FREMONT ST IMPROVEMENTS
LAS VEGAS BLVD TO 14TH ST

TECHNICAL DRAINAGE REPORT

PREPARED FOR:

CITY OF LAS VEGAS DEPARTMENT OF PUBLIC WORKS

PREPARED BY:

CA GROUP, INC.
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LAS VEGAS, NV 89146

DECEMBER 26, 2018

CA Group, Inc
CAVIOLA ANSON

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Executive Summary

CA Group is designing complete street improvements for Fremont St between Las Vegas Blvd and 14th St, a project referred to as the Fremont St Improvement Project, Las Vegas Blvd to 14th St (Fremont Project). The improvements will reconfigure the roadway width and lanes and provide landscape and amenity zones by eliminating a loading zone and narrowing the roadway section. The project also includes improvements to existing bus stops on Carson Ave, between 8th St and 9th St, and on 13th Ave, between Maryland Pkwy and Carson Ave. Funding for the Fremont St Improvement project is provided by the Regional Transportation Commission of Southern Nevada (RTC) under the Fuel Revenue Indexing (FRI) initiative.

The *Fremont St Improvements, Las Vegas Blvd to 12th St Preliminary Drainage Memorandum* (Fremont Drainage Memo) was prepared for the Fremont Project that identified street sections where the 100-year water surface was above nearby finished floor elevations. As a result, the City of Las Vegas requested a 100-year stormdrain system be included in the Fremont Project to protect these properties during a flood event. This subsequent technical drainage study was prepared to accompany the 90 percent construction document submittal for the Fremont Project. The purpose of this study is to present the results of the analyses performed to estimate the storm runoff that impacts the project and for design of flood control facilities. It includes the modeling and calculations performed for design of the proposed stormdrain system in Fremont St (Fremont Stormdrain) and calculations revised since the Preliminary Drainage Memo was submitted. It also documents the design of a temporary stormdrain facility in Fremont St that allows for future connection into the Flamingo Wash Maryland Pkwy system (Maryland Stormdrain), a Master Plan Flood Control Facility that is currently under design.

The hydrologic analysis for Fremont St was based on the model prepared for the Maryland Stormdrain and included in the *Flamingo - Boulder Hwy North, Charleston – Maryland To Boulder Hwy And Maryland Pkwy System, Preliminary Design Report* (Charleston/Maryland Drainage Report). The referenced model was prepared for the ultimate condition, which assumes both the stormdrain in Las Vegas Blvd and the Maryland Stormdrain are constructed; however, construction of these projects is not expected to be concurrent. Fremont St is expected to be constructed first, followed by Las Vegas Blvd, then the Maryland Stormdrain. Therefore, for the Fremont Project, the following conditions exist: 1) Interim 1, where Fremont St is constructed; 2) Interim 2, where Fremont St and Las Vegas Blvd are constructed; and 3) the ultimate condition. At the time this study was being prepared, 70 percent construction documents for Las Vegas Blvd were completed November 2018, and 70 percent construction documents for the Maryland Stormdrain were being completed.

To estimate the peak flow rates within the Fremont Project, the subbasins in the Charleston/Maryland Drainage Report (MPU subbasin) were subdivided at each road intersecting Fremont St. Then the ratio of each smaller subbasin area to the MPU subbasin within which it is located was calculated. This ratio was multiplied by the peak flow of the MPU subbasin and the resulting flow rated added to the flow rates estimated for upstream subbasins to estimate the peak flow rates at each intersection. This exercise was performed to determine both the 10- and 100-year flows. To address the interim conditions, flows diverted to the Las Vegas Blvd stormdrain and to the Maryland Stormdrain were added

back to the concentration points affecting the Fremont Project. The highest peak flow rates in Fremont St occur for the 100-year Interim 1 condition; the 10-year interim conditions are less than the peak flow rates for the ultimate condition.

The stormdrain system in Fremont St (Fremont Stormdrain) will be located between 10th St and Maryland Pkwy. The associated drop inlets, laterals and main line are designed to capture and convey the 100-year ultimate flow in Fremont St to the Maryland Stormdrain. In addition, the downstream end of the system was designed for the period between construction of the stormdrain in Fremont St and construction of the MPU facility in Maryland Pkwy. For this condition, the system in Fremont St was designed with a bubbler system that operates during surcharge conditions and to vertically discharge the 100-year storm while meeting a 1.5 ft maximum depth of flow in the street.

The bubbler system is designed with a sacrificial manhole set at roughly the midpoint of the connection to the future Maryland Stormdrain. This manhole connects the stormdrain to the bubbler system. When the MPU facility is constructed, this manhole can be removed and the connection to the Maryland Stormdrain completed without damaging the upstream connection of the drop inlet laterals to the stormdrain mainline. An 18in. RCP constructed with the bubbler system and connecting to a drop inlet east of Maryland Pkwy can be cut and connected to the east side of the MPU facility, providing an additional drop inlet downstream of Maryland Pkwy.

Normal depth calculations were performed to verify adjacent properties are protected during the 100-year storm. The Fremont Drainage Memo reported 5 properties with finished floor elevations below the existing 100-year water surface elevation. In the ultimate condition, the finished floor elevations are all above the 100-year water surface elevation. For those properties that are currently below the 100-year water surface, a modest amount of freeboard is provided, 0.1 ft in most cases. In Interim 1, the depth of flow at the five properties that are currently below the 100-year water surface is reduced by the proposed stormdrain; however, four of the finished floor elevations are slightly below the Interim 1 water surface. In all cases, the proposed stormdrain improves the existing condition, and once the stormdrain proposed in Las Vegas Boulevard is constructed, these properties will be protected. This stormdrain system is part of the 70 percent improvement package that was submitted to the City of Las Vegas November 2018.

Depth times velocity criteria are met for the 10- and 100-year storm events. Between Las Vegas Boulevard and 8th Street, drylane, by definition, cannot be met because the proposed street section is only 30 feet wide (two 10 ft travel lanes and a 10 ft center turn lane). Between 8th and 13th, the proposed stormdrain system provides a dry half street section between 13 and 17 feet wide. Considering a 12 ft center turn lane, the drylane provided is 8 to 12 feet. The drylane calculations are conservative because they include flow that is potentially captured by existing roof drains and the two existing drop inlets located east of Las Vegas Blvd.

According to the RTC's Policy and Procedures Manual, RTC funds may be used to fund flood control projects required to meet the All-Weather-Roads criteria and for facilities located within 600 ft of an existing MPU facility or facility on the 10-year plan. The stormdrain system proposed with the Fremont

Project meets both these requirements. Therefore, it is anticipated that the RTC will fully fund the proposed stormdrain facility.

Based on the hydrologic and hydraulic analyses, CA Group recommends that the City of Las Vegas construct the stormdrain system and bubbler facility proposed in this study and shown on the 90 percent plans for the Fremont St Improvements. Potential conflicts between the proposed stormdrain system and existing utilities were identified during design of the stormdrain. CA Group also recommends potholing proposed lateral and mainline locations at utility crossings to identify vertical conflicts and opportunities to minimize these conflicts.

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1. Introduction

Fremont St is an existing 80-foot public right-of-way located downtown in the City of Las Vegas, Section 34, Township 20 and Range 61. Traffic in Fremont St flows in the northwest and southeast directions. CA Group is designing complete street improvements for Fremont St between Las Vegas Blvd and 14th Street, a project referred to as the Fremont St Improvement Project, Las Vegas Blvd to 14th Street (Fremont Project). The improvements will reconfigure the roadway width and lanes and provide landscape and amenity zones by eliminating a loading zone and narrowing the roadway section. The project also includes improvements to existing bus stops on Carson Ave, between 8th St and 9th St, and on 13th Ave, between Maryland Pkwy and Carson Ave. The project extents are shown on Figure 1, Vicinity Map.

Flood control improvements associated with the Fremont Project include drop inlets and a stormdrain designed to collect and convey 100-year storm flow to a future Clark County Regional Flood Control District Master Plan Facility located in Maryland Pkwy. A Preliminary Drainage Memo was prepared for the Fremont Project that identified street sections that did not meet drainage criteria published in the Clark County Regional Flood Control District's Hydraulic Criteria and Drainage Design Manual.

This subsequent technical drainage study was prepared to accompany the 90 percent construction document submittal for the Fremont Project. The purpose of this study is to present the results of the analyses performed to estimate the storm runoff that impacts the project and for design of flood control facilities. It includes the modeling and calculations performed for design of the proposed stormdrain system in Fremont St (Fremont Stormdrain) and calculations revised since the Preliminary Drainage Memo was submitted. It also documents the design of a temporary facility in Fremont St that allows for future connection into the Regional system.

2. Project Background Information

2.1 FEMA Floodplain Information

The Project is located on the Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Map (FIRM) panel 2170 of 4090, Map Number 32003C2170F, revised November 16, 2011. Figure 2 shows the limits of the project on this FIRM panel. The project lies within areas of minimal flood hazard designated as Zone X. Zone X indicates the areas are determined to be outside of the 0.2-percent-annual-chance floodplain.

2.2 Clark County Regional Flood Control District Facilities

The Clark County Regional Flood Control District's (CCRFCD) Las Vegas Valley Flood Control Master Plan (MPU) provides the sizes and locations of the existing and planned flood control facilities within the valley. The master plan is required to be updated a minimum of once every 5 years. The last update was adopted in 2013 and the 2018 update is expected to be adopted early 2019.

Figure 3A is a map showing the project location with respect to the MPU facilities in the area. This figure is reproduced from Figure F-32 of the MPU. An annotated facility inventory is also included as Figure 3B.

Figure 3A shows the Fremont Project crosses a proposed MPU facility in Maryland Pkwy. This facility is the Flamingo Wash Maryland Pkwy system, designation number FLMP 0000. It is currently being designed by Atkins, under contract to the City of Las Vegas. The design is part of the scope for the Flamingo - Boulder Hwy North, Charleston – Maryland to Boulder Hwy and Maryland Pkwy System. The portion in Maryland Pkwy is referred to as the Maryland Stormdrain. The Preliminary Design Report for this system was prepared by Atkins, November 10, 2017. This report is referred to as the Charleston/Maryland Drainage Report. It includes hydrologic analysis for the watershed contributing flow to the system, a hydraulic analysis of the proposed system, and 30 percent design drawings.

The 30 percent design drawings for the Maryland Stormdrain show a 6 ft by 4 ft reinforced concrete box (RCB) system in Maryland Pkwy. In addition, a 36 in. diameter reinforced concrete pipe (RCP) stormdrain in Fremont St with four, 20-ft long drop inlets near the corner of Fremont St and Maryland Pkwy are shown to capture the 100-year flow. Work to complete the 70 percent drawings for the Maryland Stormdrain was in progress during the time this drainage study was being prepared. Updated plans and analyses associated with the design of the Maryland Stormdrain will need to be studied to verify no subsequent changes affect the Fremont Project. Referenced sections from the Charleston/Maryland Drainage Report are included in Appendix C.

2.3 Local Facilities

A site visit was performed to inventory the existing flood control facilities within the project area. These facilities were also surveyed and are shown on the construction drawings. A minor system with four, 3-ft long drop inlets exists between Las Vegas Boulevard and 7th Street. Flow captured by these drop inlets is conveyed northwest in an existing 18 in. RCP to an existing 48 in. RCP stormdrain system located in Las Vegas Blvd. Photographs of these inlets were provided in the Preliminary Drainage Memorandum for the Fremont Project prepared by CA Group, August 2018. The proposed design for Fremont St will protect these inlets and associated stormdrain in place.

As-built drawings for the 18 in. RCP in Fremont St show connections to several roof drains at the existing drop inlets. They also show the stormdrain sloped at 0.3 percent. Therefore, the maximum it will convey from the project area is 6 cfs. It is not known whether the roof drains include area outside of the subbasin boundaries; therefore, calculations performed for this study include the 6 cfs that is potentially captured by this existing stormdrain system.

The Las Vegas Blvd Improvements, Stewart Ave to Sahara Ave, Project will construct a 42 in. RCP stormdrain system in Las Vegas Blvd at the intersection of Fremont St. This system is expected to capture and convey 10-year storm flows approaching Fremont St from the northwest side of Las Vegas Blvd. The existing connections to the 18 in. RCP in Fremont St will be maintained. This project is currently being designed by CA Group. Construction of Fremont St is scheduled to start October 2019; construction for Las Vegas Blvd is expected to start the following spring (2020).

2.4 Previous Studies

As previously noted, a Preliminary Drainage Memorandum for the Fremont Project, referred to as Fremont Drainage Memo, was prepared by CA Group and is included as Appendix C. The Fremont

Drainage Memo provided a comparison between the existing and developed condition water surface elevations during a 100-year storm and showed the finished floor elevations with respect to these water surface elevations. Elevation data for the existing grades for Fremont Street were referenced from the LIDAR data provided to CA Group for the project. The City also provided CA Group with finished floor elevations at building entrances where flow depths were higher than the back of walk. For both the existing condition and after the roadway improvements are constructed, the analysis identified several properties with finished floor elevations below the 100-year water surface. As a result, CA Group recommended a storm drain system be included in the Fremont Street Project to protect these properties during a flood event.

The hydrologic calculations performed for the Preliminary Memo were updated for the two interim conditions described in Section 3, Hydrology. The normal depth calculations were also updated to reflect recommended grading for the street sections.

3. Hydrologic Analysis

3.1 Reference Study Hydrologic Criteria and Modeling

The design for the Maryland Stormdrain was performed in accordance with the CCRFCD *Hydrologic Criteria and Drainage Design Manual (HCDDM)*. It included a hydrologic analysis that encompassed the Fremont Project area. This analysis was described in the Charleston/Maryland Drainage Report, portions of which are included in Appendix C. To predict storm runoff, the analysis used the Soil Conservation Service (SCS) method to estimate rainfall losses and the SCS unit hydrograph method for transforming precipitation excess to runoff.

The model format used was the HEC-1 Flood Hydrograph Computer Model Version 4.1 (dated June 1998). This program was developed by the U.S. Army Corps of Engineers Hydrologic Engineering Center in the late 1970's and adopted in 1988 by the CCRFCD's HCDDM for rainfall and runoff predictions. The HEC-1 model simulates the surface runoff response of a watershed to a design rainfall event by representing the watershed as an interconnected system of hydrologic and hydraulic components. Each component models an aspect of the rainfall-runoff process within a portion of the watershed. This portion is referred to as a subbasin. The model combined the runoff hydrographs of these subbasins to obtain a final discharge hydrograph.

HEC-1 input parameters include the design storm, subbasin delineation, curve numbers, lag time and flow routing. These parameters were described in detail in the Charleston/Maryland Drainage Report. The design storm included both the 10- and 100-year 6-hour storm events. The storm distribution model SDN3, referenced from Table 503 of the *HCDDM,* was used because the upstream watershed area at any given concentration point is less than eight square miles.

The HEC-1 model was prepared for the ultimate condition. This condition assumes that both the 10-year capacity stormdrain system in Las Vegas Blvd and the MPU facility in Maryland Pkwy are constructed. Contour information provided in the Charleston/Maryland Drainage Report and the 2 ft contours available on the Clark County GISMO website were examined to determine flow patterns during the

interim conditions that exist after the Fremont Project is constructed: 1) before the stormdrain in Las Vegas Blvd is constructed; and 2) before the Maryland Stormdrain is constructed.

To estimate the peak flow rates within the Fremont Project, the subbasins in the Charleston/Maryland Drainage Report (MPU subbasin) were subdivided at each road intersecting Fremont St. Then the ratio of each smaller subbasin area to the MPU subbasin within which it is located was calculated. This ratio was multiplied by the peak flow of the MPU subbasin and the resulting flow rated added to the flow rates estimated for upstream subbasins to estimate the peak flow rates at each intersection. This exercise was performed to determine both the 10- and 100-year flows. These calculations are included in Appendix A. To address the interim conditions, flows diverted to the Las Vegas Blvd stormdrain and to the Maryland Stormdrain were added back to the concentration points affecting the Fremont Project.

3.2 Maryland Stormdrain Hydrologic Modeling Results

The subbasins developed for the Fremont Project are shown with respect to the MPU subbasins on Figure 4. Referring to this figure and the subbasin map published in the Charleston/Maryland Drainage Report and included in Appendix C, the MPU subbasins affecting the project are subbasins 59-3, 60A-3 and 68-2. For the ultimate condition, storm runoff generated in subbasin 59-3 is conveyed southeast within Fremont St. The model diverts the 10-year surface flow, 24 cfs, to the future stormdrain in Las Vegas Blvd. The remaining flow, 25 cfs during the 100-year storm, continues southeast in Fremont St, through subbasin 60A-3. The total surface flow at the intersection of Fremont St and Las Vegas Blvd is 61 cfs during the 100-year storm. Most of this flow is captured by proposed drop inlets and continues south within the Maryland Stormdrain. The remaining flow, 1.5 cfs, continues southeast in Fremont St into subbasin 68-2. The results of the HEC-1 model for the area near the Fremont Project are summarized in Table 1.

The hydrologic model for the Maryland Stormdrain was prepared for the ultimate condition, which assumes both the stormdrain in Las Vegas Blvd and the Maryland Stormdrain are constructed. Construction of the projects is not expected to be concurrent. Fremont St is expected to be constructed first, followed by Las Vegas Blvd, then the Maryland Stormdrain. Therefore, for the Fremont Project, the following conditions exist: 1) interim 1, where Fremont St is constructed; 2) interim 2, where Fremont St and Las Vegas Blvd are constructed; and 3) the ultimate condition.

The available topographic contour information indicates that during both interim condition 1 and 2, the intersection of Stewart Ave and Maryland Pkwy, concentration point C60A-1, will continue southeast in Stewart Ave and will not impact the Fremont Project. However, surface flow will split at the intersection of Ogden Ave and Maryland Pkwy, concentration point C60A-2. The flow split is described in detail in Section 3.3, Fremont St Hydrologic Modeling Results.

Table 1: Maryland Pkwy Stormdrain HEC-1 Summary Ultimate Condition at Fremont St

MPU Basin / Concentration Point	Area, sq mi	Q10, cfs	Q100, cfs	Description
59-1	0.05386	38	76	MPU subbasin
DC1		38	38	Diversion to LVB Stormdrain
D59-1		0	38	Remaining flow
60A-1	0.0493	37	72	MPU subbasin
C60A-1	0.10316	37	99	Concentration point at Stewart and Maryland
59-2	0.03076	22	45	MPU subbasin
DC2		22	22	Diversion to LVB Stormdrain
D59-2		0	23	Remaining flow
60A-2	0.02992	22	43	MPU subbasin
C60A-2	0.06068	22	59	Concentration point at Ogden Maryland
CC60A-2	0.16384	58	156	Concentration point C60A-1 and -2
59-3	0.03367	24	49	MPU subbasin
DC3		24	24	Diversion to LVB Stormdrain
D59-3		0	25	Remaining flow
60-3	0.03114	23	46	MPU subbasin
C60A-3	0.06481	23	61	Concentration point at Fremont and Maryland
CC60A-3	0.22865	80	216	Concentration point CC60A-2 and C60A-3
68-2	0.04018	28	60	MPU subbasin

3.3 Fremont St Hydrologic Modeling Results

The designations for the subbasins developed for the Fremont Project and shown on Figure 4 are based on the MPU subbasin names with a letter appended to the end (e.g. MPU subbasin 60A-3 is divided into 60A-3A, 60-A3B, etc.). The peak flow rates for each of these subbasins during the 10- and 100-year storm events are listed in Table 2. The peak flow rates for the concentration points, located at the intersections within the Fremont Project, are listed in Table 3. Results are included for the three hydrologic conditions developed for the Fremont Project:

- Interim 1 - Fremont St improvements are complete and the existing drop inlets and stormdrain facilities are protected in place.
- Interim 2 – Fremont St improvements are complete and the 10-year system in Las Vegas Blvd is constructed.
- Ultimate Condition – the improvements described in interim condition 1 and 2 are complete and the MPU facility, Maryland Stormdrain, is constructed.

To estimate the surface flow conveyed to the project from the intersection of Ogden and Maryland Pkwy, C60A-2, during the two interim conditions, a flow split calculation was performed as described in Section 4.1, Hydraulic Criteria and Modeling. Calculations were performed for both the 10- and 100-year flows. Results from the flow split were used to determine peak flow rates during the interim condition at the intersection of Fremont St and Maryland Pkwy and are included in Table 3.

Referring to this table, peak flow rates within the Fremont Project for the 10- and 100-year storms are highest during the Interim 1 condition. However, the flow rates the 10-year Interim 1 are less than the 100-year ultimate condition.

Table 2: 10- and 100-year flow rates for Fremont St Subbasins

MPU subbasin	Total Basin Area (sq. mi)	10-Yr Flow (cfs)	100-Yr Flow (cfs)	Diverted Out (cfs)	Fremont St subbasin	Subbasin Area (sq. mi)	Prorated Basin Area (%)	Prorated 10-Yr Flow (cfs)	Prorated 100-Yr Flow (cfs)
59-3	0.03367	24	49	24	N/A				
60A-3	0.03114	23	46	-	60A-3A	0.003546	11.39%	2.62	5.24
					60A-3B	0.002086	6.70%	1.54	3.08
					60A-3C	0.001163	3.74%	0.86	1.72
					60A-3D	0.004163	13.37%	3.07	6.15
					60A-3E	0.006199	19.91%	4.58	9.16
					60A-3F	0.006623	21.27%	4.89	9.78
					60A-3G	0.007363	23.64%	5.44	10.88
68-2	0.04018	28	60	-	68-2A	0.009272	23.08%	6.46	13.85
					68-2B	0.010284	25.60%	7.17	15.36

Table 3: Summary of 10- and 100-year flow rates at Fremont St Intersections

Combination Points	Contributing Basins	Interim 1 10-Yr Flow (cfs)	Interim 2 10-Yr Flow (cfs)	Ultimate 10-Yr Flow (cfs)	Interim 1 100-Yr Flow (cfs)	Interim 2 100-Yr Flow (cfs)	Ultimate 100-Yr Flow (cfs)
CF6	59-3, 60A-3A	26.6	2.6	2.6	54.2	30.2	30.2
CF7	60A-3B	28.2	4.2	4.2	57.3	33.3	33.3
CF8	60A-3C	29.0	5.0	5.0	59.0	35.0	35.0
CF9	60A-3D	32.1	8.1	8.1	65.2	41.2	41.2
CF10	60A-3E	36.7	12.7	12.7	74.3	50.3	50.3
CF11	60A-3F	41.6	17.6	17.6	84.1	60.1	60.1
C60A-3	59-3, 60A-3 (FROM HEC-1)	47.0	23.0	23.0	85.0	61.0	61.0
C60A-2	59-2, 60A-2 (FROM HEC-1)	44.0	22.0	N/A	65.0	43.0	N/A

Combination Points	Contributing Basins	Interim 1 10-Yr Flow (cfs)	Interim 2 10-Yr Flow (cfs)	Ultimate 10-Yr Flow (cfs)	Interim 1 100-Yr Flow (cfs)	Interim 2 100-Yr Flow (cfs)	Ultimate 100-Yr Flow (cfs)
Flowsplit Ogden/ Maryland (Q_L)		10.0	5.0	N/A	14.0	10.0	N/A
Surface flow at Fremont/ Maryland		57.0	28.0	N/A	99.0	71.0	N/A
CF13	68-2A, C60A-2, C60A-3	63.5	34.5	6.5	108.8	84.8	13.8
CF14	682-B, CF13	77.1	48.1	13.6	138.0	114.0	29.2

4. Hydraulic Analysis

4.1 Hydraulic Criteria and Modeling

Based on the preliminary findings reported in the Fremont Drainage Memo, which indicated the 100-year water surface is above the finished floor elevation of several buildings along Fremont St, the City of Las Vegas requested CA Group design a 100-year system to be constructed with the Fremont Project. The system will be located between 10th St and Maryland Pkwy and will connect to the Maryland Stormdrain that is currently in design. Design for the proposed stormdrain in Fremont St (Fremont Stormdrain) was performed in accordance with HCDDM. For the ultimate condition, when the Fremont Stormdrain is connected to the Maryland Stormdrain, the following criteria were used:

- Maintain the hydraulic grade line (HGL) at 1 ft below the final grade above the stormdrain at all locations; utilize locking manhole lids for HGL less than 1.5 ft below the final grade.
- Limit the maximum velocity in the system to 25 ft/sec and the minimum velocity in the system to 3 ft/sec at half or full conduit flow conditions (minimum 0.3 percent slope of the stormdrain).
- Increase conduit cross section area in the downstream direction. Locate manholes a maximum of 400 ft apart and outside of the normal vehicle wheel path.
- Provide minimum 18-in. diameter RCP for new stormdrain laterals.
- Manning's roughness used for design is 0.013.

In addition to these criteria, the downstream end of the system was designed for the period between construction of the stormdrain in Fremont St and construction of the MPU facility in Maryland Pkwy. For this condition, the system in Fremont St was designed for surcharge conditions using the following criteria:

- Design a downstream drop inlet and lateral to function as a bubbler to discharge storm flow from the system; the lateral will be oriented such that it can be connected to the future MPU facility and the drop inlet used to capture and convey flow to the future system (i.e. the lateral will be sloped downstream toward the future system).

- Manholes at the downstream end of the Fremont Stormdrain will have grated lids. These lids shall also have hinges oriented toward oncoming traffic so that City maintenance crews can retrofit the lids to open under surcharge conditions with a maximum clear opening of 6 inches.
- Provide extended concrete collars for the manholes.
- City of Las Vegas criteria for vertical discharge: The maximum water surface above the manholes and drop inlets calculated using the orifice equation shall not exceed 1.5 feet (using an orifice coefficient of 0.65).

The Water Surface Pressure Gradient Hydraulic Model (WSPG) 2010 software, updated by XP Software, was used to estimate hydraulic losses, including friction, expansion, contraction, bend, and junction losses, and to calculate the energy grade line (EGL) and hydraulic grade line (HGL) for both Maryland Stormdrain and the 100-year facility proposed in Fremont St. The starting HGL for the Fremont Stormdrain was referenced from the WSPG analysis for the Maryland Stormdrain. WSPG results for the Fremont Stormdrain are included in Appendix B; WSPG results for the Maryland Stormdrain are included in Appendix C.

The hydraulic grade line and energy grade line for the proposed laterals in Fremont St were calculated using Standard Form 6 from the HCDDM. The starting HGLs for the laterals were referenced from the WSPG analysis for the stormdrain main in Fremont St.

To design the surcharged system, HY-8 version 7.5 was used to determine the maximum flow rate that can be conveyed in the bubbler system. The remaining flow was then used to balance the flow discharged between the stormdrain manholes and the upstream drop inlets. The water surface elevation in the road is the elevation for which the sum of flow discharged from each of the manholes and the drop inlets is equal to the total the flow in the system (excluding the flow conveyed in the bubbler system).

The vertical discharge through the manholes was calculated using the method described in Chapter 14 of the Water Measurement Manual, United States Department of the Interior Bureau of Reclamation, downloaded November 30, 2018. https://www.usbr.gov/tsc/techreferences/mands/wmm/index.htm These results were compared to those obtained using the orifice equation to verify City of Las Vegas criteria for vertical discharge were met.

In addition to the stormdrain design, the following criteria applied to the project:

- Street capacity requires that the 10-and 100-year events meet a depth times velocity of less than 6 and 8, respectively. Additionally, streets with 80 ft or more right-of-way are typically required to provide a 12-ft drylane on either side of the 14 ft wide median (or center turn-lane) during the 10-year event. Because the street section is narrower than typical for an 80-ft right-of-way, a 12-ft drylane cannot be maintained. Therefore, the available drylane is reported. Additionally, this drylane is based upon the proposed 12-ft center turn lane.
- Depth and velocity for the street sections were based on the normal depth equation and were determined from FlowMaster V8i. Additionally, the existing buildings along the project need to

be protected during the 100-year storm (the 100-year water surface shall be below the back of curb in the proposed condition).

- Flow splits for the interim conditions were determined using Equation 12.3 from the Standards Manual for Drainage Design and Floodplain Management in Tucson, Arizona.
- Drop inlet capture was calculated using FlowMaster V8i, which utilizes procedures developed by the Federal Highway Administration's (FHWA) HEC-22. A 50 percent clogging factor was applied.
- The 6 cfs potentially captured by the existing 3 ft drop inlets is included in the downstream calculations for normal depth and drop inlet capture.

4.2 Street Flow and Drop Inlet Capture Calculations

The stormdrain and drop inlets proposed in Fremont St are designed for the ultimate condition flow rates. The drop inlets proposed are combination inlets on grade with an upstream "sweeper" (Type C-D Modified or Type C-M, Standard Drawing 412.1 and 422 of the Uniform Standard Drawings Clark County Area, respectively). Two 15 ft drop inlets northwest of 10th St and another two located southeast of 10th St capture most of the 100-year storm flow at the intersection of Fremont St and 10th St. Two 5 ft inlets are proposed at 11th St. These capture flow before it crosses 11th St. Northwest of Maryland Pkwy, two 15 ft inlets are proposed to capture the bulk of the 100-year storm. An additional inlet is proposed southeast of Maryland Pkwy. This inlet will collect bypass in the south side of Fremont St during the ultimate condition and function as bubbler in the interim conditions. Design of the bubbler system is described in Section 4.3, Discharge Calculations.

The total flow captured by the stormdrain system is 59 cfs during the 100-year storm. The remaining flow in the street and continuing south east is 2 cfs. This flow rate is equivalent to the 1.4 cfs bypass reported in the Charleston/Maryland Drainage Report. Drop inlet capture calculations are included in Appendix B. Table 4 is a summary of the peak flow rate in Fremont, flow captured by the drop inlets and flow in the Fremont Stormdrain. Figure 5 shows the surface flow, drop inlet capture, and stormdrain flow.

Table 4: Street, Drop Inlet Capture and Fremont Stormdrain Flow Summary Table

	Peak Flow Rates				Stormdrain	
	10-yr	100-yr				
Concentration Point / Description	**Ultimate (cfs)**	**Interim 1 (cfs)**	**Interim 2 (cfs)**	**Ultimate (cfs)**	**10-yr (cfs)**	**100-yr (cfs)**
CF6	2.6	54.2	30.2	30.2		
CF7	4.2	57.3	33.3	33.3		
CF8	5.0	59.0	35.0	35.0		
CF9	8.1	65.2	41.2	41.2		
CF10	12.7	74.3	50.3	50.3		
Flow captured by 2 ea. 15-ft DI West of 10th	-10.0	-28.0	-28.0	-28.0	10.0	28.0

Concentration Point / Description	Peak Flow Rates				Stormdrain	
	10-yr	100-yr				
	Ultimate (cfs)	Interim 1 (cfs)	Interim 2 (cfs)	Ultimate (cfs)	10-yr (cfs)	100-yr (cfs)
Remaining surface flow in Fremont at 10th	2.7	46.3	22.3	22.3		
Flow captured by 2 ea. 15-ft DI East of 10th	-2.7	-16.0	-16.0	-16.0	12.7	44.0
Remaining surface flow in Fremont at 10th	0.0	30.3	6.3	6.3		
CF11	17.6	84.1	60.1	60.1		
Street flow (CF11 minus flow in stormdrain)	4.9	40.1	16.1	16.1		
Flow captured by 2 ea. 5-ft DI West of 11th	-3.8	-8.0	-8.0	-8.0	16.5	52.0
Remaining surface flow in Fremont at 11th	1.1	32.1	8.1	8.1		
C60A-3	23.0	85.0	61.0	61.0		
Street flow (C60A-3 minus flow in stormdrain)	6.5	33.0	9.0	9.0		
Flow captured by 2 ea. 15-ft DI West of Maryland	-4.9	-7.0	-7.0	-7.0	21.4	59.0
Remaining surface flow in Fremont at Maryland (excludes vertical discharge)	1.6	26.0	2.0	2.0		
C60A-3 plus Maryland/Ogden Flow Split	N/A	99.0	71.0	N/A		
CF13	6.5	108.8	84.8	13.8		
CF14	13.6	138.0	114.0	29.2		

To minimize the amount of full-depth reconstruction of the asphalt section, the roadway grading will preserve as much of the centerline grades as possible and utilize steeper cross slopes for the outside lane. The maximum cross section slope recommended is 5%. The FlowMaster cross sections used to determine the normal depth reported in the Preliminary Study were updated as required to meet this criterion.

Normal depth calculations were performed for the 10- and 100-year ultimate conditions and for the interim condition with the greatest flows, Interim 1 for the 100-year storm. The results of the normal depth calculations are shown in tables 5 and 6.

Table 5 lists the normal depth and freeboard provided to the finished floor elevations. It shows that for the ultimate condition the proposed stormdrain will provide protection from the 100-year storm for all

the properties along the project. It also shows that most of the properties will also be protected during the Interim 1 condition.

The proposed stormdrain system improves upon the existing condition for the properties that have finished floor elevations below the 100-year water surface in the existing condition. Four of these properties will be fully protected once the stormdrain system in Las Vegas Blvd is constructed (Spring 2020).

Table 6 lists the depth times velocity results and the available drylane during the Ultimate condition. Depth times velocity criteria are met for the 10- and 100-year storm events. Between Las Vegas Boulevard and 8th St, drylane will not be met because the proposed street section is only 30 ft wide (two 10 ft travel lanes and a 10 ft center turn lane). Between 8th and 13th, the proposed stormdrain system provides a dry half street section between 13 and 17 ft wide. Reducing this to account for the 12 ft center turn lane, the drylane provided is 8 to 12 ft.

The drylane calculations are conservative because flow captured by roof drains and the existing drop inlets east of Las Vegas Blvd is included in these calculations. If excluded the total flow in the street west of Maryland Pkwy could be reduced by as much as 6 cfs.

Table 5: Normal Depth Calculations

Fremont Street Block	Cross Section No.	Station	Interim 1 Q_{100}, cfs	Ultimate Q_{100}, cfs	Depth, ft		Freeboard, ft (to back of walk or finished floor elev.)		Existing Condition Freeboard [1]
					Interim 1	Ultimate	Interim 1	Ultimate	
LVB to 6th	1P	Loading zone on south side	54.2	30.2	0.62	0.51	0.27	0.38	
LVB to 6th	2P	Loading zone on north side	54.2	30.2	0.72	0.62	0.06	0.16	
6th to 7th	5P	Loading zone on south side	57.3	33.3	0.68	0.57	0.12	0.23	
6th to 7th	6P	Loading zone on north side	57.3	33.3	0.70	0.60	0.43	0.53	
7th to 8th	7P	Loading zone on south side	59.0	35.0	0.78	0.69	0.09	0.18	
7th to 8th	8P	Loading zone on north side	59.0	35.0	0.70	0.59	0.31	0.42	
8th to 9th	10P	STA 24+11 RT	65.2	41.2	0.86	0.77	0.70	0.79	
8th to 9th	10P	STA 24+75 RT					0.18	0.27	
10th to 11th	11P	STA 29+70 LT	40.1	16.1	0.65	0.54	1.23	1.34	
10th to 11th	11P	STA 30+52 LT					0.18	0.29	
10th to 11th	11P	STA 30+77 LT					0.44	0.55	
10th to 11th	11P	STA 31+33 LT					0.32	0.43	
10th to 11th	11P	STA 32+37 RT					0.05	0.16	
10th to 11th	16P	STA 31+39 RT	40.1	16.1	0.71	0.58	(0.04)	0.09	-0.21
10th to 11th	16P	STA 32+37 RT					(0.02)	0.11	-0.21
11th to Maryland	12P1	STA 33+53 LT	32.1	8.1	0.62	0.42	0.81	1.01	
11th to Maryland	12P1	STA 33+35 RT					0.59	0.79	

Fremont Street Block	Cross Section No.	Station	Interim 1 Q_{100}, cfs	Ultimate Q_{100}, cfs	Depth, ft		Freeboard, ft (to back of walk or finished floor elev.)		Existing Condition Freeboard [1]
					Interim 1	Ultimate	Interim 1	Ultimate	
11th to Maryland	12P1	STA 33+75 RT					(0.14)	0.06	-0.21
11th to Maryland	12P1	STA 33+91 RT					0.36	0.56	
11th to Maryland	12P1	STA 34+09 LT					0.89	1.09	
11th to Maryland	12P1	STA 34+28 RT					0.23	0.43	
11th to Maryland	12P1	STA 34+67 RT					0.39	0.59	
11th to Maryland	12P1	STA 34+74 LT					1.57	1.77	
11th to Maryland	12P2	STA 34+81 RT	33.0	9.0	0.62	0.43	(0.03)	0.16	-0.10
11th to Maryland	12P2	STA 34+97 RT					0.28	0.47	
11th to Maryland	12P2	STA 35+29 RT					0.37	0.56	
11th to Maryland	17P	STA 35+45 RT	33.0	9.0	0.59	0.40	0.02	0.21	
11th to Maryland	17P	STA 35+65 RT					0.67	0.86	
11th to Maryland	17P	STA 36+00 LT					2.62	2.81	
11th to Maryland	17P	STA 36+17 RT					0.93	1.12	
Maryland to 13th (Interim)	13P	STA 37+38 LT	108.8	13.8	0.75	0.48	3.17	3.44	
Maryland to 13th (Interim)	13P	STA 37+89 LT					2.84	3.11	
Maryland to 13th (Interim)	13P	STA 38+32 LT					2.03	2.30	
Maryland to 13th (Interim)	13P	STA 38+36 LT					1.31	1.58	
Maryland to 13th (Interim)	13P	STA 38+87 LT					1.04	1.31	
Maryland to 13th (Interim)	13P	STA 39+36 LT					0.19	0.46	
Maryland to 13th (Interim)	13P	STA 39+42 LT					0.17	0.44	
13th to 14th (Interim)	14P	STA 41+26 LT	138.8	29.2	0.94	0.67	2.31	2.58	
13th to 14th (Interim)	14P	STA 42+07 LT					2.61	2.88	
13th to 14th (Interim)	14P	STA 41+37 RT					0.68	0.95	
13th to 14th (Interim)	14P	STA 41+78 RT					1.43	1.70	
13th to 14th (Interim)	14P	STA 42+15 RT					1.10	1.37	
13th to 14th (Interim)	15P	STA 42+86 LT	138.8	29.2	0.88	0.64	0.71	0.95	
13th to 14th (Interim)	15P	STA 43+68 LT					0.50	0.74	
13th to 14th (Interim)	15P	STA 43+29 RT					0.94	1.18	
13th to 14th (Interim)	15P	STA 43+49 RT					1.34	1.58	

[1] Freeboard for the four properties with finished floor elevations below the Interim 1 water surface elevation is referenced from the Fremont Drainage Memo

Table 6: Depth Times Velocity and Dry Lane Calculations for Ultimate Conditions

Fremont Street Block	Cross Section No.	Q_{10}, cfs	Q_{100}, cfs	Slope, %	V, ft/sec		Depth, ft		Depth times Velocity		Total Dry Roadway Width, ft	1/2 Dry Roadway Width, ft	Center Lane Width, ft	Dry Lane Width, ft
					10-yr	100-yr	10-yr	100-yr	10-yr	100-yr				
LVB to 6th	1P	2.6	30.2	0.89	1.81	3.38	0.25	0.51	0.45	1.72	17.5	8.8	10	3.8
LVB to 6th	2P	2.6	30.2	0.89	2.13	3.18	0.34	0.62	0.72	1.97	22.5	11.3	10	6.3
6th to 7th	5P	4.2	33.3	0.72	1.64	3.22	0.35	0.57	0.57	1.84	6.0	3.0	10	0.0
6th to 7th	6P	4.2	33.3	0.72	1.85	3.17	0.35	0.60	0.65	1.90	12.5	6.3	10	1.3
7th to 8th	7P	5.0	35.0	0.68	2.14	2.99	0.45	0.69	0.96	2.06	17.5	8.8	10	3.8
7th to 8th	8P	5.0	35.0	0.68	1.59	3.24	0.37	0.59	0.59	1.91	0.0	0.0	10	0.0
8th to 9th	10P	8.1	41.2	0.50	2.03	2.75	0.54	0.77	1.10	2.12	27.5	13.8	12	7.8
10th to 11th	11P	4.9	16.1	1.94	3.58	3.93	0.36	0.54	1.29	2.12	35.0	17.5	12	11.5
10th to 11th	16P	4.9	16.1	2.00	3.88	4.05	0.41	0.58	1.59	2.35	35.0	17.5	12	11.5
11th to Maryland	12P1	1.1	8.1	2.93	3.38	4.71	0.22	0.42	0.74	1.98	35.0	17.5	12	11.5
11th to Maryland	12P2	6.5	9.0	2.93	4.51	4.82	0.39	0.43	1.76	2.07	33.8	16.9	12	10.9
11th to Maryland	17P	6.5	9.0	2.93	4.25	4.56	0.36	0.40	1.53	1.82	32.5	16.3	12	10.3
Maryland to 13th	13P	6.5	13.8	1.75	3.21	3.53	0.39	0.48	1.25	1.69	28.8	14.4	12	8.4
13th to 14th	14P	13.6	29.2	2.16	4.00	4.65	0.57	0.67	2.28	3.12	30.0	15.0	12	9.0
13th to 14th	15P	13.6	29.2	2.16	4.03	4.87	0.54	0.64	2.18	3.12	28.8	14.4	12	8.4

4.3 Vertical Discharge Calculations (Bubbler System)

After the Fremont Stormdrain is constructed and before the MPU system is in place, the downstream end of the stormdrain system will be surcharged. The proposed system provides grated manhole lids for the three manholes located at the intersection of Fremont St and Maryland Pkwy. The manholes are located outside of the wheel path and the hinges are oriented northwest, toward oncoming traffic as required. Extended concrete collars are proposed for the manholes.

The downstream end of the stormdrain system was designed to discharge 61 cfs, the total 100-year flow at the intersection of Fremont St and Maryland Pkwy. An 18 in. RCP with a 15-ft long drop inlet are proposed for the bubbler system. The capacity of this pipe is between 10 and 20 cfs. For these flow rates, vertical discharge through the drop inlet is less than the 1.5 ft maximum. Because the flow in the lateral is limited to 20 cfs, discharge through the manhole connecting the lateral to the drop inlet is neglected. This produces a more conservative estimate for the water surface at the drop inlet.

The remaining flow in the Fremont Stormdrain, 50 cfs, is discharged through the two manhole grates and the two 15 ft drop inlets all located northwest of Maryland Pkwy (upstream of the bubbler system). The water surface elevation during a surcharge event is estimated to be a maximum of 1 ft above the road surface during the 100-year storm. Discharge calculations performed for the design of the bubbler system are included in Appendix B.

4.4 Fremont Stormdrain Design

The Fremont Stormdrain is proposed as a 30 in. RCP system. The WSPG analysis for this system was performed for the ultimate condition, after the downstream MPU is constructed. This analysis shows the hydraulic grade line for this system meets criteria (more than 1.5 feet below the finished road surface). Due to the slopes of the road ranging from 1 to 3 percent, the Fremont Stormdrain is designed at a supercritical slope. The downstream MPU system is set at a slope of 0.3 percent, as a result flow in this system is subcritical. Therefore, a hydraulic jump is expected and occurs within the Fremont Stormdrain upstream of its connection to the MPU facility. An additional hydraulic jump occurs farther upstream due to losses at a junction.

The Fremont Stormdrain and bubbler were designed to minimize the amount of infrastructure required to be removed to connect the Fremont Stormdrain to the MPU facility. The future connection from the Fremont Stormdrain to the MPU facility is shown on the 90 percent construction drawings for Fremont St. It is at approximately the same location as shown on the 30 percent plans for the Maryland Stormdrain. A sacrificial manhole is set at roughly the midpoint of this pipe and connects the stormdrain to the bubbler system. When the MPU facility is constructed, this manhole can be removed without damaging the upstream connection of the drop inlet laterals to the stormdrain mainline. The 18” RCP of the bubbler system can be cut and connected to the east side of the MPU facility, providing an additional inlet downstream. Because the flow continuing east in Fremont St is minimal, hydraulic calculations were not performed for this future drop inlet and lateral.

5. Funding

Funding for the Fremont St Improvement project is provided by the Regional Transportation Commission of Southern Nevada (RTC) under the Fuel Revenue Indexing (FRI) initiative. According to the RTC’s Policy and Procedures Manual, RTC funds may be used to partially fund flood control projects located within the limits of a funded RTC project. Funded facilities include drainage facilities designed to collect the 100-year storm event that are both within the project limits and within 600 ft of a CCRFCD MPU facility (existing or on the 10-year construction program). They also include those facilities required to provide All-Weather Roads, which are defined by the RTC as meeting the following criteria:
1) twelve ft of road in each direction remains serviceable (dry) for emergency vehicles during a 10-year storm 2) at cross streets, depth of water does not exceed curb depth during a 10-year storm 3) the roadway is protected from a 10-year storm for longitudinal drainage and a 100-year storm from transverse drainage.

The proposed stormdrain system is required to meet the All-Weather-Roads criteria. Additionally, the downstream section is located within 600 ft of the Maryland Stormdrain, a future MPU facility that is currently in design. Therefore, it is anticipated that the RTC will fully fund the proposed stormdrain facility.

6. Conclusions

The drainage analyses for the Fremont Project was conducted in accordance with the criteria set forth by the City of Las Vegas and the Clark County Regional Flood Control District. Background information was obtained from review of previous studies and site investigations. The hydrologic models prepared for the *Flamingo - Boulder Hwy North, Charleston – Maryland To Boulder Hwy And Maryland Pkwy System, Preliminary Design Report* were used as the basis for the hydrologic analysis to determine peak flow rates in Fremont St. This study was also used as a reference for the hydraulic analysis of the MPU system proposed in Maryland Pkwy.

Hydraulic calculations were performed to provide recommendations for drop inlet sizes and locations; to design a stormdrain system to capture and convey the 100-year storm flow to the future MPU facility in Maryland Pkwy; and to design a bubbler system for the interim condition (the Fremont Stormdrain is complete but the MPU system is not constructed). Street flow normal depth and velocity calculations were also performed. Three conditions were analyzed: 1) interim 1, where Fremont St is constructed; 2) interim 2, where Fremont St and Las Vegas Blvd are constructed; and 3) the ultimate condition, where the MPU facility in Maryland Pkwy is constructed.

Study findings are summarized as follows:

- The project site is within FEMA Flood Zone X.
- In the existing condition, the 100-year water surface elevations in Fremont St are above the sidewalk and in some cases above the finished floor elevations.
- The highest peak flow rates occur for the 100-year Interim 1 condition; the 10-year interim conditions are less than the peak flow rate for the ultimate condition.
- The proposed drop inlet sizes and locations shown on the stormdrain plans are designed to capture the 100-year ultimate storm flow.
- The proposed stormdrain system main and laterals meet CCRFCD HCDDM criteria and are sized to convey the 100-year storm flow to the future MPU facility located in Maryland Pkwy.
- The bubbler system proposed limits the depth of flow discharged from the system to less than the 1.5 feet.
- The proposed configuration limits the amount of infrastructure that will need to be removed to connect the system to the future MPU facility in Maryland Pkwy. It also allows the bubbler system to be utilized as a drop inlet in the ultimate condition.
- CCRFCD street flow depth times velocity criteria will be met as required in the HCDDM; where the street section width is only 30 feet and drylane, by definition, cannot be met; elsewhere, a drylane width of 8 to 12 ft is provided by the proposed stormdrain system. Note the estimated

drylane widths are conservative as they included flow that is potentially captured by existing roof drains and 3 ft inlets located east of Las Vegas Blvd.

- In the interim 1 condition, prior to construction of the 10-year system in Las Vegas Blvd, four properties along Fremont St have finished floor elevations below the 100-year water surface. However, this condition is improved from the existing condition because the 100-year water surface elevation has decreased and will be eliminated once Las Vegas Blvd is constructed (Spring 2020).
- After construction of the stormdrain system in Fremont St and the proposed 10-year system in Las Vegas Blvd, the existing finished floor elevations along the project will be above the 100-year water surface.

Based on the hydrologic and hydraulic analyses, CA Group recommends that the City of Las Vegas construct the stormdrain system and bubbler facility proposed in this study and shown on the 90 percent plans. Potential conflicts between the proposed stormdrain system and existing utilities were identified during design of the stormdrain. CA Group also recommends potholing proposed lateral and mainline locations at utility crossings to identify vertical conflicts and opportunities to minimize these conflicts.

