PREPARED FOR:

STORMWATER REPORT







WEST COMPLEX ROADWAYS

PORT OF STOCKTON

FINAL DESIGN

AUGUST 31, 2026

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1. Introduction

In recent years, the Port of Stockton (Port) has experienced a significant increase in annual rail throughput, resulting in constrained rail access and switching capacity and reduced rail storage Port-wide. Additionally, the Port has identified several prospective tenants seeking a new rail service, with a significant volume identified for the West Complex. As a result, the Port has commissioned the construction of a new 4-track rail yard – McCloy Rail Yard, in West Complex between Fyffe Avenue to the north and McCloy Avenue to the south. The construction of this yard necessitates the closure of two at-grade crossings for operational safety in West Complex – McCloy Avenue and Dagget Road. The West Complex Roadways project addresses the need for additional roadway connectivity in West Complex to compensate for the closure of the two crossings as part of the McCloy Rail Yard project. The project scope includes extension of two existing Port roadways:

- Gillis Avenue extends east until it joins Port Expressway to compensate for the closure of McCloy Avenue at-grade crossing, and
- Humphreys Street extends south to provide access to the windmill farm west of Gillis Avenue and compensate for the closure of the Daggett Road at-grade crossing.

This stormwater report defines the major drainage design elements related to the proposed West Complex Roadways, and other associated improvements. This effort evaluates the proposed localized drainage improvements along the newly built roadways. The primary stormwater component of the improvements is the construction of three culverts over three Port ditch segments to maintain drainage flow patterns. The culverts under the extended Humphreys Street are especially critical since they cover ditches that lie close to the downstream end of West Complex drainage path and therefore anticipated to carry significant volume.

An area-wide drainage evaluation of the Port drainage system is outside the scope of this report. The design team relied on Port confirmation on overall flow patterns in West Complex and determined the peak anticipated flow through the ditches that will be culverted to accommodate the roadways. As a result, the design team performed a sensitivity analysis with several assumed downstream flow conditions to ensure that the culverts are adequately sized for the design storm.

1.1 Revisions

The following is a summary showing the tracking for this Drainage Report:

Table 1: Revision Summary Table

Revision	**A**	**Previous Revisions**	
Date	08/31/2026	Rev	Date
Description	Final Stormwater Report		
Prepared By	B. DiPietro		
Checked By	A. Ghosh		
Approved By	J. Marshall		

1.2 Terms and Definitions

Table 2: Terms and Definitions

Abbreviation	Full Form
AC-FT	Acre- Feet
BMP	Best Management Practices
BNSF	Burlington Northern Santa Fe Railway
CCTC	Central California Traction Company
CFS	Cubic Feet per Second
CMP	Corrugated Metal Pipe
CN	Curve Number
DMA	Drainage Management Area
DSP	Port of Stockton Storm Water Development Standards Plan
DTSC	Department of Toxic Substances Control
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
HDPE	High-Density Polyethylene
LID	Low Impact Development
NAVD	North American Vertical Datum of 1988
NGVD	National Geodetic Vertical Datum of 1929
NOAA	National Oceanic and Atmospheric Administration
RAP	Remedial Action Plan
SCS	Soil Conservative Service
SD	Storm Drain
SSA	Storm and Sewer Analysis Package
UD	Under Drain
UPRR	Union Pacific Railroad
USDA	United States Department of Agriculture

1.3 Project Location

The project is located at 315 W Fyffe Street in Stockton, CA. The Port facility is located between MP 1123 and MP 1125 along the BNSF Stockton Subdivision. The Port of Stockton is the fourth largest Port in California by volume, shipping upwards of 4.7 million tons annually, and is the largest inland Port in California, occupying approximately 4,200 acres. The proposed roadway improvements will be situated south of the new McCloy Yard between Daggett Road and Port Expressway, and along Humphreys St between Fyffe Avenue and the wind blade laydown area, respectively. These areas are bound to the south by the Burns Cutoff River which flows into the San Joaquin River. Burns Cutoff also serves as the ultimate drainage outlet for the Port's West Complex through a network of ditches and culverts. The proposed project sites, project outlet locations, and the ultimate downstream outfall into Burns Cutoff are shown in **Figure 1**.



Figure 1: **Site Location Map**

1.4 Project Stakeholders

1.4.1 Design Team

Owner:	Port of Stockton, Jason Katindoy - Deputy Port Director, Maritime & Real Estate
Railroad Operations:	CCTC, Jason Nalder, General Manager
Prime Consultant/Bridge Engineer:	HDR, Inc., Matthew Archer, P.E. – Sr. Rail Engineer
Civil, Hydraulics, and Rail Engineer:	JMA Civil, Inc., Arka Ghosh, P.E. – Sr. Civil Engineer

Geotechnical Engineer:	Kleinfelder, Nathan L. Dahlen, P.E. – Sr Project Manager
Surveyor:	Cinquini and Passarino (C&P), Inc., Jim Dickey, P.L.S. – Principal Engineer
Environmental Engineer:	Anchor QEA, LLC, Marine Vie – Sr. Managing Environmental Planner
Hazardous Materials:	Geosyntec Consultants, Anju Wicke – Sr. Principal Scientist

1.4.2 Agency Stakeholders

Port of Stockton

The Port of Stockton is the Owner of the project site and is responsible for leasing property to Port tenants. The Port manages all stormwater permitting and works collectively with the City of Stockton to issue all building permits. The Port has a Stormwater Development Standards Plan that outlines the necessary mitigation measures for new construction.

Railroad

CCTC is the Port's rail operator and is jointly owned by BNSF and UPRR. Both BNSF and UPRR serve tenants at the Port. All rail design at the Port is subject to approval from CCTC with input from BNSF and UPRR. CCTC does not have its own drainage standard. Rail projects at the Port comply with Port and UPRR/BNSF requirements.

California State Water Board

Portions of the project lie within Site 19 and Site 47 which are sites regulated by the DTSC and California State Water Board (Water Board) as having known arsenic contamination. The project limits overlap with these sites between the area bound by Track 946, McCloy Avenue and Port Expressway, and the area along Humphreys St to the south of Track LD01. Any proposed drainage features such as ditches are subject to evaluation by the Water Board specifically concerning potential groundwater contamination.

1.5 Applicable Codes and Standards

This report and the resulting design shall comply with the following standards, including all addenda, specifications, and recommended practices.

- Port of Stockton Storm Water DSP
- USDA/SCS TR-55 Urban Hydrology for Small Watersheds, June 1986
- AASHTO Drainage Manual – Chapter 11: Culverts

1.6 Project Survey Datum

A ground survey was performed on 04/24/2023. The benchmark for the survey is city of Stockton benchmark number 305 stamped '10S-1' near entrance to the port of Stockton main offices. Horizontal coordinates are based on California state plane coordinate system zone #3, NAVD83. Vertical datum is based on NGVD88.

1.7 Flood Hazard Analysis

The project sites are in a "Zone X Other Flood Area," which indicates an area with a 0.2% annual chance of flood or an area with a 1% annual chance of flood with average depths of less than 1 foot or with drainage areas less than 1 square mile, as well as areas protected by levees from a 1% annual chance of flood.

The project lies in an area with reduced flood risk, as shown in the FEMA FIRM Panel on **Appendix A.** A portion of the San Joaquin River is classified as a Regulatory Floodway. However, the risk of flooding is significantly reduced due to the levee system around both banks of the San Joaquin River and Burns Cutoff, which are maintained by the Reclamation Districts 403 and 404. The base flood elevations at the San Joaquin River vary from 10' at the north end of the Port to approximately 12.5 feet to the south at the BNSF mainline bridge.

1.8 Existing Facilities

The project sites are in two separate areas of the West Complex, referred to by the road being modified. The eastern portion of the project is within the area bound by Track 946 to the north, Port Expressway to the southeast, and the east end of Gillis Ave to the west, and can be described as an extension of Gillis Ave connecting to Port Expressway. The western portion of the project is within the area bound by Fyffe Avenue to the north, the west end of McCloy Ave to the east, and the wind blade laydown area to the southeast, and can be described as an extension of Humphreys Street connecting Fyffe Ave to the wind blade laydown area.

1.8.1 Gillis Avenue Site

For the eastern Gillis Avenue site area, the ground is largely impervious, consisting of track roadbed, paved roadway, warehouse roofs, and an undeveloped area bound by roadways on all sides. Drainage is primarily provided by v-ditches on both sides of Port Expressway, and the west side of Daggett Road beginning south of Gillis Avenue. The ditch west of Daggett Road flows south to the larger sitewide drainage ditches. The ditch west of Port Expressway has high points at its north and south ends and flows to a central culvert that crosses underneath Port Expressway into a series of ditches that ultimately convey runoff to the Burns Cutoff outlet.

This area also falls under Site 47 which is regulated by DTSC and the Water Board. This site is known for arsenic contamination, and a RAP is in place as part of the adjacent Trammell Crow project on other side of Port Expressway to protect exposure to contaminated soil and groundwater contamination in this area. As part of the conditions in the RAP, the disturbed soil within this Site must not be relocated outside the site but instead be stored in piles within the site. A summary of existing drainage areas, flow patterns and drainage facilities is provided in **Appendix B**.

1.8.2 Humphreys Street/McCloy Avenue Site

For the western Humphreys Street and McCloy Avenue site area, the ground is largely pervious, consisting of undeveloped areas, soil piles, gravel roadway shoulders, and the Track LD01 roadbed, and is bound by paved roadways to the north and east. Drainage is primarily provided by overland sheet flow to v-ditches along the north, south, and southwest portions of the site perimeter. These ditches are terminal portions of the drainage network for the West Complex, and flow west to the ultimate site outfall at Burns Cutoff.

This area also falls under Site 19 which is regulated by DTSC and the Water Board as a site known for arsenic contamination. A summary of existing drainage areas, flow patterns and drainage facilities is provided in **Appendix B**.

1.9 Nearby Tributaries

The Port's West Complex is an island bound by the Stockton Deepwater Channel to the north, San Joaquin River to the east and Burns Cutoff to the south and west. Burns Cutoff is the primary drainage outfall for the Port, and it ultimately flows into the San Joaquin River. The San Joaquin River is a major riverine system in California's Central Valley. Stockton lies within the most downstream reaches of the river where it creates a delta region with the Sacramento River.

1.10 SWPPP Risk Evaluation

The Contractor will prepare the SWPPP document for this project. However, an independent evaluation was performed to ascertain the level of risk for the project site based on the anticipated construction start and end dates. A Risk Level of 1 was deemed appropriate for both East and West Complex spanning the entire project footprint for an assumed duration starting March 2027 and ending in October 2028.

The NPDES risk worksheet was used to compute the three key risk factors using the GIS method. It was also verified through the Water Board portal that there were no high-risk receiving watersheds that the project footprint will discharge to. The receiving water bodies adjacent to the project site include 'Five Mile Slough' and Stockton Deepwater Channel and per 2022 Water Board data, neither of these water bodies are identified as having potential sedimentation risk. The results are summarized in **Table 3** below.

Table 3: SWPPP Analysis Summary

Attribute	Value
Rainfall Erosivity (R) Factor	40.72
Soil Erodibility (K) Factor	0.43
Length-Slope (LS) Factor	0.73
Watershed Erosion Estimate	6.48 tons/acre
Risk Level	1

2. Stormwater Analysis Approach

Autodesk Storm and Sanitary Analysis (SSA) was utilized to develop the stormwater model, which included the subbasins (drainage areas), culverts, and ditches. The SCS TR-55 method was utilized to compute peak runoffs. The 'Hydrodynamic' mode was utilized as the link routing method. The software employs Manning's Equation to calculate capacity, velocity, and flow depth for open channel flow under uniform flow conditions. For closed conduit systems, SSA applies open channel hydraulics (Manning's Equation) to partially full flow and utilizes the Hazen-Williams or Darcy-

Weisbach equations to model full or pressurized flow. For surcharged conditions, dynamic wave routing is used to simulate unsteady flow behavior.

Flow capacity is reported based on the maximum flow rate a conduit or channel can convey under typical design conditions. Gradually varied flow is analyzed using the continuity and energy equations in conjunction with Manning's Equation. The model also accounts for minor losses throughout the system. In hydrodynamic routing mode, the full momentum equation is incorporated to simulate complex flow interactions. Additionally, storage curves are developed from elevation-area tables to determine the retention capacity of storage basins within the network.

The widely used FHWA software HY-8 was also used to determine the tailwater and headwater conditions for the two culverts proposed at the Port ditches under the extended Humphreys Street.

2.1 Design Principles

The stormwater analysis was conducted to satisfy the Port's DSP and AASHTO Drainage Manual requirements. The Port's DSP does not specify a specific analysis methodology but outlines key objectives to be met for any future development at the Port. The main Port DSP objectives are as follows:

- Incorporate permanent control measures to mitigate pollutants in storm water
- Maintain post-development runoff rates as close to the pre-development rates as possible
- Implement mandatory and site-specific BMPs for any proposed development.

The design team also performed a sensitivity analysis for the sizing of the proposed culverts over Port ditches accommodating the Humphreys extension. This was because the ditches spanned were on the downstream end of West Complex drainage system and there was no prior analysis or peak flow data through these ditches. Therefore, analyses were performed assuming the downstream ditch was flowing at 25%, 50%, 75% and 100% depth.

2.2 Return Periods

As part of the analysis, three return periods were evaluated – 10-year, 50-year, and 100-year. The 10-year period is the prevalent local jurisdictional standard for sizing drainage features at this site. The 100-year period is the recommended period for areas in FEMA flood plains. However, this project falls under Port jurisdiction and is subject to Port and local regulation requirements only. AASHTO Drainage Manual recommends a return period of 10-year for culverts under local roads and 50-year for culverts under interstate or freeways (Table 11-1). The 100-year period was used to size proposed structures on a conservative basis of unknown peripheral drainage conditions that were beyond the scope of detailed analysis for this project.

3. Hydrologic Analysis

3.1 Rainfall Data

Rainfall intensity data for the evaluated return periods were obtained from NOAA Atlas 14, Volume 6, Version 2 and a copy of the data is included in **Attachment D**. Precipitation data was obtained for the 10-year, 50-year, and 100-year 24-hour storms. **Table 4** below summarizes the total precipitation value determined for the Project area for each return period.

Table 4: Rainfall Data Summary

Design Storm	Total Precipitation (inches)	Reference Document
10-Year 24-hr	2.44	NOAA Atlas 14
50-Year 24-hr	3.25	NOAA Atlas 14
100-Year 24-hr	3.61	NOAA Atlas 14

3.2 Rainfall-Runoff Losses

The SSA software was used for hydrologic calculations and to model the rainfall-runoff losses. The SCS CN method was used as the rainfall loss method. The SCS CN method estimates total rainfall losses as function of cumulative precipitation, soil type and land use.

The SCS CN method requires the following inputs:

- **Curve Number (CN)**: The curve number represents soil type and land use for the drainage area. A geotechnical report was prepared for this project by Kleinfelder, Inc., in April 2026, and an excerpt for the predominant soil type in the project area is included in **Attachment D**. According to the referenced geotechnical report, the soil type was identified and classified accordingly. Based on this classification, typical infiltration rates were estimated to range between 0.1 and 1.0 inches per hour. Given these values, the soil was determined to belong to Hydrologic Soil Group D, as defined in USDA Table 7-1, which is provided in **Appendix D**. The land use of the project area varies but can be described as a combination of open space with good condition, impervious areas with roadway pavement, based on Table 2-2a of the TR-55 manual which is included in **Attachment D.** Detailed curve number calculations for all pre-and post-development drainage areas are provided in **Table 1** of **Attachment E.**
- **Initial Abstractions (I_a, inches)**: The amount of precipitation that falls before runoff begins. Detailed Initial Abstraction calculations for all drainage areas are provided in **Table 1** of **Attachment E**.
- **Impervious Area (%)**: The percentage of directly connected impervious area, defined as any impervious surface that is either directly connected to the drainage area discharge point or flows directly into a pipe or impervious conduit to the discharge point. Detailed impervious area percentage calculations for all drainage areas are provided in **Table 1** of **Attachment E**.
- **Time of Concentration (Tc)/Lag**: Time of concentration is the time it takes runoff to travel from the most hydraulically distant point of the drainage area to the downstream element. Due to the small size of the individual drainage areas and for conservativeness, a minimum value of 5 minutes for time of concentration was selected for all drainage areas, which results in a lag time of 3 minutes based on the following formula:
  Lag, L (min.) = Tc X 0.6 = (5 min.) X 0.6 = 3 min.
  (Ref : National Engineering Handbook (NEH), Part 630 – Hydrology, Chapter 15: Time of Concentration, Washington, D.C., 2010.)

The only exception was the computation of one of the drainage areas assumed to be draining into Ditch-02 as shown in **Attachments B** and **C**. This area is large in size being approximately 30 acres. The time of concentration for this area was computed to be 50 minutes using the TR-55 method.

4. Existing Conditions Analysis

The ditches west of Humphreys Street convey runoff to the ultimate outfall location on Burns Cutoff. The area south of McCloy Avenue drains south through a v-ditch into an existing cross-culvert flowing east underneath Port Expressway.

For the purposes of this project analysis, the confluence of 2 ditches west of Humphreys Street, and the culvert underneath Port Expressway will be the two outfall locations that will receive runoff from the site areas modified due to the project.

4.1 Tributary Areas

4.1.1 Gillis Avenue Site

The Gillis Avenue site is comprised of one drainage area (Ex. DMA-09) bound by the crown of Port Expressway to the east, the roadbed of Track 946 to the north, and the crown of Daggett Road to the west. The drainage area map for the existing conditions is provided in **Appendix B.**

4.1.2 Humphreys Street/McCloy Avenue Site

The Humphreys Street and McCloy Avenue site is comprised of 2 drainage areas. The northernmost area (Ex DMA-01) is bound by Fyffe Avenue to the north, Humphreys street crown to the east and a natural high point that cuts through the site around the stockpiles. The ditch/ channel (Ditch-01) cutting through this area is downstream of a series of ditches and culverts that collect runoff from adjacent sites and drain through this ditch. Therefore, these other drainage areas bound by Fyffe Avenue to the north and McCloy Avenue to the south (Ex DMA-03 to Ex. DMA-08 in **Appendix B**) are also included in the analysis.

The other area (Ex. DMA-02) is assumed to be much larger to render a conservative analysis AND includes all areas south of the McCloy Avenue crown up until the stockpiles. This area only excludes the two south warehouses north of Gillis Avenue as they have been determined per survey data to be draining to a different ditch with a separate outfall outside project extents. This area drains to 'Ditch-02' as illustrated in **Appendix B**.

4.2 Runoff Data

The SCS TR55 Unit Hydrograph method determines the runoff data in SSA to transform point precipitation data into a design storm. This analysis is based on an SCS Type 1 storm, based on the project location per TR-55 Manual, Figure B-2. A copy of the rainfall distribution map is included in **Attachment D.** SSA output values for the peak run-off flow and corresponding volume for the 10-year, 50-year, and 100-year storms are included in **Table 1** of **Attachment F.**

Table 5: **Existing Runoff Data**

EXISTING CONDITIONS				
Drainage Area Name	**Area (AC)**	**Peak Outflow, Q, 100YR (CFS)**	**Total Runoff 100YR (inches)**	**Total Runoff Volume 100YR (AC-FT)**
Ex DMA-01	11.41	22.37	2.41	2.29
Ex DMA-02	29.66	27.71	2.59	6.40
Ex DMA-03	5.76	11.25	2.39	1.15
Ex DMA-04	4.00	8.62	2.67	0.89
Ex DMA-05	3.09	6.11	2.44	0.63
Ex DMA-06	0.69	1.49	2.67	0.15
Ex DMA-07	6.03	13.02	2.67	1.34
Ex DMA-08	6.56	12.76	2.39	1.31
Ex DMA-09	4.29	8.23	1.80	0.64
TOTAL	**71.52**	**111.56**	**22.03**	**14.81**

5. Proposed Condition Analysis

Gillis Avenue Site

The extension of Gillis Avenue will fill in the ditch on the west side of the Port Expressway. Drainage will be restored with a new v-ditch along the north side of the proposed roadway connection draining towards a new culvert underneath the roadway. The new culvert (18" CMP Culvert-03) will receive runoff from the north and tie back to the existing v-ditch along Port Expressway to the south of the new roadway. This tie in location and elevation will coincide with the inlet of the existing culvert that passes underneath the Port Expressway, serving as the Gillis Avenue site outfall. The drainage area map for the existing conditions is provided in **Appendix C.**

Humphreys Street/McCloy Avenue Site

The extension of Humphreys Street fills in ditches south of Track LD01 (Ditch-01), and at the northwest corner of the wind blade laydown area (Ditch-02). Drainage will be restored by providing new culverts beneath Humphreys Street at the locations of ditch crossings. A new perforated underdrain pipe is also proposed to capture runoff at the new LD01 crossing location, and to route it west into an existing ditch. The drainage area map for the existing conditions is provided in **Appendix C.**

5.1 Tributary Areas

The proposed improvements will increase the impervious area and weighted CN number but also break up the existing drainage areas into smaller management areas by creating new high points due to new roadway crowns. The proposed drainage areas are shown in **Appendix C**.

5.1.1 Gillis Avenue Site

South of McCloy Avenue, the area between Track 946 and Port Expressway will be broken into two smaller areas due to the introduction of a new roadway crown connecting Port Expressway and Daggett Road. The Site 47 area and the area east of McCloy Avenue at-grade crossing will ultimately drain to the recently completed Trammell Crow ditch that connects to the Port's drainage network feeding the ultimate outfall to Burns Cutoff. The area south of the new roadway will also be divided into two smaller areas due to the extension of Gillis Avenue and its associated roadway crown. The area south of the Gillis Avenue extension will continue to drain southeast into the existing v-ditch along Port Expressway.

5.1.2 Humphreys Street/McCloy Avenue Site

The three areas between Fyffe Avenue and Track LD01, Track LD01 and an existing ditch, and the existing ditch and an existing fenceline, will each be divided into two smaller areas by the crown of the new Humphreys Street Roadway extension. The area bound by ditches to the northwest, southwest, and south, roadway crowns to the east, and fenceline to the north, will be subdivided into three smaller areas by the crowns of the proposed roadway extensions to Humphreys Street and McCloy Avenue. However, the area in the proposed condition was kept as the same area as existing in order to ensure that the proposed culverts are conservatively sized for a larger area.

5.2 Runoff Data

The results of the peak runoff and total runoff volume from the site drainage area for the proposed conditions for the 100-year storm are summarized in **Table 6**. A detailed report of the results is presented in **Table 1** of **Appendix G**. The proposed improvements increased total runoff volume by 0.01 AC-FT.

Table 6: Proposed Runoff Data

PROPOSED CONDITIONS				
Drainage Area Name	**Area (AC)**	**Peak Outflow, Q, 100YR (CFS)**	**Total Runoff 100YR (inches)**	**Total Runoff Volume 100YR (AC-FT)**
DMA-01	11.41	22.37	2.41	2.29
DMA-02	29.66	27.71	2.59	6.40
DMA-03	5.76	11.25	2.39	1.15
DMA-04	4.00	8.62	2.67	0.89
DMA-05	3.09	6.11	2.44	0.63
DMA-06	0.69	1.49	2.67	0.15
DMA-07	6.03	13.02	2.67	1.34
DMA-08	6.56	12.76	2.39	1.31
DMA-09A	2.90	4.07	1.79	0.43
DMA-09B	1.39	2.10	1.91	0.22
TOTAL	**71.52**	**109.50**	**23.93**	**14.82**

5.3 Terminal Drainage Conditions

The project does not modify the terminal drainage conditions to the two outfall locations at the ditch confluence west of Humphreys Street and the Port Expressway culvert.

6. Hydraulic Analysis

The Civil3D SSA software was used for the hydraulic calculations to determine whether the drainage elements of basins, ditches, and pipes had adequate capacity to accommodate the design storm event. **Attachment E** shows the schematic SSA project set up for both existing and proposed conditions.

SSA utilizes Manning's equation to calculate the capacity of the proposed HDPE underdrains and existing storm drain pipes, to confirm that they have adequate capacity for the design flow rate resulting from a 10-year design storm. The flow is calculated as follows:

$$Q = \frac{1.49}{n} * A * R^{\left(\frac{2}{3}\right)} * S^{\left(\frac{1}{2}\right)}$$

Where:

Q or Q_{CAP} = Volumetric flow rate passing through the pipe in cfs.

A = Cross-sectional area of flow normal to the flow direction in ft^2

S = Bottom slope of the channel in ft/ft

n = Manning Roughness coefficient. Manning's value is provided in SSA for the conduit type, size, and material. Typically, they are 0.010 for RCP pipes, and 0.011-0.015 for HDPE pipes

R = Hydraulic Radius = A/P

P = Wetted perimeter of the cross-sectional area of flow in ft.

Q_{REQ} = Peak flow for 10-year storm event

In SSA (Autodesk), entrance losses, exit losses, and bend losses are accounted for in hydraulic calculations as minor losses due to flow transitions in the system. These losses represent energy dissipation from turbulence and flow disruption as water moves through various components like junctions, manholes, bends, and transitions between pipes or structures.

$$he = Ke \cdot \frac{v^2}{2g}$$

$$hx = Kx \cdot \frac{v^2}{2g}$$

$$hb = Kb \cdot \frac{v^2}{2g}$$

Where:

h_e = entrance head loss (ft or m)

h_x = exit head loss (ft or m)

h_b = bent head loss (ft or m)

K_e = entrance loss coefficient (typically ranges from 0.2 to 0.5)

K_x = exit loss coefficient (1.0 is typical unless otherwise modified)

K_e = bent loss coefficient (45° bend: Kb≈0.2, 90° bend: Kb≈0.3–0.5)

v = velocity of flow entering the structure (ft/s or m/s)

g = gravitational acceleration

For gradually varied conditions across manholes, transitions, or junctions, SSA uses a simplified energy balance approach:

$$H1 = H2 + hl$$

Where:

H_1, H_2 = total heads at upstream and downstream

h_l = head loss due to friction, entrance/exit/bend losses, etc.

6.1 Culvert Analysis

The project proposes 4 culverts beneath the extension of Humphreys Street and 1 culvert underneath the new Gillis Avenue roadway. All culverts are proposed to be RCP and vary in diameter from 18" to 36". The Manning's values are typically 0.011-0.015 for RCP culverts with higher values for bigger sizes. SSA utilizes a similar method to compute flow through culverts as closed pipes except the losses at the entrance and exit sections. All culverts were modeled as projecting out into their respective ditches. **Table 7** below summarizes the 100-year results for all proposed culverts. Detailed results for all design storms are provided in **Appendix G Tables 3, 4, and 5**.

Table 7: Culvert Capacity Summary

Pipe Name	Drainage Areas	Peak flow 100-Year (cfs)	D (in)	Manning's (n)	Slope S (%)	Flow Velocity (fps)	Capacity Q_{CAP} (cfs)	$Q_{CAP} > Q_{REQ}$
Ex. Culv-01	02	21.24	42.0	0.0150	0.60	2.88	66.60	Yes
Ex. Culv-02	02	19.58	24.0	0.0240	-1.50	6.92	14.74	No
Ex. Culv-03	09A, 09B	3.25	18.0	0.0110	0.28	3.21	4.81	Yes
Prop Culv-01 (Humphreys)	01, 03 - 08	19.61	36.0	0.0130	0.15	1.48	63.51	Yes
Prop Culv-02 (Humphreys)	02	27.33	36.0	0.0130	0.23	3.14	51.09	Yes
Prop Culv-03 (Gillis)	09A	1.29	18.0	0.0240	0.61	1.65	4.21	Yes

All culverts flow under capacity except the existing 24" RCP pipe along Ditch-02, that is sloped in the opposite direction. This culvert was installed to provide a temporary crossing that is no longer in use and acts as a bottleneck. As part of the permitting efforts with the Water Board for the proposed installation of the new culvert, this existing culvert will also be removed to increase system capacity and provide balance of earthwork cut and fill, which is desired by the permitting agencies. Although the existing 42" RCP culvert has adequate capacity, it will also be removed since it is also an inactive crossing. The excavated earthwork from this culvert may be reused as fill for Ditch-01.

The most critical improvements are the two culverts proposed along Ditch-01 and Ditch-02 to enable crossing of the extended Humphreys Street. Since the design team was not in receipt of any published or shared data on the peak flow through these ditches under existing conditions, a sensitivity analysis was performed by varying the tailwater elevation to mimic pre-existing flow conditions. The downstream ditch segment of the culverts was assumed to be flowing at 25, 50, 75, and 100% full conditions to determine whether any flooding/overtopping around the culvert may occur. The water level analysis through the culverts is summarized in **Table 8** below. **Tables 6 and 7** in Appendix G provide a detailed summary of the calculated results.

As shown in the table below, the existing 24" culvert surcharges and likely overtops across all scenarios modeled. The existing 42" culvert surcharges and overtops when the downstream ditch is flowing at full depth. The proposed culvert on the north Ditch-01 does not overtop across any scenario while the culvert on the south Ditch-02 surcharges at the 75% and 100% flow conditions. This implies that under full flow conditions, the areas around proposed Culvert-02 may experience flooding conditions depending on contour data. Both the proposed culverts for Humphrey extensions are two (2) barrels of 36" dia. RCP pipes. A larger configuration at either location is not feasible owing to geometry limitations posed by the ditch width and depth and also the proposed height of the roadway.

Table 8: Summary of Culvert Sensitivity Analysis

Culvert Name	Top El. Of Culv	Btm Elev of D/S ditch	Max HGL 25% Full	Max HGL 50% Full	Max HGL 75% Full	Max HGL 100% Full
Ex. Culv-01	-2.95	-5.85	-3.46	-3.37	-2.77	-2.35
Ex. Culv-02	-2.21	-4.95	-2.21	-2.21	-2.21	-2.21
Prop Culv-01	-0.44	-3.44	-1.79	-1.79	-1.57	-0.56
Prop Culv-02	-3.14	-6.14	-3.57	-3.47	-3.14	-3.14

Due to the potential for surcharging per the SSA analysis, we also conducted culvert-specific analysis using the FHWA software HY-8 to determine overtopping conditions along the culvert and also potential for flooding along the proposed roadway. A similar approach for sensitivity analysis was taken by varying the tailwater elevation downstream of the culvert to determine the impacts to water level upstream due to the capacity bottleneck. The key goal was to determine whether the flooded volume exceeds the height of the proposed roadway or the bottom of the aggregate base.

Pages G-12 through G-15 in **Appendix G** demonstrate the varying conditions analyzed for Culvert-1. The water level stays well under top of roadway and bottom of aggregate across all conditions, including 100% flow conditions at the downstream ditch. This satisfies AASHTO and Caltrans recommendations that the tailwater and headwater elevations remain below the roadway subgrade. Pages G-16 through G-19 of Culvert-2 show similar water profiles. As shown on G-17, the water level exceeds bottom of aggregate base in full flow condition but stays below the top of road surface. The key results from HY-8 are summarized in **Table 9** below.

Table 9: Summary of HY-8 Results under 100% Tailwater Flow Condition

Culvert Name	Top Of Roadway Elevation	Bottom of Aggregate Base Elevation[1]	Downstream HGL	Upstream HGL
Prop Culv-01	1.40	0.48	-0.40	0.30
Prop Culv-02	1.86	0.95	1.0	1.1

[1] Assumes 5.5" HMA layer; 5.5" aggregate base layer with lime treated subgrade around culverts

6.2 Ditch Analysis

The project proposes a new v-ditch north of the Gillis Avenue extension flowing east into the proposed culvert beneath the Gillis Avenue extension. This ditch receives runoff from the undeveloped area to the north, and the existing ditch along the west side of Port Expressway. The ditch gets deeper as it approaches the proposed culvert and existing Port Expressway ditch.

