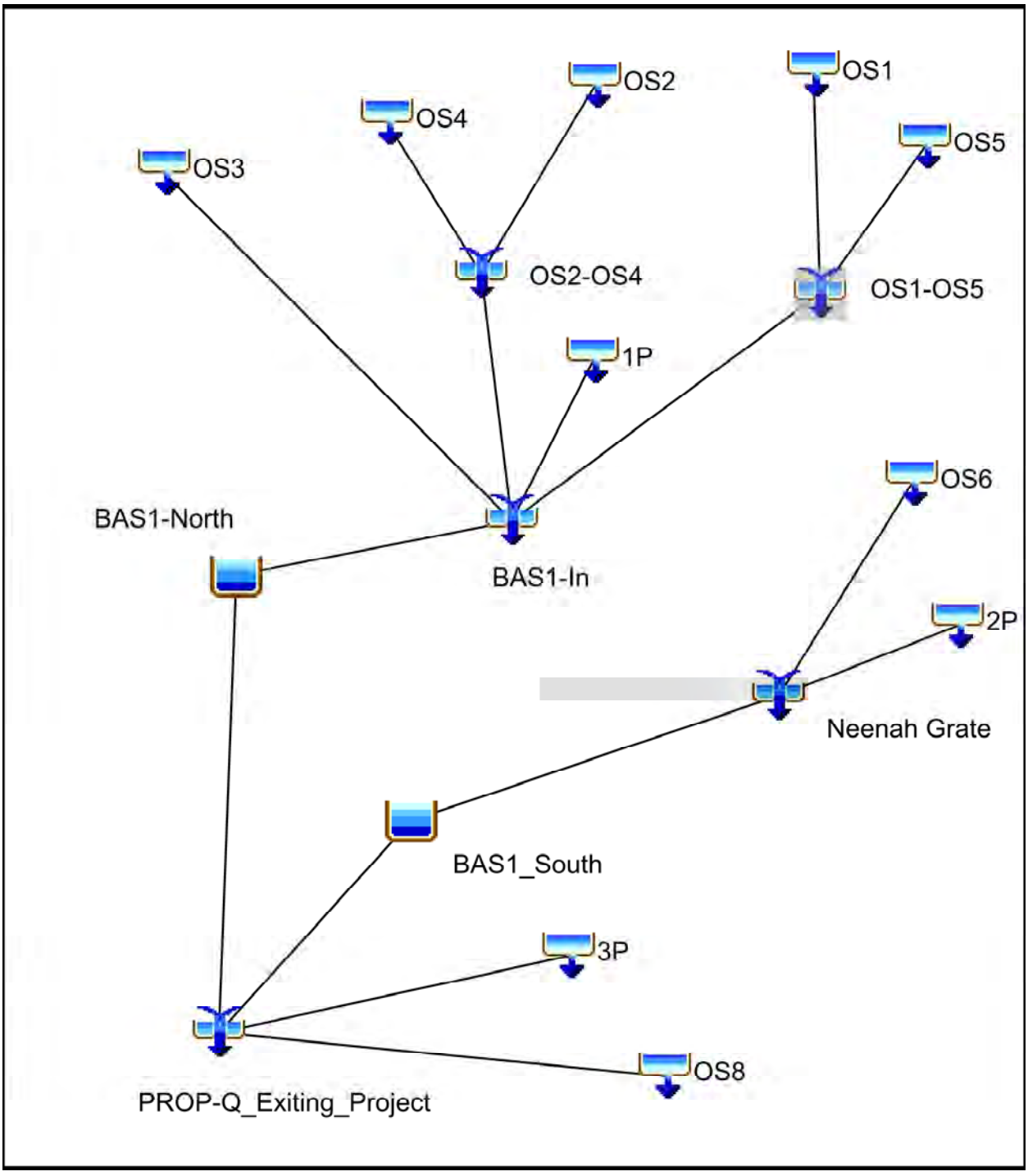
Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
1E	Not Specified	14.0	01Jan2001, 00:14	0.3
OS8	Not Specified	2.1	01Jan2001, 00:13	0.1
OS3	Not Specified	0.8	01Jan2001, 00:14	0.0
OS4	Not Specified	3.3	01Jan2001, 00:14	0.1
OS2	Not Specified	11.0	01Jan2001, 00:00	2.7
OS2-OS4	Not Specified	14.3	01Jan2001, 00:14	2.8
OS1	Not Specified	7.0	01Jan2001, 00:00	1.7
OS5	Not Specified	14.6	01Jan2001, 00:14	0.4
OS1-OS5	Not Specified	21.6	01Jan2001, 00:14	2.1
OS6	Not Specified	0.3	01Jan2001, 00:14	0.0
OS	Not Specified	37.0	01Jan2001, 00:14	4.9
Exist-Q_Exiting_Project	Not Specified	53.1	01Jan2001, 00:14	5.3

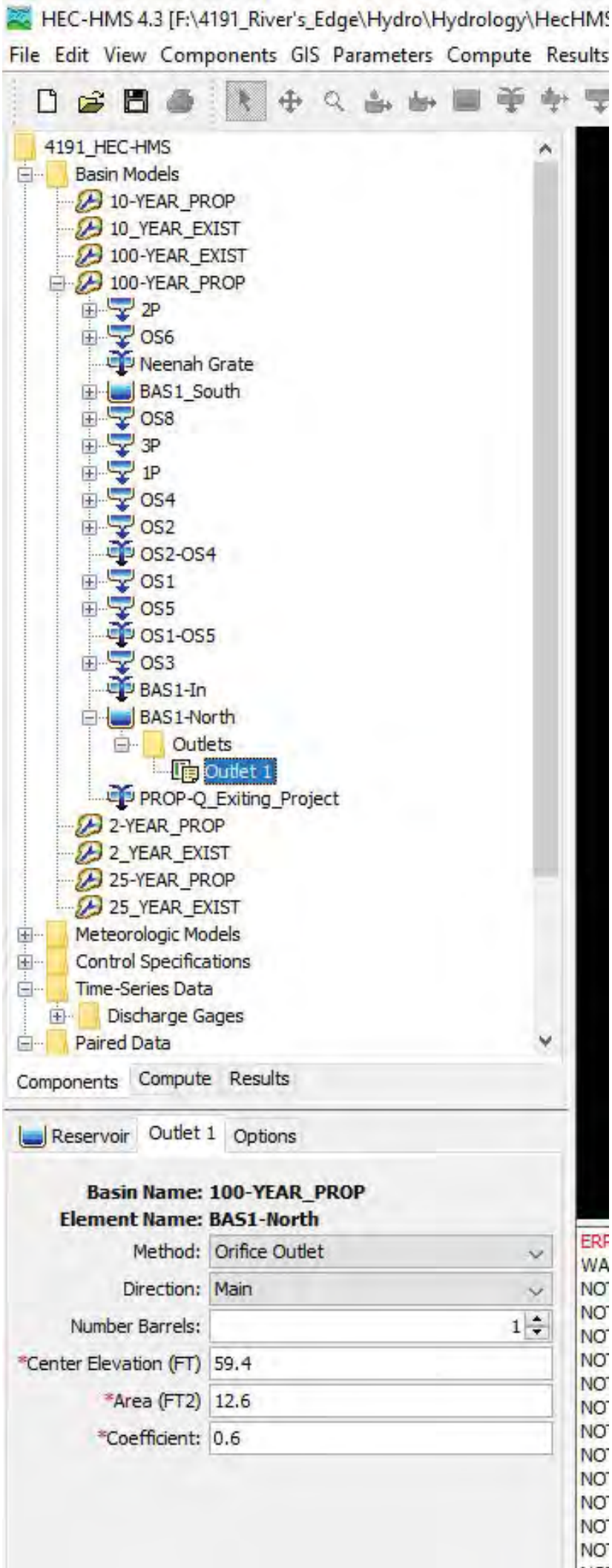
Project: 4191_HEC-HMS Simulation Run: Exist_100yr

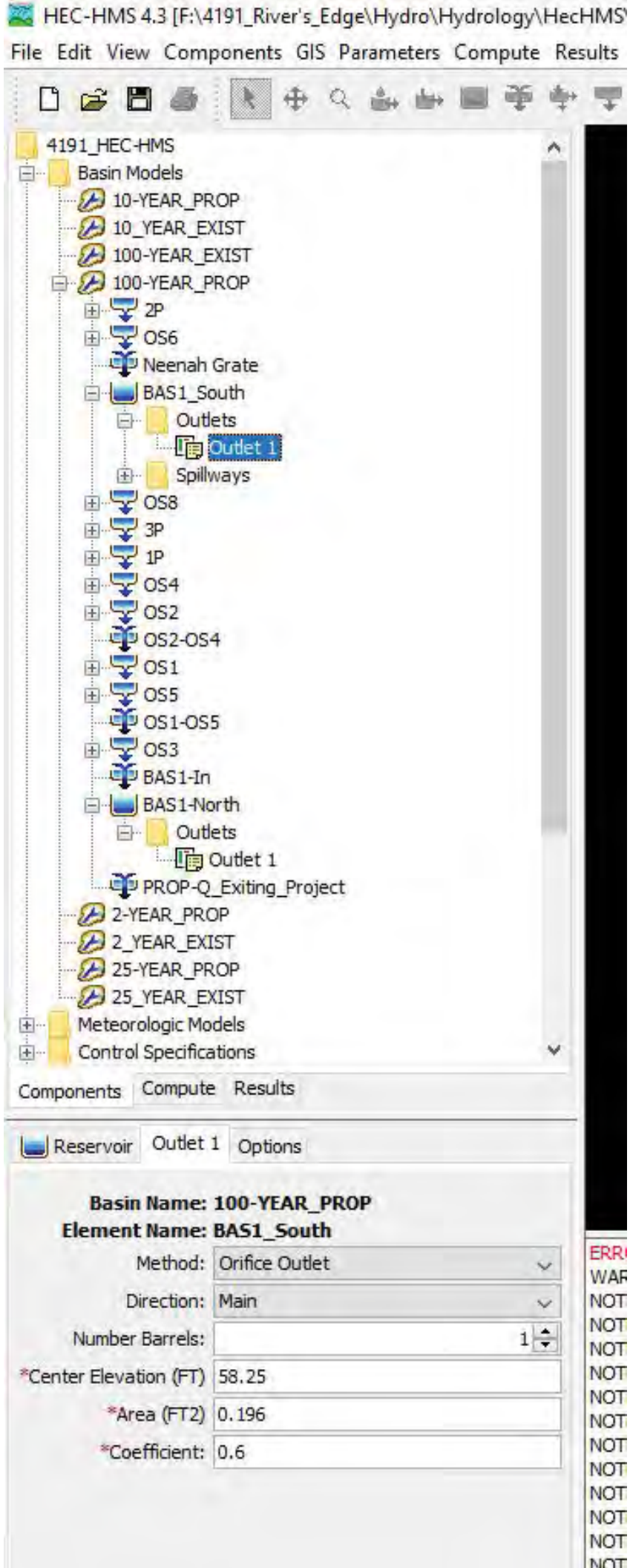
Start of Run: 01Jan2001, 00:00 Basin Model: 100-YEAR_EXIST
End of Run: 01Jan2001, 03:00 Meteorologic Model: Met 1
Compute Time: 11Apr2019, 13:34:05 Control Specifications: Control 1

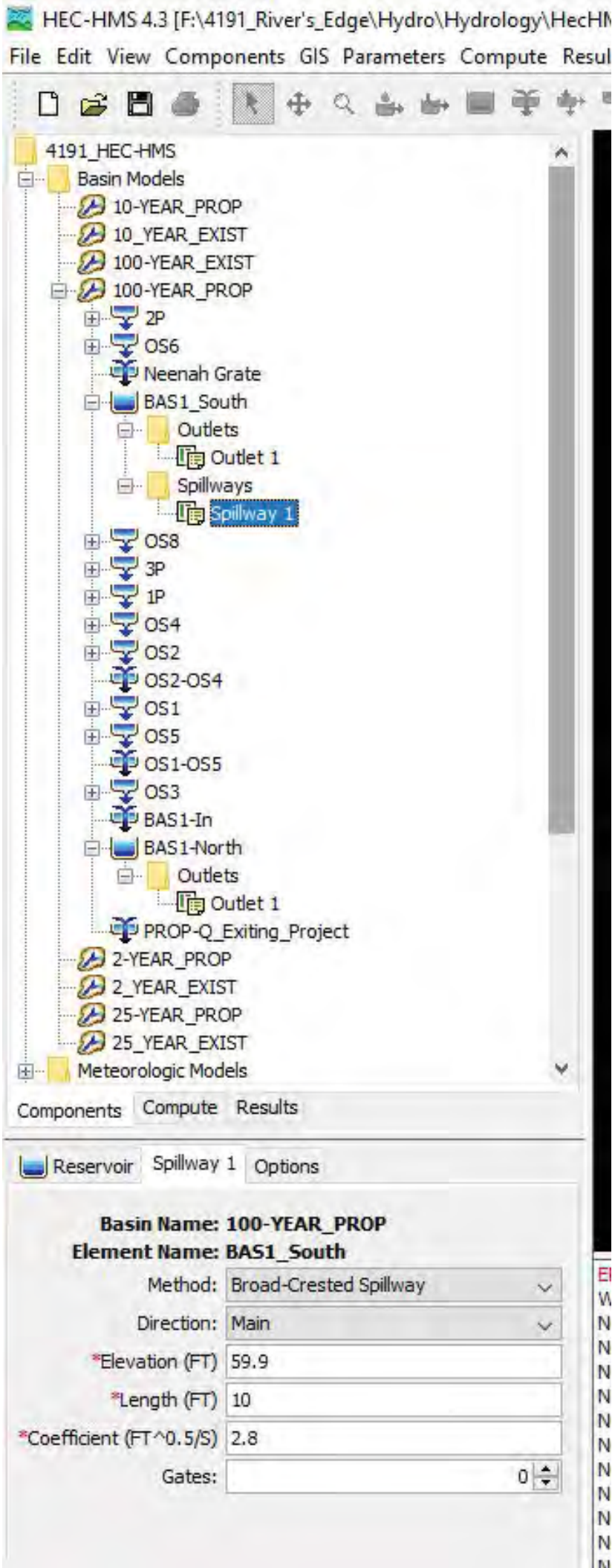
Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
1E	Not Specified	34.8	01Jan2001, 00:14	0.8
OS8	Not Specified	4.9	01Jan2001, 00:14	0.1
OS3	Not Specified	1.9	01Jan2001, 00:14	0.0
OS4	Not Specified	7.9	01Jan2001, 00:14	0.2
OS2	Not Specified	19.0	01Jan2001, 00:00	4.7
OS2-OS4	Not Specified	26.9	01Jan2001, 00:14	4.9
OS1	Not Specified	13.0	01Jan2001, 00:00	3.2
OS5	Not Specified	35.0	01Jan2001, 00:14	0.8
OS1-OS5	Not Specified	48.0	01Jan2001, 00:14	4.1
OS6	Not Specified	0.6	01Jan2001, 00:12	0.0
OS	Not Specified	77.4	01Jan2001, 00:14	9.0
Exist-Q_Exiting_Project	Not Specified	117.1	01Jan2001, 00:14	10.0

HEC-HMS Proposed Map




HEC-HMS 4.3 [F:\4191_River's_Edge\Hydro\Hydrology\HecHMS
File Edit View Components GIS Parameters Compute Results
4191_HEC-HMS
Basin Models
10-YEAR_PROP
10_YEAR_EXIST
100-YEAR_EXIST
100-YEAR_PROP
2P
OS6
Neenah Grate
BAS1_South
OS8
3P
1P
OS4
OS2
OS2-OS4
OS1
OS5
OS1-OS5
OS3
BAS1-In
BAS1-North
Outlets
Outlet 1
PROP-Q_Exiting_Project
2-YEAR_PROP
2_YEAR_EXIST
25-YEAR_PROP
25_YEAR_EXIST
Meteorologic Models
Control Specifications
Time-Series Data
Discharge Gages
Paired Data
Components Compute Results
Reservoir Outlet 1 Options
Basin Name: 100-YEAR_PROP
Element Name: BAS1-North
Method: Orifice Outlet
Direction: Main
Number Barrels: 1
*Center Elevation (FT) 59.4
*Area (FT2) 12.6
*Coefficient: 0.6


HEC-HMS 4.3 [F:\4191_River's_Edge\Hydro\Hydrology\HecHMS\
File Edit View Components GIS Parameters Compute Results
4191_HEC-HMS
Basin Models
10-YEAR_PROP
10_YEAR_EXIST
100-YEAR_EXIST
100-YEAR_PROP
2P
OS6
Neenah Grate
BAS1_South
Outlets
Outlet 1
Spillways
OS8
3P
1P
OS4
OS2
OS2-OS4
OS1
OS5
OS1-OS5
OS3
BAS1-In
BAS1-North
Outlets
Outlet 1
PROP-Q_Exiting_Project
2-YEAR_PROP
2_YEAR_EXIST
25-YEAR_PROP
25_YEAR_EXIST
Meteorologic Models
Control Specifications
Components Compute Results
Reservoir Outlet 1 Options
Basin Name: 100-YEAR_PROP
Element Name: BAS1_South
Method: Orifice Outlet
Direction: Main
Number Barrels: 1
*Center Elevation (FT) 58.25
*Area (FT2) 0.196
*Coefficient: 0.6