7. *References*

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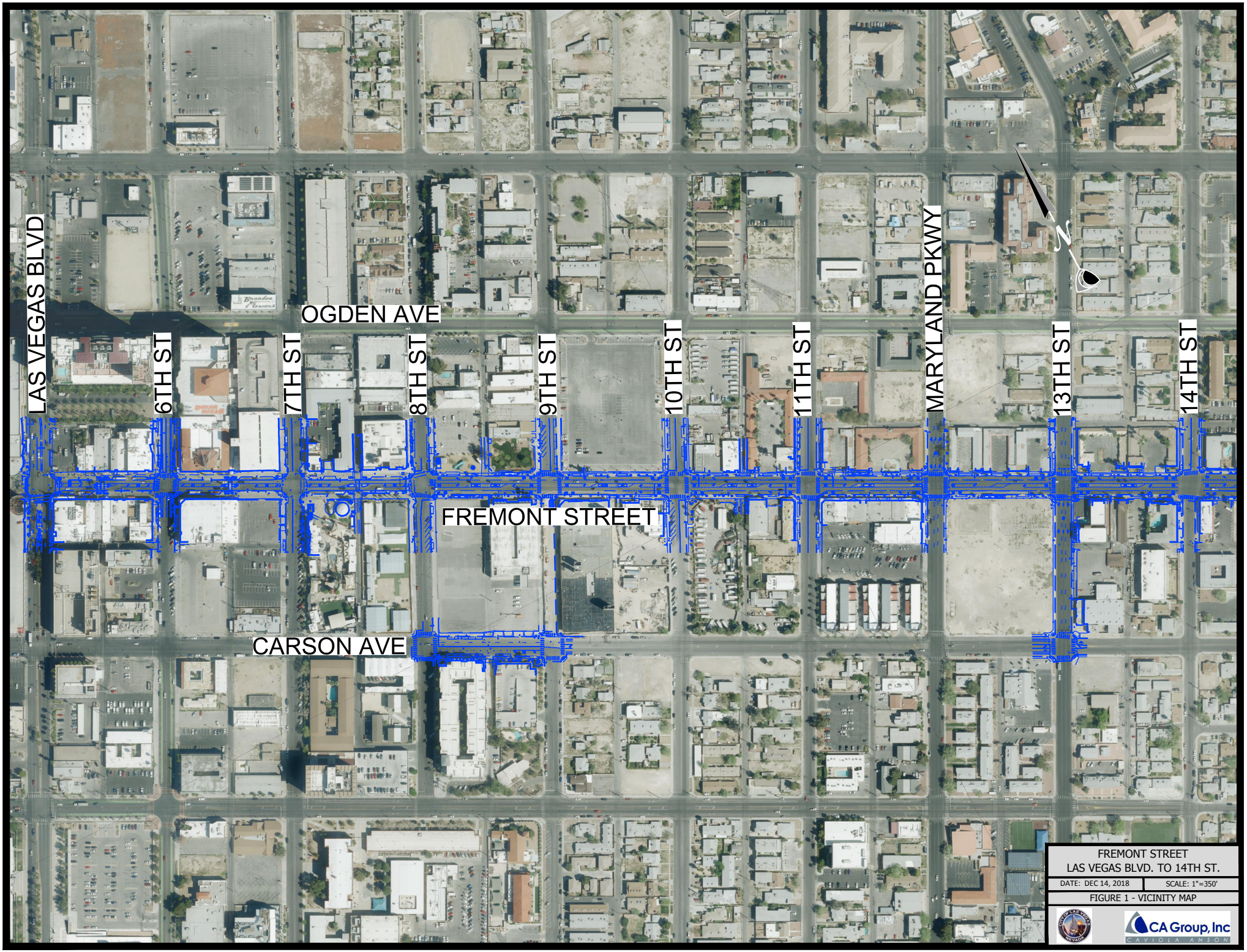
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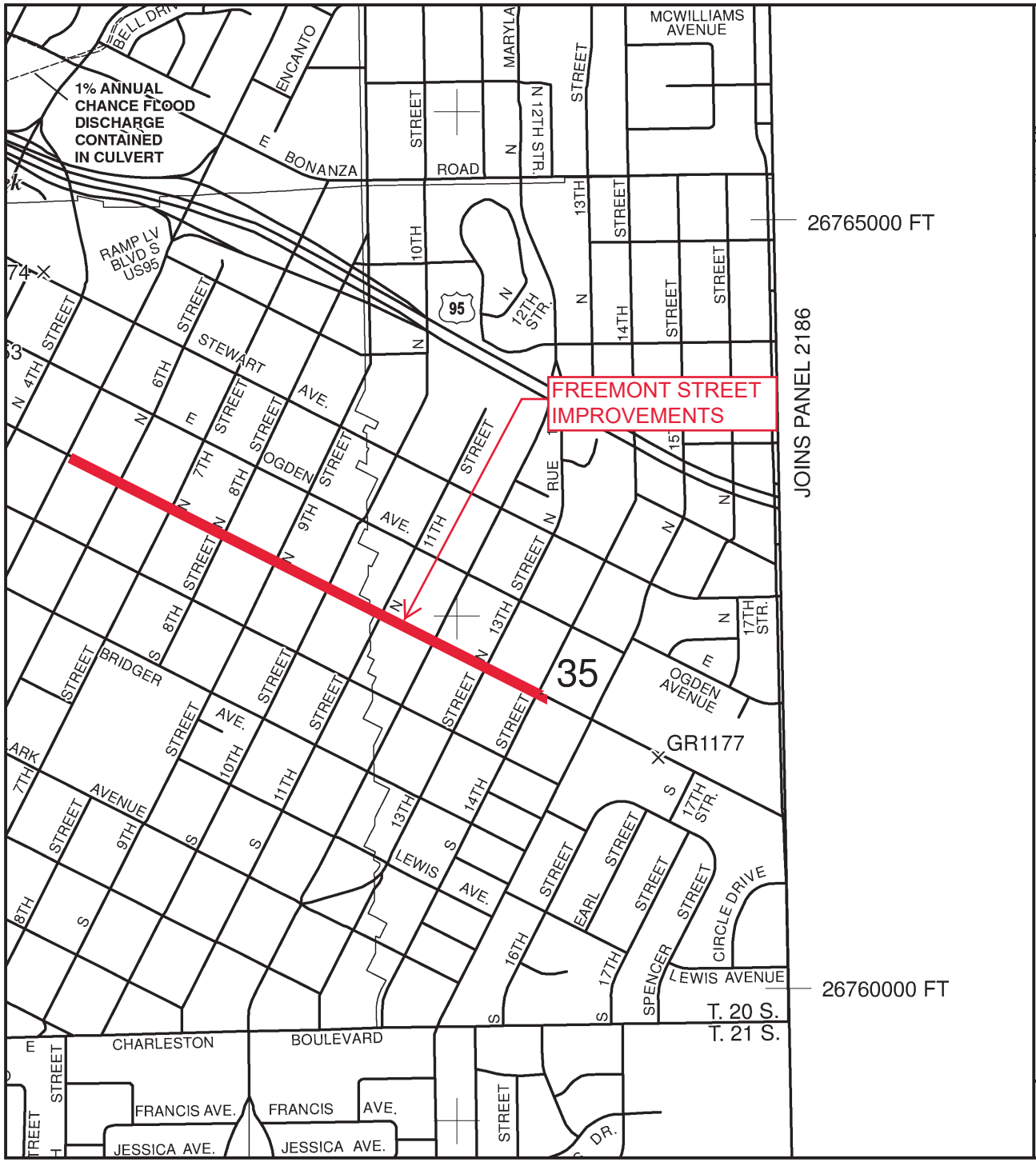
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LAS VEGAS BLVD
6TH ST
OGDEN AVE
7TH ST
8TH ST
9TH ST
10TH ST
11TH ST
MARYLAND PKWY
13TH ST
14TH ST
FREMONT STREET
CARSON AVE
FREMONT STREET
LAS VEGAS BLVD. TO 14TH ST.
DATE: DEC 14, 2018
SCALE: 1"=350'
FIGURE 1 - VICINITY MAP
CA Group, Inc
CAVIOLA ANSON



MAP SCALE 1" = 1000'

500 0 1000 2000 FEET METE

PANEL 2170F

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

CLARK COUNTY, NEVADA

AND INCORPORATED AREAS

PANEL 2170 OF 4090

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CLARK COUNTY	320003	2170	F
LAS VEGAS, CITY OF	325276	2170	F
NORTH LAS VEGAS, CITY OF	320007	2170	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
32003C2170F

MAP REVISED
NOVEMBER 16, 2011

Federal Emergency Management Agency

FIGURE 2

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

REGIONAL FLOOD CONTROL DISTRICT

2013
LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE

FIGURE F- 32
FLOOD CONTROL FACILITIES

LEGEND

- Ultimate Development Boundary
- Existing Facilities
- Category A Proposed Facilities
- Category B Proposed Facilities
- Local Existing Facilities
- Local Proposed Facilities
- Detention Basin
- Stormdrain
- Lined Channel
- Unlined Channel
- Levee/Dike
- Natural Wash/Floodway
- ID-Mile Separator

Remove & Replace/Parallel Facilities

Category A	Category B
Channel	Channel
Stormdrain	Stormdrain

N

0 500 1,000 2,000 3,000
Feet

Scale: 1 inch = 2,000 feet

Refer to Figure G-2 for Aerial Source(s)

US95 / I-15 / I-215

	1	2	3						A1	A2		
	4	5	6						A3	A4		
		7	8	9	10	A5	A6					
11	12	13	14	15	16	17						
	18	19	20	21	22	23						
	24	25	26	27	28							
	29	30	31	32	33	34						
	35	36	37	38	39	40						
	41	42	43	44	45	46						
	47	48	49	50	51	52						
	53	54	55	56								
	57	58	59									

FIGURE 3A

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
BHSA		**BOULDER HIGHWAY SAHARA AVENUE**						
0000	P2	14' X 10' RCB	1350	3837	CSA13*	SW3	7.93	0.50
0026	P1	14' X 11' RCB	4000	3837	CSA13*	SW3	7.93	1.30
0075	P1	12' X 11' RCB	5280	3837	CSA13*	SW3	7.93	2.11
0175	P1	14' X 14' RCB	6000	3837	CSA13	SW3	7.93	0.67
CABZ		**CEDAR AVENUE - BONANZA**						
0000	E	72" RCP	525					0.30
0010	E	60" RCP	1450					0.30
CACH		**CEDAR AVENUE CHANNEL**						
0000	E	Conc Chnl 10'W 8'D 1.5:1 SS	1681	1544	CCA10-C	SW3	1.81	0.20
0027	E	2: 15'X5' RCBC @ Marion	82	1544	CCA10-C	SW3	1.81	0.35
0029	E	Conc Chnl 10'W 8'D 1.5:1 SS	1284	1544	CCA10-C	SW3	1.81	0.37
0051	E	2: 15'X5' RCBC @ Page	64	1544	CCA10-C	SW3	1.81	0.38
0053	E	Conc Chnl 10'W 6'D 1.5:1 SS	1275	1544	CCA10-C	SW3	1.81	0.38
0079	E	2: 12' X 6' RCBC @ Lamb	100	1387	CCA08-C	SW3	1.61	0.38
0081	E	Conc Chnl 12'W 6'D 1.5:1 SS	2562	1387	CCA08-C	SW3	1.61	0.20
0127	E	3: 12'X4' RCBC @ Sandhill	80	1387	CCA08-C	SW3	1.61	0.20
0129	E	Conc Chnl 10'W 8'D 1.5:1 SS	971	1387	CCA08-C	SW3	1.61	0.26
0146	E	2: 12' X 5.5' RCBC @ Honolulu	62	1387	CCA08-C	SW3	1.61	0.53
0148	E	Conc Chnl 10'W 8'D 1.5:1 SS	959	1387	CCA08-C	SW3	1.61	0.53
CACN		**CEDAR AVENUE - CHARLESTON**						
0000	E	72" RCP (Replace w/ CACN0001)	1867	933	CCA05	SW3	0.96	0.41
0001	P1	10 'X 9' RCB (Replaces CACN0000)	1867	933	CCA05	SW3	0.96	0.41
0034	E	2: 48" RCP (Replace w/ CACN0035)	685	254	CA05	SW3	0.24	0.30
0035	P0	6' X 6' RCB (Replaces CACN0034)	685	254	CA05	SW3	0.24	0.30
0049	E	66" RCP (Replace w/ CACN0050)	2146	254	CA05	SW3	0.24	0.60
0050	P0	6' X 5' RCB (Replaces CACN0049)	2146	254	CA05	SW3	0.24	0.60
CNST		**CEDAR AVENUE CHANNEL - STEWART**						
0000	P1	8' X 7' RCB	2120	690	CCA04	SW3	0.72	0.90
COLM		**COLORADO / LAMB**						
0000	E	72" RCP	1500	470	CCH94	SW3	0.63	0.87
FLAG		**FLAMINGO WASH - ALGONQUIN**						
0000	E	72" RCP	1080	513	FW21	FLAM3A	0.47	0.50
0020	E	66" RCP	460	513	FW21	FLAM3A	0.47	1.00
FLBN		**FLAMINGO - BOULDER HIGHWAY NORTH**						
0001	E	5: 10' X 6' RCB	350	4784	CCFR03	BOULDER4	11.13	0.58
0008	E	3: 14' X 12' RCB	1055	4784	CCFR03	BOULDER4	11.13	0.20
0028	E	3: 14' X 12' RCB	275	4784	CCFR03	BOULDER4	11.13	0.20
0033	E	3: 14' X 12' RCB	500	4784	CCFR03	BOULDER4	11.13	0.20
0038	P1	15' X 10' RCB	6600	2448	CFR03	SW3	3.46	0.59
0167	P1	2: 10' X 6' RCB	700	2046	CCH68-C	SW3	2.86	1.14
0180	P1	2: 10' X 6' RCB	1300	1799	CCCH67-C	SW3	2.55	1.31
0205	P1	10' X 6' RCB	4000	1461	CCH63-C	SW3	1.88	2.30
0281	P1	10' X 7' RCB	3100	1259	CCH56	SW3	1.64	1.33
0312	P1	7' X 4' RCB	1800	555	CCH52	SW3	0.55	4.20
0342	P1	7' X 4'" RCB	2500	555	CCH52	SW3	0.55	4.20
FLBS		**FLAMINGO - BOULDER HIGHWAY SOUTH**						
0000	E	Unlined Median Chnl 0'W 6.5'D 4.5:1 SS	4060	945	CB4	FLAM3A	1.38	1.30
0167	E	Unlined Median Chnl 0'W 3.5'D 9:1 SS	8850	452	CB4N	FLAM3A	0.63	0.90
FLDN		**DESERT INN DRAIN EAST**						
0000	E	60" RCP (Replace w/ FLDN0001)	6160	1267	CFW30AW	FLAM3A	2.12	1.22
0001	P0	12' X 6' RCB (Replaces FLDN0000)	6160	1267	CFW30AW	FLAM3A	2.12	1.22
0116	E	54" RCP (Replace w/ FLDN0117)	2330	1178	CFW29	FLAM3A	1.82	1.77
0117	P0	10' X 6' RCB (Replaces FLDN0116)	2330	1178	CFW29	FLAM3A	1.82	1.77
0160	E	48" RCP (Replace w/ FLDN0160)	2950	906	CFW28	FLAM3A	1.51	1.28
0161	P0	10' X 6' RCB (Replaces FLDN0161)	2950	906	CFW28	FLAM3A	1.51	1.28

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
FLMP		**FLAMINGO WASH-MARYLAND PARKWAY SYSTEM**						
0000	P1	8' X 6' RCB	3800	492	CCH60A-C	SW3	0.75	0.49
FLSP		**FLAMINGO WASH - SPENCER**						
0000	E	48" RCP	420	513	FW21	FLAM3A	0.47	1.10
FLWA		**FLAMINGO WASH**						
0000	E	Grass Chnl 107'W 5'D 2:1 SS (Replace w/ FLWA0001)	4570	10952	CFW36*	FLAM5B	36.14	0.40
0001	P1	Conc Chnl 100'W 7.5'D 1:1 SS (Replaces FLWA0000)	4570	10952	CFW36*	FLAM5B	36.14	0.40
0078	E	3 Span Bridge 108.25'W 5.5'D @ Nellis	120	10952	CFW36	FLAM5B	36.14	0.70
0080	E	Conc Chnl 50'W 8.5'D 1:1 SS	5080	10952	CFW36	FLAM5B	36.14	1.20
0174	E	9: 10' X 6' RCBC @ Lamb	110	10822	CFW34	FLAM5B	35.66	1.40
0176	E	Conc Chnl 60'W 9'D 1:1 SS	1180	10822	CFW34	FLAM5B	35.66	0.70
0200	E	Conc Chnl 70'W 8'D to 12'D w/ Pier 0:1 SS	1245	10822	CFW34	FLAM5B	35.66	0.50
0226	E	Free Span Bridge 100'W 10'D @ I-515	170	10822	CFW34	FLAM5B	35.66	0.80
0228	E	Conc Chnl 70'W 8'D to 12'D 0:1 SS	1500	10788	CFW33	FLAM5B	35.36	0.80
0255	E	2 Span Bridge 150'W 9'D @ Boulder Hwy	65	10788	CFW33	FLAM5B	35.36	1.00
0256	E	Conc Chnl 60'W 7.5'D 0:1 SS	40	8146	CFW33W	FLAM5B	24.23	1.00
0257	E	2 Span Bridge 150'W 9'D @ Boulder Hwy	60	8146	CFW33W	FLAM5B	24.23	1.00
0258	E	Conc Chnl 60'W 7.5'D 0:1 SS	750	8146	CFW33W	FLAM5B	24.23	0.44
0273	E	Free Span Bridge 60'W 9'D @ MMMHP	20	8146	CFW33W	FLAM5B	24.23	0.40
0274	E	Conc Chnl 60'W 8.1'D 0:1 SS	1370	8146	CFW33W	FLAM5B	24.23	1.00
0295	E	Conc Chnl 60'W 8.1'D 0:1 SS	430	7669	CFW31	FLAM5B	22.62	0.80
0307	E	Conc Chnl 60'W 8.1'D 2:1 SS	410	7669	CFW31	FLAM5B	22.62	0.70
0314	E	Conc Chnl 60'W 8.1'D 2:1 SS	1500	7195	CFW30B	FLAM5B	21.25	0.90
0347	E	5: 10' X 8' RCBC @ Mojave	80	7195	CFW30B	FLAM5B	21.25	0.94
0348	E	Conc Chnl 30'W 12'D 1:1 SS	1150	7195	CFW30B	FLAM5B	21.25	0.70
0375	E	5: 10' X 8' RCBC @ Desert Inn	140	7102	CFW30A	FLAM5B	20.96	2.70
0377	E	Conc Chnl 50'W 9.5'D 0:1 SS	1372	6964	CFW23	FLAM5B	19.36	1.04
0399	E	Free Span Bridge 60'W 16'D @ McLeod	120	6964	CFW23	FLAM5B	19.36	0.50
0401	E	Conc Chnl 50'W 11.5'D 0:1 SS	123	6964	CFW23	FLAM5B	19.36	0.50
0406	E	Conc Chnl 33'W 11.5'D 0:1 SS	690	6964	CFW23	FLAM5B	19.36	1.01
0419	E	Conc Chnl 33'-50'W 9.8'D 0:1 SS	200	6964	CFW23	FLAM5B	19.36	2.00
0423	E	Conc Chnl 50'W 9.8'D 0:1 SS	1686	6964	CFW23	FLAM5B	19.36	0.76
0455	E	Conc Chnl 50'-75'W 9.8'D 0:1 SS	169	6964	CFW23	FLAM5B	19.36	1.83
0458	E	Conc Chnl 75'-80'W 9.8'D 0:1 SS	347	6964	CFW23	FLAM5B	19.36	1.50
0471	E	5: 10' X 8' RCBC @ Eastern	110	5781	CFW22W	FLAM5B	14.95	1.30
0472	P1	Add 1: 22' X 8' RCBC @ Eastern	110	5781	CFW22W	FLAM5B	14.95	0.50
0473	E	Grass Chnl 60'W 15'D 2:1 SS	100	5781	CFW22W	FLAM5B	14.95	0.47
0477	E	3 Span Bridge 47'W 15'D	10	5781	CFW22W	FLAM5B	14.95	0.80
0478	E	Grass Chnl 60'W 15'D 2:1 SS	520	5781	CFW22W	FLAM5B	14.95	0.47
0481	E	3: 90° CMAP @ Tioga (Replace w/ FLWA0482)	60	5781	CFW22W	FLAM5B	14.95	0.87
0482	P1	4: 20' X 8' RCBC @ Tioga (Replaces FLWA0481)	60	5781	CFW22W	FLAM5B	14.95	0.87
0483	E	Grass Chnl 60'W 15'D 2:1 SS	300	5781	CFW22W	FLAM5B	14.95	0.63
0492	E	3 Span Bridge 47'W 15'D	10	5781	CFW22W	FLAM5B	14.95	0.50
0493	E	Grass Chnl 60'W 15'D 2:1 SS	1520	5781	CFW22W	FLAM5B	14.95	0.46
0555	E	3 Span Bridge 47'W 15'D	10	5701	CFW21	FLAM5B	14.55	0.50
0556	E	Earth Chnl 60'W 15'D 2:1 SS (Replace w/ FLWA0557)	520	5701	CFW21	FLAM5B	14.55	0.54
0557	P1	Gabion Chnl 30'W 10.5'D 2:1 SS (Replaces FLWA0556)	520	5701	CFW21	FLAM5B	14.55	0.54
LVBZ		**LAS VEGAS WASH - BONANZA**						
0000	P1	2: 12' X 7' RCB	3400	1636	CBN15-C	SW3	2.40	0.40
0064	P1	2: 12' X 6' RCB	2630	1449	CBN12-C	SW3	2.12	0.40
0114	P1	2: 12' X 6' RCB	2740	1256	CBN10-C	SW3	1.79	0.40
0166	E	54" RCP (Replace w/ LVBZ0167)	1095	1051	CBN09	SW3	1.54	0.45
0167	P0	10' X 9' RCB (Replaces LVBZ0166)	1095	1051	CBN09	SW3	1.54	0.45
0187	E	48" RCP (Replace w/ LVBZ0188)	1235	1051	CBN09	SW3	1.54	0.71
0188	P0	9' X 9' RCB (Replaces LVBZ0187)	1235	1051	CBN09	SW3	1.54	0.71
0210	E	42" RCP (Replace w/ LVBZ0211)	704	911	CBN08	SW3	1.30	1.37
0211	P0	8' X 7' RCB (Replaces LVBZ0210)	704	911	CBN08	SW3	1.30	1.37
0223	E	36" RCP (Replace w/ LVBZ0224)	2275	722	CBN03	SW3	1.09	0.72
0224	P0	8' X 7' RCB (Replaces LVBZ0223)	2275	722	CBN03	SW3	1.09	0.72

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
LVCA		**LAS VEGAS WASH - CHARLESTON**						
0000	P1	12' X 9' RCB	4600	1104	CCH77-C	SW3	1.34	0.30
LVCO		**COLORADO AVENUE SYSTEM**						
0000	E	18' X 8' RCB	610	1015	CNEL06	SW3	1.30	0.24
0012	E	14' X 8' RCB	2560	1015	CNEL06	SW3	1.30	0.24
0064	E	10' X 8' RCB	2165	827	CCCH94	SW3	0.98	0.24
0106	E	10' X 8' RCB	590	394	CCH92-C	SW3	0.35	0.24
0109	E	10' X 5' RCB	2350	394	CCH92-C	SW3	0.35	0.67
LVMD		**LAS VEGAS WASH - MIDDLE**						
1032	E	Earth Chnl 75'W 10'-12'D 1:1 SS (Replace w/ LVMD1033)	715	15156	CNLWY	CLVWASH5	118.28	0.30
1033	P1	Conc Chnl 75'W 11'D 1:1 SS (Replaces LVMD1032)	739	15156	CNLWY	CLVWASH5	118.28	0.30
1045	E	5 Span Bridge 75'W 10'D 1:1 SS (Replace w/ LVMD1046)	120	15156	CNLWY	CLVWASH5	118.28	0.52
1046	P1	Bridge 75'W 9.5'D 1:1 SS @ Nellis (Replaces LVMD1045)	120	15156	CNLWY	CLVWASH5	118.28	0.52
1047	E	Earth Chnl 80'W 8'D 2:1 SS (Replace w/ LVMD1048)	340	15083	CCNEL06	CLVWASH5	117.81	0.50
1048	P1	Conc Chnl 120'W 8'D 0:1 SS (Replaces LVMD1047)	340	15083	CCNEL06	CLVWASH5	117.81	0.50
1053	E	Earth Chnl 80'W 8'D 2:1 SS (Replace w/ LVMD1054)	860	14811	CNEL04-2	CLVWASH5	116.51	0.50
1054	P1	Conc Chnl 120'W 8'D 0:1 SS (Replaces LVMD1053)	860	14811	CNEL04-2	CLVWASH5	116.51	0.50
1068	E	5 Span Bridge 90'W 6'D 2:1 SS (Replace w/ LVMD1069)	120	14438	CCST03-C	CLVWASH5	114.87	0.50
1069	P1	5 Span Bridge 110'W 8'D 2:1 SS (Replaces LVMD1068)	120	14438	CCST03-C	CLVWASH5	114.87	0.50
1070	E	Earth Chnl 90'W 10'-12'D 1.5:1 SS (Replace w/ LVMD1071)	2587	14438	CCST03-C	CLVWASH5	114.87	0.43
1071	P1	Conc Chnl 90'W 9'D 1.5:1 SS (Replaces LVMD1070)	2587	14438	CCST03-C	CLVWASH5	114.87	0.43
1119	E	5 Span Bridge 90'W 12'D 2:1 SS @ Stewart	120	14354	CCCA10-C	CLVWASH5	114.40	0.20
1120	E	Earth Chnl 90'W 12'D 1:1 SS (Replace w/ LVMD1121)	1400	14354	CCCA10-C	CLVWASH5	114.40	0.20
1121	P1	Conc Chnl 90'W 10.5'D 1:1 SS (Replaces LVMD1120)	1400	14354	CCCA10-C	CLVWASH5	114.40	0.20
1148	E	Earth Chnl 70'W 18'-20'D 1.5:1 SS (Replace w/ LVMD1149)	1675	13944	CCBN15-C	CLVWASH5	112.59	0.41
1149	P1	Conc Chnl 70'W 10'D 1.5:1 SS (Replaces LVMD1148)	1675	13944	CCBN15-C	CLVWASH5	112.59	0.41
1176	E	5 Span Bridge 110'W 20'D 2:1 SS @ Bonanza	120	12690	CLVW04-C	CLVWASH5	106.80	0.57
1178	E	Earth Chnl 30'W 18'-20'D 2:1 SS (Replace w/ LVMD1179)	1500	12690	CLVW04-C	CLVWASH5	106.80	0.57
1179	P1	Conc Chnl 60'W 9.5'D 2:1 SS (Replaces LVMD1178)	1500	12690	CLVW04-C	CLVWASH5	106.80	0.57
LVNE		**LAS VEGAS WASH - NELLIS**						
0000	P1	2: 13' X 10' RCB	4675	2303	CNEL02-C	WEST3	3.39	0.20
LVOE		**OWENS AVENUE - EAST**						
0345	P1	13' X 11' RCB	1685	2369	DLVOE	SW5	22.79	0.60
LVWH		**WASHINGTON AVENUE CHANNEL**						
0389	E	12' X 8' RCB	2110	1607	(1/2) CV1-C	SW5SC	15.16	0.90
0426	E	16' X 8' RCB	150	1607	(1/2) CV1-C	SW5SC	15.16	1.08
0429	E	Splitter Structure (2: 12' X 8' RCB)	190	2870	DCLC21	SW5	22.79	1.90
0431	E	3: 14.33' X 10' RCB	665	2870	DCLC21	SW5	22.79	0.15
0446	E	Junction Structure	69	2870	DCLC21	SW5	22.79	0.15
0447	E	3: 14.33' X 10' RCB	1955	4978	CCAL93	SW5	22.19	0.15
NLFL		**NELLIS FLAMINGO STORM DRAIN**						
0028	P0	Add 1: 7' X 6' RCB	1530	338^	CM3^	FLAM3A	1.27	0.39
0029	E	76" & 48" RCP	1530	391^	CM3^	FLAM3A	1.27	0.39
0059	E	60" RCP	1370	143^	CM3^	FLAM3A	1.27	0.30
0060	P0	Add 1: 12' X 6' RCB	1370	586^	CM3^	FLAM3A	1.27	0.34
0084	E	48" RCP	2490	79^	CM2^	FLAM3A	0.98	0.30
0085	P0	Add 1: 11' X 6' RCB	2490	505^	CM2^	FLAM3A	0.98	0.30
0131	E	42" RCP	650	350	M1	FLAM3A	0.51	0.23
0144	E	36" RCP	620	350	M1	FLAM3A	0.51	0.20
NLWY		**NELLIS - WYOMING CHANNEL**						
0000	E	Conc Chnl 8'W 4'D 1.3:1 SS	260	338	FW35	FLAM3A	0.47	1.71
0004	E	15' X 6' RCAC	80	338	FW35	FLAM3A	0.47	1.30
0006	E	Conc Chnl 8'W 4'D 1.3:1 SS	400	338	FW35	FLAM3A	0.47	0.38
0014	E	12' X 4' RCBC @ Winterwood	70	338	FW35	FLAM3A	0.47	0.40
0015	E	Conc Chnl 8'W 4'D 1.3:1 SS	720	338	FW35	FLAM3A	0.47	0.38
0028	E	12' X 4' RCBC @ Wyoming	90	338	FW35	FLAM3A	0.47	0.80
0030	E	Conc Chnl 8'W 4'D 1.3:1 SS	250	338	FW35	FLAM3A	0.47	0.38
SAEA		**SAHARA AVENUE - EASTERN LATERAL**						
0000	P1	10' X 8' RCB	1440	564	CFR02	SW3	0.66	0.20

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
VAVD		**VEGAS VALLEY DRIVE**						
0000	P1	8' X 6' RCB	1300	606	CFW32WW	FLAM3A	0.84	2.10
0025	P1	84" RCP	5300	606	CFW32WW	FLAM3A	0.84	1.60
VBCH		**VAN BUSKIRK CHANNEL**						
0000	E	12' X 3' RCB	500	888	CVB16	FLAM3A	1.16	1.00
0008	E	8' X 5' RCB	5490	888	CVB16	FLAM3A	1.16	1.00
VBEA		**VAN BUSKIRK - EASTERN AVE**						
0000	P1	14' X 6' RCB	3020	1561	CVB11	FLAM3A	3.35	1.30
VBMC		**VAN BUSKIRK - McLEOD DRIVE**						
0000	E	2: 8' X 8' RCB	3850	997	CVB13	FLAM3A	3.43	0.50
VBTW		**VAN BUSKIRK - TWAIN**						
0000	E	18" RCP	6640	541	CB2	FLAM3A	0.74	0.70
WAGC		**WASHINGTON AVENUE CHANNEL - GRAND CENTRAL**						
0000	E	2: 12' X 4' RCB	700	557	LC21	SW3	0.60	0.20
0014	E	1: 12' X 4' RCB and 1: 11' X 4' RCB	2440	557	LC21	SW3	0.60	0.20
WAPR		**WASHINGTON AVENUE CHANNEL PARALLEL**						
0132	E	2: 9' X 8' RCB	387	1607	(1/2) CV1-C	SW5SC	15.16	1.67

** The HEC-1 node shown identifies the controlling concentration point for the associated facility and is located upstream of this facility due to decreasing peak flow with increasing tributary area caused by storm distribution transitions, depth area reduction factors, or attenuation of flow from routing.*

*** As-built or design slopes were used when available. All other slopes are based on existing topography. The user should verify the facility slope listed prior to performing any facility specific analysis.*

^ For parallel facilities, the existing facility flow equals its normal depth capacity, and the proposed parallel facility flow equals the remaining flow (i.e., HEC-1 Node flow = existing facility normal depth capacity + proposed parallel facility flow).

REGIONAL FLOOD CONTROL DISTRICT

2013 LAS VEGAS VALLEY FLOOD CONTROL MASTER PLAN UPDATE

FACILITY INVENTORY FIGURE F - 32

LEGEND

ID (Facility Identifier) AABB
- Parent Stream Name
- Stream Name

River Mile 0000
- Distance Above Confluence with Parent Stream (Miles)
- Miles in Hundredths

Existing Facility.....E
Proposed or Modified Facility.....P
Contingency Level
- Category B.....P0
- Master Plan.....P1
- Preliminary Design.....P2
- Design.....P3

Bottom Width.....W

Depth.....D

Side Slope, H:V.....SS

Construction Features

Cast in Place Concrete Pipe	CIPCP	Reinforced Concrete Arch Culvert	RCAC
Corrugated Metal Arch Pipe Culvert	CMAP	Reinforced Concrete Box	RCB
Corrugated Metal Pipe Culvert	CMPC	Reinforced Concrete Box Culvert	RCBC
High Density Polyethylene	HDPE	Reinforced Concrete Pipe	RCP
Horizontal Elliptical Reinforced Concrete Pipe	HERCP	Reinforced Concrete Pipe Culvert	RCPC
Reinforced Concrete Arch Pipe	RCAP	Storm Sewer Pipe	SSP

FIGURE 3B

HYDROLOGIC ANALYSIS SYMMARY

Combination Points	Contributing Basins	Interim 1 10-Yr Flow (cfs)	Interim 2 10-Yr Flow (cfs)	Ultimate 10-Yr Flow (cfs)	Interim 1 100-Yr Flow (cfs)	Interim 2 100-Yr Flow (cfs)	Ultimate 100-Yr Flow (cfs)
CF6	59-3, 60A-3A	26.6	2.6	2.6	54.2	30.2	30.2
CF7	60A-3B	28.2	4.2	4.2	57.3	33.3	33.3
CF8	60A-3C	29.0	5.0	5.0	59.0	35.0	35.0
CF9	60A-3D	32.1	8.1	8.1	65.2	41.2	41.2
CF10	60A-3E	36.7	12.7	12.7	74.3	50.3	50.3
CF11	60A-3F	41.6	17.6	17.6	84.1	60.1	60.1
C60A-3	59-3, 60A-3 (FROM HEC-1)	47.0	23.0	23.0	85.0	61.0	61.0
C60A-2	59-2, 60A-2 (FROM HEC-1)	44.0	22.0	N/A	65.0	43.0	N/A
Flowsplit Ogden/ Maryland (Q_L)		10.0	5.0	N/A	14.0	10.0	N/A
Surface flow at Freemont/ Maryland		57.0	28.0	N/A	99.0	71.0	N/A
CF13	68-2A, C60A-2, C60A-3	63.5	34.5	6.5	108.8	84.8	13.8
CF14	682-B, CF13	77.1	48.1	13.6	138.0	114.0	29.2

LEGEND

Charleston/Maryland MPU Basins

Freemont Street Basins

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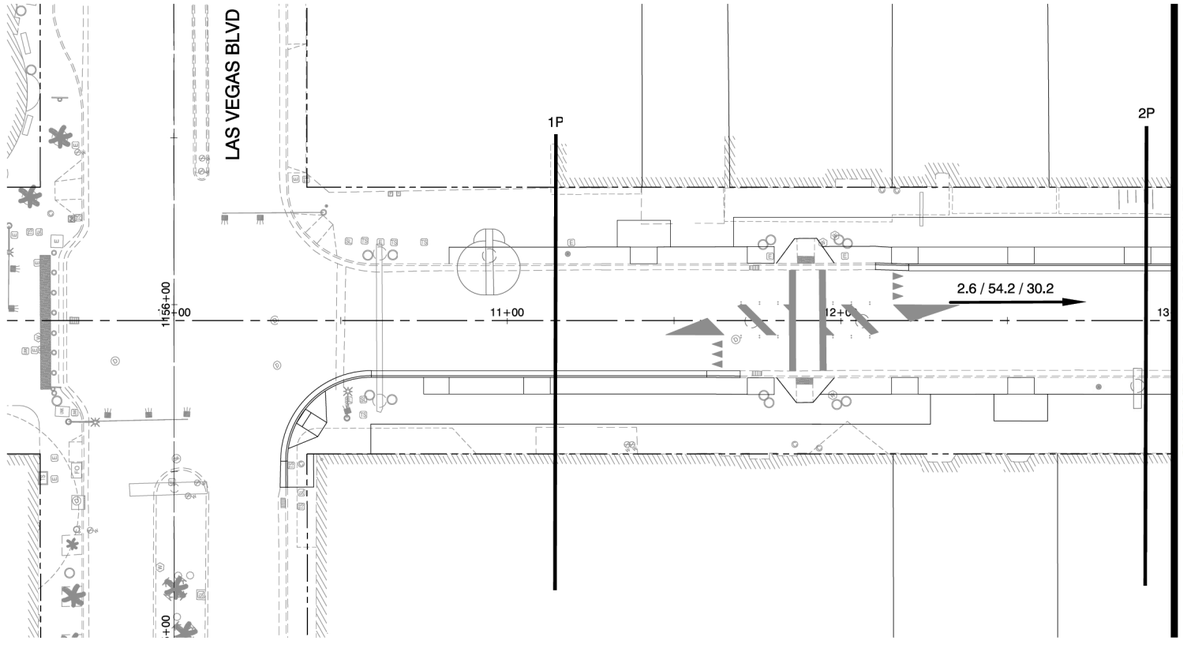
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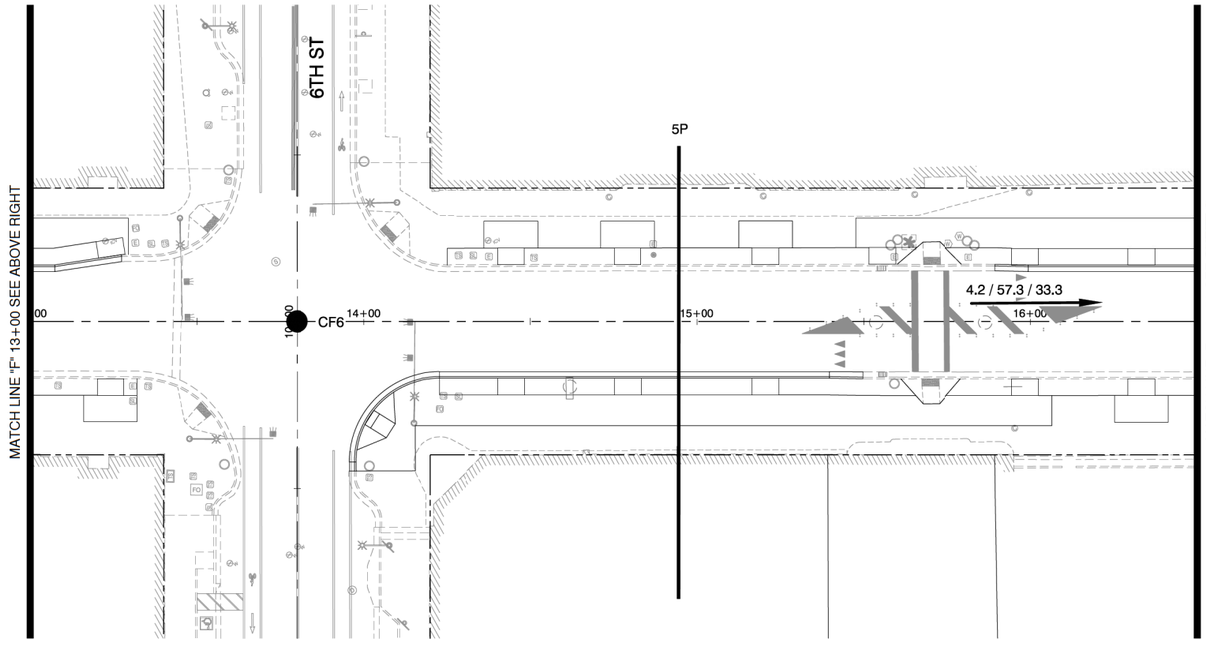
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FREMONT STREET IMPROVEMENT PROJECT
LAS VEGAS BLVD TO 14TH ST

SHEET
FIGURE 4 DRAINAGE BASIN MAP

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1 OF 1
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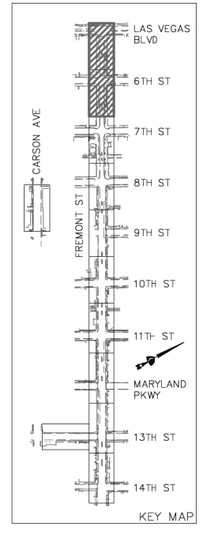
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LEGEND

10-YR ULTIMATE / 100-YR ULTIMATE	STORMDRAIN FLOW IN CFS
10-YR ULTIMATE / 100-YR INTERIM 1 / 100-YR ULTIMATE	STREET FLOW IN CFS
10-YR ULTIMATE / 100-YR ULTIMATE	DROP INLET FLOW IN CFS
1P	CROSS SECTION LOCATION
CF6	CONCENTRATION POINT



GRAPHIC SCALE
20 0 10 20 40
1" = 20' (AT 24" X 36")

NO.	DATE	SHEET	REVISIONS

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H # 72618

DATE: 12/21/18

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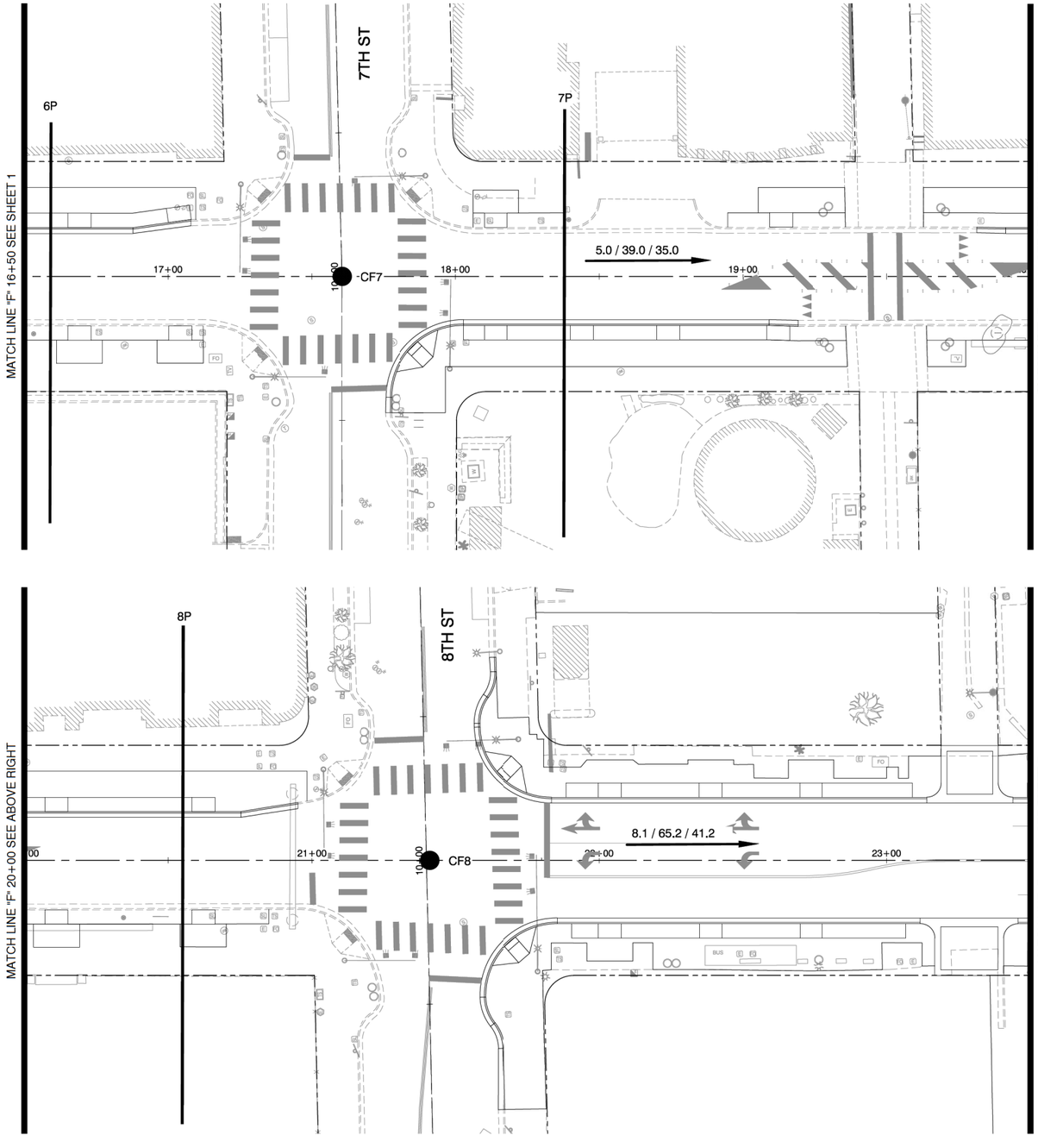
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FREMONT STREET IMPROVEMENT PROJECT
LAS VEGAS BLVD TO 14TH ST

SHEET
FIGURE 5
STREET & STORMDRAIN FLOW

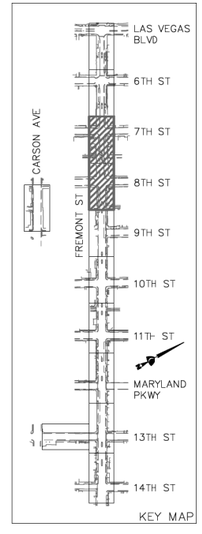
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LEGEND

10-YR ULTIMATE / 100-YR ULTIMATE	STORMDRAIN FLOW IN CFS
10-YR ULTIMATE / 100-YR INTERIM 1 / 100-YR ULTIMATE	STREET FLOW IN CFS
10-YR ULTIMATE / 100-YR ULTIMATE	DROP INLET FLOW IN CFS
1P	CROSS SECTION LOCATION
CF6	CONCENTRATION POINT



GRAPHIC SCALE
20 0 10 20 40
1" = 20' (AT 24" X 36")

REVISIONS	
NO.	
DATE	
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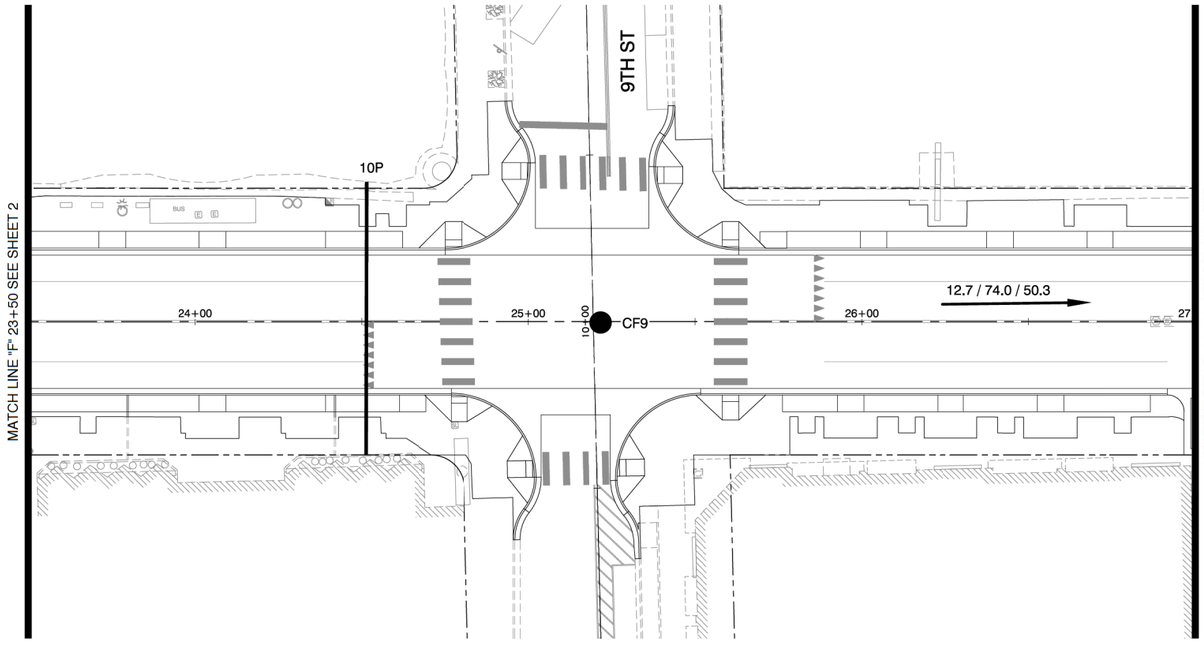
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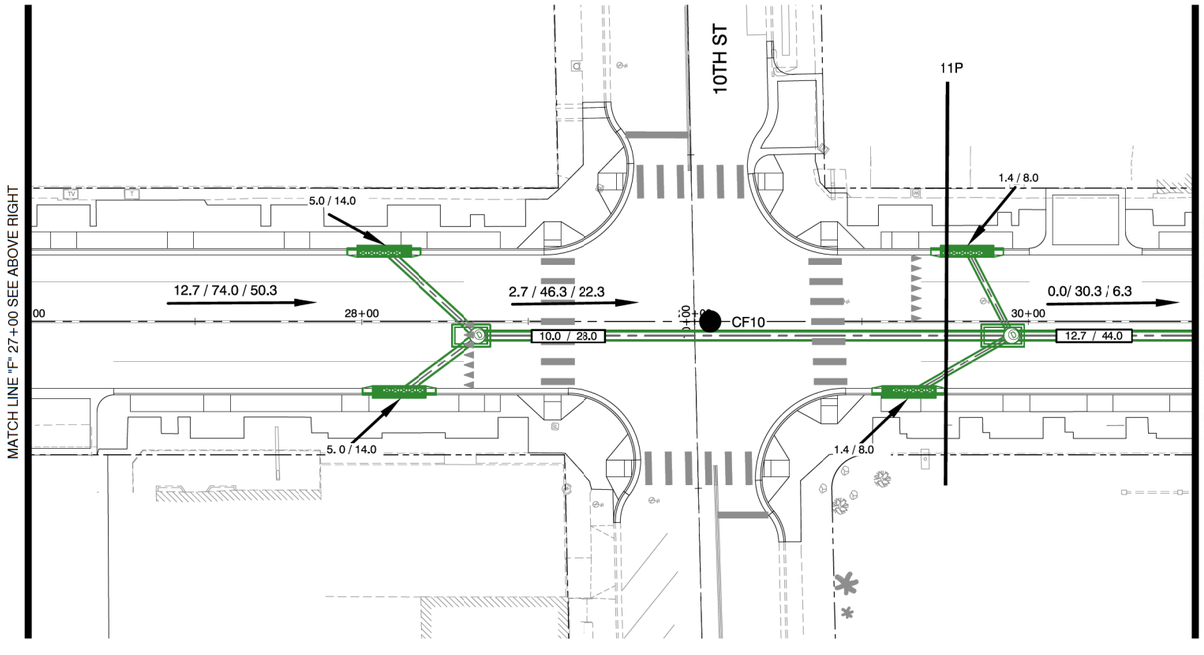
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LAS VEGAS BLVD TO 14TH ST

SHEET
FIGURE 5
STREET & STORMDRAIN FLOW

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2 OF 5
DRAWING NO.

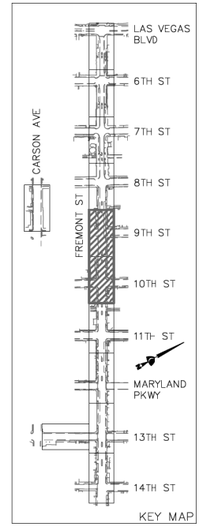
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LEGEND

10-YR ULTIMATE / 100-YR ULTIMATE	STORMDRAIN FLOW IN CFS
10-YR ULTIMATE / 100-YR INTERIM 1 / 100-YR ULTIMATE	STREET FLOW IN CFS
10-YR ULTIMATE / 100-YR ULTIMATE	DROP INLET FLOW IN CFS
1P	CROSS SECTION LOCATION
CF6	CONCENTRATION POINT



GRAPHIC SCALE
20 0 10 20 40
1" = 20' (AT 24" X 36")

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NO.	DATE	SHEET	REVISIONS

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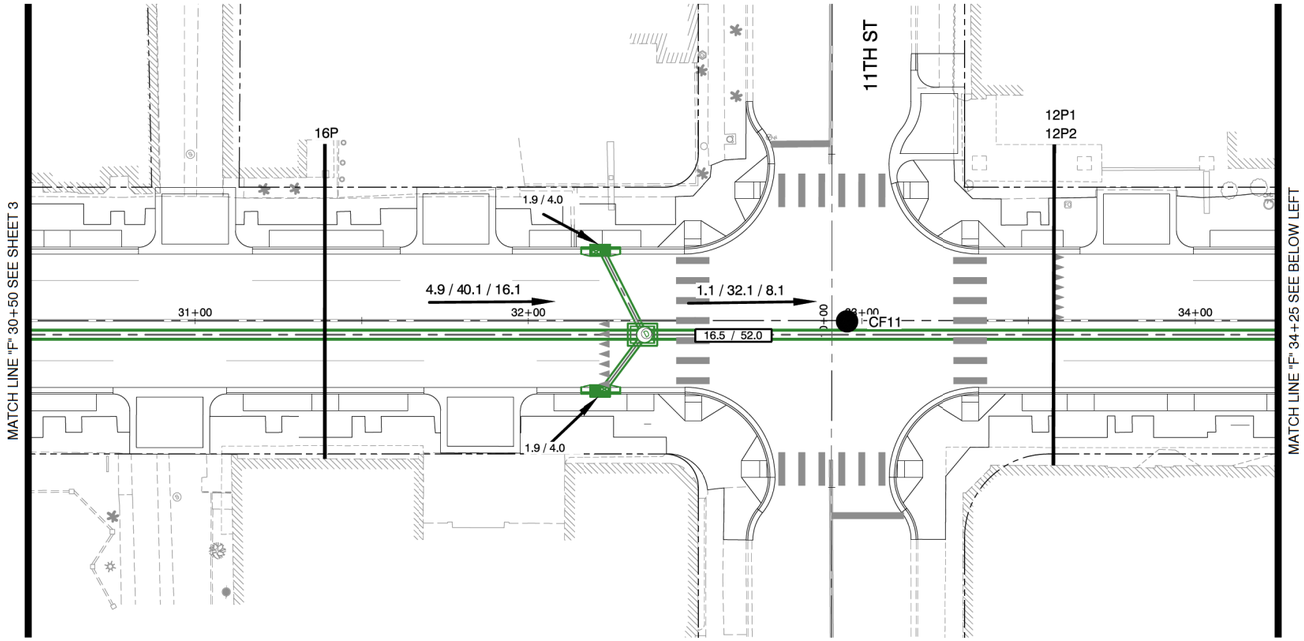
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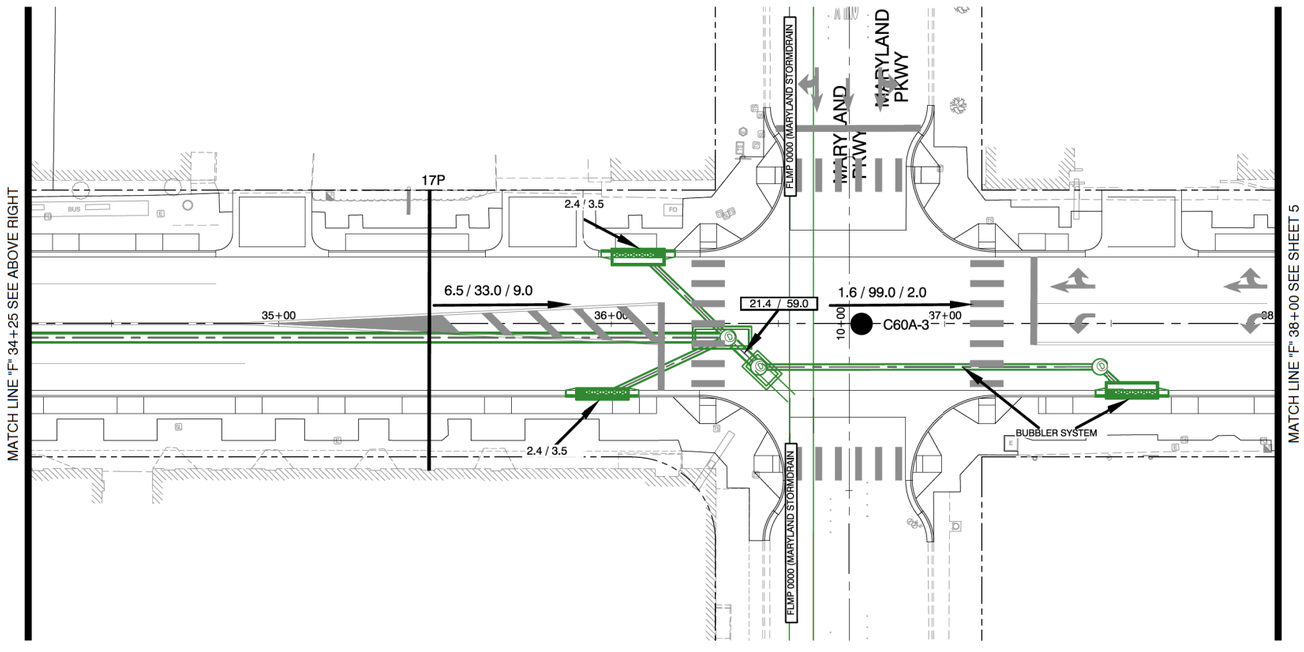
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FREMONT STREET IMPROVEMENT PROJECT
LAS VEGAS BLVD TO 14TH ST

SHEET
FIGURE 5
STREET & STORMDRAIN FLOW

SHEET
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3 OF 5
DRAWING NO.