No ditches are proposed along the Humphreys Avenue site (DMA-01 and DMA-02). However, runoff in this area is received by several ditch segments, namely Ditches 01, 02, and 04 as shown in

Appendix B. The project footprint discharges into and crosses Ditch 01 and 02 as described in previous sections. All ditches in this area are trapezoidal with a mild slope due west towards the ultimate outfall at Burns Cutoff. Ditch-01 receives runoff largely from the areas bound between Fyffe Street and McCloy Avenue. Ditch-02 receives runoff from the area bound by McCloy Avenue and Daggett Road. Both these ditches ultimately outfall into the larger Ditch-04 that runs northwest into the ultimate Burns Cutoff outfall.

From an SSA analysis standpoint, this ditch was modeled as multiple ditch segments, as shown in **Table 10** to simulate the progressively increasing flows that this ditch receives from the cross-culverts as we move west.

SSA incorporates hydrostatic pressure relationships and detailed channel geometry to support the calculation of gradually varied flow. Parameters such as top width, flow area, and hydraulic radius are derived from the conduit or channel cross-section geometry and are essential in computing conveyance and flow depth changes.

Table 10 below summarizes the 100-year results for all open-channels. Detailed results for all design storms are provided in **Appendix G Tables 4** and **7**.

Table 10: Open Channel Capacity Summary

Open Channel Name	Drainage Areas	Peak flow 10 Year (cfs)	Manning's (n)	Slope S (ft)	Flow Velocity (fps)	Capacity Q_{CAP} (cfs)	Q_{CAP}> Q_{REQ}
Gillis V-Ditch	09A	1.50	0.0250	0.10	0.51	24.18	Yes

7. Stormwater Quality Evaluation

7.1 Project Specific Requirements

None of the Port's mandatory BMPs apply for a roadway project. The Port's DSP lists the following drainage zone specific BMPs that apply to this project, since it is located in West Complex:

- **Conserve Natural Areas**: The project complied with this criterion by limiting proposed development to pre-existing impervious areas. The Humphreys Street extension only impacts a 50' wide vegetation patch just south of Ditch-01. The proposed roadway cuts through the existing stockpiles containing hazardous material that will be relocated and an existing barren area devoid of vegetation. South of Ditch-02, the roadway alignment bends and follows the existing patch of graveled pathway that is already impervious.
- **Minimize Impervious Areas:** The project is compliant with this requirement since the roadway width has been kept to minimum that can safely facilitate the turn movement of large trucks that will traverse through the roadway. No sidewalks have been proposed due to no presence of pedestrian activity at this location.
- **No Net increase in Runoff Volume or Peak Rate:** This project is compliant with this requirement since it does not increase peak flow despite the addition of impervious area. At the site of Gillis Avenue extension, this is likely achieved by bifurcating the drainage area due

to the new roadway and the addition of a new v-ditch and culvert that intercepts runoff and conveys it through a longer route, thus attenuating the flow. Table 11 below summarizes the results of peak flow through the main outfalls within project footprints in the pre and post condition for all design storms.

Table 11: Outfall Peak Runoff Values

Outfall	Location	Peak Flow (cfs)					
		Ex 10-yr	Prop 10-yr	Ex 50-yr	Prop 50-yr	Ex 100-yr	Prop 100-yr
Burns Cutoff	West of Humphreys Street	25.90	16.78	25.90	19.59	25.90	20.31
Port Expressway	Culvert underneath Port Expressway	4.10	4.08	6.98	5.21	8.20	6.11

7.2 Treatment Controls

As per Port DSP Table 2.3.3.2, all roadway projects adding greater than 1 acre of paved surface are subject to treatment control measures for a select group of pollutants and sediments. The extended Gillis Avenue is not subject to this requirement since it is less than 1 acre in size. The extended Humphreys Street is subject to this requirement due to its size. The scope of this project was primarily to provide stormwater measures to maintain existing flow patterns and attenuate peak flow. Water quality treatment was not a part of this project scope and may be undertaken as a future project, as desired by the Port.

The Port has several BMP alternatives for providing treatment control options in accordance with CASQA BMP Handbook requirements. Given the Humphreys street traverses through adjacent areas with dense vegetation, an adequately sized Vegetated Buffer Strip (TC-31) or Vegetated Swale (TC-30) may be most suitable to provide the desired water quality treatment.

List of Appendices

Appendix A: FEMA Maps

Appendix B: Existing Drainage Area Maps

Appendix C: Proposed Drainage Area Maps

Appendix D: Hydrologic Data

Appendix E: SSA Input Data

Appendix F: Existing Drainage Calculations

Appendix G: Proposed Drainage Calculations

Appendix A: FEMA Maps

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction, and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures in this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) Zone 10N. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey, SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit their website at http://www.ngs.noaa.gov/.

Base map information shown on this FIRM was derived from multiple sources. This information was compiled from the U.S. Geological Survey, 2002, National Geodetic Survey, 2002, City of Lathrop, 1997, City of Manteca, Department of Public Works, 2001, and San Joaquin County Community Development Department, 2008. Additional information was photogrammetrically compiled at a scale of 1:12,000 from U.S. Geological Survey aerial photography dated 1989, 1993 and 2002.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

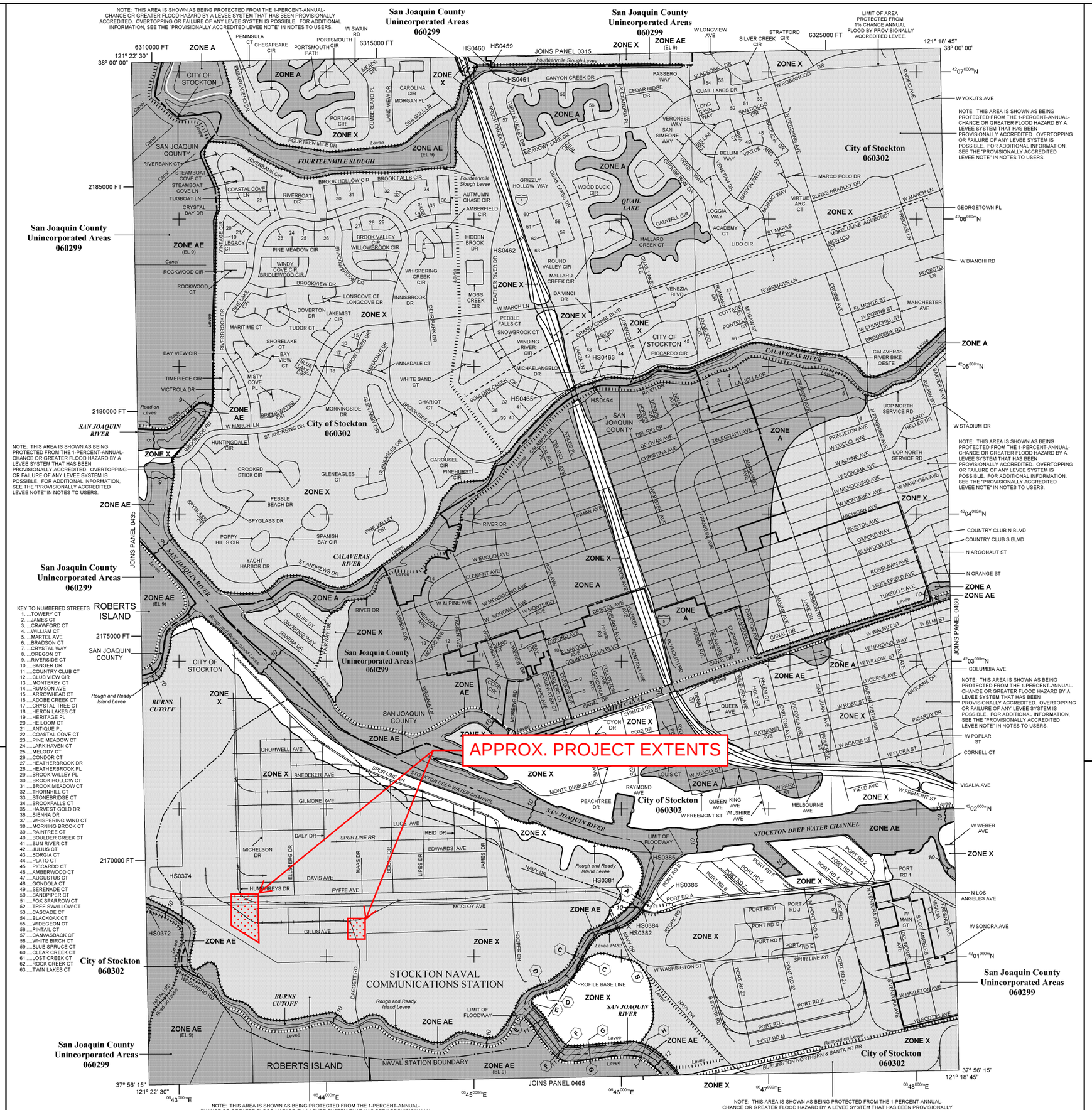
Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and their website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1- 877- FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/.

Provisionally Accredited Levee Notes to Users: Check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annnual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection for areas on this panel. To maintain accreditation, the levee owner or community is required to submit the data and documentation necessary to comply with Section 65.10 of the NFIP regulations by August 23, 2009, for the Fourteenmile Slough Levee (east of Interstate 5) and the Rough and Ready Island Levees; August 23, 2010, for Levee P452 (along the northwest boundary of Reclamation District 404); and March 30, 2010, for all other levees. If the community or owner does not provide the necessary data and documentation or if the data and documentation provided indicate the levee system does not comply with Section 65.10 requirements, FEMA will revise the flood hazard and risk information for this area to reflect de-accreditation of the levee system. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at http://www.fema.gov/business/nfip/index.shtm.



NOTE: THIS AREA IS SHOWN AS BEING PROTECTED FROM THE 1-PERCENT-ANNUAL-CHANCE OR GREATER FLOOD HAZARD BY A LEVEE SYSTEM THAT HAS BEEN PROVISIONALLY ACCREDITED. OVERTOPPING OR FAILURE OF ANY LEVEE SYSTEM IS POSSIBLE. FOR ADDITIONAL INFORMATION, SEE THE "PROVISIONALLY ACCREDITED LEVEE NOTE" IN NOTES TO USERS.

NOTE: THIS AREA IS SHOWN AS BEING PROTECTED FROM THE 1-PERCENT-ANNUAL-CHANCE OR GREATER FLOOD HAZARD BY A LEVEE SYSTEM THAT HAS BEEN PROVISIONALLY ACCREDITED. OVERTOPPING OR FAILURE OF ANY LEVEE SYSTEM IS POSSIBLE. FOR ADDITIONAL INFORMATION, SEE THE "PROVISIONALLY ACCREDITED LEVEE NOTE" IN NOTES TO USERS.

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LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain boundary
- Floodway boundary
- Zone D Boundary
- CBRS and OPA Boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 (EL 987) — Base Flood Elevation line and value; elevation in feet*
- Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- A (A) — Cross section line
- 23 (23) — Transect line
- 97° 07' 30", 32° 22' 30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
- 4396000mE — 1000-meter Universal Transverse Mercator grid values, zone 10
- 600000 FT — 5000-foot grid ticks: California State Plane coordinate system, zone III (FIPSZONE 0403), Lambert Conformal Conic Projection
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index.

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP PANEL
October 16, 2009

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

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'
500 0 1000 2000 FEET
300 0 300 600 METERS

NFIP NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0455F

FIRM

FLOOD INSURANCE RATE MAP

SAN JOAQUIN COUNTY, CALIFORNIA AND INCORPORATED AREAS

PANEL 455 OF 950

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
SAN JOAQUIN COUNTY	060299	0455	F
STOCKTON, CITY OF	060302	0455	F

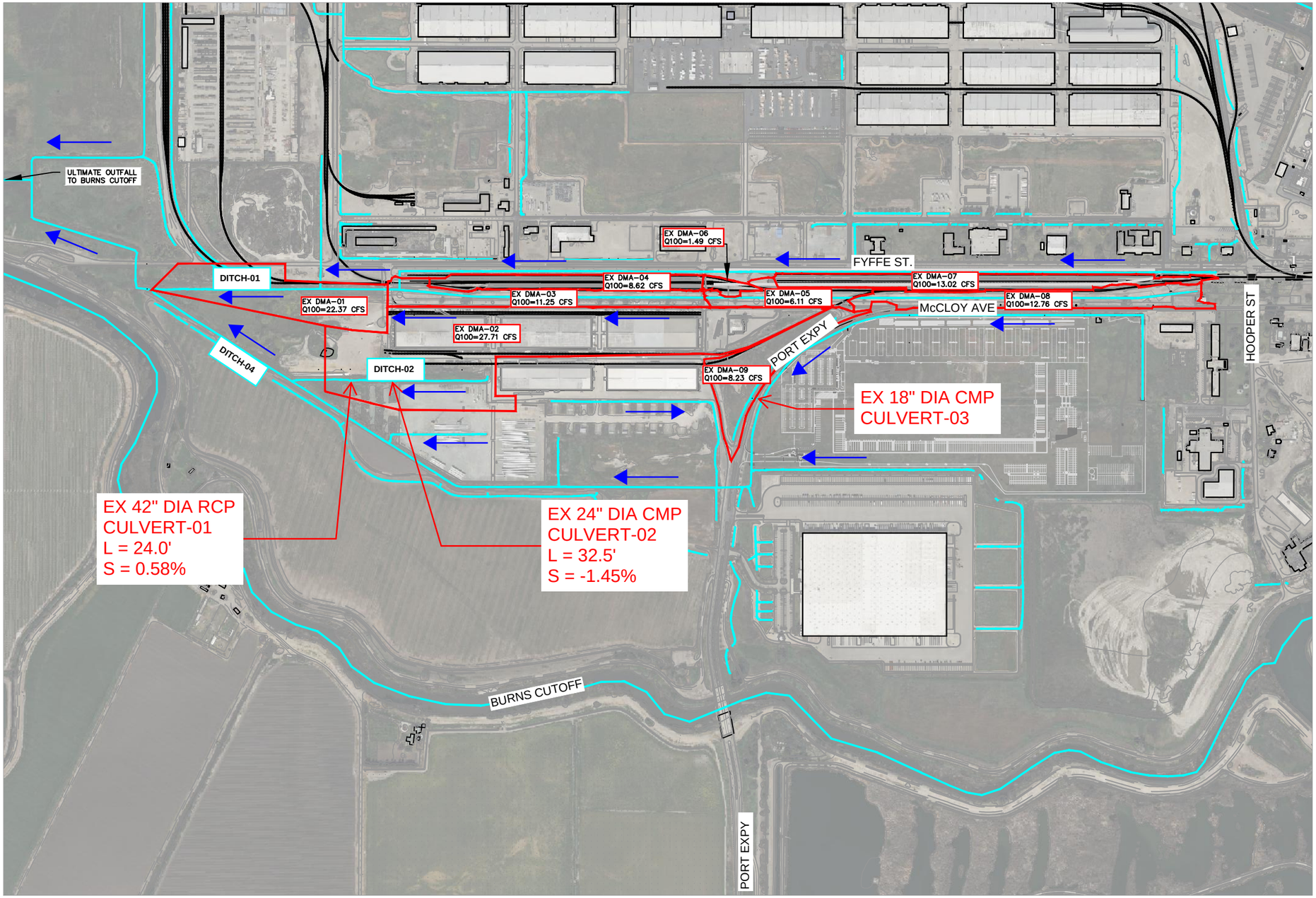
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06077C0455F

EFFECTIVE DATE
OCTOBER 16, 2009

Federal Emergency Management Agency

Appendix B: Existing Drainage Area Maps



DESIGN NOTES:

1. *PEAK FLOW RATE CALCULATED AUTODESK STORM AND SANITARY ANALYSIS BASED ON 100-YEAR RETURN PERIOD, 24-HOUR DURATION RAIN EVENT DERIVED FROM NOAA ATLAS 14 PRECIPITATION DATA.*
2. *CURVE NUMBERS ESTIMATED FROM AUTODESK STORM AND SANITARY ANALYSIS RECOMMENDED VALUES, ASSUMED SOIL GROUP D, AND AERIAL IMAGERY.*

LEGEND:

- *DRAINAGE AREA DELINEATION*
- *FLOW PATH*
- *FLOW DIRECTION*

DRAINAGE AREA SUMMARY TABLE:

DRAINAGE AREA NO.	Q100 (CFS)	AREA (ACRES)	WEIGHTED CN (SEE NOTE 2)
EX DMA-01	22.37	11.41	90.34
EX DMA-02	27.71	29.66	92.23
EX DMA-03	11.25	5.79	90.09
EX DMA-04	8.62	4.00	93.00
EX DMA-05	6.11	3.09	90.58
EX DMA-06	1.49	0.69	93.00
EX DMA-07	13.02	6.03	93.00
EX DMA-08	12.76	6.56	90.11
EX DMA-09	8.23	5.84	83.01

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www.jmacivil.com
SUBCONSULTANTS:

FDR
2379 Gateway Oaks Dr, Ste. 200
Sacramento, CA 95833
T: 916.679.8700
www.hdrinc.com
PRIME CONSULTANT:

PROFESSIONAL SEAL:

DRAFT
NOT FOR CONSTRUCTION
-
08/20/2026
ISSUE:

REVISIONS:		
MARK	DATE	DESCRIPTION

PORT OF STOCKTON
WEST COMPLEX ROADWAYS
SSA DRAINAGE ANALYSIS
305 FYFFE STREET
STOCKTON, CA 95203

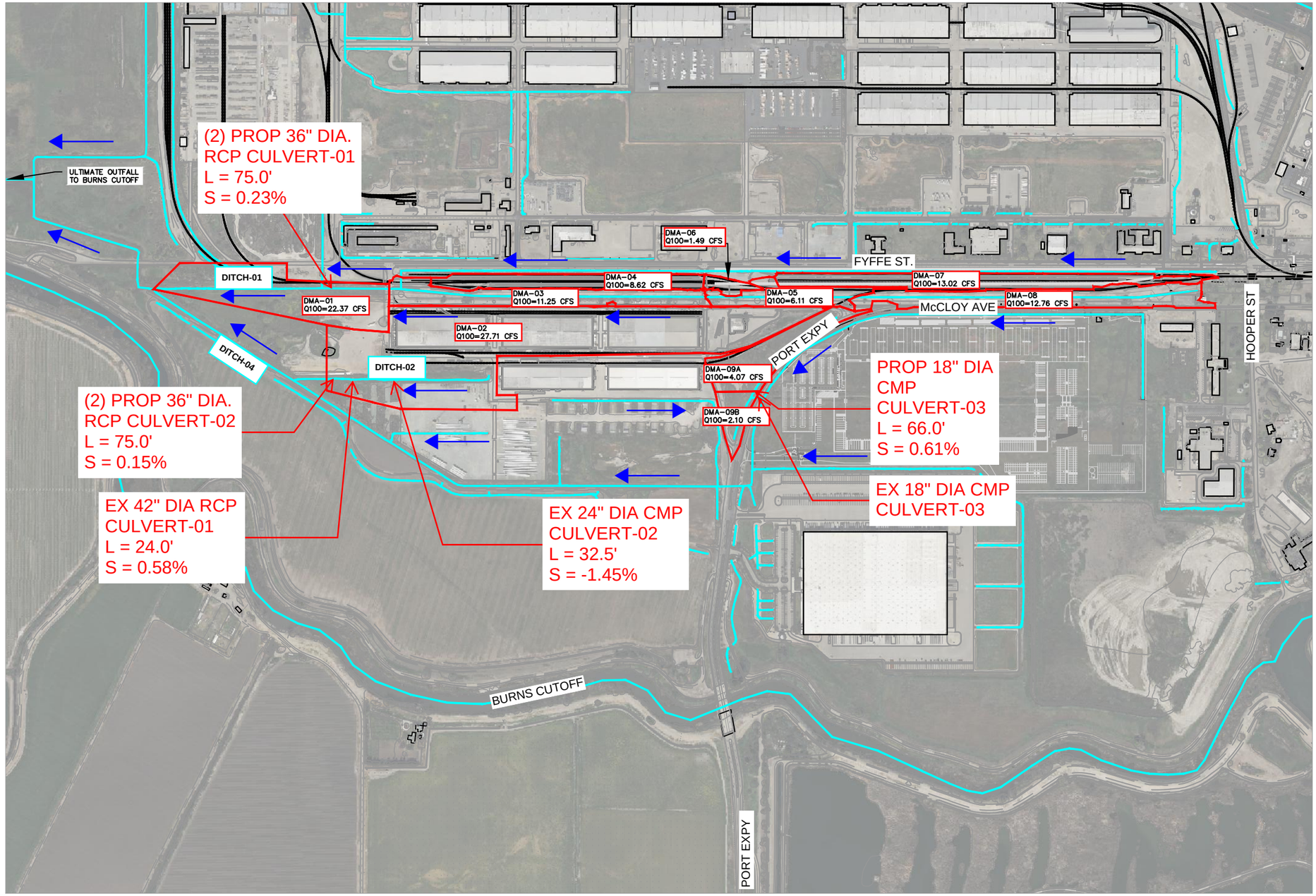
SHEET TITLE:

DESIGNED BY: BLD
DRAWN BY: BLD
CHECKED BY:
APPROVED BY:

SHEET NO.
SHEET OF SHEET NO

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Appendix C: Proposed Drainage Area Maps



DESIGN NOTES:

1. PEAK FLOW RATE CALCULATED AUTODESK STORM AND SANITARY ANALYSIS BASED ON 100-YEAR RETURN PERIOD, 24-HOUR DURATION RAIN EVENT DERIVED FROM NOAA ATLAS 14 PRECIPITATION DATA.
2. CURVE NUMBERS ESTIMATED FROM AUTODESK STORM AND SANITARY ANALYSIS RECOMMENDED VALUES, ASSUMED SOIL GROUP D, AND AERIAL IMAGERY.

LEGEND:

- DRAINAGE AREA DELINEATION
- FLOW PATH
- FLOW DIRECTION

DRAINAGE AREA SUMMARY TABLE:

DRAINAGE AREA NO.	Q100 (CFS)	AREA (ACRES)	WEIGHTED CN (SEE NOTE 2)
DMA-01	22.37	11.41	90.34
DMA-02	27.71	29.66	92.23
DMA-03	11.25	5.79	90.09
DMA-04	8.62	4.00	93.00
DMA-05	6.11	3.09	90.58
DMA-06	1.49	0.69	93.00
DMA-07	13.02	6.03	93.00
DMA-08	12.76	6.56	90.11
DMA-09A	4.07	2.90	82.91
DMA-09B	2.10	1.39	84.40

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www.hdrinc.com
PRIME CONSULTANT:

PROFESSIONAL SEAL:

DRAFT
NOT FOR CONSTRUCTION
-
08/20/2026
ISSUE:

REVISIONS:		
MARK	DATE	DESCRIPTION

PORT OF STOCKTON
WEST COMPLEX ROADWAYS
SSA DRAINAGE ANALYSIS
305 FYFFE STREET
STOCKTON, CA 95203

SHEET TITLE:

DESIGNED BY: BLD
DRAWN BY: BLD
CHECKED BY:
APPROVED BY:

SHEET NO.
SHEET OF SHEET NO

C:\BENTLEY\PWWORKING\DFW\JMA-PW-APP JMA\CIVIL COM_JMA-PW-JMACIVIL_BDPIETRO\D0173814\26-08-20_DELIN.DWG
BRENDON DIPIETRO
8/20/2026 1:59 AM

Appendix D: Hydrologic Data

NOAA Atlas 14, Volume 6, Version 2
Location name: Stockton, California, USA*
Latitude: 37.947°, Longitude: -121.3626°
Elevation: 1 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.101 (0.089-0.114)	0.130 (0.115-0.148)	0.168 (0.148-0.192)	0.199 (0.174-0.230)	0.241 (0.201-0.292)	0.275 (0.222-0.342)	0.309 (0.242-0.398)	0.345 (0.260-0.461)	0.395 (0.282-0.559)	0.436 (0.298-0.646)
10-min	0.144 (0.128-0.164)	0.186 (0.165-0.212)	0.240 (0.213-0.275)	0.285 (0.249-0.330)	0.346 (0.289-0.419)	0.394 (0.319-0.490)	0.443 (0.347-0.570)	0.494 (0.373-0.661)	0.566 (0.404-0.801)	0.625 (0.427-0.926)
15-min	0.174 (0.155-0.198)	0.225 (0.199-0.256)	0.291 (0.257-0.332)	0.345 (0.301-0.399)	0.418 (0.349-0.507)	0.476 (0.386-0.593)	0.535 (0.419-0.690)	0.598 (0.451-0.800)	0.685 (0.489-0.969)	0.756 (0.516-1.12)
30-min	0.238 (0.211-0.270)	0.307 (0.272-0.349)	0.397 (0.351-0.453)	0.470 (0.411-0.544)	0.571 (0.476-0.691)	0.649 (0.526-0.809)	0.730 (0.572-0.941)	0.815 (0.615-1.09)	0.934 (0.667-1.32)	1.03 (0.704-1.53)
60-min	0.331 (0.294-0.377)	0.427 (0.379-0.486)	0.552 (0.488-0.631)	0.655 (0.572-0.757)	0.795 (0.663-0.962)	0.904 (0.732-1.13)	1.02 (0.797-1.31)	1.14 (0.857-1.52)	1.30 (0.929-1.84)	1.44 (0.980-2.13)
2-hr	0.476 (0.423-0.541)	0.580 (0.515-0.661)	0.723 (0.639-0.826)	0.844 (0.737-0.975)	1.02 (0.846-1.23)	1.15 (0.934-1.44)	1.30 (1.02-1.67)	1.46 (1.10-1.95)	1.68 (1.20-2.38)	1.87 (1.28-2.77)
3-hr	0.575 (0.511-0.654)	0.691 (0.613-0.787)	0.850 (0.751-0.971)	0.986 (0.861-1.14)	1.18 (0.985-1.43)	1.34 (1.09-1.67)	1.51 (1.18-1.95)	1.70 (1.28-2.27)	1.96 (1.40-2.78)	2.19 (1.49-3.24)
6-hr	0.786 (0.699-0.894)	0.931 (0.826-1.06)	1.13 (1.00-1.29)	1.30 (1.14-1.51)	1.55 (1.30-1.88)	1.76 (1.42-2.19)	1.98 (1.55-2.54)	2.21 (1.67-2.96)	2.56 (1.83-3.62)	2.85 (1.94-4.22)
12-hr	1.03 (0.913-1.17)	1.23 (1.09-1.40)	1.51 (1.33-1.73)	1.74 (1.52-2.02)	2.07 (1.73-2.51)	2.33 (1.89-2.91)	2.61 (2.04-3.36)	2.90 (2.19-3.88)	3.31 (2.36-4.68)	3.65 (2.49-5.40)
24-hr	1.38 (1.25-1.56)	1.69 (1.53-1.91)	2.10 (1.90-2.38)	2.44 (2.19-2.77)	2.90 (2.52-3.39)	3.25 (2.78-3.87)	3.61 (3.03-4.39)	3.99 (3.26-4.97)	4.50 (3.55-5.82)	4.90 (3.76-6.53)
2-day	1.74 (1.58-1.96)	2.13 (1.93-2.41)	2.64 (2.39-2.99)	3.06 (2.74-3.48)	3.62 (3.15-4.23)	4.04 (3.46-4.81)	4.47 (3.75-5.44)	4.91 (4.02-6.12)	5.50 (4.35-7.11)	5.97 (4.57-7.94)
3-day	1.99 (1.80-2.24)	2.44 (2.21-2.75)	3.01 (2.72-3.40)	3.48 (3.12-3.96)	4.10 (3.57-4.80)	4.57 (3.91-5.45)	5.05 (4.23-6.14)	5.53 (4.53-6.90)	6.19 (4.89-8.00)	6.70 (5.13-8.92)
4-day	2.19 (1.98-2.47)	2.68 (2.43-3.02)	3.31 (2.99-3.74)	3.82 (3.42-4.34)	4.49 (3.92-5.26)	5.00 (4.28-5.96)	5.51 (4.62-6.71)	6.03 (4.94-7.52)	6.73 (5.32-8.70)	7.27 (5.57-9.68)
7-day	2.67 (2.42-3.00)	3.26 (2.96-3.68)	4.02 (3.63-4.54)	4.62 (4.14-5.26)	5.41 (4.72-6.34)	6.01 (5.14-7.16)	6.60 (5.53-8.03)	7.20 (5.89-8.97)	7.99 (6.31-10.3)	8.60 (6.59-11.4)
10-day	2.99 (2.71-3.37)	3.66 (3.32-4.13)	4.51 (4.08-5.10)	5.18 (4.64-5.89)	6.05 (5.27-7.08)	6.69 (5.73-7.97)	7.33 (6.14-8.92)	7.97 (6.52-9.93)	8.80 (6.95-11.4)	9.44 (7.23-12.6)
20-day	3.91 (3.54-4.40)	4.85 (4.39-5.46)	5.98 (5.40-6.76)	6.85 (6.14-7.79)	7.95 (6.93-9.30)	8.74 (7.48-10.4)	9.49 (7.96-11.6)	10.2 (8.38-12.8)	11.2 (8.83-14.4)	11.9 (9.10-15.8)
30-day	4.66 (4.23-5.25)	5.82 (5.27-6.56)	7.19 (6.50-8.13)	8.22 (7.38-9.35)	9.49 (8.27-11.1)	10.4 (8.89-12.4)	11.2 (9.41-13.7)	12.0 (9.85-15.0)	13.0 (10.3-16.9)	13.8 (10.6-18.4)
45-day	5.76 (5.22-6.49)	7.24 (6.55-8.16)	8.95 (8.09-10.1)	10.2 (9.16-11.6)	11.7 (10.2-13.7)	12.8 (10.9-15.2)	13.7 (11.5-16.7)	14.6 (12.0-18.2)	15.7 (12.4-20.3)	16.5 (12.7-22.0)
60-day	6.88 (6.23-7.74)	8.66 (7.83-9.76)	10.7 (9.66-12.1)	12.2 (10.9-13.8)	13.9 (12.1-16.3)	15.1 (12.9-18.0)	16.1 (13.5-19.6)	17.1 (14.0-21.3)	18.3 (14.5-23.7)	19.2 (14.7-25.5)

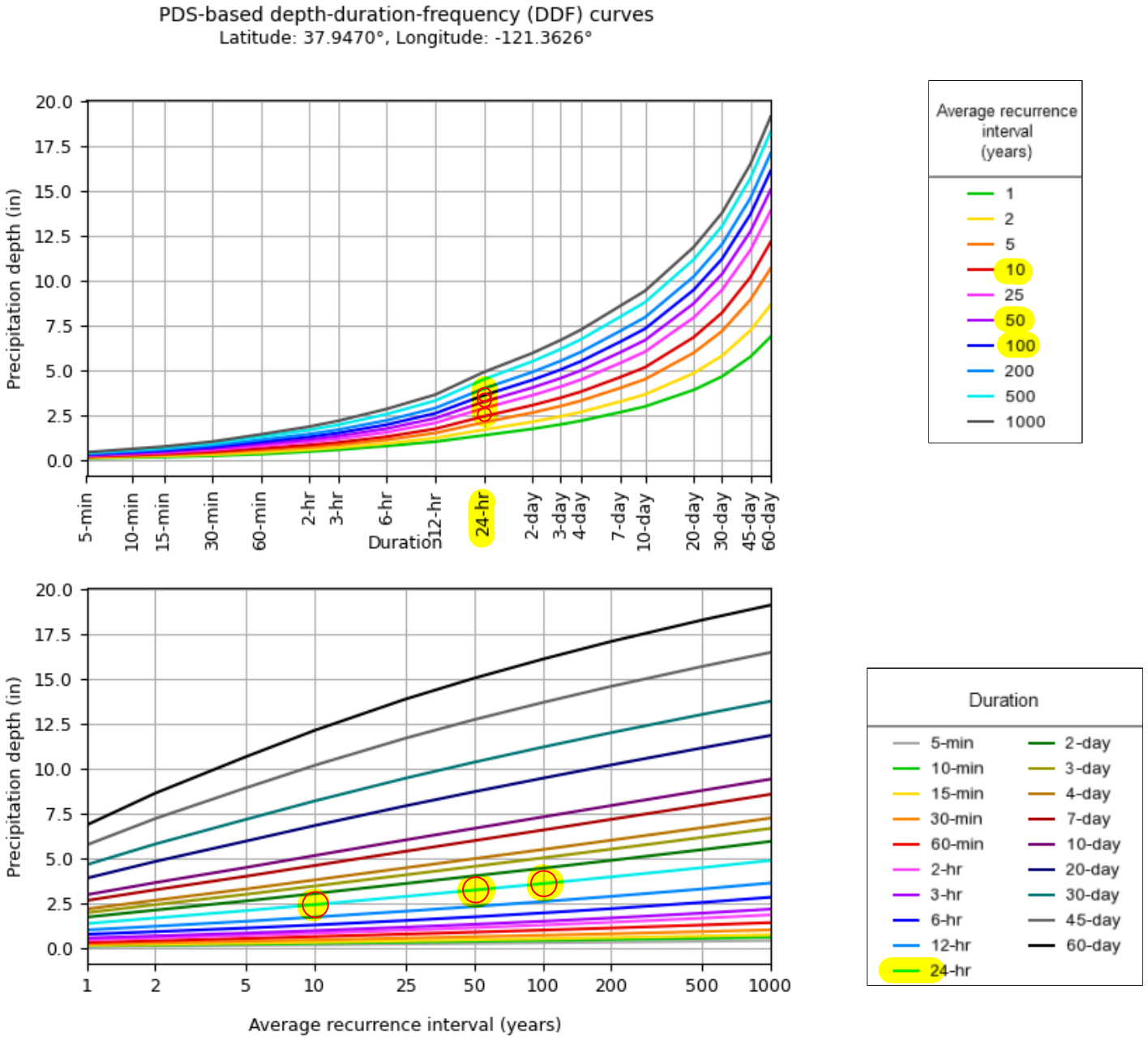
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

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

Please refer to NOAA Atlas 14 document for more information.