HEC-HMS 4.3 [F:\4191_River's_Edge\Hydro\Hydrology\HecHM
File Edit View Components GIS Parameters Compute Resul
4191_HEC-HMS
Basin Models
10-YEAR_PROP
10_YEAR_EXIST
100-YEAR_EXIST
100-YEAR_PROP
2P
OS6
Neenah Grate
BAS1_South
Outlets
Outlet 1
Spillways
Spillway 1
OS8
3P
1P
OS4
OS2
OS2-OS4
OS1
OS5
OS1-OS5
OS3
BAS1-In
BAS1-North
Outlets
Outlet 1
PROP-Q_Exiting_Project
2-YEAR_PROP
2_YEAR_EXIST
25-YEAR_PROP
25_YEAR_EXIST
Meteorologic Models
Components
Compute
Results
Reservoir
Spillway 1
Options
Basin Name: 100-YEAR_PROP
Element Name: BAS1_South
Method:
Broad-Crested Spillway
Direction:
Main
*Elevation (FT)
59.9
*Length (FT)
10
*Coefficient (FT^0.5/S)
2.8
Gates:
0

Project: 4191_HEC HMS Simulation Run: Prop_2yr

Start of Run: 01Jan2001, 00:00 Basin Model: 2-YEAR_PROP

End of Run: 01Jan2001, 03:00 Meteorologic Model: Met 1

Compute Time: 29Jul2019, 15:19:57 Control Specifications: Control 1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
2P	Not Specified	4.9	01Jan2001, 00:14	0.1
OS6	Not Specified	0.1	01Jan2001, 00:11	0.0
Neenah Grate	Not Specified	5.0	01Jan2001, 00:14	0.1
BAS1_South	Not Specified	1.1	01Jan2001, 00:31	0.1
OS8	Not Specified	0.8	01Jan2001, 00:13	0.0
3P	Not Specified	1.8	01Jan2001, 00:14	0.0
1P	Not Specified	2.6	01Jan2001, 00:14	0.1
OS4	Not Specified	1.1	01Jan2001, 00:14	0.0
OS2	Not Specified	2.0	01Jan2001, 00:00	0.5
OS2-OS4	Not Specified	3.1	01Jan2001, 00:14	0.5
OS1	Not Specified	1.0	01Jan2001, 00:00	0.2
OS5	Not Specified	5.7	01Jan2001, 00:14	0.1
OS1-OS5	Not Specified	6.7	01Jan2001, 00:14	0.4
OS3	Not Specified	0.2	01Jan2001, 00:11	0.0
BAS2_IN	Not Specified	12.6	01Jan2001, 00:14	1.0
BAS1-North	Not Specified	8.3	01Jan2001, 00:22	0.8
PROP-Q_Exiting_Project	Not Specified	10.9	01Jan2001, 00:22	0.9

Project: 4191_HEC-HMS Simulation Run: Prop_100yr
Reservoir: BAS1-North

Start of Run:	01Jan2001, 00:00	Basin Model:	100-YEAR_PROP
End of Run:	01Jan2001, 03:00	Meteorologic Model:	Met 1
Compute Time:	29Jul2019, 16:29:40	Control Specifications:	Control 1

Volume Units: AC-FT

Computed Results

Peak Inflow:	91.1 (CFS)	Date/Time of Peak Inflow:	01Jan2001, 00:13
Peak Discharge:	76.8 (CFS)	Date/Time of Peak Discharge	01Jan2001, 00:18
Inflow Volume:	9.3 (AC-FT)	Peak Storage:	0.5 (AC-FT)
Discharge Volume	9.1 (AC-FT)	Peak Elevation:	61.2 (FT)

Project: 4191_HEC-HMS Simulation Run: Prop_100yr
Reservoir: BAS1_South

Start of Run:	01Jan2001, 00:00	Basin Model:	100-YEAR_PROP
End of Run:	01Jan2001, 03:00	Meteorologic Model:	Met 1
Compute Time:	29Jul2019, 16:29:40	Control Specifications:	Control 1

Volume Units: AC-FT

Computed Results

Peak Inflow:	24.5 (CFS)	Date/Time of Peak Inflow:	01Jan2001, 00:13
Peak Discharge:	22.0 (CFS)	Date/Time of Peak Discharge	01Jan2001, 00:16
Inflow Volume:	0.6 (AC-FT)	Peak Storage:	0.2 (AC-FT)
Discharge Volume	0.6 (AC-FT)	Peak Elevation:	60.7 (FT)

Project: 4191_HEC-HMS Simulation Run: Prop_25yr

Start of Run: 01Jan2001, 00:00 Basin Model: 25-YEAR_PROP
End of Run: 01Jan2001, 03:00 Meteorologic Model: Met 1
Compute Time: 29Jul2019, 16:32:57 Control Specifications: Control 1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
2P	Not Specified	10.6	01Jan2001, 00:14	0.3
OS6	Not Specified	0.3	01Jan2001, 00:14	0.0
Neenah Grate	Not Specified	10.9	01Jan2001, 00:14	0.3
BAS1_South	Not Specified	7.1	01Jan2001, 00:20	0.3
OS8	Not Specified	2.1	01Jan2001, 00:13	0.1
3P	Not Specified	3.8	01Jan2001, 00:14	0.1
1P	Not Specified	6.2	01Jan2001, 00:14	0.2
OS4	Not Specified	3.3	01Jan2001, 00:14	0.1
OS2	Not Specified	11.0	01Jan2001, 00:00	2.7
OS2-OS4	Not Specified	14.3	01Jan2001, 00:14	2.8
OS1	Not Specified	7.0	01Jan2001, 00:00	1.7
OS5	Not Specified	14.6	01Jan2001, 00:14	0.4
OS1-OS5	Not Specified	21.6	01Jan2001, 00:14	2.1
OS3	Not Specified	0.8	01Jan2001, 00:14	0.0
BAS2_IN	Not Specified	42.9	01Jan2001, 00:14	5.1
BAS1-North	Not Specified	37.6	01Jan2001, 00:17	4.8
PROP-Q_Exiting_Project	Not Specified	48.4	01Jan2001, 00:19	5.2

Project: 4191_HEC-HMS Simulation Run: Prop_25yr

Reservoir: BAS1-North

Start of Run:	01Jan2001, 00:00	Basin Model:	25-YEAR_PROP
End of Run:	01Jan2001, 03:00	Meteorologic Model:	Met 1
Compute Time:	29Jul2019, 16:32:57	Control Specifications:	Control 1

Volume Units: AC-FT

Computed Results

Peak Inflow:	42.9 (CFS)	Date/Time of Peak Inflow:	01Jan2001, 00:13
Peak Discharge:	37.6 (CFS)	Date/Time of Peak Discharge	01Jan2001, 00:17
Inflow Volume:	5.0 (AC-FT)	Peak Storage:	0.3 (AC-FT)
Discharge Volume	4.8 (AC-FT)	Peak Elevation:	60.2 (FT)

Project: 4191_HEC-HMS Simulation Run: Prop_25yr
Reservoir: BAS1_South

Start of Run:	01Jan2001, 00:00	Basin Model:	25-YEAR_PROP
End of Run:	01Jan2001, 03:00	Meteorologic Model:	Met 1
Compute Time:	29Jul2019, 16:32:57	Control Specifications:	Control 1

Volume Units: AC-FT

Computed Results

Peak Inflow:	10.9 (CFS)	Date/Time of Peak Inflow:	01Jan2001, 00:13
Peak Discharge:	7.1 (CFS)	Date/Time of Peak Discharge	01Jan2001, 00:20
Inflow Volume:	0.3 (AC-FT)	Peak Storage:	0.1 (AC-FT)
Discharge Volume	0.3 (AC-FT)	Peak Elevation:	60.2 (FT)

Project: 4191_HEC-HMS Simulation Run: Prop_10yr

Start of Run: 01Jan2001, 00:00 Basin Model: 10-YEAR_PROP
End of Run: 01Jan2001, 03:00 Meteorologic Model: Met 1
Compute Time: 29Jul2019, 16:32:37 Control Specifications: Control 1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
2P	Not Specified	8.6	01Jan2001, 00:14	0.2
OS6	Not Specified	0.2	01Jan2001, 00:12	0.0
Neenah Grate	Not Specified	8.8	01Jan2001, 00:14	0.2
BAS1_South	Not Specified	4.8	01Jan2001, 00:22	0.2
OS8	Not Specified	1.7	01Jan2001, 00:14	0.0
3P	Not Specified	3.1	01Jan2001, 00:14	0.1
1P	Not Specified	4.9	01Jan2001, 00:14	0.1
OS4	Not Specified	2.5	01Jan2001, 00:14	0.1
OS2	Not Specified	7.0	01Jan2001, 00:00	1.7
OS2-OS4	Not Specified	9.5	01Jan2001, 00:14	1.8
OS1	Not Specified	5.0	01Jan2001, 00:00	1.2
OS5	Not Specified	11.4	01Jan2001, 00:14	0.3
OS1-OS5	Not Specified	16.4	01Jan2001, 00:14	1.5
OS3	Not Specified	0.6	01Jan2001, 00:14	0.0
BAS2_IN	Not Specified	31.4	01Jan2001, 00:14	3.4
BAS1-North	Not Specified	28.9	01Jan2001, 00:16	3.2
PROP-Q_Exiting_Project	Not Specified	34.5	01Jan2001, 00:19	3.5

Project: 4191_HEC-HMS Simulation Run: Prop_10yr
Reservoir: BAS1-North

Start of Run:	01Jan2001, 00:00	Basin Model:	10-YEAR_PROP
End of Run:	01Jan2001, 03:00	Meteorologic Model:	Met 1
Compute Time:	29Jul2019, 16:32:37	Control Specifications:	Control 1

Volume Units: AC-FT

Computed Results

Peak Inflow:	31.4 (CFS)	Date/Time of Peak Inflow:	01Jan2001, 00:13
Peak Discharge:	28.9 (CFS)	Date/Time of Peak Discharge	01Jan2001, 00:16
Inflow Volume:	3.4 (AC-FT)	Peak Storage:	0.3 (AC-FT)
Discharge Volume	3.2 (AC-FT)	Peak Elevation:	59.9 (FT)

Project: 4191_HEC-HMS Simulation Run: Prop_10yr
Reservoir: BAS1_South

Start of Run:	01Jan2001, 00:00	Basin Model:	10-YEAR_PROP
End of Run:	01Jan2001, 03:00	Meteorologic Model:	Met 1
Compute Time:	29Jul2019, 16:32:37	Control Specifications:	Control 1

Volume Units: AC-FT

Computed Results

Peak Inflow:	8.8 (CFS)	Date/Time of Peak Inflow:	01Jan2001, 00:13
Peak Discharge:	4.8 (CFS)	Date/Time of Peak Discharge	01Jan2001, 00:22
Inflow Volume:	0.2 (AC-FT)	Peak Storage:	0.1 (AC-FT)
Discharge Volume	0.2 (AC-FT)	Peak Elevation:	60.1 (FT)

Project: 4191_HEC-HMS Simulation Run: Prop_2yr

Start of Run: 01Jan2001, 00:00 Basin Model: 2-YEAR_PROP
End of Run: 01Jan2001, 03:00 Meteorologic Model: Met 1
Compute Time: 29Jul2019, 16:32:47 Control Specifications: Control 1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
2P	Not Specified	4.9	01Jan2001, 00:14	0.1
OS6	Not Specified	0.1	01Jan2001, 00:11	0.0
Neenah Grate	Not Specified	5.0	01Jan2001, 00:14	0.1
BAS1_South	Not Specified	1.1	01Jan2001, 00:31	0.1
OS8	Not Specified	0.8	01Jan2001, 00:13	0.0
3P	Not Specified	1.8	01Jan2001, 00:14	0.0
1P	Not Specified	2.6	01Jan2001, 00:14	0.1
OS4	Not Specified	1.1	01Jan2001, 00:14	0.0
OS2	Not Specified	2.0	01Jan2001, 00:00	0.5
OS2-OS4	Not Specified	3.1	01Jan2001, 00:14	0.5
OS1	Not Specified	1.0	01Jan2001, 00:00	0.2
OS5	Not Specified	5.7	01Jan2001, 00:14	0.1
OS1-OS5	Not Specified	6.7	01Jan2001, 00:14	0.4
OS3	Not Specified	0.2	01Jan2001, 00:11	0.0
BAS2_IN	Not Specified	12.6	01Jan2001, 00:14	1.0
BAS1-North	Not Specified	8.3	01Jan2001, 00:22	0.8
PROP-Q_Exiting_Project	Not Specified	10.9	01Jan2001, 00:22	0.9

Project: 4191_HEC-HMS Simulation Run: Prop_2yr
Reservoir: BAS1-North

Start of Run:	01Jan2001, 00:00	Basin Model:	2-YEAR_PROP
End of Run:	01Jan2001, 03:00	Meteorologic Model:	Met 1
Compute Time:	29Jul2019, 16:32:47	Control Specifications:	Control 1

Volume Units: AC-FT

Computed Results

Peak Inflow:	12.6 (CFS)	Date/Time of Peak Inflow:	01Jan2001, 00:13
Peak Discharge:	8.3 (CFS)	Date/Time of Peak Discharge	01Jan2001, 00:22
Inflow Volume:	1.0 (AC-FT)	Peak Storage:	0.2 (AC-FT)
Discharge Volume	0.8 (AC-FT)	Peak Elevation:	59.6 (FT)

Project: 4191_HEC-HMS Simulation Run: Prop_2yr
Reservoir: BAS1_South

Start of Run:	01Jan2001, 00:00	Basin Model:	2-YEAR_PROP
End of Run:	01Jan2001, 03:00	Meteorologic Model:	Met 1
Compute Time:	29Jul2019, 16:32:47	Control Specifications:	Control 1

Volume Units: AC-FT

Computed Results

Peak Inflow:	5.0 (CFS)	Date/Time of Peak Inflow:	01Jan2001, 00:13
Peak Discharge:	1.1 (CFS)	Date/Time of Peak Discharge	01Jan2001, 00:31
Inflow Volume:	0.1 (AC-FT)	Peak Storage:	0.1 (AC-FT)
Discharge Volume	0.1 (AC-FT)	Peak Elevation:	59.6 (FT)

APPENDIX E – SEDIMENT TRANSPORT

Worksheet for OS4_3cfs_2-yr

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03500	ft/ft
Discharge	3.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	2571.50
0+40	2569.00
0+45	2568.50
0+50	2569.00
0+89	2571.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2571.50)	(0+89, 2571.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.38	ft
Elevation Range	2568.50 to 2571.50 ft	
Flow Area	1.48	ft²
Wetted Perimeter	7.88	ft
Hydraulic Radius	0.19	ft
Top Width	7.85	ft
Normal Depth	0.38	ft
Critical Depth	0.35	ft

Worksheet for OS4_3cfs_2-yr

Results

Critical Slope		0.05313	ft/ft
Velocity		2.03	ft/s
Velocity Head		0.06	ft
Specific Energy		0.44	ft
Froude Number		0.82	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.38	ft
Critical Depth	0.35	ft
Channel Slope	0.03500	ft/ft
Critical Slope	0.05313	ft/ft

Worksheet for OS4_10cfs_10-yr

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03500	ft/ft
Discharge	10.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	2571.50
0+40	2569.00
0+45	2568.50
0+50	2569.00
0+89	2571.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2571.50)	(0+89, 2571.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.60	ft
Elevation Range	2568.50 to 2571.50 ft	
Flow Area	3.84	ft²
Wetted Perimeter	14.07	ft
Hydraulic Radius	0.27	ft
Top Width	14.02	ft
Normal Depth	0.60	ft
Critical Depth	0.57	ft

Worksheet for OS4_10cfs_10-yr

Results

Critical Slope		0.04617	ft/ft
Velocity		2.60	ft/s
Velocity Head		0.11	ft
Specific Energy		0.71	ft
Froude Number		0.88	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.60	ft
Critical Depth	0.57	ft
Channel Slope	0.03500	ft/ft
Critical Slope	0.04617	ft/ft

Worksheet for OS4_14cfs_25-yr

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03500	ft/ft
Discharge	14.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	2571.50
0+40	2569.00
0+45	2568.50
0+50	2569.00
0+89	2571.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2571.50)	(0+89, 2571.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.68	ft
Elevation Range	2568.50 to 2571.50 ft	
Flow Area	5.06	ft²
Wetted Perimeter	16.88	ft
Hydraulic Radius	0.30	ft
Top Width	16.82	ft
Normal Depth	0.68	ft
Critical Depth	0.65	ft

Worksheet for OS4_14cfs_25-yr

Results

Critical Slope		0.04477	ft/ft
Velocity		2.77	ft/s
Velocity Head		0.12	ft
Specific Energy		0.80	ft
Froude Number		0.89	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.68	ft
Critical Depth	0.65	ft
Channel Slope	0.03500	ft/ft
Critical Slope	0.04477	ft/ft

Worksheet for OS4_27cfs_100-yr

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03500	ft/ft
Discharge	27.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	2571.50
0+40	2569.00
0+45	2568.50
0+50	2569.00
0+89	2571.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2571.50)	(0+89, 2571.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.85	ft
Elevation Range	2568.50 to 2571.50 ft	
Flow Area	8.49	ft²
Wetted Perimeter	23.02	ft
Hydraulic Radius	0.37	ft
Top Width	22.95	ft
Normal Depth	0.85	ft
Critical Depth	0.83	ft