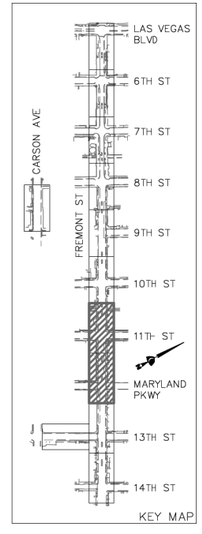
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LEGEND

10-YR ULTIMATE / 100-YR ULTIMATE	STORMDRAIN FLOW IN CFS
10-YR ULTIMATE / 100-YR INTERIM 1 / 100-YR ULTIMATE	STREET FLOW IN CFS
10-YR ULTIMATE / 100-YR ULTIMATE	DROP INLET FLOW IN CFS
1P	CROSS SECTION LOCATION
CF6	CONCENTRATION POINT



GRAPHIC SCALE
20 0 10 20 40
1" = 20' (AT 24" X 36")

REVISIONS	NO.	DATE	SHEET

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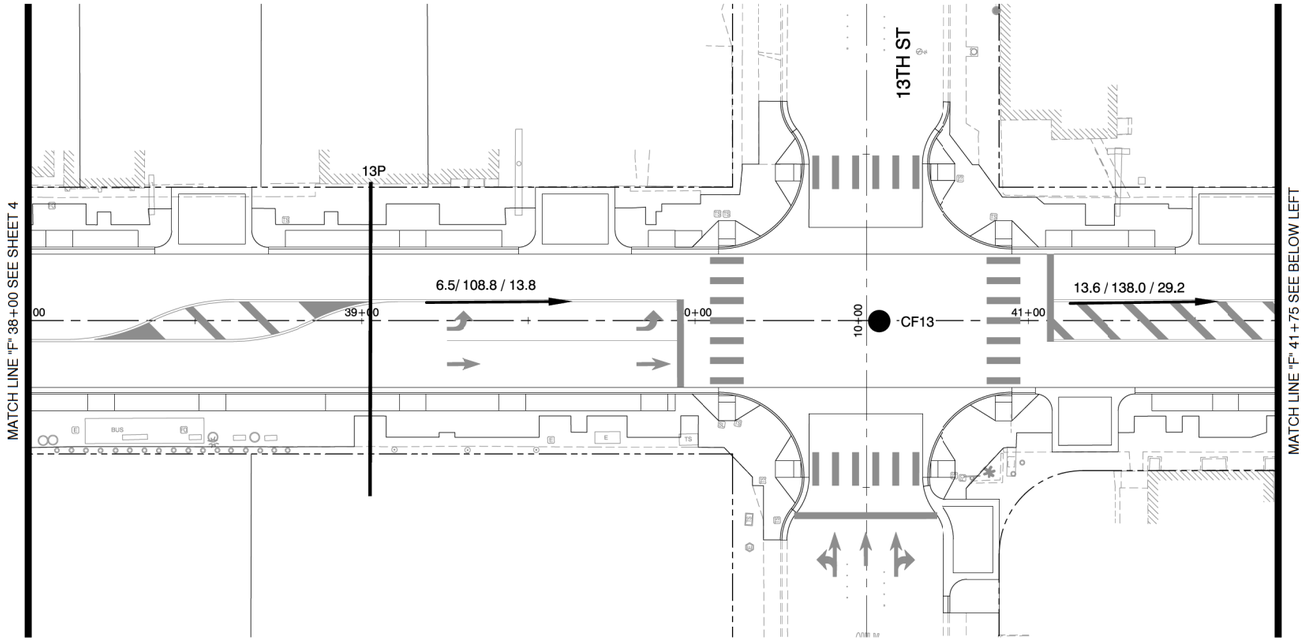
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TITLE
FREMONT STREET IMPROVEMENT PROJECT
LAS VEGAS BLVD TO 14TH ST

SHEET
FIGURE 5
STREET & STORMDRAIN FLOW

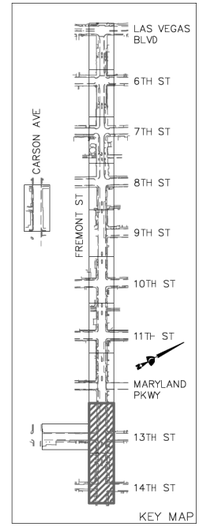
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4 OF 5
DRAWING NO.

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LEGEND

10-YR ULTIMATE / 100-YR ULTIMATE	STORMDRAIN FLOW IN CFS
10-YR ULTIMATE / 100-YR INTERIM 1 / 100-YR ULTIMATE	STREET FLOW IN CFS
10-YR ULTIMATE / 100-YR ULTIMATE	DROP INLET FLOW IN CFS
1P	CROSS SECTION LOCATION
CF6	CONCENTRATION POINT



GRAPHIC SCALE

20 0 10 20 40

1" = 20' (AT 24" X 36")

REVISIONS

NO.	DATE	SHEET

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DRAINAGE STUDY

TITLE
FREMONT STREET IMPROVEMENT PROJECT
LAS VEGAS BLVD TO 14TH ST

SHEET
FIGURE 5
STREET & STORMDRAIN FLOW

SHEET
F5
5 OF 5
DRAWING NO.

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APPENDIX A:
HYDROLOGIC ANALYSIS

Summary of HEC-1 flow and subbasins referenced from Charleston/Maryland Drainage Report (MPU subbasins)

MPU Basin / Concentration Point	Area, sq mi	Q10, cfs	Q100, cfs	Description
59-1	0.05386	38	76	MPU subbasin
DC1		38	38	Diversion to LVB Stormdrain
D59-1		0	38	Remaining flow
60A-1	0.0493	37	72	MPU subbasin
C60A-1	0.10316	37	99	Concentration point at Stewart and Maryland
59-2	0.03076	22	45	MPU subbasin
DC2		22	22	Diversion to LVB Stormdrain
D59-2		0	23	Remaining flow
60A-2	0.02992	22	43	MPU subbasin
C60A-2	0.06068	22	59	Concentration point at Ogden Maryland
CC60A-2	0.16384	58	156	Concentration point C60A-1 and -2
59-3	0.03367	24	49	MPU subbasin
DC3		24	24	Diversion to LVB Stormdrain
D59-3		0	25	Remaining flow
60-3	0.03114	23	46	MPU subbasin
C60A-3	0.06481	23	61	Concentration point at Fremont and Maryland
CC60A-3	0.22865	80	216	Concentration point CC60A-2 and C60A-3
68-2	0.04018	28	60	MPU subbasin

Determination of prorated area and peak flow for Fremont Project Subbasins

Basin / Concentration Point	MPU 10-Yr Flow (cfs)	MPU 100-Yr Flow (cfs)	Diverted to LVB Storm Drain	MPU Basin Area (sq. mi)	MPU Basin Area (sq. ft)	MPU Basin Area (sq. mi)	Fremont St Area (sq. ft)	Fremont St Area (sq. mi)	Prorated Area (sq. mi)	Prorated 10-Yr Flow (cfs)	Prorated 100-Yr Flow (cfs)
59-2	22	45		0.03076	857,513.23	0.03076	3434.91	0.000123	0.00401	0.09	0.18
59-3	24	49	24	0.03367	938,674.50	0.03367	4431.17	0.000159	0.00472	0.11	0.23
60A-2	22	43	-	0.02992	834,174.11	0.02992	60643.56	0.002175	0.07270	1.60	3.13
60A-3	23	46	-	0.03114	868,180.17	0.03114	97436.62	0.003495	0.11224	2.58	5.16
68-2	28	60	-	0.04018	1,120,252.03	0.04018	21513.12	0.000772	0.01921	0.54	1.15
60A-3A	23	46	-	0.03114	98,858.53	0.003546	-	-	0.1139	2.62	5.24
60A-3B	23	46	-	0.03114	58,150.95	0.002086	-	-	0.0670	1.54	3.08
60A-3C	23	46	-	0.03114	32,434.67	0.001163	-	-	0.0374	0.86	1.72
60A-3D	23	46	-	0.03114	116,048.10	0.004163	-	-	0.1337	3.07	6.15
60A-3E	23	46	-	0.03114	172,806.69	0.006199	-	-	0.1991	4.58	9.16
60A-3F	23	46	-	0.03114	184,625.12	0.006623	-	-	0.2127	4.89	9.78
60A-3G	23	46	-	0.03114	205,255.37	0.007363	-	-	0.2364	5.44	10.88
68-2A	28	60	-	0.04018	258,485.55	0.009272	-	-	0.2308	6.46	13.85
68-2B	28	60	-	0.04018	286713.6147	0.010284	-	-	0.2560	7.17	15.36

Determination of 10- and 100-year flow rates for Fremont Project Concentration Points for following conditions: 1) interim 1, where Fremont St is constructed; 2) interim 2, where Fremont St and Las Vegas Blvd are constructed; and 3) the ultimate condition.

Combination Points	Contributing Basins	Interim 1 10-Yr Flow (cfs)	Interim 2 10-Yr Flow (cfs)	Ultimate 10-Yr Flow (cfs)	Interim 1 100-Yr Flow (cfs)	Interim 2 100-Yr Flow (cfs)	Ultimate 100-Yr Flow (cfs)
CF6	59-3, 60A-3A	26.6	2.6	2.6	54.2	30.2	30.2
CF7	60A-3B	28.2	4.2	4.2	57.3	33.3	33.3
CF8	60A-3C	29.0	5.0	5.0	59.0	35.0	35.0
CF9	60A-3D	32.1	8.1	8.1	65.2	41.2	41.2
CF10	60A-3E	36.7	12.7	12.7	74.3	50.3	50.3
CF11	60A-3F	41.6	17.6	17.6	84.1	60.1	60.1
C60A-3	59-3, 60A-3 (FROM HEC-1)	47.0	23.0	23.0	85.0	61.0	61.0
C60A-2	59-2, 60A-2 (FROM HEC-1)	44.0	22.0	N/A	65.0	43.0	N/A
Flowsplit Ogden/ Maryland (Q_L)		10.0	5.0	N/A	14.0	10.0	N/A
Surface flow at Fremont/ Maryland		57.0	28.0	N/A	99.0	71.0	N/A
CF13	68-2A, C60A-2, C60A-3	63.5	34.5	6.5	108.8	84.8	13.8
CF14	682-B, CF13	77.1	48.1	13.6	138.0	114.0	29.2

APPENDIX B:
HYDRAULIC CALCULATIONS

Appendix B1:
Normal Depth Calculations

Street, Drop Inlet Capture and Freemont Storm Drain Flow Summary Table

	Peak Flow Rates				Half Street Peak Flow				Storm Drain	
	10-yr	100-yr			10-yr	100-yr				
Concentration Point / Description	Ultimate (cfs)	Interim 1 (cfs)	Interim 2 (cfs)	Ultimate (cfs)	Ultimate (cfs)	Interim 1 (cfs)	Interim 2 (cfs)	Ultimate (cfs)	10-yr (cfs)	100-yr (cfs)
CF6	2.6	54.2	30.2	30.2	1.3	27.1	15.1	15.1		
CF7	4.2	57.3	33.3	33.3	2.1	28.7	16.7	16.7		
CF8	5.0	59.0	35.0	35.0	2.5	29.5	17.5	17.5		
CF9	8.1	65.2	41.2	41.2	4.0	32.6	20.6	20.6		
CF10	12.7	74.3	50.3	50.3	6.3	37.2	25.2	25.2		
Flow captured by 2 ea. 15-ft DI West of 10th	-10.0	-28.0	-28.0	-28.0	-5.0	-14.0	-14.0	-14.0	10.0	28.0
Remaining surface flow in Freemont at 10th	2.7	46.3	22.3	22.3	1.3	23.2	11.2	11.2		
Flow captured by 2 ea. 15-ft DI East of 10th	-2.7	-16.0	-16.0	-16.0	-1.3	-8.0	-8.0	-8.0	12.7	44.0
Remaining surface flow in Freemont at 10th	0.0	30.3	6.3	6.3	0.0	15.2	3.2	3.2		
CF11	17.6	84.1	60.1	60.1	8.8	42.1	30.1	30.1		
Street flow (CF11 minus flow in stormdrain)	4.9	40.1	16.1	16.1	2.4	20.1	8.1	8.1		
Flow captured by 2 ea. 5-ft DI West of 11th	-3.8	-8.0	-8.0	-8.0	-1.9	-4.0	-4.0	-4.0	16.5	52.0
Remaining surface flow in Freemont at 11th	1.1	32.1	8.1	8.1	0.5	16.1	4.1	4.1		
C60A-3	23.0	85.0	61.0	61.0	11.5	42.5	30.5	30.5		
Street flow (C60A-3 minus flow in stormdrain)	6.5	33.0	9.0	9.0	3.3	16.5	4.5	4.5		
Flow captured by 2 ea. 15-ft DI West of Maryland	-4.9	-7.0	-7.0	-7.0	-2.4	-3.5	-3.5	-3.5	21.4	59.0
Remaining surface flow in Freemont at Maryland (excludes vertical discharge)	1.6	26.0	2.0	2.0	0.8	13.0	1.0	1.0		
C60A-3 plus Maryland/Ogden FlowSplit	N/A	99.0	71.0	N/A						
CF13	6.5	108.8	84.8	13.8	3.2	54.4	42.4	6.9		
CF14	13.6	138.0	114.0	29.2	6.8	69.0	57.0	14.6		

Table 1: 100-year Storm, Normal Depth Summary, Existing versus Proposed Conditions, Fremont Street, Las Vegas Blvd (LVB) to 14th Street

Fremont Street Block	XS	Station	Interim 1 Q_{100} cfs	Ultimate Q_{100} cfs	Slope, %	V		Depth, ft		Freeboard, ft (to back of walk or finished floor elev.)		Min elev	Min back walk elev/FF elev	Existing Condition FB (at select locations)
						Interim 1	Ultimate	Interim 1	Ultimate	Interim 1	Ultimate	Proposed		
LVB to 6th	1P	Loading zone on south side	54.2	30.2	0.89	3.9	3.4	0.62	0.51	0.27	0.38	2005.98	2006.87	
LVB to 6th	2P	Loading zone on north side	54.2	30.2	0.89	3.7	3.2	0.72	0.62	0.06	0.16	2004.52	2005.30	
6th to 7th	5P	Loading zone on south side	57.3	33.3	0.72	3.7	3.2	0.68	0.57	0.12	0.23	2003.19	2003.99	
6th to 7th	6P	Loading zone on north side	57.3	33.3	0.72	3.8	3.2	0.70	0.60	0.43	0.53	2002.07	2003.20	
7th to 8th	7P	Loading zone on south side	59.0	35.0	0.68	3.5	3.0	0.78	0.69	0.09	0.18	2000.42	2001.29	
7th to 8th	8P	Loading zone on north side	59.0	35.0	0.68	3.7	3.2	0.70	0.59	0.31	0.42	1999.06	2000.07	
8th to 9th	10P	STA 24+11 RT	65.2	41.2	0.50	3.1	2.8	0.86	0.77	0.70	0.79	1996.216	1997.78	
8th to 9th	10P	STA 24+75 RT								0.18	0.27	1995.882	1996.92	
10th to 11th	11P	STA 29+70 LT	40.1	16.1	1.94	4.5	3.9	0.65	0.54	1.23	1.34	1992.00	1993.88	
10th to 11th	11P	STA 30+52 LT								0.18	0.29	1990.38	1991.21	
10th to 11th	11P	STA 30+77 LT								0.44	0.55	1989.88	1990.97	
10th to 11th	11P	STA 31+33 LT								0.32	0.43	1988.79	1989.76	
10th to 11th	11P	STA 32+37 RT								0.05	0.16	1986.56	1987.26	
10th to 11th	16P	STA 31+39 RT	40.1	16.1	2.00	5.0	4.1	0.71	0.58	(0.04)	0.09	1988.53	1989.20	-0.21
10th to 11th	16P	STA 32+37 RT								(0.02)	0.11	1986.57	1987.26	-0.21
11th to Maryland	12P1	STA 33+53 LT	32.1	8.1	2.93	4.8	4.7	0.62	0.42	0.81	1.01	1984.46	1985.89	
11th to Maryland	12P1	STA 33+35 RT								0.59	0.79	1984.99	1986.20	
11th to Maryland	12P1	STA 33+75 RT								(0.14)	0.06	1983.81	1984.29	-0.21
11th to Maryland	12P1	STA 33+91 RT								0.36	0.56	1983.34	1984.32	
11th to Maryland	12P1	STA 34+09 LT								0.89	1.09	1982.81	1984.32	
11th to Maryland	12P1	STA 34+28 RT								0.23	0.43	1982.27	1983.12	
11th to Maryland	12P1	STA 34+67 RT								0.39	0.59	1981.10	1982.11	
11th to Maryland	12P1	STA 34+74 LT								1.57	1.77	1980.92	1983.11	
11th to Maryland	12P2	STA 34+81 RT	33.0	9.0	2.93	4.9	4.8	0.62	0.43	(0.03)	0.16	1980.70	1981.29	-0.10
11th to Maryland	12P2	STA 34+97 RT								0.28	0.47	1980.24	1981.14	
11th to Maryland	12P2	STA 35+29 RT								0.37	0.56	1979.31	1980.30	
11th to Maryland	17P	STA 35+45 RT	33.0	9.0	2.93	4.9	4.6	0.59	0.40	0.02	0.21	1978.64	1979.25	
11th to Maryland	17P	STA 35+65 RT								0.67	0.86	1978.05	1979.31	
11th to Maryland	17P	STA 36+00 LT								2.62	2.81	1977.03	1980.24	
11th to Maryland	17P	STA 36+17 RT								0.93	1.12	1976.53	1978.05	
Maryland to 13th (Interim)	13P	STA 37+38 LT	108.8	13.8	1.75	5.1	3.5	0.75	0.48	3.17	3.44	1973.97	1977.89	
Maryland to 13th (Interim)	13P	STA 37+89 LT								2.84	3.11	1973.09	1976.68	
Maryland to 13th (Interim)	13P	STA 38+32 LT								2.03	2.30	1972.29	1975.07	
Maryland to 13th (Interim)	13P	STA 38+36 LT								1.31	1.58	1972.26	1974.32	
Maryland to 13th (Interim)	13P	STA 38+87 LT								1.04	1.31	1971.36	1973.15	
Maryland to 13th (Interim)	13P	STA 39+36 LT								0.19	0.46	1970.50	1971.44	
Maryland to 13th (Interim)	13P	STA 39+42 LT								0.17	0.44	1970.41	1971.33	
13th to 14th (Interim)	14P	STA 41+26 LT	138.8	29.2	2.16	6.3	4.7	0.94	0.67	2.31	2.58	1964.83	1968.08	
13th to 14th (Interim)	14P	STA 42+07 LT								2.61	2.88	1963.09	1966.64	
13th to 14th (Interim)	14P	STA 41+37 RT								0.68	0.95	1964.59	1966.21	
13th to 14th (Interim)	14P	STA 41+78 RT								1.43	1.70	1963.70	1966.07	
13th to 14th (Interim)	14P	STA 42+15 RT								1.10	1.37	1962.90	1964.94	
13th to 14th (Interim)	15P	STA 42+86 LT	138.8	29.2	2.16	6.49	4.87	0.88	0.64	0.71	0.95	1961.24	1962.83	
13th to 14th (Interim)	15P	STA 43+68 LT								0.50	0.74	1959.54	1960.92	
13th to 14th (Interim)	15P	STA 43+29 RT								0.94	1.18	1960.29	1962.11	
13th to 14th (Interim)	15P	STA 43+49 RT								1.34	1.58	1959.86	1962.08	

Table 2: 10-yr/100-year DV Summary Table

Fremont Street Block	XS	Ultimate Q_{10} cfs	Interim 1 Q_{100} cfs	Ultimate Q_{100} cfs	Slope, %	V			Depth, ft			DV			Total Dry Roadway Width, ft	1/2 Dry Roadway Width, ft	Center Lane Width, ft	Dry Lane Width (excludes turn lane), ft
						10-yr	100-yr I1	100-yr U	10-yr	100-yr I1	100-yr U	10-yr	100-yr I1	100-yr U				
LVB to 6th	1P	2.6	54.2	30.2	0.89	1.81	3.93	3.38	0.25	0.62	0.51	0.45	2.44	1.72	17.5	8.8	10	3.8
LVB to 6th	2P	2.6	54.2	30.2	0.89	2.13	3.71	3.18	0.34	0.72	0.62	0.72	2.67	1.97	22.5	11.3	10	6.3
6th to 7th	5P	4.2	57.3	33.3	0.72	1.64	3.70	3.22	0.35	0.68	0.57	0.57	2.52	1.84	6.0	3.0	10	0.0
6th to 7th	6P	4.2	57.3	33.3	0.72	1.85	3.75	3.17	0.35	0.70	0.60	0.65	2.63	1.90	12.5	6.3	10	1.3
7th to 8th	7P	5.0	59.0	35.0	0.68	2.14	3.54	2.99	0.45	0.78	0.69	0.96	2.76	2.06	17.5	8.8	10	3.8
7th to 8th	8P	5.0	59.0	35.0	0.68	1.59	3.71	3.24	0.37	0.70	0.59	0.59	2.60	1.91	0.0	0.0	10	0.0
8th to 9th	10P	8.1	65.2	41.2	0.50	2.03	3.10	2.75	0.54	0.86	0.77	1.10	2.67	2.12	27.5	13.8	12	7.8
10th to 11th	11P	4.9	40.1	16.1	1.94	3.58	4.51	3.93	0.36	0.65	0.54	1.29	2.93	2.12	35.0	17.5	12	11.5
10th to 11th	16P	4.9	40.1	16.1	2.00	3.88	5.00	4.05	0.41	0.71	0.58	1.59	3.55	2.35	35.0	17.5	12	11.5
11th to Maryland	12P1	1.1	32.1	8.1	2.93	3.38	4.82	4.71	0.22	0.62	0.42	0.74	2.99	1.98	35.0	17.5	12	11.5
11th to Maryland	12P2	6.5	33.0	9.0	2.93	4.51	4.86	4.82	0.39	0.62	0.43	1.76	3.01	2.07	33.8	16.9	12	10.9
11th to Maryland	17P	6.5	33.0	9.0	2.93	4.25	4.94	4.56	0.36	0.59	0.40	1.53	2.91	1.82	32.5	16.3	12	10.3
Maryland to 13th	13P	6.5	108.8	13.8	1.75	3.21	5.12	3.53	0.39	0.75	0.48	1.25	3.84	1.69	28.8	14.4	12	8.4
13th to 14th	14P	13.6	138.8	29.2	2.16	4.00	6.29	4.65	0.57	0.94	0.67	2.28	5.91	3.12	30.0	15.0	12	9.0
13th to 14th	15P	13.6	138.8	29.2	2.16	4.03	6.49	4.87	0.54	0.88	0.64	2.18	5.71	3.12	28.8	14.4	12	8.4

Worksheet for 1P - 10-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.89000	%
Discharge	2.60	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+40.90	2006.87
0+58.78	2006.56
0+63.78	2006.46
0+64.28	2006.46
0+64.28	2005.98
0+65.78	2006.09
0+65.78	2006.13
0+80.75	2006.40
0+95.95	2006.06
0+97.28	2005.98
0+97.37	2006.42
1+20.61	2006.87

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+40.90, 2006.87)	(0+65.78, 2006.09)	0.013
(0+65.78, 2006.09)	(0+95.95, 2006.06)	0.016
(0+95.95, 2006.06)	(1+20.61, 2006.87)	0.013

Options

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

Worksheet for 1P - 10-yr Ultimate

Results

Normal Depth		0.25	ft
Elevation Range	2005.98 to 2006.87 ft		
Flow Area		1.43	ft²
Wetted Perimeter		16.09	ft
Hydraulic Radius		0.09	ft
Top Width		15.60	ft
Normal Depth		0.25	ft
Critical Depth		0.25	ft
Critical Slope		0.00796	ft/ft
Velocity		1.81	ft/s
Velocity Head		0.05	ft
Specific Energy		0.30	ft
Froude Number		1.05	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.25	ft
Critical Depth	0.25	ft
Channel Slope	0.89000	%
Critical Slope	0.00796	ft/ft

Cross Section for 1P - 10-yr Ultimate

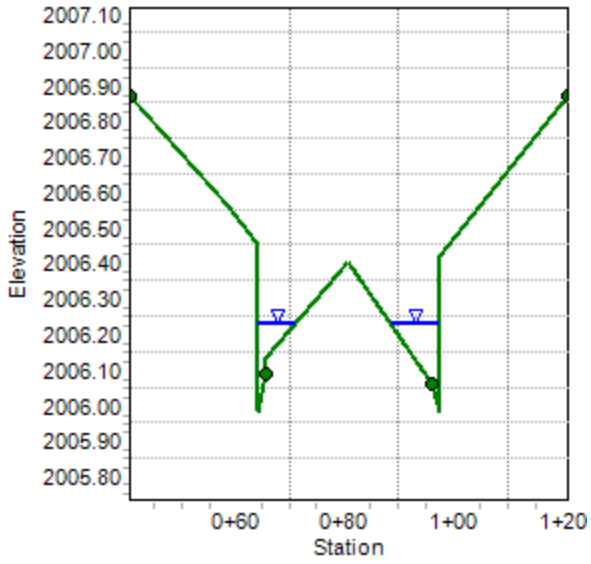
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.89000	%
Normal Depth	0.25	ft
Discharge	2.60	ft³/s

Cross Section Image



Worksheet for 1P - 100-yr Interim 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.89000	%
Discharge	54.20	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+40.90	2006.87
0+58.78	2006.56
0+63.78	2006.46
0+64.28	2006.46
0+64.28	2005.98
0+65.78	2006.09
0+65.78	2006.13
0+80.75	2006.40
0+95.95	2006.06
0+97.28	2005.98
0+97.37	2006.42
1+20.61	2006.87

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+40.90, 2006.87)	(0+65.78, 2006.09)	0.013
(0+65.78, 2006.09)	(0+95.95, 2006.06)	0.016
(0+95.95, 2006.06)	(1+20.61, 2006.87)	0.013

Options

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

Worksheet for 1P - 100-yr Interim 1

Results

Normal Depth		0.62	ft
Elevation Range	2005.98 to 2006.87 ft		
Flow Area		13.78	ft²
Wetted Perimeter		51.26	ft
Hydraulic Radius		0.27	ft
Top Width		50.37	ft
Normal Depth		0.62	ft
Critical Depth		0.69	ft
Critical Slope		0.00489	ft/ft
Velocity		3.93	ft/s
Velocity Head		0.24	ft
Specific Energy		0.86	ft
Froude Number		1.33	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.62	ft
Critical Depth	0.69	ft
Channel Slope	0.89000	%
Critical Slope	0.00489	ft/ft

Cross Section for 1P - 100-yr Interim 1

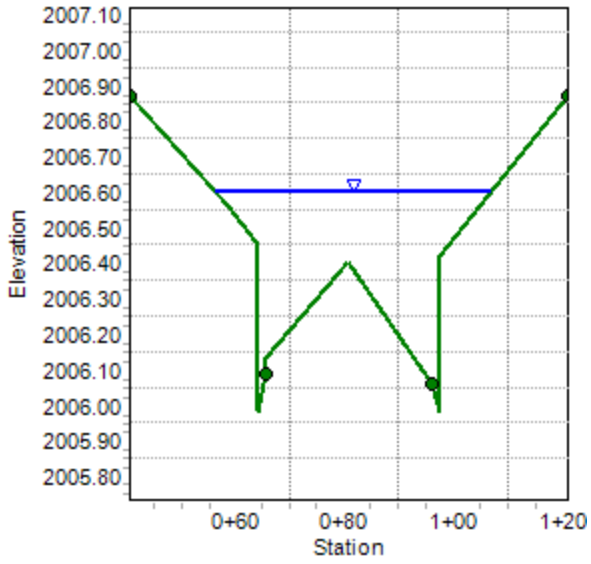
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.89000	%
Normal Depth	0.62	ft
Discharge	54.20	ft³/s

Cross Section Image



Worksheet for 1P - 100-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.89000	%
Discharge	30.20	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+40.90	2006.87
0+58.78	2006.56
0+63.78	2006.46
0+64.28	2006.46
0+64.28	2005.98
0+65.78	2006.09
0+65.78	2006.13
0+80.75	2006.40
0+95.95	2006.06
0+97.28	2005.98
0+97.37	2006.42
1+20.61	2006.87

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+40.90, 2006.87)	(0+65.78, 2006.09)	0.013
(0+65.78, 2006.09)	(0+95.95, 2006.06)	0.016
(0+95.95, 2006.06)	(1+20.61, 2006.87)	0.013

Options

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

Worksheet for 1P - 100-yr Ultimate

Results

Normal Depth		0.51	ft
Elevation Range	2005.98 to 2006.87 ft		
Flow Area		8.95	ft²
Wetted Perimeter		39.93	ft
Hydraulic Radius		0.22	ft
Top Width		39.04	ft
Normal Depth		0.51	ft
Critical Depth		0.56	ft
Critical Slope		0.00560	ft/ft
Velocity		3.38	ft/s
Velocity Head		0.18	ft
Specific Energy		0.69	ft
Froude Number		1.24	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.51	ft
Critical Depth	0.56	ft
Channel Slope	0.89000	%
Critical Slope	0.00560	ft/ft

Cross Section for 1P - 100-yr Ultimate

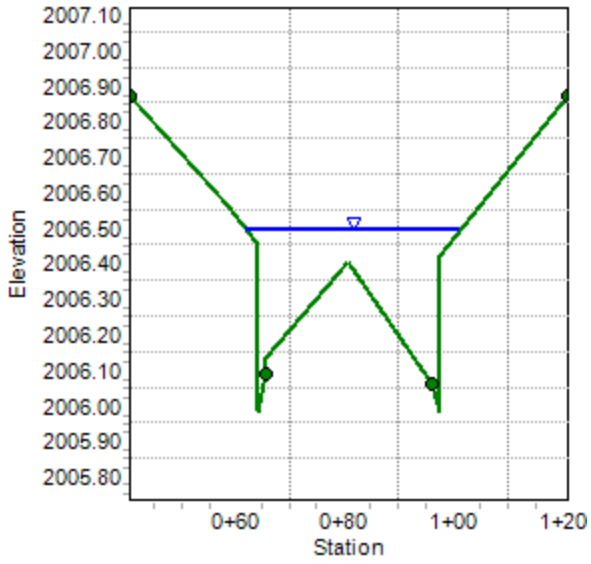
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.89000	%
Normal Depth	0.51	ft
Discharge	30.20	ft³/s

Cross Section Image



Worksheet for 2P - 10-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.89000	%
Discharge	2.60	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+41.42	2005.30
0+62.94	2005.01
0+63.13	2004.52
0+64.67	2004.69
0+79.57	2005.03
0+95.07	2004.86
0+95.07	2004.82
0+96.57	2004.69
0+96.57	2005.07
0+97.07	2005.07
1+02.07	2005.17
1+19.45	2005.42

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+41.42, 2005.30)	(0+64.67, 2004.69)	0.013
(0+64.67, 2004.69)	(0+95.07, 2004.86)	0.016
(0+95.07, 2004.86)	(1+19.45, 2005.42)	0.013

Options

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

Worksheet for 2P - 10-yr Ultimate

Results

Normal Depth		0.34	ft
Elevation Range	2004.52 to 2005.42 ft		
Flow Area		1.22	ft²
Wetted Perimeter		11.11	ft
Hydraulic Radius		0.11	ft
Top Width		10.66	ft
Normal Depth		0.34	ft
Critical Depth		0.35	ft
Critical Slope		0.00726	ft/ft
Velocity		2.13	ft/s
Velocity Head		0.07	ft
Specific Energy		0.41	ft
Froude Number		1.11	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.34	ft
Critical Depth	0.35	ft
Channel Slope	0.89000	%
Critical Slope	0.00726	ft/ft

Cross Section for 2P - 10-yr Ultimate

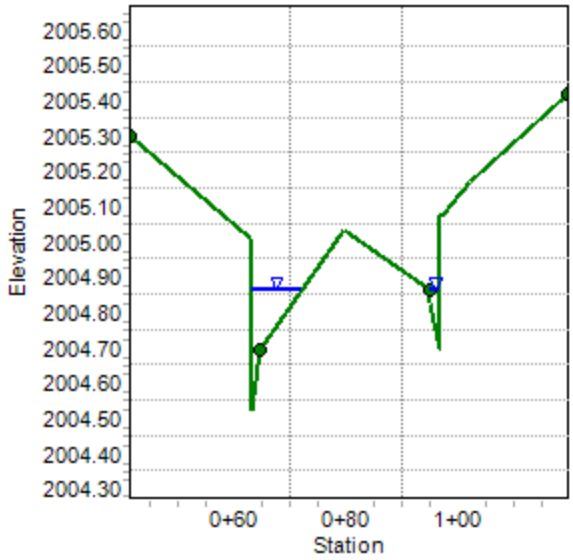
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.89000	%
Normal Depth	0.34	ft
Discharge	2.60	ft³/s

Cross Section Image



Worksheet for 2P - 100-yr Interim 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.89000	%
Discharge	54.20	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+41.42	2005.30
0+62.94	2005.01
0+63.13	2004.52
0+64.67	2004.69
0+79.57	2005.03
0+95.07	2004.86
0+95.07	2004.82
0+96.57	2004.69
0+96.57	2005.07
0+97.07	2005.07
1+02.07	2005.17
1+19.45	2005.42

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+41.42, 2005.30)	(0+64.67, 2004.69)	0.013
(0+64.67, 2004.69)	(0+95.07, 2004.86)	0.016
(0+95.07, 2004.86)	(1+19.45, 2005.42)	0.013

Options

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

Worksheet for 2P - 100-yr Interim 1

Results

Normal Depth		0.72	ft
Elevation Range	2004.52 to 2005.42 ft		
Flow Area		14.61	ft²
Wetted Perimeter		61.16	ft
Hydraulic Radius		0.24	ft
Top Width		60.38	ft
Normal Depth		0.72	ft
Critical Depth		0.78	ft
Critical Slope		0.00487	ft/ft
Velocity		3.71	ft/s
Velocity Head		0.21	ft
Specific Energy		0.93	ft
Froude Number		1.33	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.72	ft
Critical Depth	0.78	ft
Channel Slope	0.89000	%
Critical Slope	0.00487	ft/ft

Cross Section for 2P - 100-yr Interim 1

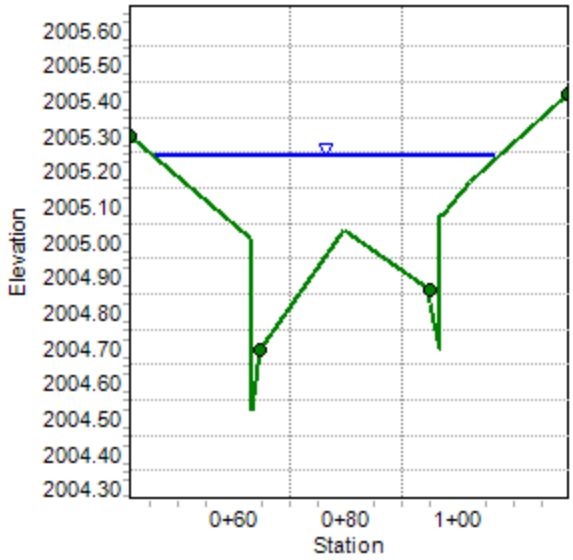
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.89000	%
Normal Depth	0.72	ft
Discharge	54.20	ft³/s

Cross Section Image



Worksheet for 2P - 100-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.89000	%
Discharge	30.20	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+41.42	2005.30
0+62.94	2005.01
0+63.13	2004.52
0+64.67	2004.69
0+79.57	2005.03
0+95.07	2004.86
0+95.07	2004.82
0+96.57	2004.69
0+96.57	2005.07
0+97.07	2005.07
1+02.07	2005.17
1+19.45	2005.42

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+41.42, 2005.30)	(0+64.67, 2004.69)	0.013
(0+64.67, 2004.69)	(0+95.07, 2004.86)	0.016
(0+95.07, 2004.86)	(1+19.45, 2005.42)	0.013

Options

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

Worksheet for 2P - 100-yr Ultimate

Results

Normal Depth		0.62	ft
Elevation Range	2004.52 to 2005.42 ft		
Flow Area		9.49	ft²
Wetted Perimeter		48.09	ft
Hydraulic Radius		0.20	ft
Top Width		47.31	ft
Normal Depth		0.62	ft
Critical Depth		0.66	ft
Critical Slope		0.00553	ft/ft
Velocity		3.18	ft/s
Velocity Head		0.16	ft
Specific Energy		0.78	ft
Froude Number		1.25	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.62	ft
Critical Depth	0.66	ft
Channel Slope	0.89000	%
Critical Slope	0.00553	ft/ft

Cross Section for 2P - 100-yr Ultimate

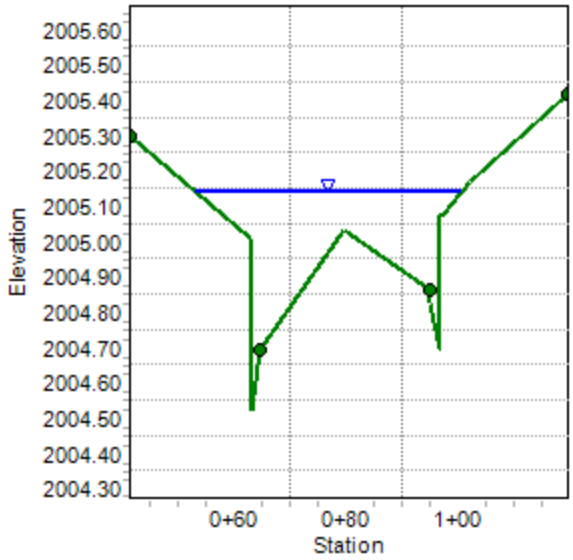
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.89000	%
Normal Depth	0.62	ft
Discharge	30.20	ft³/s

Cross Section Image



Worksheet for 5P - 10-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.72000	%
Discharge	4.20	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+43.26	2003.99
0+61.09	2003.71
0+66.09	2003.61
0+66.59	2003.61
0+66.59	2003.19
0+68.09	2003.32
0+68.09	2003.36
0+83.40	2003.58
0+98.36	2003.42
0+99.59	2003.33
0+99.76	2003.79
1+24.28	2004.21

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+43.26, 2003.99)	(0+68.09, 2003.32)	0.013
(0+68.09, 2003.32)	(0+98.36, 2003.42)	0.016
(0+98.36, 2003.42)	(1+24.28, 2004.21)	0.013

Options

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

Worksheet for 5P - 10-yr Ultimate

Results

Normal Depth		0.35	ft
Elevation Range	2003.19 to 2004.21 ft		
Flow Area		2.57	ft²
Wetted Perimeter		27.89	ft
Hydraulic Radius		0.09	ft
Top Width		27.33	ft
Normal Depth		0.35	ft
Critical Depth		0.35	ft
Critical Slope		0.00815	ft/ft
Velocity		1.64	ft/s
Velocity Head		0.04	ft
Specific Energy		0.40	ft
Froude Number		0.94	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.35	ft
Critical Depth	0.35	ft
Channel Slope	0.72000	%
Critical Slope	0.00815	ft/ft

Cross Section for 5P - 10-yr Ultimate

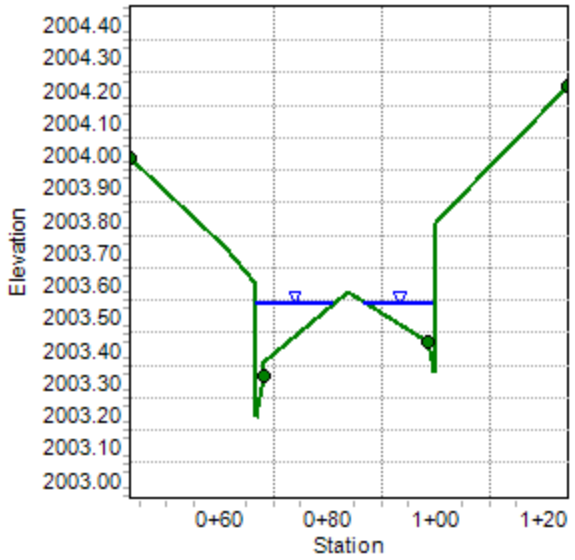
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.72000	%
Normal Depth	0.35	ft
Discharge	4.20	ft³/s

Cross Section Image



Worksheet for 5P - 100-yr Interim 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.72000	%
Discharge	57.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+43.26	2003.99
0+61.09	2003.71
0+66.09	2003.61
0+66.59	2003.61
0+66.59	2003.19
0+68.09	2003.32
0+68.09	2003.36
0+83.40	2003.58
0+98.36	2003.42
0+99.59	2003.33
0+99.76	2003.79
1+24.28	2004.21

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+43.26, 2003.99)	(0+68.09, 2003.32)	0.013
(0+68.09, 2003.32)	(0+98.36, 2003.42)	0.016
(0+98.36, 2003.42)	(1+24.28, 2004.21)	0.013

Options

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

Worksheet for 5P - 100-yr Interim 1

Results

Normal Depth		0.68	ft
Elevation Range	2003.19 to 2004.21 ft		
Flow Area		15.50	ft²
Wetted Perimeter		54.48	ft
Hydraulic Radius		0.28	ft
Top Width		53.69	ft
Normal Depth		0.68	ft
Critical Depth		0.73	ft
Critical Slope		0.00478	ft/ft
Velocity		3.70	ft/s
Velocity Head		0.21	ft
Specific Energy		0.89	ft
Froude Number		1.21	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.68	ft
Critical Depth	0.73	ft
Channel Slope	0.72000	%
Critical Slope	0.00478	ft/ft

Cross Section for 5P - 100-yr Interim 1

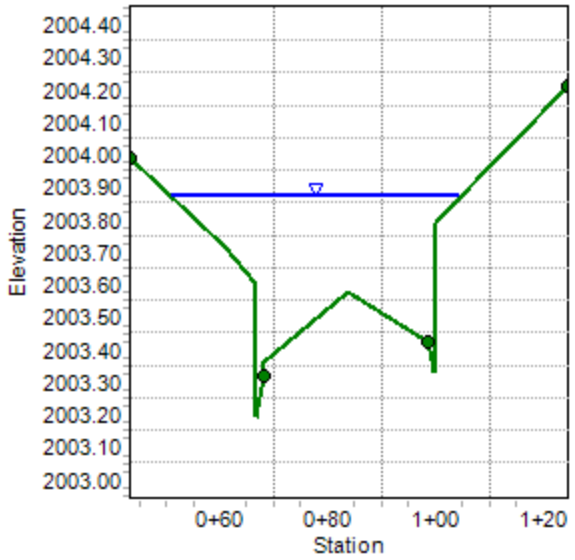
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.72000	%
Normal Depth	0.68	ft
Discharge	57.30	ft³/s

Cross Section Image



Worksheet for 5P - 100-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.72000	%
Discharge	33.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+43.26	2003.99
0+61.09	2003.71
0+66.09	2003.61
0+66.59	2003.61
0+66.59	2003.19
0+68.09	2003.32
0+68.09	2003.36
0+83.40	2003.58
0+98.36	2003.42
0+99.59	2003.33
0+99.76	2003.79
1+24.28	2004.21

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+43.26, 2003.99)	(0+68.09, 2003.32)	0.013
(0+68.09, 2003.32)	(0+98.36, 2003.42)	0.016
(0+98.36, 2003.42)	(1+24.28, 2004.21)	0.013

Options

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

Worksheet for 5P - 100-yr Ultimate

Results

Normal Depth		0.57	ft
Elevation Range	2003.19 to 2004.21 ft		
Flow Area		10.34	ft²
Wetted Perimeter		42.75	ft
Hydraulic Radius		0.24	ft
Top Width		41.98	ft
Normal Depth		0.57	ft
Critical Depth		0.60	ft
Critical Slope		0.00538	ft/ft
Velocity		3.22	ft/s
Velocity Head		0.16	ft
Specific Energy		0.73	ft
Froude Number		1.14	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.57	ft
Critical Depth	0.60	ft
Channel Slope	0.72000	%
Critical Slope	0.00538	ft/ft

Cross Section for 5P - 100-yr Ultimate

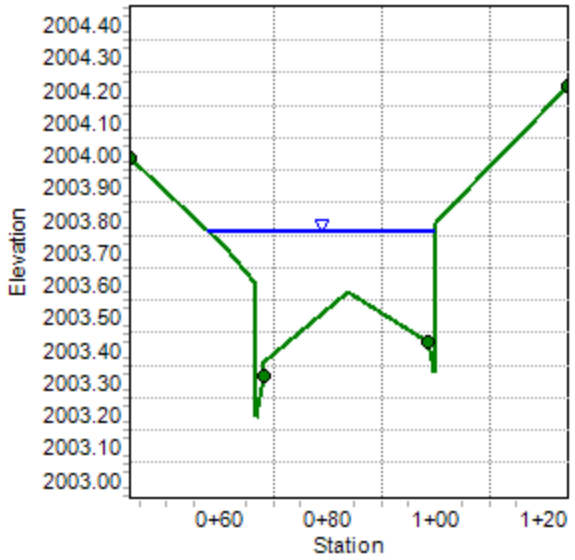
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.72000	%
Normal Depth	0.57	ft
Discharge	33.30	ft³/s

Cross Section Image



Worksheet for 6P - 10-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.72000	%
Discharge	4.20	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+42.69	2003.21
0+69.14	2002.53
0+69.29	2002.07
0+70.70	2002.19
0+86.22	2002.54
1+01.15	2002.32
1+01.15	2002.28
1+02.65	2002.15
1+02.65	2002.52
1+03.15	2002.52
1+08.15	2002.67
1+28.03	2003.20

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+42.69, 2003.21)	(0+70.70, 2002.19)	0.013
(0+70.70, 2002.19)	(1+01.15, 2002.32)	0.016
(1+01.15, 2002.32)	(1+28.03, 2003.20)	0.013

Options

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

Worksheet for 6P - 10-yr Ultimate

Results

Normal Depth		0.35	ft
Elevation Range	2002.07 to 2003.21 ft		
Flow Area		2.26	ft²
Wetted Perimeter		20.74	ft
Hydraulic Radius		0.11	ft
Top Width		20.17	ft
Normal Depth		0.35	ft
Critical Depth		0.35	ft
Critical Slope		0.00758	ft/ft
Velocity		1.85	ft/s
Velocity Head		0.05	ft
Specific Energy		0.40	ft
Froude Number		0.98	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.35	ft
Critical Depth	0.35	ft
Channel Slope	0.72000	%
Critical Slope	0.00758	ft/ft

Cross Section for 6P - 10-yr Ultimate

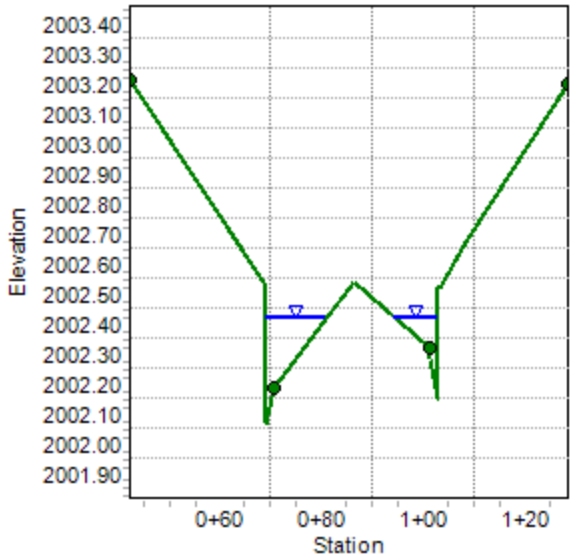
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.72000	%
Normal Depth	0.35	ft
Discharge	4.20	ft³/s

Cross Section Image



Worksheet for 6P - 100-yr Interim 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.72000	%
Discharge	57.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+42.69	2003.21
0+69.14	2002.53
0+69.29	2002.07
0+70.70	2002.19
0+86.22	2002.54
1+01.15	2002.32
1+01.15	2002.28
1+02.65	2002.15
1+02.65	2002.52
1+03.15	2002.52
1+08.15	2002.67
1+28.03	2003.20

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+42.69, 2003.21)	(0+70.70, 2002.19)	0.013
(0+70.70, 2002.19)	(1+01.15, 2002.32)	0.016
(1+01.15, 2002.32)	(1+28.03, 2003.20)	0.013

Options

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

Worksheet for 6P - 100-yr Interim 1

Results

Normal Depth		0.70	ft
Elevation Range	2002.07 to 2003.21 ft		
Flow Area		15.29	ft²
Wetted Perimeter		52.44	ft
Hydraulic Radius		0.29	ft
Top Width		51.68	ft
Normal Depth		0.70	ft
Critical Depth		0.74	ft
Critical Slope		0.00475	ft/ft
Velocity		3.75	ft/s
Velocity Head		0.22	ft
Specific Energy		0.92	ft
Froude Number		1.21	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.70	ft
Critical Depth	0.74	ft
Channel Slope	0.72000	%
Critical Slope	0.00475	ft/ft

Cross Section for 6P - 100-yr Interim 1

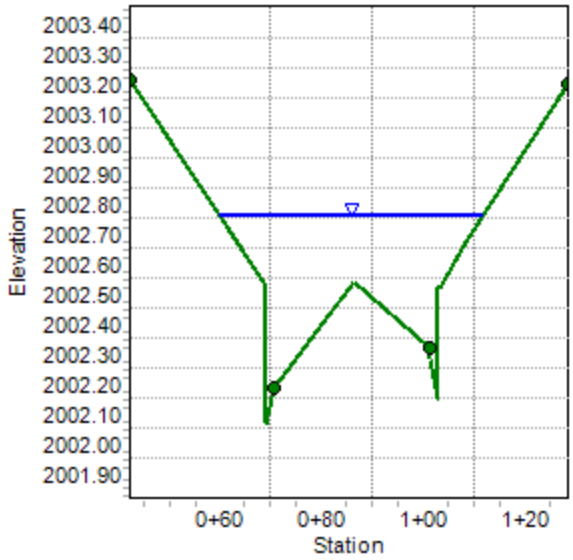
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.72000	%
Normal Depth	0.70	ft
Discharge	57.30	ft³/s

Cross Section Image



Worksheet for 6P - 100-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.72000	%
Discharge	33.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+42.69	2003.21
0+69.14	2002.53
0+69.29	2002.07
0+70.70	2002.19
0+86.22	2002.54
1+01.15	2002.32
1+01.15	2002.28
1+02.65	2002.15
1+02.65	2002.52
1+03.15	2002.52
1+08.15	2002.67
1+28.03	2003.20

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+42.69, 2003.21)	(0+70.70, 2002.19)	0.013
(0+70.70, 2002.19)	(1+01.15, 2002.32)	0.016
(1+01.15, 2002.32)	(1+28.03, 2003.20)	0.013

Options

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

Worksheet for 6P - 100-yr Ultimate

Results

Normal Depth		0.60	ft
Elevation Range	2002.07 to 2003.21 ft		
Flow Area		10.50	ft²
Wetted Perimeter		44.82	ft
Hydraulic Radius		0.23	ft
Top Width		44.05	ft
Normal Depth		0.60	ft
Critical Depth		0.62	ft
Critical Slope		0.00537	ft/ft
Velocity		3.17	ft/s
Velocity Head		0.16	ft
Specific Energy		0.75	ft
Froude Number		1.15	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.60	ft
Critical Depth	0.62	ft
Channel Slope	0.72000	%
Critical Slope	0.00537	ft/ft