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PF graphical



NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Tue Jun 2 22:54:41 2026

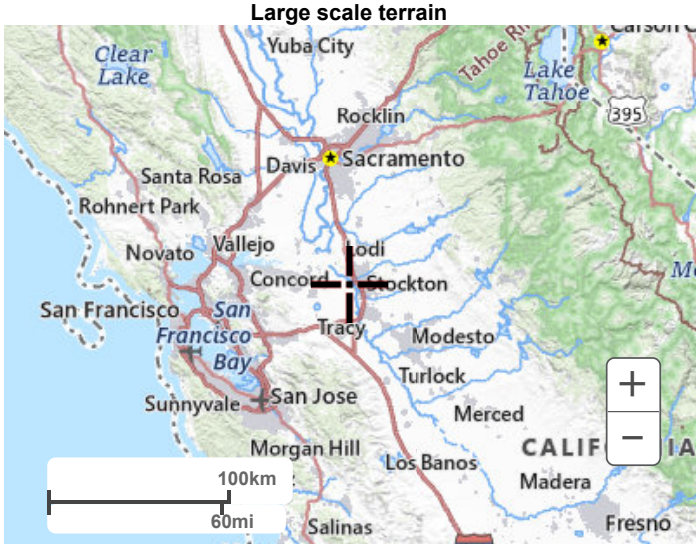
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Maps & aerials

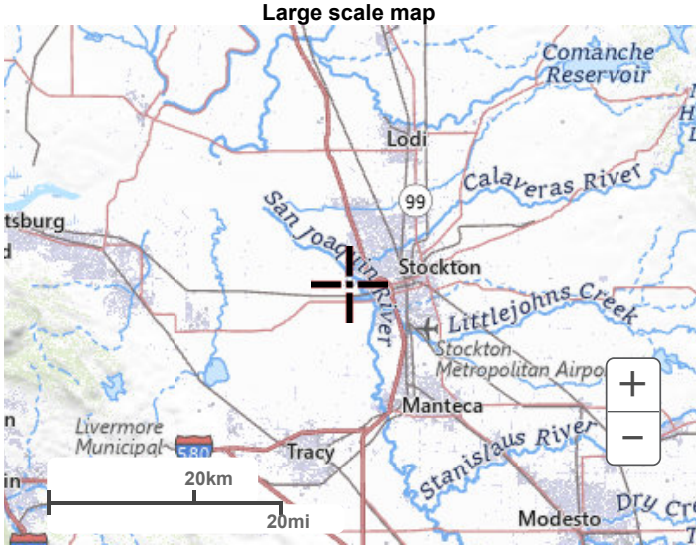
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

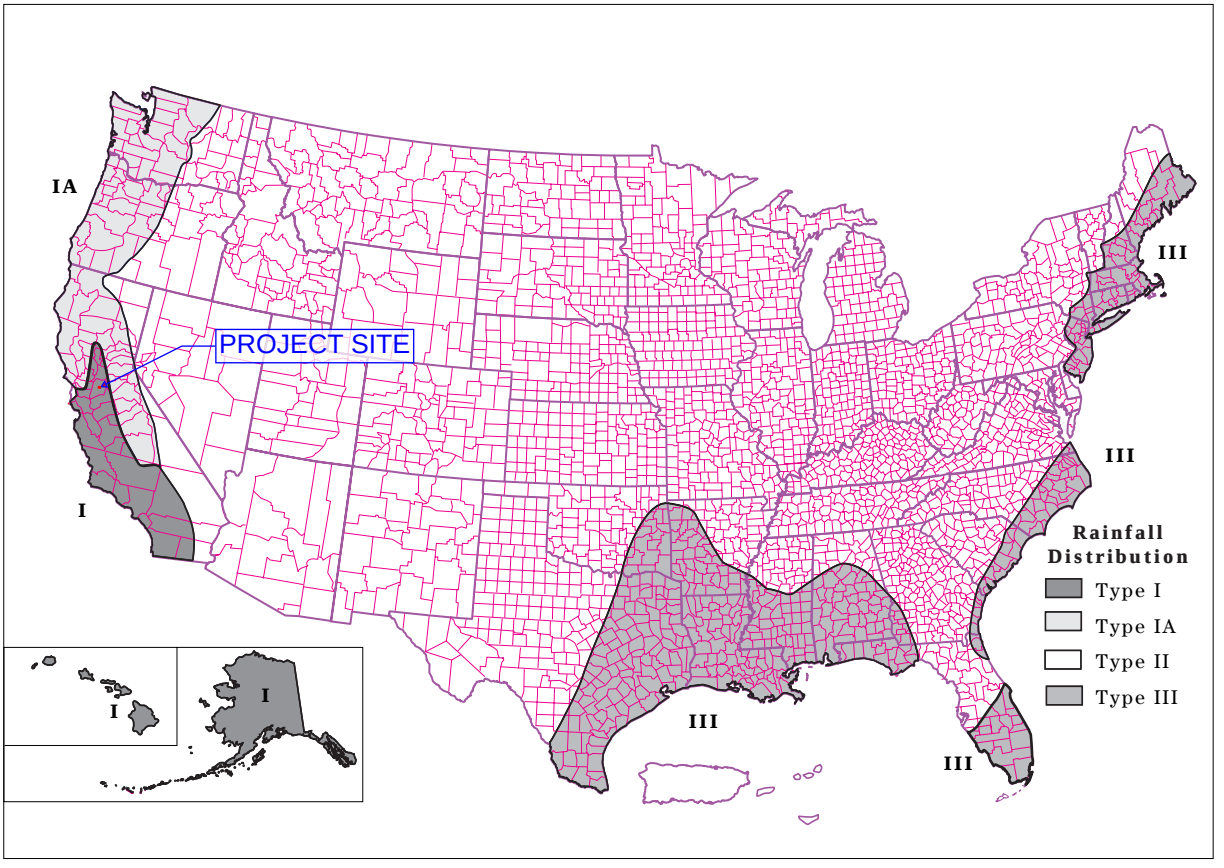


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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Figure B-2 Approximate geographic boundaries for NRCS (SCS) rainfall distributions



Rainfall data sources

This section lists the most current 24-hour rainfall data published by the National Weather Service (NWS) for various parts of the country. Because NWS Technical Paper 40 (TP-40) is out of print, the 24-hour rainfall maps for areas east of the 105th meridian are included here as figures B-3 through B-8. For the area generally west of the 105th meridian, TP-40 has been superseded by NOAA Atlas 2, the Precipitation-Frequency Atlas of the Western United States, published by the National Ocean and Atmospheric Administration.

East of 105th meridian

Hershfield, D.M. 1961. Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 40. Washington, DC. 155 p.

West of 105th meridian

Miller, J.F., R.H. Frederick, and R.J. Tracey. 1973. Precipitation-frequency atlas of the Western United States. Vol. I Montana; Vol. II, Wyoming; Vol III, Colorado; Vol. IV, New Mexico; Vol V, Idaho; Vol. VI, Utah; Vol. VII, Nevada; Vol. VIII, Arizona; Vol. IX, Washington; Vol. X, Oregon; Vol. XI, California. U.S. Dept. of Commerce, National Weather Service, NOAA Atlas 2. Silver Spring, MD.

Alaska

Miller, John F. 1963. Probable maximum precipitation and rainfall-frequency data for Alaska for areas to 400 square miles, durations to 24 hours and return periods from 1 to 100 years. U.S. Dept. of Commerce, Weather Bur. Tech. Pap. No. 47. Washington, DC. 69 p.

Hawaii

Weather Bureau. 1962. Rainfall-frequency atlas of the Hawaiian Islands for areas to 200 square miles, durations to 24 hours and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 43. Washington, DC. 60 p.

Puerto Rico and Virgin Islands

Weather Bureau. 1961. Generalized estimates of probable maximum precipitation and rainfall-frequency data for Puerto Rico and Virgin Islands for areas to 400 square miles, durations to 24 hours, and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 42. Washington, DC. 94 P.

- **Artificial Fill (map symbol af) –** Unconsolidated sand and silt with lesser amounts of gravel and clay hydraulically emplaced from dredging of the San Joaquin River. Artificial fill may include organic materials.

- **Holocene Dos Palos Alluvium (map symbol Qdp) –** Unweathered, unconsolidated deposits of arkosic gravel, sand, silt, and clay covering the floodbasin of the lower San Joaquin River.

- **Late Pleistocene Modesto Formation (map symbol Qm) –** Represents glacial outwash from the core of Sierra Nevada and lesser local (not Sierran) sediment sources. Consists predominantly of sand and silt with lesser amounts of gravel and clay.

The Riverbank Formation is not exposed at the surface along the alignment but is interpreted to be located at a depth of about 45 to 60 feet below ground surface based on a significant increase in density and the presence of sandier deposits. The Riverbank Formation is described as follows:

- **Late Pleistocene Riverbank Formation (map symbol Qr) –** Arkosic sand forming terraces topographically at or above Modesto Formation level. Represents glacial outwash from core of Sierra Nevada and lesser locally sourced sediments.

A geologic map of the alignment, based on Wagner, et al. (1991) is presented on Figure 2.

3.3 EARTH MATERIALS

The following description provides a general summary of the subsurface conditions encountered during the field exploration and further validated by the laboratory testing program. For a more thorough description of the actual conditions encountered at specific boring locations, refer to the log of borings in Appendix A. All soils have been classified according to the Unified Soil Classification System (ASTM D2487).

Subsurface soils encountered during our investigation primarily consisted of soft to stiff clay, clay with sand, sandy clay, stiff to very stiff silt, loose to medium dense silty sands, clayey sands, poorly graded sands and soft to stiff cohesive soils in the upper 8 to 13 feet underlain by similar soils that are medium dense to dense and stiff to hard plus poorly graded sand with silt at depth below 40 ft.

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Table 2-2a Runoff curve numbers for urban areas [1/]

Cover description: Cover type and hydrologic condition	Average percent impervious area [2/]	Curve numbers for hydrologic soil group: A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3/]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4/]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5/]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

Vegetated areas west of Humphreys and along Port Expressway

Areas adjacent to McCloy Avenue

Assumed for all impervious areas at Port including tracks and roadway

[1] Average runoff condition, and $I_a = 0.2S$.

[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[4] Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Appendix A Hydrologic Soil Groups

Soils are classified into hydrologic soil groups (HSG's) to indicate the minimum rate of infiltration obtained for bare soil after prolonged wetting. The HSG's, which are A, B, C, and D, are one element used in determining runoff curve numbers (see chapter 2). For the convenience of TR-55 users, exhibit A-1 lists the HSG classification of United States soils.

The infiltration rate is the rate at which water enters the soil at the soil surface. It is controlled by surface conditions. HSG also indicates the transmission rate—the rate at which the water moves within the soil. This rate is controlled by the soil profile. Approximate numerical ranges for transmission rates shown in the HSG definitions were first published by Musgrave (USDA 1955). The four groups are defined by SCS soil scientists as follows:

Group A soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sand or gravel and have a high rate of water transmission (greater than 0.30 in/hr).

Group B soils have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15-0.30 in/hr).

Group C soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission (0.05-0.15 in/hr).

Group D soils have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission (0-0.05 in/hr).

In exhibit A-1, some of the listed soils have an added modifier; for example, "Abrazo, gravelly." This refers to a gravelly phase of the Abrazo series that is found in SCS soil map legends.

Disturbed soil profiles

As a result of urbanization, the soil profile may be considerably altered and the listed group classification may no longer apply. In these circumstances, use the following to determine HSG according to the texture of the new surface soil, provided that significant compaction has not occurred (Brakensiek and Rawls 1983).

HSG	*Soil textures*
A	Sand, loamy sand, or sandy loam
B	Silt loam or loam
C	Sandy clay loam
D	Clay loam, silty clay loam, sandy clay, silty clay, or clay

Drainage and group D soils

Some soils in the list are in group D because of a high water table that creates a drainage problem. Once these soils are effectively drained, they are placed in a different group. For example, Ackerman soil is classified as A/D. This indicates that the drained Ackerman soil is in group A and the undrained soil is in group D.

Support Material

APPENDIX 19.A
Manning's Roughness Coefficient[a,b]
(design use)

channel material	n
plastic (PVC and ABS)	0.009
clean, uncoated cast iron	0.013–0.015
clean, coated cast iron	0.012–0.014
dirty, tuberculated cast iron	0.015–0.035
riveted steel	0.015–0.017
lock-bar and welded steel pipe	0.012–0.013
galvanized iron	0.015–0.017
brass and glass	0.009–0.013
wood stave	
small diameter	0.011–0.012
large diameter	0.012–0.013
concrete	
average value used	0.013
typical commercial, ball and spigot rubber gasketed end connections	
– full (pressurized and wet)	0.010
– partially full	0.0085
with rough joints	0.016–0.017
dry mix, rough forms	0.015–0.016
wet mix, steel forms	0.012–0.014
very smooth, finished	0.011–0.012
vitrified sewer	0.013–0.015
common-clay drainage tile	0.012–0.014
asbestos	0.011
planed timber (flume)	0.012 (0.010–0.014)
canvas	0.012
unplaned timber (flume)	0.013 (0.011–0.015)
brick	0.016
rubble masonry	0.017
smooth earth	0.018
firm gravel	0.023
corrugated metal pipe (CMP)	0.022–0.033
natural channels, good condition	0.025
rip rap	0.035
natural channels with stones and weeds	0.035
very poor natural channels	0.060

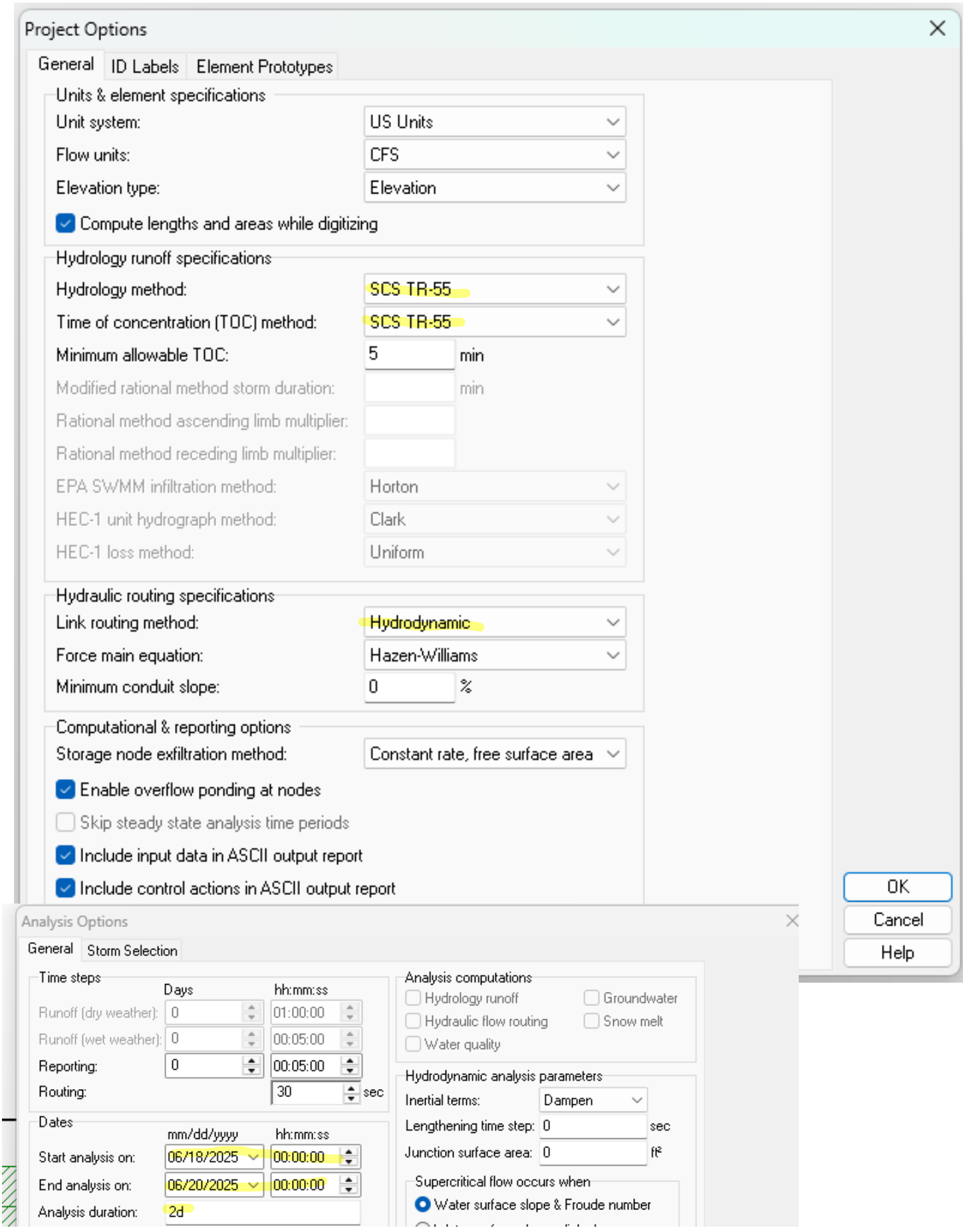
[a]compiled from various sources
[b]Values outside these ranges have been observed, but these values are typical.

Appendix E: SSA Input Data

Port of Stockton West Complex Roadways Project

Table 1 - SSA Input Values - Existing and Proposed Drainage Areas

Construction Phase	Drainage Area	Area A (AC)	Impervious Area B (AC)	Pervious Area C (AC)	% Impervious Area =B/A X 100%	Area, A (Mi^2) =A X 0.0015625	Impervious SCS Curve Number D (CN)	Pervious SCS Curve Number E (CN)	Weight Average CN F=((B X D)+(C X E))/A	Initial Abstraction Ia (inch) =0.2 X ((1000/F)-10)	Time of Concentration, Assumed Tc (min)	Lag, L (min.) =Tc x 0.6
Existing	Ex DMA-01	11.41	3.82	7.59	33.5%	0.0178	93	89	90	0.2	5	3
Existing	Ex DMA-02	29.66	23.95	5.71	80.7%	0.0463	93	89	92	0.2	50	30
Existing	Ex DMA-03	5.79	1.58	4.21	27.3%	0.0090	93	89	90	0.2	5	3
Existing	Ex DMA-04	4.00	4.00	0.00	100.0%	0.0063	93	80	93	0.2	5	3
Existing	Ex DMA-05	3.09	1.21	1.88	39.2%	0.0048	93	89	91	0.2	5	3
Existing	Ex DMA-06	0.69	0.69	0.00	100.0%	0.0011	93	80	93	0.2	5	3
Existing	Ex DMA-07	6.03	6.03	0.00	100.0%	0.0094	93	80	93	0.2	5	3
Existing	Ex DMA-08	6.56	1.82	4.74	27.7%	0.0103	93	89	90	0.2	5	3
Existing	Ex DMA-09	5.83	1.35	4.48	23.2%	0.0091	93	80	83	0.4	5	3
Proposed	DMA-01	11.41	0.42	10.99	3.7%	0.0178	93	89	89	0.2	5	3
Proposed	DMA-02	29.66	0.79	28.87	2.7%	0.0463	93	89	89	0.2	50	30
Proposed	DMA-03	5.79	0.43	5.36	7.4%	0.0090	93	89	89	0.2	5	3
Proposed	DMA-04	4.00	0.26	3.74	6.5%	0.0063	93	80	81	0.5	5	3
Proposed	DMA-05	3.09	3.09	0.00	100.0%	0.0048	93	89	93	0.2	5	3
Proposed	DMA-06	0.69	0.12	0.57	17.4%	0.0011	93	80	82	0.4	5	3
Proposed	DMA-07	6.03	0.40	5.63	6.7%	0.0094	93	80	81	0.5	5	3
Proposed	DMA-08	6.56	6.56	0.00	100.0%	0.0103	93	89	93	0.2	5	3
Proposed	DMA-09A	2.90	0.65	2.25	22.4%	0.0045	93	80	83	0.4	5	3
Proposed	DMA-09B	1.39	0.92	0.47	66.2%	0.0022	93	80	89	0.3	5	3


Project Options
General
ID Labels
Element Prototypes
Units & element specifications
Unit system:
US Units
Flow units:
CFS
Elevation type:
Elevation
Compute lengths and areas while digitizing
Hydrology runoff specifications
Hydrology method:
SCS TR-55
Time of concentration (TOC) method:
SCS TR-55
Minimum allowable TOC:
5
min
Modified rational method storm duration:
min
Rational method ascending limb multiplier:
Rational method receding limb multiplier:
EPA SWMM infiltration method:
Horton
HEC-1 unit hydrograph method:
Clark
HEC-1 loss method:
Uniform
Hydraulic routing specifications
Link routing method:
Hydrodynamic
Force main equation:
Hazen-Williams
Minimum conduit slope:
0
%
Computational & reporting options
Storage node exfiltration method:
Constant rate, free surface area
Enable overflow ponding at nodes
Skip steady state analysis time periods
Include input data in ASCII output report
Include control actions in ASCII output report
OK
Cancel
Help
Analysis Options
General
Storm Selection
Time steps
Days
hh:mm:ss
Runoff (dry weather):
0
01:00:00
Runoff (wet weather):
0
00:05:00
Reporting:
0
00:05:00
Routing:
30
sec
Dates
mm/dd/yyyy
hh:mm:ss
Start analysis on:
06/18/2025
00:00:00
End analysis on:
06/20/2025
00:00:00
Analysis duration:
2d
Analysis computations
Hydrology runoff
Groundwater
Hydraulic flow routing
Snow melt
Water quality
Hydrodynamic analysis parameters
Inertial terms:
Dampen
Lengthening time step:
0
sec
Junction surface area:
0
ft²
Supercritical flow occurs when
Water surface slope & Froude number

Time Series

General

Time series ID: TS-100 Year

Description: 100-year cumulative storm for San Joaquin (Stockton) County, California, with a total rainfall amount of 3.43 in using a SCS Type I 24-hr storm

Time series data

Data type

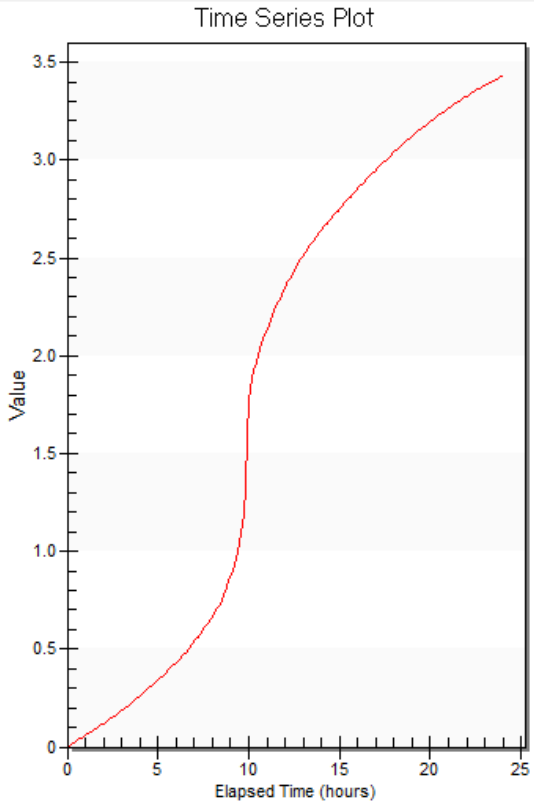
User defined

Standard rainfall — Rainfall Designer...

Date (MM/DD/YYYY)	Time (H:MM)	Value
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	0:06	0.00597
	0:12	0.01194
	0:18	0.01790
	0:24	0.02391
	0:30	0.02988
	0:36	0.03588

Time series curves

	ID	Number of Points	Description
1	TS-100 Year	241	100-year cumulative storm
2	TS-2 Year	241	2-year cumulative storm
3	TS-50 Year	241	50-year cumulative storm



Add
Delete
Load...
Save...
Close
Help

Time Series

General

Time series ID: TS-50 Year

Description: 50-year cumulative storm for San Joaquin (Stockton) County, California, with a total rainfall amount of 3.13 in using a SCS Type I 24-hr storm

Time series data

Data type

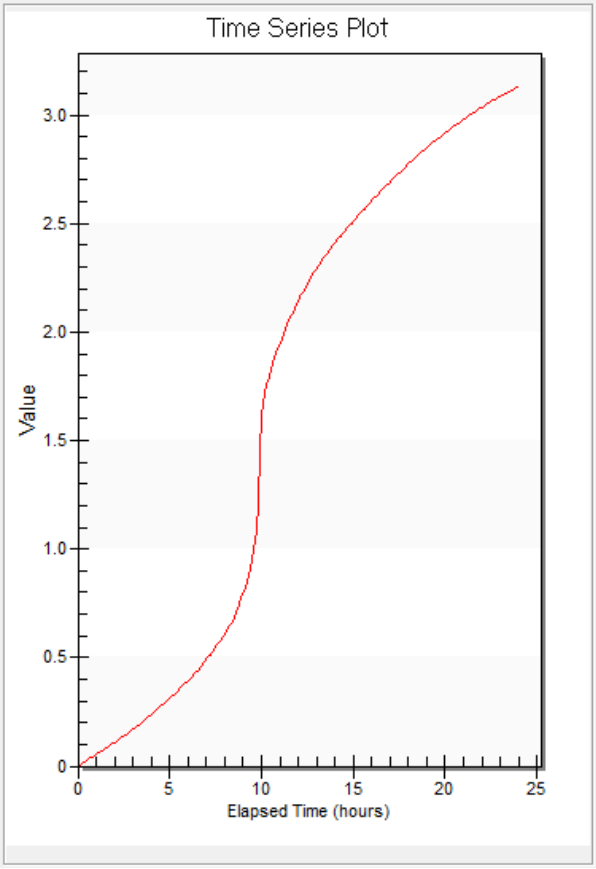
User defined

Standard rainfall — Rainfall Designer...