Worksheet for OS4_27cfs_100-yr

Results

Critical Slope		0.04166	ft/ft
Velocity		3.18	ft/s
Velocity Head		0.16	ft
Specific Energy		1.01	ft
Froude Number		0.92	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.85	ft
Critical Depth	0.83	ft
Channel Slope	0.03500	ft/ft
Critical Slope	0.04166	ft/ft

Worksheet for 2A_Prop_2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.025	
Channel Slope	0.02500	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	10.00	ft^3/s

Results

Normal Depth	0.26	ft
Flow Area	2.72	ft^2
Wetted Perimeter	11.16	ft
Hydraulic Radius	0.24	ft
Top Width	11.04	ft
Critical Depth	0.31	ft
Critical Slope	0.01398	ft/ft
Velocity	3.67	ft/s
Velocity Head	0.21	ft
Specific Energy	0.47	ft
Froude Number	1.30	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.26	ft
Critical Depth	0.31	ft
Channel Slope	0.02500	ft/ft

Worksheet for 2A_Prop_2

GVF Output Data

Critical Slope	0.01398	ft/ft

Worksheet for 2A_Prop_10

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.025	
Channel Slope	0.02500	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	27.00	ft^3/s

Results

Normal Depth	0.47	ft
Flow Area	5.11	ft^2
Wetted Perimeter	12.09	ft
Hydraulic Radius	0.42	ft
Top Width	11.87	ft
Critical Depth	0.59	ft
Critical Slope	0.01159	ft/ft
Velocity	5.29	ft/s
Velocity Head	0.43	ft
Specific Energy	0.90	ft
Froude Number	1.42	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.47	ft
Critical Depth	0.59	ft
Channel Slope	0.02500	ft/ft

Worksheet for 2A_Prop_10

GVF Output Data

Critical Slope	0.01159	ft/ft

Worksheet for 2A_Prop_25

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.025	
Channel Slope	0.02500	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	42.00	ft³/s

Results

Normal Depth	0.61	ft
Flow Area	6.79	ft²
Wetted Perimeter	12.71	ft
Hydraulic Radius	0.53	ft
Top Width	12.42	ft
Critical Depth	0.78	ft
Critical Slope	0.01073	ft/ft
Velocity	6.19	ft/s
Velocity Head	0.60	ft
Specific Energy	1.20	ft
Froude Number	1.48	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.61	ft
Critical Depth	0.78	ft
Channel Slope	0.02500	ft/ft

Worksheet for 2A_Prop_25

GVF Output Data

Critical Slope	0.01073	ft/ft

Worksheet for 2A_Prop_100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.020	
Channel Slope	0.02500	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	75.00	ft³/s

Results

Normal Depth	0.75	ft
Flow Area	8.57	ft²
Wetted Perimeter	13.34	ft
Hydraulic Radius	0.64	ft
Top Width	12.98	ft
Critical Depth	1.11	ft
Critical Slope	0.00624	ft/ft
Velocity	8.75	ft/s
Velocity Head	1.19	ft
Specific Energy	1.94	ft
Froude Number	1.90	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.75	ft
Critical Depth	1.11	ft
Channel Slope	0.02500	ft/ft

Worksheet for 2A_Prop_100

GVF Output Data

Critical Slope	0.00624	ft/ft

Sediment Transport Analysis of Proposed Channel and/or Culvert

PROJECT NAME: 4191 River's Edge
CP: OS4-2A

OS4

Storm Event:	2	yr
Q=(exist)	3	cfs

1) First determine sediment supply from the upstream channel for the chosen storm event for OS4 @ XS 2A

Using Equation 11.7 from Engineering Analysis of Fluvial Systems,

----> Where G=3, and d_{50}=2 mm

$$q_s=3.72*10^{-6}*Y_h^{-0.02}*V^{3.85}$$

Upstream Channel Information Determined by FlowMaster*

XS 2A

Bottom Width =	0	ft	
Side Slope =	20	ft/ft	
Top Width=	7.9	ft	*
Depth=	0.4	ft	*
Area=	1.5	ft^2	*
Perimeter=	7.9	ft	*
Manning's n=	0.045		
Slope=	0.035	ft/ft	
Velocity=	2	fps	*
Yh=	0.19	ft	

q_s=	**0.0001**	cfs-ft
Q_s=	**0.0004**	cfs

2) Determine sediment transport capability of the lined collector channel @ XS 2A

Stable Slope equation 8-V from PC Drainage and Channel Design Standards to determine supply=outgoing sediment. Compare Stable Slope with slope of lined channel

Given:

$$S_u = \left[\frac{N_u}{N_n}\right]^2 \left[\frac{Q_{wu}}{Q_{wn}}\right]^{-1.4} \left[\frac{T_u}{T_n}\right]^{0.5} (1-R)^{0.9} S_n \quad \text{eq. 8-V}$$

Nu=	0.02		Manning's n after Urbanization
Nn=	0.045		Manning's n for natural condition
Qwu=	10	cfs	Peak Discharge of chosen event after Urbanization
Qwn=	3	cfs	Peak Discharge of chosen event before Urbanization (cfs)
Tu=	4.6	ft	Urbanized Top Width
Tn=	7.9	ft	Natural Top Width
R=	0		Reduction Factor for Sediment Supply
Sn=	0.035	ft/ft	Slope in Natural Channel

Su=	**0.03**	ft/ft

$S_{channel}$= 0.03 ft/ft **OK**

3) Determine sediment transport capability of culvert inlet at face of culvert

Using Method A from Estimating Sediment Movement in Drainage Structures (Richards/Zeller, 1999)

$$Q_{max} = 13{,}590 * d_s^{-1.02} * S^{2.52} * R^{1.52} * A$$

Culvert Parameters at Entrance. If multiple culverts, use information for one pipe only

Slope=	0	ft/ft	ds=	0	mm	Typically 2 mm assumed
Flow Depth=	0	ft/ft	$S_{culvert}$	0	m/m	
Flow Area=	0	sq. ft.	R=	0.000	m	
Hydraulic Radius=	0	ft**	A=	0.000	sq. m.	

Qmax= 0.0000 cms

Qmax= 0.0000 cfs **NA**

Check if Qmax is more than Sediment Supply in Step 1, if yes, then Culvert OK

Sediment Transport Analysis of Proposed Channel and/or Culvert

PROJECT NAME: 4191 River's Edge
CP: OS4-2A

OS4

Storm Event:	10	yr
Q=(exist)	10	cfs

1) First determine sediment supply from the upstream channel for the chosen storm event for OS4 @ XS 2A

Using Equation 11.7 from Engineering Analysis of Fluvial Systems,

----> Where G=3, and d_{50}=2 mm

$$q_s=3.72*10^{-6}*Y_h^{-0.02}*V^{3.85}$$

Upstream Channel Information Determined by FlowMaster*

XS 2A

Bottom Width =	0	ft	
Side Slope =	20	ft/ft	
Top Width=	14	ft	*
Depth=	0.6	ft	*
Area=	3.8	ft^2	*
Perimeter=	14.1	ft	*
Manning's n=	0.045		
Slope=	0.035	ft/ft	
Velocity=	2.6	fps	*
Yh=	0.27	ft	

q_s=	**0.0001**	cfs-ft
Q_s=	**0.0021**	cfs

2) Determine sediment transport capability of the lined collector channel @ XS 2A

Stable Slope equation 8-V from PC Drainage and Channel Design Standards to determine supply=outgoing sediment. Compare Stable Slope with slope of lined channel

Given:

$$S_u = \left[\frac{N_u}{N_n}\right]^2 \left[\frac{Q_{wu}}{Q_{wn}}\right]^{-1.4} \left[\frac{T_u}{T_n}\right]^{0.5} (1-R)^{0.9} S_n \quad \text{eq. 8-V}$$

Nu=	0.02		Manning's n after Urbanization
Nn=	0.045		Manning's n for natural condition
Qwu=	27	cfs	Peak Discharge of chosen event after Urbanization
Qwn=	10	cfs	Peak Discharge of chosen event before Urbanization (cfs)
Tu=	11.6	ft	Urbanized Top Width
Tn=	14	ft	Natural Top Width
R=	0		Reduction Factor for Sediment Supply
Sn=	0.035	ft/ft	Slope in Natural Channel

Su=	**0.03**	ft/ft

$S_{channel}$= 0.03 ft/ft **OK**

3) Determine sediment transport capability of culvert inlet at face of culvert

Using Method A from Estimating Sediment Movement in Drainage Structures (Richards/Zeller, 1999)

$$Q_{max} = 13{,}590 * d_s^{-1.02} * S^{2.52} * R^{1.52} * A$$

Culvert Parameters at Entrance. If multiple culverts, use information for one pipe only

Slope=	0	ft/ft	ds=	0	mm	Typically 2 mm assumed
Flow Depth=	0	ft/ft	$S_{culvert}$	0	m/m	
Flow Area=	0	sq. ft.	R=	0.000	m	
Hydraulic Radius=	0	ft**	A=	0.000	sq. m.	

Qmax= 0.0000 cms

Qmax= 0.0000 cfs **NA**

Check if Qmax is more than Sediment Supply in Step 1, if yes, then Culvert OK

Sediment Transport Analysis of Proposed Channel and/or Culvert

PROJECT NAME: 4191 River's Edge
CP: OS4-2A

OS4

Storm Event:	25	yr
Q=(exist)	14	cfs

1) First determine sediment supply from the upstream channel for the chosen storm event for OS4 @ XS 2A

Using Equation 11.7 from Engineering Analysis of Fluvial Systems,

----> Where G=3, and d_{50}=2 mm

$$q_s=3.72*10^{-6}*Y_h^{-0.02}*V^{3.85}$$

Upstream Channel Information Determined by FlowMaster*

XS 2A

Bottom Width =	0	ft	
Side Slope =	20	ft/ft	
Top Width=	17	ft	*
Depth=	0.7	ft	*
Area=	5.1	ft^2	*
Perimeter=	16.9	ft	*
Manning's n=	0.045		
Slope=	0.035	ft/ft	
Velocity=	2.8	fps	*
Yh=	0.30	ft	

q_s=	**0.0002**	cfs-ft
Q_s=	**0.0034**	cfs

2) Determine sediment transport capability of the lined collector channel @ XS 2A

Stable Slope equation 8-V from PC Drainage and Channel Design Standards to determine supply=outgoing sediment. Compare Stable Slope with slope of lined channel

Given:

$$S_u = \left[\frac{N_u}{N_n}\right]^2 \left[\frac{Q_{wu}}{Q_{wn}}\right]^{-1.4} \left[\frac{T_u}{T_n}\right]^{0.5} (1-R)^{0.9} S_n \quad \text{eq. 8-V}$$

Nu=	0.02		Manning's n after Urbanization
Nn=	0.045		Manning's n for natural condition
Qwu=	42	cfs	Peak Discharge of chosen event after Urbanization
Qwn=	14	cfs	Peak Discharge of chosen event before Urbanization (cfs)
Tu=	12.4	ft	Urbanized Top Width
Tn=	17	ft	Natural Top Width
R=	0		Reduction Factor for Sediment Supply
Sn=	0.035	ft/ft	Slope in Natural Channel

Su=	**0.03**	ft/ft

$S_{channel}$= 0.03 ft/ft **OK**

3) Determine sediment transport capability of culvert inlet at face of culvert

Using Method A from Estimating Sediment Movement in Drainage Structures (Richards/Zeller, 1999)

$$Q_{max} = 13{,}590 * d_s^{-1.02} * S^{2.52} * R^{1.52} * A$$

Culvert Parameters at Entrance. If multiple culverts, use information for one pipe only

Slope=	0	ft/ft	ds=	0	mm	Typically 2 mm assumed
Flow Depth=	0	ft/ft	$S_{culvert}$	0	m/m	
Flow Area=	0	sq. ft.	R=	0.000	m	
Hydraulic Radius=	0	ft**	A=	0.000	sq. m.	

Qmax= 0.0000 cms

Qmax= 0.0000 cfs **NA**

Check if Qmax is more than Sediment Supply in Step 1, if yes, then Culvert OK

Sediment Transport Analysis of Proposed Channel and/or Culvert

PROJECT NAME: 4191 River's Edge

CP: Existing Upstream Supply XS OS4 XS 2A

OS4

Storm Event:	100	yr
Q=(exist)	27	cfs

1) First determine sediment supply from the upstream channel for the chosen storm event for OS4 @ XS 2A

Using Equation 11.7 from Engineering Analysis of Fluvial Systems,

----> Where G=3, and d_{50}=2 mm

$$q_s=3.72*10^{-6}*Y_h^{-0.02}*V^{3.85}$$

Upstream Channel Information Determined by FlowMaster*

XS 2A

Bottom Width =	0	ft	
Side Slope =	20	ft/ft	
Top Width=	22.3	ft	*
Depth=	0.9	ft	*
Area=	8.5	ft^2	*
Perimeter=	23	ft	*
Manning's n=	0.045		
Slope=	0.035	ft/ft	
Velocity=	3.2	fps	*
Yh=	0.38	ft	

q_s=	**0.0003**	cfs-ft
Q_s=	**0.0073**	cfs

2) Determine sediment transport capability of the lined collector channel @ XS 2A

Stable Slope equation 8-V from PC Drainage and Channel Design Standards to determine supply=outgoing sediment. Compare Stable Slope with slope of lined channel

Given:

$$S_u = \left[\frac{N_u}{N_n}\right]^2 \left[\frac{Q_{wu}}{Q_{wn}}\right]^{-1.4} \left[\frac{T_u}{T_n}\right]^{0.5} (1-R)^{0.9} S_n \quad \text{eq. 8-V}$$

Nu=	0.02		Manning's n after Urbanization
Nn=	0.045		Manning's n for natural condition
Qwu=	75	cfs	Peak Discharge of chosen event after Urbanization
Qwn=	27	cfs	Peak Discharge of chosen event before Urbanization (cfs)
Tu=	13	ft	Urbanized Top Width
Tn=	23	ft	Natural Top Width
R=	0		Reduction Factor for Sediment Supply
Sn=	0.035	ft/ft	Slope in Natural Channel

Su=	**0.02**	ft/ft

$S_{channel}$= 0.03 ft/ft **OK**

3) Determine sediment transport capability of culvert inlet at face of culvert

Using Method A from Estimating Sediment Movement in Drainage Structures (Richards/Zeller, 1999)

$$Q_{max} = 13{,}590 * d_s^{-1.02} * S^{2.52} * R^{1.52} * A$$

Culvert Parameters at Entrance. If multiple culverts, use information for one pipe only

Slope=	0	ft/ft	ds=	0	mm	Typically 2 mm assumed
Flow Depth=	0	ft/ft	$S_{culvert}$	0	m/m	
Flow Area=	0	sq. ft.	R=	0.000	m	
Hydraulic Radius=	0	ft**	A=	0.000	sq. m.	