Cross Section for 6P - 100-yr Ultimate

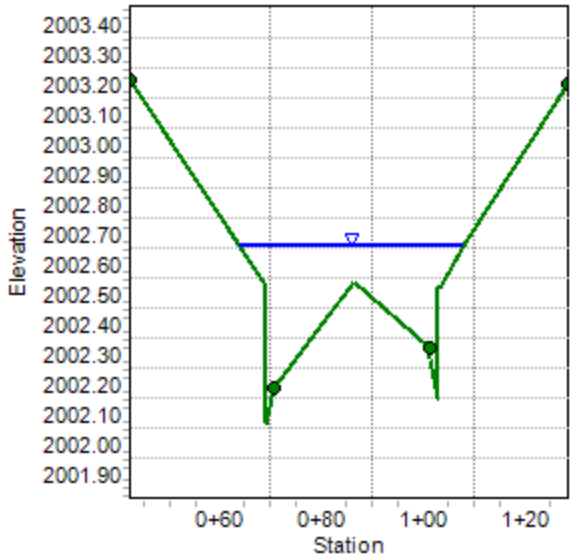
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.72000	%
Normal Depth	0.60	ft
Discharge	33.30	ft³/s

Cross Section Image



Worksheet for 7P - 10-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.68000	%
Discharge	5.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+39.71	2001.29
0+68.09	2000.93
0+73.09	2000.83
0+73.59	2000.83
0+73.59	2000.42
0+75.09	2000.55
0+75.09	2000.59
0+91.26	2000.97
1+05.76	2000.91
1+07.11	2000.84
1+07.31	2001.31
1+30.76	2001.41

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+39.71, 2001.29)	(0+75.09, 2000.59)	0.013
(0+75.09, 2000.59)	(1+05.76, 2000.91)	0.016
(1+05.76, 2000.91)	(1+30.76, 2001.41)	0.013

Options

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

Worksheet for 7P - 10-yr Ultimate

Results

Normal Depth		0.45	ft
Elevation Range	2000.42 to 2001.41 ft		
Flow Area		2.34	ft²
Wetted Perimeter		17.26	ft
Hydraulic Radius		0.14	ft
Top Width		16.78	ft
Normal Depth		0.45	ft
Critical Depth		0.45	ft
Critical Slope		0.00669	ft/ft
Velocity		2.14	ft/s
Velocity Head		0.07	ft
Specific Energy		0.52	ft
Froude Number		1.01	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.45	ft
Critical Depth	0.45	ft
Channel Slope	0.68000	%
Critical Slope	0.00669	ft/ft

Cross Section for 7P - 10-yr Ultimate

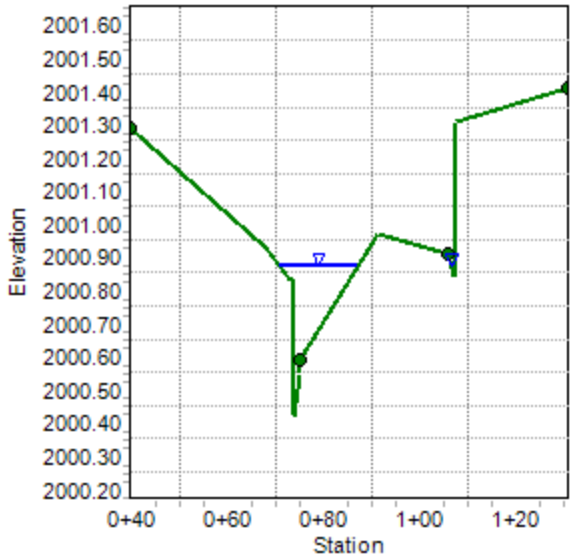
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.68000	%
Normal Depth	0.45	ft
Discharge	5.00	ft³/s

Cross Section Image



Worksheet for 7P - 100-yr Interim 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.68000	%
Discharge	59.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+39.71	2001.29
0+68.09	2000.93
0+73.09	2000.83
0+73.59	2000.83
0+73.59	2000.42
0+75.09	2000.55
0+75.09	2000.59
0+91.26	2000.97
1+05.76	2000.91
1+07.11	2000.84
1+07.31	2001.31
1+30.76	2001.41

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+39.71, 2001.29)	(0+75.09, 2000.59)	0.013
(0+75.09, 2000.59)	(1+05.76, 2000.91)	0.016
(1+05.76, 2000.91)	(1+30.76, 2001.41)	0.013

Options

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

Worksheet for 7P - 100-yr Interim 1

Results

Normal Depth		0.78	ft
Elevation Range	2000.42 to 2001.41 ft		
Flow Area		16.68	ft²
Wetted Perimeter		61.04	ft
Hydraulic Radius		0.27	ft
Top Width		60.34	ft
Normal Depth		0.78	ft
Critical Depth		0.82	ft
Critical Slope		0.00470	ft/ft
Velocity		3.54	ft/s
Velocity Head		0.19	ft
Specific Energy		0.97	ft
Froude Number		1.19	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.78	ft
Critical Depth	0.82	ft
Channel Slope	0.68000	%
Critical Slope	0.00470	ft/ft

Cross Section for 7P - 100-yr Interim 1

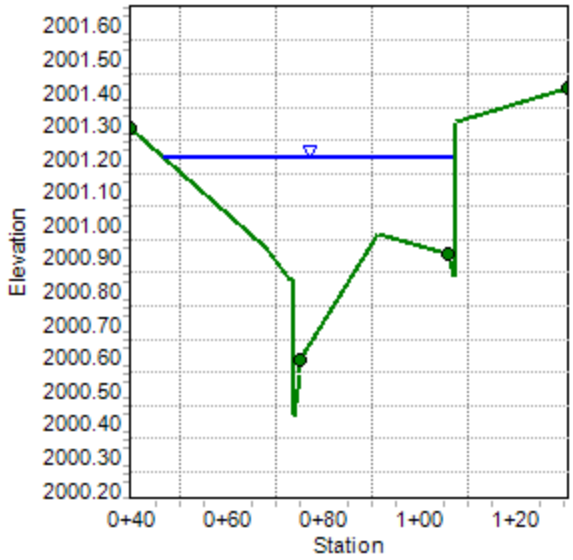
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.68000	%
Normal Depth	0.78	ft
Discharge	59.00	ft³/s

Cross Section Image



Worksheet for 7P - 100-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.68000	%
Discharge	35.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+39.71	2001.29
0+68.09	2000.93
0+73.09	2000.83
0+73.59	2000.83
0+73.59	2000.42
0+75.09	2000.55
0+75.09	2000.59
0+91.26	2000.97
1+05.76	2000.91
1+07.11	2000.84
1+07.31	2001.31
1+30.76	2001.41

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+39.71, 2001.29)	(0+75.09, 2000.59)	0.013
(0+75.09, 2000.59)	(1+05.76, 2000.91)	0.016
(1+05.76, 2000.91)	(1+30.76, 2001.41)	0.013

Options

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

Worksheet for 7P - 100-yr Ultimate

Results

Normal Depth		0.69	ft
Elevation Range	2000.42 to 2001.41 ft		
Flow Area		11.71	ft²
Wetted Perimeter		54.12	ft
Hydraulic Radius		0.22	ft
Top Width		53.48	ft
Normal Depth		0.69	ft
Critical Depth		0.71	ft
Critical Slope		0.00526	ft/ft
Velocity		2.99	ft/s
Velocity Head		0.14	ft
Specific Energy		0.83	ft
Froude Number		1.13	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.69	ft
Critical Depth	0.71	ft
Channel Slope	0.68000	%
Critical Slope	0.00526	ft/ft

Cross Section for 7P - 100-yr Ultimate

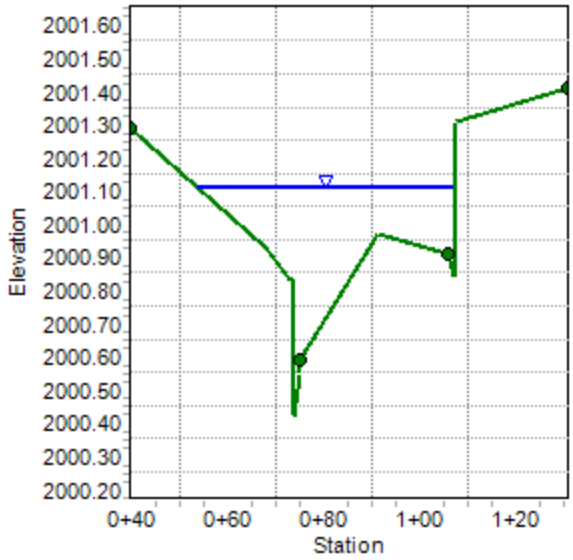
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.68000	%
Normal Depth	0.69	ft
Discharge	35.00	ft³/s

Cross Section Image



Worksheet for 8P - 10-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.68000	%
Discharge	5.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+52.26	2000.07
0+75.04	1999.57
0+75.18	1999.06
0+76.59	1999.20
0+92.48	1999.41
1+07.24	1999.41
1+07.24	1999.37
1+08.74	1999.24
1+08.74	1999.59
1+09.24	1999.59
1+14.24	1999.69
1+37.16	2000.13

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+52.26, 2000.07)	(0+76.59, 1999.20)	0.013
(0+76.59, 1999.20)	(1+07.24, 1999.41)	0.016
(1+07.24, 1999.41)	(1+37.16, 2000.13)	0.013

Options

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

Worksheet for 8P - 10-yr Ultimate

Results

Normal Depth		0.37	ft
Elevation Range	1999.06 to 2000.13 ft		
Flow Area		3.15	ft²
Wetted Perimeter		34.20	ft
Hydraulic Radius		0.09	ft
Top Width		33.66	ft
Normal Depth		0.37	ft
Critical Depth		0.37	ft
Critical Slope		0.00825	ft/ft
Velocity		1.59	ft/s
Velocity Head		0.04	ft
Specific Energy		0.41	ft
Froude Number		0.91	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.37	ft
Critical Depth	0.37	ft
Channel Slope	0.68000	%
Critical Slope	0.00825	ft/ft

Cross Section for 8P - 10-yr Ultimate

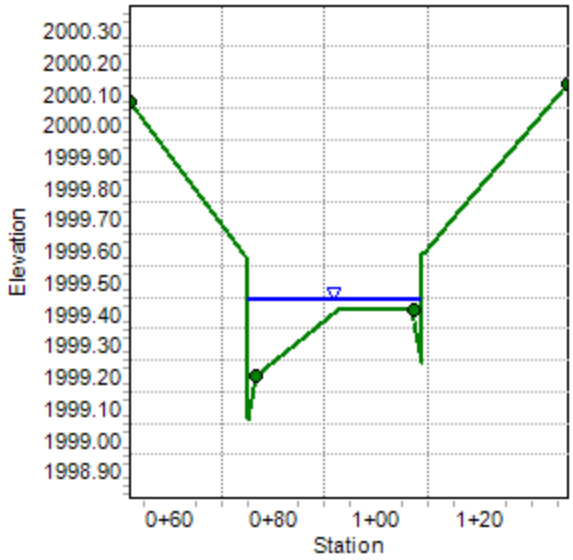
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.68000	%
Normal Depth	0.37	ft
Discharge	5.00	ft³/s

Cross Section Image



Worksheet for 8P - 100-yr Interim 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.68000	%
Discharge	59.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+52.26	2000.07
0+75.04	1999.57
0+75.18	1999.06
0+76.59	1999.20
0+92.48	1999.41
1+07.24	1999.41
1+07.24	1999.37
1+08.74	1999.24
1+08.74	1999.59
1+09.24	1999.59
1+14.24	1999.69
1+37.16	2000.13

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+52.26, 2000.07)	(0+76.59, 1999.20)	0.013
(0+76.59, 1999.20)	(1+07.24, 1999.41)	0.016
(1+07.24, 1999.41)	(1+37.16, 2000.13)	0.013

Options

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

Worksheet for 8P - 100-yr Interim 1

Results

Normal Depth		0.70	ft
Elevation Range	1999.06 to 2000.13 ft		
Flow Area		15.88	ft²
Wetted Perimeter		52.74	ft
Hydraulic Radius		0.30	ft
Top Width		51.96	ft
Normal Depth		0.70	ft
Critical Depth		0.74	ft
Critical Slope		0.00474	ft/ft
Velocity		3.71	ft/s
Velocity Head		0.21	ft
Specific Energy		0.91	ft
Froude Number		1.18	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.70	ft
Critical Depth	0.74	ft
Channel Slope	0.68000	%
Critical Slope	0.00474	ft/ft

Cross Section for 8P - 100-yr Interim 1

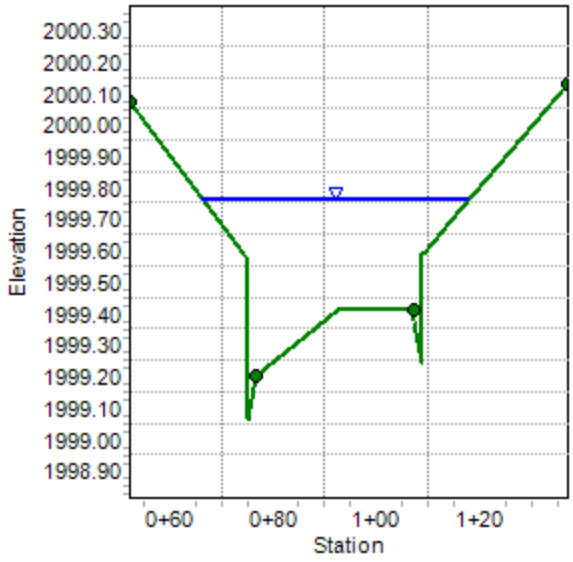
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.68000	%
Normal Depth	0.70	ft
Discharge	59.00	ft³/s

Cross Section Image



Worksheet for 8P - 100-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.68000	%
Discharge	35.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+52.26	2000.07
0+75.04	1999.57
0+75.18	1999.06
0+76.59	1999.20
0+92.48	1999.41
1+07.24	1999.41
1+07.24	1999.37
1+08.74	1999.24
1+08.74	1999.59
1+09.24	1999.59
1+14.24	1999.69
1+37.16	2000.13

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+52.26, 2000.07)	(0+76.59, 1999.20)	0.013
(0+76.59, 1999.20)	(1+07.24, 1999.41)	0.016
(1+07.24, 1999.41)	(1+37.16, 2000.13)	0.013

Options

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

Worksheet for 8P - 100-yr Ultimate

Results

Normal Depth		0.59	ft
Elevation Range	1999.06 to 2000.13 ft		
Flow Area		10.80	ft²
Wetted Perimeter		42.25	ft
Hydraulic Radius		0.26	ft
Top Width		41.47	ft
Normal Depth		0.59	ft
Critical Depth		0.62	ft
Critical Slope		0.00535	ft/ft
Velocity		3.24	ft/s
Velocity Head		0.16	ft
Specific Energy		0.75	ft
Froude Number		1.12	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.59	ft
Critical Depth	0.62	ft
Channel Slope	0.68000	%
Critical Slope	0.00535	ft/ft

Cross Section for 8P - 100-yr Ultimate

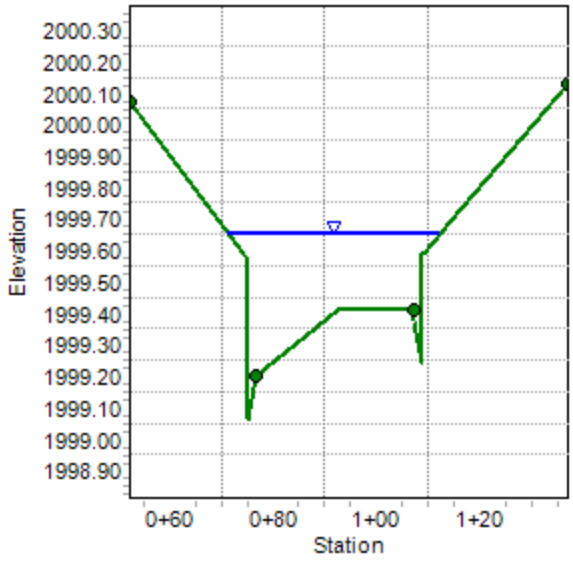
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.68000	%
Normal Depth	0.59	ft
Discharge	35.00	ft³/s

Cross Section Image



Worksheet for 10P - 10-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.50000	%
Discharge	8.10	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
-0+15.96	1996.92
0+00.03	1996.63
0+01.83	1996.60
0+02.88	1996.60
0+11.41	1996.43
0+17.84	1996.44
0+17.84	1995.94
0+19.34	1996.07
0+19.34	1996.11
0+33.71	1996.83
0+36.00	1996.89
0+41.00	1996.93
0+46.00	1996.81
0+50.40	1996.67
0+60.32	1996.18
0+60.32	1996.14
0+61.82	1996.01
0+61.82	1996.51
0+67.92	1996.51
0+68.12	1996.50
0+68.15	1996.49
0+79.50	1996.74
0+81.80	1996.84

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient

Worksheet for 10P - 10-yr Ultimate

Input Data

Start Station	Ending Station	Roughness Coefficient
(-0+15.96, 1996.92)	(0+19.34, 1996.07)	0.013
(0+19.34, 1996.07)	(0+60.32, 1996.14)	0.016
(0+60.32, 1996.14)	(0+81.80, 1996.84)	0.013

Options

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

Results

Normal Depth		0.54	ft
Elevation Range	1995.94 to 1996.93 ft		
Flow Area		3.99	ft²
Wetted Perimeter		26.61	ft
Hydraulic Radius		0.15	ft
Top Width		25.53	ft
Normal Depth		0.54	ft
Critical Depth		0.53	ft
Critical Slope		0.00619	ft/ft
Velocity		2.03	ft/s
Velocity Head		0.06	ft
Specific Energy		0.61	ft
Froude Number		0.91	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.54	ft

Worksheet for 10P - 10-yr Ultimate

GVF Output Data

Critical Depth	0.53	ft
Channel Slope	0.50000	%
Critical Slope	0.00619	ft/ft

Cross Section for 10P - 10-yr Ultimate

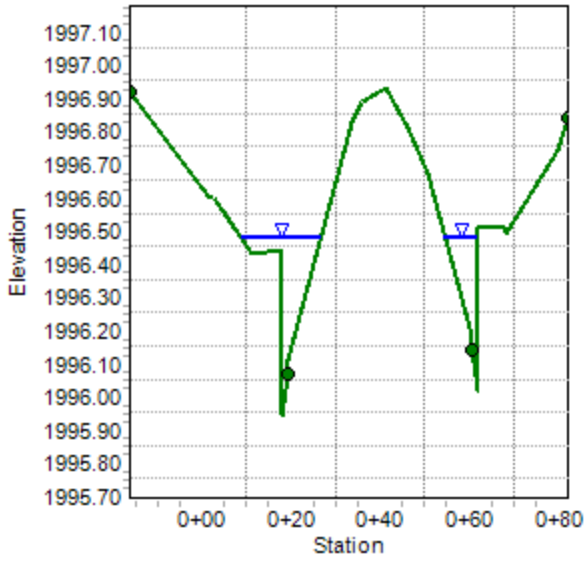
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.50000	%
Normal Depth	0.54	ft
Discharge	8.10	ft³/s

Cross Section Image



Worksheet for 10P - 100-yr Interim 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.50000	%
Discharge	65.20	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
-0+15.96	1996.92
0+00.03	1996.63
0+01.83	1996.60
0+02.88	1996.60
0+11.41	1996.43
0+17.84	1996.44
0+17.84	1995.94
0+19.34	1996.07
0+19.34	1996.11
0+33.71	1996.83
0+36.00	1996.89
0+41.00	1996.93
0+46.00	1996.81
0+50.40	1996.67
0+60.32	1996.18
0+60.32	1996.14
0+61.82	1996.01
0+61.82	1996.51
0+67.92	1996.51
0+68.12	1996.50
0+68.15	1996.49
0+79.50	1996.74
0+81.80	1996.84

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient

Worksheet for 10P - 100-yr Interim 1

Input Data

Start Station	Ending Station	Roughness Coefficient
(-0+15.96, 1996.92)	(0+19.34, 1996.07)	0.013
(0+19.34, 1996.07)	(0+60.32, 1996.14)	0.016
(0+60.32, 1996.14)	(0+81.80, 1996.84)	0.013

Options

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

Results

Normal Depth		0.86	ft
Elevation Range	1995.94 to 1996.93 ft		
Flow Area		21.03	ft²
Wetted Perimeter		78.01	ft
Hydraulic Radius		0.27	ft
Top Width		76.88	ft
Normal Depth		0.86	ft
Critical Depth		0.87	ft
Critical Slope		0.00455	ft/ft
Velocity		3.10	ft/s
Velocity Head		0.15	ft
Specific Energy		1.01	ft
Froude Number		1.05	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.86	ft

Worksheet for 10P - 100-yr Interim 1

GVF Output Data

Critical Depth	0.87	ft
Channel Slope	0.50000	%
Critical Slope	0.00455	ft/ft

Cross Section for 10P - 100-yr Interim 1

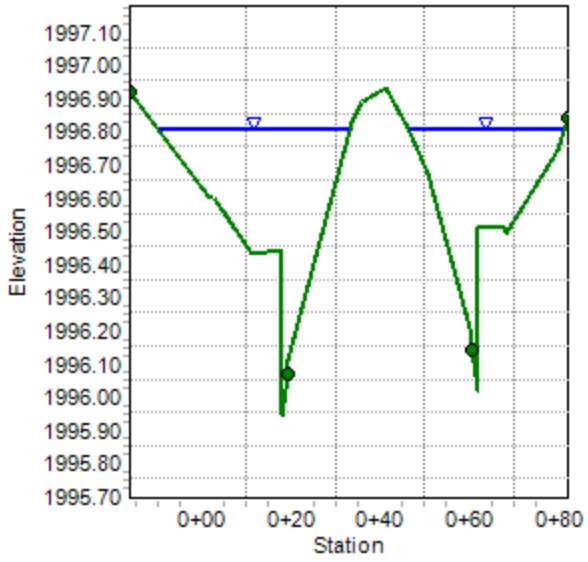
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.50000	%
Normal Depth	0.86	ft
Discharge	65.20	ft³/s

Cross Section Image



Worksheet for 10P - 100-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.50000	%
Discharge	41.20	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
-0+15.96	1996.92
0+00.03	1996.63
0+01.83	1996.60
0+02.88	1996.60
0+11.41	1996.43
0+17.84	1996.44
0+17.84	1995.94
0+19.34	1996.07
0+19.34	1996.11
0+33.71	1996.83
0+36.00	1996.89
0+41.00	1996.93
0+46.00	1996.81
0+50.40	1996.67
0+60.32	1996.18
0+60.32	1996.14
0+61.82	1996.01
0+61.82	1996.51
0+67.92	1996.51
0+68.12	1996.50
0+68.15	1996.49
0+79.50	1996.74
0+81.80	1996.84

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient

Worksheet for 10P - 100-yr Ultimate

Input Data

Start Station	Ending Station	Roughness Coefficient
(-0+15.96, 1996.92)	(0+19.34, 1996.07)	0.013
(0+19.34, 1996.07)	(0+60.32, 1996.14)	0.016
(0+60.32, 1996.14)	(0+81.80, 1996.84)	0.013

Options

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

Results

Normal Depth		0.77	ft
Elevation Range	1995.94 to 1996.93 ft		
Flow Area		14.98	ft²
Wetted Perimeter		66.63	ft
Hydraulic Radius		0.22	ft
Top Width		65.51	ft
Normal Depth		0.77	ft
Critical Depth		0.78	ft
Critical Slope		0.00486	ft/ft
Velocity		2.75	ft/s
Velocity Head		0.12	ft
Specific Energy		0.89	ft
Froude Number		1.01	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.77	ft

Worksheet for 10P - 100-yr Ultimate

GVF Output Data

Critical Depth	0.78	ft
Channel Slope	0.50000	%
Critical Slope	0.00486	ft/ft

Cross Section for 10P - 100-yr Ultimate

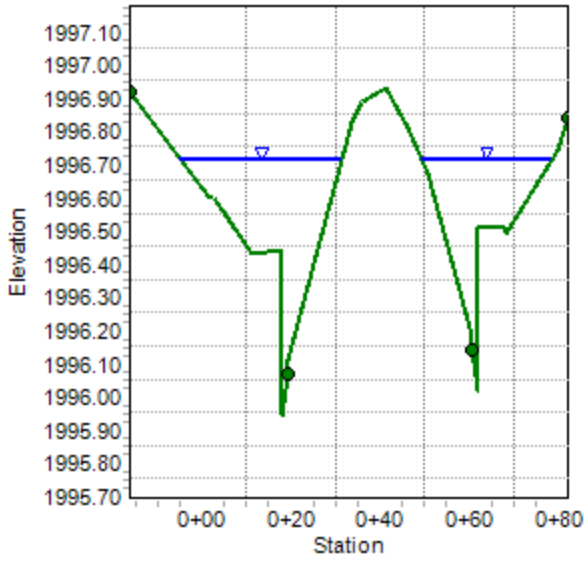
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.50000	%
Normal Depth	0.77	ft
Discharge	41.20	ft³/s

Cross Section Image



Worksheet for 11P - 10-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.94000	%
Discharge	4.90	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.06	1992.91
0+02.47	1992.95
0+05.47	1992.84
0+08.51	1992.64
0+09.61	1992.50
0+20.56	1992.38
0+20.56	1992.40
0+20.84	1992.38
0+26.94	1992.38
0+26.94	1991.88
0+28.44	1992.01
0+28.44	1992.05
0+49.63	1993.11
0+69.81	1992.10
0+69.81	1992.06
0+71.31	1991.93
0+71.31	1992.43
0+77.41	1992.43
0+86.25	1992.58
0+89.01	1992.88
0+96.33	1992.91
1+01.46	1993.03
1+40.70	1993.80
1+40.84	1993.88

Roughness Segment Definitions

Worksheet for 11P - 10-yr Ultimate

Input Data

(0+00.06, 1992.91)	(0+28.44, 1992.01)	0.013
(0+28.44, 1992.01)	(0+69.81, 1992.06)	0.016
(0+69.81, 1992.06)	(1+40.84, 1993.88)	0.013

Options

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

Results

Normal Depth		0.36	ft
Elevation Range	1991.88 to 1993.88 ft		
Flow Area		1.37	ft²
Wetted Perimeter		10.38	ft
Hydraulic Radius		0.13	ft
Top Width		9.61	ft
Normal Depth		0.36	ft
Critical Depth		0.43	ft
Critical Slope		0.00650	ft/ft
Velocity		3.58	ft/s
Velocity Head		0.20	ft
Specific Energy		0.56	ft
Froude Number		1.67	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Worksheet for 11P - 10-yr Ultimate

GVF Output Data

Normal Depth	0.36	ft
Critical Depth	0.43	ft
Channel Slope	1.94000	%
Critical Slope	0.00650	ft/ft

Cross Section for 11P - 10-yr Ultimate

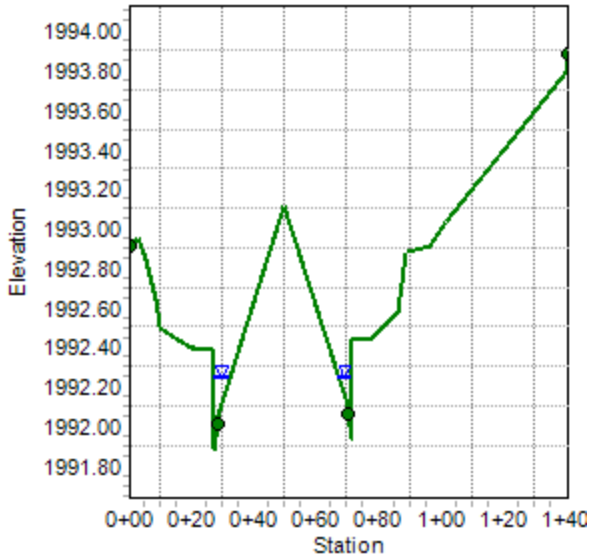
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.94000	%
Normal Depth	0.36	ft
Discharge	4.90	ft³/s

Cross Section Image



Worksheet for 11P - 100-yr Interim 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.94000	%
Discharge	40.10	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.06	1992.91
0+02.47	1992.95
0+05.47	1992.84
0+08.51	1992.64
0+09.61	1992.50
0+20.56	1992.38
0+20.56	1992.40
0+20.84	1992.38
0+26.94	1992.38
0+26.94	1991.88
0+28.44	1992.01
0+28.44	1992.05
0+49.63	1993.11
0+69.81	1992.10
0+69.81	1992.06
0+71.31	1991.93
0+71.31	1992.43
0+77.41	1992.43
0+86.25	1992.58
0+89.01	1992.88
0+96.33	1992.91
1+01.46	1993.03
1+40.70	1993.80
1+40.84	1993.88

Roughness Segment Definitions

Worksheet for 11P - 100-yr Interim 1

Input Data

(0+00.06, 1992.91)	(0+28.44, 1992.01)	0.013
(0+28.44, 1992.01)	(0+69.81, 1992.06)	0.016
(0+69.81, 1992.06)	(1+40.84, 1993.88)	0.013

Options

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

Results

Normal Depth		0.65	ft
Elevation Range	1991.88 to 1993.88 ft		
Flow Area		8.90	ft²
Wetted Perimeter		52.30	ft
Hydraulic Radius		0.17	ft
Top Width		51.16	ft
Normal Depth		0.65	ft
Critical Depth		0.75	ft
Critical Slope		0.00478	ft/ft
Velocity		4.51	ft/s
Velocity Head		0.32	ft
Specific Energy		0.97	ft
Froude Number		1.90	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Worksheet for 11P - 100-yr Interim 1

GVF Output Data

Normal Depth	0.65	ft
Critical Depth	0.75	ft
Channel Slope	1.94000	%
Critical Slope	0.00478	ft/ft

Cross Section for 11P - 100-yr Interim 1

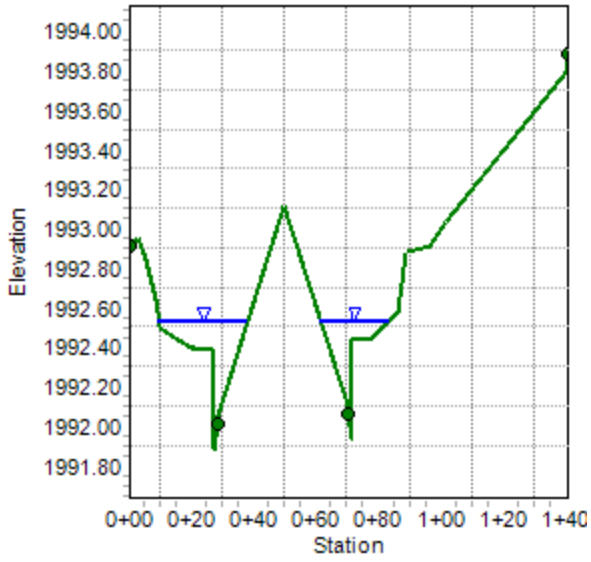
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.94000	%
Normal Depth	0.65	ft
Discharge	40.10	ft³/s

Cross Section Image



Worksheet for 11P - 100-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.94000	%
Discharge	16.10	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.06	1992.91
0+02.47	1992.95
0+05.47	1992.84
0+08.51	1992.64
0+09.61	1992.50
0+20.56	1992.38
0+20.56	1992.40
0+20.84	1992.38
0+26.94	1992.38
0+26.94	1991.88
0+28.44	1992.01
0+28.44	1992.05
0+49.63	1993.11
0+69.81	1992.10
0+69.81	1992.06
0+71.31	1991.93
0+71.31	1992.43
0+77.41	1992.43
0+86.25	1992.58
0+89.01	1992.88
0+96.33	1992.91
1+01.46	1993.03
1+40.70	1993.80
1+40.84	1993.88

Roughness Segment Definitions

Worksheet for 11P - 100-yr Ultimate

Input Data

(0+00.06, 1992.91)	(0+28.44, 1992.01)	0.013
(0+28.44, 1992.01)	(0+69.81, 1992.06)	0.016
(0+69.81, 1992.06)	(1+40.84, 1993.88)	0.013

Options

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

Results

Normal Depth		0.54	ft
Elevation Range	1991.88 to 1993.88 ft		
Flow Area		4.10	ft²
Wetted Perimeter		28.24	ft
Hydraulic Radius		0.15	ft
Top Width		27.12	ft
Normal Depth		0.54	ft
Critical Depth		0.62	ft
Critical Slope		0.00596	ft/ft
Velocity		3.93	ft/s
Velocity Head		0.24	ft
Specific Energy		0.78	ft
Froude Number		1.78	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Worksheet for 11P - 100-yr Ultimate

GVF Output Data

Normal Depth	0.54	ft
Critical Depth	0.62	ft
Channel Slope	1.94000	%
Critical Slope	0.00596	ft/ft

Cross Section for 11P - 100-yr Ultimate

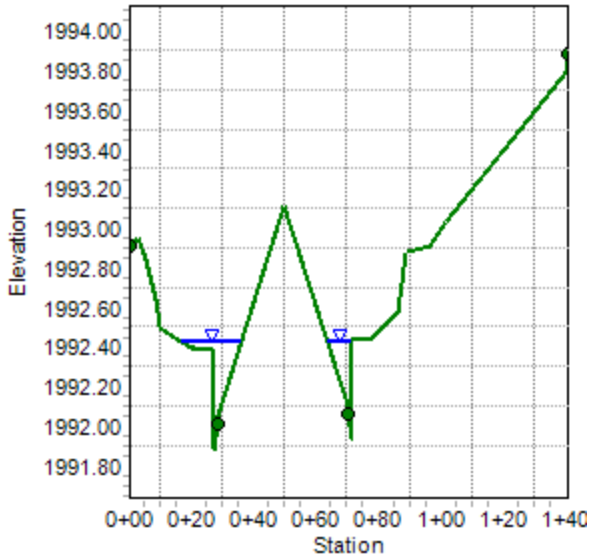
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.94000	%
Normal Depth	0.54	ft
Discharge	16.10	ft³/s

Cross Section Image



Worksheet for 16P - 10-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.00000	%
Discharge	4.90	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.05	1989.24
0+01.05	1989.23
0+13.28	1989.03
0+19.38	1989.03
0+19.38	1988.53
0+20.88	1988.66
0+20.88	1988.70
0+43.69	1989.84
0+62.16	1988.92
0+62.16	1988.88
0+63.66	1988.75
0+63.66	1989.25
0+69.76	1989.25
0+75.63	1989.36
0+85.15	1989.53
0+86.46	1989.65
0+88.11	1989.58
0+93.86	1989.51
0+94.42	1989.52

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.05, 1989.24)	(0+20.88, 1988.66)	0.013
(0+20.88, 1988.66)	(0+62.16, 1988.88)	0.016

Worksheet for 16P - 10-yr Ultimate

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+62.16, 1988.88)	(0+94.42, 1989.52)	0.013

Options

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

Results

Normal Depth		0.41	ft
Elevation Range	1988.53 to 1989.84 ft		
Flow Area		1.26	ft²
Wetted Perimeter		8.78	ft
Hydraulic Radius		0.14	ft
Top Width		8.09	ft
Normal Depth		0.41	ft
Critical Depth		0.49	ft
Critical Slope		0.00626	ft/ft
Velocity		3.88	ft/s
Velocity Head		0.23	ft
Specific Energy		0.64	ft
Froude Number		1.73	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.41	ft
Critical Depth	0.49	ft

Worksheet for 16P - 10-yr Ultimate

GVF Output Data

Channel Slope	2.00000	%
Critical Slope	0.00626	ft/ft

Cross Section for 16P - 10-yr Ultimate

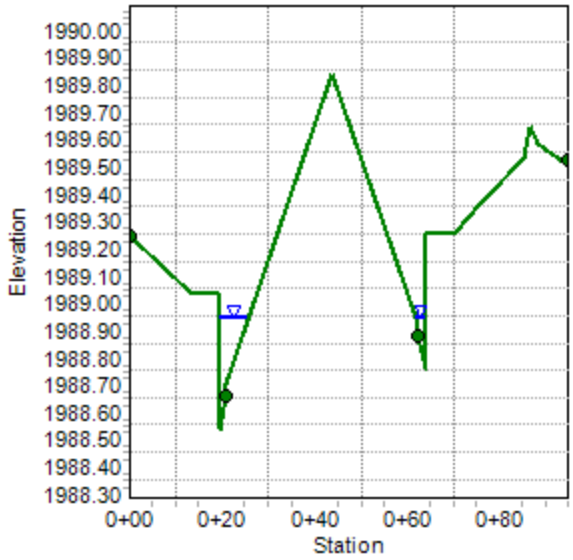
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.00000	%
Normal Depth	0.41	ft
Discharge	4.90	ft³/s

Cross Section Image



Worksheet for 16P - 100-yr Interim 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.00000	%
Discharge	40.10	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.05	1989.24
0+01.05	1989.23
0+13.28	1989.03
0+19.38	1989.03
0+19.38	1988.53
0+20.88	1988.66
0+20.88	1988.70
0+43.69	1989.84
0+62.16	1988.92
0+62.16	1988.88
0+63.66	1988.75
0+63.66	1989.25
0+69.76	1989.25
0+75.63	1989.36
0+85.15	1989.53
0+86.46	1989.65
0+88.11	1989.58
0+93.86	1989.51
0+94.42	1989.52

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.05, 1989.24)	(0+20.88, 1988.66)	0.013
(0+20.88, 1988.66)	(0+62.16, 1988.88)	0.016

Worksheet for 16P - 100-yr Interim 1

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+62.16, 1988.88)	(0+94.42, 1989.52)	0.013

Options

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

Results

Normal Depth		0.71	ft
Elevation Range	1988.53 to 1989.84 ft		
Flow Area		8.01	ft²
Wetted Perimeter		40.06	ft
Hydraulic Radius		0.20	ft
Top Width		38.96	ft
Normal Depth		0.71	ft
Critical Depth		0.83	ft
Critical Slope		0.00490	ft/ft
Velocity		5.00	ft/s
Velocity Head		0.39	ft
Specific Energy		1.09	ft
Froude Number		1.95	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.71	ft
Critical Depth	0.83	ft

Worksheet for 16P - 100-yr Interim 1

GVF Output Data

Channel Slope	2.00000	%
Critical Slope	0.00490	ft/ft

Cross Section for 16P - 100-yr Interim 1

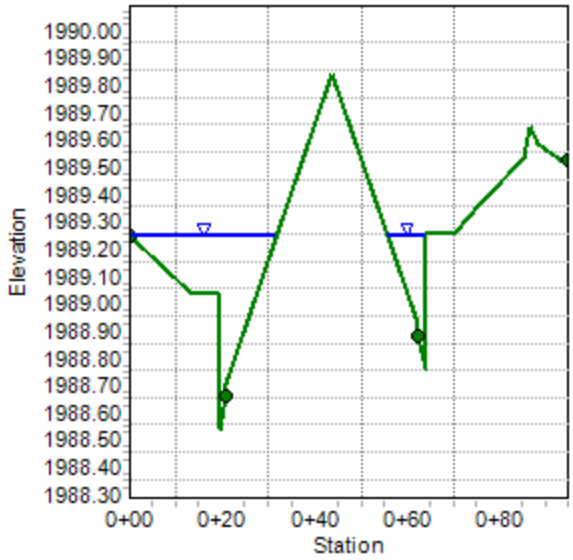
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.00000	%
Normal Depth	0.71	ft
Discharge	40.10	ft³/s

Cross Section Image



Worksheet for 16P - 100-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.00000	%
Discharge	16.10	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.05	1989.24
0+01.05	1989.23
0+13.28	1989.03
0+19.38	1989.03
0+19.38	1988.53
0+20.88	1988.66
0+20.88	1988.70
0+43.69	1989.84
0+62.16	1988.92
0+62.16	1988.88
0+63.66	1988.75
0+63.66	1989.25
0+69.76	1989.25
0+75.63	1989.36
0+85.15	1989.53
0+86.46	1989.65
0+88.11	1989.58
0+93.86	1989.51
0+94.42	1989.52

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.05, 1989.24)	(0+20.88, 1988.66)	0.013
(0+20.88, 1988.66)	(0+62.16, 1988.88)	0.016

Worksheet for 16P - 100-yr Ultimate

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+62.16, 1988.88)	(0+94.42, 1989.52)	0.013

Options

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

Results

Normal Depth		0.58	ft
Elevation Range	1988.53 to 1989.84 ft		
Flow Area		3.97	ft²
Wetted Perimeter		27.10	ft
Hydraulic Radius		0.15	ft
Top Width		26.13	ft
Normal Depth		0.58	ft
Critical Depth		0.67	ft
Critical Slope		0.00550	ft/ft
Velocity		4.05	ft/s
Velocity Head		0.26	ft
Specific Energy		0.84	ft
Froude Number		1.83	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.58	ft
Critical Depth	0.67	ft

Worksheet for 16P - 100-yr Ultimate

GVF Output Data

Channel Slope	2.00000	%
Critical Slope	0.00550	ft/ft

Cross Section for 16P - 100-yr Ultimate

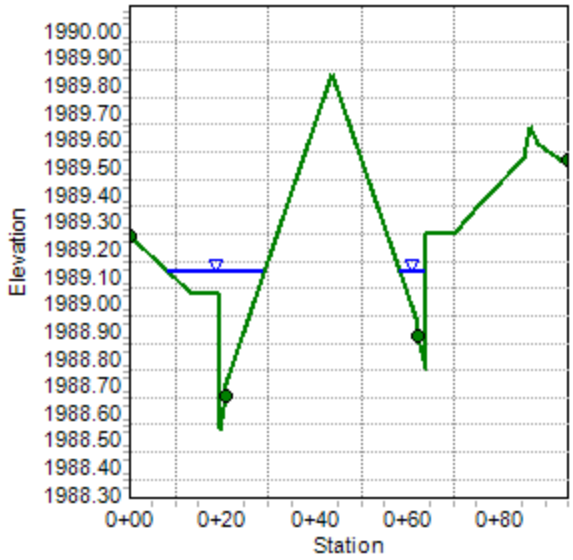
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.00000	%
Normal Depth	0.58	ft
Discharge	16.10	ft³/s

Cross Section Image



Worksheet for 12P1 - 10-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.93000	%
Discharge	1.10	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
-0+04.76	1986.20
0+00.00	1984.91
0+15.28	1984.83
0+21.38	1984.83
0+21.38	1984.33
0+22.88	1984.46
0+22.88	1984.50
0+41.26	1985.42
0+45.32	1985.42
0+49.67	1985.32
0+64.00	1984.61
0+64.00	1984.57
0+65.50	1984.44
0+65.50	1984.94
0+71.61	1984.94
0+81.24	1985.06
0+96.22	1985.08
1+08.89	1985.61

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+04.76, 1986.20)	(0+22.88, 1984.46)	0.013
(0+22.88, 1984.46)	(0+64.00, 1984.57)	0.016
(0+64.00, 1984.57)	(1+08.89, 1985.61)	0.013

Worksheet for 12P1 - 10-yr Ultimate

Options

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

Results

Normal Depth		0.22	ft
Elevation Range	1984.33 to 1986.20 ft		
Flow Area		0.33	ft²
Wetted Perimeter		4.13	ft
Hydraulic Radius		0.08	ft
Top Width		3.75	ft
Normal Depth		0.22	ft
Critical Depth		0.28	ft
Critical Slope		0.00656	ft/ft
Velocity		3.38	ft/s
Velocity Head		0.18	ft
Specific Energy		0.40	ft
Froude Number		2.03	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.22	ft
Critical Depth	0.28	ft
Channel Slope	2.93000	%
Critical Slope	0.00656	ft/ft

Cross Section for 12P1 - 10-yr Ultimate

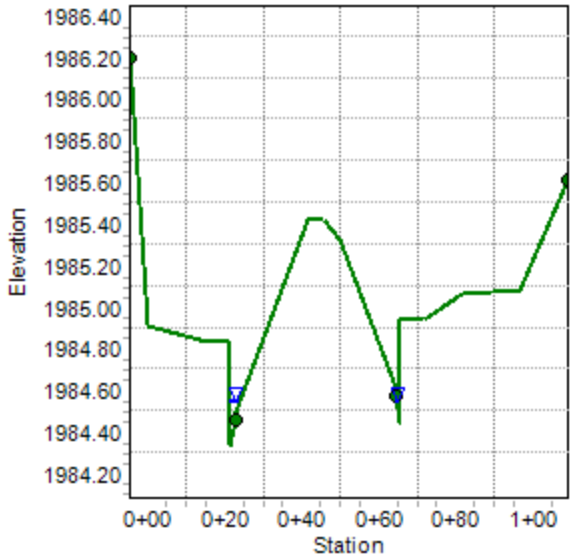
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.93000	%
Normal Depth	0.22	ft
Discharge	1.10	ft³/s

Cross Section Image



Worksheet for 12P1 - 100-yr Interim 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.93000	%
Discharge	32.10	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
-0+04.76	1986.20
0+00.00	1984.91
0+15.28	1984.83
0+21.38	1984.83
0+21.38	1984.33
0+22.88	1984.46
0+22.88	1984.50
0+41.26	1985.42
0+45.32	1985.42
0+49.67	1985.32
0+64.00	1984.61
0+64.00	1984.57
0+65.50	1984.44
0+65.50	1984.94
0+71.61	1984.94
0+81.24	1985.06
0+96.22	1985.08
1+08.89	1985.61

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+04.76, 1986.20)	(0+22.88, 1984.46)	0.013
(0+22.88, 1984.46)	(0+64.00, 1984.57)	0.016
(0+64.00, 1984.57)	(1+08.89, 1985.61)	0.013

Worksheet for 12P1 - 100-yr Interim 1

Options

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

Results

Normal Depth		0.62	ft
Elevation Range	1984.33 to 1986.20 ft		
Flow Area		6.65	ft²
Wetted Perimeter		48.42	ft
Hydraulic Radius		0.14	ft
Top Width		47.30	ft
Normal Depth		0.62	ft
Critical Depth		0.73	ft
Critical Slope		0.00499	ft/ft
Velocity		4.82	ft/s
Velocity Head		0.36	ft
Specific Energy		0.98	ft
Froude Number		2.27	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.62	ft
Critical Depth	0.73	ft
Channel Slope	2.93000	%
Critical Slope	0.00499	ft/ft

Cross Section for 12P1 - 100-yr Interim 1

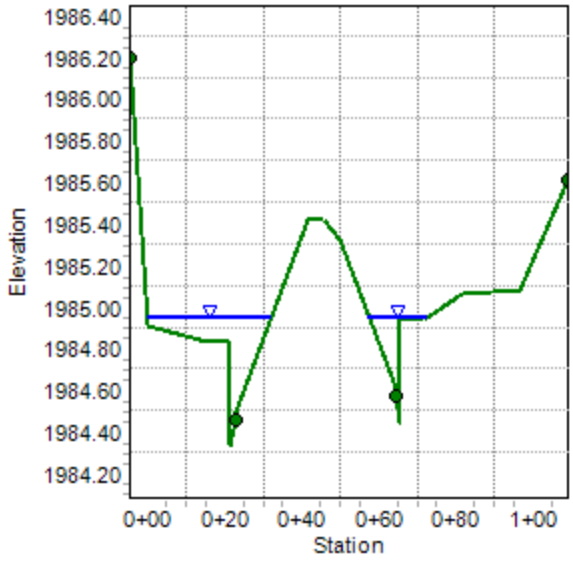
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.93000	%
Normal Depth	0.62	ft
Discharge	32.10	ft³/s

Cross Section Image



Worksheet for 12P1 - 100-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.93000	%
Discharge	8.10	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
-0+04.76	1986.20
0+00.00	1984.91
0+15.28	1984.83
0+21.38	1984.83
0+21.38	1984.33
0+22.88	1984.46
0+22.88	1984.50
0+41.26	1985.42
0+45.32	1985.42
0+49.67	1985.32
0+64.00	1984.61
0+64.00	1984.57
0+65.50	1984.44
0+65.50	1984.94
0+71.61	1984.94
0+81.24	1985.06
0+96.22	1985.08
1+08.89	1985.61

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+04.76, 1986.20)	(0+22.88, 1984.46)	0.013
(0+22.88, 1984.46)	(0+64.00, 1984.57)	0.016
(0+64.00, 1984.57)	(1+08.89, 1985.61)	0.013

Worksheet for 12P1 - 100-yr Ultimate

Options

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

Results

Normal Depth		0.42	ft
Elevation Range	1984.33 to 1986.20 ft		
Flow Area		1.72	ft²
Wetted Perimeter		11.65	ft
Hydraulic Radius		0.15	ft
Top Width		10.82	ft
Normal Depth		0.42	ft
Critical Depth		0.55	ft
Critical Slope		0.00690	ft/ft
Velocity		4.71	ft/s
Velocity Head		0.34	ft
Specific Energy		0.76	ft
Froude Number		2.08	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.42	ft
Critical Depth	0.55	ft
Channel Slope	2.93000	%
Critical Slope	0.00690	ft/ft

Cross Section for 12P1 - 100-yr Ultimate

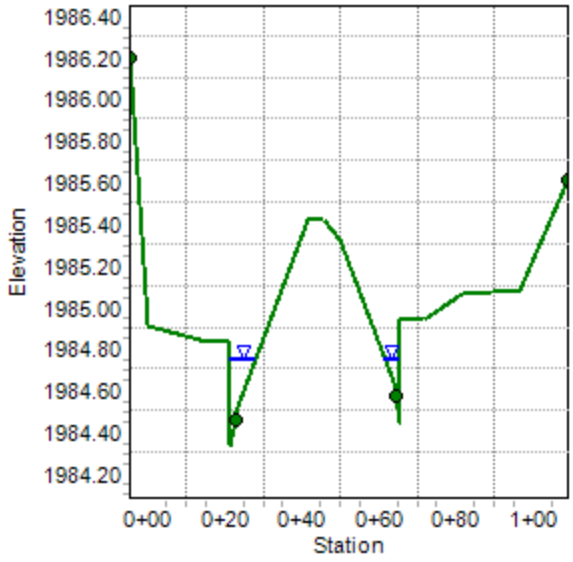
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.93000	%
Normal Depth	0.42	ft
Discharge	8.10	ft³/s

Cross Section Image



Worksheet for 12P2 - 10-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.93000	%
Discharge	6.50	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
-0+04.76	1986.20
0+00.00	1984.91
0+15.28	1984.83
0+21.38	1984.83
0+21.38	1984.33
0+22.88	1984.46
0+22.88	1984.50
0+41.26	1985.42
0+45.32	1985.42
0+49.67	1985.32
0+64.00	1984.61
0+64.00	1984.57
0+65.50	1984.44
0+65.50	1984.94
0+71.61	1984.94
0+81.24	1985.06
0+96.22	1985.08
1+08.89	1985.61

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+04.76, 1986.20)	(0+22.88, 1984.46)	0.013
(0+22.88, 1984.46)	(0+64.00, 1984.57)	0.016
(0+64.00, 1984.57)	(1+08.89, 1985.61)	0.013

Worksheet for 12P2 - 10-yr Ultimate

Options

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

Results

Normal Depth		0.39	ft
Elevation Range	1984.33 to 1986.20 ft		
Flow Area		1.44	ft²
Wetted Perimeter		10.49	ft
Hydraulic Radius		0.14	ft
Top Width		9.72	ft
Normal Depth		0.39	ft
Critical Depth		0.52	ft
Critical Slope		0.00687	ft/ft
Velocity		4.51	ft/s
Velocity Head		0.32	ft
Specific Energy		0.71	ft
Froude Number		2.07	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.39	ft
Critical Depth	0.52	ft
Channel Slope	2.93000	%
Critical Slope	0.00687	ft/ft

Cross Section for 12P2 - 10-yr Ultimate

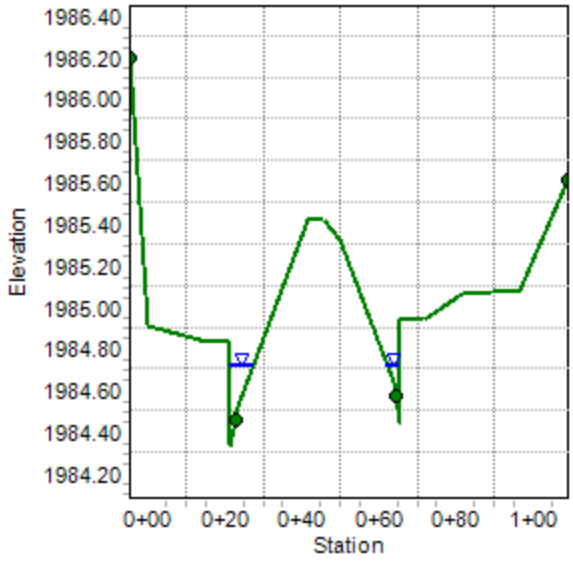
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.93000	%
Normal Depth	0.39	ft
Discharge	6.50	ft³/s