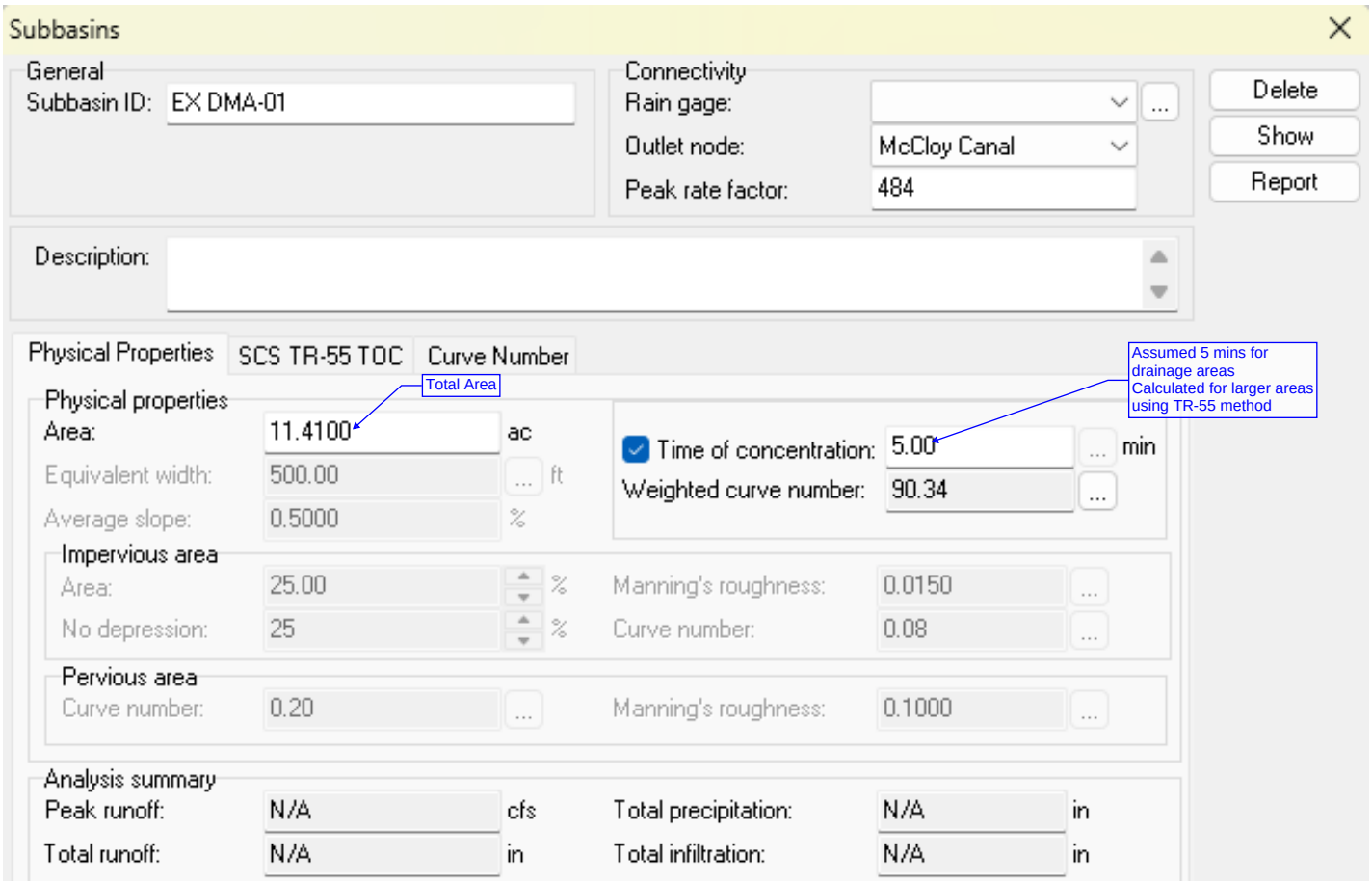
Date (MM/DD/YYYY)	Time (H:MM)	Value
	0:00	0.00000
	0:06	0.00545
	0:12	0.01089
	0:18	0.01634
	0:24	0.02182
	0:30	0.02726
	0:36	0.03274

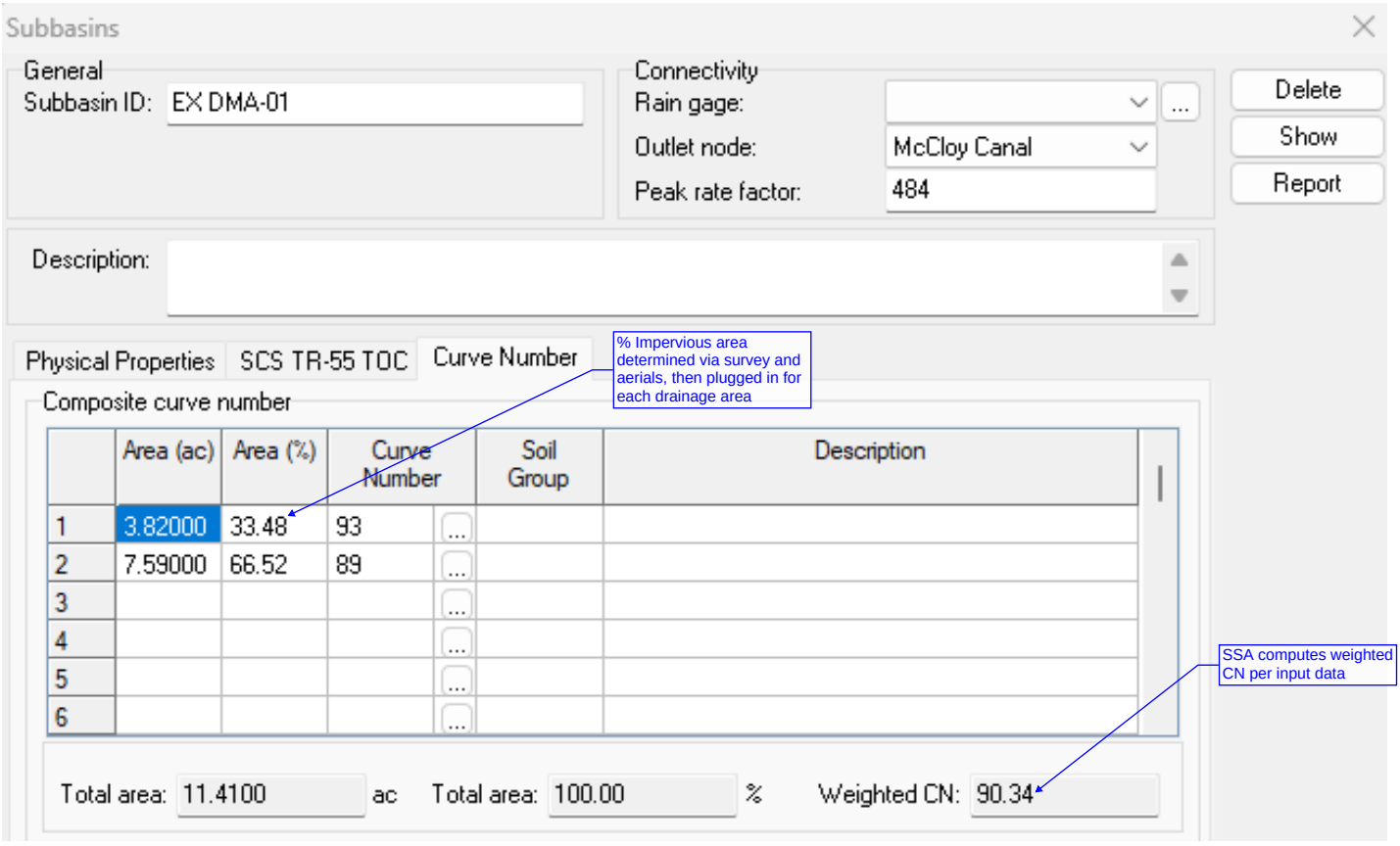
Time series curves

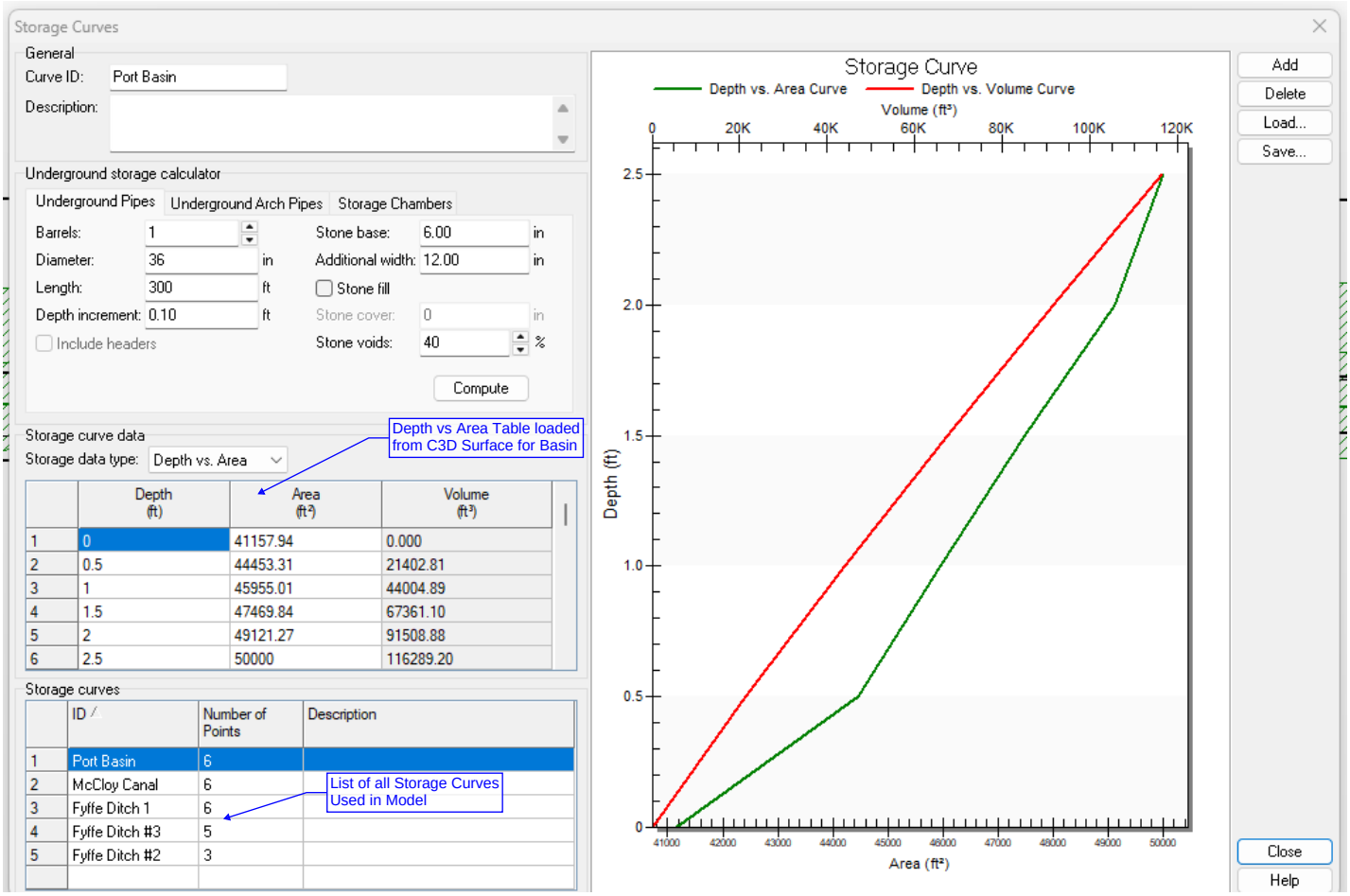
	ID	Number of Points	Description
1	TS-100 Year	241	100-year cumulative storm
2	TS-2 Year	241	2-year cumulative storm
3	TS-50 Year	241	50-year cumulative storm

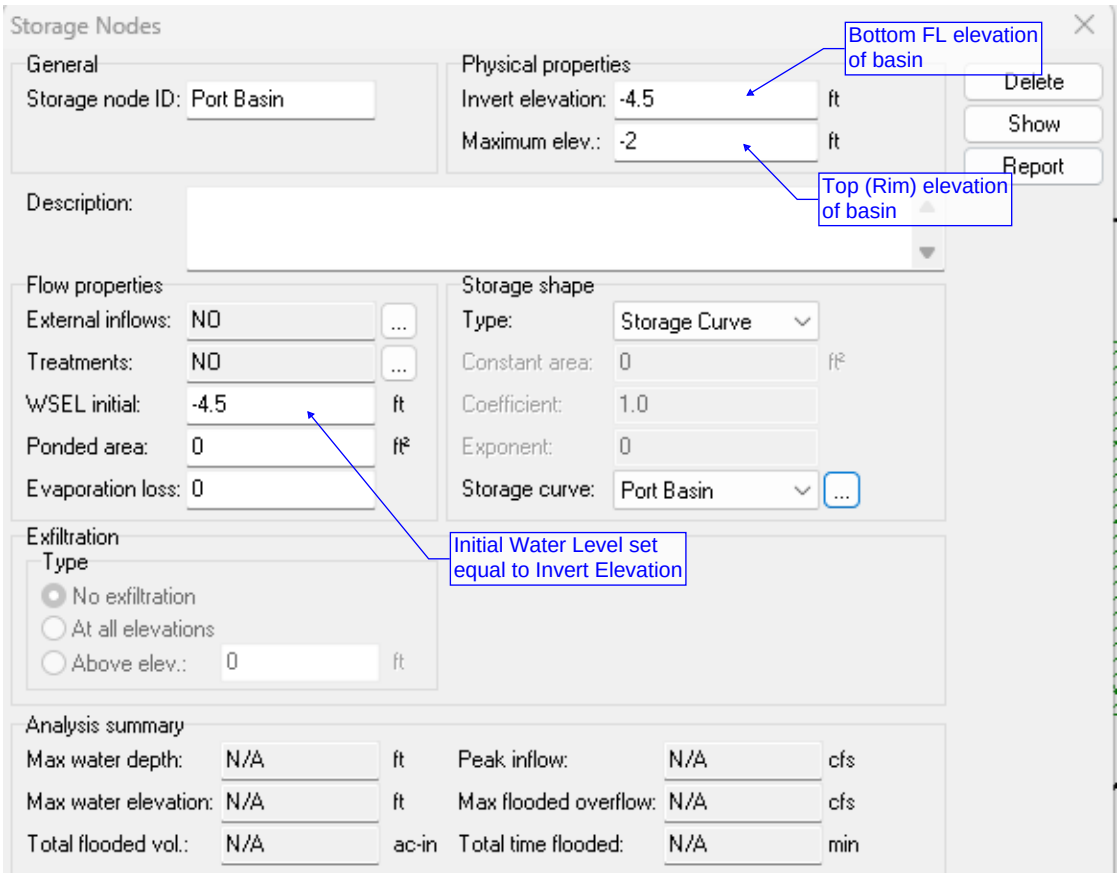


Add
Delete
Load...
Save...
Close
Help

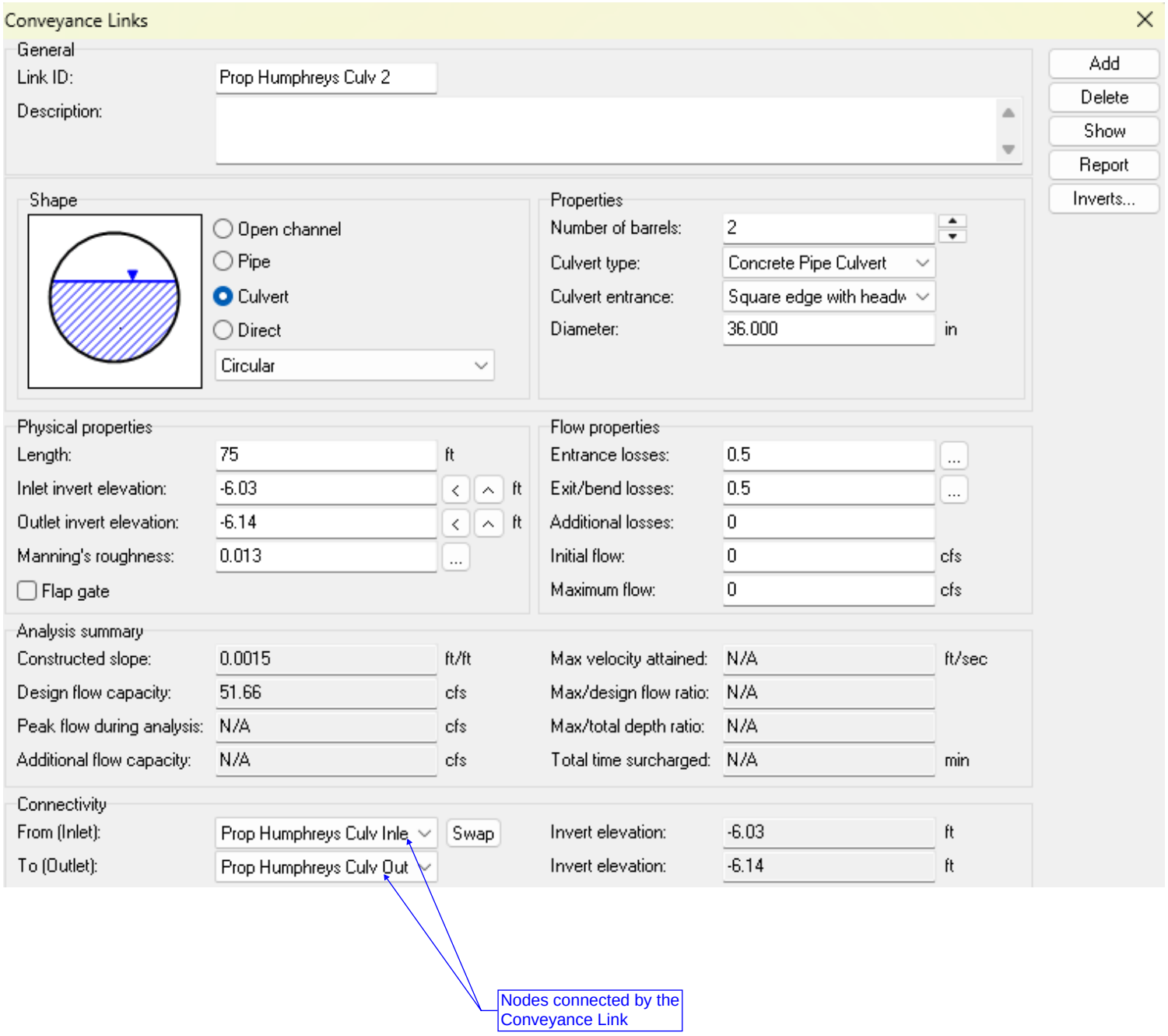

Subbasins
General
Subbasin ID: EX DMA-01
Connectivity
Rain gage:
Outlet node: McCloy Canal
Peak rate factor: 484
Delete
Show
Report
Description:
Physical Properties
SCS TR-55 TOC
Curve Number
Total Area
Assumed 5 mins for drainage areas
Calculated for larger areas using TR-55 method
Physical properties
Area: 11.4100 ac
Equivalent width: 500.00 ft
Average slope: 0.5000 %
Time of concentration: 5.00 min
Weighted curve number: 90.34
Impervious area
Area: 25.00 %
No depression: 25 %
Manning's roughness: 0.0150
Curve number: 0.08
Pervious area
Curve number: 0.20
Manning's roughness: 0.1000
Analysis summary
Peak runoff: N/A cfs
Total runoff: N/A in
Total precipitation: N/A in
Total infiltration: N/A in


Subbasins
General
Subbasin ID: EX DMA-01
Connectivity
Rain gage:
Outlet node: McCloy Canal
Peak rate factor: 484
Delete
Show
Report
Description:
Physical Properties
SCS TR-55 TOC
Curve Number
% Impervious area determined via survey and aerials, then plugged in for each drainage area
Composite curve number
Area (ac) | Area (%) | Curve Number | Soil Group | Description
1 | 3.82000 | 33.48 | 93
2 | 7.59000 | 66.52 | 89
3
4
5
6
SSA computes weighted CN per input data
Total area: 11.4100 ac
Total area: 100.00 %
Weighted CN: 90.34


Storage Curves
General
Curve ID: Port Basin
Description:
Underground storage calculator
Underground Pipes
Underground Arch Pipes
Storage Chambers
Barrels: 1
Diameter: 36 in
Length: 300 ft
Depth increment: 0.10 ft
Include headers
Stone base: 6.00 in
Additional width: 12.00 in
Stone fill
Stone cover: 0 in
Stone voids: 40 %
Compute
Storage curve data
Storage data type: Depth vs. Area
Depth vs Area Table loaded from C3D Surface for Basin
Depth (ft) | Area (ft²) | Volume (ft³)
1 | 0 | 41157.94 | 0.000
2 | 0.5 | 44453.31 | 21402.81
3 | 1 | 45955.01 | 44004.89
4 | 1.5 | 47469.84 | 67361.10
5 | 2 | 49121.27 | 91508.88
6 | 2.5 | 50000 | 116289.20
Storage curves
ID | Number of Points | Description
1 | Port Basin | 6
2 | McCloy Canal | 6
3 | Fyffe Ditch 1 | 6
4 | Fyffe Ditch #3 | 5
5 | Fyffe Ditch #2 | 3
List of all Storage Curves Used in Model
Storage Curve
Depth vs. Area Curve
Depth vs. Volume Curve
Volume (ft³)
0 20K 40K 60K 80K 100K 120K
Depth (ft)
0 0.5 1.0 1.5 2.0 2.5
41000 42000 43000 44000 45000 46000 47000 48000 49000 50000
Area (ft²)
Add
Delete
Load...
Save...
Close
Help


Storage Nodes
General
Storage node ID: Port Basin
Physical properties
Invert elevation: -4.5 ft
Maximum elev.: -2 ft
Bottom FL elevation of basin
Top (Rim) elevation of basin
Delete
Show
Report
Description:
Flow properties
External inflows: NO
Treatments: NO
WSEL initial: -4.5 ft
Ponded area: 0 ft²
Evaporation loss: 0
Storage shape
Type: Storage Curve
Constant area: 0 ft²
Coefficient: 1.0
Exponent: 0
Storage curve: Port Basin
Initial Water Level set equal to Invert Elevation
Exfiltration
Type
No exfiltration
At all elevations
Above elev.: 0 ft
Analysis summary
Max water depth: N/A ft
Max water elevation: N/A ft
Total flooded vol.: N/A ac-in
Peak inflow: N/A cfs
Max flooded overflow: N/A cfs
Total time flooded: N/A min

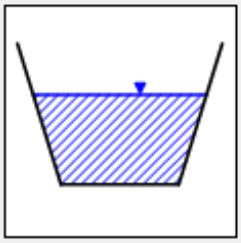
SET UP CONVEYANCE LINKS (PIPES/CULVERTS/OPEN CHANNEL)



Conveyance Links

General
Link ID: Ditch-01C
Description:

Add
Delete
Show
Report
Inverts...

Shape

Open channel
Pipe
Culvert
Direct
Trapezoidal

Properties
Number of barrels: 1
Height: 5.180 ft
Bottom width: 7.490 ft
Left side slope: 1: 2.6 (V:H)
Right side slope: 1: 2.1 (V:H)

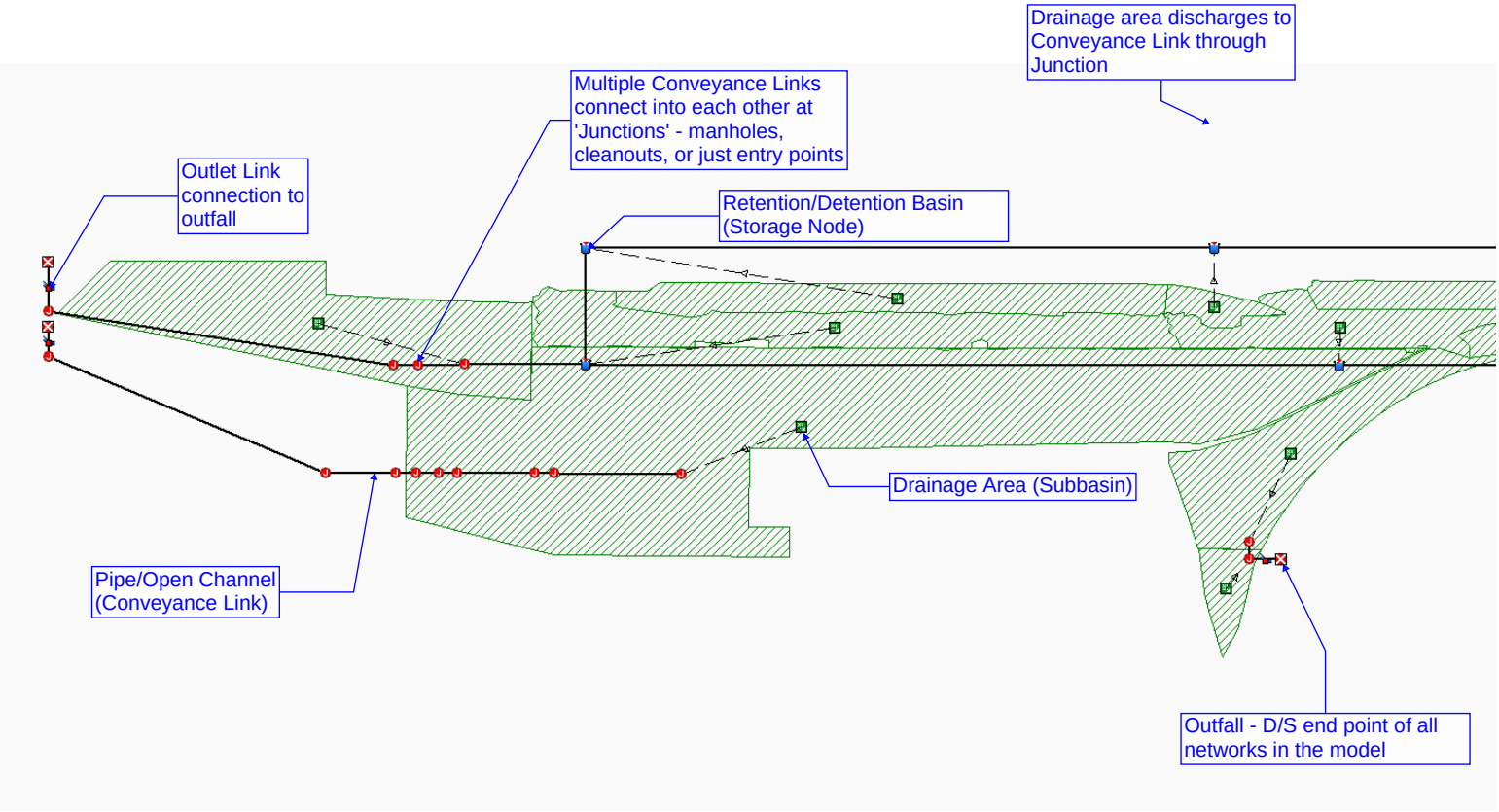
Physical properties
Length: 69.69 ft
Inlet invert elevation: -5.85 ft
Outlet invert elevation: -6.03 ft
Manning's roughness: 0.08
Flap gate

Flow properties
Entrance losses: 0.5
Exit/bend losses: 0.5
Additional losses: 0
Initial flow: 0 cfs
Maximum flow: 0 cfs

Analysis summary
Constructed slope: 0.0026 ft/ft
Design flow capacity: 200.60 cfs
Peak flow during analysis: N/A cfs
Additional flow capacity: N/A cfs
Max velocity attained: N/A ft/sec
Max/design flow ratio: N/A
Max/total depth ratio: N/A
Total time surcharged: N/A min

Connectivity
From (Inlet): Ex 42in RCP Outlet Swap
To (Outlet): Prop Humphreys Culv Inle
Invert elevation: -5.85 ft
Invert elevation: -6.03 ft

WEST COMPLEX ROADWAYS
100% STORMWATER REPORT
ILLUSTRATION OF SETTING UP STORM DRAIN NETWORK



Appendix F: Existing Drainage Calculations

West Complex Roadways
100% Stormwater Report
Table 1: Existing Drainage Area Summary

SN	Drainage Area	Area (acres)	Drainage Outlet	Weighted CN	100-Year			50-Year			10-Year		
					Total Precipitation (inches)	Total Runoff (inches)	Peak Runoff (cfs)	Total Precipitation (inches)	Total Runoff (inches)	Peak Runoff (cfs)	Total Precipitation (inches)	Total Runoff (inches)	Peak Runoff (cfs)
1	EX DMA-01	11.41	McCloy Canal	90.34	3.43	2.41	22.37	3.13	2.13	19.77	2.41	1.48	13.55
2	EX DMA-02	29.66	Begin Ditch-01	92.23	3.43	2.59	27.71	3.13	2.31	24.60	2.41	1.63	17.30
3	EX DMA-03	5.79	McCloy Ditch #1	90.09	3.43	2.39	11.25	3.13	2.11	9.92	2.41	1.46	6.78
4	EX DMA-04	4.00	Fyffe Ditch #1	93.00	3.43	2.67	8.62	3.13	2.38	7.70	2.41	1.70	5.50
5	EX DMA-05	3.09	McCloy Ditch #2	90.58	3.43	2.44	6.11	3.13	2.16	5.41	2.41	1.50	3.72
6	EX DMA-06	0.69	Fyffe Ditch #2	93.00	3.43	2.67	1.49	3.13	2.38	1.33	2.41	1.70	0.95
7	EX DMA-07	6.03	Fyffe Ditch #3	93.00	3.43	2.67	13.02	3.13	2.38	11.63	2.41	1.70	8.31
8	EX DMA-08	6.56	McCloy Ditch #4	90.11	3.43	2.39	12.76	3.13	2.11	11.26	2.41	1.46	7.69
9	EX DMA-09	5.83	Port Expy Inlet	83.01	3.43	1.80	8.23	3.13	1.55	7.01	2.41	0.99	4.24

West Complex Roadways
100% Stormwater Report
Table 2: Existing Junction Analysis

SN	Junction	Invert (ft)	Rim (ft)	Initial Water Elevation (ft)	Surchage Elevation (ft)	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation (ft)	Min Freeboard (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-inches)	Total Time Flooded (minutes)
100-Year													
1	Begin Ditch-01	-2.97	0.50	-2.97	0.50	27.53	27.53	-1.11	1.64	0 10:32	0 00:00	0.00	0.00
2	EndDitch-02	-6.84	0.54	-6.84	0.54	30.45	0.00	-3.92	4.46	0 10:53	0 00:00	0.00	0.00
3	EndDitch-04	-6.84	0.54	0.00	0.54	20.15	0.00	-0.13	0.67	0 00:00	0 00:00	0.00	0.00
4	Ex 24in CMP Inlet	-5.42	-1.52	-5.42	-1.52	26.92	0.00	-1.52	0.00	0 10:27	0 10:33	1.54	23.00
5	Ex 24in CMP Outlet	-4.95	-1.63	-4.95	-1.63	21.26	0.00	-2.97	1.34	0 10:51	0 00:00	0.00	0.00
6	Ex 42in RCP Inlet	-5.71	-0.84	-5.71	-0.84	20.17	0.00	-3.27	2.43	0 10:52	0 00:00	0.00	0.00
7	Ex 42in RCP Outlet	-5.85	-0.67	-5.85	-0.67	19.70	0.00	-3.40	2.73	0 10:52	0 00:00	0.00	0.00
8	Inlet to Ditch-04	-6.38	-1.37	-6.38	-1.37	73.96	0.00	-3.49	3.69	0 10:51	0 00:00	0.00	0.00
9	McCloy Canal	-3.00	-0.50	-3.00	-0.50	28.32	22.35	-1.15	0.95	0 10:04	0 00:00	0.00	0.00
10	Port Expy Inlet	-2.90	0.00	-2.90	0.00	8.20	8.20	-2.90	2.90	0 05:55	0 00:00	0.00	0.00
50-Year													
1	Begin Ditch-01	-2.97	0.50	-2.97	0.50	24.55	24.55	-1.21	1.74	0 10:38	0 00:00	0.00	0.00
2	EndDitch-02	-6.84	0.54	-6.84	0.54	26.79	0.00	-4.32	4.86	0 10:53	0 00:00	0.00	0.00
3	EndDitch-04	-6.84	0.54	0.00	0.54	19.75	0.00	-0.13	0.67	0 00:00	0 00:00	0.00	0.00
4	Ex 24in CMP Inlet	-5.42	-1.52	-5.42	-1.52	24.30	0.00	-1.52	0.00	0 10:35	0 10:38	0.19	10.00
5	Ex 24in CMP Outlet	-4.95	-1.63	-4.95	-1.63	20.88	0.00	-2.98	1.35	0 10:49	0 00:00	0.00	0.00
6	Ex 42in RCP Inlet	-5.71	-0.84	-5.71	-0.84	20.10	0.00	-3.28	2.44	0 10:52	0 00:00	0.00	0.00
7	Ex 42in RCP Outlet	-5.85	-0.67	-5.85	-0.67	19.34	0.00	-3.41	2.74	0 10:53	0 00:00	0.00	0.00
8	Inlet to Ditch-04	-6.38	-1.37	-6.38	-1.37	73.96	0.00	-3.49	3.69	0 10:53	0 00:00	0.00	0.00
9	McCloy Canal	-3.00	-0.50	-3.00	-0.50	24.58	19.74	-1.20	1.00	0 10:05	0 00:00	0.00	0.00
10	Port Expy Inlet	-2.90	0.00	-2.90	0.00	6.98	6.98	-2.90	2.90	0 06:20	0 00:00	0.00	0.00
10-Year													
1	Begin Ditch-01	-2.97	0.50	-2.97	0.50	17.26	17.26	-1.64	2.17	0 10:31	0 00:00	0.00	0.00
2	EndDitch-02	-6.84	0.54	-6.84	0.54	17.87	0.00	-5.15	5.69	0 10:45	0 00:00	0.00	0.00
3	EndDitch-04	-6.84	0.54	0.00	0.54	14.02	0.00	-0.13	0.67	0 00:00	0 00:00	0.00	0.00
4	Ex 24in CMP Inlet	-5.42	-1.52	-5.42	-1.52	17.05	0.00	-2.39	0.87	0 10:43	0 00:00	0.00	0.00
5	Ex 24in CMP Outlet	-4.95	-1.63	-4.95	-1.63	15.22	0.00	-3.32	1.69	0 10:51	0 00:00	0.00	0.00
6	Ex 42in RCP Inlet	-5.71	-0.84	-5.71	-0.84	15.84	0.00	-3.62	2.78	0 10:57	0 00:00	0.00	0.00
7	Ex 42in RCP Outlet	-5.85	-0.67	-5.85	-0.67	17.41	0.00	-3.70	3.03	0 10:58	0 00:00	0.00	0.00
8	Inlet to Ditch-04	-6.38	-1.37	-6.38	-1.37	73.96	0.00	-3.77	3.97	0 10:58	0 00:00	0.00	0.00
9	McCloy Canal	-3.00	-0.50	-3.00	-0.50	16.64	13.53	-1.39	1.19	0 10:07	0 00:00	0.00	0.00
10	Port Expy Inlet	-2.90	0.00	-2.90	0.00	4.21	4.21	-2.90	2.90	0 07:30	0 00:00	0.00	0.00