Qmax= 0.0000 cms

Qmax= 0.0000 cfs **NA**

Check if Qmax is more than Sediment Supply in Step 1, if yes, then Culvert OK

Worksheet for OS5_2-yr

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02630	ft/ft
Discharge	7.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	2585.00
0+28	2580.00
0+46	2578.00
0+67	2577.90
1+19	2578.00
1+60	2585.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2585.00)	(1+60, 2585.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.13	ft
Elevation Range	2577.90 to 2585.00 ft	
Flow Area	6.11	ft²
Wetted Perimeter	73.50	ft
Hydraulic Radius	0.08	ft
Top Width	73.50	ft
Normal Depth	0.13	ft

Worksheet for OS5_2-yr

Results

Critical Depth		0.12	ft
Critical Slope		0.05771	ft/ft
Velocity		1.14	ft/s
Velocity Head		0.02	ft
Specific Energy		0.15	ft
Froude Number		0.70	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth		0.00	ft
Length		0.00	ft
Number Of Steps		0	

GVF Output Data

Upstream Depth		0.00	ft
Profile Description			
Profile Headloss		0.00	ft
Downstream Velocity		Infinity	ft/s
Upstream Velocity		Infinity	ft/s
Normal Depth		0.13	ft
Critical Depth		0.12	ft
Channel Slope		0.02630	ft/ft
Critical Slope		0.05771	ft/ft

Worksheet for Copy of OS5_10-yr

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02630	ft/ft
Discharge	17.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	2585.00
0+28	2580.00
0+46	2578.00
0+67	2577.90
1+19	2578.00
1+60	2585.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2585.00)	(1+60, 2585.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.19	ft
Elevation Range	2577.90 to 2585.00 ft	
Flow Area	10.43	ft²
Wetted Perimeter	74.38	ft
Hydraulic Radius	0.14	ft
Top Width	74.37	ft
Normal Depth	0.19	ft

Worksheet for Copy of OS5_10-yr

Results

Critical Depth		0.17	ft
Critical Slope		0.04758	ft/ft
Velocity		1.63	ft/s
Velocity Head		0.04	ft
Specific Energy		0.23	ft
Froude Number		0.77	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth		0.00	ft
Length		0.00	ft
Number Of Steps		0	

GVF Output Data

Upstream Depth		0.00	ft
Profile Description			
Profile Headloss		0.00	ft
Downstream Velocity		Infinity	ft/s
Upstream Velocity		Infinity	ft/s
Normal Depth		0.19	ft
Critical Depth		0.17	ft
Channel Slope		0.02630	ft/ft
Critical Slope		0.04758	ft/ft

Worksheet for OS5_25-yr

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02630	ft/ft
Discharge	28.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	2585.00
0+28	2580.00
0+46	2578.00
0+67	2577.90
1+19	2578.00
1+60	2585.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2585.00)	(1+60, 2585.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.24	ft
Elevation Range	2577.90 to 2585.00 ft	
Flow Area	14.13	ft²
Wetted Perimeter	75.12	ft
Hydraulic Radius	0.19	ft
Top Width	75.10	ft
Normal Depth	0.24	ft

Worksheet for OS5_25-yr

Results

Critical Depth		0.22	ft
Critical Slope		0.04264	ft/ft
Velocity		1.98	ft/s
Velocity Head		0.06	ft
Specific Energy		0.30	ft
Froude Number		0.81	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth		0.00	ft
Length		0.00	ft
Number Of Steps		0	

GVF Output Data

Upstream Depth		0.00	ft
Profile Description			
Profile Headloss		0.00	ft
Downstream Velocity		Infinity	ft/s
Upstream Velocity		Infinity	ft/s
Normal Depth		0.24	ft
Critical Depth		0.22	ft
Channel Slope		0.02630	ft/ft
Critical Slope		0.04264	ft/ft

Worksheet for OS5_100-yr

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02630	ft/ft
Discharge	48.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	2585.00
0+28	2580.00
0+46	2578.00
0+67	2577.90
1+19	2578.00
1+60	2585.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2585.00)	(1+60, 2585.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.31	ft
Elevation Range	2577.90 to 2585.00 ft	
Flow Area	19.66	ft²
Wetted Perimeter	76.22	ft
Hydraulic Radius	0.26	ft
Top Width	76.19	ft
Normal Depth	0.31	ft

Worksheet for OS5_100-yr

Results

Critical Depth		0.29	ft
Critical Slope		0.03798	ft/ft
Velocity		2.44	ft/s
Velocity Head		0.09	ft
Specific Energy		0.41	ft
Froude Number		0.85	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth		0.00	ft
Length		0.00	ft
Number Of Steps		0	

GVF Output Data

Upstream Depth		0.00	ft
Profile Description			
Profile Headloss		0.00	ft
Downstream Velocity		Infinity	ft/s
Upstream Velocity		Infinity	ft/s
Normal Depth		0.31	ft
Critical Depth		0.29	ft
Channel Slope		0.02630	ft/ft
Critical Slope		0.03798	ft/ft

Worksheet for 1A_Prop_2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.025	
Channel Slope	0.02500	ft/ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	1.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	7.00	ft³/s

Results

Normal Depth	0.21	ft
Flow Area	2.15	ft²
Wetted Perimeter	10.60	ft
Hydraulic Radius	0.20	ft
Top Width	10.42	ft
Critical Depth	0.25	ft
Critical Slope	0.01503	ft/ft
Velocity	3.25	ft/s
Velocity Head	0.16	ft
Specific Energy	0.38	ft
Froude Number	1.26	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.21	ft
Critical Depth	0.25	ft
Channel Slope	0.02500	ft/ft

Worksheet for 1A_Prop_2

GVF Output Data

Critical Slope	0.01503	ft/ft

Worksheet for 1A_Prop_10

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.025	
Channel Slope	0.02500	ft/ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	1.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	17.00	ft^3/s

Results

Normal Depth	0.36	ft
Flow Area	3.73	ft^2
Wetted Perimeter	11.02	ft
Hydraulic Radius	0.34	ft
Top Width	10.72	ft
Critical Depth	0.44	ft
Critical Slope	0.01268	ft/ft
Velocity	4.56	ft/s
Velocity Head	0.32	ft
Specific Energy	0.68	ft
Froude Number	1.36	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.36	ft
Critical Depth	0.44	ft
Channel Slope	0.02500	ft/ft

Worksheet for 1A_Prop_10

GVF Output Data

Critical Slope	0.01268	ft/ft

Worksheet for 1A_Prop_25

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.025	
Channel Slope	0.02500	ft/ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	1.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	48.00	ft^3/s

Results

Normal Depth	0.67	ft
Flow Area	7.17	ft^2
Wetted Perimeter	11.90	ft
Hydraulic Radius	0.60	ft
Top Width	11.34	ft
Critical Depth	0.87	ft
Critical Slope	0.01060	ft/ft
Velocity	6.70	ft/s
Velocity Head	0.70	ft
Specific Energy	1.37	ft
Froude Number	1.49	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.67	ft
Critical Depth	0.87	ft
Channel Slope	0.02500	ft/ft

Worksheet for 1A_Prop_25

GVF Output Data

Critical Slope	0.01060	ft/ft

Worksheet for 1A_Prop_100yr

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.025	
Channel Slope	0.02500	ft/ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	1.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	48.00	ft³/s

Results

Normal Depth	0.67	ft
Flow Area	7.17	ft²
Wetted Perimeter	11.90	ft
Hydraulic Radius	0.60	ft
Top Width	11.34	ft
Critical Depth	0.87	ft
Critical Slope	0.01060	ft/ft
Velocity	6.70	ft/s
Velocity Head	0.70	ft
Specific Energy	1.37	ft
Froude Number	1.49	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.67	ft
Critical Depth	0.87	ft
Channel Slope	0.02500	ft/ft

Worksheet for 1A_Prop_100yr

GVF Output Data

Critical Slope	0.01060	ft/ft

Sediment Transport Analysis of Proposed Channel and/or Culvert

PROJECT NAME: 4191 River's Edge
CP: OS5-1A

Storm Event:	2	yr
Q=	7	cfs

1) First determine sediment supply from the upstream channel for the chosen storm event

Using Equation 11.7 from Engineering Analysis of Fluvial Systems,

----> Where G=3, and d_{50}=2 mm

$$q_s=3.72*10^{-6}*Y_h^{-0.02}*V^{3.85}$$

Upstream Channel Information Detemined by FlowMaster*

Bottom Width =	1	ft	
Side Slope =	20	ft/ft	
Top Width=	73.5	ft	*
Depth=	0.13	ft	*
Area=	6.11	ft^2	*
Perimeter=	73.5	ft	*
Manning's n=	0.04		
Slope=	0.0263	ft/ft	
Velocity=	1.14	fps	*

q_s=	**0.0000**	cfs-ft
Q_s=	**0.0005**	cfs

2) Determine sediment transport capability of the lined collector channel

Stable Slope equation 8-V from PC Drainage and Channel Design Standards to determine supply=outgoing sediment. Compare Stable Slope with slope of lined channel

Given:

$$S_u = \left[\frac{N_u}{N_n}\right]^2 \left[\frac{Q_{wu}}{Q_{wn}}\right]^{-1.4} \left[\frac{T_u}{T_n}\right]^{0.5} (1-R)^{0.9} S_n \quad \text{eq. 8-V}$$

Nu=	0.025		Manning's n after Urbanization
Nn=	0.04		Manning's n for natural condition
Qwu=	7	cfs	Peak Discharge of chosen event after Urbanization
Qwn=	7	cfs	Peak Discharge of chosen event before Urbanization (cfs)
Tu=	10.4	ft	Urbanized Top Width
Tn=	73.5	ft	Natural Top Width
R=	0		Reduction Factor for Sediment Supply
Sn=	0.0263	ft/ft	Slope in Natural Channel

Su=	**0.0039**	ft/ft

$S_{channel}$= 0.025 ft/ft **OK**

3) Determine sediment transport capability of culvert inlet at face of culvert

Using Method A from Estimating Sediment Movement in Drainage Structures (Richards/Zeller, 1999)

$$Q_{max} = 13{,}590 * d_s^{-1.02} * S^{2.52} * R^{1.52} * A$$

Culvert Parameters at Entrance pre FHWA Hydraulic Toolbox. If multiple culverts, use information for one pipe only

Slope=	0	ft/ft	ds=	0	mm	Typically 2 mm assumed
Flow Depth=	0	ft/ft	$S_{culvert}$	0	m/m	
Flow Area=	0	sq. ft.	R=	0.000	m	
Hydraulic Radius=	0	ft**	A=	0.000	sq. m.	

Qmax= 0.0000 cms

Qmax= 0.0000 cfs **NA**

Check if Qmax is more than Sediment Supply in Step 1, if yes, then Culvert OK

Sediment Transport Analysis of Proposed Channel and/or Culvert

PROJECT NAME: 4191 River's Edge
CP: OS5-1A

Storm Event:	10	yr
Q=	17	cfs

1) First determine sediment supply from the upstream channel for the chosen storm event

Using Equation 11.7 from Engineering Analysis of Fluvial Systems,

----> Where G=3, and d_{50}=2 mm

$$q_s=3.72*10^{-6}*Y_h^{-0.02}*V^{3.85}$$

Upstream Channel Information Detemined by FlowMaster*

Bottom Width =	1	ft	
Side Slope =	20	ft/ft	
Top Width=	74.4	ft	*
Depth=	0.19	ft	*
Area=	10.4	ft^2	*
Perimeter=	74.4	ft	*
Manning's n=	0.04		
Slope=	0.0263	ft/ft	
Velocity=	1.63	fps	*

q_s=	**0.0000**	cfs-ft
Q_s=	**0.0019**	cfs

2) Determine sediment transport capability of the lined collector channel

Stable Slope equation 8-V from PC Drainage and Channel Design Standards to determine supply=outgoing sediment. Compare Stable Slope with slope of lined channel

Given:

$$S_u = \left[\frac{N_u}{N_n}\right]^2 \left[\frac{Q_{wu}}{Q_{wn}}\right]^{-1.4} \left[\frac{T_u}{T_n}\right]^{0.5} (1-R)^{0.9} S_n \quad \text{eq. 8-V}$$

Nu=	0.025		Manning's n after Urbanization
Nn=	0.04		Manning's n for natural condition
Qwu=	17	cfs	Peak Discharge of chosen event after Urbanization
Qwn=	17	cfs	Peak Discharge of chosen event before Urbanization (cfs)
Tu=	10.7	ft	Urbanized Top Width
Tn=	74.4	ft	Natural Top Width
R=	0		Reduction Factor for Sediment Supply
Sn=	0.0263	ft/ft	Slope in Natural Channel

Su=	**0.0039**	ft/ft

$S_{channel}$= 0.025 ft/ft **OK**

3) Determine sediment transport capability of culvert inlet at face of culvert

Using Method A from Estimating Sediment Movement in Drainage Structures (Richards/Zeller, 1999)

$$Q_{max} = 13{,}590 * d_s^{-1.02} * S^{2.52} * R^{1.52} * A$$

Culvert Parameters at Entrance pre FHWA Hydraulic Toolbox. If multiple culverts, use information for one pipe only

Slope=	0	ft/ft	ds=	0	mm	Typically 2 mm assumed
Flow Depth=	0	ft/ft	$S_{culvert}$	0	m/m	
Flow Area=	0	sq. ft.	R=	0.000	m	
Hydraulic Radius=	0	ft**	A=	0.000	sq. m.	

Qmax= 0.0000 cms

Qmax= 0.0000 cfs **NA**

Check if Qmax is more than Sediment Supply in Step 1, if yes, then Culvert OK

Sediment Transport Analysis of Proposed Channel and/or Culvert

PROJECT NAME: 4191 River's Edge
CP: OS5-1A

Storm Event:	25	yr
Q=	28	cfs

1) First determine sediment supply from the upstream channel for the chosen storm event

Using Equation 11.7 from Engineering Analysis of Fluvial Systems,

----> Where G=3, and d_{50}=2 mm

$$q_s=3.72*10^{-6}*Y_h^{-0.02}*V^{3.85}$$

Upstream Channel Information Detemined by FlowMaster*

Bottom Width =	1	ft	
Side Slope =	20	ft/ft	
Top Width=	75.1	ft	*
Depth=	0.24	ft	*
Area=	14.13	ft^2	*
Perimeter=	75.12	ft	*
Manning's n=	0.04		
Slope=	0.0263	ft/ft	
Velocity=	1.98	fps	*

q_s=	**0.0001**	cfs-ft
Q_s=	**0.0040**	cfs

2) Determine sediment transport capability of the lined collector channel

Stable Slope equation 8-V from PC Drainage and Channel Design Standards to determine supply=outgoing sediment. Compare Stable Slope with slope of lined channel

Given:

$$S_u = \left[\frac{N_u}{N_n}\right]^2 \left[\frac{Q_{wu}}{Q_{wn}}\right]^{-1.4} \left[\frac{T_u}{T_n}\right]^{0.5} (1-R)^{0.9} S_n \quad \text{eq. 8-V}$$

Nu=	0.025		Manning's n after Urbanization
Nn=	0.04		Manning's n for natural condition
Qwu=	28	cfs	Peak Discharge of chosen event after Urbanization
Qwn=	28	cfs	Peak Discharge of chosen event before Urbanization (cfs)
Tu=	11.3	ft	Urbanized Top Width
Tn=	76.2	ft	Natural Top Width
R=	0		Reduction Factor for Sediment Supply
Sn=	0.0263	ft/ft	Slope in Natural Channel

Su=	**0.0040**	ft/ft

$S_{channel}$= 0.025 ft/ft **OK**

3) Determine sediment transport capability of culvert inlet at face of culvert

Using Method A from Estimating Sediment Movement in Drainage Structures (Richards/Zeller, 1999)

$$Q_{max} = 13{,}590 * d_s^{-1.02} * S^{2.52} * R^{1.52} * A$$

Culvert Parameters at Entrance pre FHWA Hydraulic Toolbox. If multiple culverts, use information for one pipe only

Slope=	0	ft/ft	ds=	0	mm	Typically 2 mm assumed
Flow Depth=	0	ft/ft	$S_{culvert}$	0	m/m	
Flow Area=	0	sq. ft.	R=	0.000	m	
Hydraulic Radius=	0	ft**	A=	0.000	sq. m.	

Qmax= 0.0000 cms

Qmax= 0.0000 cfs **NA**

Check if Qmax is more than Sediment Supply in Step 1, if yes, then Culvert OK

Sediment Transport Analysis of Proposed Channel and/or Culvert

PROJECT NAME: 4191 River's Edge
CP: OS5-1A

Storm Event:	100	yr
Q=	48	cfs

1) First determine sediment supply from the upstream channel for the chosen storm event

Using Equation 11.7 from Engineering Analysis of Fluvial Systems,

----> Where G=3, and d_{50}=2 mm

$$q_s=3.72*10^{-6}*Y_h^{-0.02}*V^{3.85}$$

Upstream Channel Information Detemined by FlowMaster*

Bottom Width =	1	ft	
Side Slope =	20	ft/ft	
Top Width=	76.2	ft	*
Depth=	0.3	ft	*
Area=	19.7	ft^2	*
Perimeter=	76.22	ft	*
Manning's n=	0.04		
Slope=	0.0263	ft/ft	
Velocity=	2.4	fps	*

q_s=	**0.0001**	cfs-ft
Q_s=	**0.0084**	cfs

2) Determine sediment transport capability of the lined collector channel

Stable Slope equation 8-V from PC Drainage and Channel Design Standards to determine supply=outgoing sediment. Compare Stable Slope with slope of lined channel

Given:

$$S_u = \left[\frac{N_u}{N_n}\right]^2 \left[\frac{Q_{wu}}{Q_{wn}}\right]^{-1.4} \left[\frac{T_u}{T_n}\right]^{0.5} (1-R)^{0.9} S_n \quad \text{eq. 8-V}$$

Nu=	0.025		Manning's n after Urbanization
Nn=	0.04		Manning's n for natural condition
Qwu=	48	cfs	Peak Discharge of chosen event after Urbanization
Qwn=	48	cfs	Peak Discharge of chosen event before Urbanization (cfs)
Tu=	11.3	ft	Urbanized Top Width
Tn=	76.2	ft	Natural Top Width
R=	0		Reduction Factor for Sediment Supply
Sn=	0.0263	ft/ft	Slope in Natural Channel

Su=	**0.0040**	ft/ft

$S_{channel}$= 0.025 ft/ft **OK**

3) Determine sediment transport capability of culvert inlet at face of culvert

Using Method A from Estimating Sediment Movement in Drainage Structures (Richards/Zeller, 1999)

$$Q_{max} = 13{,}590 * d_s^{-1.02} * S^{2.52} * R^{1.52} * A$$

Culvert Parameters at Entrance pre FHWA Hydraulic Toolbox. If multiple culverts, use information for one pipe only

Slope=	0	ft/ft	ds=	0	mm	Typically 2 mm assumed
Flow Depth=	0	ft/ft	$S_{culvert}$	0	m/m	
Flow Area=	0	sq. ft.	R=	0.000	m	
Hydraulic Radius=	0	ft**	A=	0.000	sq. m.	