Cross Section Image



Worksheet for 12P2 - 100-yr Interim 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.93000	%
Discharge	33.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
-0+04.76	1986.20
0+00.00	1984.91
0+15.28	1984.83
0+21.38	1984.83
0+21.38	1984.33
0+22.88	1984.46
0+22.88	1984.50
0+41.26	1985.42
0+45.32	1985.42
0+49.67	1985.32
0+64.00	1984.61
0+64.00	1984.57
0+65.50	1984.44
0+65.50	1984.94
0+71.61	1984.94
0+81.24	1985.06
0+96.22	1985.08
1+08.89	1985.61

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+04.76, 1986.20)	(0+22.88, 1984.46)	0.013
(0+22.88, 1984.46)	(0+64.00, 1984.57)	0.016
(0+64.00, 1984.57)	(1+08.89, 1985.61)	0.013

Worksheet for 12P2 - 100-yr Interim 1

Options

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

Results

Normal Depth		0.62	ft
Elevation Range	1984.33 to 1986.20 ft		
Flow Area		6.79	ft²
Wetted Perimeter		48.76	ft
Hydraulic Radius		0.14	ft
Top Width		47.64	ft
Normal Depth		0.62	ft
Critical Depth		0.73	ft
Critical Slope		0.00497	ft/ft
Velocity		4.86	ft/s
Velocity Head		0.37	ft
Specific Energy		0.99	ft
Froude Number		2.27	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.62	ft
Critical Depth	0.73	ft
Channel Slope	2.93000	%
Critical Slope	0.00497	ft/ft

Cross Section for 12P2 - 100-yr Interim 1

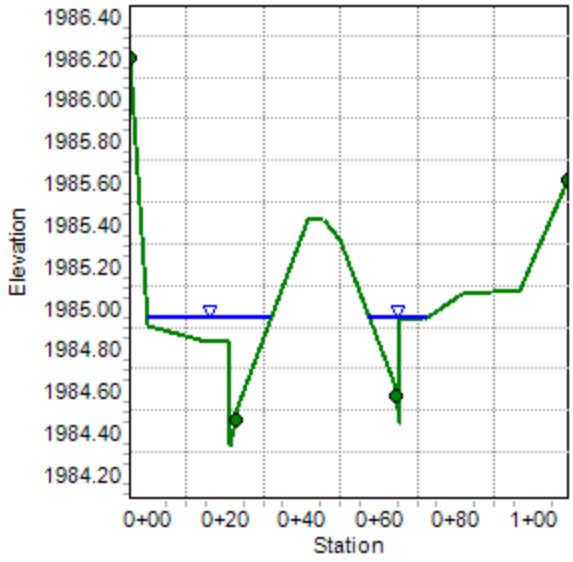
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.93000	%
Normal Depth	0.62	ft
Discharge	33.00	ft³/s

Cross Section Image



Worksheet for 12P2 - 100-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.93000	%
Discharge	9.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
-0+04.76	1986.20
0+00.00	1984.91
0+15.28	1984.83
0+21.38	1984.83
0+21.38	1984.33
0+22.88	1984.46
0+22.88	1984.50
0+41.26	1985.42
0+45.32	1985.42
0+49.67	1985.32
0+64.00	1984.61
0+64.00	1984.57
0+65.50	1984.44
0+65.50	1984.94
0+71.61	1984.94
0+81.24	1985.06
0+96.22	1985.08
1+08.89	1985.61

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+04.76, 1986.20)	(0+22.88, 1984.46)	0.013
(0+22.88, 1984.46)	(0+64.00, 1984.57)	0.016
(0+64.00, 1984.57)	(1+08.89, 1985.61)	0.013

Worksheet for 12P2 - 100-yr Ultimate

Options

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

Results

Normal Depth		0.43	ft
Elevation Range	1984.33 to 1986.20 ft		
Flow Area		1.87	ft²
Wetted Perimeter		12.21	ft
Hydraulic Radius		0.15	ft
Top Width		11.35	ft
Normal Depth		0.43	ft
Critical Depth		0.56	ft
Critical Slope		0.00689	ft/ft
Velocity		4.82	ft/s
Velocity Head		0.36	ft
Specific Energy		0.79	ft
Froude Number		2.09	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.43	ft
Critical Depth	0.56	ft
Channel Slope	2.93000	%
Critical Slope	0.00689	ft/ft

Cross Section for 12P2 - 100-yr Ultimate

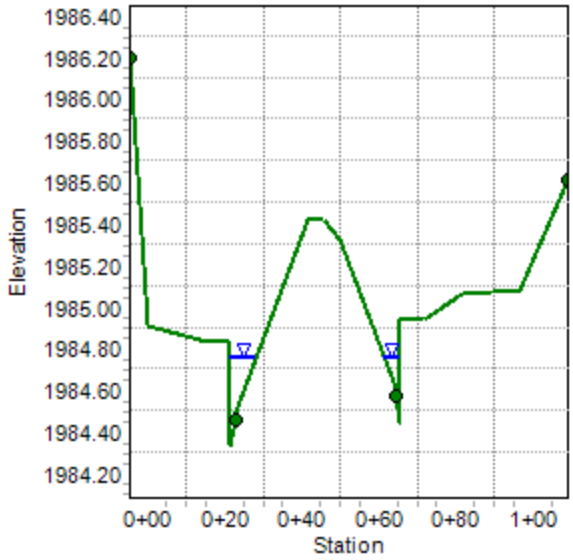
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.93000	%
Normal Depth	0.43	ft
Discharge	9.00	ft³/s

Cross Section Image



Worksheet for 17P - 10-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.93000	%
Discharge	6.50	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.05	1979.25
0+00.27	1979.26
0+06.80	1979.25
0+08.07	1979.27
0+10.17	1979.27
0+13.30	1979.21
0+15.64	1979.20
0+15.84	1979.17
0+15.92	1979.17
0+22.02	1979.17
0+22.02	1978.67
0+23.52	1978.80
0+23.52	1978.84
0+35.44	1979.43
0+36.13	1979.45
0+41.13	1979.49
0+46.13	1979.45
0+51.14	1979.31
0+61.13	1978.95
0+62.55	1978.92
0+64.63	1978.81
0+64.63	1978.77
0+66.13	1978.64
0+66.13	1979.14
0+72.23	1979.14
0+81.20	1979.28
0+82.12	1979.33

Worksheet for 17P - 10-yr Ultimate

Input Data

Station (ft)	Elevation (ft)
0+84.26	1979.38

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.05, 1979.25)	(0+23.52, 1978.80)	0.013
(0+23.52, 1978.80)	(0+64.63, 1978.77)	0.016
(0+64.63, 1978.77)	(0+84.26, 1979.38)	0.013

Options

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

Results

Normal Depth		0.36	ft
Elevation Range	1978.64 to 1979.49 ft		
Flow Area		1.53	ft²
Wetted Perimeter		12.01	ft
Hydraulic Radius		0.13	ft
Top Width		11.22	ft
Normal Depth		0.36	ft
Critical Depth		0.45	ft
Critical Slope		0.00646	ft/ft
Velocity		4.25	ft/s
Velocity Head		0.28	ft
Specific Energy		0.64	ft
Froude Number		2.03	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

Worksheet for 17P - 10-yr Ultimate

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.36	ft
Critical Depth	0.45	ft
Channel Slope	2.93000	%
Critical Slope	0.00646	ft/ft

Cross Section for 17P - 10-yr Ultimate

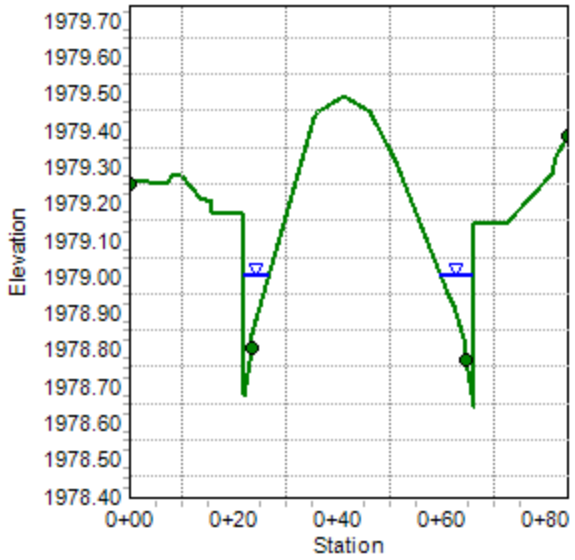
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.93000	%
Normal Depth	0.36	ft
Discharge	6.50	ft³/s

Cross Section Image



Worksheet for 17P - 100-yr Interim 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.93000	%
Discharge	33.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.05	1979.25
0+00.27	1979.26
0+06.80	1979.25
0+08.07	1979.27
0+10.17	1979.27
0+13.30	1979.21
0+15.64	1979.20
0+15.84	1979.17
0+15.92	1979.17
0+22.02	1979.17
0+22.02	1978.67
0+23.52	1978.80
0+23.52	1978.84
0+35.44	1979.43
0+36.13	1979.45
0+41.13	1979.49
0+46.13	1979.45
0+51.14	1979.31
0+61.13	1978.95
0+62.55	1978.92
0+64.63	1978.81
0+64.63	1978.77
0+66.13	1978.64
0+66.13	1979.14
0+72.23	1979.14
0+81.20	1979.28
0+82.12	1979.33

Worksheet for 17P - 100-yr Interim 1

Input Data

Station (ft)	Elevation (ft)
0+84.26	1979.38

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.05, 1979.25)	(0+23.52, 1978.80)	0.013
(0+23.52, 1978.80)	(0+64.63, 1978.77)	0.016
(0+64.63, 1978.77)	(0+84.26, 1979.38)	0.013

Options

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

Results

Normal Depth		0.59	ft
Elevation Range	1978.64 to 1979.49 ft		
Flow Area		6.68	ft²
Wetted Perimeter		45.19	ft
Hydraulic Radius		0.15	ft
Top Width		44.08	ft
Normal Depth		0.59	ft
Critical Depth		0.70	ft
Critical Slope		0.00528	ft/ft
Velocity		4.94	ft/s
Velocity Head		0.38	ft
Specific Energy		0.97	ft
Froude Number		2.24	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

Worksheet for 17P - 100-yr Interim 1

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.59	ft
Critical Depth	0.70	ft
Channel Slope	2.93000	%
Critical Slope	0.00528	ft/ft

Cross Section for 17P - 100-yr Interim 1

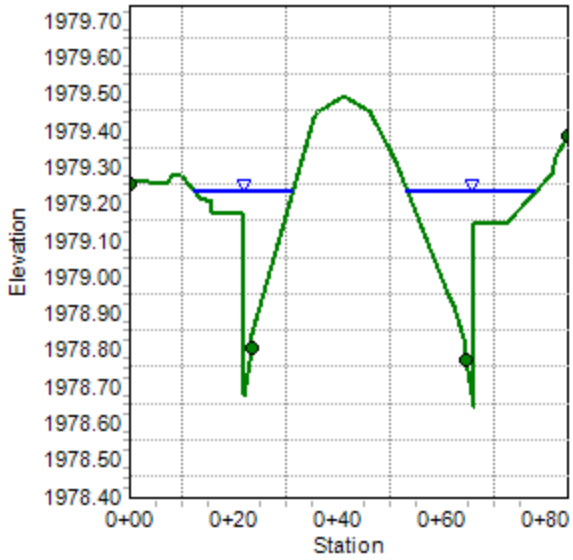
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.93000	%
Normal Depth	0.59	ft
Discharge	33.00	ft³/s

Cross Section Image



Worksheet for 17P - 100-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.93000	%
Discharge	9.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.05	1979.25
0+00.27	1979.26
0+06.80	1979.25
0+08.07	1979.27
0+10.17	1979.27
0+13.30	1979.21
0+15.64	1979.20
0+15.84	1979.17
0+15.92	1979.17
0+22.02	1979.17
0+22.02	1978.67
0+23.52	1978.80
0+23.52	1978.84
0+35.44	1979.43
0+36.13	1979.45
0+41.13	1979.49
0+46.13	1979.45
0+51.14	1979.31
0+61.13	1978.95
0+62.55	1978.92
0+64.63	1978.81
0+64.63	1978.77
0+66.13	1978.64
0+66.13	1979.14
0+72.23	1979.14
0+81.20	1979.28
0+82.12	1979.33

Worksheet for 17P - 100-yr Ultimate

Input Data

Station (ft)	Elevation (ft)
0+84.26	1979.38

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.05, 1979.25)	(0+23.52, 1978.80)	0.013
(0+23.52, 1978.80)	(0+64.63, 1978.77)	0.016
(0+64.63, 1978.77)	(0+84.26, 1979.38)	0.013

Options

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

Results

Normal Depth		0.40	ft
Elevation Range	1978.64 to 1979.49 ft		
Flow Area		1.97	ft²
Wetted Perimeter		13.85	ft
Hydraulic Radius		0.14	ft
Top Width		12.98	ft
Normal Depth		0.40	ft
Critical Depth		0.53	ft
Critical Slope		0.00697	ft/ft
Velocity		4.56	ft/s
Velocity Head		0.32	ft
Specific Energy		0.72	ft
Froude Number		2.06	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

Worksheet for 17P - 100-yr Ultimate

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.40	ft
Critical Depth	0.53	ft
Channel Slope	2.93000	%
Critical Slope	0.00697	ft/ft

Cross Section for 17P - 100-yr Ultimate

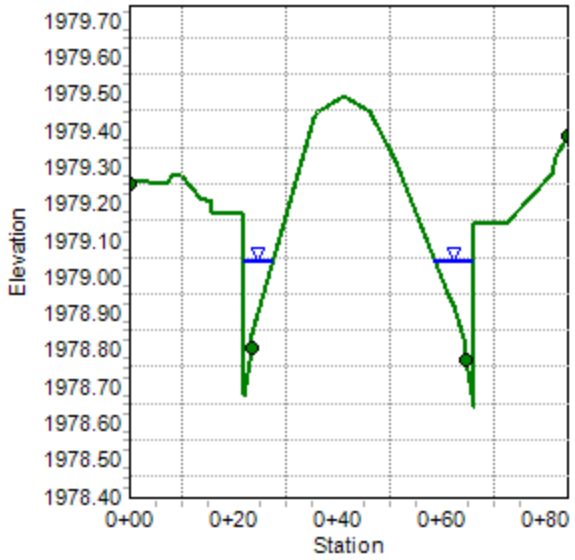
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.93000	%
Normal Depth	0.40	ft
Discharge	9.00	ft³/s

Cross Section Image



Worksheet for 13P - 10-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.75000	%
Discharge	6.50	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1971.75
0+00.88	1971.76
0+09.91	1971.73
0+12.88	1971.76
0+13.58	1971.77
0+14.80	1971.78
0+24.52	1971.63
0+30.62	1971.59
0+30.62	1971.09
0+32.12	1971.22
0+32.12	1971.26
0+32.62	1971.28
0+40.02	1971.48
0+45.02	1971.58
0+55.02	1971.64
0+60.02	1971.63
0+70.60	1971.45
0+73.33	1971.31
0+73.33	1971.27
0+74.83	1971.14
0+74.83	1971.64
0+80.93	1971.64
0+89.91	1971.76
0+93.73	1971.96

Roughness Segment Definitions

Worksheet for 13P - 10-yr Ultimate

Input Data

(0+00.00, 1971.75)	(0+32.12, 1971.22)	0.013
(0+32.12, 1971.22)	(0+73.33, 1971.31)	0.016
(0+73.33, 1971.31)	(0+93.73, 1971.96)	0.013

Options

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

Results

Normal Depth		0.39	ft
Elevation Range	1971.09 to 1971.96 ft		
Flow Area		2.02	ft²
Wetted Perimeter		16.08	ft
Hydraulic Radius		0.13	ft
Top Width		15.25	ft
Normal Depth		0.39	ft
Critical Depth		0.44	ft
Critical Slope		0.00696	ft/ft
Velocity		3.21	ft/s
Velocity Head		0.16	ft
Specific Energy		0.55	ft
Froude Number		1.56	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Worksheet for 13P - 10-yr Ultimate

GVF Output Data

Normal Depth	0.39	ft
Critical Depth	0.44	ft
Channel Slope	1.75000	%
Critical Slope	0.00696	ft/ft

Cross Section for 13P - 10-yr Ultimate

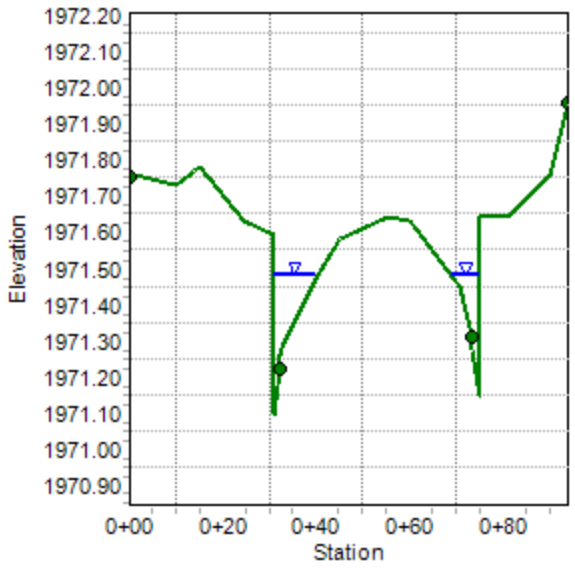
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.75000	%
Normal Depth	0.39	ft
Discharge	6.50	ft³/s

Cross Section Image



Worksheet for 13P - 100-yr Interim 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.75000	%
Discharge	108.80	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1971.75
0+00.88	1971.76
0+09.91	1971.73
0+12.88	1971.76
0+13.58	1971.77
0+14.80	1971.78
0+24.52	1971.63
0+30.62	1971.59
0+30.62	1971.09
0+32.12	1971.22
0+32.12	1971.26
0+32.62	1971.28
0+40.02	1971.48
0+45.02	1971.58
0+55.02	1971.64
0+60.02	1971.63
0+70.60	1971.45
0+73.33	1971.31
0+73.33	1971.27
0+74.83	1971.14
0+74.83	1971.64
0+80.93	1971.64
0+89.91	1971.76
0+93.73	1971.96

Roughness Segment Definitions

Worksheet for 13P - 100-yr Interim 1

Input Data

(0+00.00, 1971.75)	(0+32.12, 1971.22)	0.013
(0+32.12, 1971.22)	(0+73.33, 1971.31)	0.016
(0+73.33, 1971.31)	(0+93.73, 1971.96)	0.013

Options

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

Results

Normal Depth		0.75	ft
Elevation Range	1971.09 to 1971.96 ft		
Flow Area		21.26	ft²
Wetted Perimeter		92.59	ft
Hydraulic Radius		0.23	ft
Top Width		91.40	ft
Normal Depth		0.75	ft
Critical Depth		0.87	ft
Critical Slope		0.00439	ft/ft
Velocity		5.12	ft/s
Velocity Head		0.41	ft
Specific Energy		1.15	ft
Froude Number		1.87	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Worksheet for 13P - 100-yr Interim 1

GVF Output Data

Normal Depth	0.75	ft
Critical Depth	0.87	ft
Channel Slope	1.75000	%
Critical Slope	0.00439	ft/ft

Cross Section for 13P - 100-yr Interim 1

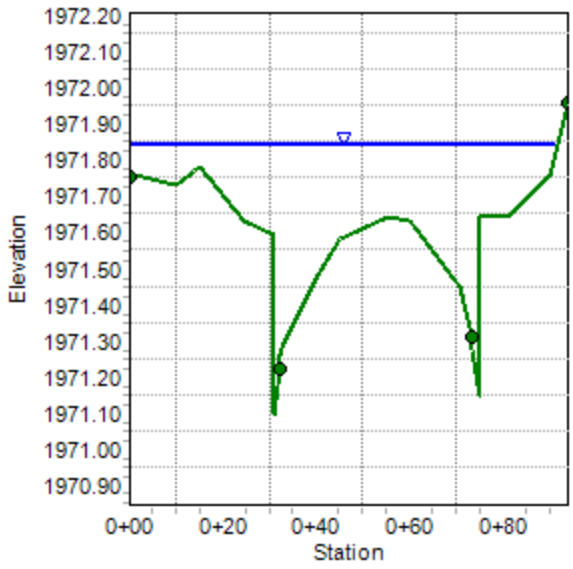
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.75000	%
Normal Depth	0.75	ft
Discharge	108.80	ft³/s

Cross Section Image



Worksheet for 13P - 100-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.75000	%
Discharge	13.80	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1971.75
0+00.88	1971.76
0+09.91	1971.73
0+12.88	1971.76
0+13.58	1971.77
0+14.80	1971.78
0+24.52	1971.63
0+30.62	1971.59
0+30.62	1971.09
0+32.12	1971.22
0+32.12	1971.26
0+32.62	1971.28
0+40.02	1971.48
0+45.02	1971.58
0+55.02	1971.64
0+60.02	1971.63
0+70.60	1971.45
0+73.33	1971.31
0+73.33	1971.27
0+74.83	1971.14
0+74.83	1971.64
0+80.93	1971.64
0+89.91	1971.76
0+93.73	1971.96

Roughness Segment Definitions

Worksheet for 13P - 100-yr Ultimate

Input Data

(0+00.00, 1971.75)	(0+32.12, 1971.22)	0.013
(0+32.12, 1971.22)	(0+73.33, 1971.31)	0.016
(0+73.33, 1971.31)	(0+93.73, 1971.96)	0.013

Options

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

Results

Normal Depth		0.48	ft
Elevation Range	1971.09 to 1971.96 ft		
Flow Area		3.90	ft²
Wetted Perimeter		26.34	ft
Hydraulic Radius		0.15	ft
Top Width		25.33	ft
Normal Depth		0.48	ft
Critical Depth		0.56	ft
Critical Slope		0.00736	ft/ft
Velocity		3.53	ft/s
Velocity Head		0.19	ft
Specific Energy		0.68	ft
Froude Number		1.59	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Worksheet for 13P - 100-yr Ultimate

GVF Output Data

Normal Depth	0.48	ft
Critical Depth	0.56	ft
Channel Slope	1.75000	%
Critical Slope	0.00736	ft/ft

Cross Section for 13P - 100-yr Ultimate

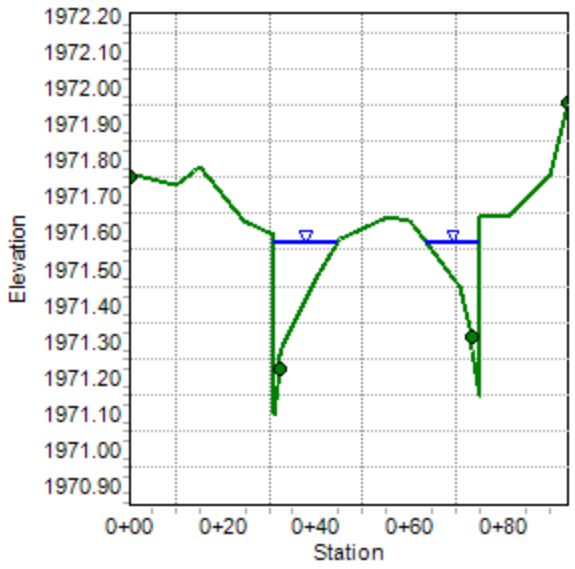
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.75000	%
Normal Depth	0.48	ft
Discharge	13.80	ft³/s

Cross Section Image



Worksheet for 14P - 10-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.16082	%
Discharge	13.60	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+03.43	1964.64
0+04.18	1964.58
0+05.48	1964.35
0+16.77	1964.20
0+22.87	1964.20
0+22.87	1963.70
0+24.37	1963.83
0+24.37	1963.87
0+36.51	1964.48
0+42.48	1964.56
0+47.48	1964.58
0+52.48	1964.53
0+63.38	1964.27
0+65.24	1964.18
0+65.24	1964.14
0+66.74	1964.01
0+66.74	1964.51
0+72.84	1964.51
0+78.47	1964.51
0+81.85	1964.57
0+97.77	1965.40

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient

Worksheet for 14P - 10-yr Ultimate

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+03.43, 1964.64)	(0+24.37, 1963.83)	0.013
(0+24.37, 1963.83)	(0+65.24, 1964.18)	0.016
(0+65.24, 1964.18)	(0+97.77, 1965.40)	0.013

Options

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

Results

Normal Depth		0.57	ft
Elevation Range	1963.70 to 1965.40 ft		
Flow Area		3.40	ft²
Wetted Perimeter		25.39	ft
Hydraulic Radius		0.13	ft
Top Width		24.52	ft
Normal Depth		0.57	ft
Critical Depth		0.65	ft
Critical Slope		0.00558	ft/ft
Velocity		4.00	ft/s
Velocity Head		0.25	ft
Specific Energy		0.82	ft
Froude Number		1.90	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		

Worksheet for 14P - 10-yr Ultimate

GVF Output Data

Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.57	ft
Critical Depth	0.65	ft
Channel Slope	2.16082	%
Critical Slope	0.00558	ft/ft

Cross Section for 14P - 10-yr Ultimate

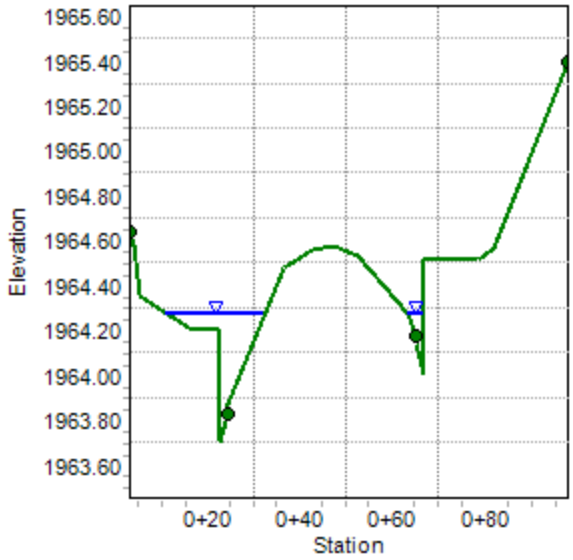
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.16082	%
Normal Depth	0.57	ft
Discharge	13.60	ft³/s

Cross Section Image



Worksheet for 14P - 100-yr Interim 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.16082	%
Discharge	138.80	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+03.43	1964.64
0+04.18	1964.58
0+05.48	1964.35
0+16.77	1964.20
0+22.87	1964.20
0+22.87	1963.70
0+24.37	1963.83
0+24.37	1963.87
0+36.51	1964.48
0+42.48	1964.56
0+47.48	1964.58
0+52.48	1964.53
0+63.38	1964.27
0+65.24	1964.18
0+65.24	1964.14
0+66.74	1964.01
0+66.74	1964.51
0+72.84	1964.51
0+78.47	1964.51
0+81.85	1964.57
0+97.77	1965.40

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient

Worksheet for 14P - 100-yr Interim 1

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+03.43, 1964.64)	(0+24.37, 1963.83)	0.013
(0+24.37, 1963.83)	(0+65.24, 1964.18)	0.016
(0+65.24, 1964.18)	(0+97.77, 1965.40)	0.013

Options

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

Results

Normal Depth		0.94	ft
Elevation Range	1963.70 to 1965.40 ft		
Flow Area		22.06	ft²
Wetted Perimeter		81.05	ft
Hydraulic Radius		0.27	ft
Top Width		79.91	ft
Normal Depth		0.94	ft
Critical Depth		1.13	ft
Critical Slope		0.00416	ft/ft
Velocity		6.29	ft/s
Velocity Head		0.62	ft
Specific Energy		1.56	ft
Froude Number		2.11	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		

Worksheet for 14P - 100-yr Interim 1

GVF Output Data

Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.94	ft
Critical Depth	1.13	ft
Channel Slope	2.16082	%
Critical Slope	0.00416	ft/ft

Cross Section for 14P - 100-yr Interim 1

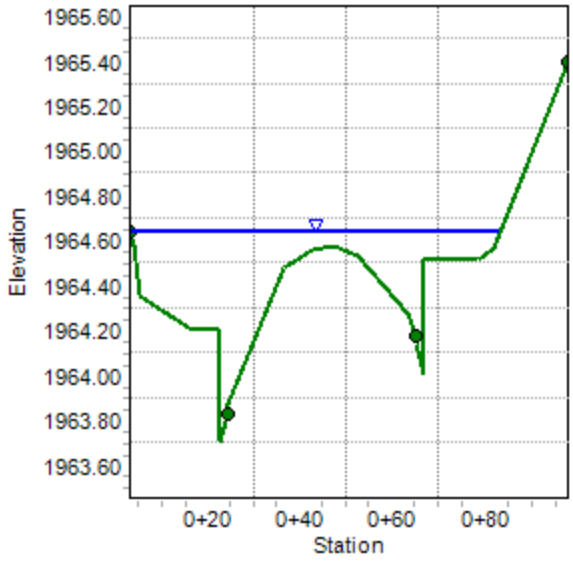
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.16082	%
Normal Depth	0.94	ft
Discharge	138.80	ft³/s

Cross Section Image



Worksheet for 14P - 100-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.16082	%
Discharge	29.20	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+03.43	1964.64
0+04.18	1964.58
0+05.48	1964.35
0+16.77	1964.20
0+22.87	1964.20
0+22.87	1963.70
0+24.37	1963.83
0+24.37	1963.87
0+36.51	1964.48
0+42.48	1964.56
0+47.48	1964.58
0+52.48	1964.53
0+63.38	1964.27
0+65.24	1964.18
0+65.24	1964.14
0+66.74	1964.01
0+66.74	1964.51
0+72.84	1964.51
0+78.47	1964.51
0+81.85	1964.57
0+97.77	1965.40

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient

Worksheet for 14P - 100-yr Ultimate

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+03.43, 1964.64)	(0+24.37, 1963.83)	0.013
(0+24.37, 1963.83)	(0+65.24, 1964.18)	0.016
(0+65.24, 1964.18)	(0+97.77, 1965.40)	0.013

Options

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

Results

Normal Depth		0.67	ft
Elevation Range	1963.70 to 1965.40 ft		
Flow Area		6.28	ft²
Wetted Perimeter		37.18	ft
Hydraulic Radius		0.17	ft
Top Width		36.21	ft
Normal Depth		0.67	ft
Critical Depth		0.77	ft
Critical Slope		0.00498	ft/ft
Velocity		4.65	ft/s
Velocity Head		0.34	ft
Specific Energy		1.00	ft
Froude Number		1.97	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		

Worksheet for 14P - 100-yr Ultimate

GVF Output Data

Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.67	ft
Critical Depth	0.77	ft
Channel Slope	2.16082	%
Critical Slope	0.00498	ft/ft

Cross Section for 14P - 100-yr Ultimate

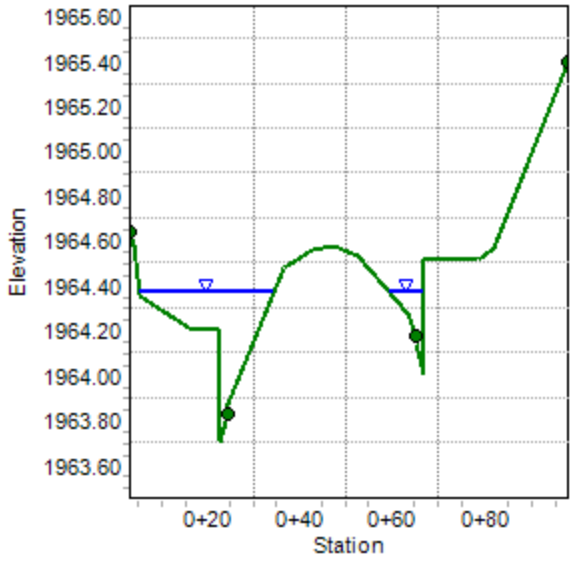
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.16082	%
Normal Depth	0.67	ft
Discharge	29.20	ft³/s

Cross Section Image



Worksheet for 15P - 10-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.16082	%
Discharge	13.60	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.09	1962.09
0+08.23	1961.34
0+09.98	1961.19
0+11.73	1961.09
0+14.06	1961.09
0+23.56	1960.98
0+29.66	1960.98
0+29.66	1960.48
0+31.16	1960.61
0+31.16	1960.65
0+49.71	1961.58
0+72.13	1960.42
0+72.13	1960.46
0+73.63	1960.29
0+73.63	1960.79
0+79.73	1960.79
0+85.47	1960.88
0+88.73	1960.98
0+91.59	1961.00
0+94.45	1960.94
0+94.95	1960.94
1+04.53	1961.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient

Worksheet for 15P - 10-yr Ultimate

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+00.09, 1962.09)	(0+31.16, 1960.61)	0.013
(0+31.16, 1960.61)	(0+72.13, 1960.46)	0.016
(0+72.13, 1960.46)	(1+04.53, 1961.00)	0.013

Options

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

Results

Normal Depth		0.54	ft
Elevation Range	1960.29 to 1962.09 ft		
Flow Area		3.37	ft²
Wetted Perimeter		24.21	ft
Hydraulic Radius		0.14	ft
Top Width		23.25	ft
Normal Depth		0.54	ft
Critical Depth		0.62	ft
Critical Slope		0.00566	ft/ft
Velocity		4.03	ft/s
Velocity Head		0.25	ft
Specific Energy		0.79	ft
Froude Number		1.87	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft

Worksheet for 15P - 10-yr Ultimate

GVF Output Data

Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.54	ft
Critical Depth	0.62	ft
Channel Slope	2.16082	%
Critical Slope	0.00566	ft/ft

Cross Section for 15P - 10-yr Ultimate

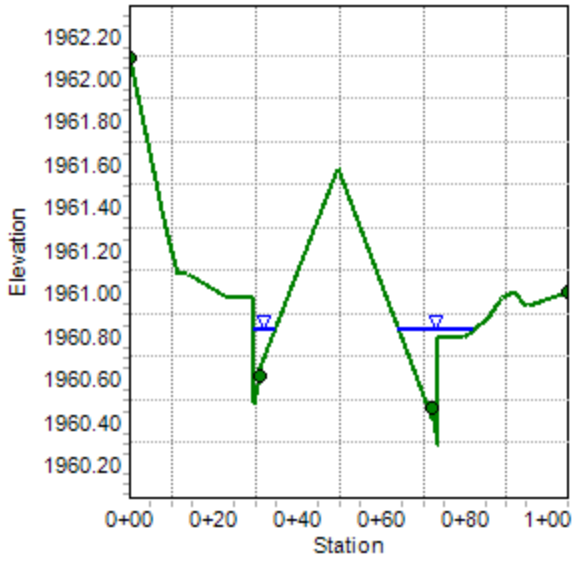
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.16082	%
Normal Depth	0.54	ft
Discharge	13.60	ft³/s

Cross Section Image



Worksheet for 15P - 100-yr Interim 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.16082	%
Discharge	138.80	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.09	1962.09
0+08.23	1961.34
0+09.98	1961.19
0+11.73	1961.09
0+14.06	1961.09
0+23.56	1960.98
0+29.66	1960.98
0+29.66	1960.48
0+31.16	1960.61
0+31.16	1960.65
0+49.71	1961.58
0+72.13	1960.42
0+72.13	1960.46
0+73.63	1960.29
0+73.63	1960.79
0+79.73	1960.79
0+85.47	1960.88
0+88.73	1960.98
0+91.59	1961.00
0+94.45	1960.94
0+94.95	1960.94
1+04.53	1961.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient

Worksheet for 15P - 100-yr Interim 1

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+00.09, 1962.09)	(0+31.16, 1960.61)	0.013
(0+31.16, 1960.61)	(0+72.13, 1960.46)	0.016
(0+72.13, 1960.46)	(1+04.53, 1961.00)	0.013

Options

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

Results

Normal Depth		0.88	ft
Elevation Range	1960.29 to 1962.09 ft		
Flow Area		21.40	ft²
Wetted Perimeter		79.71	ft
Hydraulic Radius		0.27	ft
Top Width		78.40	ft
Normal Depth		0.88	ft
Critical Depth		1.08	ft
Critical Slope		0.00390	ft/ft
Velocity		6.49	ft/s
Velocity Head		0.65	ft
Specific Energy		1.54	ft
Froude Number		2.19	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft

Worksheet for 15P - 100-yr Interim 1

GVF Output Data

Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.88	ft
Critical Depth	1.08	ft
Channel Slope	2.16082	%
Critical Slope	0.00390	ft/ft

Cross Section for 15P - 100-yr Interim 1

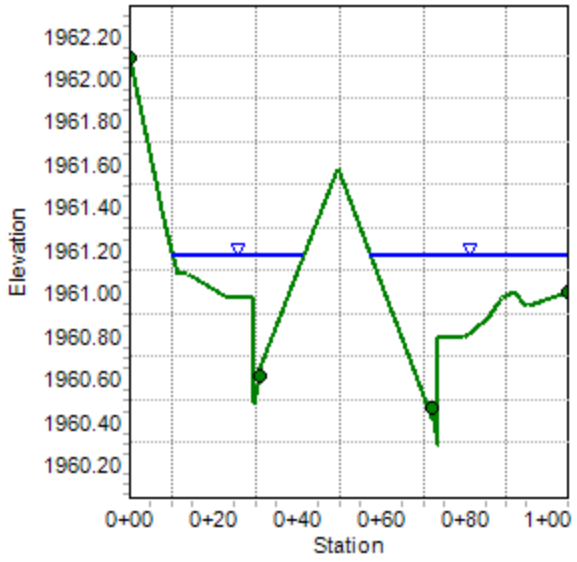
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.16082	%
Normal Depth	0.88	ft
Discharge	138.80	ft³/s

Cross Section Image



Worksheet for 15P - 100-yr Ultimate

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.16082	%
Discharge	29.20	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.09	1962.09
0+08.23	1961.34
0+09.98	1961.19
0+11.73	1961.09
0+14.06	1961.09
0+23.56	1960.98
0+29.66	1960.98
0+29.66	1960.48
0+31.16	1960.61
0+31.16	1960.65
0+49.71	1961.58
0+72.13	1960.42
0+72.13	1960.46
0+73.63	1960.29
0+73.63	1960.79
0+79.73	1960.79
0+85.47	1960.88
0+88.73	1960.98
0+91.59	1961.00
0+94.45	1960.94
0+94.95	1960.94
1+04.53	1961.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient

Worksheet for 15P - 100-yr Ultimate

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+00.09, 1962.09)	(0+31.16, 1960.61)	0.013
(0+31.16, 1960.61)	(0+72.13, 1960.46)	0.016
(0+72.13, 1960.46)	(1+04.53, 1961.00)	0.013

Options

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

Results

Normal Depth		0.64	ft
Elevation Range	1960.29 to 1962.09 ft		
Flow Area		5.99	ft²
Wetted Perimeter		32.59	ft
Hydraulic Radius		0.18	ft
Top Width		31.53	ft
Normal Depth		0.64	ft
Critical Depth		0.76	ft
Critical Slope		0.00551	ft/ft
Velocity		4.87	ft/s
Velocity Head		0.37	ft
Specific Energy		1.00	ft
Froude Number		1.97	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft

Worksheet for 15P - 100-yr Ultimate

GVF Output Data

Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.64	ft
Critical Depth	0.76	ft
Channel Slope	2.16082	%
Critical Slope	0.00551	ft/ft

Cross Section for 15P - 100-yr Ultimate

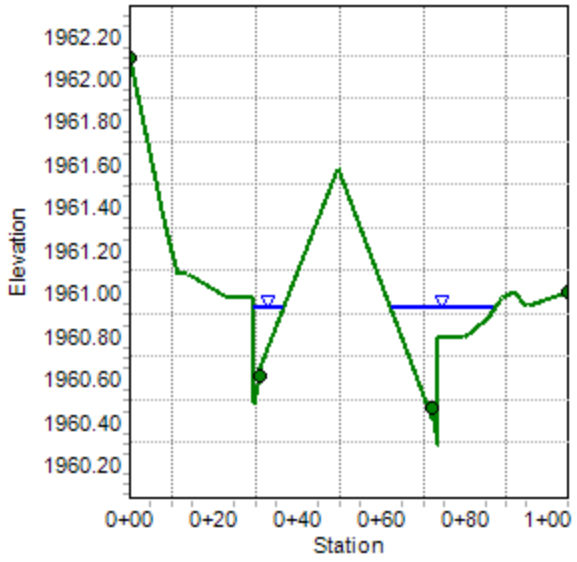
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.16082	%
Normal Depth	0.64	ft
Discharge	29.20	ft³/s

Cross Section Image



Appendix B2:
Drop Inlet Calculations

Worksheet for Combination Inlet On Grade - 15ft 1.9%slope

Project Description

Solve For	Efficiency

Input Data

Discharge		25.00	ft³/s
Slope		0.01900	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.09	ft/ft
Road Cross Slope		0.02	ft/ft
Roughness Coefficient		0.016	
Local Depression		2.00	in
Local Depression Width		15.00	ft
Grate Width		1.50	ft
Grate Length		12.50	ft
Grate Type	Curved Vaned		
Clogging		50.00	%
Curb Opening Length		15.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency		56.97	%
Intercepted Flow		14.24	ft³/s
Bypass Flow		10.76	ft³/s
Spread		21.09	ft
Depth		0.52	ft
Flow Area		4.52	ft²
Gutter Depression		0.10	ft
Total Depression		0.27	ft
Velocity		5.53	ft/s
Splash Over Velocity		16.48	ft/s
Frontal Flow Factor		1.00	
Side Flow Factor		0.29	
Grate Flow Ratio		0.21	
Equivalent Cross Slope		0.02372	ft/ft
Active Grate Length		6.25	ft
Length Factor		0.11	
Total Interception Length		79.68	ft

Worksheet for Combination Inlet On Grade - 15ft 1.9%slope

Messages

Messages	Grate Length should be within the defined range of HEC-22's Chart 5 (approx. 0.5-4.5 ft / 0.15-1.35 m).

Rating Table for Combination Inlet On Grade - 15ft 1.9%slope

Project Description

Solve For	Efficiency

Input Data

Discharge		25.00	ft³/s
Slope		0.01900	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.09	ft/ft
Road Cross Slope		0.02	ft/ft
Roughness Coefficient		0.016	
Local Depression		2.00	in
Local Depression Width		15.00	ft
Grate Width		1.50	ft
Grate Length		12.50	ft
Grate Type	Curved Vaned		
Clogging		50.00	%
Curb Opening Length		15.00	ft

Discharge (ft³/s)	Efficiency (%)	Intercepted Flow (ft³/s)
1.50	98.60	1.48
2.00	96.23	1.92
2.50	93.83	2.35
3.00	91.57	2.75
3.50	89.48	3.13
4.00	87.55	3.50
4.50	85.79	3.86
5.00	84.15	4.21
5.50	82.64	4.55
6.00	81.23	4.87
6.50	79.91	5.19
7.00	78.68	5.51
7.50	77.52	5.81
8.00	76.43	6.11
8.50	75.40	6.41
9.00	74.42	6.70
9.50	73.50	6.98

Rating Table for Combination Inlet On Grade - 15ft 1.9%slope

Input Data

Discharge (ft³/s)	Efficiency (%)	Intercepted Flow (ft³/s)
10.00	72.61	7.26
10.50	71.77	7.54
11.00	70.97	7.81

Worksheet for Combination Inlet On Grade - 5ft 2.9%slop

Project Description

Solve For	Efficiency

Input Data

Discharge		8.00	ft³/s
Slope		0.02900	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.09	ft/ft
Road Cross Slope		0.02	ft/ft
Roughness Coefficient		0.016	
Local Depression		2.00	in
Local Depression Width		5.00	ft
Grate Width		1.50	ft
Grate Length		2.50	ft
Grate Type	Curved Vaned		
Clogging		50.00	%
Curb Opening Length		5.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency		48.85	%
Intercepted Flow		3.91	ft³/s
Bypass Flow		4.09	ft³/s
Spread		12.38	ft
Depth		0.35	ft
Flow Area		1.61	ft²
Gutter Depression		0.10	ft
Total Depression		0.27	ft
Velocity		4.98	ft/s
Splash Over Velocity		4.61	ft/s
Frontal Flow Factor		0.97	
Side Flow Factor		0.01	
Grate Flow Ratio		0.36	
Equivalent Cross Slope		0.03945	ft/ft
Active Grate Length		1.25	ft
Length Factor		0.09	
Total Interception Length		41.31	ft

Worksheet for Combination Inlet On Grade - 5ft 2.9%slop

Messages

Messages	Grate Length should be within the defined range of HEC-22's Chart 5 (approx. 0.5-4.5 ft / 0.15-1.35 m).

Rating Table for Combination Inlet On Grade - 5ft 2.9%slop

Project Description

Solve For	Efficiency

Input Data

Discharge		8.00	ft³/s
Slope		0.02900	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.09	ft/ft
Road Cross Slope		0.02	ft/ft
Roughness Coefficient		0.016	
Local Depression		2.00	in
Local Depression Width		5.00	ft
Grate Width		1.50	ft
Grate Length		2.50	ft
Grate Type	Curved Vaned		
Clogging		50.00	%
Curb Opening Length		5.00	ft

Discharge (ft³/s)	Efficiency (%)	Intercepted Flow (ft³/s)
2.50	76.67	1.92
5.00	59.48	2.97
7.50	50.36	3.78

Appendix B3:
Flow Split Calculations

Roadway Intersection Flow Split Calculation

Project Name: Freemont Street Improvements, Las Vegas Blvd to 14th
Project Number: CA2158
Date: 12/12/2018
Calculated By: HM

$$Q_L = \frac{Q_m^{0.93} * W_{ss}^{0.85}}{S_m^{0.41} * W_m^{0.79}} * 0.042$$

Equation 12.3: Standards Manual for Drainage Design and Floodplain Management in Tucson, Arizona, December, 1989 (Revised July, 1998), prepared for the City of Tucson Department of Transportation Engineering Division, by Simons, Li & Associates, Inc.