West Complex Roadways
100% Stormwater Report
Table 3: Existing Condition Closed Pipes Analysis

SN	Drainage Pipe / Culv.	Inlet	Outlet	Length (ft)	Slope (%)	Dia. (inches)	Manning's Roughness	Max Velocity (ft/sec)	Design Capacity (cfs)	Peak Flow (cfs)	Max Design/Capacity	Max Flow Depth (ft)	Max Depth/Dia.	Time of Peak Occurene (days:hh:mm)	Total Time Surcharged (min)	Reported Condition
100-Year																
1	Daggett Culv	Fyffe Ditch #2	Fyffe Ditch #1	41.75	5.9900	27.960	0.0180	2.17	60.31	5.64	0.09	1.67	0.71	0 10:30	0.00	Calculated
2	Ex 24in CMP	Ex 24in CMP Inlet	Ex 24in CMP Outlet	32.50	-1.4500	24.000	0.0240	6.93	14.74	21.26	1.44	1.99	1.00	0 10:27	0.00	> CAPACITY
3	Ex 42in RCP	Ex 42in RCP Inlet	Ex 42in RCP Outlet	24.00	0.5800	42.000	0.0150	5.53	66.60	19.70	0.30	2.44	0.70	0 10:52	0.00	Calculated
4	Fyffe Culv	Fyffe Ditch #3	Fyffe Ditch #2	59.67	0.0000	18.000	0.0140	3.62	0.40	5.70	14.28	1.25	0.83	0 10:09	0.00	> CAPACITY
5	Humphreys Culv	McCloy Ditch #1	McCloy Canal	67.00	0.0000	30.000	0.0170	4.10	1.21	14.80	12.22	1.94	0.78	0 10:24	0.00	> CAPACITY
6	Humphreys Culv 2	Fyffe Ditch #1	McCloy Ditch #1	94.09	0.5300	18.000	0.0150	3.93	6.64	6.95	1.05	1.50	1.00	0 10:32	90.00	SURCHARGED
7	McCloy Culv 1	McCloy Ditch #1	McCloy Ditch #2	49.00	-1.0200	15.000	0.0110	3.89	7.71	4.78	0.62	1.25	1.00	0 10:37	115.00	SURCHARGED
8	McCloy Culv 2	McCloy Ditch #2	McCloy Ditch #3	105.99	-0.4700	18.000	0.0140	2.57	6.70	4.12	0.61	1.50	1.00	0 09:58	43.00	SURCHARGED
9	McCloy Culv 3	McCloy Ditch #4	McCloy Ditch #3	17.60	11.3600	12.000	0.0150	8.36	10.41	6.53	0.63	1.00	1.00	0 09:59	9.00	SURCHARGED
50-Year																
1	Daggett Culv	Fyffe Ditch #2	Fyffe Ditch #1	41.75	5.9900	27.960	0.0180	2.08	60.31	5.64	0.09	1.59	0.68	0 10:23	0.00	Calculated
2	Ex 24in CMP	Ex 24in CMP Inlet	Ex 24in CMP Outlet	32.50	-1.4500	24.000	0.0240	6.72	14.74	20.88	1.42	1.98	0.99	0 10:35	0.00	> CAPACITY
3	Ex 42in RCP	Ex 42in RCP Inlet	Ex 42in RCP Outlet	24.00	0.5800	42.000	0.0150	5.53	66.60	19.34	0.29	2.43	0.70	0 10:48	0.00	Calculated
4	Fyffe Culv	Fyffe Ditch #3	Fyffe Ditch #2	59.67	0.0000	18.000	0.0140	3.38	0.40	5.18	12.98	1.23	0.82	0 10:09	0.00	> CAPACITY
5	Humphreys Culv	McCloy Ditch #1	McCloy Canal	67.00	0.0000	30.000	0.0170	4.02	1.21	13.96	11.52	1.87	0.76	0 10:24	0.00	> CAPACITY
6	Humphreys Culv 2	Fyffe Ditch #1	McCloy Ditch #1	94.09	0.5300	18.000	0.0150	3.73	6.64	6.60	0.99	1.50	1.00	0 10:25	78.00	SURCHARGED
7	McCloy Culv 1	McCloy Ditch #1	McCloy Ditch #2	49.00	-1.0200	15.000	0.0110	3.77	7.71	4.62	0.60	1.25	1.00	0 10:33	99.00	SURCHARGED
8	McCloy Culv 2	McCloy Ditch #2	McCloy Ditch #3	105.99	-0.4700	18.000	0.0140	2.61	6.70	4.21	0.63	1.50	1.00	0 10:00	27.00	SURCHARGED
9	McCloy Culv 3	McCloy Ditch #4	McCloy Ditch #3	17.60	11.3600	12.000	0.0150	8.37	10.41	6.54	0.63	1.00	1.00	0 10:00	7.00	SURCHARGED
10-Year																
1	Daggett Culv	Fyffe Ditch #2	Fyffe Ditch #1	41.75	5.9900	27.960	0.0180	2.07	60.31	4.50	0.07	1.28	0.55	0 10:06	0.00	Calculated
2	Ex 24in CMP	Ex 24in CMP Inlet	Ex 24in CMP Outlet	32.50	-1.4500	24.000	0.0240	5.91	14.74	15.22	1.03	1.81	0.91	0 10:42	0.00	> CAPACITY
3	Ex 42in RCP	Ex 42in RCP Inlet	Ex 42in RCP Outlet	24.00	0.5800	42.000	0.0150	5.53	66.60	15.84	0.24	2.12	0.61	0 00:07	0.00	Calculated
4	Fyffe Culv	Fyffe Ditch #3	Fyffe Ditch #2	59.67	0.0000	18.000	0.0140	3.24	0.40	4.15	10.39	1.04	0.70	0 10:07	0.00	> CAPACITY
5	Humphreys Culv	McCloy Ditch #1	McCloy Canal	67.00	0.0000	30.000	0.0170	3.74	1.21	11.31	9.34	1.67	0.67	0 10:27	0.00	> CAPACITY
6	Humphreys Culv 2	Fyffe Ditch #1	McCloy Ditch #1	94.09	0.5300	18.000	0.0150	2.94	6.64	5.19	0.78	1.50	1.00	0 10:26	42.00	SURCHARGED
7	McCloy Culv 1	McCloy Ditch #1	McCloy Ditch #2	49.00	-1.0200	15.000	0.0110	3.20	7.71	3.92	0.51	1.25	1.00	0 10:24	54.00	SURCHARGED
8	McCloy Culv 2	McCloy Ditch #2	McCloy Ditch #3	105.99	-0.4700	18.000	0.0140	2.76	6.70	4.53	0.68	1.37	0.92	0 10:08	0.00	Calculated
9	McCloy Culv 3	McCloy Ditch #4	McCloy Ditch #3	17.60	11.3600	12.000	0.0150	7.75	10.41	5.76	0.55	0.90	0.90	0 10:05	0.00	Calculated

West Complex Roadways
100% Stormwater Report
Table 4: Existing Condition Open Channel Analysis

SN	Channel	Inlet	Outlet	Length (ft)	Slope (ft)	Channel Height (ft)	Channel Width (ft)	Manning's Roughness	Max Velocity (ft/sec)	Design Capacity (cfs)	Peak Flow (cfs)	Max Design/Capacity	Max Flow Depth (ft)	Max/Total Depth	Time of Peak Occurrence (days:hh:mm)	Total Time Surcharged (min)	Reported Condition
100-Year																	
1	Ditch-01A	Begin Ditch-01	Ex 24in CMP Inlet	574.65	0.4300	3.500	23.94	0.0800	0.78	26.92	111.72	0.24	2.68	0.77	0 10:33	0.00	Calculated
2	Ditch-01B	Ex 24in CMP Outlet	Ex 42in RCP Inlet	355.92	0.2100	3.320	23.09	0.0800	0.83	20.17	70.91	0.28	2.21	0.67	0 10:32	0.00	Calculated
3	Ditch-01C	Ex 42in RCP Outlet	Inlet to Ditch-04	208.97	0.2500	5.180	31.84	0.0800	0.84	19.72	198.13	0.10	2.67	0.52	0 10:53	0.00	Calculated
4	Ditch-02	McCloy Canal	EndDitch-02	1114.00	0.3400	2.800	23.75	0.0800	1.28	30.45	74.00	0.41	2.08	0.74	0 10:08	0.00	Calculated
5	Ditch-04	Inlet to Ditch-04	EndDitch-04	1111.00	0.0400	6.580	34.09	0.0800	1.83	73.96	108.43	0.68	3.32	0.52	0 00:01	0.00	Calculated
50-Year																	
1	Ditch-01A	Begin Ditch-01	Ex 24in CMP Inlet	574.65	0.4300	3.500	23.94	0.0800	0.76	111.72	24.30	0.22	2.63	0.75	0 10:31	0.00	Calculated
2	Ditch-01B	Ex 24in CMP Outlet	Ex 42in RCP Inlet	355.92	0.2100	3.320	23.09	0.0800	0.81	70.91	20.10	0.28	2.19	0.66	0 10:38	0.00	Calculated
3	Ditch-01C	Ex 42in RCP Outlet	Inlet to Ditch-04	208.97	0.2500	5.180	31.84	0.0800	0.84	198.13	19.19	0.10	2.66	0.51	0 10:51	0.00	Calculated
4	Ditch-02	McCloy Canal	EndDitch-02	1114.00	0.3400	2.800	23.75	0.0800	1.25	74.00	26.79	0.36	1.90	0.68	0 10:10	0.00	Calculated
5	Ditch-04	Inlet to Ditch-04	EndDitch-04	1111.00	0.0400	6.580	34.09	0.0800	1.83	108.43	73.96	0.68	3.32	0.52	0 00:01	0.00	Calculated
10-Year																	
1	Ditch-01A	Begin Ditch-01	Ex 24in CMP Inlet	574.65	0.4300	3.500	23.94	0.0800	0.71	111.72	17.05	0.15	2.15	0.61	0 10:31	0.00	Calculated
2	Ditch-01B	Ex 24in CMP Outlet	Ex 42in RCP Inlet	355.92	0.2100	3.320	23.09	0.0800	0.78	70.91	14.81	0.21	1.85	0.56	0 10:44	0.00	Calculated
3	Ditch-01C	Ex 42in RCP Outlet	Inlet to Ditch-04	208.97	0.2500	5.180	31.84	0.0800	0.84	198.13	17.41	0.09	2.38	0.46	0 00:08	0.00	Calculated
4	Ditch-02	McCloy Canal	EndDitch-02	1114.00	0.3400	2.800	23.75	0.0800	1.12	74.00	17.87	0.24	1.41	0.50	0 10:20	0.00	Calculated
5	Ditch-04	Inlet to Ditch-04	EndDitch-04	1111.00	0.0400	6.580	34.09	0.0800	1.83	108.43	73.96	0.68	3.32	0.52	0 00:01	0.00	Calculated

Table 5: Existing Junction Sensitivity Analysis

Junction	Initial WSEL Scenario	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation (ft)	Min Freeboard (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-inches)	Total Time Flooded (minutes)
Begin Ditch-01	0% Full (Initial WSEL = -6.85')	27.53	27.53	-1.11	1.64	0 10:32	0 00:00	0.00	0.00
	25% Full (Initial WSEL = -5.54')	27.54	27.54	-1.11	1.64	0 10:32	0 00:00	0.00	0.00
	50% Full (Initial WSEL = -4.24')	27.53	27.53	-1.10	1.63	0 10:32	0 00:00	0.00	0.00
	75% Full (Initial WSEL = -2.93')	27.53	27.53	-1.09	1.62	0 10:30	0 00:00	0.00	0.00
	100% Full (Initial WSEL = -1.63')	27.53	27.53	-1.09	1.62	0 10:30	0 00:00	0.00	0.00
End Ditch-02	0% Full (Initial WSEL = -6.85')	30.45	0.00	-3.92	4.46	0 10:53	0 00:00	0.00	0.00
	25% Full (Initial WSEL = -5.54')	26.02	0.00	-4.01	4.55	0 10:50	0 00:00	0.00	0.00
	50% Full (Initial WSEL = -4.24')	26.56	0.00	0.54	0.00	0 10:09	0 10:09	0.00	0.00
	75% Full (Initial WSEL = -2.93')	48.31	0.00	0.54	0.00	0 00:37	0 10:35	42.84	372.00
	100% Full (Initial WSEL = -1.63')	55.15	0.00	0.54	0.00	0 00:17	0 16:29	99.45	836.00
End Ditch-04	0% Full (Initial WSEL = -6.85')	20.15	0.00	-0.13	0.67	0 00:00	0 00:00	0.00	0.00
	25% Full (Initial WSEL = -5.54')	18.96	0.00	-0.14	0.68	0 00:00	0 00:00	0.00	0.00
	50% Full (Initial WSEL = -4.24')	18.35	0.00	-0.14	0.68	0 00:00	0 00:00	0.00	0.00
	75% Full (Initial WSEL = -2.93')	21.82	0.00	-0.14	0.68	0 00:00	0 00:00	0.00	0.00
	100% Full (Initial WSEL = -1.63')	23.43	0.00	-0.14	0.68	0 00:00	0 00:00	0.00	0.00
Ex 24in CMP Inlet	0% Full (Initial WSEL = -6.85')	26.92	0.00	-1.52	0.00	0 10:27	0 10:33	1.54	23.00
	25% Full (Initial WSEL = -5.54')	26.91	0.00	-1.52	0.00	0 10:27	0 10:33	1.38	22.00
	50% Full (Initial WSEL = -4.24')	26.96	0.00	-1.52	0.00	0 10:26	0 10:33	1.57	24.00
	75% Full (Initial WSEL = -2.93')	27.44	0.00	-1.52	0.00	0 10:19	0 10:30	4.11	37.00
	100% Full (Initial WSEL = -1.63')	27.45	0.00	-1.52	0.00	0 09:38	0 10:30	20.69	173.00
Ex 24in CMP Outlet	0% Full (Initial WSEL = -6.85')	21.26	0.00	-2.97	1.34	0 10:51	0 00:00	0.00	0.00
	25% Full (Initial WSEL = -5.54')	21.36	0.00	-3.01	1.38	0 10:52	0 00:00	0.00	0.00
	50% Full (Initial WSEL = -4.24')	21.14	0.00	-2.97	1.34	0 10:52	0 00:00	0.00	0.00
	75% Full (Initial WSEL = -2.93')	17.39	0.00	-2.59	0.96	0 10:56	0 00:00	0.00	0.00
	100% Full (Initial WSEL = -1.63')	11.78	0.00	-1.63	0.00	0 01:10	0 01:13	64.41	1918.00
Ex 42in RCP Inlet	0% Full (Initial WSEL = -6.85')	20.17	0.00	-3.27	2.43	0 10:52	0 00:00	0.00	0.00
	25% Full (Initial WSEL = -5.54')	20.57	0.00	-3.34	2.50	0 10:57	0 00:00	0.00	0.00
	50% Full (Initial WSEL = -4.24')	20.22	0.00	-3.27	2.43	0 10:58	0 00:00	0.00	0.00
	75% Full (Initial WSEL = -2.93')	16.93	0.00	-2.69	1.85	0 10:57	0 00:00	0.00	0.00
	100% Full (Initial WSEL = -1.63')	18.39	0.00	-1.59	0.75	0 01:11	0 00:00	0.00	0.00
Ex 42in RCP Outlet	0% Full (Initial WSEL = -6.85')	19.70	0.00	-3.40	2.73	0 10:52	0 00:00	0.00	0.00
	25% Full (Initial WSEL = -5.54')	19.77	0.00	-3.48	2.81	0 11:00	0 00:00	0.00	0.00
	50% Full (Initial WSEL = -4.24')	19.61	0.00	-3.39	2.72	0 11:03	0 00:00	0.00	0.00
	75% Full (Initial WSEL = -2.93')	17.54	0.00	-2.76	2.09	0 10:56	0 00:00	0.00	0.00
	100% Full (Initial WSEL = -1.63')	22.47	0.00	-1.61	0.94	0 01:12	0 00:00	0.00	0.00
Inlet to Ditch-04	0% Full (Initial WSEL = -6.85')	73.96	0.00	-3.49	3.69	0 10:51	0 00:00	0.00	0.00
	25% Full (Initial WSEL = -5.54')	73.96	0.00	-3.57	3.77	0 11:01	0 00:00	0.00	0.00
	50% Full (Initial WSEL = -4.24')	73.96	0.00	-3.46	3.66	0 11:05	0 00:00	0.00	0.00
	75% Full (Initial WSEL = -2.93')	73.96	0.00	-2.78	2.98	0 10:55	0 00:00	0.00	0.00
	100% Full (Initial WSEL = -1.63')	73.96	0.00	-1.61	1.81	0 01:11	0 00:00	0.00	0.00
McCloy Canal	0% Full (Initial WSEL = -6.85')	28.32	22.35	-1.15	0.95	0 10:04	0 00:00	0.00	0.00
	25% Full (Initial WSEL = -5.54')	30.50	22.34	-1.36	1.16	0 10:06	0 00:00	0.00	0.00
	50% Full (Initial WSEL = -4.24')	30.69	22.35	-1.34	1.14	0 10:09	0 00:00	0.00	0.00
	75% Full (Initial WSEL = -2.93')	30.58	22.35	-1.20	1.00	0 10:08	0 00:00	0.00	0.00
	100% Full (Initial WSEL = -1.63')	22.35	22.35	-0.45	0.25	0 09:58	0 00:00	0.00	0.00
Port Expy Inlet	0% Full (Initial WSEL = -6.85')	8.20	8.20	-2.90	2.90	0 05:55	0 00:00	0.00	0.00
	25% Full (Initial WSEL = -5.54')	8.20	8.20	-2.90	2.90	0 05:55	0 00:00	0.00	0.00
	50% Full (Initial WSEL = -4.24')	8.21	8.21	-2.90	2.90	0 05:55	0 00:00	0.00	0.00
	75% Full (Initial WSEL = -2.93')	8.20	8.20	-2.90	2.90	0 05:55	0 00:00	0.00	0.00
	100% Full (Initial WSEL = -1.63')	8.21	8.21	-2.90	2.90	0 05:55	0 00:00	0.00	0.00

Table 6: Existing Condition Closed Pipes Sensitivity Analysis

Drainage Pipe / Culvert	Initial WSEL Scenario	Max Velocity (ft/sec)	Peak Flow (cfs)	Max Design/Capacity	Max Flow Depth (ft)	Max Depth/Dia.	Time of Peak Occurene (days:hh:mm)	Total Time Surcharged (min)	Reported Condition
Daggett Culv	0% Full (Initial WSEL = -6.85')	2.17	5.64	0.09	1.67	0.71	0 10:30	0.00	Calculated
	25% Full (Initial WSEL = -5.54')	2.18	5.64	0.09	1.63	0.70	0 10:30	0.00	Calculated
	50% Full (Initial WSEL = -4.24')	2.18	5.64	0.09	1.63	0.70	0 10:30	0.00	Calculated
	75% Full (Initial WSEL = -2.93')	2.07	5.64	0.09	1.65	0.71	0 10:30	0.00	Calculated
	100% Full (Initial WSEL = -1.63')	1.75	5.64	0.09	1.67	0.71	0 10:30	0.00	Calculated
Ex 24in CMP	0% Full (Initial WSEL = -6.85')	6.93	21.26	1.44	1.99	1.00	0 10:27	0.00	> CAPACITY
	25% Full (Initial WSEL = -5.54')	7.01	21.36	1.45	1.97	0.99	0 10:27	0.00	> CAPACITY
	50% Full (Initial WSEL = -4.24')	6.86	21.14	1.43	1.99	0.99	0 10:27	0.00	> CAPACITY
	75% Full (Initial WSEL = -2.93')	5.64	17.39	1.18	2.00	1.00	0 10:19	2841.00	SURCHARGED
	100% Full (Initial WSEL = -1.63')	5.91	10.56	0.72	2.00	1.00	0 00:25	2851.00	SURCHARGED
Ex 42in RCP	0% Full (Initial WSEL = -6.85')	5.53	19.70	0.30	2.44	0.70	0 10:52	0.00	Calculated
	25% Full (Initial WSEL = -5.54')	5.53	19.77	0.30	2.37	0.68	0 10:50	0.00	Calculated
	50% Full (Initial WSEL = -4.24')	5.53	19.61	0.29	2.45	0.70	0 10:42	0.00	Calculated
	75% Full (Initial WSEL = -2.93')	5.53	16.93	0.25	3.05	0.87	0 10:50	0.00	Calculated
	100% Full (Initial WSEL = -1.63')	5.76	18.39	0.28	3.50	1.00	0 00:07	2829.00	SURCHARGED
Fyffe Culv	0% Full (Initial WSEL = -6.85')	3.62	5.70	14.28	1.25	0.83	0 10:09	0.00	> CAPACITY
	25% Full (Initial WSEL = -5.54')	3.62	5.70	14.28	1.25	0.83	0 10:09	0.00	> CAPACITY
	50% Full (Initial WSEL = -4.24')	3.62	5.70	14.28	1.25	0.83	0 10:09	0.00	> CAPACITY
	75% Full (Initial WSEL = -2.93')	3.62	5.70	14.27	1.25	0.83	0 10:09	0.00	> CAPACITY
	100% Full (Initial WSEL = -1.63')	3.62	5.70	14.27	1.25	0.83	0 10:09	0.00	> CAPACITY
Humphreys Culv 1	0% Full (Initial WSEL = -6.85')	4.10	14.80	12.22	1.94	0.78	0 10:24	0.00	> CAPACITY
	25% Full (Initial WSEL = -5.54')	4.04	14.05	11.59	1.79	0.72	0 10:29	0.00	> CAPACITY
	50% Full (Initial WSEL = -4.24')	4.04	14.09	11.62	1.81	0.73	0 10:31	0.00	> CAPACITY
	75% Full (Initial WSEL = -2.93')	4.01	14.50	11.96	1.92	0.77	0 10:34	0.00	> CAPACITY
	100% Full (Initial WSEL = -1.63')	2.96	13.43	11.08	2.50	1.00	0 16:33	10.00	SURCHARGED
Humphreys Culv 2	0% Full (Initial WSEL = -6.85')	3.93	6.95	1.05	1.50	1.00	0 10:32	90.00	SURCHARGED
	25% Full (Initial WSEL = -5.54')	3.87	6.84	1.03	1.50	1.00	0 10:32	87.00	SURCHARGED
	50% Full (Initial WSEL = -4.24')	3.86	6.82	1.03	1.50	1.00	0 10:32	87.00	SURCHARGED
	75% Full (Initial WSEL = -2.93')	3.85	6.81	1.03	1.50	1.00	0 10:32	90.00	SURCHARGED
	100% Full (Initial WSEL = -1.63')	3.13	5.53	0.83	1.50	1.00	0 10:20	1039.00	SURCHARGED
McCloy Culv 1	0% Full (Initial WSEL = -6.85')	3.89	4.78	0.62	1.25	1.00	0 10:37	115.00	SURCHARGED
	25% Full (Initial WSEL = -5.54')	3.84	4.72	0.61	1.25	1.00	0 10:34	110.00	SURCHARGED
	50% Full (Initial WSEL = -4.24')	3.83	4.70	0.61	1.25	1.00	0 10:35	110.00	SURCHARGED
	75% Full (Initial WSEL = -2.93')	3.80	4.66	0.60	1.25	1.00	0 10:37	114.00	SURCHARGED
	100% Full (Initial WSEL = -1.63')	1.94	2.38	0.31	1.25	1.00	0 16:36	1179.00	SURCHARGED
McCloy Culv 2	0% Full (Initial WSEL = -6.85')	2.57	4.12	0.61	1.50	1.00	0 09:58	43.00	SURCHARGED
	25% Full (Initial WSEL = -5.54')	2.70	4.45	0.66	1.50	1.00	0 10:00	35.00	SURCHARGED
	50% Full (Initial WSEL = -4.24')	2.70	4.45	0.66	1.50	1.00	0 10:00	35.00	SURCHARGED
	75% Full (Initial WSEL = -2.93')	2.65	4.31	0.64	1.50	1.00	0 09:59	40.00	SURCHARGED
	100% Full (Initial WSEL = -1.63')	2.57	4.54	0.68	1.50	1.00	0 10:19	192.00	SURCHARGED
McCloy Culv 3	0% Full (Initial WSEL = -6.85')	8.36	6.53	0.63	1.00	1.00	0 09:59	9.00	SURCHARGED
	25% Full (Initial WSEL = -5.54')	8.36	6.54	0.63	1.00	1.00	0 09:59	9.00	SURCHARGED
	50% Full (Initial WSEL = -4.24')	8.36	6.54	0.63	1.00	1.00	0 09:59	9.00	SURCHARGED
	75% Full (Initial WSEL = -2.93')	8.36	6.54	0.63	1.00	1.00	0 09:59	9.00	SURCHARGED
	100% Full (Initial WSEL = -1.63')	7.26	5.67	0.55	1.00	1.00	0 09:58	11.00	SURCHARGED

Table 7: Existing Condition Open Channel Sensitivity Analysis

Channel	Initial WSEL Scenario	Max Velocity (ft/sec)	Peak Flow (cfs)	Max Design/Capacity	Max Flow Depth (ft)	Max/Total Depth	Time of Peak Occurrence (days:hh:mm)	Total Time Surcharged (min)	Reported Condition
Ditch-01A	0% Full (Initial WSEL = -6.85')	0.78	111.72	0.24	2.68	0.77	0 10:33	0.00	Calculated
	25% Full (Initial WSEL = -5.54')	0.78	26.91	0.24	2.68	0.77	0 10:33	0.00	Calculated
	50% Full (Initial WSEL = -4.24')	0.77	26.96	0.24	2.68	0.77	0 10:32	0.00	Calculated
	75% Full (Initial WSEL = -2.93')	0.74	27.44	0.25	2.69	0.77	0 10:30	0.00	Calculated
	100% Full (Initial WSEL = -1.63')	0.74	27.45	0.25	2.69	0.77	0 10:30	0.00	Calculated
Ditch-01B	0% Full (Initial WSEL = -6.85')	0.83	70.91	0.28	2.21	0.67	0 10:32	0.00	Calculated
	25% Full (Initial WSEL = -5.54')	0.91	20.57	0.29	2.15	0.65	0 10:33	0.00	Calculated
	50% Full (Initial WSEL = -4.24')	0.80	20.22	0.29	2.21	0.66	0 10:33	0.00	Calculated
	75% Full (Initial WSEL = -2.93')	0.63	16.93	0.24	2.69	0.81	0 10:51	0.00	Calculated
	100% Full (Initial WSEL = -1.63')	0.74	11.78	0.17	3.32	1.00	0 00:26	1907.00	FLOODED
Ditch-01C	0% Full (Initial WSEL = -6.85')	0.84	198.13	0.10	2.67	0.52	0 10:53	0.00	Calculated
	25% Full (Initial WSEL = -5.54')	0.84	19.53	0.10	2.59	0.50	0 10:52	0.00	Calculated
	50% Full (Initial WSEL = -4.24')	0.84	19.38	0.10	2.69	0.52	0 10:48	0.00	Calculated
	75% Full (Initial WSEL = -2.93')	0.84	17.54	0.09	3.35	0.65	0 00:08	0.00	Calculated
	100% Full (Initial WSEL = -1.63')	0.84	22.47	0.11	4.49	0.87	0 00:08	0.00	Calculated
Ditch-02	0% Full (Initial WSEL = -6.85')	1.28	74.00	0.41	2.08	0.74	0 10:08	0.00	Calculated
	25% Full (Initial WSEL = -5.54')	1.14	26.02	0.35	2.06	0.74	0 10:06	0.00	Calculated
	50% Full (Initial WSEL = -4.24')	0.81	26.56	0.36	2.21	0.80	0 10:09	0.00	Calculated
	75% Full (Initial WSEL = -2.93')	0.86	28.53	0.39	2.30	0.82	0 10:03	0.00	Calculated
	100% Full (Initial WSEL = -1.63')	0.84	32.32	0.44	2.67	0.95	0 16:29	0.00	Calculated
Ditch-04	0% Full (Initial WSEL = -6.85')	1.83	108.43	0.68	3.32	0.52	0 00:01	0.00	Calculated
	25% Full (Initial WSEL = -5.54')	1.83	73.96	0.68	3.32	0.52	0 00:01	0.00	Calculated
	50% Full (Initial WSEL = -4.24')	1.83	73.96	0.68	3.32	0.52	0 00:01	0.00	Calculated
	75% Full (Initial WSEL = -2.93')	1.83	73.96	0.68	3.75	0.57	0 00:01	0.00	Calculated
	100% Full (Initial WSEL = -1.63')	1.83	73.96	0.68	4.98	0.76	0 00:01	0.00	Calculated

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Figure 1: Existing Ditch-01 Profile Plot
100-Year Peak Flow