Qmax= 0.0000 cms

Qmax= 0.0000 cfs **NA**

Check if Qmax is more than Sediment Supply in Step 1, if yes, then Culvert OK

Worksheet for OS7_5cfs_2-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02900	ft/ft
Discharge	5.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	2587.00
0+51	2586.86
0+55	2586.40
0+98	2586.10
1+27	2587.00
1+37	2589.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2587.00)	(1+37, 2589.50)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.18	ft
Elevation Range	2586.10 to 2589.50 ft	
Flow Area	2.93	ft²
Wetted Perimeter	32.02	ft
Hydraulic Radius	0.09	ft
Top Width	32.01	ft
Normal Depth	0.18	ft

Worksheet for OS7_5cfs_2-year

Results

Critical Depth		0.18	ft
Critical Slope		0.02913	ft/ft
Velocity		1.71	ft/s
Velocity Head		0.05	ft
Specific Energy		0.23	ft
Froude Number		1.00	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth		0.00	ft
Length		0.00	ft
Number Of Steps		0	

GVF Output Data

Upstream Depth		0.00	ft
Profile Description			
Profile Headloss		0.00	ft
Downstream Velocity		Infinity	ft/s
Upstream Velocity		Infinity	ft/s
Normal Depth		0.18	ft
Critical Depth		0.18	ft
Channel Slope		0.02900	ft/ft
Critical Slope		0.02913	ft/ft

Worksheet for OS7_17cfs_10-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02900	ft/ft
Discharge	17.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	2587.00
0+51	2586.86
0+55	2586.40
0+98	2586.10
1+27	2587.00
1+37	2589.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2587.00)	(1+37, 2589.50)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.29	ft
Elevation Range	2586.10 to 2589.50 ft	
Flow Area	7.31	ft²
Wetted Perimeter	50.59	ft
Hydraulic Radius	0.14	ft
Top Width	50.58	ft
Normal Depth	0.29	ft

Worksheet for OS7_17cfs_10-year

Results

Critical Depth		0.30	ft
Critical Slope		0.02475	ft/ft
Velocity		2.33	ft/s
Velocity Head		0.08	ft
Specific Energy		0.37	ft
Froude Number		1.08	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth		0.00	ft
Length		0.00	ft
Number Of Steps		0	

GVF Output Data

Upstream Depth		0.00	ft
Profile Description			
Profile Headloss		0.00	ft
Downstream Velocity		Infinity	ft/s
Upstream Velocity		Infinity	ft/s
Normal Depth		0.29	ft
Critical Depth		0.30	ft
Channel Slope		0.02900	ft/ft
Critical Slope		0.02475	ft/ft

Worksheet for OS7_24cfs_25-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02900	ft/ft
Discharge	24.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	2587.00
0+51	2586.86
0+55	2586.40
0+98	2586.10
1+27	2587.00
1+37	2589.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2587.00)	(1+37, 2589.50)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.33	ft
Elevation Range	2586.10 to 2589.50 ft	
Flow Area	9.20	ft²
Wetted Perimeter	53.50	ft
Hydraulic Radius	0.17	ft
Top Width	53.49	ft
Normal Depth	0.33	ft

Worksheet for OS7_24cfs_25-year

Results

Critical Depth		0.34	ft
Critical Slope		0.02309	ft/ft
Velocity		2.61	ft/s
Velocity Head		0.11	ft
Specific Energy		0.43	ft
Froude Number		1.11	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.33	ft
Critical Depth	0.34	ft
Channel Slope	0.02900	ft/ft
Critical Slope	0.02309	ft/ft

Worksheet for OS7_47cfs_100-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02900	ft/ft
Discharge	47.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	2587.00
0+51	2586.86
0+55	2586.40
0+98	2586.10
1+27	2587.00
1+37	2589.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2587.00)	(1+37, 2589.50)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.41	ft
Elevation Range	2586.10 to 2589.50 ft	
Flow Area	14.12	ft²
Wetted Perimeter	57.02	ft
Hydraulic Radius	0.25	ft
Top Width	57.00	ft
Normal Depth	0.41	ft

Worksheet for OS7_47cfs_100-year

Results

Critical Depth		0.44	ft
Critical Slope		0.02024	ft/ft
Velocity		3.33	ft/s
Velocity Head		0.17	ft
Specific Energy		0.59	ft
Froude Number		1.18	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.41	ft
Critical Depth	0.44	ft
Channel Slope	0.02900	ft/ft
Critical Slope	0.02024	ft/ft

Worksheet for 3A_Prop_2yr

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.40000	ft/ft
Discharge	5.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	2586.00
0+23	2587.00
0+41	2587.00
0+72	2586.90
0+78	2580.50
1+07	2584.00
1+22	2586.50
1+37	2586.00
1+43	2585.80
1+48	2586.00
1+69	2586.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2586.00)	(0+23, 2587.00)	0.020
(0+23, 2587.00)	(0+41, 2587.00)	0.025
(0+41, 2587.00)	(0+72, 2586.90)	0.025
(0+72, 2586.90)	(0+78, 2580.50)	0.015
(0+78, 2580.50)	(1+07, 2584.00)	0.015
(1+07, 2584.00)	(1+22, 2586.50)	0.015
(1+22, 2586.50)	(1+37, 2586.00)	0.025
(1+37, 2586.00)	(1+43, 2585.80)	0.025
(1+43, 2585.80)	(1+48, 2586.00)	0.025
(1+48, 2586.00)	(1+69, 2586.50)	0.025

Worksheet for 3A_Prop_2yr

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		0.26	ft
Elevation Range	2580.50 to 2587.00 ft		
Flow Area		0.32	ft²
Wetted Perimeter		2.55	ft
Hydraulic Radius		0.13	ft
Top Width		2.43	ft
Normal Depth		0.26	ft
Critical Depth		0.59	ft
Critical Slope		0.00526	ft/ft
Velocity		15.66	ft/s
Velocity Head		3.81	ft
Specific Energy		4.08	ft
Froude Number		7.62	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.26	ft
Critical Depth	0.59	ft
Channel Slope	0.40000	ft/ft
Critical Slope	0.00526	ft/ft

Worksheet for 3A_Prop_10yr

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.40000	ft/ft
Discharge	17.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	2586.00
0+23	2587.00
0+41	2587.00
0+72	2586.90
0+78	2580.50
1+07	2584.00
1+22	2586.50
1+37	2586.00
1+43	2585.80
1+48	2586.00
1+69	2586.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2586.00)	(0+23, 2587.00)	0.020
(0+23, 2587.00)	(0+41, 2587.00)	0.025
(0+41, 2587.00)	(0+72, 2586.90)	0.025
(0+72, 2586.90)	(0+78, 2580.50)	0.015
(0+78, 2580.50)	(1+07, 2584.00)	0.015
(1+07, 2584.00)	(1+22, 2586.50)	0.015
(1+22, 2586.50)	(1+37, 2586.00)	0.025
(1+37, 2586.00)	(1+43, 2585.80)	0.025
(1+43, 2585.80)	(1+48, 2586.00)	0.025
(1+48, 2586.00)	(1+69, 2586.50)	0.025

Worksheet for 3A_Prop_10yr

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		0.42	ft
Elevation Range	2580.50 to 2587.00 ft		
Flow Area		0.80	ft²
Wetted Perimeter		4.04	ft
Hydraulic Radius		0.20	ft
Top Width		3.84	ft
Normal Depth		0.42	ft
Critical Depth		0.97	ft
Critical Slope		0.00446	ft/ft
Velocity		21.27	ft/s
Velocity Head		7.03	ft
Specific Energy		7.45	ft
Froude Number		8.22	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.42	ft
Critical Depth	0.97	ft
Channel Slope	0.40000	ft/ft
Critical Slope	0.00446	ft/ft

Worksheet for 3A_Prop_25yr

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.40000	ft/ft
Discharge	24.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	2586.00
0+23	2587.00
0+41	2587.00
0+72	2586.90
0+78	2580.50
1+07	2584.00
1+22	2586.50
1+37	2586.00
1+43	2585.80
1+48	2586.00
1+69	2586.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2586.00)	(0+23, 2587.00)	0.020
(0+23, 2587.00)	(0+41, 2587.00)	0.025
(0+41, 2587.00)	(0+72, 2586.90)	0.025
(0+72, 2586.90)	(0+78, 2580.50)	0.015
(0+78, 2580.50)	(1+07, 2584.00)	0.015
(1+07, 2584.00)	(1+22, 2586.50)	0.015
(1+22, 2586.50)	(1+37, 2586.00)	0.025
(1+37, 2586.00)	(1+43, 2585.80)	0.025
(1+43, 2585.80)	(1+48, 2586.00)	0.025
(1+48, 2586.00)	(1+69, 2586.50)	0.025

Worksheet for 3A_Prop_25yr

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		0.47	ft
Elevation Range	2580.50 to 2587.00 ft		
Flow Area		1.03	ft²
Wetted Perimeter		4.60	ft
Hydraulic Radius		0.23	ft
Top Width		4.37	ft
Normal Depth		0.47	ft
Critical Depth		1.11	ft
Critical Slope		0.00426	ft/ft
Velocity		23.19	ft/s
Velocity Head		8.36	ft
Specific Energy		8.83	ft
Froude Number		8.40	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.47	ft
Critical Depth	1.11	ft
Channel Slope	0.40000	ft/ft
Critical Slope	0.00426	ft/ft

Worksheet for 3A_Prop_100yr

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.40000	ft/ft
Discharge	47.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	2586.00
0+23	2587.00
0+41	2587.00
0+72	2586.90
0+78	2580.50
1+07	2584.00
1+22	2586.50
1+37	2586.00
1+43	2585.80
1+48	2586.00
1+69	2586.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2586.00)	(0+23, 2587.00)	0.020
(0+23, 2587.00)	(0+41, 2587.00)	0.025
(0+41, 2587.00)	(0+72, 2586.90)	0.025
(0+72, 2586.90)	(0+78, 2580.50)	0.015
(0+78, 2580.50)	(1+07, 2584.00)	0.015
(1+07, 2584.00)	(1+22, 2586.50)	0.015
(1+22, 2586.50)	(1+37, 2586.00)	0.025
(1+37, 2586.00)	(1+43, 2585.80)	0.025
(1+43, 2585.80)	(1+48, 2586.00)	0.025
(1+48, 2586.00)	(1+69, 2586.50)	0.025

Worksheet for 3A_Prop_100yr

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		0.61	ft
Elevation Range	2580.50 to 2587.00 ft		
Flow Area		1.71	ft²
Wetted Perimeter		5.91	ft
Hydraulic Radius		0.29	ft
Top Width		5.63	ft
Normal Depth		0.61	ft
Critical Depth		1.45	ft
Critical Slope		0.00390	ft/ft
Velocity		27.43	ft/s
Velocity Head		11.69	ft
Specific Energy		12.30	ft
Froude Number		8.76	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.61	ft
Critical Depth	1.45	ft
Channel Slope	0.40000	ft/ft
Critical Slope	0.00390	ft/ft

Sediment Transport Analysis of Proposed Channel and/or Culvert

PROJECT NAME: 4191 River's Edge
CP: OS7- 3A

Storm Event:	2	yr
Q=	5	cfs

1) First determine sediment supply from the upstream channel (OS7)for the chosen storm event

Using Equation 11.7 from Engineering Analysis of Fluvial Systems,

----> Where G=3, and d_{50}=2 mm

$$q_s=3.72*10^{-6}*Y_h^{-0.02}*V^{3.85}$$

Upstream Existing Channel (OS7) Information Detemined by FlowMaster*

Bottom Width =	4	ft	
Side Slope =	18	ft/ft	
Top Width=	32	ft	*
Depth=	0.18	ft	*
Area=	2.93	ft^2	*
Perimeter=	32	ft	*
Manning's n=	0.03		
Slope=	0.029	ft/ft	
Velocity=	1.7	fps	*

q_s=	**0.0000**	cfs-ft
Q_s=	**0.0010**	cfs

2) Determine sediment transport capability of the lined collector channel (3A)

Stable Slope equation 8-V from PC Drainage and Channel Design Standards to determine supply=outgoing sediment. Compare Stable Slope with slope of lined channel

Given:

$$S_u = \left[\frac{N_u}{N_n}\right]^2 \left[\frac{Q_{wu}}{Q_{wn}}\right]^{-1.4} \left[\frac{T_u}{T_n}\right]^{0.5} (1-R)^{0.9} S_n \quad \text{eq. 8-V}$$

Nu=	0.015		Manning's n after Urbanization
Nn=	0.03		Manning's n for natural condition
Qwu=	5	cfs	Peak Discharge of chosen event after Urbanization
Qwn=	5	cfs	Peak Discharge of chosen event before Urbanization (cfs)
Tu=	2.43	ft	Urbanized Top Width
Tn=	32	ft	Natural Top Width
R=	0		Reduction Factor for Sediment Supply
Sn=	0.029	ft/ft	Slope in Natural Channel

Su=	**0.0020**	ft/ft

$S_{channel}$= 0.4 ft/ft **OK**

3) Determine sediment transport capability of culvert inlet at face of culvert

Using Method A from Estimating Sediment Movement in Drainage Structures (Richards/Zeller, 1999)

$$Q_{max} = 13{,}590 * d_s^{-1.02} * S^{2.52} * R^{1.52} * A$$

Culvert Parameters at Entrance pre FHWA Hydraulic Toolbox. If multiple culverts, use information for one pipe only

Slope=	0.046	ft/ft	ds=	2	mm	Typically 2 mm assumed
Flow Depth=	0.459	ft/ft	$S_{culvert}$	0.046	m/m	
Flow Area=	0.617	sq. ft.	R=	0.085	m	
Hydraulic Radius=	0.279	ft**	A=	0.057	sq. m.	

Qmax= 0.0159 cms

Qmax= 0.5620 cfs **OK**

Check if Qmax is more than Sediment Supply in Step 1, if yes, then Culvert OK

Sediment Transport Analysis of Proposed Channel and/or Culvert

PROJECT NAME: 4191 River's Edge
CP: OS7- 3A

Storm Event:	10	yr
Q=	17	cfs

1) First determine sediment supply from the upstream channel (OS7)for the chosen storm event

Using Equation 11.7 from Engineering Analysis of Fluvial Systems,

----> Where G=3, and d_{50}=2 mm

$$q_s=3.72*10^{-6}*Y_h^{-0.02}*V^{3.85}$$

Upstream Existing Channel (OS7) Information Detemined by FlowMaster*

Bottom Width =	4	ft	
Side Slope =	18	ft/ft	
Top Width=	50.6	ft	*
Depth=	0.29	ft	*
Area=	7.3	ft^2	*
Perimeter=	50.6	ft	*
Manning's n=	0.03		
Slope=	0.029	ft/ft	
Velocity=	2.3	fps	*

q_s=	**0.0001**	cfs-ft
Q_s=	**0.0048**	cfs

2) Determine sediment transport capability of the lined collector channel (3A)

Stable Slope equation 8-V from PC Drainage and Channel Design Standards to determine supply=outgoing sediment. Compare Stable Slope with slope of lined channel

Given:

$$S_u = \left[\frac{N_u}{N_n}\right]^2 \left[\frac{Q_{wu}}{Q_{wn}}\right]^{-1.4} \left[\frac{T_u}{T_n}\right]^{0.5} (1-R)^{0.9} S_n \quad \text{eq. 8-V}$$

Nu=	0.015		Manning's n after Urbanization
Nn=	0.03		Manning's n for natural condition
Qwu=	17	cfs	Peak Discharge of chosen event after Urbanization
Qwn=	17	cfs	Peak Discharge of chosen event before Urbanization (cfs)
Tu=	3.8	ft	Urbanized Top Width
Tn=	50.6	ft	Natural Top Width
R=	0		Reduction Factor for Sediment Supply
Sn=	0.029	ft/ft	Slope in Natural Channel

Su=	**0.0020**	ft/ft

$S_{channel}$= 0.4 ft/ft **OK**

3) Determine sediment transport capability of culvert inlet at face of culvert

Using Method A from Estimating Sediment Movement in Drainage Structures (Richards/Zeller, 1999)

$$Q_{max} = 13{,}590 * d_s^{-1.02} * S^{2.52} * R^{1.52} * A$$

Culvert Parameters at Entrance pre FHWA Hydraulic Toolbox. If multiple culverts, use information for one pipe only

Slope=	0.046	ft/ft	ds=	2	mm	Typically 2 mm assumed
Flow Depth=	0.693	ft/ft	$S_{culvert}$	0.046	m/m	
Flow Area=	1.11	sq. ft.	R=	0.122	m	
Hydraulic Radius=	0.4	ft**	A=	0.103	sq. m.	