Parameters:

Q	=	Total Q in the main street
Q_m	=	Q in the main street (measured between curbs in cfs)
W_{ss}	=	Width of the side street (in feet)
S_m	=	Slope of the main street (in feet/foot)
W_m	=	Width of the main street (in feet)
Q_L	=	Lateral flow into the side street (in cfs)
$Q_{L(total)}$	=	QL + minimum (Qo, Actual Overbank Q)

Overbank Flow

Overbank Q	=	Overbank flow upstream of flow split [$(Q-Q_L)/2$]
Qo	=	$46.8\ y_o\ W_{ss}\ (S_s^{0.5}) - Q_L$
Qo	=	Max amount of overbank flow intercepted by side street
Ss	=	Slope of the side street (in feet/foot)
yo	=	avg depth of overbank flow intercepted by side street

Location: Ogden / Maryland Intersection

RT Point	1		RT Point	2		RT Point	3	
Q	22	cfs	Q	44	cfs	Q	65	cfs
Q_m	22	cfs	Q_m	44	cfs	Q_m	64	cfs
W_{ss}	80	ft	W_{ss}	80	ft	W_{ss}	80	ft
S_m	0.0230	ft/ft	S_m	0.0230	ft/ft	S_m	0.0230	ft/ft
W_m	70	ft	W_m	70	ft	W_m	70	ft
Q_L	**5.05**	**cfs**	**Q_L**	**9.62**	**cfs**	**Q_L**	**13.64**	**cfs**
Overbank Q	**0**	**cfs**	**Overbank Q**	**0**	**cfs**	**Overbank Q**	**0.5**	**cfs**
W_{ss}	80	ft	W_{ss}	80	ft	W_{ss}	80	ft
Ss	0.0200	ft/ft	Ss	0.0200	ft/ft	Ss	0.0200	ft/ft
yo	0.00	ft	yo	0.00	ft	yo	0.10	ft
Qo		**cfs**	**Qo**		**cfs**	**Qo**	**39.3**	**cfs**
$Q_{L\ (total)}$	**5.1**	**cfs**	**$Q_{L\ (total)}$**	**9.6**	**cfs**	**$Q_{L\ (total)}$**	**14.1**	**cfs**

Worksheet for Flow Split - Street Section

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02500	ft/ft
Discharge	65.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
-0+40.0	0.60
-0+34.5	0.50
-0+34.5	0.00
-0+32.0	0.13
-0+32.0	0.17
0+00.0	0.81
0+32.0	0.17
0+32.0	0.13
0+34.5	0.00
0+34.5	0.50
0+40.0	0.60

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+40.0, 0.60)	(-0+32.0, 0.13)	0.013
(-0+32.0, 0.13)	(0+32.0, 0.13)	0.016
(0+32.0, 0.13)	(0+40.0, 0.60)	0.013

Options

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

Worksheet for Flow Split - Street Section

Results

Normal Depth		0.59	ft
Elevation Range	0.00 to 0.81 ft		
Flow Area		12.09	ft²
Wetted Perimeter		58.72	ft
Hydraulic Radius		0.21	ft
Top Width		57.62	ft
Normal Depth		0.59	ft
Critical Depth		0.73	ft
Critical Slope		0.00522	ft/ft
Velocity		5.38	ft/s
Velocity Head		0.45	ft
Specific Energy		1.04	ft
Froude Number		2.07	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.59	ft
Critical Depth	0.73	ft
Channel Slope	0.02500	ft/ft
Critical Slope	0.00522	ft/ft

Worksheet for Flow Split - yo determination

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.02500	ft/ft
Normal Depth	0.09	ft

Section Definitions

Station (ft)	Elevation (ft)
-0+35.0	0.60
-0+30.0	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+35.0, 0.60)	(-0+30.0, 0.50)	0.013

Options

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

Results

Discharge	0.50	ft³/s
Elevation Range	0.50 to 0.60 ft	
Flow Area	0.22	ft²
Wetted Perimeter	4.75	ft
Hydraulic Radius	0.05	ft
Top Width	4.65	ft
Normal Depth	0.09	ft
Critical Depth	0.12	ft
Critical Slope	0.00626	ft/ft
Velocity	2.31	ft/s
Velocity Head	0.08	ft

Worksheet for Flow Split - yo determination

Results

Specific Energy		0.18	ft
Froude Number		1.89	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.09	ft
Critical Depth	0.12	ft
Channel Slope	0.02500	ft/ft
Critical Slope	0.00626	ft/ft

Rating Table for Flow Split - Street Section

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02500	ft/ft
Discharge	65.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
-0+40.0	0.60
-0+34.5	0.50
-0+34.5	0.00
-0+32.0	0.13
-0+32.0	0.17
0+00.0	0.81
0+32.0	0.17
0+32.0	0.13
0+34.5	0.00
0+34.5	0.50
0+40.0	0.60

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+40.0, 0.60)	(-0+32.0, 0.13)	0.013
(-0+32.0, 0.13)	(0+32.0, 0.13)	0.016
(0+32.0, 0.13)	(0+40.0, 0.60)	0.013

Discharge (ft³/s)	Water Surface Elevation (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
22.00	0.42	4.45	4.94	31.06	30.13

Rating Table for Flow Split - Street Section

Input Data

Discharge (ft³/s)	Water Surface Elevation (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
27.00	0.45	4.67	5.79	33.81	32.82
32.00	0.47	4.86	6.59	36.22	35.19
37.00	0.49	5.02	7.37	38.41	37.33
42.00	0.52	5.09	8.25	42.45	41.35
47.00	0.54	5.14	9.14	46.72	45.62
52.00	0.55	5.20	10.00	50.51	49.42
57.00	0.57	5.26	10.83	53.94	52.85
62.00	0.59	5.34	11.61	56.97	55.87

Appendix B4:
WSPG Calculations: Fremont Stormdrain Main

```
[TITLE]
 Freemont Street Improvements, LV Blvd to 14th St
 Stormdrain System
 Ultimate Condition: MPU facility in LVB constructed

[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Node6"
Reach            "Link5"
Reach            "Link4"
Junction         "Node4"
Reach            "Link3"
Junction         "Node3"
Reach            "Link2"
Junction         "Node2"
Reach            "Link1"
Headwork         "Node1"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Node6"             -3661.14   1966.71    1976       "11toLVB"   1972.5

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Node1"             1987.1     1994.5     "10to11"    28         0

[WALLENTRANCE]
**NAME              INVERT     GROUND     CHANNEL     LOSS
**                  ELEV       ELEV       ID          COEFFICIENT(opt.)
**------------      ---------  ---------- ----------  --------------

[WALLEXIT]
**NAME              INVERT     GROUND     CHANNEL     LOSS
**                  ELEV       ELEV       ID          COEFFICIENT(opt.)
**------------      ---------  ---------- ----------  --------------

[BRIDGEENTRANCE]
**NAME              INVERT     GROUND     CHANNEL     REDUCTION
**                  ELEV       ELEV       ID          FACTOR(opt.)
**------------      ---------  ---------- ----------  --------------
```

[BRIDGEEXIT]

**NAME	INVERT ELEV	GROUND ELEV	CHANNEL ID	REDUCTION FACTOR(opt.)

[JOIN]

**NAME	INVERT ELEV	GROUND ELEV	CHANNEL ID	LENGTH	MANNINGS n	NUMBER OF BRANCHES	CONFLUENCE ANGLE

[JUNCTION]

**Name	INVERT ELEV	GROUND ELEV	CHANNEL ID	LENGTH	MANNINGS n	NUMBER OF LATERALS	CONFLUENCE ANGLE	FLOW
"Node2"	1984.99	1992.89	"10to11"	5	0.013	2		
"Node2_Lateral1"	1986		"18RCP"				45	8
"Node2_Lateral2"	1986		"18RCP"				45	8
"Node3"	1979.73	1987.76	"10to11"	5	0.013	2		
"Node3_Lateral1"	1980.76		"18RCP"				45	4
"Node3_Lateral2"	1980.76		"18RCP"				45	4
"Node4"	1967.96	1976.8	"10to11"	5	0.013	2		
"Node4_Lateral1"	1968.46		"18RCP"				45	3.5
"Node4_Lateral2"	1968.46		"18RCP"				45	3.5

[TRANSITION]

**NAME	INVERT ELEV	GROUND ELEV	CHANNEL ID	LENGTH	MANNINGS n

[REACH]

**NAME	INVERT ELEV	GROUND ELEV	CHANNEL ID	LENGTH	MANNINGS n	CURVE (opt)	ANGLE POINT(opt)	NUMBER MANHOLES(opt)
"Link1"	1986.6	1994.5	"10to11"	155.11	0.013	0	0	1
"Link2"	1984.79	1992.89	"10to11"	234.89	0.013	0	0	1
"Link3"	1979.56	1987.73	"10to11"	395	0.013	0	0	1
"Link4"	1967.76	1976.8	"11toLVB"	12.72	0.013	0	15	1
"Link5"	1967.25	1976.4	"11toLVB"	13.49	0.013	0	0	1

[CHANNEL]