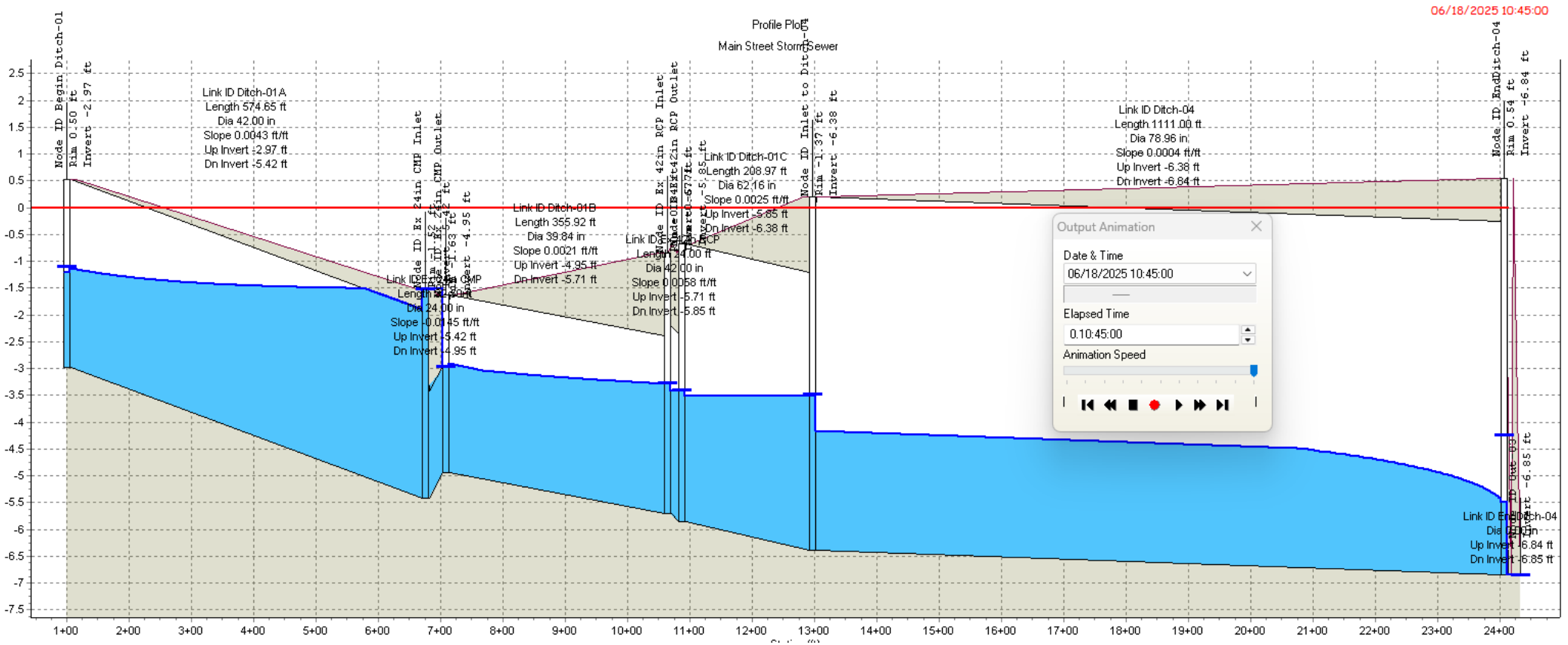
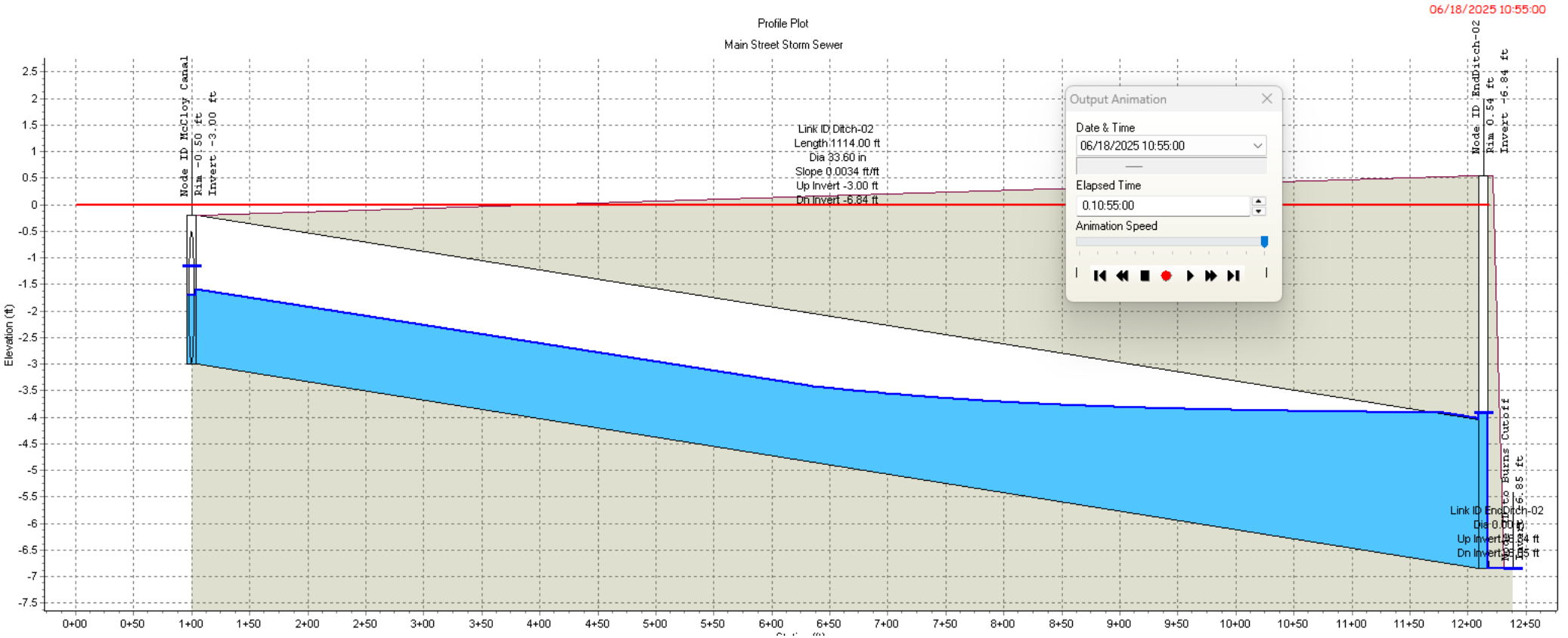


Figure 2: Existing Ditch-02 Profile Plot
100-Year Peak Flow



Appendix G: Proposed Drainage Calculations

Table 1: Proposed Drainage Area Summary

SN	Drainage Area	Area (acres)	Drainage Outlet	Weighted CN	100-Year Total Precipitation (inches)	100-Year Total Runoff (inches)	100-Year Peak Runoff (cfs)	50-Year Total Precipitation (inches)	50-Year Total Runoff (inches)	50-Year Peak Runoff (cfs)	10-Year Total Precipitation (inches)	10-Year Total Runoff (inches)	10-Year Peak Runoff (cfs)
1	DMA-01	11.41	McCloy Canal	90.34	3.43	2.41	22.37	3.13	2.13	19.77	2.41	1.48	13.55
2	DMA-02	29.66	Begin Ditch-01	92.23	3.43	2.59	27.71	3.13	2.31	24.60	2.41	1.63	17.30
3	DMA-03	5.79	McCloy Ditch #1	90.09	3.43	2.39	11.25	3.13	2.11	9.92	2.41	1.46	6.78
4	DMA-04	4.00	Fyffe Ditch #1	93.00	3.43	2.67	8.62	3.13	2.38	7.70	2.41	1.70	5.50
5	DMA-05	3.09	McCloy Ditch #2	90.58	3.43	2.44	6.11	3.13	2.16	5.41	2.41	1.50	3.72
6	DMA-06	0.69	Fyffe Ditch #2	93.00	3.43	2.67	1.49	3.13	2.38	1.33	2.41	1.70	0.95
7	DMA-07	6.03	Fyffe Ditch #3	93.00	3.43	2.67	13.02	3.13	2.38	11.63	2.41	1.70	8.31
8	DMA-08	6.56	McCloy Ditch #4	90.11	3.43	2.39	12.76	3.13	2.11	11.26	2.41	1.46	7.69
9	DMA-09A	2.90	Gillis Culvert Inlet	82.91	3.43	1.79	4.07	3.13	1.55	3.46	2.41	0.98	2.09
10	DMA-09B	1.39	Port Expy Inlet	84.40	3.43	1.91	2.10	3.13	1.65	1.80	2.41	1.07	1.12

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Table 2: Proposed Junction Analysis

SN	Junction	Invert (ft)	Rim (ft)	Initial Water Elevation (ft)	Surchage Elevation (ft)	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation (ft)	Min Freeboard (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-inches)	Total Time Flooded (minutes)
100-Year													
1	Begin Ditch-01	-2.97	0.50	-2.97	0.50	27.53	27.53	-1.11	1.64	0 10:32	0 00:00	0.00	0.00
2	End Ditch-02	-6.84	0.54	-6.84	0.54	29.66	0.00	-3.77	4.31	0 10:45	0 00:00	0.00	0.00
3	EndDitch-04	-6.84	0.54	-6.84	0.54	20.07	0.00	-4.25	4.79	0 11:26	0 00:00	0.00	0.00
4	Ex 24in CMP Inlet	-5.42	-1.52	-5.42	-1.52	26.92	0.00	-1.52	0.00	0 10:27	0 10:33	1.59	24.00
5	Ex 24in CMP Outlet	-4.95	-1.63	-4.95	-1.63	21.24	0.00	-2.96	1.33	0 10:51	0 00:00	0.00	0.00
6	Ex 42in RCP Inlet	-5.71	-0.84	-5.71	-0.84	20.08	0.00	-3.24	2.40	0 10:52	0 00:00	0.00	0.00
7	Ex 42in RCP Outlet	-5.85	-0.67	-5.85	-0.67	19.58	0.00	-3.37	2.70	0 10:51	0 00:00	0.00	0.00
8	Gillis Culvert Inlet	-2.50	0.00	-2.50	0.00	4.06	4.06	0.00	0.00	0 12:44	0 12:44	0.00	0.00
9	Inlet to Ditch-04	-6.38	-1.37	-6.38	-1.37	19.64	0.00	-3.49	3.69	0 10:51	0 00:00	0.00	0.00
10	McCloy Canal	-3.00	-0.50	-3.00	-0.50	27.50	22.34	-1.22	1.02	0 10:04	0 00:00	0.00	0.00
11	Port Expy Inlet	-2.90	0.00	-2.90	0.00	6.12	2.09	-2.53	2.53	0 10:00	0 00:00	0.00	0.00
12	Prop Humphreys Culv Inlet 1	-3.27	2.73	-3.27	2.73	27.40	0.00	-1.43	4.16	0 10:05	0 00:00	0.00	0.00
13	Prop Humphreys Culv Inlet 2	-6.03	-0.03	-6.03	-0.03	19.60	0.00	-3.41	3.38	0 10:51	0 00:00	0.00	0.00
14	Prop Humphreys Culv Outlet 1	-3.44	2.56	-3.44	2.56	27.33	0.00	-1.66	4.22	0 10:05	0 00:00	0.00	0.00
15	Prop Humphreys Culv Outlet 2	-6.14	-0.14	-6.14	-0.14	19.61	0.00	-3.46	3.32	0 10:51	0 00:00	0.00	0.00
50-Year													
1	Begin Ditch-01	-2.97	0.50	-2.97	0.50	24.55	24.55	-1.21	1.74	0 10:37	0 00:00	0.00	0.00
2	End Ditch-02	-6.84	0.54	-6.84	0.54	27.16	0.00	-4.28	4.82	0 10:48	0 00:00	0.00	0.00
3	EndDitch-04	-6.84	0.54	-6.84	0.54	19.71	0.00	-4.39	4.93	0 11:24	0 00:00	0.00	0.00
4	Ex 24in CMP Inlet	-5.42	-1.52	-5.42	-1.52	24.30	0.00	-1.52	0.00	0 10:35	0 10:38	0.21	10.00
5	Ex 24in CMP Outlet	-4.95	-1.63	-4.95	-1.63	20.84	0.00	-2.97	1.34	0 10:49	0 00:00	0.00	0.00
6	Ex 42in RCP Inlet	-5.71	-0.84	-5.71	-0.84	20.01	0.00	-3.26	2.42	0 10:52	0 00:00	0.00	0.00
7	Ex 42in RCP Outlet	-5.85	-0.67	-5.85	-0.67	19.22	0.00	-3.38	2.71	0 10:52	0 00:00	0.00	0.00
8	Gillis Culvert Inlet	-2.50	0.00	-2.50	0.00	3.45	3.45	-0.16	0.16	0 11:47	0 00:00	0.00	0.00
9	Inlet to Ditch-04	-6.38	-1.37	-6.38	-1.37	19.11	0.00	-3.49	3.69	0 10:53	0 00:00	0.00	0.00
10	McCloy Canal	-3.00	-0.50	-3.00	-0.50	24.46	19.73	-1.30	1.10	0 10:05	0 00:00	0.00	0.00
11	Port Expy Inlet	-2.90	0.00	-2.90	0.00	5.21	1.79	-2.63	2.63	0 10:00	0 00:00	0.00	0.00
12	Prop Humphreys Culv Inlet 1	-3.27	2.73	-3.27	2.73	24.34	0.00	-1.50	4.23	0 10:05	0 00:00	0.00	0.00
13	Prop Humphreys Culv Inlet 2	-6.03	-0.03	-6.03	-0.03	19.17	0.00	-3.42	3.39	0 10:53	0 00:00	0.00	0.00
14	Prop Humphreys Culv Outlet 1	-3.44	2.56	-3.44	2.56	24.26	0.00	-1.69	4.25	0 10:05	0 00:00	0.00	0.00
15	Prop Humphreys Culv Outlet 2	-6.14	-0.14	-6.14	-0.14	19.13	0.00	-3.46	3.32	0 10:53	0 00:00	0.00	0.00
10-Year													
1	Begin Ditch-01	-2.97	0.50	-2.97	0.50	17.26	17.26	-1.64	2.17	0 10:31	0 00:00	0.00	0.00
2	End Ditch-02	-6.84	0.54	-6.84	0.54	18.75	0.00	-5.12	5.66	0 10:40	0 00:00	0.00	0.00
3	EndDitch-04	-6.84	0.54	-6.84	0.54	14.06	0.00	-5.34	5.88	0 11:24	0 00:00	0.00	0.00
4	Ex 24in CMP Inlet	-5.42	-1.52	-5.42	-1.52	17.05	0.00	-2.39	0.87	0 10:43	0 00:00	0.00	0.00
5	Ex 24in CMP Outlet	-4.95	-1.63	-4.95	-1.63	15.21	0.00	-3.31	1.68	0 10:52	0 00:00	0.00	0.00
6	Ex 42in RCP Inlet	-5.71	-0.84	-5.71	-0.84	14.77	0.00	-3.60	2.76	0 10:57	0 00:00	0.00	0.00
7	Ex 42in RCP Outlet	-5.85	-0.67	-5.85	-0.67	13.99	0.00	-3.68	3.01	0 10:58	0 00:00	0.00	0.00
8	Gillis Culvert Inlet	-2.50	0.00	-2.50	0.00	2.07	2.07	-0.42	0.42	0 10:59	0 00:00	0.00	0.00
9	Inlet to Ditch-04	-6.38	-1.37	-6.38	-1.37	13.57	0.00	-3.76	3.96	0 10:58	0 00:00	0.00	0.00
10	McCloy Canal	-3.00	-0.50	-3.00	-0.50	17.36	13.53	-1.56	1.36	0 10:05	0 00:00	0.00	0.00
11	Port Expy Inlet	-2.90	0.00	-2.90	0.00	4.21	1.11	-2.73	2.73	0 09:58	0 00:00	0.00	0.00
12	Prop Humphreys Culv Inlet 1	-3.27	2.73	-3.27	2.73	17.21	0.00	-1.73	4.46	0 10:06	0 00:00	0.00	0.00
13	Prop Humphreys Culv Inlet 2	-6.03	-0.03	-6.03	-0.03	13.85	0.00	-3.71	3.68	0 10:58	0 00:00	0.00	0.00
14	Prop Humphreys Culv Outlet 1	-3.44	2.56	-3.44	2.56	16.98	0.00	-1.83	4.39	0 10:07	0 00:00	0.00	0.00
15	Prop Humphreys Culv Outlet 2	-6.14	-0.14	-6.14	-0.14	13.71	0.00	-3.74	3.60	0 10:58	0 00:00	0.00	0.00

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Table 3: Proposed Condition Closed Pipes Analysis

SN	Drainage Pipe / Culv.	Inlet	Outlet	Length (ft)	Slope (%)	Dia. (inches)	Manning's Roughness	Max Velocity (ft/sec)	Design Capacity (cfs)	Peak Flow (cfs)	Max Design/Capacity	Max Flow Depth (ft)	Max Depth/Dia.	Time of Peak Occurene (days:hh:mm)	Total Time Surcharged (min)	Reported Condition
100-Year																
1	Daggett Culv	Fyffe Ditch #2	Fyffe Ditch #1	41.75	5.9900	27.960	0.0180	2.19	60.31	5.64	0.09	1.65	0.71	0 10:30	0.00	Calculated
2	Ex 24in CMP	Ex 24in CMP Inlet	Ex 24in CMP Outlet	32.50	-1.4500	24.000	0.0240	6.92	14.74	21.24	1.44	2.00	1.00	0 10:27	0.00	> CAPACITY
3	Ex 42in RCP	Ex 42in RCP Inlet	Ex 42in RCP Outlet	24.00	0.5800	42.000	0.0150	2.88	66.60	19.58	0.29	2.47	0.71	0 10:53	0.00	Calculated
4	Fyffe Culv	Fyffe Ditch #3	Fyffe Ditch #2	59.67	0.0000	18.000	0.0140	3.62	0.40	5.70	14.28	1.25	0.83	0 10:09	0.00	> CAPACITY
5	Humphreys Culv	McCloy Ditch #1	McCloy Canal	67.00	0.0000	30.000	0.0170	4.05	1.21	14.38	11.87	1.88	0.76	0 10:26	0.00	> CAPACITY
6	Humphreys Culv 2	Fyffe Ditch #1	McCloy Ditch #1	94.09	0.5300	18.000	0.0150	3.90	6.64	6.89	1.04	1.50	1.00	0 10:32	89.00	SURCHARGED
7	McCloy Culv 1	McCloy Ditch #1	McCloy Ditch #2	49.00	-1.0200	15.000	0.0110	3.86	7.71	4.74	0.61	1.25	1.00	0 10:35	112.00	SURCHARGED
8	McCloy Culv 2	McCloy Ditch #2	McCloy Ditch #3	105.99	-0.4700	18.000	0.0140	2.66	6.70	4.35	0.65	1.50	1.00	0 09:59	39.00	SURCHARGED
9	McCloy Culv 3	McCloy Ditch #4	McCloy Ditch #3	17.60	11.3600	12.000	0.0150	8.36	10.41	6.54	0.63	1.00	1.00	0 09:59	9.00	SURCHARGED
10	Prop Gillis Culv	Gillis Culvert Inlet	Port Expy Inlet	66.00	0.6100	18.000	0.0240	5.15	4.43	4.03	0.91	0.76	0.50	0 10:00	0.00	Calculated
11	Prop Humphreys Culv 1	Prop Humphreys Culv Inlet 1	Prop Humphreys Culv Outlet 1	75.00	0.2300	36.000	0.0130	3.14	63.51	27.33	0.43	1.81	0.60	0 10:05	0.00	Calculated
12	Prop Humphreys Culv 2	Prop Humphreys Culv Inlet 2	Prop Humphreys Culv Outlet 2	75.00	0.1500	36.000	0.0130	1.48	51.09	19.61	0.38	2.65	0.88	0 10:54	0.00	Calculated
50-Year																
1	Daggett Culv	Fyffe Ditch #2	Fyffe Ditch #1	41.75	5.9900	27.960	0.0180	2.11	60.31	5.64	0.09	1.57	0.67	0 10:06	0.00	Calculated
2	Ex 24in CMP	Ex 24in CMP Inlet	Ex 24in CMP Outlet	32.50	-1.4500	24.000	0.0240	6.70	14.74	20.84	1.41	1.99	0.99	0 10:35	0.00	> CAPACITY
3	Ex 42in RCP	Ex 42in RCP Inlet	Ex 42in RCP Outlet	24.00	0.5800	42.000	0.0150	2.82	66.60	19.22	0.29	2.46	0.70	0 10:49	0.00	Calculated
4	Fyffe Culv	Fyffe Ditch #3	Fyffe Ditch #2	59.67	0.0000	18.000	0.0140	3.38	0.40	5.18	12.98	1.23	0.82	0 10:09	0.00	> CAPACITY
5	Humphreys Culv	McCloy Ditch #1	McCloy Canal	67.00	0.0000	30.000	0.0170	3.97	1.21	13.47	11.11	1.79	0.72	0 10:28	0.00	> CAPACITY
6	Humphreys Culv 2	Fyffe Ditch #1	McCloy Ditch #1	94.09	0.5300	18.000	0.0150	3.71	6.64	6.55	0.99	1.50	1.00	0 10:25	76.00	SURCHARGED
7	McCloy Culv 1	McCloy Ditch #1	McCloy Ditch #2	49.00	-1.0200	15.000	0.0110	3.74	7.71	4.58	0.59	1.25	1.00	0 10:31	96.00	SURCHARGED
8	McCloy Culv 2	McCloy Ditch #2	McCloy Ditch #3	105.99	-0.4700	18.000	0.0140	2.69	6.70	4.43	0.66	1.50	1.00	0 10:01	21.00	SURCHARGED
9	McCloy Culv 3	McCloy Ditch #4	McCloy Ditch #3	17.60	11.3600	12.000	0.0150	8.37	10.41	6.54	0.63	1.00	1.00	0 10:00	7.00	SURCHARGED
10	Prop Gillis Culv	Gillis Culvert Inlet	Port Expy Inlet	66.00	0.6100	18.000	0.0240	5.13	4.43	3.43	0.77	0.76	0.50	0 10:00	0.00	Calculated
11	Prop Humphreys Culv 1	Prop Humphreys Culv Inlet 1	Prop Humphreys Culv Outlet 1	75.00	0.2300	36.000	0.0130	2.91	63.51	24.26	0.38	1.76	0.59	0 10:05	0.00	Calculated
12	Prop Humphreys Culv 2	Prop Humphreys Culv Inlet 2	Prop Humphreys Culv Outlet 2	75.00	0.1500	36.000	0.0130	1.45	51.09	19.13	0.37	2.64	0.88	0 10:51	0.00	Calculated
10-Year																
1	Daggett Culv	Fyffe Ditch #2	Fyffe Ditch #1	41.75	5.9900	27.960	0.0180	2.10	60.31	4.50	0.07	1.25	0.54	0 10:06	0.00	Calculated
2	Ex 24in CMP	Ex 24in CMP Inlet	Ex 24in CMP Outlet	32.50	-1.4500	24.000	0.0240	5.13	14.74	15.21	1.03	1.82	0.91	0 10:42	0.00	> CAPACITY
3	Ex 42in RCP	Ex 42in RCP Inlet	Ex 42in RCP Outlet	24.00	0.5800	42.000	0.0150	2.59	66.60	13.99	0.21	2.13	0.61	0 10:49	0.00	Calculated
4	Fyffe Culv	Fyffe Ditch #3	Fyffe Ditch #2	59.67	0.0000	18.000	0.0140	3.24	0.40	4.15	10.39	1.04	0.70	0 10:07	0.00	> CAPACITY
5	Humphreys Culv	McCloy Ditch #1	McCloy Canal	67.00	0.0000	30.000	0.0170	3.70	1.21	10.75	8.87	1.52	0.61	0 10:28	0.00	> CAPACITY
6	Humphreys Culv 2	Fyffe Ditch #1	McCloy Ditch #1	94.09	0.5300	18.000	0.0150	3.06	6.64	5.23	0.79	1.50	1.00	0 10:01	38.00	SURCHARGED
7	McCloy Culv 1	McCloy Ditch #1	McCloy Ditch #2	49.00	-1.0200	15.000	0.0110	3.29	7.71	4.04	0.52	1.25	1.00	0 10:20	49.00	SURCHARGED
8	McCloy Culv 2	McCloy Ditch #2	McCloy Ditch #3	105.99	-0.4700	18.000	0.0140	2.81	6.70	4.65	0.69	1.36	0.91	0 10:10	0.00	Calculated
9	McCloy Culv 3	McCloy Ditch #4	McCloy Ditch #3	17.60	11.3600	12.000	0.0150	7.75	10.41	5.76	0.55	0.90	0.90	0 10:05	0.00	Calculated
10	Prop Gillis Culv	Gillis Culvert Inlet	Port Expy Inlet	66.00	0.6100	18.000	0.0240	5.13	4.43	3.29	0.74	0.75	0.50	0 09:57	0.00	Calculated
11	Prop Humphreys Culv 1	Prop Humphreys Culv Inlet 1	Prop Humphreys Culv Outlet 1	75.00	0.2300	36.000	0.0130	2.59	63.51	16.98	0.27	1.56	0.52	0 10:05	0.00	Calculated
12	Prop Humphreys Culv 2	Prop Humphreys Culv Inlet 2	Prop Humphreys Culv Outlet 2	75.00	0.1500	36.000	0.0130	1.33	51.09	13.71	0.27	2.36	0.79	0 10:52	0.00	Calculated

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Table 4: Proposed Condition Open Channel Analysis

SN	Channel	Inlet	Outlet	Length (ft)	Slope (ft)	Channel Height (ft)	Channel Width (ft)	Manning's Roughness	Max Velocity (ft/sec)	Design Capacity (cfs)	Peak Flow (cfs)	Max Design/Capacity	Max Flow Depth (ft)	Max/Total Depth	Time of Peak Occurrence (days:hh:mm)	Total Time Surcharged (min)	Reported Condition
100-Year																	
1	Ditch-01A	Begin Ditch-01	Ex 24in CMP Inlet	574.65	0.4300	3.500	23.94	0.0800	0.78	111.72	26.92	0.24	2.68	0.77	0 10:33	0.00	Calculated
2	Ditch-01B	Ex 24in CMP Outlet	Ex 42in RCP Inlet	355.92	0.2100	3.320	23.09	0.0800	0.82	70.91	20.08	0.28	2.23	0.67	0 10:32	0.00	Calculated
3	Ditch-01C	Ex 42in RCP Outlet	Prop Humphreys Culv Inlet 2	69.69	0.2600	5.180	31.84	0.0800	0.62	199.94	19.60	0.10	2.55	0.49	0 10:53	0.00	Calculated
4	Ditch-01D	Prop Humphreys Culv Outlet 2	Inlet to Ditch-04	93.96	0.2600	5.180	31.84	0.0800	0.50	198.83	19.64	0.10	2.79	0.54	0 10:54	0.00	Calculated
5	Ditch-02A	McCloy Canal	Prop Humphreys Culv Inlet 1	77.18	0.3500	2.800	23.75	0.0800	1.16	74.55	27.40	0.37	1.81	0.65	0 10:03	0.00	Calculated
6	Ditch-02B	Prop Humphreys Culv Outlet 1	End Ditch-02	988.79	0.3400	2.800	23.75	0.0800	1.27	73.91	29.66	0.40	2.09	0.75	0 10:07	0.00	Calculated
7	Ditch-04	Inlet to Ditch-04	EndDitch-04	1111.00	0.0400	6.580	34.09	0.0800	0.93	108.43	20.07	0.19	2.67	0.41	0 10:57	0.00	Calculated
50-Year																	
1	Ditch-01A	Begin Ditch-01	Ex 24in CMP Inlet	574.65	0.4300	3.500	23.94	0.0800	0.76	111.72	24.30	0.22	2.63	0.75	0 10:31	0.00	Calculated
2	Ditch-01B	Ex 24in CMP Outlet	Ex 42in RCP Inlet	355.92	0.2100	3.320	23.09	0.0800	0.80	70.91	20.01	0.28	2.21	0.67	0 10:38	0.00	Calculated
3	Ditch-01C	Ex 42in RCP Outlet	Prop Humphreys Culv Inlet 2	69.69	0.2600	5.180	31.84	0.0800	0.61	199.94	19.17	0.10	2.54	0.49	0 10:50	0.00	Calculated
4	Ditch-01D	Prop Humphreys Culv Outlet 2	Inlet to Ditch-04	93.96	0.2600	5.180	31.84	0.0800	0.50	198.83	19.11	0.10	2.78	0.54	0 10:53	0.00	Calculated
5	Ditch-02A	McCloy Canal	Prop Humphreys Culv Inlet 1	77.18	0.3500	2.800	23.75	0.0800	1.10	74.55	24.34	0.33	1.73	0.62	0 10:04	0.00	Calculated
6	Ditch-02B	Prop Humphreys Culv Outlet 1	End Ditch-02	988.79	0.3400	2.800	23.75	0.0800	1.25	73.91	27.16	0.37	1.92	0.69	0 10:09	0.00	Calculated
7	Ditch-04	Inlet to Ditch-04	EndDitch-04	1111.00	0.0400	6.580	34.09	0.0800	0.93	108.43	19.71	0.18	2.57	0.39	0 10:59	0.00	Calculated
10-Year																	
1	Ditch-01A	Begin Ditch-01	Ex 24in CMP Inlet	574.65	0.4300	3.500	23.94	0.0800	0.71	111.72	17.05	0.15	2.15	0.61	0 10:31	0.00	Calculated
2	Ditch-01B	Ex 24in CMP Outlet	Ex 42in RCP Inlet	355.92	0.2100	3.320	23.09	0.0800	0.77	70.91	14.77	0.21	1.87	0.56	0 10:44	0.00	Calculated
3	Ditch-01C	Ex 42in RCP Outlet	Prop Humphreys Culv Inlet 2	69.69	0.2600	5.180	31.84	0.0800	0.56	199.94	13.85	0.07	2.24	0.43	0 10:50	0.00	Calculated
4	Ditch-01D	Prop Humphreys Culv Outlet 2	Inlet to Ditch-04	93.96	0.2600	5.180	31.84	0.0800	0.43	198.83	13.57	0.07	2.51	0.48	0 10:54	0.00	Calculated
5	Ditch-02A	McCloy Canal	Prop Humphreys Culv Inlet 1	77.18	0.3500	2.800	23.75	0.0800	0.98	74.55	17.21	0.23	1.49	0.53	0 10:05	0.00	Calculated
6	Ditch-02B	Prop Humphreys Culv Outlet 1	End Ditch-02	988.79	0.3400	2.800	23.75	0.0800	1.15	73.91	18.75	0.25	1.43	0.51	0 10:17	0.00	Calculated
7	Ditch-04	Inlet to Ditch-04	EndDitch-04	1111.00	0.0400	6.580	34.09	0.0800	0.87	108.43	14.06	0.13	1.96	0.30	0 11:06	0.00	Calculated