Qmax= 0.0495 cms

Qmax= 1.7481 cfs **OK**

Check if Qmax is more than Sediment Supply in Step 1, if yes, then Culvert OK

Sediment Transport Analysis of Proposed Channel and/or Culvert

PROJECT NAME: 4191 River's Edge
CP: OS7- 3A

Storm Event:	25	yr
Q=	24	cfs

1) First determine sediment supply from the upstream channel (OS7)for the chosen storm event

Using Equation 11.7 from Engineering Analysis of Fluvial Systems,

----> Where G=3, and d_{50}=2 mm

$$q_s=3.72*10^{-6}*Y_h^{-0.02}*V^{3.85}$$

Upstream Existing Channel (OS7) Information Detemined by FlowMaster*

Bottom Width =	4	ft	
Side Slope =	18	ft/ft	
Top Width=	53.5	ft	*
Depth=	0.33	ft	*
Area=	9.2	ft^2	*
Perimeter=	53.5	ft	*
Manning's n=	0.03		
Slope=	0.029	ft/ft	
Velocity=	2.6	fps	*

q_s=	**0.0002**	cfs-ft
Q_s=	**0.0081**	cfs

2) Determine sediment transport capability of the lined collector channel (3A)

Stable Slope equation 8-V from PC Drainage and Channel Design Standards to determine supply=outgoing sediment. Compare Stable Slope with slope of lined channel

Given:

$$S_u = \left[\frac{N_u}{N_n}\right]^2 \left[\frac{Q_{wu}}{Q_{wn}}\right]^{-1.4} \left[\frac{T_u}{T_n}\right]^{0.5} (1-R)^{0.9} S_n \quad \text{eq. 8-V}$$

Nu=	0.015		Manning's n after Urbanization
Nn=	0.03		Manning's n for natural condition
Qwu=	24	cfs	Peak Discharge of chosen event after Urbanization
Qwn=	24	cfs	Peak Discharge of chosen event before Urbanization (cfs)
Tu=	4.4	ft	Urbanized Top Width
Tn=	53.5	ft	Natural Top Width
R=	0		Reduction Factor for Sediment Supply
Sn=	0.029	ft/ft	Slope in Natural Channel

Su=	**0.0021**	ft/ft

$S_{channel}$= 0.4 ft/ft **OK**

3) Determine sediment transport capability of culvert inlet at face of culvert

Using Method A from Estimating Sediment Movement in Drainage Structures (Richards/Zeller, 1999)

$$Q_{max} = 13{,}590 * d_s^{-1.02} * S^{2.52} * R^{1.52} * A$$

Culvert Parameters at Entrance pre FHWA Hydraulic Toolbox. If multiple culverts, use information for one pipe only

Slope=	0.046	ft/ft	ds=	2	mm	Typically 2 mm assumed
Flow Depth=	0.84	ft/ft	$S_{culvert}$	0.046	m/m	
Flow Area=	1.44	sq. ft.	R=	0.142	m	
Hydraulic Radius=	0.467	ft**	A=	0.134	sq. m.	

Qmax= 0.0813 cms

Qmax= 2.8697 cfs **OK**

Check if Qmax is more than Sediment Supply in Step 1, if yes, then Culvert OK

Sediment Transport Analysis of Proposed Channel and/or Culvert

PROJECT NAME: 4191 River's Edge
CP: OS7- 3A

Storm Event:	100	yr
Q=	47	cfs

1) First determine sediment supply from the upstream channel (OS7)for the chosen storm event

Using Equation 11.7 from Engineering Analysis of Fluvial Systems,

----> Where G=3, and d_{50}=2 mm

$$q_s=3.72*10^{-6}*Y_h^{-0.02}*V^{3.85}$$

Upstream Existing Channel (OS7) Information Detemined by FlowMaster*

Bottom Width =	4	ft	
Side Slope =	18	ft/ft	
Top Width=	57	ft	*
Depth=	0.41	ft	*
Area=	14.12	ft^2	*
Perimeter=	57	ft	*
Manning's n=	0.03		
Slope=	0.029	ft/ft	
Velocity=	3.33	fps	*

q_s=	**0.0004**	cfs-ft
Q_s=	**0.0222**	cfs

2) Determine sediment transport capability of the lined collector channel (3A)

Stable Slope equation 8-V from PC Drainage and Channel Design Standards to determine supply=outgoing sediment. Compare Stable Slope with slope of lined channel

Given:

$$S_u = \left[\frac{N_u}{N_n}\right]^2 \left[\frac{Q_{wu}}{Q_{wn}}\right]^{-1.4} \left[\frac{T_u}{T_n}\right]^{0.5} (1-R)^{0.9} S_n \quad \text{eq. 8-V}$$

Nu=	0.015		Manning's n after Urbanization
Nn=	0.03		Manning's n for natural condition
Qwu=	47	cfs	Peak Discharge of chosen event after Urbanization
Qwn=	47	cfs	Peak Discharge of chosen event before Urbanization (cfs)
Tu=	5.6	ft	Urbanized Top Width
Tn=	57	ft	Natural Top Width
R=	0		Reduction Factor for Sediment Supply
Sn=	0.029	ft/ft	Slope in Natural Channel

Su=	**0.0023**	ft/ft

$S_{channel}$= 0.4 ft/ft **OK**

3) Determine sediment transport capability of culvert inlet at face of culvert

Using Method A from Estimating Sediment Movement in Drainage Structures (Richards/Zeller, 1999)

$$Q_{max} = 13{,}590 * d_s^{-1.02} * S^{2.52} * R^{1.52} * A$$

Culvert Parameters at Entrance pre FHWA Hydraulic Toolbox. If multiple culverts, use information for one pipe only

Slope=	0.046	ft/ft	ds=	2	mm	Typically 2 mm assumed
Flow Depth=	1.13	ft/ft	$S_{culvert}$	0.046	m/m	
Flow Area=	2.44	sq. ft.	R=	0.188	m	
Hydraulic Radius=	0.6157	ft**	A=	0.227	sq. m.	

Qmax= 0.2096 cms

Qmax= 7.4018 cfs **OK**

Check if Qmax is more than Sediment Supply in Step 1, if yes, then Culvert OK

APPENDIX F – REFERENCE DOCUMENTATION

RE/CDOE 1-45

JAN 2 6 2006





RIVERS EDGE/CANADA DEL ORO ESTATES LOTS 1-45 AND COMMON AREA "A" & B"


Stantec

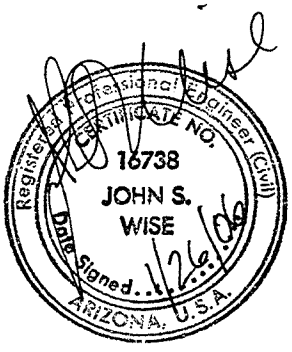
04-12-03-18
FILED: FRIDAY (04/07/06)

Stantec

RIVERS EDGE/CANADA DEL ORO ESTATES LOTS 1-45 AND COMMON AREA "A" & B"

HYDROLOGIC AND HYDRAULIC REPORT

Revised January 25, 2006
Revised August 21, 2003
July 17, 2003
Stantec File No. 85602631-68



Report Prepared By:

Michael Georgalas, PE and Sandy Steichen under the Supervision of John S. Wise, PE

C:\Documents and Settings\ssteichen\My Documents\2006 hydro report cover.doc

TABLE OF CONTENTS

LIST OF FIGURES

APPENDICES

INTRODUCTION

This Hydrologic and Hydraulic Report presents the results of a study performed in support of the Rivers Edge/Canada Del Oro Estates Lots 1-45 and Common Areas "A" and "B" Preliminary Plat. The study site is approximately 36.8 acres in size and will consist of 46 lots for single family detached homes. The site is accessed via Lambert Lane to the south and Naranja Drive to the north and lies in the northeast quarter of Section 12, Township 12 South, Range 13 East of the Gila and Salt River Base and Meridian, Pima, County (see Figure 1, Location Map). The property is currently undeveloped.

Cella Barr Associates previously prepared the report, *Master Drainage Plan for Rivers Edge* which documented existing flooding conditions impacting the entire Rivers Edge Development area and developed a comprehensive master drainage plan for the site. Proposed site specific improvements were also addressed in the "*Drainage Report for The Uplands @ Rivers Edge"* and the "*Drainage Statement for Canada Del Oro Estates"*, which were both prepared by Cella Barr Associates. In addition, a Planned Area Development (P.A.D.) for Rivers Edge was adopted by Ordinance No. (O) 95-32 (OV9-95-50) May 17, 1995. See References at the end of this report.

The River's Edge P.A.D. states that onsite retention must be provided up to the 5-year event. This requires that the volumetric difference between the developed and existing conditions 5-year runoff be retained onsite. Due to conveyance of the 100-year peak discharge to the CDO Wash within future drainage infrastructure, detention is not required for the site.

Based upon the most current Federal Emergency Management Agency (FEMA) FEMA Flood Insurance Rate Map (FIRM) for Pima County, Arizona and Incorporated Areas, Community Panel Nos. 04019C1039 K and 04019C1040 K, effective date February 8, 1999, the site is not located within a currently designated FEMA Special Flood Hazard Area. The parcel is located in Zone X, which is an area determined to be outside the 500-year floodplain. See Figure 2, Flood Insurance Rate Map Exhibit.

This investigation was performed in conformance with current Town of Oro Valley design criteria, regulations, policies, and drainage requirements. The study was conducted utilizing a site-specific 80-foot scale, 1-foot contour interval map. Existing and developed peak discharges were determined using the rational method (see Appendix A, Hydrologic Computations and Backup).

EXISTING CONDITIONS DRAINAGE

Two offsite watersheds with 100-year peak discharges in excess of 100 cfs currently impact the subject parcel. The 100-year peak discharges for these watersheds and associated floodplains were determined within the Pima County approved Master Drainage Plan for Rivers Edge (Master Plan). A watershed map from the Master Plan annotated with the subject property is included as Figure 3, Offsite Watershed Map. Runoff from Watershed 1 concentrates east of the subject property at Naranja Drive (Concentration Point (CP) 1) with a 100-year peak discharge of 1638 cfs and drains south to Lambert Lane. In addition, a concentration point (CP507) from the Oro Valley HEC-1 modeling also exists at this location. The HEC-1 100-year peak discharge value is 864 cfs. The associated 100-year floodplain for Wash 1 per the Master Plan has been shown on the Preliminary Plat as well as Figure 4, Developed Conditions Drainage Exhibit.

Runoff from Watershed 2 concentrates at Naranja, west of the subject property with a 100-year peak discharge of 80 cfs (CP 2). This watershed drains south, generating a 100-year peak discharge of 179 cfs at the southwest property corner. At this location, a flow split occurs per the Master Plan. Approximately 100 cfs continues south and west and approximately 80 cfs flows east, to Wash 1. The calculated erosion hazard setback for Wash 2 is 14 feet. (See Figure 4, Developed Conditions Drainage Exhibit).

Onsite approximately 25.5 acres drain to Wash 1 and 11.3 acres drain to Wash 2 under existing conditions.

PROPOSED CONDITIONS DRAINAGE DESIGN

Proposed Drainage Plan

An improved channel to contain and convey the runoff from Wash 1 south to Lambert Lane has been designed in conjunction with the Rivers Edge/Canada Del Oro Estates, Lots 70 through 102 and C.A. "A" & "B", Lots 5, 6, 8,11,14,17,20,21,23,24, & 27 Improvement Plans and will be constructed prior to, or concurrent with this project. The channel has been designed to convey the entire future condition peak discharge for the site and the entire 100-year runoff (180 cfs) for Wash 2.

Developed conditions onsite discharges will be conveyed via streets, depressed curbs, catch basins/storm drains and engineered drainageways as depicted on Figure 4, Developed Conditions Drainage Exhibit. Runoff from developed condition watersheds will either be conveyed in the improved channel for Wash 1 to the east, outlet into a proposed retention basin, or discharge west into Watershed 2. The lots will be graded so that the Watershed 2 boundary essentially remains unchanged and results in a minimal increase in runoff.

The "A" Street cross-section will consist of a 30-foot wide fully warped street section with a 2 percent cross-slope and a longitudinal slope varying from 3 to 6 percent. This street section has a capacity of 42 cfs at a slope of 3 percent before overtopping the curb.

Runoff at Concentration Points D3 and D7 will be intercepted using combination catch basins, each of which consist of a 15-foot by 2-foot grate and an 8-foot curb opening, and conveyed in storm drain systems. These two storm drain systems are labeled Storm Drain System A and Storm Drain System B on Figure 4. Storm Drain System A intercepts approximately 21.4 cfs at Concentration Point D7 and conveys it east into the Wash 1 improved channel via a 24-inch SRP or RCP pipe. Storm Drain System B intercepts approximately 22.7 cfs at Concentration Point D3 and 5 cfs at Concentration Point D2. Flow from Storm Drain System B will discharge down a rock-lined side of the proposed retention basin. In addition, split-flow calculations were performed at Concentration Points D5 and D7 to estimate the amount of lateral flow onto "D" and "E" Streets from "A" Street.

Eight-inch curb will be used at Concentration Points D4 and D6, which require weir heights of ten inches, to limit the curb opening length at these locations to less than ten feet. Although the weir height required at Concentration Point D4 and D6 is greater than the proposed curb height, the sidewalk will be set ten inches above the gutter elevation to contain runoff within the right-of-way. In addition, depressed sidewalk will be used at all curb openings to convey runoff into the engineered drainageways.

A table of developed conditions 100-year peak discharges and summary of proposed drainage structures follows (See Figure 4).

Concen-tration Point	Dranage Area (A.C.)	100-year Discharge (cfs)	Proposed Drainage Structure
D1	0.70	5.0	Channel
D2	0.93	6.6	10 L.F. Curb Opening (1) Type 4 Catch Basin
D3	2.1	14.9	(1) Type 5 CB w/8' Wing and 2' x 3' Grate and (4) Type 4 CB with 2' x 3' Grate
D4	1.4	9.9	10 L.F. Curb Opening – 8 inch Curb
D5	2.66	18.9	Street Flow
D6	1.96	13.9	10 L.F. Curb Opening – 8 inch Curb
D7	6.3	44.7	(1) Type 5 CB w/8' Wing and 2' x 3' Grate and (4) Type 4 CB with 2' x 3' Grate
D8	1.01	7.2	Channel
D9	0.77	5.5	3 L.F. Curb Opening
D10	0.82	5.8	Street Flow
D11	0.91	6.5	Channel
D12	0.52	3.7	Channel

Stormwater Retention

Retention requirements will be satisfied using one retention basin, which will be located at the southern boundary of the site and designed to accept the entire discharge from Wash 2 in addition to any onsite runoff directed into it. The basin has a retention depth of 1.5 feet, with 4:1 sideslopes, and provides an estimated 26,210 cubic feet of storage. The basin emergency overflow weir section has been designed for a developed 100-year peak discharge of 222.3 cfs, which includes 179 cfs from Wash 2, 26.4 cfs from Storm Drain System B and 16.9 cfs from the engineered drainageway between Lots 18 and 19. This flow will spill over the eastern basin wall via a 1.5-foot deep by 40-foot long weir opening and discharge into the improved channel for Wash 1. In addition, a low flow pipe consisting of a 4-inch orifice plate on an 18-inch SRP or RCP pipe will be placed at the basin floor to ensure positive drainage. The basin will drain down in 10.4 hours (see Appendix B).

A dumped rock riprap blanket with D_{50}=6 inches and a thickness of 12 inches will be constructed for erosion protection where runoff from Wash 2 enters the basin. The hydraulic result of a rectangular cross-section was used to assist in determining the depth of the concrete toe-down placed at the top and toe of the riprap blanket. A toe-down depth of three feet is recommended (see Detail 15/3 on Preliminary Plat, Appendix C).

SPECIAL CONDITIONS

United States Army Corps of Engineers (USCOE) 404 Permit

Base upon a 1994 Section 404 Jurisdictional Delineation of Waters of the United States by the United States Army Corps of Engineers (USCOE) the proposed improvements for Rivers Edge/Canada Del Oro Estates Lots 1-46 and Common Area "A" Development are non-jurisdictional pursuant to Section 404 of the Federal Water Pollution Control Act amendments of 1972, 33 USC 1334. A 404 Compliance Statement is included in the appendix.

Erosion Hazard Setback Limits

As stated earlier, the calculated erosion hazard setback for Wash 2 is 14 feet. Improvements associated with Lots 13 through 18 will lie within the erosion hazard setback area. Therefore, a concrete cutoff wall will be constructed adjacent to these lots for protection. Using a rated cross-section from the Master Plan a scour calculation was performed. Based upon these results a cutoff wall with a toe-down depth of three feet is recommended (see Detail 12/2 on Preliminary Plat, Appendix C). Calculations are included within Appendix B.

CONCLUSION

1. Onsite-generated runoff will be conveyed via streets, drainageways and storm drain systems.

2. An improved channel to contain and convey the runoff from Wash 1 south to Lambert Lane has been designed in conjunction with the Rivers Edge/Canada Del Oro Estates, Lots 70 through 102 and C.A. "A" & "B" ,Lots 5, 6, 8,11,14,17,20,21,23,24,& 27 Improvement Plans and will be constructed prior to, or concurrent with this project.

3. The volumetric difference between the developed and existing conditions 5-year runoff is retained onsite. The retention basin outlet weir section has been designed to convey the 100-year peak discharge and discharge into the improved channel for Wash 1. In addition, a low flow pipe will be placed at the basin floor to ensure positive drainage.

4. The proposed improvements are non-jurisdictional pursuant to Section 404 of the Federal Water Pollution Control Act amendments of 1972, 33 USC 1334.

5. All finished floor elevations will be a minimum of 1 foot above the 100-year adjacent water surface elevation.

REFERENCES

Cella Barr Associates, *Master Drainage Plan for Rivers Edge*, Revised December 8, 1987.

Cella Barr Associates, *Drainage Report for The Uplands at Rivers Edge*, August 17, 1994.

Cella Barr Associates, *Drainage Statement for Canada Del Oro Estates,* Approved by Pima County December 12, 1994.

Cella Barr Associates and Don Laidlaw & Associates, Rivers *Edge P.A.D. as approved by Pima County and formatted per Oro Valley P.A.D. Regulations, as* attached to Town of Oro Valley Council Communication, Meeting Date May 17, 1995.