**REGULAR TYPES 1-4

**ID	TYPE	HEIGHT	WIDTH	LEFT SLOPE	RIGHT SLOPE	NUMBER PIERS	AVG PIER WIDTH	INVERT CROSS FALL
"11toLVB"	4	2.5	2.5					
"10to11"	4	2.5	2.5					
"18RCP"	4	1.5	1.5					

```
**IRREGULAR TYPES 5-6
**ID       TYPE NUMBER     AVG PIER   PIER1      PIER2      PIER3      PIER4      PIER5      PIER6      PIER7      PIER8      PIER9
PIER10
**              PIERS      WIDTH      ELEV       ELEV       ELEV       ELEV       ELEV       ELEV       ELEV       ELEV       ELEV
ELEV
**------   ---- ---------- ---------- ---------- ---------- ---------- ---------- ---------- ---------- ---------- ---------- --------
-- ----------


[POINT]
**ID          XCOORD     YCOORD
**----------- ---------- ----------
```

```
************************************
Water Surface Profile Gradient (WSPG)
XP WSPG
Engine Version 1.3         06/09/2010
XP Software        www.xpsoftware.com
************************************

INPUT FILE
************************************
H:\0158 (Fremont St 8th to 13th)\Drainage\StormdrainHydraulics\WSPG\FreemontSD-10thToLVB.wsx
Computed  12/12/18  17:48:00

TITLE INFORMATION
************************************
 Freemont Street Improvements, LV Blvd to 14th St
 Stormdrain System
 Ultimate Condition: MPU facility in LVB constructed

WARNING SUMMARY
************************************
 WARNING 47: Junction Node4 has a different channel than its direct downstream element.
 WARNING 25: Link type element Link1 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link2 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link3 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link4 has different invert elevation than its upstream node.
 WARNING 36: D/S processing stopped in junction Node2 because critical momentum is greater than maximum momentum.
 WARNING 36: D/S processing stopped in junction Node3 because critical momentum is greater than maximum momentum.

RESULTS
************************************


================================================================
   Main Line
================================================================

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Node6"	Outlet	-3661.14	1966.71	1976.00	1972.500	5.790	59.00	12.02	2.24	1974.74	0.000	2.386	0.000	0.00000	0.000	Pipe
"Link5"	Reach	-3647.65	1967.25	1976.40	1972.891	5.641	59.00	12.02	2.24	1975.13	0.000	2.386	0.000	0.04003	1.569	Pipe
"Link4"	Reach	-3634.93	1967.76	1976.80	1973.378	5.618	59.00	12.02	2.24	1975.62	0.000	2.386	0.000	0.04009	1.568	Pipe
"Node4"	Junction	-3629.93	1967.96	1976.80	1974.409	6.449	52.00	10.59	1.74	1976.15	0.000	2.323	0.000	0.04000	0.000	Pipe
HYDRAULIC JUMP at -3384.63 of length 0.09																
	"i.p."	-3384.63	1975.16	1984.00	1978.406	3.242	52.00	10.59	1.74	1980.15	0.000	2.323	0.000	0.02937	1.600	Pipe
	"i.p."	-3384.63	1975.16	1984.00	1976.816	1.652	52.00	15.11	3.54	1980.36	0.000	2.323	2.208	0.02937	1.600	Pipe
	"i.p."	-3325.77	1976.89	1985.73	1978.600	1.707	52.00	14.56	3.29	1981.89	0.000	2.323	2.070	0.02937	1.600	Pipe
	"i.p."	-3289.84	1977.95	1986.79	1979.731	1.783	52.00	13.88	2.99	1982.72	0.000	2.323	1.900	0.02937	1.600	Pipe
	"i.p."	-3267.99	1978.59	1987.43	1980.455	1.866	52.00	13.23	2.72	1983.17	0.000	2.323	1.735	0.02937	1.600	Pipe
	"i.p."	-3253.46	1979.02	1987.86	1980.972	1.956	52.00	12.62	2.47	1983.44	0.000	2.323	1.573	0.02937	1.600	Pipe
	"i.p."	-3243.65	1979.30	1988.14	1981.361	2.057	52.00	12.03	2.25	1983.61	0.000	2.323	1.409	0.02937	1.600	Pipe
	"i.p."	-3237.45	1979.49	1988.33	1981.661	2.175	52.00	11.47	2.04	1983.70	0.000	2.323	1.231	0.02937	1.600	Pipe

"Link3"	Reach	-3234.93	1979.56	1987.73	1981.882	2.322	52.00	10.94	1.86	1983.74	0.000	2.323	1.002	0.02937	1.600	Pipe
"Node3"	Junction	-3229.93	1979.73	1987.76	1982.984	3.254	44.00	8.96	1.25	1984.23	0.000	2.208	0.000	0.03400	0.000	Pipe
HYDRAULIC JUMP at -3194.07 of length 0.07																
	"i.p."	-3194.07	1980.50	1988.53	1983.406	2.904	44.00	8.96	1.25	1984.65	0.000	2.208	0.000	0.02154	1.587	Pipe
	"i.p."	-3194.07	1980.50	1988.53	1982.110	1.607	44.00	13.19	2.70	1984.81	0.000	2.208	1.971	0.02154	1.587	Pipe
	"i.p."	-3096.67	1982.60	1990.63	1984.254	1.654	44.00	12.77	2.53	1986.79	0.000	2.208	1.865	0.02154	1.587	Pipe
	"i.p."	-3050.85	1983.59	1991.62	1985.313	1.726	44.00	12.17	2.30	1987.61	0.000	2.208	1.716	0.02154	1.587	Pipe
	"i.p."	-3026.53	1984.11	1992.14	1985.915	1.803	44.00	11.61	2.09	1988.01	0.000	2.208	1.573	0.02154	1.587	Pipe
	"i.p."	-3011.64	1984.43	1992.46	1986.320	1.887	44.00	11.07	1.90	1988.22	0.000	2.208	1.435	0.02154	1.587	Pipe
	"i.p."	-3002.30	1984.63	1992.66	1986.614	1.980	44.00	10.55	1.73	1988.34	0.000	2.208	1.297	0.02154	1.587	Pipe
	"i.p."	-2996.92	1984.75	1992.78	1986.834	2.084	44.00	10.06	1.57	1988.41	0.000	2.208	1.157	0.02154	1.587	Pipe
"Link2"	Reach	-2995.04	1984.79	1992.89	1986.997	2.207	44.00	9.59	1.43	1988.43	0.000	2.208	1.001	0.02154	1.587	Pipe
"Node2"	Junction	-2990.04	1984.99	1992.89	1988.416	3.426	28.00	5.70	0.51	1988.92	0.000	1.804	0.000	0.04000	0.000	Pipe
"Link1"	Reach	-2834.93	1986.60	1994.50	1989.164	2.564	28.00	5.70	0.51	1989.67	0.000	1.804	0.000	0.01038	1.497	Pipe
"Node1"	Headwrk	-2834.93	1986.60	1994.50	1989.164	2.564	28.00	5.70	0.51	1989.67	0.000	1.804	0.000	0.00000	0.000	Pipe

*) in the W.S.ELEV column indicates flooding, it is set whenever W.S.ELEV > GROUND ELEV
i.p. = intermediate point processing results for reaches

Appendix B5:
Standard Form 6 Calculations: Drop Inlet Laterals

CA Group
2785 S. Rainbow Blvd, Las Vegas, NV 89146-4008
Project Name: FREEMONT STREET IMPROVEMENTS, LAS VEGAS BLVD TO 14TH
Project No: CA2158
Calculated By: HM
Date: 12/5/2018
STANDARD FORM 6 STORMDRAIN LATERACALCULATION

CONDUIT DATA								FLOW DATA									ENERGY LOSS DATA								EGL & HGL							
																	PIPE	TRANSITIONS							PRELIMINARY		PRESSURE		CHECK	FINAL		
STATION		PIPE	BOX / ERCP		INVERT ELEV.		FG	L	A	Flow Coeff	Q	V	Hv =	Rh	Sf	Avg.	Frict	Frict	Type	Contraction/Inlet		Misc		U/S	U/S	FLOW		D/S	U/S	U/S	COMMENT
FROM	TO	D (in.)	SPAN (ft)	RISE (ft)	D/S (ft)	U/S (ft)	U/S (ft)	(ft)	(ft2)	Phi	(cfs)	(ft/s)	$V^2/2g$ (ft)	(ft)	(ft/ft)	Sf (ft/ft)	Hf (ft)	Hf (ft)	Inlet/ Cont	Kc	Hc (ft)	Hmisc (ft)	Total (ft)	EGL	HGL	CHECK	CONTROL	EGL	EGL	HGL	
PROFILE 1 DI 1.3								Manning's n =		0.013									0.40			Starting EGL / HGL @ MH								
10+00.00	10+00.00	24	MH#	1.1	1986.60	1987.10	1993.80	0.0	3.14	0.0049	14	4.5	0.31	0.50	0.0038	0.0038								1989.48	1989.17			1988.91	1989.48	1989.17	
10+00.00	10+38.56	24			1987.10	1987.29	1993.80	38.6	3.14	0.0049	14	4.5	0.31	0.50	0.0038	0.0038	0.15						0.15	1989.63	1989.32	YES	D/S	1989.41	1989.63	1989.32	
10+38.56	10+38.56	24	DI#	1.3	1987.29	1987.29	1993.80	0.0	3.14	0.0049	14	4.5	0.31	0.50	0.0038	0.0038			INLET	0.40	0.12		0.12	1989.75	1989.44	YES	D/S	1989.60	1989.75	1989.75	
PROFILE 1 DI 1.4								Manning's n =		0.013									0.40			Starting EGL / HGL @ MH								
10+00.00	10+00.00	24	MH#	1.1	1986.60	1987.10	1993.80	0.0	3.14	0.0049	14	4.5	0.31	0.50	0.0038	0.0038								1989.48	1989.17			1988.91	1989.48	1989.17	
10+00.00	10+29.66	24			1987.10	1987.24	1993.80	29.7	3.14	0.0049	14	4.5	0.31	0.50	0.0038	0.0038	0.11						0.11	1989.59	1989.28	YES	D/S	1989.41	1989.59	1989.28	
10+29.66	10+29.66	24	DI#	1.4	1987.24	1987.24	1993.80	0.0	3.14	0.0049	14	4.5	0.31	0.50	0.0038	0.0038			INLET	0.40	0.12		0.12	1989.71	1989.41	YES	D/S	1989.55	1989.71	1989.71	
PROFILE 2 DI 1.6								Manning's n =		0.013									0.40			Starting EGL / HGL @ MH								
10+00.00	10+00.00	18	MH#	1.2	1984.79	1986.00	1992.30	0.0	1.77	0.0049	8	4.5	0.32	0.38	0.0058	0.0058								1988.74	1988.42			1986.61	1988.74	1988.42	
10+00.00	10+29.47	18			1986.00	1986.35	1992.30	29.5	1.77	0.0049	8	4.5	0.32	0.38	0.0058	0.0058	0.17						0.17	1988.91	1988.59	YES	D/S	1987.82	1988.91	1988.59	
10+29.47	10+29.47	18	DI#	1.5	1986.35	1986.35	1992.30	0.0	1.77	0.0049	8	4.5	0.32	0.38	0.0058	0.0058			INLET	0.40	0.13		0.13	1989.04	1988.72	YES	D/S	1988.17	1989.04	1989.04	
PROFILE 2 DI 1.5								Manning's n =		0.013									0.40			Starting EGL / HGL @ MH								
10+00.00	10+00.00	18	MH#	1.2	1984.79	1986.00	1992.30	0.0	1.77	0.0049	8	4.5	0.32	0.38	0.0058	0.0058								1988.74	1988.42			1986.61	1988.74	1988.42	
10+00.00	10+35.73	18			1986.00	1986.29	1992.30	35.7	1.77	0.0049	8	4.5	0.32	0.38	0.0058	0.0058	0.21						0.21	1988.94	1988.63	YES	D/S	1987.82	1988.94	1988.63	
10+35.73	10+35.73	18	DI#	1.6	1986.29	1986.29	1992.30	0.0	1.77	0.0049	8	4.5	0.32	0.38	0.0058	0.0058			INLET	0.40	0.13		0.13	1989.07	1988.75	YES	D/S	1988.11	1989.07	1989.07	
PROFILE 3 DI 2.2								Manning's n =		0.013									0.40			Starting EGL / HGL @ MH								
10+00.00	10+00.00	18	MH#	2.1	1979.56	1980.76	1987.30	0.0	1.77	0.0049	4	2.3	0.08	0.38	0.0014	0.0014								1983.08	1983.00			1981.14	1983.08	1983.00	
10+00.00	10+29.37	18			1980.76	1981.34	1987.30	29.4	1.77	0.0049	4	2.3	0.08	0.38	0.0014	0.0014	0.04						0.04	1983.12	1983.04	YES	D/S	1982.34	1983.12	1983.04	
10+29.37	10+29.37	18	DI#	2.2	1981.34	1981.34	1987.30	0.0	1.77	0.0049	4	2.3	0.08	0.38	0.0014	0.0014			INLET	0.40	0.03		0.03	1983.15	1983.07	YES	D/S	1982.92	1983.15	1983.15	
PROFILE 3 DI 2.3								Manning's n =		0.013									0.40			Starting EGL / HGL @ MH								
10+00.00	10+00.00	18	MH#	2.1	1979.56	1980.76	1987.30	0.0	1.77	0.0049	4	2.3	0.08	0.38	0.0014	0.0014								1983.08	1983.00			1981.14	1983.08	1983.00	
10+00.00	10+22.16	18			1980.76	1981.20	1987.30	22.2	1.77	0.0049	4	2.3	0.08	0.38	0.0014	0.0014	0.03						0.03	1983.11	1983.03	YES	D/S	1982.34	1983.11	1983.03	
10+22.16	10+22.16	18	DI#	2.3	1981.20	1981.20	1987.30	0.0	1.77	0.0049	4	2.3	0.08	0.38	0.0014	0.0014			INLET	0.40	0.03		0.03	1983.14	1983.06	YES	D/S	1982.78	1983.14	1983.14	
PROFILE 4 DI 3.5								Manning's n =		0.013									0.40			Starting EGL / HGL @ MH								
10+00.00	10+00.00	18	MH#	3.1	1967.76	1968.96	1976.80	0.0	1.77	0.0049	4	2.3	0.08	0.38	0.0014	0.0014								1974.58	1974.50			1969.34	1974.58	1974.50	
10+00.00	10+37.60	18			1968.96	1969.58	1977.40	37.6	1.77	0.0049	4	2.3	0.08	0.38	0.0014	0.0014	0.05						0.05	1974.63	1974.55	YES	D/S	1970.54	1974.63	1974.55	
10+37.60	10+37.60	18	DI#	3.5	1969.58	1969.58	1977.40	0.0	1.77	0.0049	4	2.3	0.08	0.38	0.0014	0.0014			INLET	0.40	0.03		0.03	1974.67	1974.59	YES	D/S	1971.16	1974.67	1974.67	
PROFILE 4 DI 3.6								Manning's n =		0.013									0.40			Starting EGL / HGL @ MH								
10+00.00	10+00.00	18	MH#	3.1	1967.76	1968.96	1976.80	0.0	1.77	0.0049	4	2.3	0.08	0.38	0.0014	0.0014								1974.58	1974.50			1969.34	1974.58	1974.50	
10+00.00	10+41.73	18			1968.96	1969.52	1977.00	41.7	1.77	0.0049	4	2.3	0.08	0.38	0.0014	0.0014	0.06						0.06	1974.64	1974.56	YES	D/S	1970.54	1974.64	1974.56	
10+41.73	10+41.73	18	DI#	3.6	1969.52	1969.52	1977.00	0.0	1.77	0.0049	4	2.3	0.08	0.38	0.0014	0.0014			INLET	0.40	0.03		0.03	1974.67	1974.59	YES	D/S	1971.10	1974.67	1974.67	

Appendix B6:
Vertical Discharge / Bubbler Calculations

CA Group
2785 S. Rainbow Blvd, Las Vegas, NV 89146-4008
Project Name: Freemont Street
Project No: CA2158
Calculated By: HM
Date: 11/30/2018

INTERIM WSE ESTIMATES FOR OUTLET FLOW AND DI SIZING FOR DISCHARGE

Step 1

Maximum discharge in bleeder line estimated using HY-8

Total in SD	60	cfs	
18" Bleeder	10	cfs	(see HY-8 calculation estimates between 10 and 20 cfs)

Remaining discharge in mainline balanced between manholes and drop inlets (Steps 3-5)

Total remaining	50	cfs	

Step 2

WSE in street for min and max Q in bleeder line (check less than final WSE in street at upstream MHs and Dis)
Neenah grates 0.9' area opening and 2' perimeter per grate; 15' DI has 5 open grates

hmin (Q=10 cfs)	0.470	ft	(see FlowMaster Weir Calc for 10' weir)
GRATE ELEV	74.57	ft	
WSEmin	74.57	ft	< WSE for MHs, 77.49
hmax (Q = 20 cfs)	0.750	ft	(see FlowMaster Weir/Orifice Calc for 20 cfs)
GRATE ELEV	74.57	ft	
WSEmax	75.32	ft	< WSE for MHs, 77.49

Step 3

Discharge through manholes estimated from vertical discharge in pipe equations, referenced from
Water Measurement Manual, Chapt 14 - Measurements in Pressure Conduits, USBR
Q for rise of water above end of pipe less than 0.37 d
$Q = 6.17\ d^{1.25}\ h^{1.35}$
$h = (Q / (6.17 d^{1.25}))^{(1/1.35)}$
Q = rate of flow, gal/min
d = inside diameter of the pipe, in
h = height of jet, in

MH 3.2

Q	25	cfs	
Q	11364	gpm	
d	30	in.	(inside diameter HM riser)
h	11.25	in.	
h	0.937	ft	(0.95' using orifice equation and neglecting tailwater)
h/d	0.375		
RIM ELEV	76.55	ft	
WSE	77.49	ft	

MH3.1

Q	17	cfs	
Q	7727	gpm	
d	30	in.	(inside diameter HM riser)
h	8.45	in.	
h	0.704	ft	(0.44' using orifice equation and neglecting tailwater)
h/d	0.282		
RIM ELEV	76.8	ft	
WSE	77.50	ft	

Step 4

Estimate discharge through the drop inlets

DI 3.6

Q	9	CFS	
H	0.44		(see FlowMaster Weir Calculation)
GRATE ELEV	77.05	ft	
WSE	77.49	ft	

DI 3.8

Q	0	CFS	
H	0		(see FlowMaster Weir Calculation)
GRATE ELEV	77.46	ft	
WSE	77.46	ft	

Step 4

Balance total Q of 60 cfs until WSEs are equal at manholes and drop inlets

	18" Bleeder	MH 3.2	MH3.1	DI 3.6	DI 3.8	Total Q
Q at each MH/DI	10	25	17	9	0	61
depth at MH/DI		0.94	0.70	0.44		
FG (rim/grate)		76.55	76.80	77.05	77.46	
WSE in street		77.49	77.50	77.49	77.46	

Note: discharge meets 1.5' max WSE discharged through manhole and inlets as determined using orifice equation.

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 40 cfs

Design Flow: 50 cfs

Maximum Flow: 60 cfs

Table 1 - Summary of Culvert Flows at Crossing: 18" Bleeder Capacity (TW at Street)

Headwater Elevation (ft)	Total Discharge (cfs)	18" Bleeder Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1976.35	40.00	8.77	31.11	5
1976.37	42.00	8.82	33.15	3
1976.38	44.00	8.86	35.12	3
1976.39	46.00	8.91	37.08	3
1976.41	48.00	8.95	38.90	2
1976.42	50.00	8.99	40.99	3
1976.43	52.00	9.03	42.86	2
1976.45	54.00	9.07	44.92	3
1976.46	56.00	9.11	46.81	2
1976.47	58.00	9.15	48.71	2
1976.48	60.00	9.19	50.80	3
1976.00	7.54	7.54	0.00	Overtopping

Table 2 - Culvert Summary Table: 18" Bleeder

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
40.00	8.77	1976.35	1.989	7.750	4-FFf	-1.000	1.142	1.500	5.810	4.962	0.000
42.00	8.82	1976.37	2.000	7.765	4-FFf	-1.000	1.145	1.500	5.810	4.990	0.000
44.00	8.86	1976.38	2.010	7.779	4-FFf	-1.000	1.148	1.500	5.810	5.015	0.000
46.00	8.91	1976.39	2.019	7.792	4-FFf	-1.000	1.150	1.500	5.810	5.040	0.000
48.00	8.95	1976.41	2.028	7.805	4-FFf	-1.000	1.153	1.500	5.810	5.062	0.000
50.00	8.99	1976.42	2.038	7.819	4-FFf	-1.000	1.156	1.500	5.810	5.088	0.000
52.00	9.03	1976.43	2.047	7.831	4-FFf	-1.000	1.158	1.500	5.810	5.110	0.000
54.00	9.07	1976.45	2.056	7.845	4-FFf	-1.000	1.161	1.500	5.810	5.134	0.000
56.00	9.11	1976.46	2.065	7.857	4-FFf	-1.000	1.163	1.500	5.810	5.156	0.000
58.00	9.15	1976.47	2.073	7.869	4-FFf	-1.000	1.165	1.500	5.810	5.178	0.000
60.00	9.19	1976.48	2.083	7.883	4-FFf	-1.000	1.168	1.500	5.810	5.201	0.000

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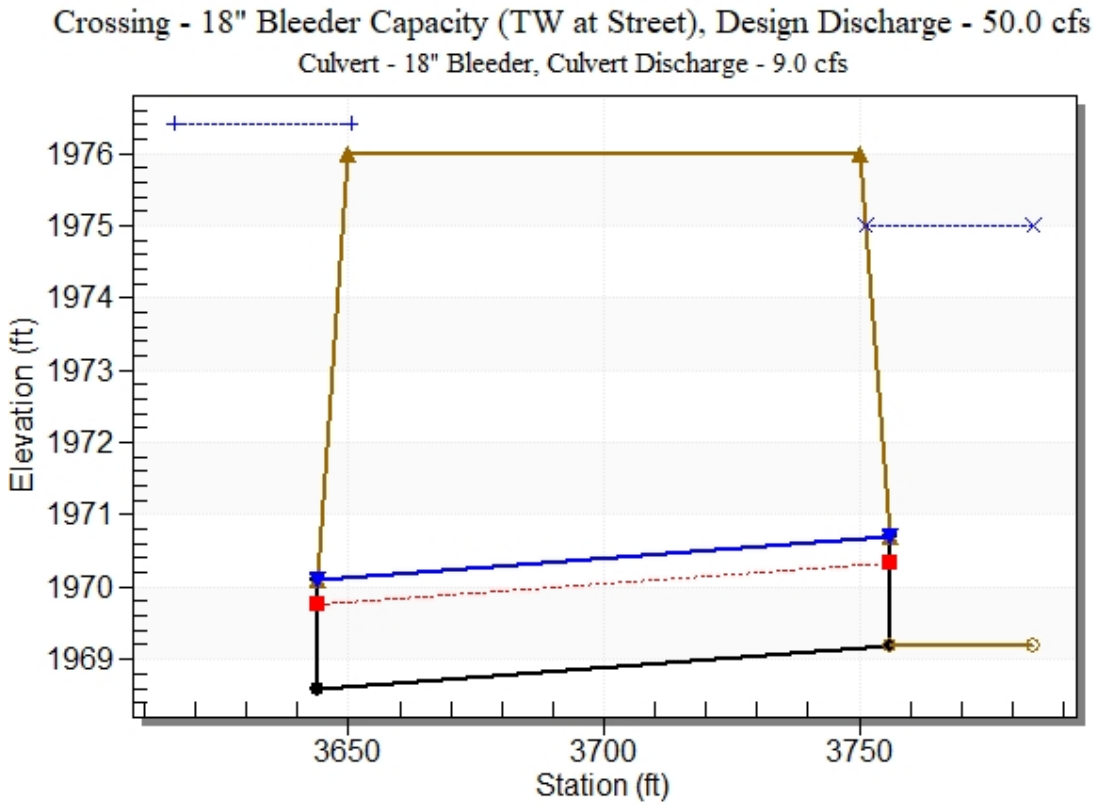
Straight Culvert

Inlet Elevation (invert): 1968.60 ft, Outlet Elevation (invert): 1969.19 ft

Culvert Length: 112.00 ft, Culvert Slope: -0.0053

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Water Surface Profile Plot for Culvert: 18" Bleeder



Site Data - 18" Bleeder

Site Data Option: Culvert Invert Data

Inlet Station: 3644.00 ft

Inlet Elevation: 1968.60 ft

Outlet Station: 3756.00 ft

Outlet Elevation: 1969.19 ft

Number of Barrels: 1

Culvert Data Summary - 18" Bleeder

Barrel Shape: Circular

Barrel Diameter: 1.50 ft

Barrel Material:

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: 18" Bleeder Capacity (TW at Street))

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
40.00	1975.00	5.81
42.00	1975.00	5.81
44.00	1975.00	5.81
46.00	1975.00	5.81
48.00	1975.00	5.81
50.00	1975.00	5.81
52.00	1975.00	5.81
54.00	1975.00	5.81
56.00	1975.00	5.81
58.00	1975.00	5.81
60.00	1975.00	5.81

Tailwater Channel Data - 18" Bleeder Capacity (TW at Street)

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 1975.00 ft

Roadway Data for Crossing: 18" Bleeder Capacity (TW at Street)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 50.00 ft

Crest Elevation: 1976.00 ft

Roadway Surface: Paved

Roadway Top Width: 100.00 ft

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 40 cfs

Design Flow: 50 cfs

Maximum Flow: 60 cfs

Table 1 - Summary of Culvert Flows at Crossing: 18" Bleeder Capacity (Max in RCP)

Headwater Elevation (ft)	Total Discharge (cfs)	18" Bleeder Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1976.27	40.00	18.91	21.04	11
1976.29	42.00	18.91	23.02	3
1976.30	44.00	18.91	25.03	3
1976.32	46.00	19.20	27.04	3
1976.34	48.00	18.91	29.05	3
1976.35	50.00	18.91	31.06	3
1976.36	52.00	18.91	33.06	3
1976.38	54.00	18.91	35.07	3
1976.40	56.00	18.36	37.58	4
1976.41	58.00	18.36	39.62	3
1976.42	60.00	18.36	41.63	3
1976.00	18.91	18.91	0.00	Overtopping

Table 2 - Culvert Summary Table: 18" Bleeder

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
40.00	18.91	1976.27	5.635	8.366	6-FFc	-1.000	1.500	1.500	0.810	10.700	0.000
42.00	18.91	1976.29	5.635	8.366	6-FFc	-1.000	1.500	1.500	0.810	10.700	0.000
44.00	18.91	1976.30	5.635	8.366	6-FFc	-1.000	1.500	1.500	0.810	10.700	0.000
46.00	19.20	1976.32	5.788	4.253	7-A2t	-1.000	1.469	1.469	0.810	10.778	0.000
48.00	18.91	1976.34	5.635	8.366	6-FFc	-1.000	1.500	1.500	0.810	10.700	0.000
50.00	18.91	1976.35	5.635	8.366	6-FFc	-1.000	1.500	1.500	0.810	10.700	0.000
52.00	18.91	1976.36	5.635	8.366	6-FFc	-1.000	1.500	1.500	0.810	10.700	0.000
54.00	18.91	1976.38	5.635	8.366	6-FFc	-1.000	1.500	1.500	0.810	10.700	0.000
56.00	18.36	1976.40	5.355	8.006	6-FFc	-1.000	1.500	1.500	0.810	10.389	0.000
58.00	18.36	1976.41	5.355	8.006	6-FFc	-1.000	1.500	1.500	0.810	10.389	0.000
60.00	18.36	1976.42	5.355	8.006	6-FFc	-1.000	1.500	1.500	0.810	10.389	0.000

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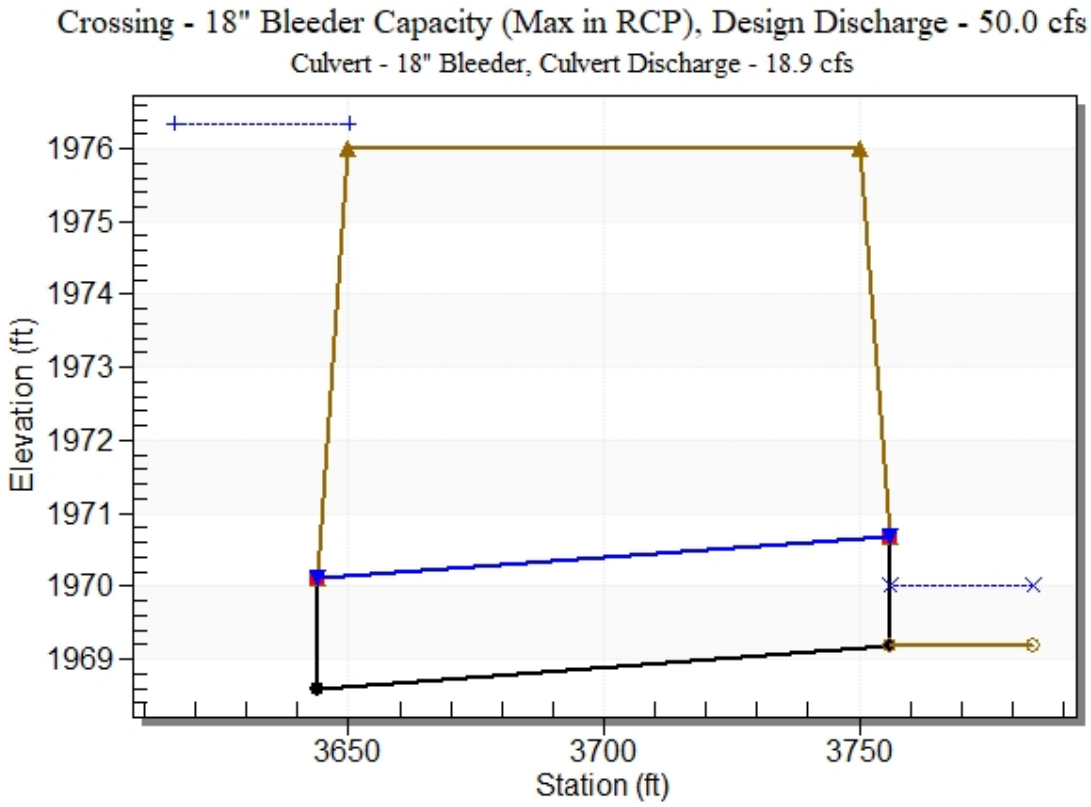
Straight Culvert

Inlet Elevation (invert): 1968.60 ft, Outlet Elevation (invert): 1969.19 ft

Culvert Length: 112.00 ft, Culvert Slope: -0.0053

****

Water Surface Profile Plot for Culvert: 18" Bleeder



Site Data - 18" Bleeder

Site Data Option: Culvert Invert Data

Inlet Station: 3644.00 ft

Inlet Elevation: 1968.60 ft

Outlet Station: 3756.00 ft

Outlet Elevation: 1969.19 ft

Number of Barrels: 1

Culvert Data Summary - 18" Bleeder

Barrel Shape: Circular

Barrel Diameter: 1.50 ft

Barrel Material:

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: 18" Bleeder Capacity (Max in RCP))

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
40.00	1970.00	0.81
42.00	1970.00	0.81
44.00	1970.00	0.81
46.00	1970.00	0.81
48.00	1970.00	0.81
50.00	1970.00	0.81
52.00	1970.00	0.81
54.00	1970.00	0.81
56.00	1970.00	0.81
58.00	1970.00	0.81
60.00	1970.00	0.81

Tailwater Channel Data - 18" Bleeder Capacity (Max in RCP)

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 1970.00 ft

Roadway Data for Crossing: 18" Bleeder Capacity (Max in RCP)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 50.00 ft

Crest Elevation: 1976.00 ft

Roadway Surface: Paved

Roadway Top Width: 100.00 ft

Worksheet for 18" RCP Main Capacity

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Normal Depth	1.50	ft
Diameter	1.50	ft
Discharge	5.75	ft³/s

Results

Discharge	5.75	ft³/s
Normal Depth	1.50	ft
Flow Area	1.77	ft²
Wetted Perimeter	4.71	ft
Hydraulic Radius	0.38	ft
Top Width	0.00	ft
Critical Depth	0.93	ft
Percent Full	100.0	%
Critical Slope	0.00610	ft/ft
Velocity	3.26	ft/s
Velocity Head	0.16	ft
Specific Energy	1.66	ft
Froude Number	0.00	
Maximum Discharge	6.19	ft³/s
Discharge Full	5.75	ft³/s
Slope Full	0.00300	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

Worksheet for 18" RCP Main Capacity

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.50	ft
Critical Depth	0.93	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00610	ft/ft

Worksheet for Drop Inlet Weir Calculation

Project Description

Solve For	Headwater Elevation

Input Data

Discharge	10.00	ft³/s
Crest Elevation	0.00	ft
Weir Coefficient	3.10	US
Crest Length	10.00	ft

Results

Headwater Elevation	0.47	ft
Headwater Height Above Crest	0.47	ft
Flow Area	4.70	ft²
Velocity	2.13	ft/s
Wetted Perimeter	10.94	ft
Top Width	10.00	ft

Messages

Notes

2 ft weir length per grate referenced from NEENAH.
Total weir lenght for 15' Inlet with 12.5' of grate, 5 grates, = 10'

Rating Table for Drop Inlet Weir Calculation

Project Description

Solve For	Headwater Elevation

Input Data

Discharge	10.00	ft³/s
Crest Elevation	0.00	ft
Weir Coefficient	3.10	US
Crest Length	10.00	ft

Discharge (ft³/s)	Headwater Elevation (ft)	Velocity (ft/s)
1.00	0.10	0.99
2.00	0.16	1.24
3.00	0.21	1.42
4.00	0.26	1.57
5.00	0.30	1.69
6.00	0.33	1.79
7.00	0.37	1.89
8.00	0.41	1.97
9.00	0.44	2.05
10.00	0.47	2.13
11.00	0.50	2.19
12.00	0.53	2.26
13.00	0.56	2.32
14.00	0.59	2.38
15.00	0.62	2.43
16.00	0.64	2.49
17.00	0.67	2.54
18.00	0.70	2.59
19.00	0.72	2.63
20.00	0.75	2.68

Roadway Intersection Flow Split Calculation

Project Name: Freemont Street Improvements, Las Vegas Blvd to 14th
Project Number: CA2158
Date: 12/12/2018
Calculated By: HM

$$Q_L = \frac{Q_m^{0.93} * W_{ss}^{0.85}}{S_m^{0.41} * W_m^{0.79}} * 0.042$$

Equation 12.3: Standards Manual for Drainage Design and Floodplain Management in Tucson, Arizona, December, 1989 (Revised July, 1998), prepared for the City of Tucson Department of Transportation Engineering Division, by Simons, Li & Associates, Inc.

Parameters:

Q	=	Total Q in the main street
Q_m	=	Q in the main street (measured between curbs in cfs)
W_{ss}	=	Width of the side street (in feet)
S_m	=	Slope of the main street (in feet/foot)
W_m	=	Width of the main street (in feet)
Q_L	=	Lateral flow into the side street (in cfs)
$Q_{L(total)}$	=	QL + minimum (Qo, Actual Overbank Q)

Overbank Flow

Overbank Q	=	Overbank flow upstream of flow split [$(Q-Q_L)/2$]
Qo	=	$46.8\ y_o\ W_{ss}\ (S_s^{0.5}) - Q_L$
Qo	=	Max amount of overbank flow intercepted by side street
Ss	=	Slope of the side street (in feet/foot)
yo	=	avg depth of overbank flow intercepted by side street

Location: Ogden / Maryland Intersection

RT Point	1		RT Point	2		RT Point	3	
Q	=	22 cfs	Q	=	44 cfs	Q	=	65 cfs
Q_m	=	22 cfs	Q_m	=	44 cfs	Q_m	=	64 cfs
W_{ss}	=	70 ft	W_{ss}	=	70 ft	W_{ss}	=	70 ft
S_m	=	0.0230 ft/ft	S_m	=	0.0230 ft/ft	S_m	=	0.0230 ft/ft
W_m	=	70 ft	W_m	=	70 ft	W_m	=	70 ft
Q_L	**=**	**4.51 cfs**	**Q_L**	**=**	**8.59 cfs**	**Q_L**	**=**	**12.17 cfs**
Overbank Q	**=**	**0 cfs**	**Overbank Q**	**=**	**0 cfs**	**Overbank Q**	**=**	**0.5 cfs**
W_{ss}	=	70 ft	W_{ss}	=	70 ft	W_{ss}	=	70 ft
Ss	=	0.0200 ft/ft	Ss	=	0.0200 ft/ft	Ss	=	0.0200 ft/ft
yo	=	0.00 ft	yo	=	0.00 ft	yo	=	0.10 ft
Qo	**=**	**cfs**	**Qo**	**=**	**cfs**	**Qo**	**=**	**34.2 cfs**
$Q_{L\ (total)}$	**=**	**4.5 cfs**	**$Q_{L\ (total)}$**	**=**	**8.6 cfs**	**$Q_{L\ (total)}$**	**=**	**12.7 cfs**

Worksheet for Generic Orifice - 15' DI Opening

Project Description

Solve For	Headwater Elevation

Input Data

Discharge	20.00	ft³/s
Centroid Elevation	0.00	ft
Tailwater Elevation	0.00	ft
Discharge Coefficient	0.65	
Opening Area	4.50	ft²

Results

Headwater Elevation	0.73	ft
Headwater Height Above Centroid	0.73	ft
Tailwater Height Above Centroid	0.00	ft
Velocity	4.44	ft/s

Rating Table for Generic Orifice - 15' DI Opening

Project Description

Solve For	Headwater Elevation

Input Data

Discharge	20.00	ft³/s
Centroid Elevation	0.00	ft
Tailwater Elevation	0.00	ft
Discharge Coefficient	0.65	
Opening Area	4.50	ft²

Discharge Coefficient	Tailwater Elevation (ft)	Headwater Elevation (ft)	Velocity (ft/s)
10.00	0.00	0.00	4.44
10.00	0.70	0.70	4.44
20.00	0.00	0.00	4.44
20.00	0.70	0.70	4.44

Worksheet for Generic Orifice - 30"MH Opening

Project Description

Solve For	Headwater Elevation

Input Data

Discharge	25.00	ft³/s
Centroid Elevation	0.00	ft
Tailwater Elevation	0.00	ft
Discharge Coefficient	0.65	
Opening Area	4.91	ft²

Results

Headwater Elevation	0.95	ft
Headwater Height Above Centroid	0.95	ft
Tailwater Height Above Centroid	0.00	ft
Velocity	5.09	ft/s

Rating Table for Generic Orifice - 30"MH Opening

Project Description

Solve For	Headwater Elevation

Input Data

Discharge	25.00	ft³/s
Centroid Elevation	0.00	ft
Tailwater Elevation	0.00	ft
Discharge Coefficient	0.65	
Opening Area	4.91	ft²

Discharge (ft³/s)	Tailwater Elevation (ft)	Headwater Elevation (ft)	Velocity (ft/s)
17.00	0.00	0.44	3.46
17.00	0.65	1.09	3.46
25.00	0.00	0.95	5.09
25.00	0.65	1.60	5.09

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(Section names followed by ✚ symbol include external resources. "*Additional Information*" sections are not part of the printed Water Measurement Manual.)

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2. Kinds of Flow
3. Basic Principles of Water Measurement
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6. Other Examples of Velocity Flow Measurement Devices
7. Velocity Head Concept
8. Orifice Relationships
9. Thin Plate Weir Relationships
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11. Hydraulic Mean Depth and Hydraulic Radius
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13. Discharge Equation for Broad-Crested Rectangular Weirs
14. Application of Energy Principle to Tube-Type Flowmeters
15. Equation Coefficients
16. Normal Flow Equations and Friction Head Loss
17. Approach Flow Conditions

** To obtain a printed copy of this manual, please see **"How to Obtain a Hardbound Water Measurement Manual."**
** If you find any problems with this electronic version of the Water Measurement Manual, please contact the Hydraulic Investigations and Laboratory Services Group at 303-445-2150.

United States Department of the Interior
Bureau of Reclamation

WATER MEASUREMENT MANUAL

A WATER RESOURCES TECHNICAL PUBLICATION

A guide to effective water measurement practices for better water management



United States Department of the Interior
Bureau of Reclamation

Water Resources Research Laboratory

CHAPTER 14 - MEASUREMENTS IN PRESSURE CONDUITS

13. Trajectory Methods

Basically, trajectory methods consist of measuring the horizontal and vertical coordinates of a point in the jet issuing from the end of a pipe (Stock, 1955). The pipe may be oriented either vertically or horizontally. The principal difficulty with this method is in measuring the coordinates of the flowing stream accurately.

(a) Vertical Pipes

Lawrence and Braunworth (1906) noted that two kinds of flow occur from the end of vertical pipes. With a small rise of water (up to 0.37*d*) above the end of the pipe, the flow acts like a circular weir. When the water rises more than 1.4*d*, jet flow occurs. When the rise is between these values, the mode of flow is in transition. Lawrence and Braunworth (1906) determined that when the height of the jet exceeded 1.4 *d*, as determined by sighting over the jet to obtain the maximum rise, the discharge is given by:

$$Q = 5.01 d^{1.99} h^{0.53}$$

where:

Q = rate of flow, gal/min
d = inside diameter of the pipe, in
h = height of jet, in

When the rise of water above the end of the pipe is less than 0.37*d*, discharge is given by:

$$Q = 6.17 d^{1.25} h^{1.35}$$

For jet heights between 0.37*d* and 1.4*d*, the flow is considerably less than that given by either of these equations. Figure 14-12, prepared using data from Stock (1955) gives flow rates in gallons per minute for standard pipes 2 to 12 in in diameter and jet heights from 12 to 60 in. Bos (1989) assigns to this method an accuracy of +/-10 percent for the jet flow range to +/-15 percent for the weir flow range.

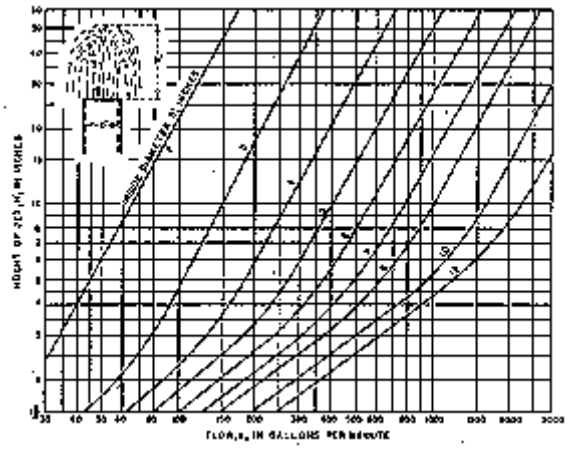
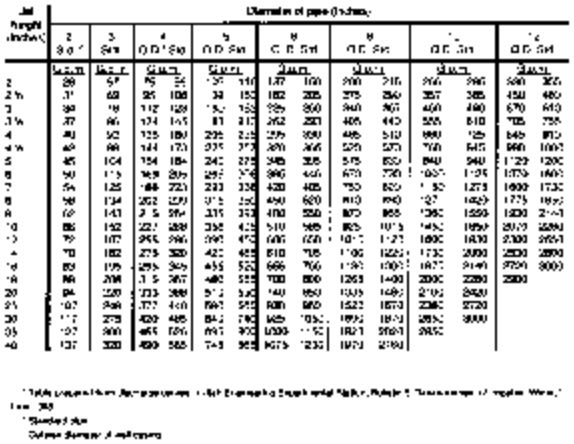


Figure 14-12 -- Discharge curves for measurement of flow

from vertical standard pipes. The curves are based on data from experiments of Lawrence and Braunworth, American Society of Civil Engineers, Transactions, Vol. 57, 1906 (courtesy of Utah State University)..

For irrigation convenience, the Natural Resources Conservation Service produced a table from curves for vertical pipes in Stock (1955) for the NRCS *National Engineering Handbook* (1962a). This table is reproduced here as table 14-1. The table gives discharges

Table 14-1 -- Flow from vertical pipes[1]



[1] Table prepared from discharge curves in Utah Engineering Experimental Station, Bulletin 5, "Measurement of Irrigation Water," June 1955.

[2] Standard pipe.

[3] Outside diameter of well casing.

for different heads up to 40 in for standard nominal pipe diameters from 2 to 12 in and for outside diameters of well casings from 4 to 12 in. As mentioned before, accuracies better than 15 and 10 percent should not be expected, depending on whether the flow is acting as a weir or jet-type flow.

(b) Horizontal Pipes

When brink depths are greater than 0.5*D*, the more general Purdue pipe method developed by Greve (1928) should be used, rather than the California pipe method. The Purdue method applies equally well to both partially and completely filled pipes. The Purdue method consists of measuring coordinates of the upper surface of the jet as shown on figure 14-13. If the water in the pipe is flowing at a depth of less than 0.8*D* at the outlet, the vertical distance, *Y*, can be measured at the end of the pipe where $X = 0$. For higher rates of flow, *Y* may be measured at horizontal distances, *X*, from the pipe exit of 6, 12, or 18 in. Flow values in gallons per minute for 2- to 6-in-diameter standard pipes are shown in graphs on figure 14-14 (Stock, 1955).

Jet height (inches)	Diameter of pipe (inches)															
	2 Std. [2]		3 Std.		4 O.D.[3] Std.		5 O.D. Std.		6 O. D. Std		8 O.D. Std.		10 O.D. Std.		12 O.D. Std.	
	G.p.m.		G.p.m.		G.p.m.		G.p.m.		G.p.m.		G.p.m.		G.p.m.		G.p.m.	
2	28		57		75	86	103	115	137	150	200	215	265	285	330	355
2 ½	31		69		95	108	132	150	182	205	275	290	357	385	450	480
3	34		78		112	128	160	183	225	250	340	367	450	490	570	610
3 ½	37		86		124	145	183	210	262	293	405	440	555	610	705	755
4	40		92		135	160	205	235	295	330	465	510	660	725	845	910
4 ½	42		98		144	173	225	257	320	365	520	570	760	845	980	1060
5	45		104		154	184	240	275	345	395	575	630	840	940	1120	1200
6	50		115		169	205	266	306	385	445	670	730	1000	1125	1370	1500
7	54		125		186	223	293	336	420	485	750	820	1150	1275	1600	1730
8	58		134		202	239	315	360	450	520	810	890	1270	1420	1775	1950
9	62		143		215	254	335	383	480	550	870	955	1360	1550	1930	2140
10	66		152		227	268	356	405	510	585	925	1015	1450	1650	2070	2280
12	72		167		255	295	390	450	565	650	1010	1120	1600	1830	2300	2550
14	78		182		275	320	420	485	610	705	1100	1220	1730	2000	2530	2800
16	83		195		295	345	455	520	655	755	1180	1300	1870	2140	2720	3000
18	89		208		315	367	480	555	700	800	1265	1400	2000	2280	2900	
20	94		220		333	388	510	590	740	850	1335	1480	2100	2420		
25	107		248		377	440	580	665	830	960	1520	1670	2380	2720		
30	117		275		420	485	640	740	925	1050	1690	1870	2650	3000		
35	127		300		455	525	695	800	1000	1150	1820	2020	2850			
40	137		320		490	565	745	865	1075	1230	1970	2160				

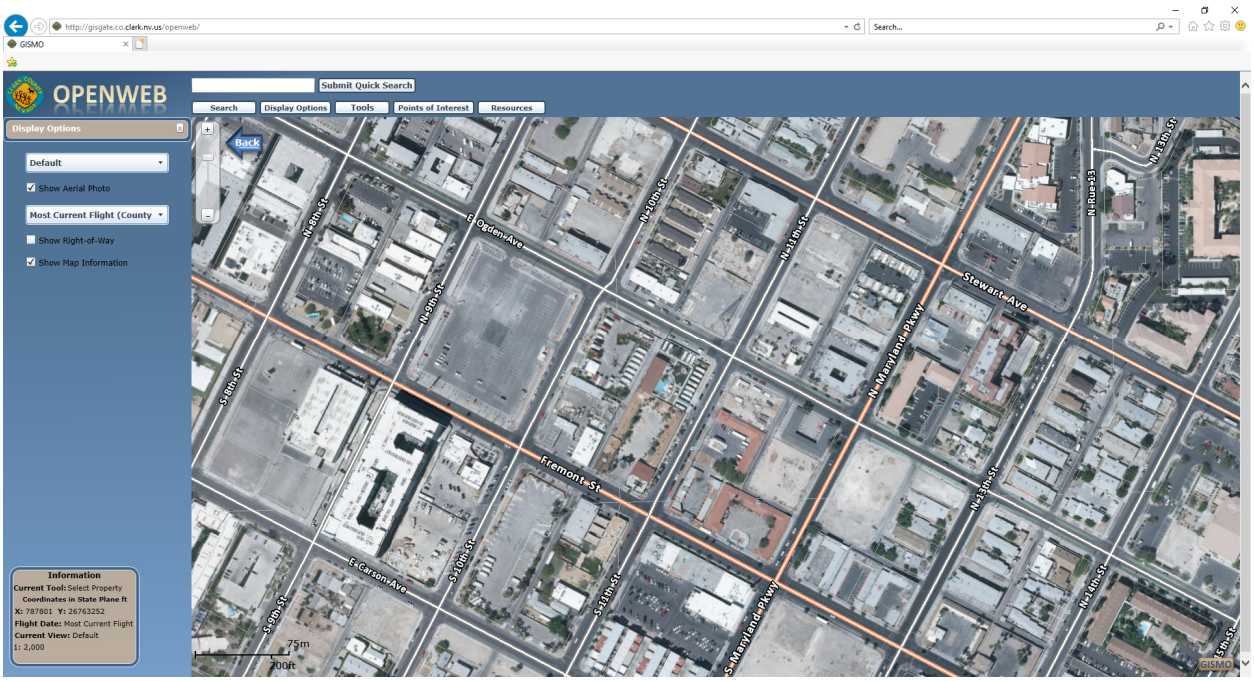
[1] Table prepared from discharge curves in Utah Engineering Experimental Station, Bulletin 5, "Measurement of Irrigation Water," June 1955.

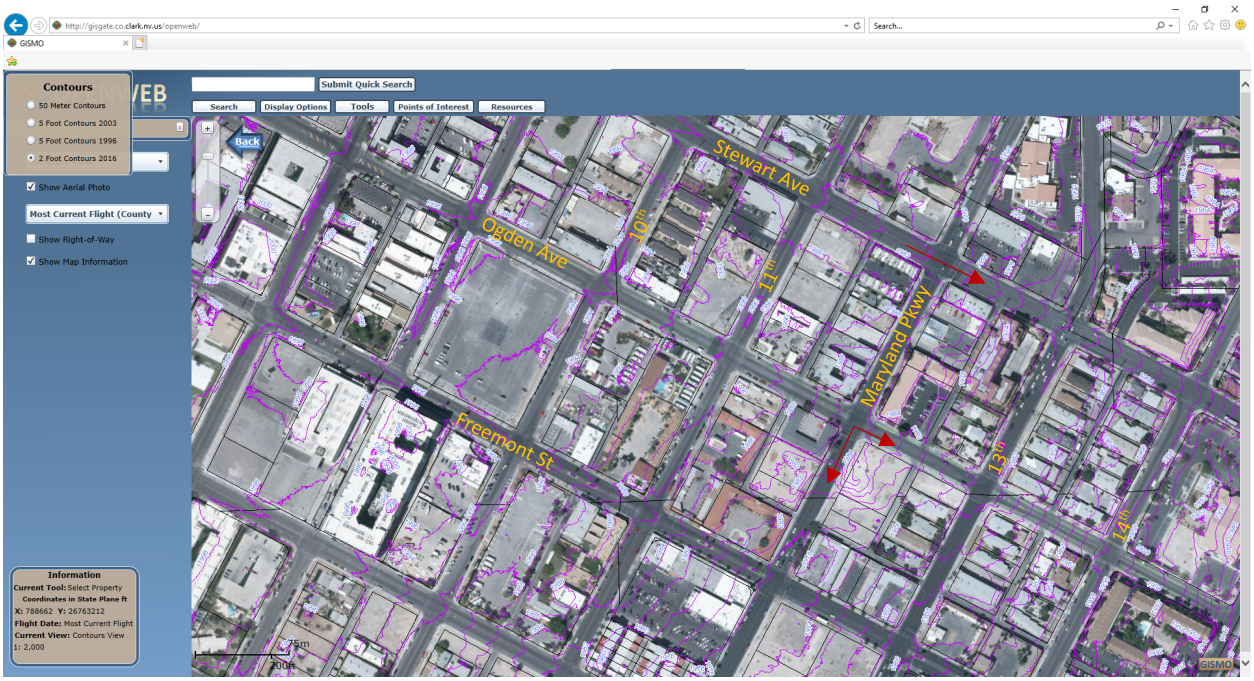
[2] Standard pipe.

[3] Outside diameter of well casing.

APPENDIX C:
REFERENCES (ELECTRONICALLY SUBMITTED)

GISMO 2-ft contours





Appendix C1:
Preliminary Drainage Memorandum for The Fremont Project (Fremont Drainage Memo)

FREMONT STREET
LAS VEGAS BLVD TO 14TH ST

PRELIMINARY DRAINAGE MEMORANDUM

PREPARED FOR:

CITY OF LAS VEGAS DEPARTMENT OF PUBLIC WORKS

PREPARED BY:

CA GROUP, INC.
2785 S. RAINBOW BOULEVARD
LAS VEGAS, NV 89146

AUGUST 10, 2018

Preliminary Drainage Memorandum – Table of Contents

Letter summarizing results of hydraulic analysis

Appendix A: Existing inlet photo inventory

Appendix B: Table 1: 100-year Storm, Normal Depth Summary, Existing versus Proposed Conditions, Fremont Street, Las Vegas Blvd (LVB) to 14th Street

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Appendix E: Subbasin peak flow rate calculations

Appendix F: Figures

- Drainage Basin Exhibit Map
- Draft Freemont Street Template Plan

August 10, 2018

Oh Sang Kwon, P.E.
City of Las Vegas
Department of Public Works
Flood Control Section
333 Rancho Drive, Suite 721
Las Vegas, NV 89107

Subject: Fremont Street Improvements, Las Vegas Blvd to 14th Street – Preliminary comparison of existing and developed condition 100-year storm water surface elevations.

Mr. Kwon,

CA Group met with the City of Las Vegas (City) on July 31 to discuss the criteria for stormwater collection for the Fremont Street, Las Vegas Blvd to 14th Street Project. At this meeting, the City asked CA Group to provide a comparison between the existing and developed condition water surface elevations, in Fremont Street, during a 100-year storm. The City also requested that the finished floor elevations be shown with respect to the water surface elevation. The analysis was performed, and this letter summarizes our assumptions and findings.

References and assumptions:

The 100-year flow rates used to compare the existing and developed water surface elevations in Fremont Street were referenced from the Preliminary Drainage Report for the Flamingo – Boulder Highway North, Charleston – Maryland Pkwy to Boulder Hgwy and Maryland Parkway System (CMSD) prepared by Atkins, November 10, 2017. The flow in Fremont Street at each of the intersections east of Las Vegas Boulevard (6th Street to 14th Street) were determined proportionally by multiplying the total flow from the subbasin in which the intersection is located by with the proportional area upstream of each intersection and dividing by the total area of the basin.

The CMSD study proposes a Clark County Regional Flood Control District (CCRFCD) Master Plan Update (MPU) facility in Maryland Parkway. This facility is proposed to capture 100 percent of the 100-year storm at 13th street. Our estimates for the water surfaces elevations in Fremont Street assume that the MPU facility will be installed after the Fremont Street project is complete. Accordingly, the flow shown captured at 13th street in the CMSD study by this future facility is instead considered to be conveyed in Fremont Street, which reflects the interim condition where Fremont Street improvements are complete, but the MPU facility is not constructed. Additionally, drop inlet capture for four, 3-ft long drop inlets that exist in Fremont Street between 6th and 7th Street was neglected in this analysis.

Elevation data for the existing grades for Fremont Street were referenced from the LIDAR data provided to CA Group for the project. The data were trimmed at the back of the existing walks and did not include the finished floor elevations. Between Las Vegas Boulevard and 8th street, the finished floor elevations appear to be at the back of walk elevation. Between 8th Street and 14th Street, CA Group requested finished floor elevation data from the City. The cross sections provided in this analysis show the water surface elevations with respect to the back of walk or, where noted, the finished floor elevations.

The proposed grades for the analysis were developed based on the proposed street sections and understanding that the City desires that the bulk of the existing pavement, and therefore existing

grades, be preserved. The plan for maintaining the pavement is to preserve the grades at the center of the street and, if required, provide adjustments in grade in the outside lanes of the road and/or the amenity zone. Since the roadway has not yet been graded, the sections were created based on how the flow line is expected to change in the proposed condition.

Bentley FlowMaster V8i software was used to estimate the normal depth of the street sections for both the existing and proposed conditions at several locations within the project. The results including cross sections are attached.

Summary of analysis results:

Two street configurations exist. The first is located between Las Vegas Boulevard and 8th street. The second is between 8th street and 14th Street. Normal depth calculations were performed at several locations in each of the two configurations. The results and cross sections for the existing and developed conditions are included. The following summarizes the existing and proposed conditions for each configuration:

1. Fremont Street between Las Vegas Boulevard and 8th Street

   Between Las Vegas Boulevard and 8th Street, the existing street section is generally 30-ft wide. It includes eastbound and westbound travel lanes and a loading lane. The location of the loading lane alternates between the north and south sides of Fremont Street. The existing flowline is located between the travel lane and the loading lane. The proposed street section will eliminate the loading lanes by installing an amenity zone and curb and gutter that maintains the existing flowline. Elsewhere, the proposed section will maintain the existing curb and gutter.

   For both the existing and proposed conditions between Las Vegas Boulevard and 8th Street, the 100-year water surface is below the back of walk and therefore the finished floors. Comparing the existing and proposed cross sections indicates that the increase in normal depth from the existing to the proposed condition is as much as 0.11 ft. For the worst case, approximately 0.24 ft freeboard is provided between the water surface and the back of walk elevation in the existing condition compared to 0.16 ft in the proposed condition.

2. Fremont Street between 8th Street and 14th Street

   Between 8th Street and 14th Street, the existing street section is generally 53-ft wide. It includes both eastbound and westbound travel and bus lanes and a center turn lane. The proposed street section will bring in the curb and gutter by approximately 7-ft on each side of Fremont Street to provide room for an amenity zone.

   Normal depth calculations indicate that 5 properties are below the 100-year water surface in the existing condition. The normal depth in the proposed condition is similar to that of the existing condition. However, the water surface is expected to increase because the flowline elevation is expected to increase with its shift in toward the street centerline. Because of this, the number of properties below the 100-year water surface increases from 5 to 10. The number of properties impacted may be reduced if the flowline elevation is able to be set lower than was anticipated for these preliminary calculations.

Table 1 included in attachments shows a summary of normal depth for the existing and developed conditions for Fremont Street during the 100-year storm. It includes the available freeboard to the back of walk between Las Vegas Boulevard and 8th Street, and to the finished floor elevation between 8th Street and 14th Street. Table 2 included in attachments shows the normal depth and freeboard between 10th Street and 14th Street assuming a 10-year storm drain system is installed.

Recommendations:
The two proposed configurations leave one travel lane in each direction. The flow lines are subject to change when the final grade is complete, but the water surface elevation is expected to rise in the proposed condition. Based on the analysis, CA Group recommends that a storm drain system be designed to capture the 10-year storm flow and additional flow as necessary to reduce the water surface in the proposed condition to below that of the existing condition. If possible, the flowline should be set to lower the water surface elevation.

Please let us know if you have any questions or need additional information.
Sincerely,

Helena Murvosh, PE, CFM
CA Group



Appendix A:
Existing inlet photo inventory

There are four drop inlets between Las Vegas Boulevard and 7th Street (see pictures below).



Drop Inlet Between Las Vegas Boulevard and 6th Street on North Side of Fremont Street



Drop Inlet Between Las Vegas Boulevard and 6th Street on South Side of Fremont Street



Drop Inlet Between 6th Street and 7th Street on North Side of Fremont Street



Drop Inlet Between 6th Street and 7th Street on South Side of Fremont Street

Appendix B:
Table 1: 100-year Storm, Normal Depth Summary, Existing versus Proposed Conditions, Fremont Street, Las Vegas Blvd (LVB) to 14th Street

Table 1: 100-year Storm, Normal Depth Summary, Existing versus Proposed Conditions, Fremont Street, Las Vegas Blvd (LVB) to 14th Street

Fremont Street Block	Station	Q_{100}, cfs	Depth, ft		Freeboard, ft (to back of walk or finished floor elev.)	
			Existing	Proposed	Existing	Proposed
LVB to 6th	Loading zone on south side	30.24	0.46	0.51	0.43	0.38
LVB to 6th	Loading zone on north side	30.24	0.54	0.62	0.24	0.16
6th to 7th	Loading zone on south side	33.32	0.46	0.57	0.34	0.23
6th to 7th	Loading zone on north side	33.32	0.51	0.60	0.62	0.53
7th to 8th	Loading zone on south side	35.04	0.60	0.69	0.27	0.18
7th to 8th	Loading zone on north side	35.04	0.51	0.59	0.50	0.42
8th to 9th	STA 24+11 RT	41.19	0.70	0.75	0.89	0.68
8th to 9th	STA 24+75 RT				0.37	0.16
10th to 11th	STA 29+70 LT	60.13	0.70	0.88	1.15	0.98
10th to 11th	STA 30+52 LT				0.10	-0.07
10th to 11th	STA 30+77 LT				0.36	0.19
10th to 11th	STA 31+33 LT				0.24	0.07
10th to 11th	STA 31+39 RT				-0.21	-0.38
10th to 11th	STA 32+37 RT				-0.03	-0.20
11th to Maryland	STA 33+53 LT	61	0.66	0.65	0.74	0.44
11th to Maryland	STA 34+09 LT				0.82	0.52
11th to Maryland	STA 34+74 LT				1.50	1.20
11th to Maryland	STA 36+00 LT				2.28	1.98
11th to Maryland	STA 33+35 RT				0.52	0.22
11th to Maryland	STA 33+75 RT				-0.21	-0.51
11th to Maryland	STA 33+91 RT				0.29	-0.01
11th to Maryland	STA 34+28 RT				0.16	-0.14
11th to Maryland	STA 34+67 RT				0.32	0.02
11th to Maryland	STA 34+81 RT				-0.10	-0.40
11th to Maryland	STA 34+97 RT				0.21	-0.09
11th to Maryland	STA 35+29 RT				0.30	0.00
11th to Maryland	STA 35+45 RT				-0.29	-0.59
11th to Maryland	STA 35+65 RT				0.37	0.07
11th to Maryland	STA 36+17 RT				0.61	0.31
Maryland to 13th (Interim)	STA 37+38 LT	74.85	0.62	0.69	3.34	3.21
Maryland to 13th (Interim)	STA 37+89 LT				3.01	2.88
Maryland to 13th (Interim)	STA 38+32 LT				2.20	2.07
Maryland to 13th (Interim)	STA 38+36 LT				1.48	1.35
Maryland to 13th (Interim)	STA 38+87 LT				1.21	1.08
Maryland to 13th (Interim)	STA 39+36 LT				0.36	0.23
Maryland to 13th (Interim)	STA 39+42 LT				0.34	0.21
13th to 14th (Interim)	STA 41+26 LT	90.2	0.73	0.72	2.48	2.27
13th to 14th (Interim)	STA 42+07 LT				2.78	2.57
13th to 14th (Interim)	STA 41+37 RT				0.85	0.64
13th to 14th (Interim)	STA 41+78 RT				1.60	1.39
13th to 14th (Interim)	STA 42+15 RT				1.27	1.06
13th to 14th (Interim)	STA 42+86 LT	90.2	0.72	0.71	0.75	0.08
13th to 14th (Interim)	STA 43+68 LT				0.54	-0.13
13th to 14th (Interim)	STA 43+29 RT				0.98	0.31
13th to 14th (Interim)	STA 43+49 RT				1.38	0.71

Appendix C:

Table 2: 100-year Storm, Normal Depth Summary, Proposed Conditions at Fremont Street and 11th Street assuming 10-year Storm Drain System is constructed

Table 2: 100-year Storm, Normal Depth Summary, Proposed Conditions at Fremont Street and 11th Street assuming 10-year Storm Drain System is constructed

Fremont Street Block	Station	Q_{Road}, cfs	Depth, ft		Freeboard, ft (to back of walk or finished floor elev.)	
			Existing	Proposed	Existing	Proposed