Table 5: Proposed Junction Sensitivity Analysis

Junction	Initial WSEL Scenario	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation (ft)	Min Freeboard (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-inches)	Total Time Flooded (minutes)
Begin Ditch-01	0% Full (Initial WSEL = -6.85')	27.53	27.53	-1.11	1.64	0 10:32	0 00:00	0.00	0.00
	25% Full (Initial WSEL = -5.54')	27.54	27.54	-1.11	1.64	0 10:32	0 00:00	0.00	0.00
	50% Full (Initial WSEL = -4.24')	27.54	27.54	-1.10	1.63	0 10:32	0 00:00	0.00	0.00
	75% Full (Initial WSEL = -2.93')	27.53	27.53	-1.09	1.62	0 10:30	0 00:00	0.00	0.00
	100% Full (Initial WSEL = -1.63')	27.54	27.54	-1.09	1.62	0 10:30	0 00:00	0.00	0.00
End Ditch-02	0% Full (Initial WSEL = -6.85')	29.66	0.00	-3.77	4.31	0 10:45	0 00:00	0.00	0.00
	25% Full (Initial WSEL = -5.54')	25.29	0.00	-3.78	4.32	0 10:44	0 00:00	0.00	0.00
	50% Full (Initial WSEL = -4.24')	24.96	0.00	-1.63	2.17	0 10:07	0 00:00	0.00	0.00
	75% Full (Initial WSEL = -2.93')	46.32	0.00	0.54	0.00	0 00:18	0 10:08	34.69	239.00
	100% Full (Initial WSEL = -1.63')	53.21	0.00	0.54	0.00	0 00:21	0 14:02	87.43	589.00
End Ditch-04	0% Full (Initial WSEL = -6.85')	20.07	0.00	-4.25	4.79	0 11:26	0 00:00	0.00	0.00
	25% Full (Initial WSEL = -5.54')	18.94	0.00	-4.31	4.85	0 11:26	0 00:00	0.00	0.00
	50% Full (Initial WSEL = -4.24')	18.78	0.00	-3.94	4.48	0 11:17	0 00:00	0.00	0.00
	75% Full (Initial WSEL = -2.93')	28.00	0.00	-2.93	3.47	0 07:56	0 00:00	0.00	0.00
	100% Full (Initial WSEL = -1.63')	23.73	0.00	-1.62	2.16	0 06:41	0 00:00	0.00	0.00
Ex 24in CMP Inlet	0% Full (Initial WSEL = -6.85')	26.92	0.00	-1.52	0.00	0 10:27	0 10:33	1.59	24.00
	25% Full (Initial WSEL = -5.54')	26.91	0.00	-1.52	0.00	0 10:27	0 10:33	1.40	23.00
	50% Full (Initial WSEL = -4.24')	26.97	0.00	-1.52	0.00	0 10:26	0 10:33	1.61	24.00
	75% Full (Initial WSEL = -2.93')	27.44	0.00	-1.52	0.00	0 10:20	0 10:30	4.17	37.00
	100% Full (Initial WSEL = -1.63')	27.45	0.00	-1.52	0.00	0 09:38	0 10:30	20.69	173.00
Ex 24in CMP Outlet	0% Full (Initial WSEL = -6.85')	21.24	0.00	-2.96	1.33	0 10:51	0 00:00	0.00	0.00
	25% Full (Initial WSEL = -5.54')	21.36	0.00	-3.00	1.37	0 10:52	0 00:00	0.00	0.00
	50% Full (Initial WSEL = -4.24')	21.12	0.00	-2.96	1.33	0 10:52	0 00:00	0.00	0.00
	75% Full (Initial WSEL = -2.93')	17.26	0.00	-2.57	0.94	0 10:57	0 00:00	0.00	0.00
	100% Full (Initial WSEL = -1.63')	9.36	0.00	-1.63	0.00	0 01:43	0 01:46	56.25	1787.00
Ex 42in RCP Inlet	0% Full (Initial WSEL = -6.85')	20.08	0.00	-3.24	2.40	0 10:52	0 00:00	0.00	0.00
	25% Full (Initial WSEL = -5.54')	20.51	0.00	-3.32	2.48	0 10:57	0 00:00	0.00	0.00
	50% Full (Initial WSEL = -4.24')	20.14	0.00	-3.25	2.41	0 10:58	0 00:00	0.00	0.00
	75% Full (Initial WSEL = -2.93')	16.77	0.00	-2.67	1.83	0 10:57	0 00:00	0.00	0.00
	100% Full (Initial WSEL = -1.63')	11.06	0.00	-1.59	0.75	0 01:43	0 00:00	0.00	0.00
Ex 42in RCP Outlet	0% Full (Initial WSEL = -6.85')	19.58	0.00	-3.37	2.70	0 10:51	0 00:00	0.00	0.00
	25% Full (Initial WSEL = -5.54')	19.65	0.00	-3.45	2.78	0 10:59	0 00:00	0.00	0.00
	50% Full (Initial WSEL = -4.24')	19.48	0.00	-3.36	2.69	0 11:02	0 00:00	0.00	0.00
	75% Full (Initial WSEL = -2.93')	16.77	0.00	-2.73	2.06	0 10:54	0 00:00	0.00	0.00
	100% Full (Initial WSEL = -1.63')	11.45	0.00	-1.61	0.94	0 01:45	0 00:00	0.00	0.00
Prop Gillis Culvert Inlet	0% Full (Initial WSEL = -6.85')	4.06	4.06	0.00	0.00	0 12:44	0 12:44	0.00	0.00
	25% Full (Initial WSEL = -5.54')	4.06	4.06	-0.18	0.18	0 12:37	0 00:00	0.00	0.00
	50% Full (Initial WSEL = -4.24')	4.06	4.06	-0.28	0.28	0 12:42	0 00:00	0.00	0.00
	75% Full (Initial WSEL = -2.93')	4.06	4.06	0.00	0.00	0 13:17	0 13:36	0.00	1.00
	100% Full (Initial WSEL = -1.63')	4.06	4.06	0.00	0.00	0 12:29	0 12:29	0.00	0.00
Inlet to Ditch-04	0% Full (Initial WSEL = -6.85')	19.64	0.00	-3.49	3.69	0 10:51	0 00:00	0.00	0.00
	25% Full (Initial WSEL = -5.54')	19.37	0.00	-3.57	3.77	0 11:01	0 00:00	0.00	0.00
	50% Full (Initial WSEL = -4.24')	19.19	0.00	-3.46	3.66	0 11:05	0 00:00	0.00	0.00
	75% Full (Initial WSEL = -2.93')	17.51	0.00	-2.78	2.98	0 10:53	0 00:00	0.00	0.00
	100% Full (Initial WSEL = -1.63')	20.33	0.00	-1.61	1.81	0 01:44	0 00:00	0.00	0.00
McCloy Canal	0% Full (Initial WSEL = -6.85')	27.50	22.34	-1.22	1.02	0 10:04	0 00:00	0.00	0.00
	25% Full (Initial WSEL = -5.54')	28.08	22.34	-1.28	1.08	0 10:05	0 00:00	0.00	0.00
	50% Full (Initial WSEL = -4.24')	28.12	22.35	-1.28	1.08	0 10:05	0 00:00	0.00	0.00
	75% Full (Initial WSEL = -2.93')	28.43	22.35	-1.22	1.02	0 10:05	0 00:00	0.00	0.00
	100% Full (Initial WSEL = -1.63')	22.34	22.34	-0.44	0.24	0 10:00	0 00:00	0.00	0.00
Port Expy Inlet	0% Full (Initial WSEL = -6.85')	6.12	2.09	-2.53	2.53	0 10:00	0 00:00	0.00	0.00
	25% Full (Initial WSEL = -5.54')	6.12	2.09	-2.53	2.53	0 10:00	0 00:00	0.00	0.00
	50% Full (Initial WSEL = -4.24')	6.12	2.10	-2.53	2.53	0 10:00	0 00:00	0.00	0.00
	75% Full (Initial WSEL = -2.93')	6.11	2.10	-2.53	2.53	0 10:00	0 00:00	0.00	0.00
	100% Full (Initial WSEL = -1.63')	6.12	2.09	-2.53	2.53	0 10:00	0 00:00	0.00	0.00
Prop Humphreys Culv Inlet 1	0% Full (Initial WSEL = -6.85')	27.40	0.00	-1.43	4.16	0 10:05	0 00:00	0.00	0.00
	25% Full (Initial WSEL = -5.54')	27.94	0.00	-1.54	4.27	0 10:05	0 00:00	0.00	0.00
	50% Full (Initial WSEL = -4.24')	28.00	0.00	-1.55	4.28	0 10:05	0 00:00	0.00	0.00
	75% Full (Initial WSEL = -2.93')	27.95	0.00	-1.41	4.14	0 10:08	0 00:00	0.00	0.00
	100% Full (Initial WSEL = -1.63')	16.47	0.00	-0.46	3.19	0 10:00	0 00:00	0.00	0.00
Prop Humphreys Culv Inlet 2	0% Full (Initial WSEL = -6.85')	19.60	0.00	-3.41	3.38	0 10:51	0 00:00	0.00	0.00
	25% Full (Initial WSEL = -5.54')	19.57	0.00	-3.49	3.46	0 10:59	0 00:00	0.00	0.00
	50% Full (Initial WSEL = -4.24')	19.39	0.00	-3.39	3.36	0 11:03	0 00:00	0.00	0.00
	75% Full (Initial WSEL = -2.93')	16.77	0.00	-2.74	2.71	0 10:54	0 00:00	0.00	0.00
	100% Full (Initial WSEL = -1.63')	11.88	0.00	-1.61	1.58	0 01:45	0 00:00	0.00	0.00
Prop Humphreys Culv Outlet 1	0% Full (Initial WSEL = -6.85')	27.33	0.00	-1.66	4.22	0 10:05	0 00:00	0.00	0.00
	25% Full (Initial WSEL = -5.54')	27.69	0.00	-1.83	4.39	0 10:07	0 00:00	0.00	0.00
	50% Full (Initial WSEL = -4.24')	27.74	0.00	-1.79	4.35	0 10:11	0 00:00	0.00	0.00
	75% Full (Initial WSEL = -2.93')	27.52	0.00	-1.54	4.10	0 10:09	0 00:00	0.00	0.00
	100% Full (Initial WSEL = -1.63')	16.97	0.00	-0.49	3.05	0 10:01	0 00:00	0.00	0.00
Prop Humphreys Culv Outlet 2	0% Full (Initial WSEL = -6.85')	19.61	0.00	-3.46	3.32	0 10:51	0 00:00	0.00	0.00
	25% Full (Initial WSEL = -5.54')	19.48	0.00	-3.54	3.40	0 11:00	0 00:00	0.00	0.00
	50% Full (Initial WSEL = -4.24')	19.29	0.00	-3.43	3.29	0 11:04	0 00:00	0.00	0.00
	75% Full (Initial WSEL = -2.93')	16.77	0.00	-2.77	2.63	0 10:54	0 00:00	0.00	0.00
	100% Full (Initial WSEL = -1.63')	12.45	0.00	-1.61	1.47	0 01:44	0 00:00	0.00	0.00

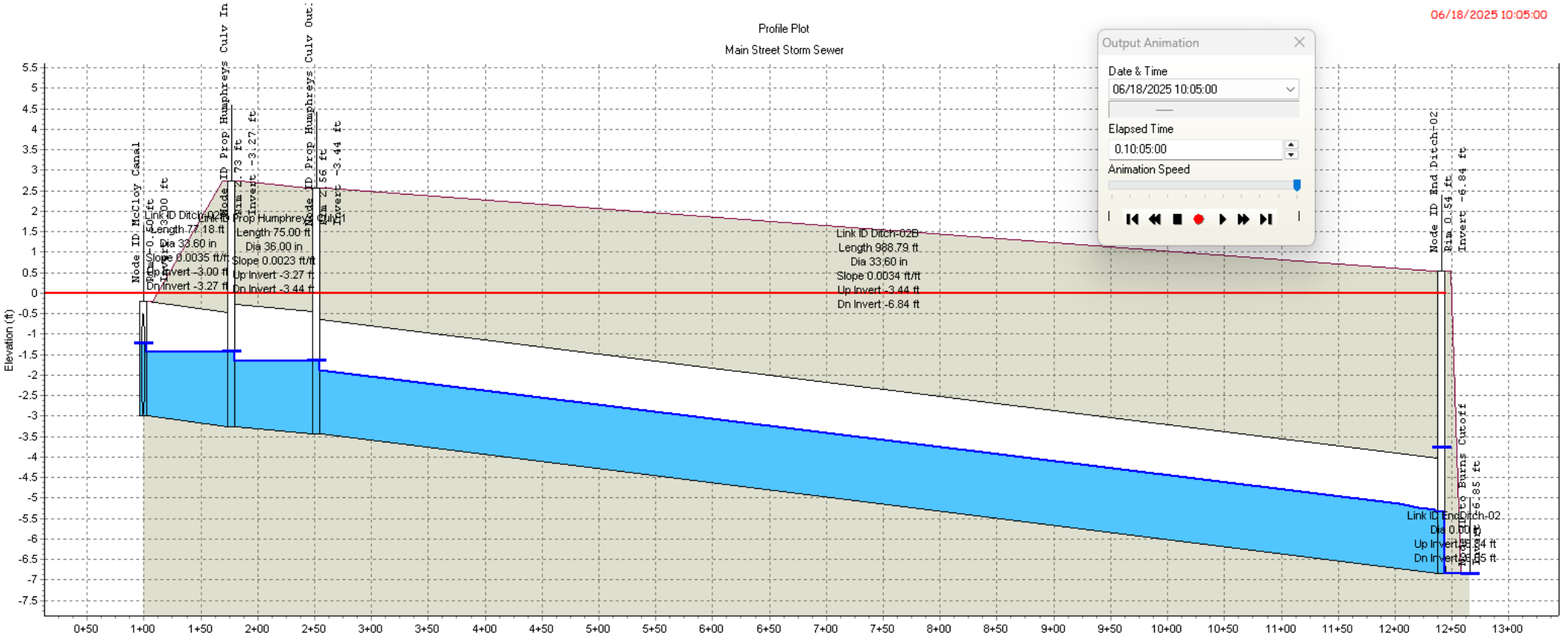
Table 6: Proposed Condition Closed Pipes Sensitivity Analysis

Drainage Pipe / Culvert	Initial WSEL Scenario	Max Velocity (ft/sec)	Peak Flow (cfs)	Max Design/Capacity	Max Flow Depth (ft)	Max Depth/Dia.	Time of Peak Occurene (days:hh:mm)	Total Time Surcharged (min)	Reported Condition
Daggett Culv	0% Full (Initial WSEL = -6.85')	2.19	5.64	0.09	1.65	0.71	0 10:30	0.00	Calculated
	25% Full (Initial WSEL = -5.54')	2.19	5.64	0.09	1.64	0.71	0 10:30	0.00	Calculated
	50% Full (Initial WSEL = -4.24')	2.19	5.64	0.09	1.64	0.71	0 10:30	0.00	Calculated
	75% Full (Initial WSEL = -2.93')	2.06	5.64	0.09	1.66	0.71	0 10:30	0.00	Calculated
	100% Full (Initial WSEL = -1.63')	1.75	5.64	0.09	1.67	0.71	0 10:30	0.00	Calculated
Ex 24in CMP	0% Full (Initial WSEL = -6.85')	6.92	21.24	1.44	2.00	1.00	0 10:27	0.00	> CAPACITY
	25% Full (Initial WSEL = -5.54')	7.00	21.36	1.45	1.98	0.99	0 10:27	0.00	> CAPACITY
	50% Full (Initial WSEL = -4.24')	6.85	21.12	1.43	1.99	1.00	0 10:27	0.00	> CAPACITY
	75% Full (Initial WSEL = -2.93')	5.57	17.26	1.17	2.00	1.00	0 10:20	2810.00	SURCHARGED
	100% Full (Initial WSEL = -1.63')	5.65	7.75	0.53	2.00	1.00	0 00:51	2819.00	SURCHARGED
Ex 42in RCP	0% Full (Initial WSEL = -6.85')	2.88	19.58	0.29	2.47	0.71	0 10:53	0.00	Calculated
	25% Full (Initial WSEL = -5.54')	3.30	19.65	0.30	2.39	0.68	0 10:51	0.00	Calculated
	50% Full (Initial WSEL = -4.24')	2.89	19.48	0.29	2.48	0.71	0 10:42	0.00	Calculated
	75% Full (Initial WSEL = -2.93')	3.24	16.77	0.25	3.08	0.88	0 10:57	0.00	Calculated
	100% Full (Initial WSEL = -1.63')	3.51	11.06	0.17	3.50	1.00	0 00:52	2796.00	SURCHARGED
Fyffe Culv	0% Full (Initial WSEL = -6.85')	3.62	5.70	14.28	1.25	0.83	0 10:09	0.00	> CAPACITY
	25% Full (Initial WSEL = -5.54')	3.62	5.70	14.28	1.25	0.83	0 10:09	0.00	> CAPACITY
	50% Full (Initial WSEL = -4.24')	3.62	5.70	14.28	1.25	0.83	0 10:09	0.00	> CAPACITY
	75% Full (Initial WSEL = -2.93')	3.62	5.70	14.27	1.25	0.83	0 10:09	0.00	> CAPACITY
	100% Full (Initial WSEL = -1.63')	3.62	5.70	14.27	1.25	0.83	0 10:09	0.00	> CAPACITY
Humphreys Culv 1	0% Full (Initial WSEL = -6.85')	4.05	14.38	11.87	1.88	0.76	0 10:26	0.00	> CAPACITY
	25% Full (Initial WSEL = -5.54')	4.04	14.21	11.73	1.84	0.74	0 10:28	0.00	> CAPACITY
	50% Full (Initial WSEL = -4.24')	4.03	14.19	11.71	1.83	0.74	0 10:34	0.00	> CAPACITY
	75% Full (Initial WSEL = -2.93')	4.02	14.30	11.80	1.89	0.76	0 10:36	0.00	> CAPACITY
	100% Full (Initial WSEL = -1.63')	3.25	14.37	11.86	2.50	1.00	0 12:33	11.00	SURCHARGED
Humphreys Culv 2	0% Full (Initial WSEL = -6.85')	3.90	6.89	1.04	1.50	1.00	0 10:32	89.00	SURCHARGED
	25% Full (Initial WSEL = -5.54')	3.89	6.87	1.04	1.50	1.00	0 10:32	88.00	SURCHARGED
	50% Full (Initial WSEL = -4.24')	3.88	6.85	1.03	1.50	1.00	0 10:32	88.00	SURCHARGED
	75% Full (Initial WSEL = -2.93')	3.87	6.84	1.03	1.50	1.00	0 10:32	90.00	SURCHARGED
	100% Full (Initial WSEL = -1.63')	3.13	5.53	0.83	1.50	1.00	0 10:12	590.00	SURCHARGED
McCloy Culv 1	0% Full (Initial WSEL = -6.85')	3.86	4.74	0.61	1.25	1.00	0 10:35	112.00	SURCHARGED
	25% Full (Initial WSEL = -5.54')	3.85	4.73	0.61	1.25	1.00	0 10:35	111.00	SURCHARGED
	50% Full (Initial WSEL = -4.24')	3.83	4.70	0.61	1.25	1.00	0 10:36	111.00	SURCHARGED
	75% Full (Initial WSEL = -2.93')	3.80	4.66	0.60	1.25	1.00	0 10:38	115.00	SURCHARGED
	100% Full (Initial WSEL = -1.63')	2.54	3.12	0.40	1.25	1.00	0 12:36	1084.00	SURCHARGED
McCloy Culv 2	0% Full (Initial WSEL = -6.85')	2.66	4.35	0.65	1.50	1.00	0 09:59	39.00	SURCHARGED
	25% Full (Initial WSEL = -5.54')	2.68	4.40	0.66	1.50	1.00	0 09:59	38.00	SURCHARGED
	50% Full (Initial WSEL = -4.24')	2.68	4.40	0.66	1.50	1.00	0 09:59	38.00	SURCHARGED
	75% Full (Initial WSEL = -2.93')	2.62	4.25	0.63	1.50	1.00	0 09:58	41.00	SURCHARGED
	100% Full (Initial WSEL = -1.63')	2.58	4.56	0.68	1.50	1.00	0 10:19	158.00	SURCHARGED
McCloy Culv 3	0% Full (Initial WSEL = -6.85')	8.36	6.54	0.63	1.00	1.00	0 09:59	9.00	SURCHARGED
	25% Full (Initial WSEL = -5.54')	8.36	6.54	0.63	1.00	1.00	0 09:59	9.00	SURCHARGED
	50% Full (Initial WSEL = -4.24')	8.36	6.54	0.63	1.00	1.00	0 09:59	9.00	SURCHARGED
	75% Full (Initial WSEL = -2.93')	8.36	6.54	0.63	1.00	1.00	0 09:59	9.00	SURCHARGED
	100% Full (Initial WSEL = -1.63')	7.21	5.64	0.54	1.00	1.00	0 09:58	11.00	SURCHARGED
Prop Gillis Culv	0% Full (Initial WSEL = -6.85')	5.15	4.03	0.91	0.76	0.50	0 10:00	0.00	Calculated
	25% Full (Initial WSEL = -5.54')	5.14	4.03	0.91	0.76	0.50	0 10:00	0.00	Calculated
	50% Full (Initial WSEL = -4.24')	5.15	4.03	0.91	0.76	0.50	0 10:00	0.00	Calculated
	75% Full (Initial WSEL = -2.93')	5.11	4.03	0.91	0.76	0.50	0 10:00	0.00	Calculated
	100% Full (Initial WSEL = -1.63')	5.12	4.03	0.91	0.76	0.50	0 10:00	0.00	Calculated
Prop Humphreys Culv 1	0% Full (Initial WSEL = -6.85')	3.14	27.33	0.43	1.81	0.60	0 10:05	0.00	Calculated
	25% Full (Initial WSEL = -5.54')	3.73	27.69	0.44	1.65	0.55	0 10:03	0.00	Calculated
	50% Full (Initial WSEL = -4.24')	3.76	27.74	0.44	1.65	0.55	0 10:01	0.00	Calculated
	75% Full (Initial WSEL = -2.93')	3.50	27.52	0.43	1.87	0.63	0 10:02	0.00	Calculated
	100% Full (Initial WSEL = -1.63')	1.51	16.97	0.27	2.88	0.96	0 12:32	0.00	Calculated
Prop Humphreys Culv 2	0% Full (Initial WSEL = -6.85')	1.48	19.61	0.38	2.65	0.88	0 10:54	0.00	Calculated
	25% Full (Initial WSEL = -5.54')	1.69	19.48	0.38	2.57	0.86	0 10:52	0.00	Calculated
	50% Full (Initial WSEL = -4.24')	1.51	19.29	0.38	2.67	0.89	0 10:47	0.00	Calculated
	75% Full (Initial WSEL = -2.93')	1.31	16.77	0.33	3.00	1.00	0 10:56	2813.00	SURCHARGED
	100% Full (Initial WSEL = -1.63')	1.38	11.88	0.23	3.00	1.00	0 00:52	2822.00	SURCHARGED

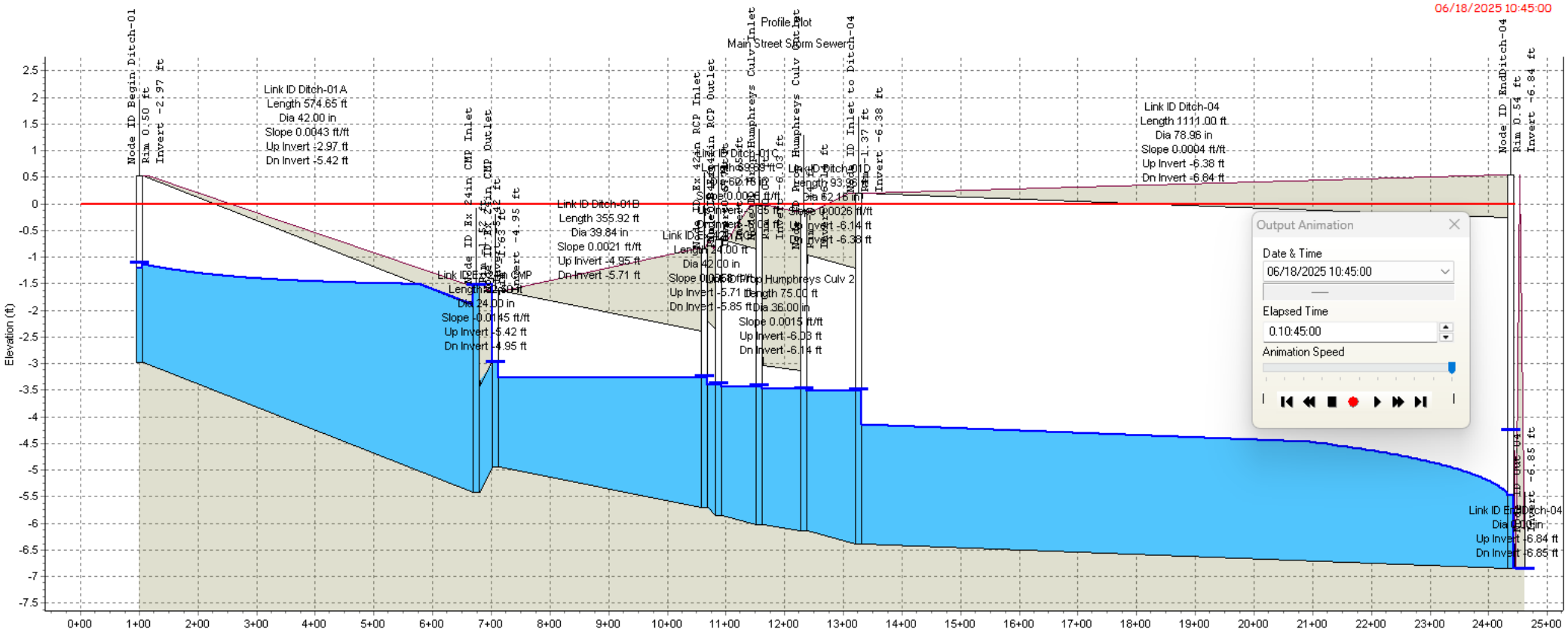
Table 7: Proposed Condition Open Channel Sensitivity Analysis

Channel	Initial WSEL Scenario	Max Velocity (ft/sec)	Peak Flow (cfs)	Max Design/Capacity	Max Flow Depth (ft)	Max/Total Depth	Time of Peak Occurrence (days:hh:mm)	Total Time Surcharged (min)	Reported Condition
Ditch-01A	0% Full (Initial WSEL = -6.85')	0.78	26.92	0.24	2.68	0.77	0 10:33	0.00	Calculated
	25% Full (Initial WSEL = -5.54')	0.78	26.91	0.24	2.68	0.77	0 10:33	0.00	Calculated
	50% Full (Initial WSEL = -4.24')	0.77	26.97	0.24	2.68	0.77	0 10:32	0.00	Calculated
	75% Full (Initial WSEL = -2.93')	0.74	27.44	0.25	2.69	0.77	0 10:30	0.00	Calculated
	100% Full (Initial WSEL = -1.63')	0.74	27.45	0.25	2.69	0.77	0 10:30	0.00	Calculated
Ditch-01B	0% Full (Initial WSEL = -6.85')	0.82	20.08	0.28	2.23	0.67	0 10:32	0.00	Calculated
	25% Full (Initial WSEL = -5.54')	0.90	20.51	0.29	2.17	0.65	0 10:33	0.00	Calculated
	50% Full (Initial WSEL = -4.24')	0.79	20.14	0.28	2.22	0.67	0 10:33	0.00	Calculated
	75% Full (Initial WSEL = -2.93')	0.45	16.77	0.24	2.71	0.82	0 10:49	0.00	Calculated
	100% Full (Initial WSEL = -1.63')	0.43	9.36	0.13	3.32	1.00	0 00:52	1785.00	FLOODED
Ditch-01C	0% Full (Initial WSEL = -6.85')	0.62	19.60	0.10	2.55	0.49	0 10:53	0.00	Calculated
	25% Full (Initial WSEL = -5.54')	0.75	19.57	0.10	2.47	0.48	0 10:51	0.00	Calculated
	50% Full (Initial WSEL = -4.24')	0.62	19.39	0.10	2.56	0.49	0 10:44	0.00	Calculated
	75% Full (Initial WSEL = -2.93')	0.46	16.77	0.08	3.21	0.62	0 10:56	0.00	Calculated
	100% Full (Initial WSEL = -1.63')	0.49	11.45	0.06	4.33	0.84	0 00:52	0.00	Calculated
Ditch-01D	0% Full (Initial WSEL = -6.85')	0.50	19.64	0.10	2.79	0.54	0 10:54	0.00	Calculated
	25% Full (Initial WSEL = -5.54')	0.61	19.37	0.10	2.70	0.52	0 10:53	0.00	Calculated
	50% Full (Initial WSEL = -4.24')	0.53	19.19	0.10	2.81	0.54	0 10:50	0.00	Calculated
	75% Full (Initial WSEL = -2.93')	0.42	16.77	0.08	3.48	0.67	0 10:56	0.00	Calculated
	100% Full (Initial WSEL = -1.63')	0.46	12.45	0.06	4.65	0.90	0 00:52	0.00	Calculated
Ditch-02A	0% Full (Initial WSEL = -6.85')	1.16	27.40	0.37	1.81	0.65	0 10:03	0.00	Calculated
	25% Full (Initial WSEL = -5.54')	1.27	27.94	0.37	1.72	0.62	0 10:02	0.00	Calculated
	50% Full (Initial WSEL = -4.24')	1.27	28.00	0.38	1.72	0.61	0 10:02	0.00	Calculated
	75% Full (Initial WSEL = -2.93')	1.24	27.95	0.37	1.80	0.64	0 10:02	0.00	Calculated
	100% Full (Initial WSEL = -1.63')	0.57	16.47	0.22	2.68	0.96	0 12:32	0.00	Calculated
Ditch-02B	0% Full (Initial WSEL = -6.85')	1.27	29.66	0.40	2.09	0.75	0 10:07	0.00	Calculated
	25% Full (Initial WSEL = -5.54')	1.10	25.29	0.34	2.08	0.75	0 10:07	0.00	Calculated
	50% Full (Initial WSEL = -4.24')	0.78	24.96	0.34	2.22	0.79	0 10:07	0.00	Calculated
	75% Full (Initial WSEL = -2.93')	0.78	26.54	0.36	2.35	0.84	0 10:08	0.00	Calculated
	100% Full (Initial WSEL = -1.63')	0.69	30.38	0.41	2.80	1.00	0 13:23	152.00	FLOODED
Ditch-04	0% Full (Initial WSEL = -6.85')	0.93	20.07	0.19	2.67	0.41	0 10:57	0.00	Calculated
	25% Full (Initial WSEL = -5.54')	0.83	18.94	0.17	2.62	0.40	0 11:01	0.00	Calculated
	50% Full (Initial WSEL = -4.24')	0.68	18.30	0.17	2.90	0.44	0 10:56	0.00	Calculated
	75% Full (Initial WSEL = -2.93')	0.76	17.51	0.16	3.75	0.57	0 00:31	0.00	Calculated
	100% Full (Initial WSEL = -1.63')	0.81	20.33	0.19	4.99	0.76	0 00:29	0.00	Calculated

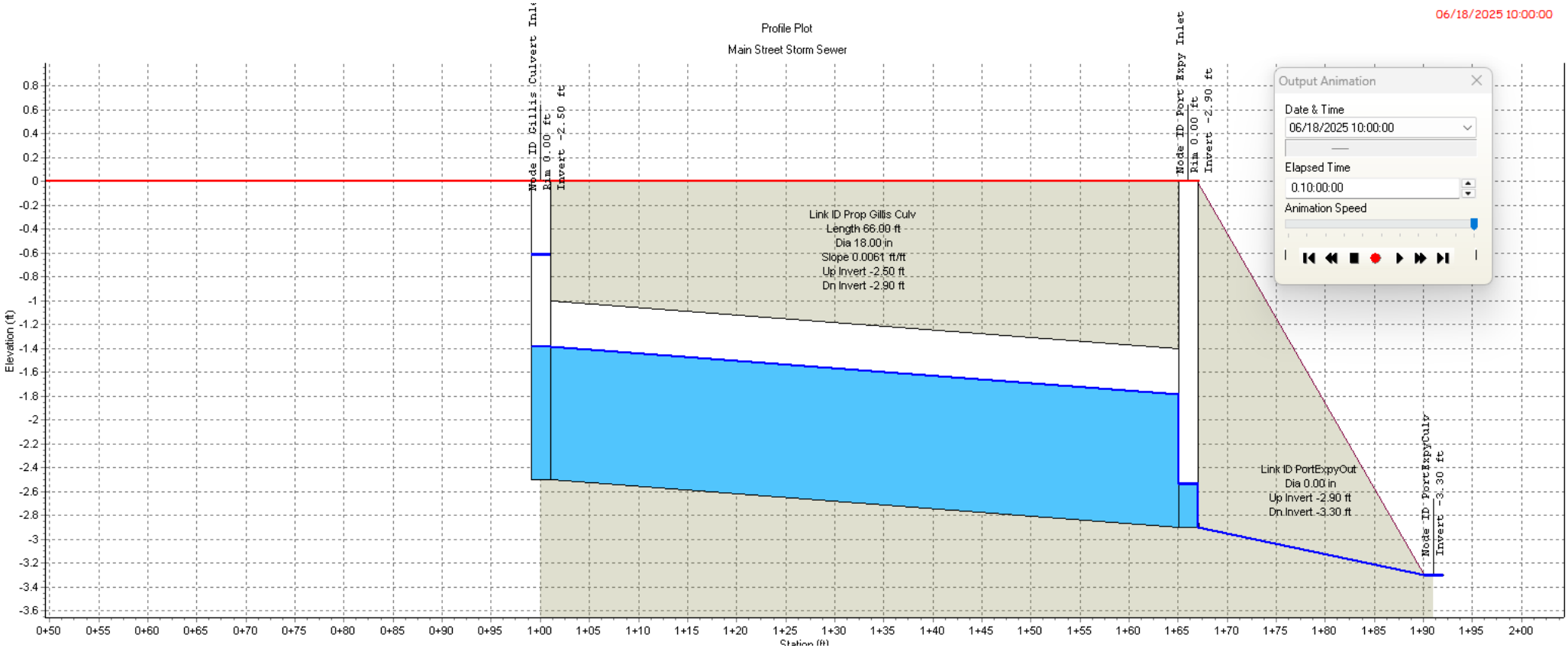
West Complex Roadways
100% Stormwater Report
Figure 1: Proposed Ditch-01 Profile Plot
100-Year Peak Flow



West Complex Roadways
100% Stormwater Report
Figure 2: Proposed Ditch-02 Profile Plot
100-Year Peak Flow