Kimley-Horn and Associates, Inc. *Town of Oro Valley Drainage Criteria Manual*, October 2002.

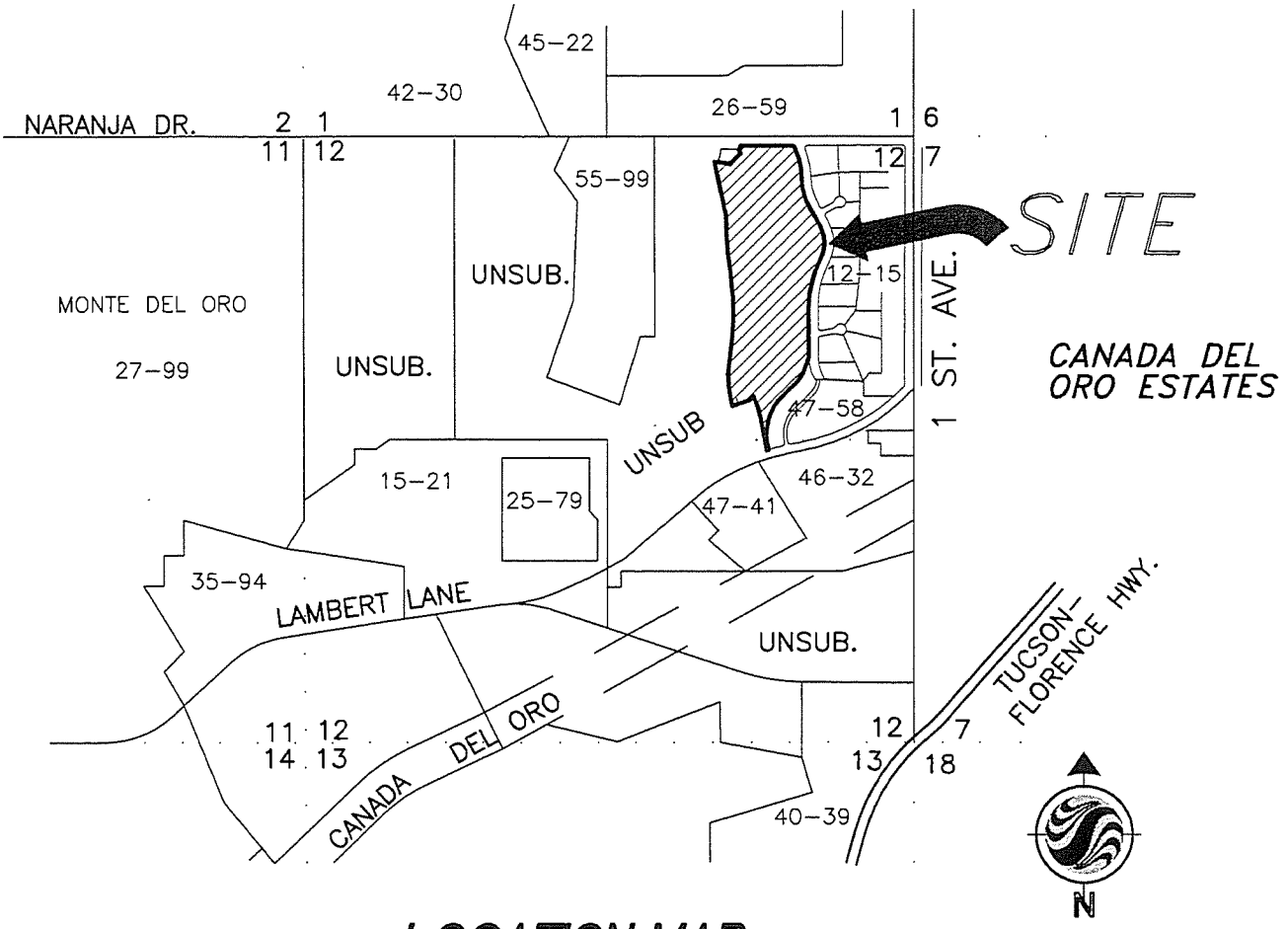
Simons Li and Associates, *Standards Manual for Drainage Design and Floodplain Management in Tucson Arizona*, December 1989.

Stantec Consulting Inc., *Rivers Edge/Canada Del Oro Estates, Lots 70 through 102 and C.A. "A" & "B" ,Lots 5, 6, 8,11,14,17,20,21,23,24,& 27 Paving, Drainage and Sanitary Sewer Plans.*

The enclosed information provides drainage-related calculations, estimates, analyses and designs for estimated flooding events up to and including the 100-year frequency flood based on specific engineering methodologies, ordinances, regulations, policies, etc. in effect and applicable at this time. This study was performed in accordance with, and to the level of, current engineering standards as established by the regulatory agency having jurisdiction of the work. A flood event of a magnitude exceeding the 100-year event as currently defined may cause or create the risk of greater flood damage than is or can be anticipated or presented in this assessment. Current regulatory agency requirements do not require that this assessment address flood events greater than the 100-year. In addition, our contract did not include, nor did our client request, that flood events greater than the 100-year event be addressed in this study. Stantec assumes no responsibility for actual flood damage, increased risks of flood damage, or increased construction or development cost resulting from or related to any such events, nor shall Stantec be responsible for any changes in or additions to regulatory requirements which may result from or be related to any such events.

Figure 1

Location Map



LOCATION MAP

PART OF SECTION 12, TOWNSHIP 12 SOUTH,
RANGE 13 EAST, G&SRM, PIMA COUNTY, ARIZONA.

V:\52856\active\85602631\environment\design\drawing\FIG1.dwg
2003-07-18 08:40AM By: mgeorgalas

JULY 2003
85602631-68

ORIGINAL SHEET - ANSI A

Stantec Consulting Inc.
201 North Bonita Avenue
Tucson AZ U.S.A.
85745-2999
Tel. 520.750.7474
Fax. 520.750.7470
www.stantec.com

Client/Project
RIVERS EDGE/
CANADA DEL ORO ESTATES

Figure No.
1

Title
LOCATION MAP

Figure 4

Developed Conditions Drainage Exhibit

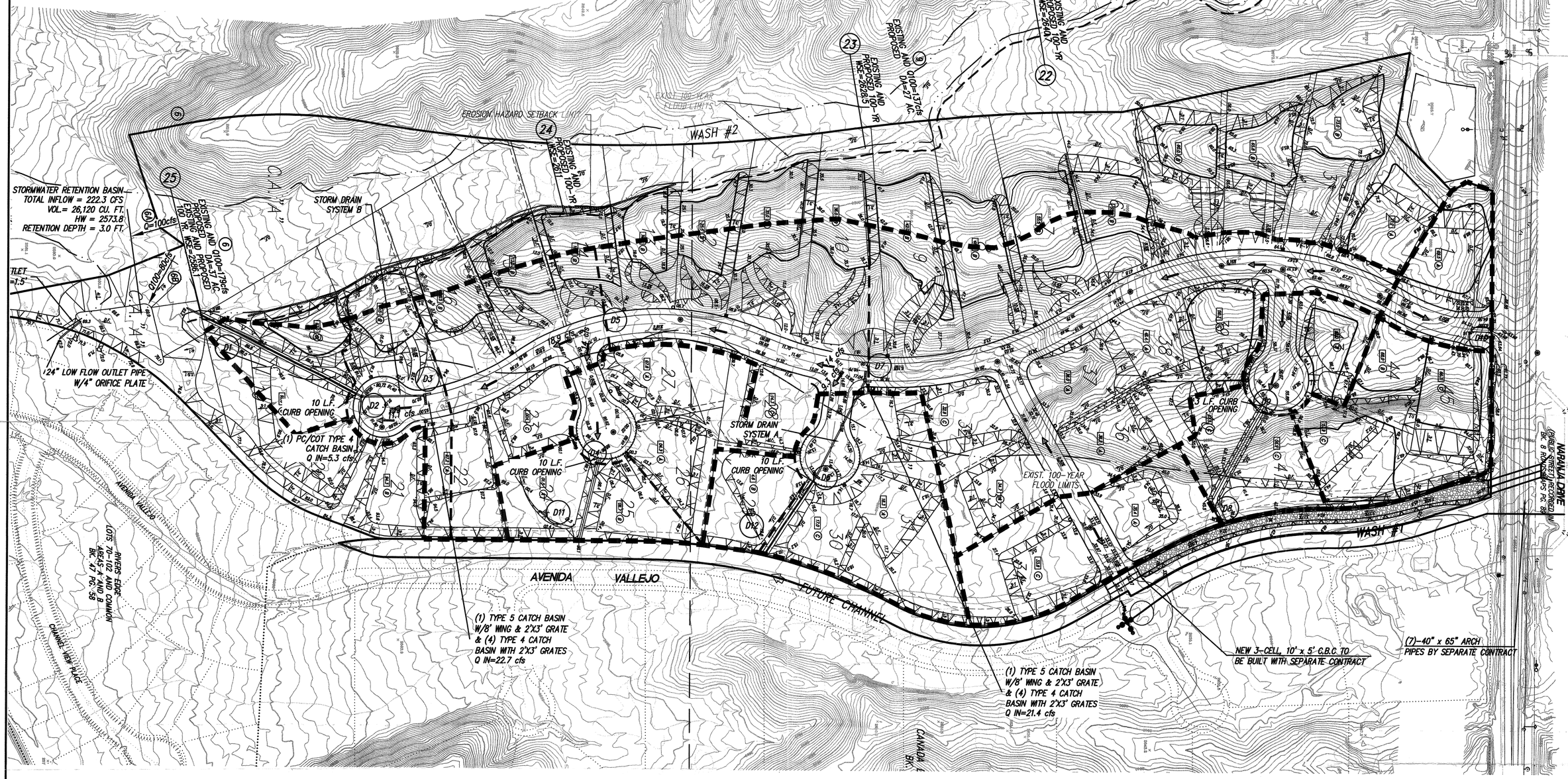


TABLE OF DEVELOPED CONDITIONS 100-YEAR PEAK DISCHARGES

CONCENTRATION POINT	DRAINAGE AREA(ac.)	100-YEAR DISCHARGE (cfs)
D1	0.70	5.0
D2	0.93	6.6
D3	2.1	14.9
D4	1.40	9.9
D5	2.66	18.9
D6	1.96	13.9
D7	6.3	44.7
D8	1.01	7.2
D9	0.77	5.5
D10	0.82	5.8
D11	0.91	6.5
D12	0.52	3.7

TABLE OF MINIMUM FINISHED FLOOR ELEVATIONS FOR LOTS ADJACENT TO WASH #2

LOT #	100 YR. WATER SURFACE ELEV. W.S.E. (ft)	MIN. FINISHED FLOOR ELEV. (ft) F.F.E.	PROPOSED PAD ELEVATION (ft)	PROPOSED FFE (ft)
6	2643.0	2644.0	2655.0	2655.7
7	2640.7	2641.7	2655.5	2656.2
8	2636.0	2637.0	2648.7	2649.2
9	2633.0	2634.0	2642.0	2642.7
10	2628.5	2629.5	2636.0	2636.7
11	2627.5	2628.5	2631.0	2631.7
12	2623.0	2624.0	2625.5	2626.2
13	2618.0	2619.0	2619.5	2620.2
14	2614.0	2615.0	2616.0	2616.7
15	2610.0	2611.0	2613.0	2613.7
16	2605.0	2606.0	2606.5	2607.2
17	2600.0	2601.0	2601.5	2602.2
18	2595.0	2596.0	2597.0	2597.7

LEGEND

- FLOW ARROW
- WATERSHED BOUNDARY
- SUBWATERSHED BOUNDARY
- D6 CONCENTRATION POINT

NORTH

80' 0' 80' 160'

SCALE: 1 INCH = 80 FEET

Stantec Consulting
201 North Bonita Ave
Tucson AZ USA
85745-2999
Tel. 520.750.7474
Fax. 520.750.7470
www.stantec.com
Stantec

REGISTERED PROFESSIONAL ENGINEER (CIVIL) 16738 JOHN S. MISE Date Signed 12/4/03 ARIZONA U.S.A.

STANTEC JOB No.: 85602631
W:\ACTIVE\85602631\CIVIL\DWG\TENTATIVEPLAT\HYDRO-08.DWG

TWO WORKING DAYS BEFORE YOU DIG CALL FOR THE BLUE STAKES 1-800-782-5348 BLUE STAKE CENTER CALL COLLECT

DEVELOPED CONDITION DRAINAGE EXHIBIT
FIGURE 4
PRELIMINARY PLAT FOR
RIVERS EDGE/CANADA DEL ORO ESTATES
LOTS 1 THROUGH 45 AND COMMON AREAS "A" & "B"

PART OF THE EAST 1/2 OF SECTION 12, T-12-S, R-13-E, AND A REPLAT OF LOTS 1-8, PORTIONS OF LOTS 9-11 AND WELL SITE, OF THE FINAL BLOCK PLAT FOR CANADA DEL ORO ESTATES, AS RECORED IN THE OFFICE OF THE PIMA COUNTY RECORDER IN BOOK 12 OF MAPS AND PLATS AT PAGE 15.

PREPARATION DATE: NOV. 2003
ORDINANCE NO. (O) 95-32 (OV9-95-5)
ORO VALLEY CASE NUMBER IS OV12-03-18

9/9

RE/CDOE 70-102

Stantec Consulting Inc.
201 North Bonita Avenue
Tucson AZ 85745-2999
Tel: (520) 750-7474 Fax: (520) 750-7470
stantec.com

Stantec

16 July 2002
File: 856 02025-68

Tel: (520) 229-4880
Fax: (520) 229-4899

Ms. Susan Russell, PE
Town of Oro Valley
11000 N. La Canada Drive
Oro Valley, Arizona 85737

Reference: Rivers Edge/ Canada Del Oro Estates

Dear Ms: Russell:

This drainage statement has been prepared in support of the revised Improvement Plans for Rivers Edge/Canada Del Oro Estates Lots 70 thru 102 and Common Area "A" & "B", Lots 55, 6, 8, 11, 14, 17, 20, 21, 23, 24, and 27. The original *Drainage Statement for Canada Del Oro Estates Pima County, Arizona* was approved by Pima County on December 2, 1994. The proposed drainage scheme for the Canada Del Oro Estates includes an improved drainage channel, running the entire length of the development along the west side of Avenida Vallejo.

The improved channel is proposed to be modified to accommodate two, future road crossings. The improved drainageway is proposed with 1:1 side slopes, a 15-foot to 28.4-foot wide riprap-lined channel, with a minimum depth of 5.3 feet. The channel has been designed to convey the entire 100-year peak discharge of 1638 cfs, with adequate freeboard. The proposed modification to the channel design will occur at the two proposed cul-de-sac roadways within the Canada Del Oro Estates subdivision. In the future, the cul-de-sac roadways will be extended to the west, crossing the improved channel to provide access to future development to the west. Three 10' x 5' box culverts are proposed at each of the two roadway crossings (see attached culvert analysis). The drainageway design includes grouted riprap on the channel floor; therefore, no additional culvert outlet protection is proposed. The culvert crossings will not be constructed at this time; however, the channel will be built to allow for future completion of the proposed box culvert crossings.

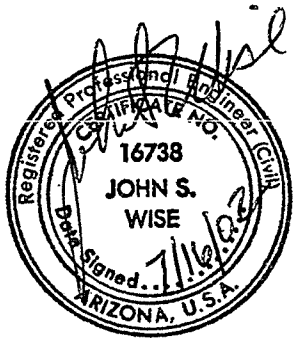
Reference: Rivers Edge/ Canada Del Oro Estates

We trust that the attached calculations and the Improvement Plans for Rivers Edge/Canada Del Oro Estates will satisfy Oro Valley drainage design criteria. Please call me if you have any questions or need additional information regarding the proposed channel and the proposed future box culvert design.

Sincerely,

STANTEC CONSULTING INC.

Jenny Laber
Hydrologist
jlaber@stantec.com



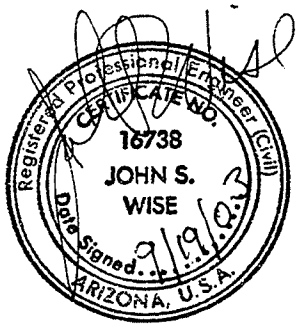
Attachment: Improvement Plans
Hydraulic calculations

Copy: Warren Thompson, Stantec

JLL:jll
T:\PROJ14\85602025\admin\russell CDO statement.doc

PRVII

HYDOLOGIC AND HYDRAULIC REPORT FOR PUSCH RIDGE VISTAS II



Revised September 19, 2003
August 15, 2003
Stantec File No. 85602669-68

W:\ACTIVE\85602669\ENVIRONMENT\DESIGN\REPORT\COV_PUSCHRIDGEVISTASII_HYDRORPTREVISED.DOC

Report Prepared Under the Supervision of:
John S. Wise, PE

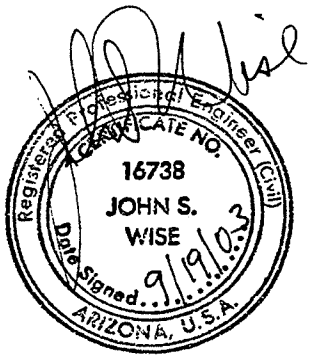
STANTEC CONSULTING INC.
201 North Bonita Avenue
Tucson, Arizona 85745-2999

Report Preparation Assisted by:
Sandy Steichen

TABLE OF CONTENTS

LIST OF FIGURES

APPENDICES



INTRODUCTION

This Hydrologic and Hydraulic Report presents the results of a study performed in support of the Pusch Ridge Vistas II Preliminary Plat. The study site is approximately 43.8 acres in size, of which approximately 19 acres will encompass grading for 33 single family detached home lots and associated infrastructure. The site is bordered by Naranja Drive to the north, approximately 1500 ft west of 1st Ave. and lies in Section 12, Township 12 South, Range 13 East of the Gila and Salt River Base and Meridian, Pima, County (see Figure 1, Location Map). The property is currently undeveloped.