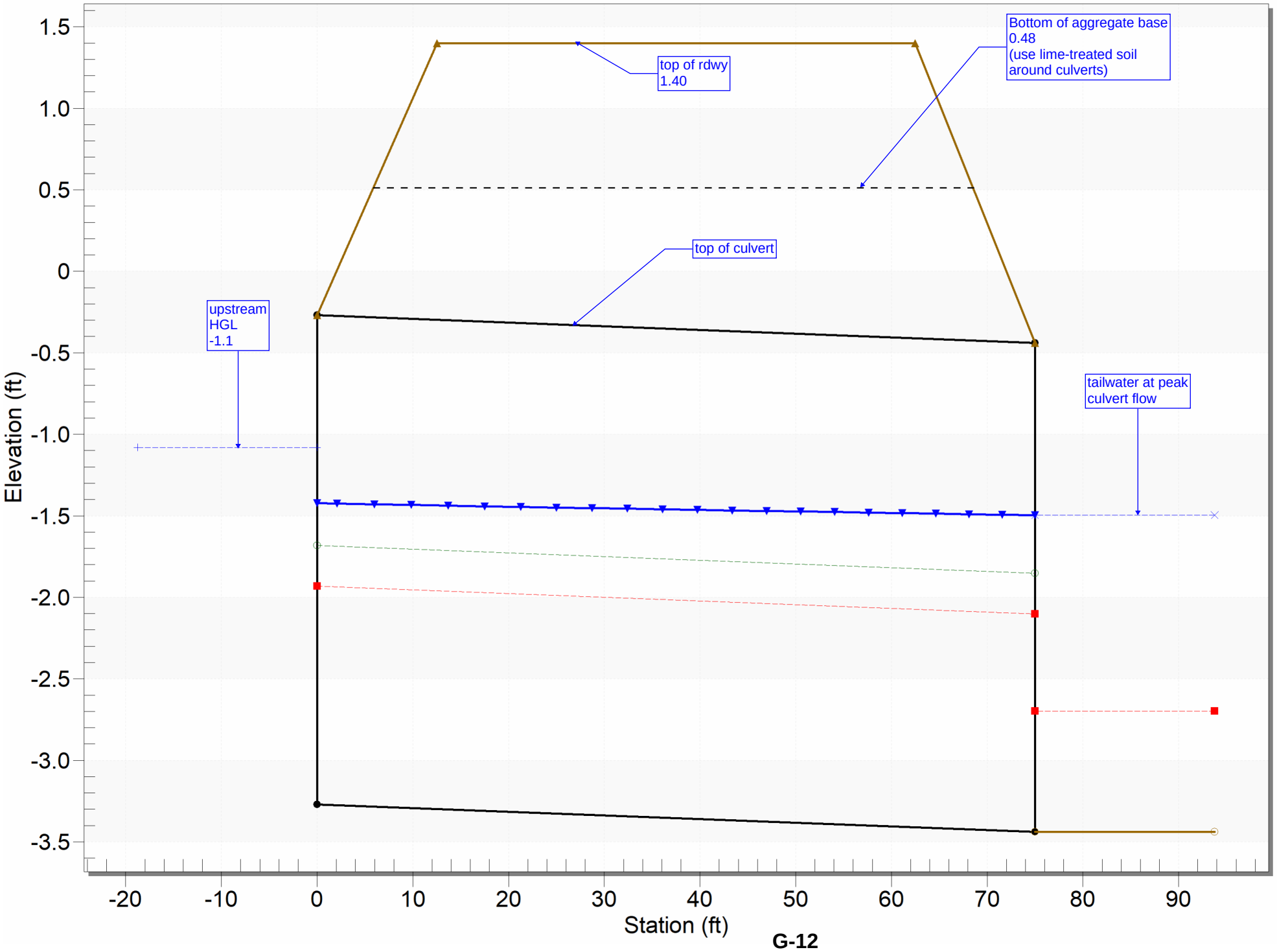


West Complex Roadways
100% Stormwater Report
Figure 3: Proposed Gillis Culvert Profile Plot
100-Year Peak Flow



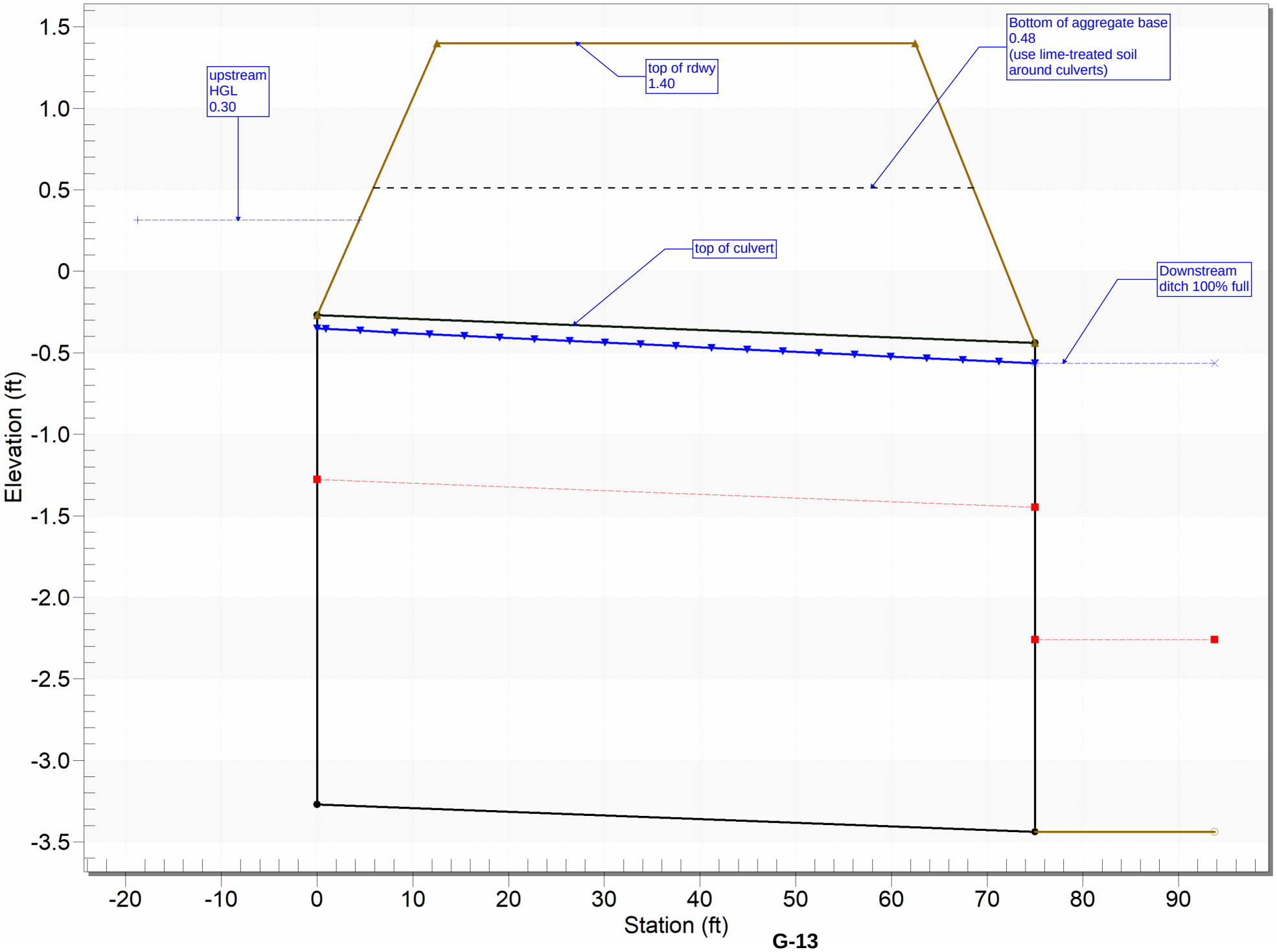
Crossing - Crossing 1, Design Discharge - 35.0 cfs

Culvert - Culvert 1, Culvert Discharge - 35.0 cfs



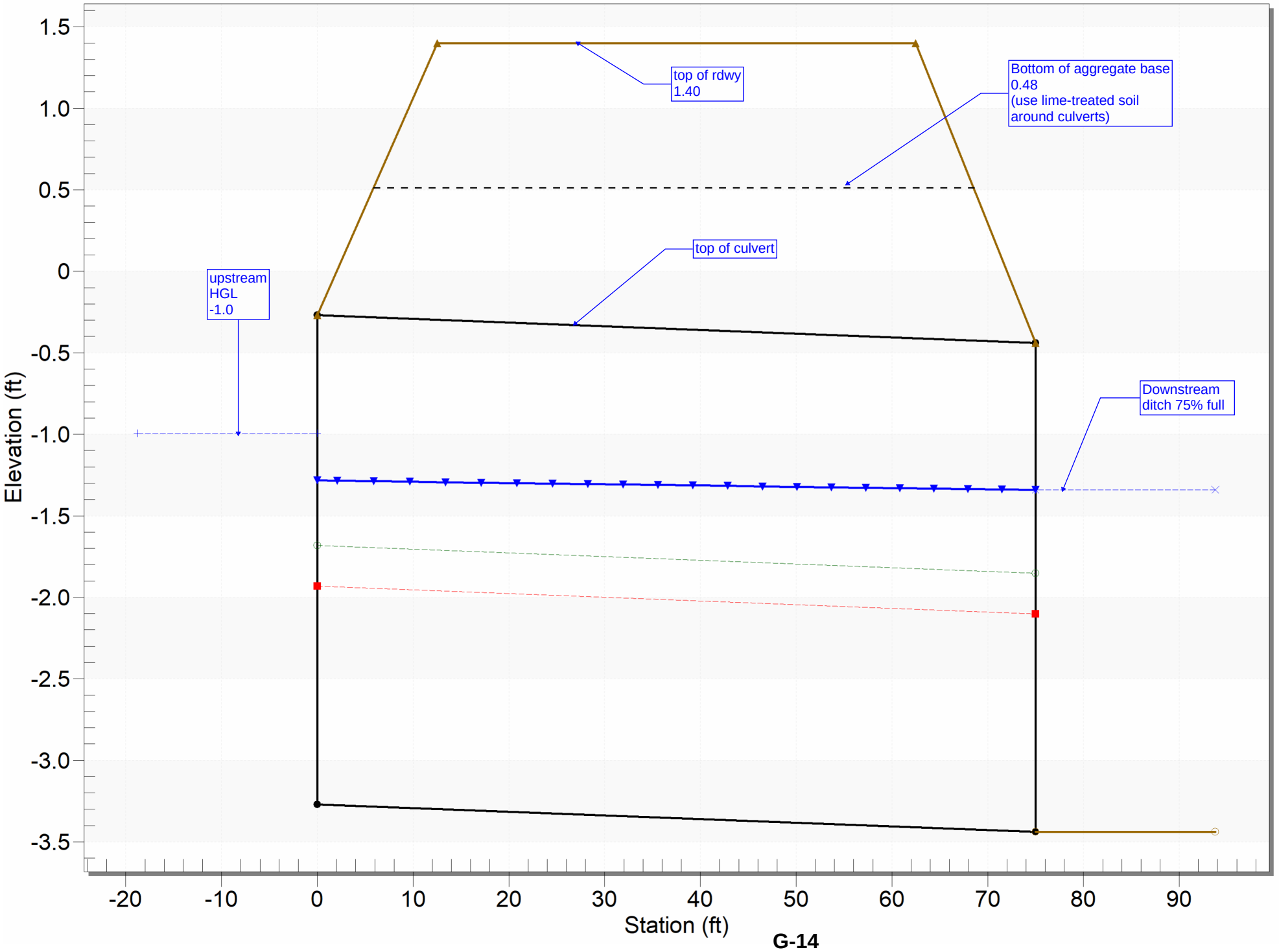
Crossing - Crossing 1, Design Discharge - 75.0 cfs

Culvert - Culvert 1, Culvert Discharge - 75.0 cfs



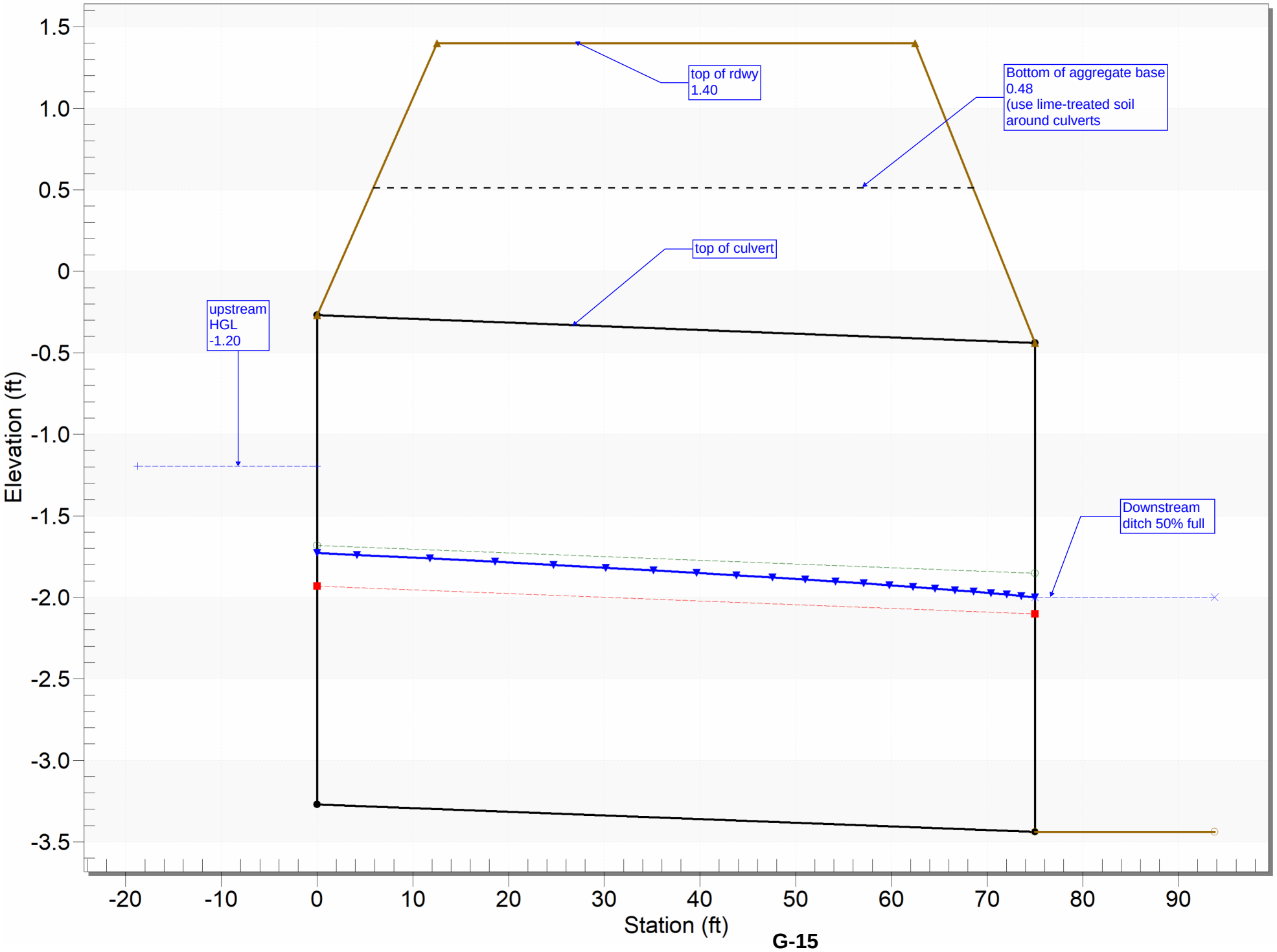
Crossing - Culv 1_75pct, Design Discharge - 35.0 cfs

Culvert - Culvert 1, Culvert Discharge - 35.0 cfs



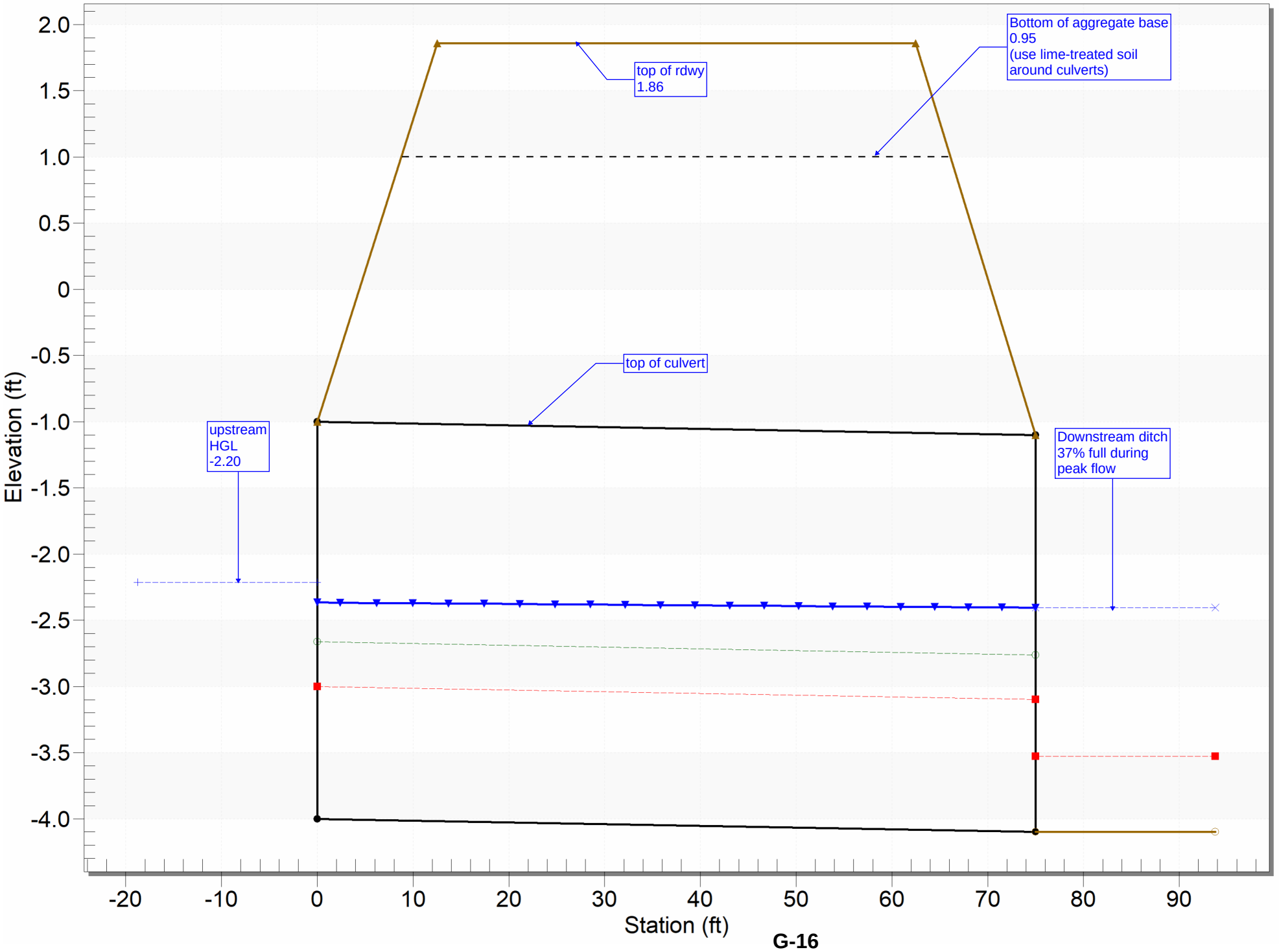
Crossing - Culv 1_50pct, Design Discharge - 35.0 cfs

Culvert - Culvert 1, Culvert Discharge - 35.0 cfs



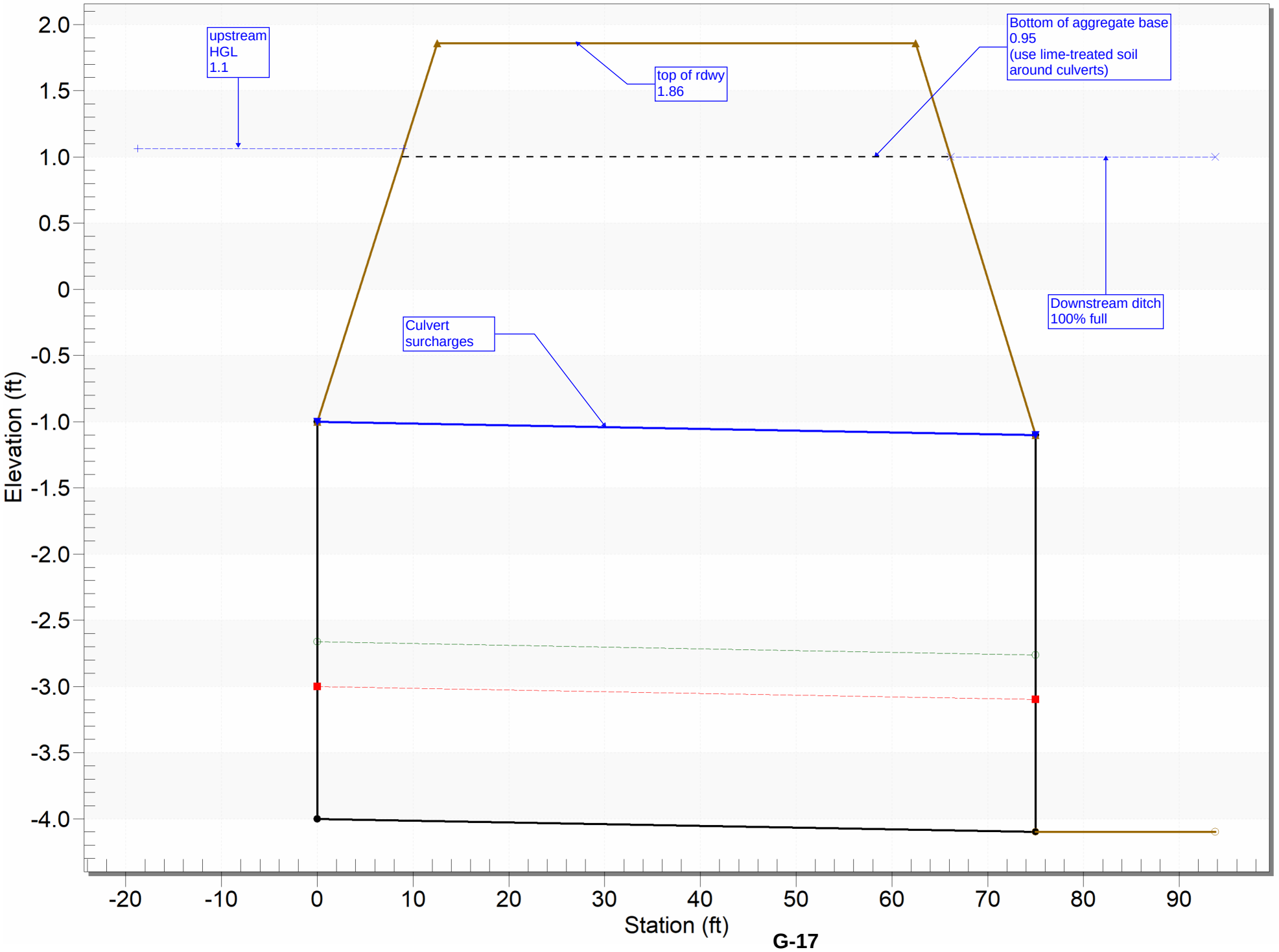
Crossing - Humphreys Ditch 2, Design Discharge - 20.0 cfs

Culvert - Culvert 1, Culvert Discharge - 20.0 cfs



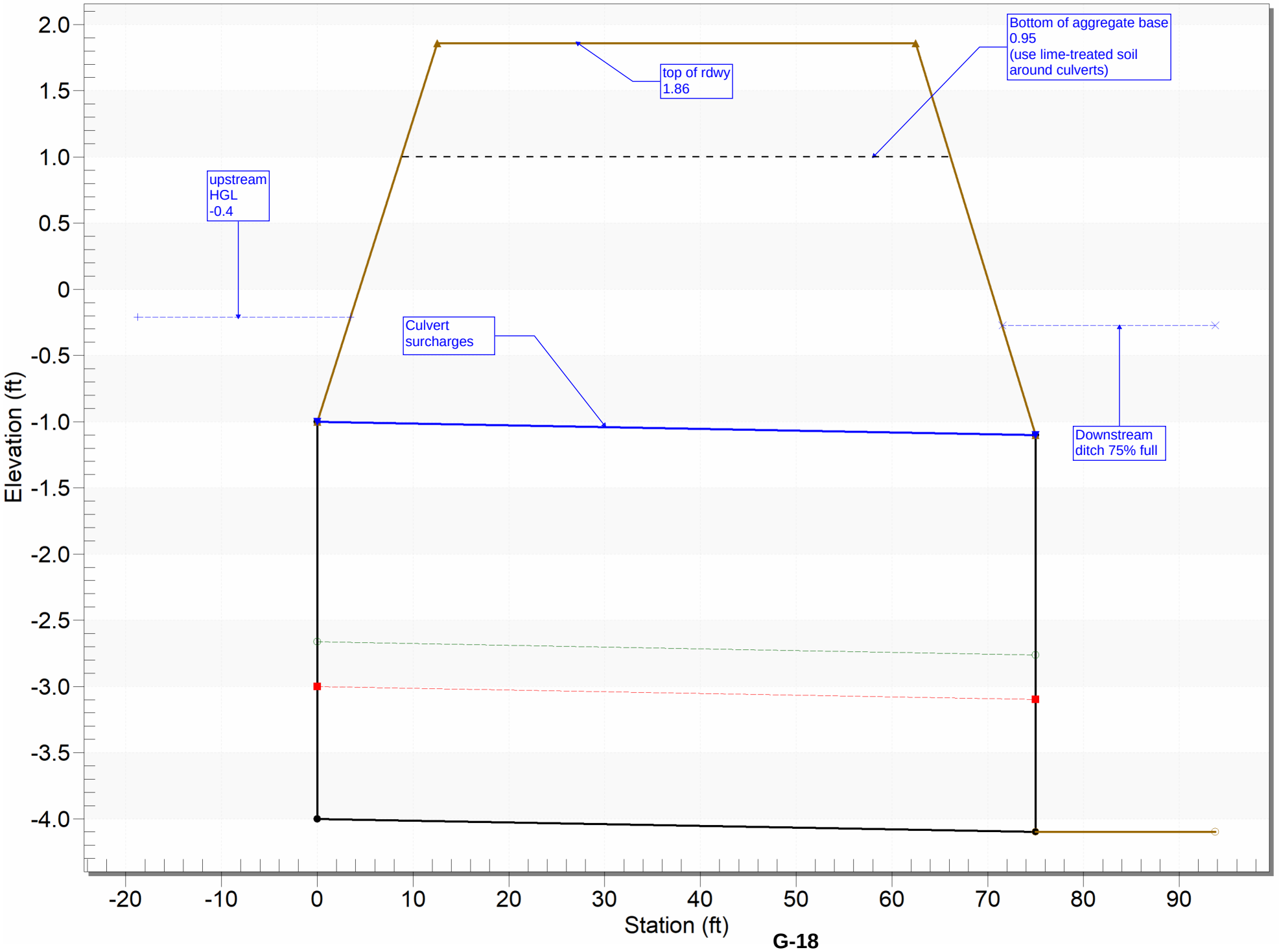
Crossing - Humphreys 100pct, Design Discharge - 20.0 cfs

Culvert - Culvert 1, Culvert Discharge - 20.0 cfs



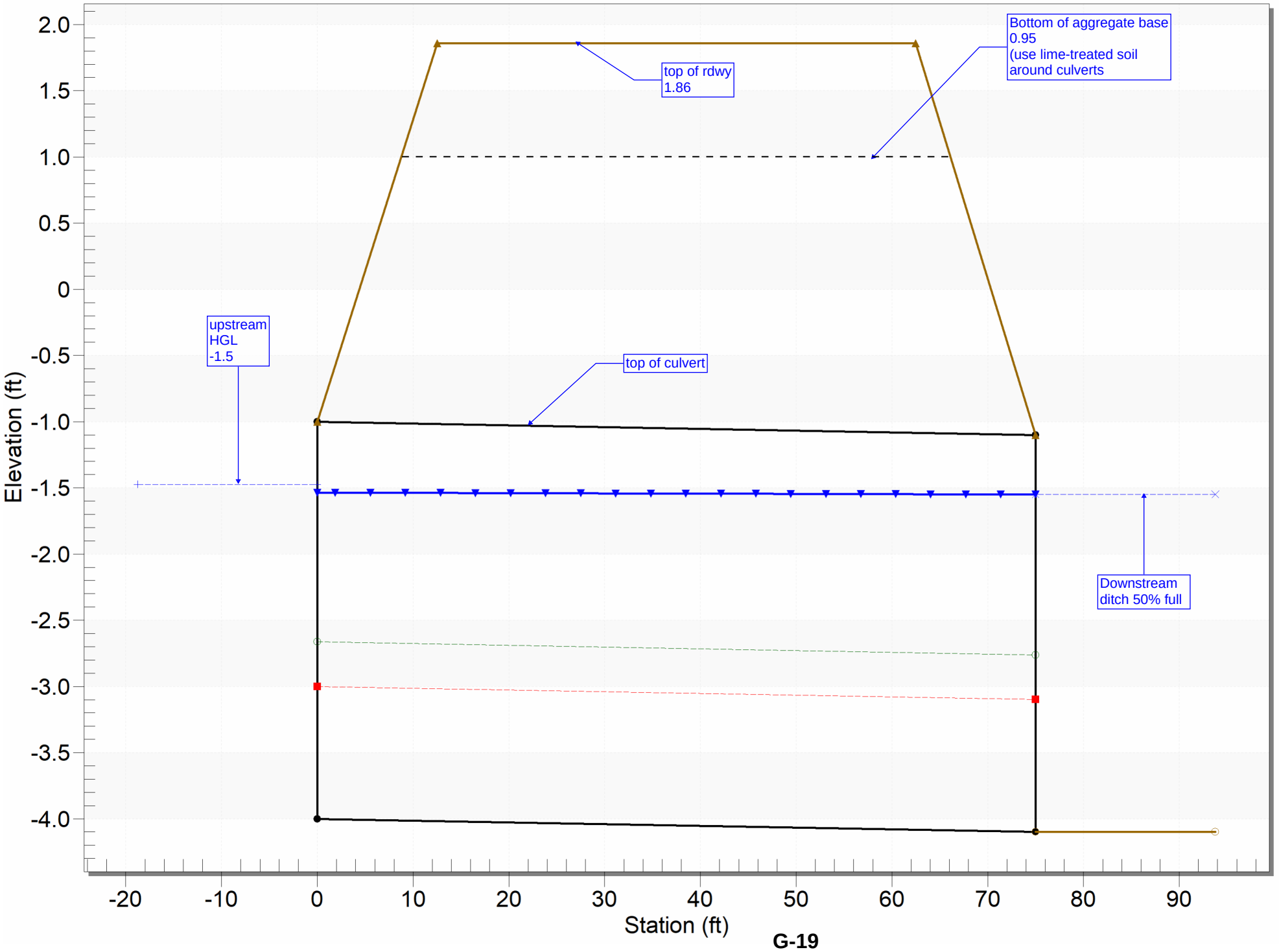
Crossing - Humphreys 75pct, Design Discharge - 20.0 cfs

Culvert - Culvert 1, Culvert Discharge - 20.0 cfs



Crossing - Humphreys 50pct, Design Discharge - 20.0 cfs

Culvert - Culvert 1, Culvert Discharge - 20.0 cfs



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