Cella Barr Associates previously prepared the report, *Master Drainage Plan for Rivers Edge* which documented existing flooding conditions impacting the entire Rivers Edge Development area and developed a comprehensive master drainage plan for the site. Proposed site specific improvements were also addressed in the "*Drainage Report for The Uplands @ Rivers Edge*" prepared by Cella Barr Associates. In addition, a Planned Area Development (P.A.D.) for Rivers Edge was adopted by Ordinance No. (O) 95-32 (OV9-95-50) May 17, 1995. See References at the end of this report.

The River's Edge P.A.D. states that onsite retention must be provided up to the 5-year event. This requires that the volumetric difference between the developed and existing conditions 5-year runoff be retained onsite. All watersheds within the Town of Oro Valley are considered critical basins, therefore, detention is also required to ensure that peak flow rates for the 2-, 10- and 100-year storm events do not exceed pre-developed flow rates.

Based upon the most current Federal Emergency Management Agency (FEMA) FEMA Flood Insurance Rate Map (FIRM) for Pima County, Arizona and Incorporated Areas, Community Panel Nos. 04019C1039 K and 04019C1040 K, effective date February 8, 1999, the site is not located within a currently designated FEMA Special Flood Hazard Area. The parcel is located in Zone X, which is an area determined to be outside the 500-year floodplain. See Figure 2, Flood Insurance Rate Map Exhibit.

This investigation was performed in conformance with current Town of Oro Valley design criteria, regulations, policies, and drainage requirements. The study was conducted utilizing a site-specific 80-foot scale, 1-foot contour interval map. Existing and developed peak discharges were determined using the rational method (see Appendix A, Hydrologic Computations).

PROPOSED CONDITIONS DRAINAGE DESIGN

Proposed Drainage Plan

Developed conditions onsite discharges will be conveyed via streets and depressed curbs to three outlet locations (Concentration Points D1, D2 and D3) into Wash 2 or Wash 3, as depicted on Figure 4, Developed Conditions Drainage Exhibit.

The street cross-section will consist of a 30-foot wide street section with a 2 percent cross-slope and a longitudinal slope varying from 1% to 10% percent. This street section has a capacity of 51 cfs before overtopping the curb at a slope of 1 percent. The super-elevated section of the roadway has a capacity of approximately 50 cfs at the curb and 70 cfs within the right-of-way at a longitudinal slope of 1% (see Appendix B).

Runoff concentrating in the proposed roadway at Concentration Point D1 (Q100 = 50 cfs), just upstream of the northern most cul-de-sac, will drain via a 54-foot scupper into Detention/Retention Basin 1. This scupper opening has been designed to convey the 100-year peak discharge and will provide conveyance of the 10-year peak discharge with a 50% clogging factor (see Appendix B).

Runoff concentrating at the southern cul-de-sac, CP D2 (Q100= 19 cfs), will drain via a 21 ft. scupper into a spillway and energy dissipator basin . This scupper opening has been designed to convey the 100-year peak discharge and will provide conveyance of the 10-year peak discharge with a 50% clogging factor (see Appendix B).

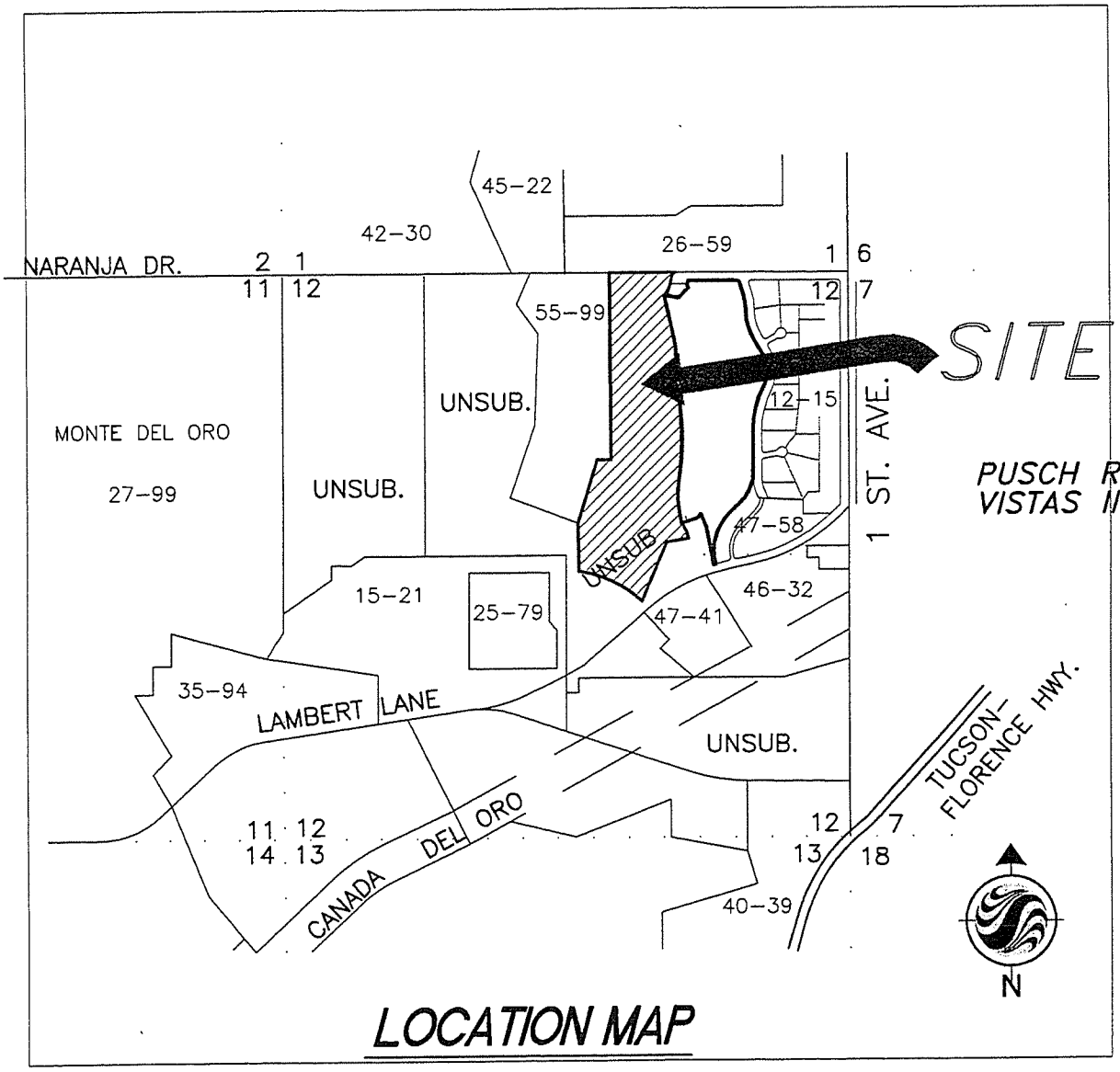
Runoff (Q100= 13 cfs) concentrating at the northern cul-de-sac will drain via a 14 ft. depressed curb at CP3 (see Appendix B). An energy dissipator basin will be provided at the outlet.

Grouted riprap bank protection will be constructed adjacent to Lots 1 and 2. A toe-down depth of three feet is recommended (see Appendix B).

All finished floor elevations will be set a minimum of 1 ft. above adjacent 100-year water-surface elevations. A table of water-surface elevations is contained in Appendix B.

Figure 1

Location Map



LOCATION MAP

PART OF SECTION 12, TOWNSHIP 12 SOUTH,
RANGE 13 EAST, G&SRM, PIMA COUNTY, ARIZONA.

V:52856\ACTIVE\85602669\ENVIRONMENT\DESIGN\DRAWING\FIG1.DWG
2003-08-13_10:40AM_BY:JTHORNE

AUGUST_2003
85602669-68

ORIGINAL SHEET - ANSI A

Stantec Consulting Inc.
201 North Bonita Avenue
Tucson AZ U.S.A.
85745-2999
Tel. 520.750.7474
Fax. 520.750.7470
www.stantec.com

Client/Project
PUSCH_RIDGE
VISTAS_II

Figure No.
1

Title
LOCATION_MAP

Figure 4

Developed Conditions Drainage Exhibit

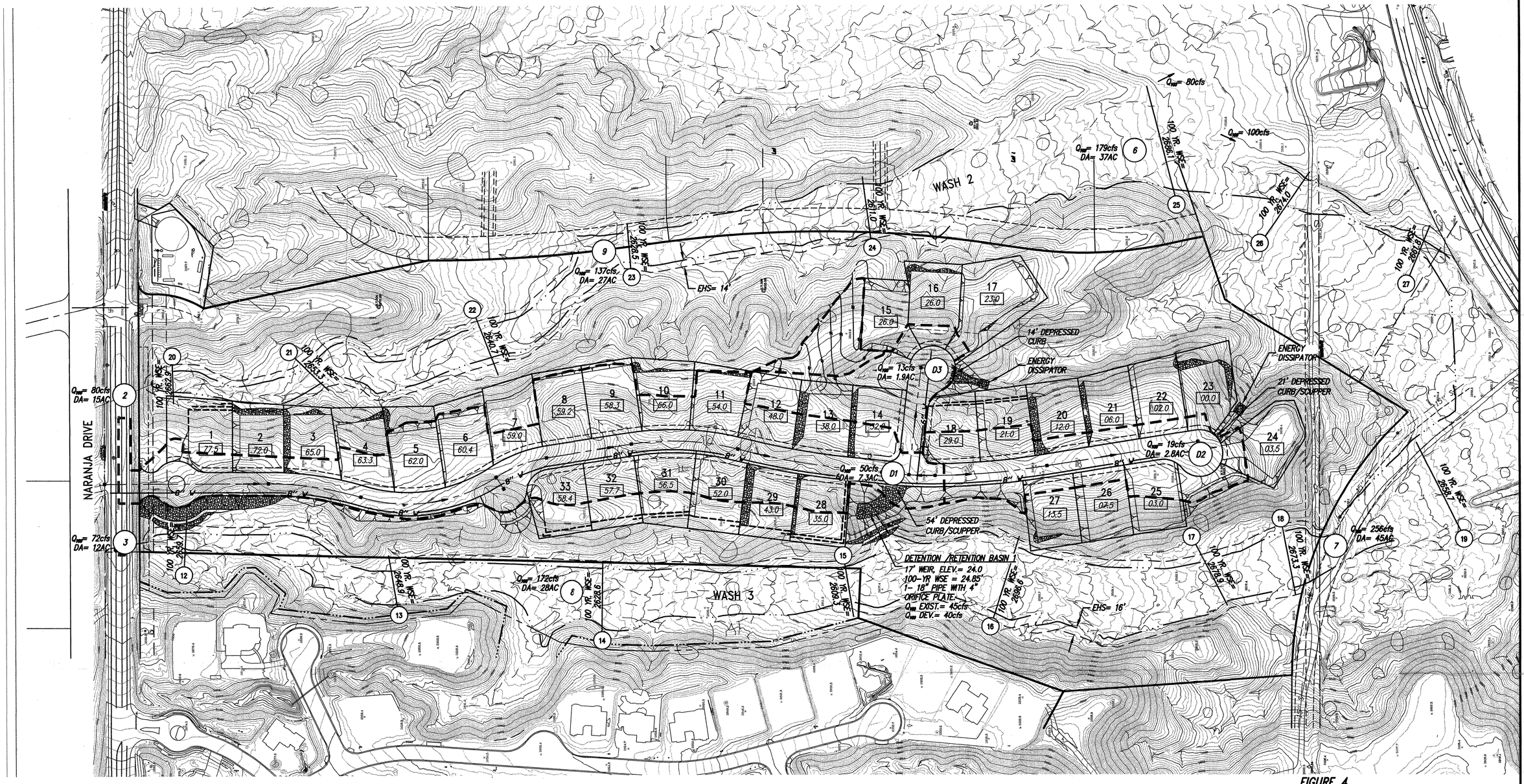


TABLE OF ONSITE DEVLEOPED CONDITONS 100-YEAR PEAK DISCHARGES

CP	AREA(AC)	100-YR PEAK DISCHARGES
D1	7.2	50
D2	2.4	17
D3	1.8	12

LEGEND

- WATERSHED BOUNDARY
- 100-YR FLOODPLAIN
- EROSION HAZARD SETBACK (EHS)
- (D3) CONCENTRATION POINT

Stantec

Stantec Consulting
201 North Bonita Ave
Tucson AZ USA
85745-2999
Tel. 520.750.7474
Fax. 520.750.7470
www.stantec.com

REGISTERED Professional Engineer (Civil) CERTIFICATE NO. 14854 WARREN D. THOMPSON 16th Street 12/31 ARIZONA U.S.A.

STANTEC JOB No.: 85602669-48
W:\active\85602669\civil\dwg\tent\2669Thydro-TP.dwg

TWO WORKING DAYS BEFORE YOU DIG CALL FOR THE BLUE STAKES 1-800-782-5348 BLUE STAKE CENTER CALL COLLECT

FIGURE 4
DEVELOPED DRAINAGE CONDITIONS

PRELIMINARY PLAT FOR
PUSCH RIDGE VISTAS II

LOTS 1 THROUGH 33 AND COMMON AREAS "A" AND "B"

BEING A SUBDIVISION OF A PORTION OF
SECTION 12, TOWNSHIP 12 SOUTH, RANGE 13 EAST, G.&S.R.M.,
TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA

PREPARATION DATE: OCTOBER 2003
ORDINANCE NO. (O) 95-32 (OV9-95-5)
OV12-03-20

RE/CDOE NDCC

Stantec Consulting Inc.
201 North Bonita Avenue
Tucson AZ 85745-2999
Tel: (520) 750-7474 Fax: (520) 750-7470
stantec.com

Stantec

4 February 2004
File: 85602631-68

Mr. Craig Civalier
Town of Oro Valley
Department of Public Works
11000 N. La Canada Drive
Oro Valley, Arizona 85737

Reference: Rivers Edge/Canada Del Oro Estates
Naranja Drive Culvert Crossing &
Peak Discharge Reduction

Dear Mr. Civalier:

This drainage statement has been prepared to support the re-submittal of the revised Improvement Plans for Rivers Edge/Canada Del Oro Estates Lots 1 through 45 and Common Area "A" & "B". Specifically, this drainage letter addresses the reduced 100-year peak discharge concentrating at Naranja Drive, north of the project area, and the associated proposed drainage structure at Naranja Drive.

The 100-year peak discharge impacting Naranja Drive, north of the project area, is estimated to be 864 cfs (drainage area equal to 0.57 mi^2). This discharge has been reduced from the original runoff estimate of 1638 cfs. The reduction in flow was determined in the recent *Oro Valley Town Wide Drainage Study,* provided by Kimley-Horn and Associates, Inc., July 12, 2001, for the Town of Oro Valley, Arizona. We have utilized the U.S. Geological Survey Regional Regression Equation for Southern Arizona Region13 to justify the revised peak flow of 864 cfs. The resultant 100-year peak discharge calculated for the drainage area of 0.57 mi^2 equals 853 cfs; therefore validating the Drainage Study value (see Exhibit 1, USGS Computation).

The drainage structure at Naranja Drive is proposed to be a two-cell 10'x 4' box culvert. The culvert performance curve is attached, which demonstrates that the entire revised 100-year peak discharge of 864 cfs will be adequately conveyed under Naranja Drive (see Exhibit 2, Culvert Capacity Calculation).

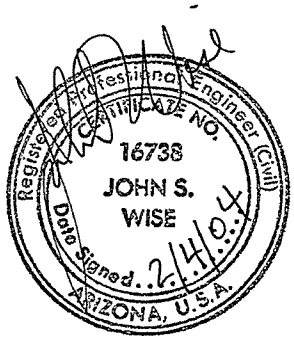
Reference: Rivers Edge/Canada Del Oro Estates
Naranja Drive Crossing

We trust that the proposed culvert crossing at Naranja Drive will satisfy the Town of Oro Valley drainage criteria. Please call us if there is any additional information you might need to approve the aforementioned drainage design at Naranja Drive. Thank you for your time and input on the Rivers Edge/Canada Del Oro Estates project.

Sincerely,

STANTEC CONSULTING INC.

Jenny Laber, CFM
Hydrologist



Attachment: Hydraulic Calculations
Hydrology Calculation

Copy: Warren Thompson, Stantec

JLL:jll
V:\52856\active\85602631\environment\design\report\ltr_naranja_drngstatement.doc

APPENDIX G – DIGITAL DATA