10th to 11th	STA 30+52 LT	42.57		0.81		0.00
10th to 11th	STA 31+39 RT					-0.31
10th to 11th	STA 32+37 RT					-0.13
11th to Maryland	STA 33+75 RT	38		0.57		-0.43
11th to Maryland	STA 33+91 RT					0.07
11th to Maryland	STA 34+28 RT					-0.06
11th to Maryland	STA 34+81 RT					-0.32
11th to Maryland	STA 34+97 RT					-0.01
11th to Maryland	STA 35+29 RT					0.08
11th to Maryland	STA 35+45 RT					-0.51
13th to 14th (Interim)	STA 43+68 LT	53.57		0.63		-0.05

Appendix D:
FlowMaster Normal Depth Calculation Results and Cross Sections

Worksheet for 1E LV to 6th

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Loading zone on south side

Input Data

Channel Slope	0.89000	%
Discharge	30.24	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+40.90	2006.87
0+55.33	2006.68
0+55.47	2006.30
0+64.74	2006.02
0+65.78	2006.13
0+80.75	2006.40
0+95.95	2006.06
0+97.28	2005.98
0+97.37	2006.42
1+20.61	2006.87

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+40.90, 2006.87)	(0+65.78, 2006.13)	0.013
(0+65.78, 2006.13)	(0+95.95, 2006.06)	0.016
(0+95.95, 2006.06)	(1+20.61, 2006.87)	0.013

Options

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

Results

Normal Depth	0.46	ft

Worksheet for 1E LV to 6th

Results

Elevation Range	2005.98 to 2006.87 ft		
Flow Area		9.19	ft²
Wetted Perimeter		43.44	ft
Hydraulic Radius		0.21	ft
Top Width		42.97	ft
Normal Depth		0.46	ft
Critical Depth		0.49	ft
Critical Slope		0.00545	ft/ft
Velocity		3.29	ft/s
Velocity Head		0.17	ft
Specific Energy		0.62	ft
Froude Number		1.25	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.46	ft
Critical Depth	0.49	ft
Channel Slope	0.89000	%
Critical Slope	0.00545	ft/ft

Cross Section for 1E LV to 6th

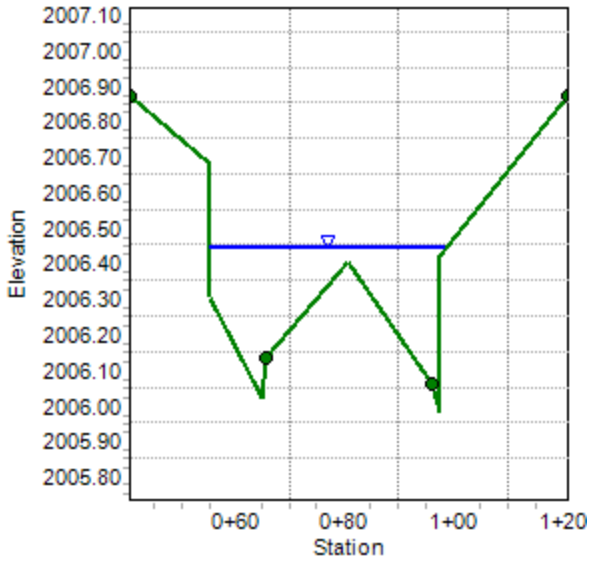
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.89000	%
Normal Depth	0.46	ft
Discharge	30.24	ft³/s

Cross Section Image



Worksheet for 1P LV to 6th

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Loading zone on south side

Input Data

Channel Slope	0.89000	%
Discharge	30.24	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+40.90	2006.87
0+58.78	2006.56
0+63.78	2006.46
0+64.28	2006.46
0+64.28	2005.98
0+65.78	2006.09
0+65.78	2006.13
0+80.75	2006.40
0+95.95	2006.06
0+97.28	2005.98
0+97.37	2006.42
1+20.61	2006.87

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+40.90, 2006.87)	(0+65.78, 2006.13)	0.013
(0+65.78, 2006.13)	(0+95.95, 2006.06)	0.016
(0+95.95, 2006.06)	(1+20.61, 2006.87)	0.013

Options

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

Worksheet for 1P LV to 6th

Results

Normal Depth		0.51	ft
Elevation Range	2005.98 to 2006.87 ft		
Flow Area		8.95	ft²
Wetted Perimeter		39.95	ft
Hydraulic Radius		0.22	ft
Top Width		39.06	ft
Normal Depth		0.51	ft
Critical Depth		0.56	ft
Critical Slope		0.00560	ft/ft
Velocity		3.38	ft/s
Velocity Head		0.18	ft
Specific Energy		0.69	ft
Froude Number		1.24	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.51	ft
Critical Depth	0.56	ft
Channel Slope	0.89000	%
Critical Slope	0.00560	ft/ft

Cross Section for 1P LV to 6th

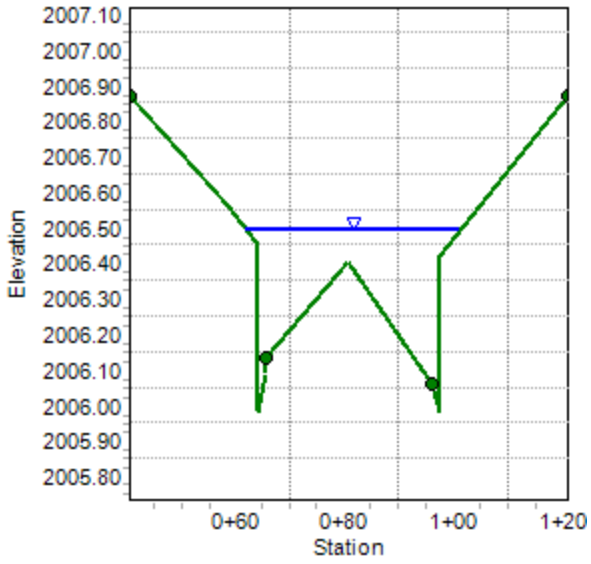
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.89000	%
Normal Depth	0.51	ft
Discharge	30.24	ft³/s

Cross Section Image



Worksheet for 2E LV to 6th

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Loading zone on north side

Input Data

Channel Slope	0.89000	%
Discharge	30.24	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+41.42	2005.30
0+62.94	2005.01
0+63.13	2004.52
0+64.67	2004.69
0+79.57	2005.03
0+95.10	2004.74
0+96.00	2004.69
0+96.98	2004.75
1+04.85	2004.84
1+04.96	2005.21
1+19.45	2005.42

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+41.42, 2005.30)	(0+64.67, 2004.69)	0.013
(0+64.67, 2004.69)	(0+95.10, 2004.74)	0.016
(0+95.10, 2004.74)	(1+19.45, 2005.42)	0.013

Options

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

Worksheet for 2E LV to 6th

Results

Normal Depth		0.54	ft
Elevation Range	2004.52 to 2005.42 ft		
Flow Area		9.41	ft²
Wetted Perimeter		46.57	ft
Hydraulic Radius		0.20	ft
Top Width		46.06	ft
Normal Depth		0.54	ft
Critical Depth		0.58	ft
Critical Slope		0.00546	ft/ft
Velocity		3.21	ft/s
Velocity Head		0.16	ft
Specific Energy		0.70	ft
Froude Number		1.25	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.54	ft
Critical Depth	0.58	ft
Channel Slope	0.89000	%
Critical Slope	0.00546	ft/ft

Cross Section for 2E LV to 6th

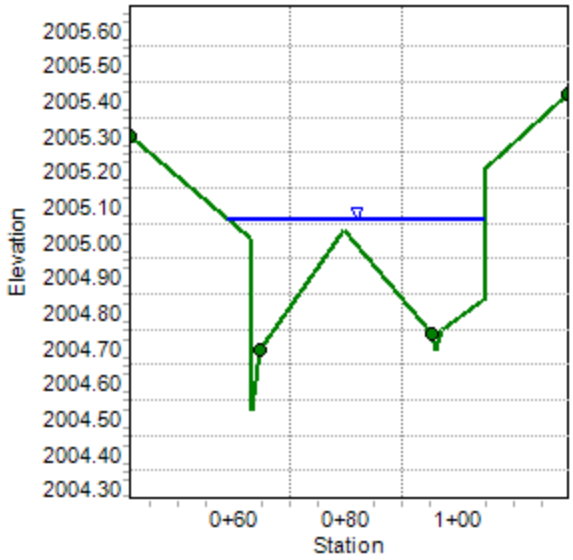
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.89000	%
Normal Depth	0.54	ft
Discharge	30.24	ft³/s

Cross Section Image



Worksheet for 2P LV to 6th

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Loading zone on north side

Input Data

Channel Slope	0.89000	%
Discharge	30.24	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+41.42	2005.30
0+62.94	2005.01
0+63.13	2004.52
0+64.67	2004.69
0+79.57	2005.03
0+95.07	2004.86
0+95.07	2004.82
0+96.57	2004.69
0+96.57	2005.07
0+97.07	2005.07
1+02.07	2005.17
1+19.45	2005.42

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+41.42, 2005.30)	(0+64.67, 2004.69)	0.013
(0+64.67, 2004.69)	(0+95.07, 2004.86)	0.016
(0+95.07, 2004.86)	(1+19.45, 2005.42)	0.013

Options

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

Worksheet for 2P LV to 6th

Results

Normal Depth		0.62	ft
Elevation Range	2004.52 to 2005.42 ft		
Flow Area		9.53	ft²
Wetted Perimeter		48.17	ft
Hydraulic Radius		0.20	ft
Top Width		47.39	ft
Normal Depth		0.62	ft
Critical Depth		0.66	ft
Critical Slope		0.00552	ft/ft
Velocity		3.17	ft/s
Velocity Head		0.16	ft
Specific Energy		0.78	ft
Froude Number		1.25	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.62	ft
Critical Depth	0.66	ft
Channel Slope	0.89000	%
Critical Slope	0.00552	ft/ft

Cross Section for 2P LV to 6th

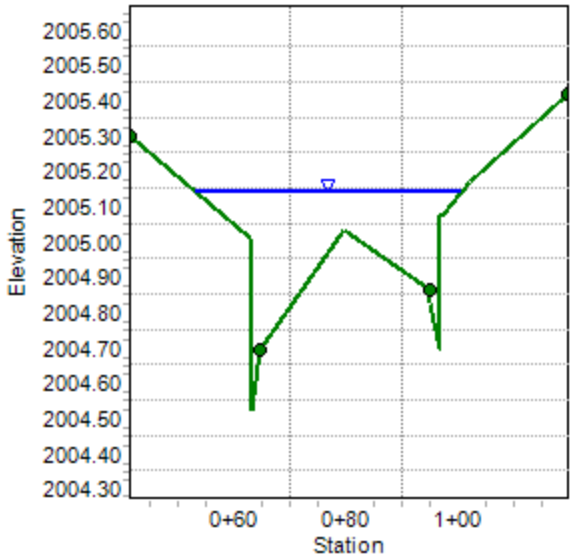
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.89000	%
Normal Depth	0.62	ft
Discharge	30.24	ft³/s

Cross Section Image



Worksheet for 5E 6th to 7th

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Loading zone on south side

Input Data

Channel Slope	0.72000	%
Discharge	33.32	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+43.26	2003.99
0+57.45	2003.68
0+57.59	2003.31
0+66.61	2003.19
0+67.36	2003.19
0+68.09	2003.28
0+83.40	2003.58
0+98.36	2003.42
0+99.59	2003.33
0+99.76	2003.79
1+24.28	2004.21

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+43.26, 2003.99)	(0+68.09, 2003.28)	0.013
(0+68.09, 2003.28)	(0+98.36, 2003.42)	0.016
(0+98.36, 2003.42)	(1+24.28, 2004.21)	0.013

Options

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

Worksheet for 5E 6th to 7th

Results

Normal Depth		0.46	ft
Elevation Range	2003.19 to 2004.21 ft		
Flow Area		10.34	ft²
Wetted Perimeter		42.73	ft
Hydraulic Radius		0.24	ft
Top Width		42.25	ft
Normal Depth		0.46	ft
Critical Depth		0.49	ft
Critical Slope		0.00530	ft/ft
Velocity		3.22	ft/s
Velocity Head		0.16	ft
Specific Energy		0.62	ft
Froude Number		1.15	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.46	ft
Critical Depth	0.49	ft
Channel Slope	0.72000	%
Critical Slope	0.00530	ft/ft

Cross Section for 5E 6th to 7th

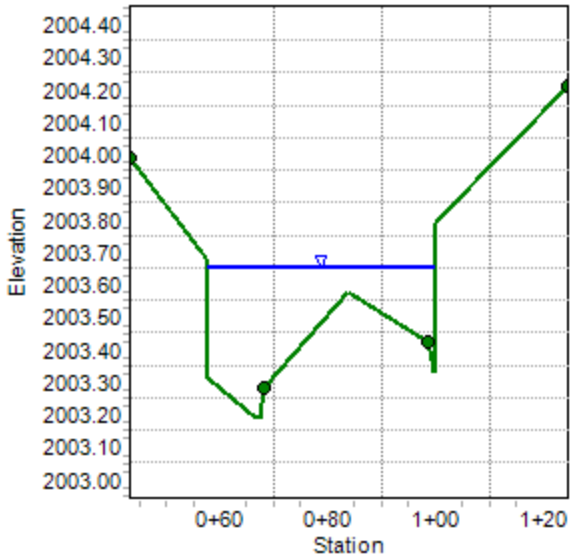
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.72000	%
Normal Depth	0.46	ft
Discharge	33.32	ft³/s

Cross Section Image



Worksheet for 5P 6th to 7th

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Loading zone on south side

Input Data

Channel Slope	0.72000	%
Discharge	33.32	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+43.26	2003.99
0+61.09	2003.71
0+66.09	2003.61
0+66.59	2003.61
0+66.59	2003.19
0+68.09	2003.32
0+68.09	2003.36
0+83.40	2003.58
0+98.36	2003.42
0+99.59	2003.33
0+99.76	2003.79
1+24.28	2004.21

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+43.26, 2003.99)	(0+68.09, 2003.36)	0.013
(0+68.09, 2003.36)	(0+98.36, 2003.42)	0.016
(0+98.36, 2003.42)	(1+24.28, 2004.21)	0.013

Options

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

Worksheet for 5P 6th to 7th

Results

Normal Depth		0.57	ft
Elevation Range	2003.19 to 2004.21 ft		
Flow Area		10.34	ft²
Wetted Perimeter		42.76	ft
Hydraulic Radius		0.24	ft
Top Width		41.99	ft
Normal Depth		0.57	ft
Critical Depth		0.60	ft
Critical Slope		0.00537	ft/ft
Velocity		3.22	ft/s
Velocity Head		0.16	ft
Specific Energy		0.73	ft
Froude Number		1.14	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.57	ft
Critical Depth	0.60	ft
Channel Slope	0.72000	%
Critical Slope	0.00537	ft/ft

Cross Section for 5P 6th to 7th

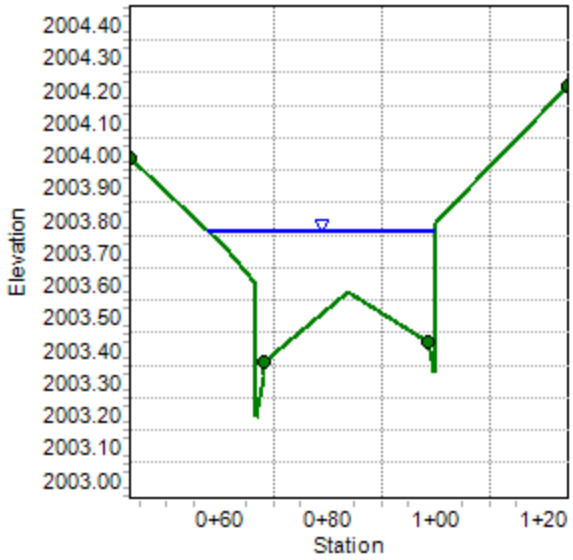
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.72000	%
Normal Depth	0.57	ft
Discharge	33.32	ft³/s

Cross Section Image



Worksheet for 6E 6th to 7th

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Loading zone on north side

Input Data

Channel Slope	0.72000	%
Discharge	33.32	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+42.69	2003.21
0+69.14	2002.53
0+69.29	2002.07
0+70.70	2002.19
0+86.22	2002.54
1+01.15	2002.19
1+02.18	2002.15
1+03.11	2002.22
1+10.99	2002.32
1+11.15	2002.68
1+28.03	2003.20

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+42.69, 2003.21)	(0+70.70, 2002.19)	0.013
(0+70.70, 2002.19)	(1+01.15, 2002.19)	0.016
(1+01.15, 2002.19)	(1+28.03, 2003.20)	0.013

Options

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

Worksheet for 6E 6th to 7th

Results

Normal Depth		0.51	ft
Elevation Range	2002.07 to 2003.21 ft		
Flow Area		10.46	ft²
Wetted Perimeter		44.29	ft
Hydraulic Radius		0.24	ft
Top Width		43.77	ft
Normal Depth		0.51	ft
Critical Depth		0.53	ft
Critical Slope		0.00532	ft/ft
Velocity		3.19	ft/s
Velocity Head		0.16	ft
Specific Energy		0.67	ft
Froude Number		1.15	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.51	ft
Critical Depth	0.53	ft
Channel Slope	0.72000	%
Critical Slope	0.00532	ft/ft

Cross Section for 6E 6th to 7th

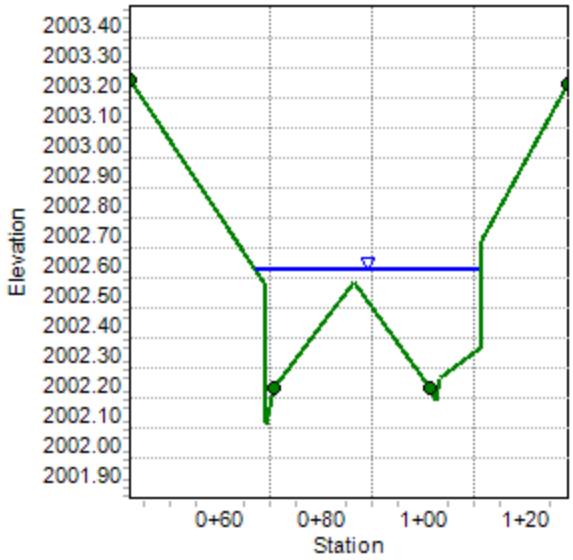
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.72000	%
Normal Depth	0.51	ft
Discharge	33.32	ft³/s

Cross Section Image



Worksheet for 6P 6th to 7th

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Loading zone on north side

Input Data

Channel Slope	0.72000	%
Discharge	33.32	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+42.69	2003.21
0+69.14	2002.53
0+69.29	2002.07
0+70.70	2002.19
0+86.22	2002.54
1+01.15	2002.32
1+01.15	2002.28
1+02.65	2002.15
1+02.65	2002.52
1+03.15	2002.52
1+08.15	2002.67
1+28.03	2003.20

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+42.69, 2003.21)	(0+70.70, 2002.19)	0.013
(0+70.70, 2002.19)	(1+01.15, 2002.32)	0.016
(1+01.15, 2002.32)	(1+28.03, 2003.20)	0.013

Options

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

Worksheet for 6P 6th to 7th

Results

Normal Depth		0.60	ft
Elevation Range	2002.07 to 2003.21 ft		
Flow Area		10.50	ft²
Wetted Perimeter		44.83	ft
Hydraulic Radius		0.23	ft
Top Width		44.06	ft
Normal Depth		0.60	ft
Critical Depth		0.62	ft
Critical Slope		0.00537	ft/ft
Velocity		3.17	ft/s
Velocity Head		0.16	ft
Specific Energy		0.75	ft
Froude Number		1.15	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.60	ft
Critical Depth	0.62	ft
Channel Slope	0.72000	%
Critical Slope	0.00537	ft/ft

Cross Section for 6P 6th to 7th

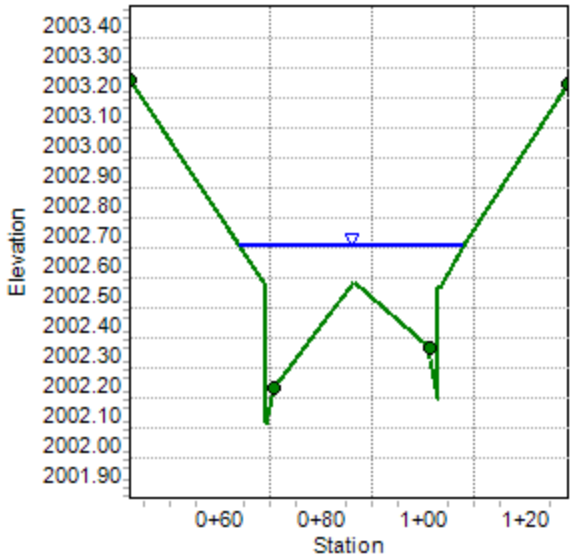
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.72000	%
Normal Depth	0.60	ft
Discharge	33.32	ft³/s

Cross Section Image



Worksheet for 7E 7th to 8th

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Loading zone on south side

Input Data

Channel Slope	0.68000	%
Discharge	35.04	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+39.71	2001.29
0+64.93	2000.99
0+65.12	2000.61
0+73.42	2000.53
0+74.49	2000.42
0+75.09	2000.50
0+91.26	2000.97
1+05.76	2000.91
1+07.11	2000.84
1+07.31	2001.31
1+30.76	2001.41

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+39.71, 2001.29)	(0+75.09, 2000.50)	0.013
(0+75.09, 2000.50)	(1+05.76, 2000.91)	0.016
(1+05.76, 2000.91)	(1+30.76, 2001.41)	0.013

Options

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

Worksheet for 7E 7th to 8th

Results

Normal Depth		0.60	ft
Elevation Range	2000.42 to 2001.41 ft		
Flow Area		11.09	ft²
Wetted Perimeter		45.82	ft
Hydraulic Radius		0.24	ft
Top Width		45.44	ft
Normal Depth		0.60	ft
Critical Depth		0.63	ft
Critical Slope		0.00527	ft/ft
Velocity		3.16	ft/s
Velocity Head		0.16	ft
Specific Energy		0.76	ft
Froude Number		1.13	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.60	ft
Critical Depth	0.63	ft
Channel Slope	0.68000	%
Critical Slope	0.00527	ft/ft

Cross Section for 7E 7th to 8th

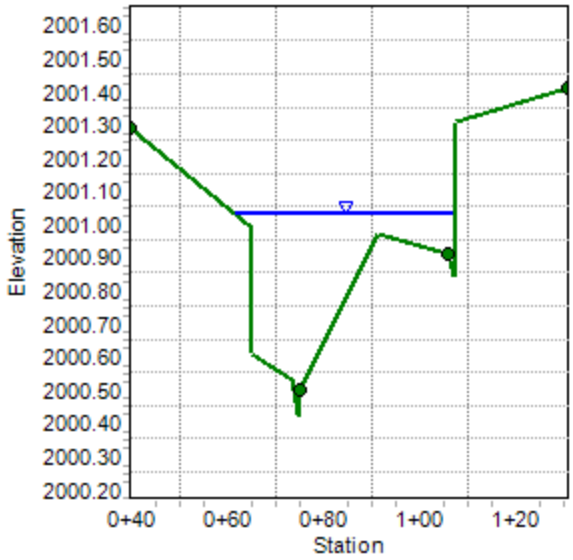
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.68000	%
Normal Depth	0.60	ft
Discharge	35.04	ft³/s

Cross Section Image



Worksheet for 7P 7th to 8th

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Loading zone on south side

Input Data

Channel Slope	0.68000	%
Discharge	35.04	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+39.71	2001.29
0+68.09	2000.93
0+73.09	2000.83
0+73.59	2000.83
0+73.59	2000.42
0+75.09	2000.55
0+75.09	2000.59
0+91.26	2000.97
1+05.76	2000.91
1+07.11	2000.84
1+07.31	2001.31
1+30.76	2001.41

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+39.71, 2001.29)	(0+75.09, 2000.59)	0.013
(0+75.09, 2000.59)	(1+05.76, 2000.91)	0.016
(1+05.76, 2000.91)	(1+30.76, 2001.41)	0.013

Options

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

Worksheet for 7P 7th to 8th

Results

Normal Depth		0.69	ft
Elevation Range	2000.42 to 2001.41 ft		
Flow Area		11.72	ft²
Wetted Perimeter		54.13	ft
Hydraulic Radius		0.22	ft
Top Width		53.49	ft
Normal Depth		0.69	ft
Critical Depth		0.71	ft
Critical Slope		0.00525	ft/ft
Velocity		2.99	ft/s
Velocity Head		0.14	ft
Specific Energy		0.83	ft
Froude Number		1.13	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.69	ft
Critical Depth	0.71	ft
Channel Slope	0.68000	%
Critical Slope	0.00525	ft/ft

Cross Section for 7P 7th to 8th

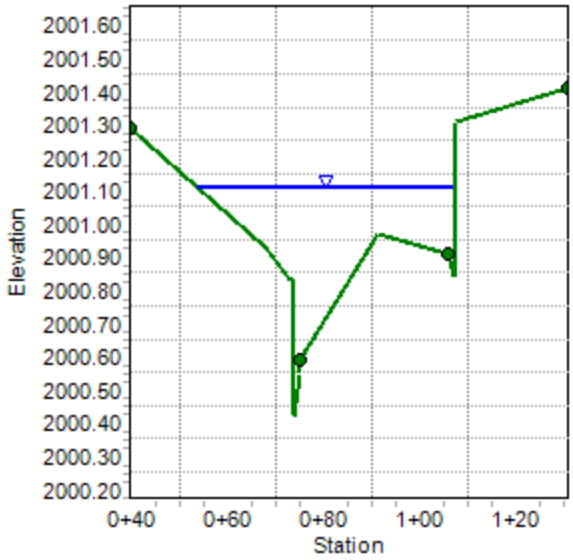
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.68000	%
Normal Depth	0.69	ft
Discharge	35.04	ft³/s

Cross Section Image



Worksheet for 8E 7th to 8th

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Loading zone on north side

Input Data

Channel Slope	0.68000	%
Discharge	35.04	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+52.26	2000.07
0+75.04	1999.57
0+75.18	1999.06
0+76.59	1999.20
0+92.48	1999.41
1+07.24	1999.26
1+08.15	1999.24
1+08.98	1999.29
1+17.02	1999.39
1+17.11	1999.76
1+37.16	2000.13

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+52.26, 2000.07)	(0+76.59, 1999.20)	0.013
(0+76.59, 1999.20)	(1+07.24, 1999.26)	0.016
(1+07.24, 1999.26)	(1+37.16, 2000.13)	0.013

Options

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

Worksheet for 8E 7th to 8th

Results

Normal Depth		0.51	ft
Elevation Range	1999.06 to 2000.13 ft		
Flow Area		10.85	ft²
Wetted Perimeter		42.83	ft
Hydraulic Radius		0.25	ft
Top Width		42.30	ft
Normal Depth		0.51	ft
Critical Depth		0.53	ft
Critical Slope		0.00528	ft/ft
Velocity		3.23	ft/s
Velocity Head		0.16	ft
Specific Energy		0.67	ft
Froude Number		1.12	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.51	ft
Critical Depth	0.53	ft
Channel Slope	0.68000	%
Critical Slope	0.00528	ft/ft

Cross Section for 8E 7th to 8th

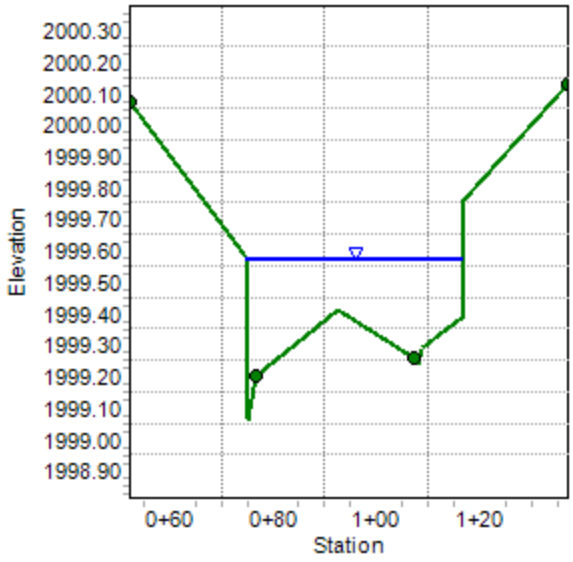
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.68000	%
Normal Depth	0.51	ft
Discharge	35.04	ft³/s

Cross Section Image



Worksheet for 8P 7th to 8th

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Loading zone on north side

Input Data

Channel Slope	0.68000	%
Discharge	35.04	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+52.26	2000.07
0+75.04	1999.57
0+75.18	1999.06
0+76.59	1999.20
0+92.48	1999.41
1+07.24	1999.41
1+07.24	1999.37
1+08.74	1999.24
1+08.74	1999.59
1+09.24	1999.59
1+14.24	1999.69
1+37.16	2000.13

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+52.26, 2000.07)	(0+76.59, 1999.20)	0.013
(0+76.59, 1999.20)	(1+07.24, 1999.41)	0.016
(1+07.24, 1999.41)	(1+37.16, 2000.13)	0.013

Options

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

Worksheet for 8P 7th to 8th

Results

Normal Depth		0.59	ft
Elevation Range	1999.06 to 2000.13 ft		
Flow Area		10.81	ft²
Wetted Perimeter		42.27	ft
Hydraulic Radius		0.26	ft
Top Width		41.49	ft
Normal Depth		0.59	ft
Critical Depth		0.62	ft
Critical Slope		0.00535	ft/ft
Velocity		3.24	ft/s
Velocity Head		0.16	ft
Specific Energy		0.76	ft
Froude Number		1.12	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.59	ft
Critical Depth	0.62	ft
Channel Slope	0.68000	%
Critical Slope	0.00535	ft/ft

Cross Section for 8P 7th to 8th

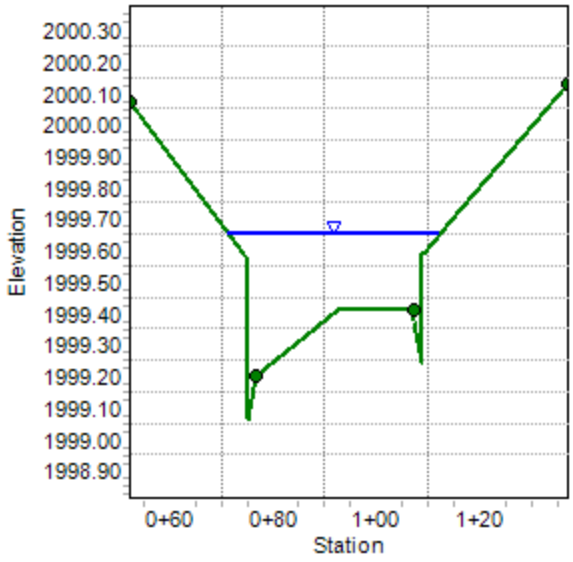
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.68000	%
Normal Depth	0.59	ft
Discharge	35.04	ft³/s

Cross Section Image



Worksheet for 10E 8th to 9th FF

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.50000	%
Discharge	41.19	ft³/s

Section Definitions

Applies to stations:
24+11 RT
24+75 RT

Station (ft)	Elevation (ft)
-0+15.96	1996.92
0+00.03	1996.63
0+01.83	1996.60
0+02.88	1996.60
0+11.41	1996.43
0+11.74	1996.44
0+11.95	1995.98
0+12.96	1996.10
0+41.00	1996.93
0+67.27	1996.06
0+67.76	1996.04
0+67.92	1996.51
0+68.12	1996.50
0+68.15	1996.49
0+79.50	1996.74
0+81.80	1996.84

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+15.96, 1996.92)	(0+12.96, 1996.10)	0.013
(0+12.96, 1996.10)	(0+67.27, 1996.06)	0.016
(0+67.27, 1996.06)	(0+81.80, 1996.84)	0.013

Worksheet for 10E 8th to 9th FF

Options

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

Results

Normal Depth		0.70	ft
Elevation Range	1995.98 to 1996.93 ft		
Flow Area		15.23	ft²
Wetted Perimeter		64.33	ft
Hydraulic Radius		0.24	ft
Top Width		63.67	ft
Normal Depth		0.70	ft
Critical Depth		0.69	ft
Critical Slope		0.00528	ft/ft
Velocity		2.70	ft/s
Velocity Head		0.11	ft
Specific Energy		0.81	ft
Froude Number		0.98	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.70	ft
Critical Depth	0.69	ft
Channel Slope	0.50000	%
Critical Slope	0.00528	ft/ft

Messages

Notes

Worksheet for 10E 8th to 9th FF

Messages

FF at 0+00, city park at end of cross section.

Cross Section for 10E 8th to 9th FF

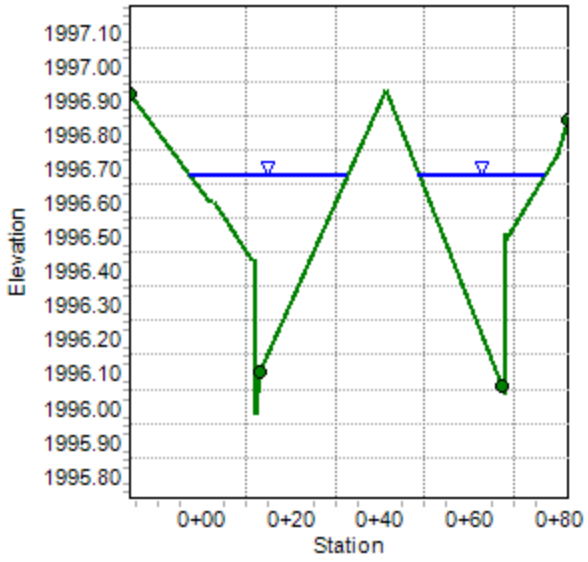
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.50000	%
Normal Depth	0.70	ft
Discharge	41.19	ft³/s

Cross Section Image



Worksheet for 10P 8th to 9th FF

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.50000	%
Discharge	41.19	ft³/s

Section Definitions

Applies to stations:
24+11 RT
24+75 RT

Station (ft)	Elevation (ft)
-0+15.96	1996.92
0+13.00	1996.81
0+18.00	1996.71
0+18.50	1996.71
0+18.50	1996.21
0+20.00	1996.34
0+20.00	1996.38
0+41.00	1996.93
0+60.00	1996.31
0+60.00	1996.27
0+61.50	1996.14
0+61.50	1996.64
0+62.00	1996.64
0+67.00	1996.74
0+79.50	1996.74
0+81.80	1996.84

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+15.96, 1996.92)	(0+20.00, 1996.34)	0.013
(0+20.00, 1996.34)	(0+60.00, 1996.27)	0.016
(0+60.00, 1996.27)	(0+81.80, 1996.84)	0.013

Worksheet for 10P 8th to 9th FF

Options

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

Results

Normal Depth		0.75	ft
Elevation Range	1996.14 to 1996.93 ft		
Flow Area		16.95	ft²
Wetted Perimeter		88.54	ft
Hydraulic Radius		0.19	ft
Top Width		87.37	ft
Normal Depth		0.75	ft
Critical Depth		0.75	ft
Critical Slope		0.00529	ft/ft
Velocity		2.43	ft/s
Velocity Head		0.09	ft
Specific Energy		0.84	ft
Froude Number		0.97	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.75	ft
Critical Depth	0.75	ft
Channel Slope	0.50000	%
Critical Slope	0.00529	ft/ft

Messages

Notes

Worksheet for 10P 8th to 9th FF

Messages

FF at 0+00, city park at end of cross section.

Cross Section for 10P 8th to 9th FF

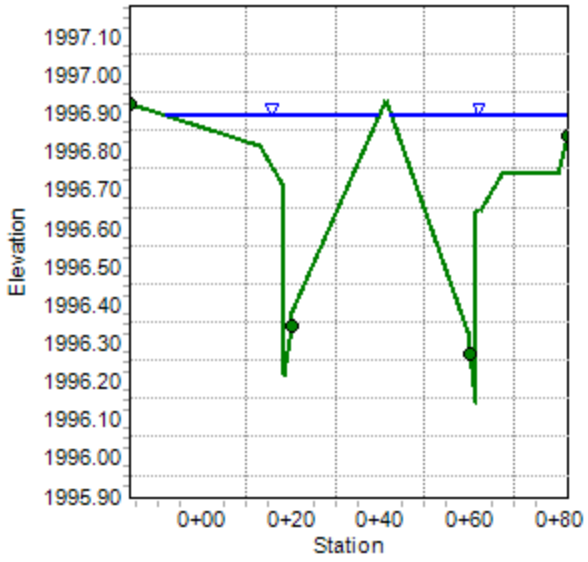
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.50000	%
Normal Depth	0.75	ft
Discharge	41.19	ft³/s

Cross Section Image



Worksheet for 11E 10th to 11th FF

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.94000	%
Discharge	60.13	ft³/s

Applies to stations:
29+70 LT
30+52 LT
30+77 LT
31+33 LT
31+39 RT
32+37 RT

Section Definitions

Station (ft)	Elevation (ft)
0+00.06	1992.91
0+02.47	1992.95
0+05.47	1992.84
0+08.51	1992.64
0+09.61	1992.50
0+20.56	1992.38
0+20.56	1992.40
0+20.84	1992.38
0+21.04	1991.91
0+21.82	1991.97
0+45.71	1993.25
0+76.24	1992.13
0+77.28	1991.99
0+77.41	1992.43
0+86.25	1992.58
0+89.01	1992.88
0+96.33	1992.91
1+40.70	1993.80
1+40.84	1993.88

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.06, 1992.91)	(0+21.82, 1991.97)	0.013
(0+21.82, 1991.97)	(0+76.24, 1992.13)	0.016

Worksheet for 11E 10th to 11th FF

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+76.24, 1992.13)	(1+40.84, 1993.88)	0.013

Options

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

Results

Normal Depth		0.70	ft
Elevation Range	1991.91 to 1993.88 ft		
Flow Area		11.32	ft²
Wetted Perimeter		49.31	ft
Hydraulic Radius		0.23	ft
Top Width		48.61	ft
Normal Depth		0.70	ft
Critical Depth		0.84	ft
Critical Slope		0.00462	ft/ft
Velocity		5.31	ft/s
Velocity Head		0.44	ft
Specific Energy		1.14	ft
Froude Number		1.94	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.70	ft
Critical Depth	0.84	ft

Worksheet for 11E 10th to 11th FF

GVF Output Data

Channel Slope	1.94000	%
Critical Slope	0.00462	ft/ft

Messages

Notes

Parking area at 0+00, FF at end of cross section.
Ran back from end of north side at a 2% slope, then jumped up to the finished floor elevation.

Cross Section for 11E 10th to 11th FF

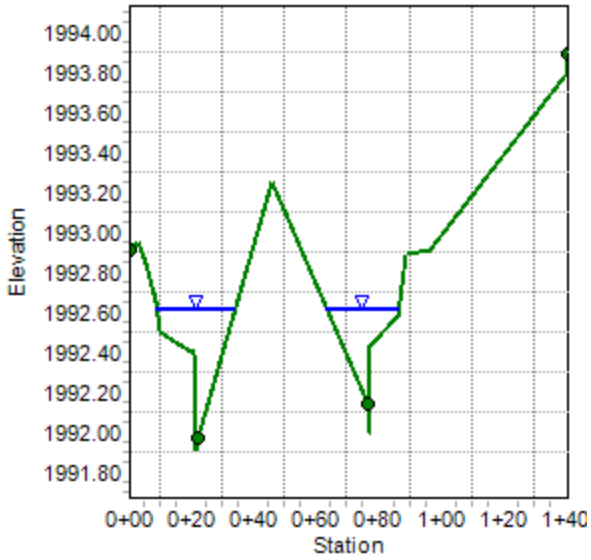
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.94000	%
Normal Depth	0.70	ft
Discharge	60.13	ft³/s

Cross Section Image



Worksheet for 11P 10th to 11th FF

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.94000	%
Discharge	60.13	ft³/s

Section Definitions

Applies to stations:
29+70 LT
30+52 LT
30+77 LT
31+33 LT
31+39 RT
32+37 RT

Station (ft)	Elevation (ft)
0+00.06	1992.91
0+02.47	1992.95
0+05.47	1992.84
0+21.00	1992.40
0+21.50	1992.40
0+21.50	1991.90
0+23.00	1992.03
0+23.00	1992.07
0+45.71	1993.25
0+69.00	1992.53
0+69.00	1992.49
0+70.50	1992.36
0+70.50	1992.86
0+71.00	1992.86
0+76.00	1992.96
0+89.01	1992.88
0+96.33	1992.91
1+40.70	1993.80
1+40.84	1993.88

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.06, 1992.91)	(0+23.00, 1992.03)	0.013
(0+23.00, 1992.03)	(0+69.00, 1992.49)	0.016

Worksheet for 11P 10th to 11th FF

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+69.00, 1992.49)	(1+40.84, 1993.88)	0.013

Options

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

Results

Normal Depth		0.88	ft
Elevation Range	1991.90 to 1993.88 ft		
Flow Area		10.46	ft²
Wetted Perimeter		39.99	ft
Hydraulic Radius		0.26	ft
Top Width		38.95	ft
Normal Depth		0.88	ft
Critical Depth		1.07	ft
Critical Slope		0.00511	ft/ft
Velocity		5.75	ft/s
Velocity Head		0.51	ft
Specific Energy		1.40	ft
Froude Number		1.96	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.88	ft
Critical Depth	1.07	ft

Worksheet for 11P 10th to 11th FF

GVF Output Data

Channel Slope	1.94000	%
Critical Slope	0.00511	ft/ft

Messages

Notes

Parking area at 0+00, FF at end of cross section.
Ran back from end of north side at a 2% slope, then jumped up to the finished floor elevation.

Cross Section for 11P 10th to 11th FF

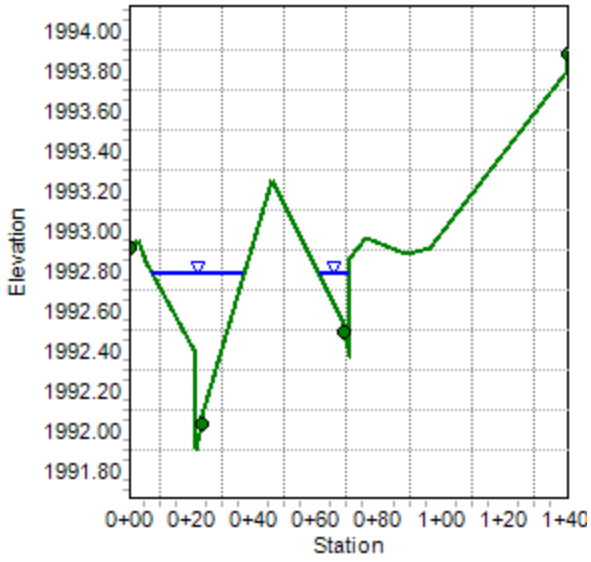
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.94000	%
Normal Depth	0.88	ft
Discharge	60.13	ft³/s

Cross Section Image



Worksheet for 12E 11th to Maryland FF

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.93000	%
Discharge	61.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
-0+04.76	1986.20
0+00.00	1984.91
0+15.28	1984.83
0+15.43	1984.36
0+16.53	1984.48
0+45.32	1985.42
0+70.53	1984.67
0+71.47	1984.56
0+71.61	1984.94
0+81.24	1985.06
0+96.22	1985.08
1+08.89	1985.61

Applies to stations:
33+53 LT
34+09 LT
34+74 LT
36+00 LT
33+35 RT
33+75 RT
33+91 RT
34+28 RT
34+67 RT
34+81 RT
34+97 RT
35+29 RT
35+45 RT
35+65 RT
36+17 RT

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+04.76, 1986.20)	(0+16.53, 1984.48)	0.013
(0+16.53, 1984.48)	(0+70.53, 1984.67)	0.016
(0+70.53, 1984.67)	(1+08.89, 1985.61)	0.013

Options

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

Worksheet for 12E 11th to Maryland FF

Results

Normal Depth		0.66	ft
Elevation Range	1984.36 to 1986.20 ft		
Flow Area		10.49	ft²
Wetted Perimeter		54.00	ft
Hydraulic Radius		0.19	ft
Top Width		53.35	ft
Normal Depth		0.66	ft
Critical Depth		0.81	ft
Critical Slope		0.00500	ft/ft
Velocity		5.82	ft/s
Velocity Head		0.53	ft
Specific Energy		1.19	ft
Froude Number		2.31	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.66	ft
Critical Depth	0.81	ft
Channel Slope	2.93000	%
Critical Slope	0.00500	ft/ft

Cross Section for 12E 11th to Maryland FF

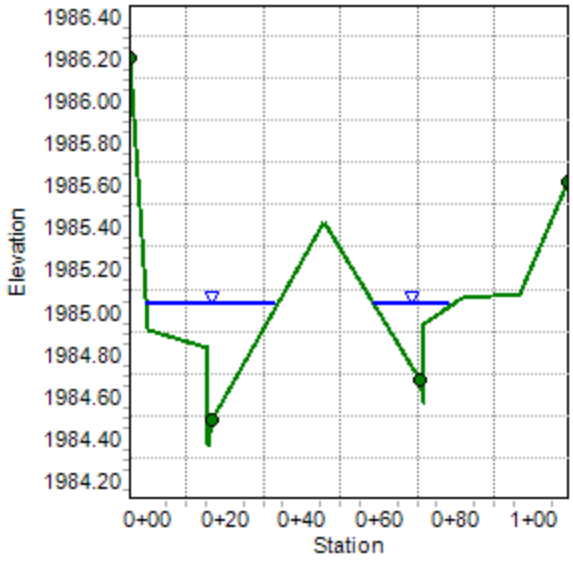
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.93000	%
Normal Depth	0.66	ft
Discharge	61.00	ft³/s

Cross Section Image



Worksheet for 12P 11th to Maryland FF

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.93000	%
Discharge	61.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
-0+04.76	1986.20
0+16.37	1985.30
0+21.37	1985.20
0+21.87	1985.20
0+21.87	1984.70
0+23.37	1984.83
0+23.37	1984.87
0+45.32	1985.42
0+63.37	1984.84
0+63.37	1984.80
0+64.87	1984.67
0+64.87	1985.17
0+65.37	1985.17
0+70.37	1985.27
1+08.89	1985.61

Applies to stations:
33+53 LT
34+09 LT
34+74 LT
36+00 LT
33+35 RT
33+75 RT
33+91 RT
34+28 RT
34+67 RT
34+81 RT
34+97 RT
35+29 RT
35+45 RT
35+65 RT
36+17 RT

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+04.76, 1986.20)	(0+23.37, 1984.83)	0.013
(0+23.37, 1984.83)	(0+63.37, 1984.80)	0.016
(0+63.37, 1984.80)	(1+08.89, 1985.61)	0.013

Options

Current Roughness Weighted Method	Pavlovskii's Method

Worksheet for 12P 11th to Maryland FF

Options

Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		0.65	ft
Elevation Range	1984.67 to 1986.20 ft		
Flow Area		10.64	ft²
Wetted Perimeter		54.66	ft
Hydraulic Radius		0.19	ft
Top Width		53.55	ft
Normal Depth		0.65	ft
Critical Depth		0.81	ft
Critical Slope		0.00516	ft/ft
Velocity		5.73	ft/s
Velocity Head		0.51	ft
Specific Energy		1.16	ft
Froude Number		2.27	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.65	ft
Critical Depth	0.81	ft
Channel Slope	2.93000	%
Critical Slope	0.00516	ft/ft

Cross Section for 12P 11th to Maryland FF

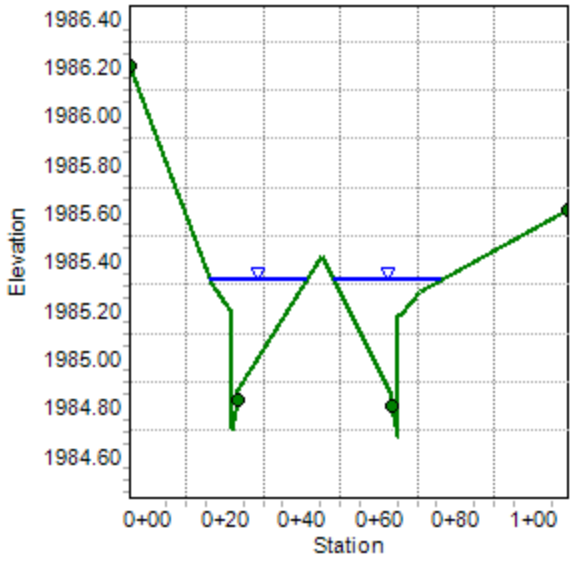
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.93000	%
Normal Depth	0.65	ft
Discharge	61.00	ft³/s

Cross Section Image



Worksheet for 13E Maryland to 13th Interim FF

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.75000	%
Discharge	74.85	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1971.75
0+00.88	1971.76
0+03.90	1971.74
0+09.91	1971.73
0+12.88	1971.76
0+13.58	1971.77
0+14.80	1971.78
0+24.52	1971.63
0+24.68	1971.05
0+25.68	1971.14
0+55.02	1971.64
0+79.76	1971.24
0+80.79	1971.19
0+80.93	1971.64
0+89.91	1971.76
0+93.73	1971.96

Applies to stations:
37+38 LT
37+89 LT
38+32 LT
38+36 LT
38+87 LT
39+36 LT
39+42 LT

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1971.75)	(0+25.68, 1971.14)	0.013
(0+25.68, 1971.14)	(0+79.76, 1971.24)	0.016
(0+79.76, 1971.24)	(0+93.73, 1971.96)	0.013

Worksheet for 13E Maryland to 13th Interim FF

Options

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

Results

Normal Depth		0.62	ft
Elevation Range	1971.05 to 1971.96 ft		
Flow Area		15.25	ft²
Wetted Perimeter		62.43	ft
Hydraulic Radius		0.24	ft
Top Width		61.65	ft
Normal Depth		0.62	ft
Critical Depth		0.75	ft
Critical Slope		0.00553	ft/ft
Velocity		4.91	ft/s
Velocity Head		0.37	ft
Specific Energy		1.00	ft
Froude Number		1.74	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.62	ft
Critical Depth	0.75	ft
Channel Slope	1.75000	%
Critical Slope	0.00553	ft/ft

Cross Section for 13E Maryland to 13th Interim FF

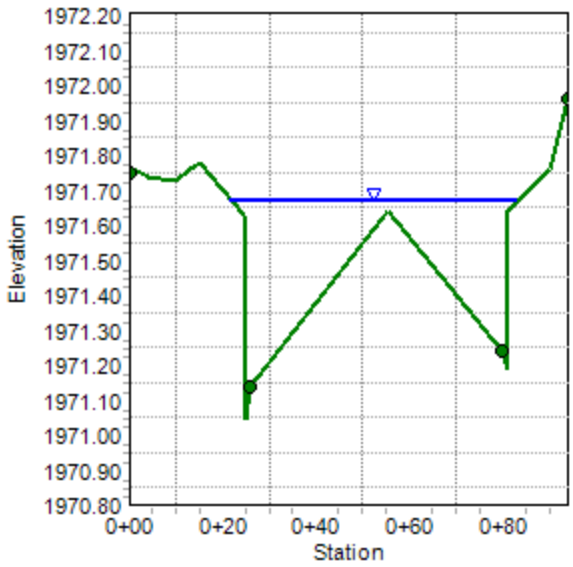
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.75000	%
Normal Depth	0.62	ft
Discharge	74.85	ft³/s

Cross Section Image



Worksheet for 13P Maryland to 13th Interim FF

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.75000	%
Discharge	74.85	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1971.75
0+00.88	1971.76
0+03.90	1971.74
0+09.91	1971.73
0+12.88	1971.76
0+13.58	1971.77
0+14.80	1971.78
0+25.62	1971.71
0+30.62	1971.61
0+31.12	1971.61
0+31.12	1971.11
0+32.62	1971.24
0+32.62	1971.28
0+55.02	1971.64
0+72.52	1971.42
0+72.52	1971.38
0+74.02	1971.25
0+74.02	1971.75
0+74.52	1971.75
0+79.52	1971.85
0+93.73	1971.96

Applies to stations:
37+38 LT
37+89 LT
38+32 LT
38+36 LT
38+87 LT
39+36 LT
39+42 LT

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient

Worksheet for 13P Maryland to 13th Interim FF

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1971.75)	(0+32.62, 1971.24)	0.013
(0+32.62, 1971.24)	(0+72.52, 1971.38)	0.016
(0+72.52, 1971.38)	(0+93.73, 1971.96)	0.013

Options

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

Results

Normal Depth		0.69	ft
Elevation Range	1971.11 to 1971.96 ft		
Flow Area		16.01	ft²
Wetted Perimeter		78.18	ft
Hydraulic Radius		0.20	ft
Top Width		77.05	ft
Normal Depth		0.69	ft
Critical Depth		0.79	ft
Critical Slope		0.00482	ft/ft
Velocity		4.68	ft/s
Velocity Head		0.34	ft
Specific Energy		1.03	ft
Froude Number		1.81	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		

Worksheet for 13P Maryland to 13th Interim FF

GVF Output Data

Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.69	ft
Critical Depth	0.79	ft
Channel Slope	1.75000	%
Critical Slope	0.00482	ft/ft

Cross Section for 13P Maryland to 13th Interim FF

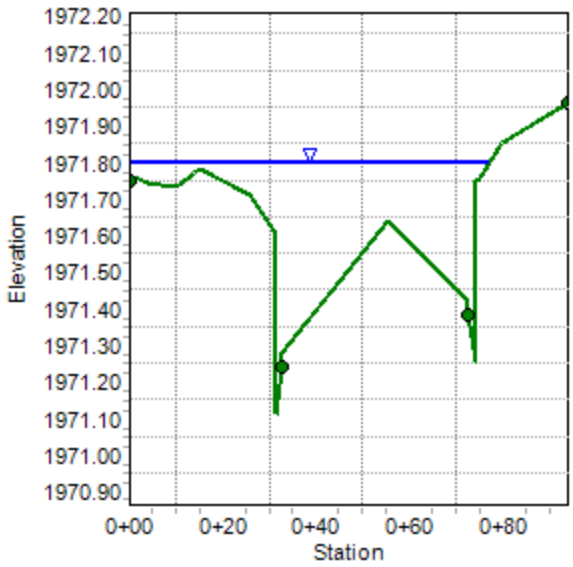
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.75000	%
Normal Depth	0.69	ft
Discharge	74.85	ft³/s

Cross Section Image



Worksheet for 14E 13th to 14th Interim FF

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.16082	%
Discharge	90.20	ft³/s

Section Definitions

Applies to stations:
41+26 LT
42+07 LT
41+37 RT
41+78 RT
42+15 RT

Station (ft)	Elevation (ft)
0+03.43	1964.64
0+04.18	1964.58
0+05.48	1964.35
0+16.77	1964.20
0+16.89	1963.74
0+17.91	1963.83
0+47.48	1964.58
0+72.26	1964.06
0+72.84	1964.01
0+72.96	1964.06
0+73.47	1964.51
0+81.85	1964.57
0+97.77	1965.40

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+03.43, 1964.64)	(0+17.91, 1963.83)	0.013
(0+17.91, 1963.83)	(0+72.26, 1964.06)	0.016
(0+72.26, 1964.06)	(0+97.77, 1965.40)	0.013

Options

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

Worksheet for 14E 13th to 14th Interim FF

Results

Normal Depth		0.73	ft
Elevation Range	1963.74 to 1965.40 ft		
Flow Area		15.52	ft²
Wetted Perimeter		59.63	ft
Hydraulic Radius		0.26	ft
Top Width		59.07	ft
Normal Depth		0.73	ft
Critical Depth		0.90	ft
Critical Slope		0.00493	ft/ft
Velocity		5.81	ft/s
Velocity Head		0.52	ft
Specific Energy		1.26	ft
Froude Number		2.00	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.73	ft
Critical Depth	0.90	ft
Channel Slope	2.16082	%
Critical Slope	0.00493	ft/ft

Cross Section for 14E 13th to 14th Interim FF

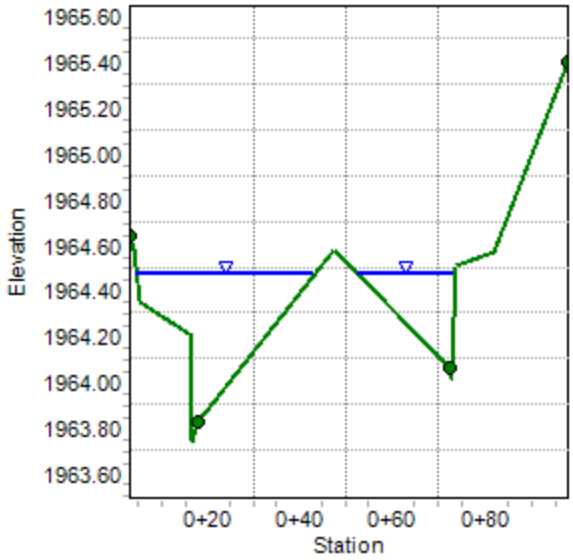
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.16082	%
Normal Depth	0.73	ft
Discharge	90.20	ft³/s

Cross Section Image



Worksheet for 14P 13th to 14th Interim FF

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.16082	%
Discharge	90.20	ft³/s

Applies to stations:
41+26 LT
42+07 LT
41+37 RT
41+78 RT
42+15 RT

Section Definitions

Station (ft)	Elevation (ft)
0+03.43	1964.64
0+17.89	1964.56
0+22.89	1964.46
0+23.39	1964.46
0+23.39	1963.96
0+24.89	1964.09
0+24.89	1964.13
0+47.48	1964.58
0+64.89	1964.23
0+64.89	1964.19
0+66.39	1964.06
0+66.39	1964.56
0+66.89	1964.56
0+71.89	1964.66
0+97.77	1965.40

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+03.43, 1964.64)	(0+24.89, 1964.09)	0.013
(0+24.89, 1964.09)	(0+64.89, 1964.19)	0.016
(0+64.89, 1964.19)	(0+97.77, 1965.40)	0.013

Options

Current Roughness Weighted Method	Pavlovskii's Method

Worksheet for 14P 13th to 14th Interim FF

Options

Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		0.72	ft
Elevation Range	1963.96 to 1965.40 ft		
Flow Area		16.21	ft²
Wetted Perimeter		70.10	ft
Hydraulic Radius		0.23	ft
Top Width		68.96	ft
Normal Depth		0.72	ft
Critical Depth		0.86	ft
Critical Slope		0.00459	ft/ft
Velocity		5.56	ft/s
Velocity Head		0.48	ft
Specific Energy		1.20	ft
Froude Number		2.02	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.72	ft
Critical Depth	0.86	ft
Channel Slope	2.16082	%
Critical Slope	0.00459	ft/ft

Cross Section for 14P 13th to 14th Interim FF

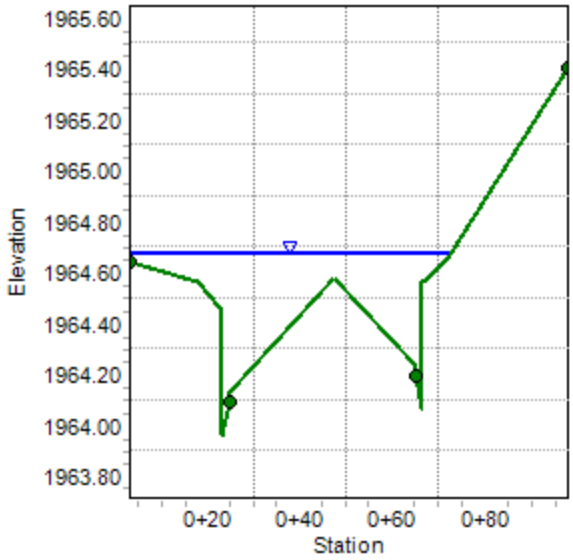
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.16082	%
Normal Depth	0.72	ft
Discharge	90.20	ft³/s

Cross Section Image



Worksheet for 15E 13th to 14th Interim FF

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.16082	%
Discharge	90.20	ft³/s

Section Definitions

Applies to stations:
42+86 LT
43+68 LT
43+29 RT
43+49 RT

Station (ft)	Elevation (ft)
0+00.09	1962.09
0+08.23	1961.34
0+09.98	1961.19
0+11.73	1961.09
0+14.06	1961.09
0+23.56	1960.98
0+23.73	1960.53
0+24.60	1960.59
0+49.43	1961.71
0+78.57	1960.45
0+79.61	1960.41
0+79.73	1960.79
0+85.47	1960.88
0+88.73	1960.98
0+91.59	1961.00
0+94.45	1960.94
0+94.95	1960.94
1+04.53	1961.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.09, 1962.09)	(0+24.60, 1960.59)	0.013
(0+24.60, 1960.59)	(0+78.57, 1960.45)	0.016
(0+78.57, 1960.45)	(1+04.53, 1961.00)	0.013

Worksheet for 15E 13th to 14th Interim FF

Options

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

Results

Normal Depth		0.72	ft
Elevation Range	1960.41 to 1962.09 ft		
Flow Area		15.69	ft²
Wetted Perimeter		68.02	ft
Hydraulic Radius		0.23	ft
Top Width		67.26	ft
Normal Depth		0.72	ft
Critical Depth		0.88	ft
Critical Slope		0.00429	ft/ft
Velocity		5.75	ft/s
Velocity Head		0.51	ft
Specific Energy		1.24	ft
Froude Number		2.10	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.72	ft
Critical Depth	0.88	ft
Channel Slope	2.16082	%
Critical Slope	0.00429	ft/ft

Cross Section for 15E 13th to 14th Interim FF

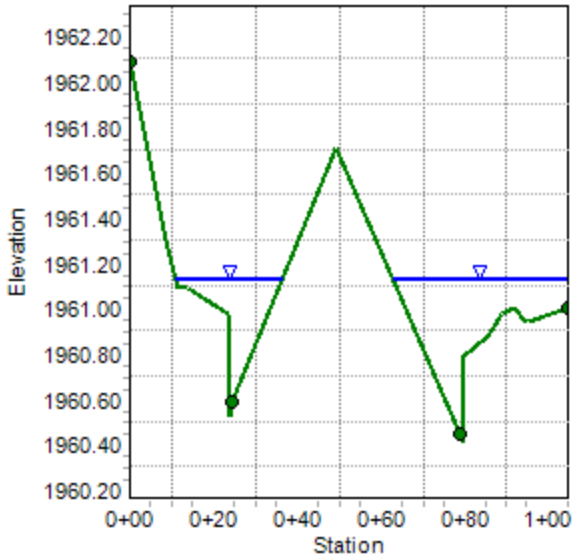
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.16082	%
Normal Depth	0.72	ft
Discharge	90.20	ft³/s

Cross Section Image



Worksheet for 15P 13th to 14th Interim FF

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.16082	%
Discharge	90.20	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.09	1962.09
0+24.65	1961.78
0+29.65	1961.68
0+30.15	1961.68
0+30.15	1961.18
0+31.65	1961.31
0+31.65	1961.35
0+49.43	1961.71
0+71.65	1961.26
0+71.65	1961.22
0+73.15	1961.09
0+73.15	1961.59
0+73.65	1961.59
0+78.65	1961.69

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.09, 1962.09)	(0+31.65, 1961.31)	0.013
(0+31.65, 1961.31)	(0+71.65, 1961.22)	0.016
(0+71.65, 1961.22)	(0+78.65, 1961.69)	0.013

Options

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

Worksheet for 15P 13th to 14th Interim FF

Options

Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		0.71	ft
Elevation Range	1961.09 to 1962.09 ft		
Flow Area		15.16	ft²
Wetted Perimeter		57.06	ft
Hydraulic Radius		0.27	ft
Top Width		55.84	ft
Normal Depth		0.71	ft
Critical Depth		0.89	ft
Critical Slope		0.00478	ft/ft
Velocity		5.95	ft/s
Velocity Head		0.55	ft
Specific Energy		1.26	ft
Froude Number		2.01	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.71	ft
Critical Depth	0.89	ft
Channel Slope	2.16082	%
Critical Slope	0.00478	ft/ft

Cross Section for 15P 13th to 14th Interim FF

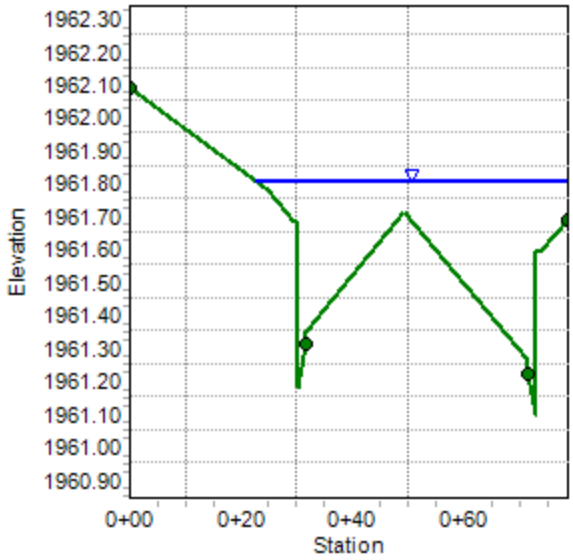
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.16082	%
Normal Depth	0.71	ft
Discharge	90.20	ft³/s

Cross Section Image



Worksheet for 11P 10th to 11th FF 10yr Collect

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.94000	%
Discharge	42.57	ft³/s

Section Definitions

Applies to stations:
30+52 LT
31+39 RT
32+37 RT

Station (ft)	Elevation (ft)
0+00.06	1992.91
0+02.47	1992.95
0+05.47	1992.84
0+21.00	1992.40
0+21.50	1992.40
0+21.50	1991.90
0+23.00	1992.03
0+23.00	1992.07
0+45.71	1993.25
0+69.00	1992.53
0+69.00	1992.49
0+70.50	1992.36
0+70.50	1992.86
0+71.00	1992.86
0+76.00	1992.96
0+89.01	1992.88
0+96.33	1992.91
1+40.70	1993.80
1+40.84	1993.88

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.06, 1992.91)	(0+23.00, 1992.03)	0.013
(0+23.00, 1992.03)	(0+69.00, 1992.49)	0.016

Worksheet for 11P 10th to 11th FF 10yr Collect

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+69.00, 1992.49)	(1+40.84, 1993.88)	0.013

Options

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

Results

Normal Depth		0.81	ft
Elevation Range	1991.90 to 1993.88 ft		
Flow Area		7.94	ft²
Wetted Perimeter		33.81	ft
Hydraulic Radius		0.23	ft
Top Width		32.85	ft
Normal Depth		0.81	ft
Critical Depth		0.96	ft
Critical Slope		0.00485	ft/ft
Velocity		5.36	ft/s
Velocity Head		0.45	ft
Specific Energy		1.26	ft
Froude Number		1.92	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.81	ft
Critical Depth	0.96	ft

Worksheet for 11P 10th to 11th FF 10yr Collect

GVF Output Data

Channel Slope	1.94000	%
Critical Slope	0.00485	ft/ft

Messages

Notes

Parking area at 0+00, FF at end of cross section.
Ran back from end of north side at a 2% slope, then jumped up to the finished floor elevation.

Cross Section for 11P 10th to 11th FF 10yr Collect

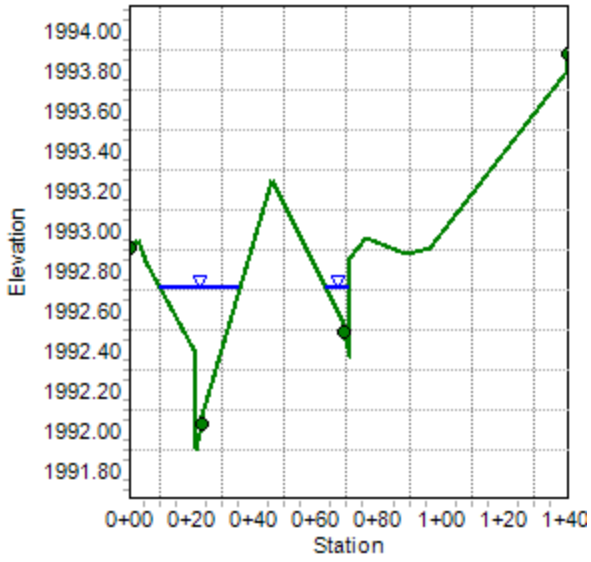
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.94000	%
Normal Depth	0.81	ft
Discharge	42.57	ft³/s

Cross Section Image



Worksheet for 12P 11th to Maryland FF 10yr Collect

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.93000	%
Discharge	38.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
-0+04.76	1986.20
0+16.37	1985.30
0+21.37	1985.20
0+21.87	1985.20
0+21.87	1984.70
0+23.37	1984.83
0+23.37	1984.87
0+45.32	1985.42
0+63.37	1984.84
0+63.37	1984.80
0+64.87	1984.67
0+64.87	1985.17
0+65.37	1985.17
0+70.37	1985.27
1+08.89	1985.61

Applies to stations:
33+75 RT
33+91 RT
34+28 RT
34+81 RT
34+97 RT
35+29 RT
35+45 RT

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+04.76, 1986.20)	(0+23.37, 1984.83)	0.013
(0+23.37, 1984.83)	(0+63.37, 1984.80)	0.016
(0+63.37, 1984.80)	(1+08.89, 1985.61)	0.013

Options

Current Roughness Weighted Method	Pavlovskii's Method

Worksheet for 12P 11th to Maryland FF 10yr Collect

Options

Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		0.57	ft
Elevation Range	1984.67 to 1986.20 ft		
Flow Area		7.04	ft²
Wetted Perimeter		38.40	ft
Hydraulic Radius		0.18	ft
Top Width		37.29	ft
Normal Depth		0.57	ft
Critical Depth		0.72	ft
Critical Slope		0.00574	ft/ft
Velocity		5.40	ft/s
Velocity Head		0.45	ft
Specific Energy		1.03	ft
Froude Number		2.19	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.57	ft
Critical Depth	0.72	ft
Channel Slope	2.93000	%
Critical Slope	0.00574	ft/ft

Cross Section for 12P 11th to Maryland FF 10yr Collect

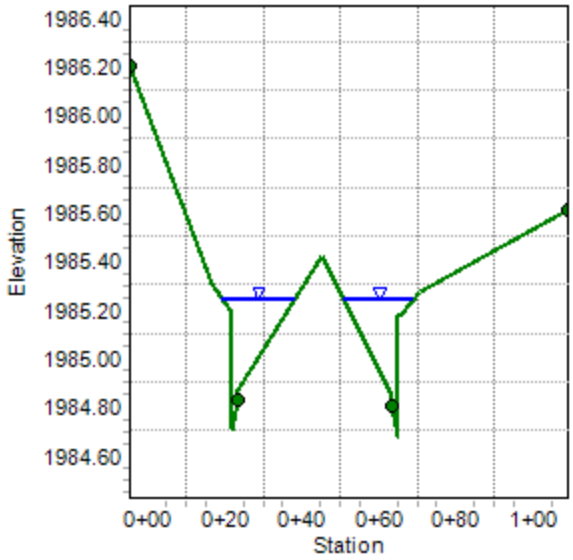
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.93000	%
Normal Depth	0.57	ft
Discharge	38.00	ft³/s

Cross Section Image



Worksheet for 15P 13th to 14th Interim FF 10yr Collect

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.16082	%
Discharge	53.57	ft³/s

Applies to station: 43+68 LT

Section Definitions

Station (ft)	Elevation (ft)
0+00.09	1962.09
0+24.65	1961.78
0+29.65	1961.68
0+30.15	1961.68
0+30.15	1961.18
0+31.65	1961.31
0+31.65	1961.35
0+49.43	1961.71
0+71.65	1961.26
0+71.65	1961.22
0+73.15	1961.09
0+73.15	1961.59
0+73.65	1961.59
0+78.65	1961.69

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.09, 1962.09)	(0+31.65, 1961.31)	0.013
(0+31.65, 1961.31)	(0+71.65, 1961.22)	0.016
(0+71.65, 1961.22)	(0+78.65, 1961.69)	0.013

Options

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

Worksheet for 15P 13th to 14th Interim FF 10yr Collect

Options

Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		0.63	ft
Elevation Range	1961.09 to 1962.09 ft		
Flow Area		10.77	ft²
Wetted Perimeter		52.15	ft
Hydraulic Radius		0.21	ft
Top Width		51.02	ft
Normal Depth		0.63	ft
Critical Depth		0.75	ft
Critical Slope		0.00531	ft/ft
Velocity		4.97	ft/s
Velocity Head		0.38	ft
Specific Energy		1.01	ft
Froude Number		1.91	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.63	ft
Critical Depth	0.75	ft
Channel Slope	2.16082	%
Critical Slope	0.00531	ft/ft

Cross Section for 15P 13th to 14th Interim FF 10yr Collect

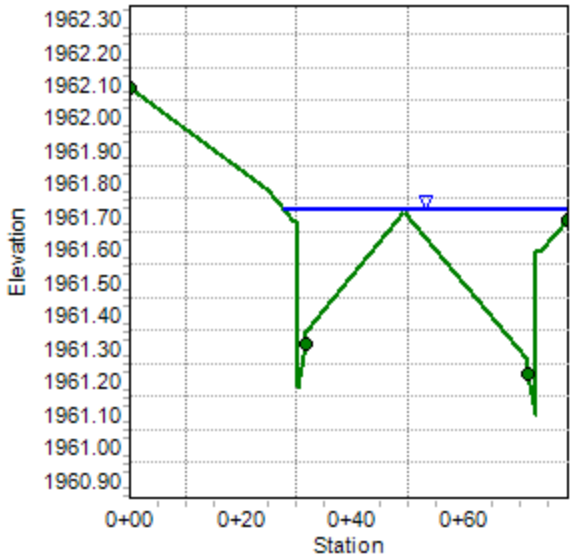
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.16082	%
Normal Depth	0.63	ft
Discharge	53.57	ft³/s

Cross Section Image



Appendix E:
Subbasin peak flow rate calculations

CMSD Basin Name	Total Basin Area (sq. mi)	CMSD 10-Yr Flow (cfs)	CMSD 100-Yr Flow (cfs)	Diverted Out (cfs)	Prorated Basin Name	Prorated Basin Area (%)	Prorated 10-Yr Flow (cfs)	Prorated 100-Yr Flow (cfs)
59-3	0.03367	24	49	24	-			
60A-2	0.02992	22	43	-	**60A-2A**	2.02%	0.45	0.87
					60A-2B	2.63%	0.58	1.13
					60A-2C	2.65%	0.58	1.14
60A-3	0.03114	23	46	-	**60A-3A**	11.39%	2.62	5.24
					60A-3B	6.70%	1.54	3.08
					60A-3C	3.74%	0.86	1.72
					60A-3D	13.37%	3.07	6.15
					60A-3E	19.91%	4.58	9.16
					60A-3F	21.27%	4.89	9.78
					60A-3G	23.64%	5.44	10.88
68-2	0.04018	28	60	-	**68-2A**	23.08%	6.46	13.85
					68-2B	25.60%	7.17	15.36

Combination Points	Contributing Basins	CMSD 10-Yr Flow (cfs)	CMSD 100-Yr Flow (cfs)
CF6	59-3, 60A-3A	2.62	30.24
CF7	60A-3B	4.16	33.32
CF8	60A-3C	5.02	35.04
CF9	60A-3D	8.09	41.19
CF10	60A-3E	12.67	50.34
CF11	60A-3F	17.56	60.13
C60A-3	59-3, 60A-3 (FROM HEC-1)	23.00	61.00
CF13 (Devel)	68-2A	6.46	13.85
CF13 (Interim)	68-2A, C60A-3	29.46	74.85
CF14 (Devel)	682-B	13.63	29.20
CF14 (Interim)	682-B	36.63	90.20

Interim indicates all flow is conveyed within the road

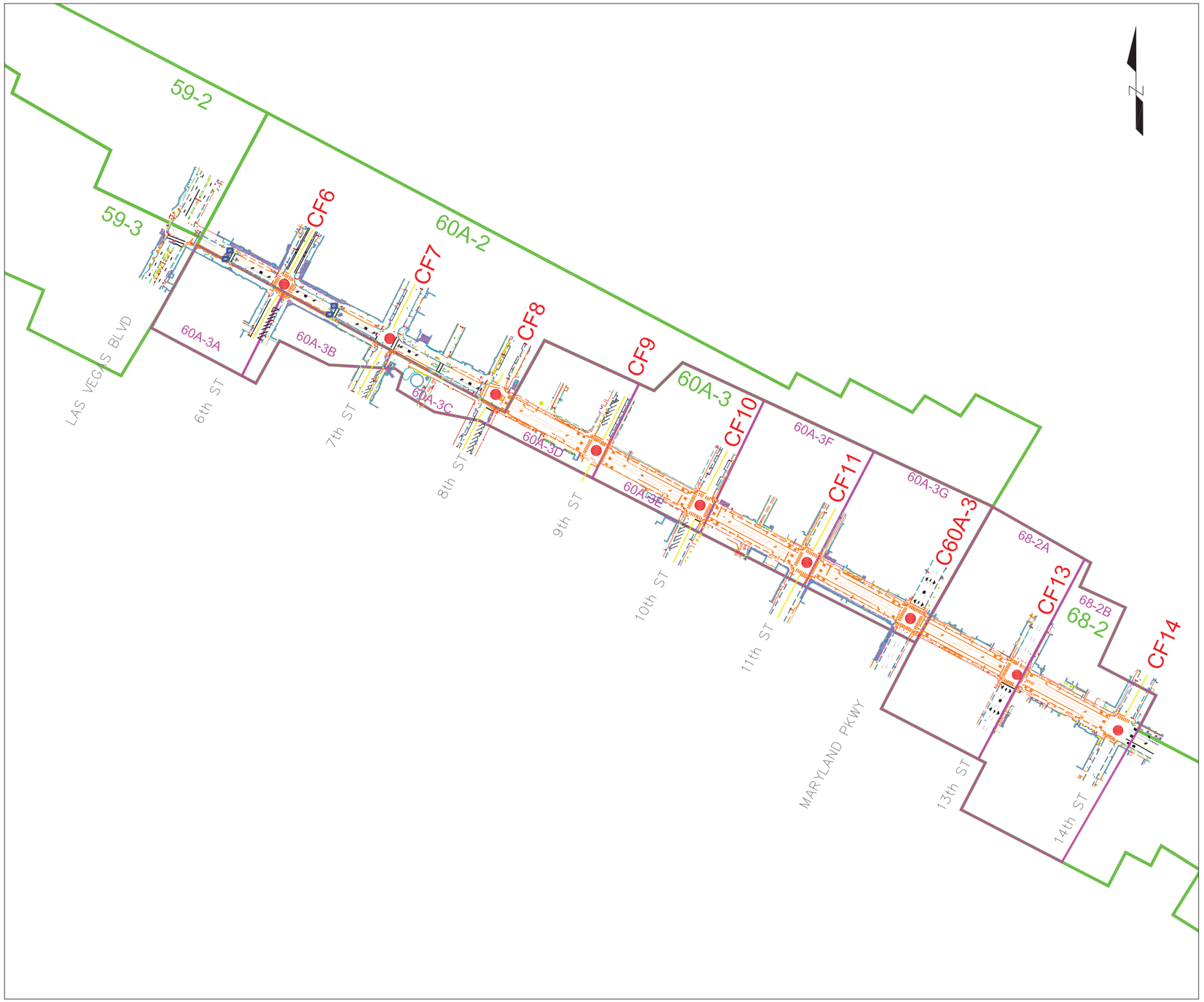
Devel indicates MPU facility in Las Vegas Blvd is constructed

Appendix F:

Figures

Drainage Basin Exhibit Map

Draft Freemont Street Template Plan



Combination Point	10–Year Flow (cfs)	100–Year Flow (cfs)
CF6	2.62	30.24
CF7	4.16	33.32
CF8	5.02	35.04
CF9	8.09	41.19
CF10	12.67	50.34
CF11	17.56	60.13
C60A–3	23.00	61.00
CF13 (INTERIM)	29.46	74.85
CF14 (INTERIM)	36.63	90.20

LEGEND

- Atkins Study Basins
- Prorated Basins
- 3' Combination Curb and Grate Inlet

08/10/2018 H:\0158 (Fremont St 8th to 13th)\Drainage\AutoCAD\0158 (Fremont St 8th to 13th) Drainage Basins.dwg

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PHONE: (702) 685-5945

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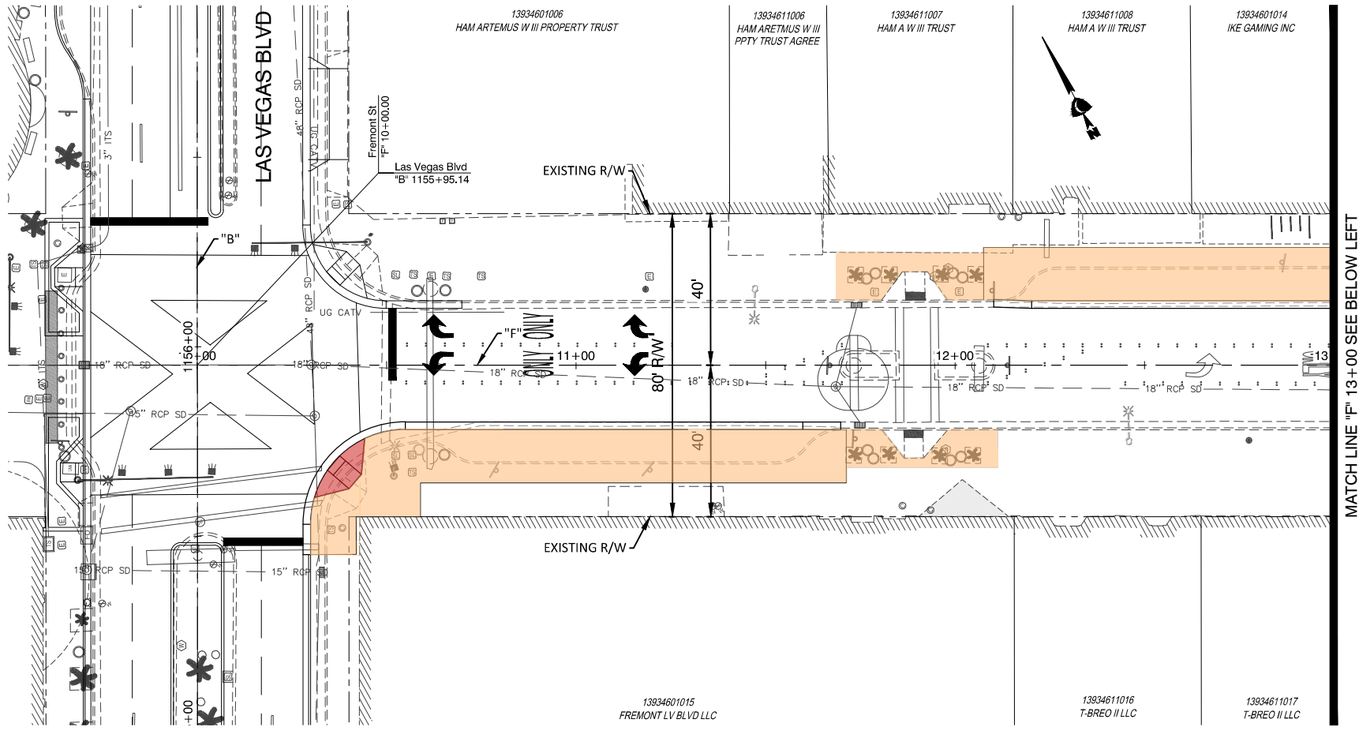
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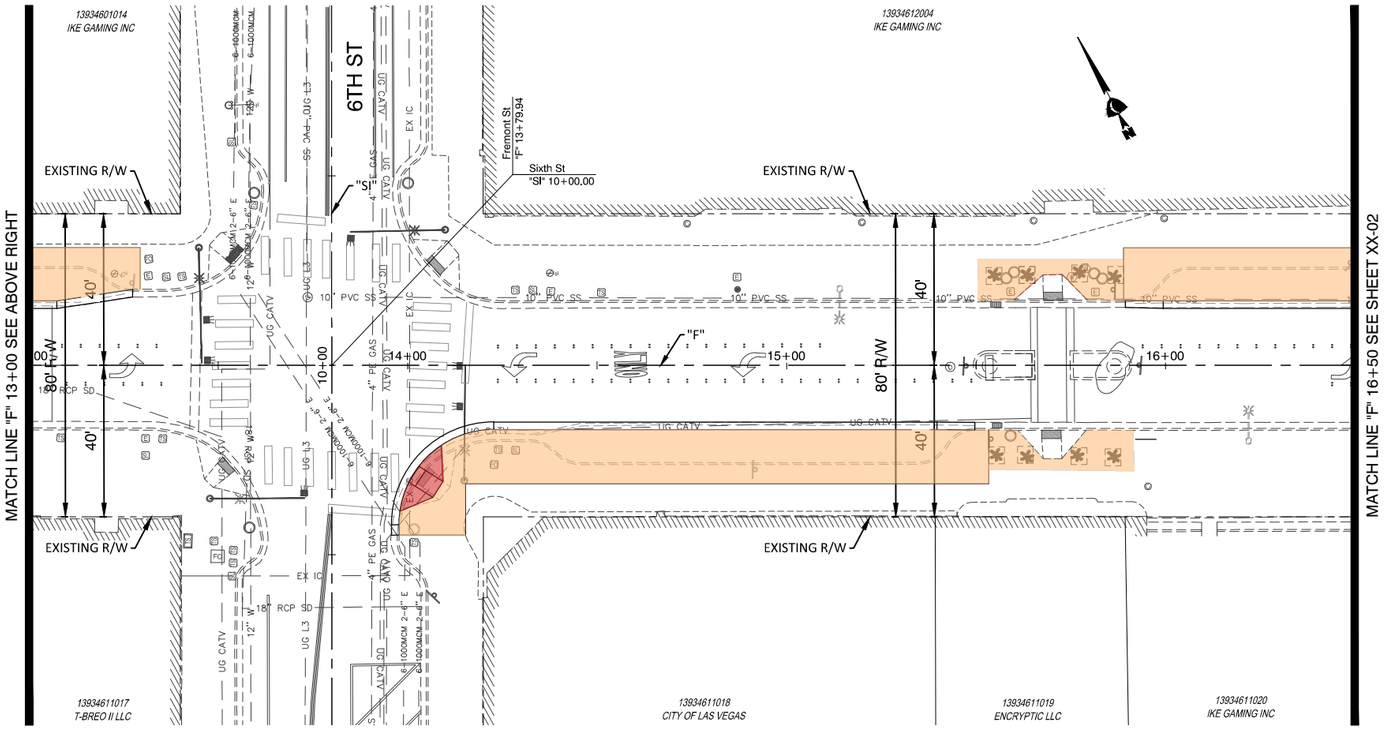
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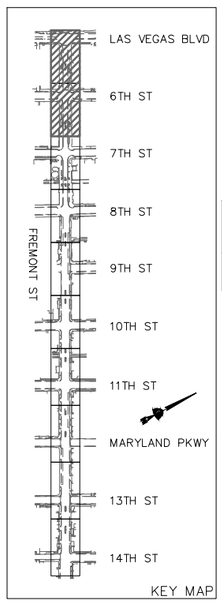
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GRAPHIC SCALE

20 0 10 20 40

1" = 20'

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	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

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PHONE: (702) 685-5945

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CITY OF LAS VEGAS

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BID# XX-XXXXX-XX
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DRAWN BY: JB
CHECKED BY: JC
SUBMITTAL STAGE:
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PROJECT TITLE
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LAS VEGAS BLVD TO 14TH ST

SHEET TITLE
TEMPLATE PLAN
"F" 9+50.00 TO "F" 16+50.00

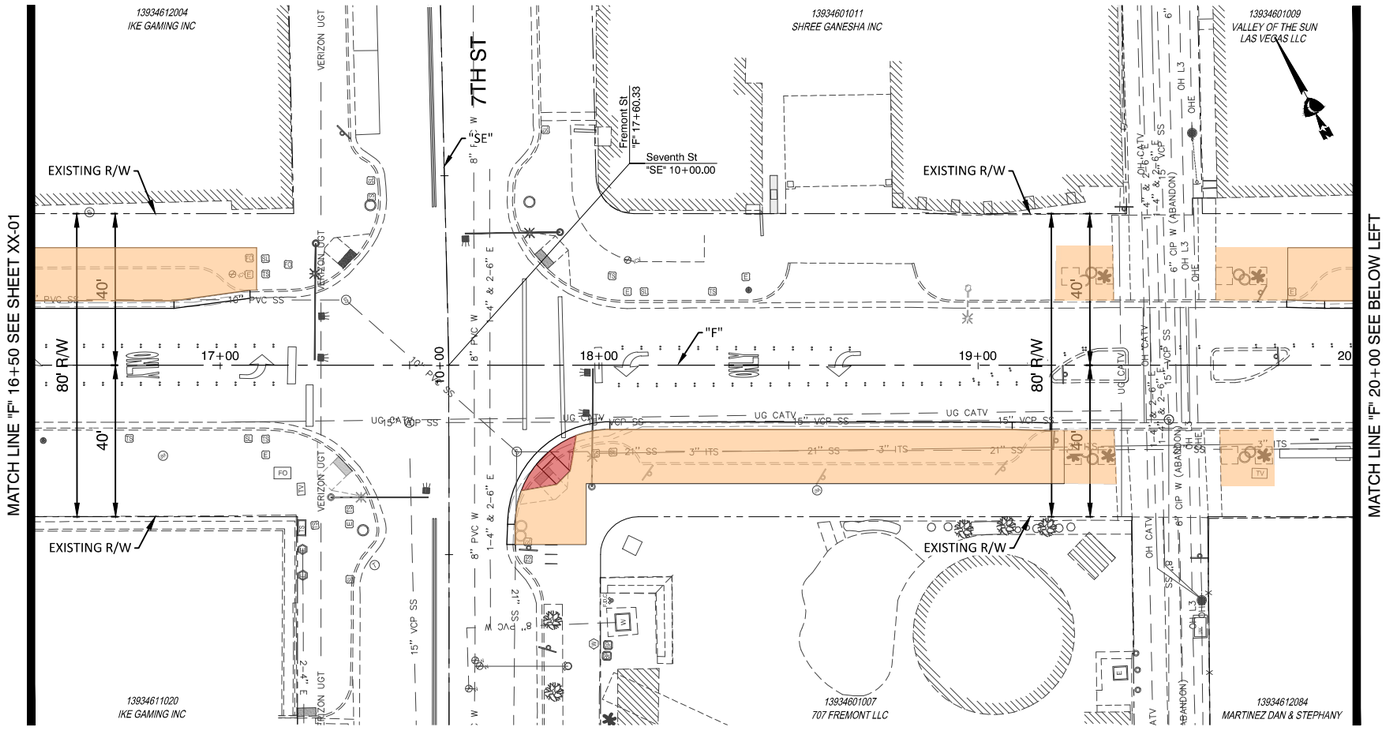
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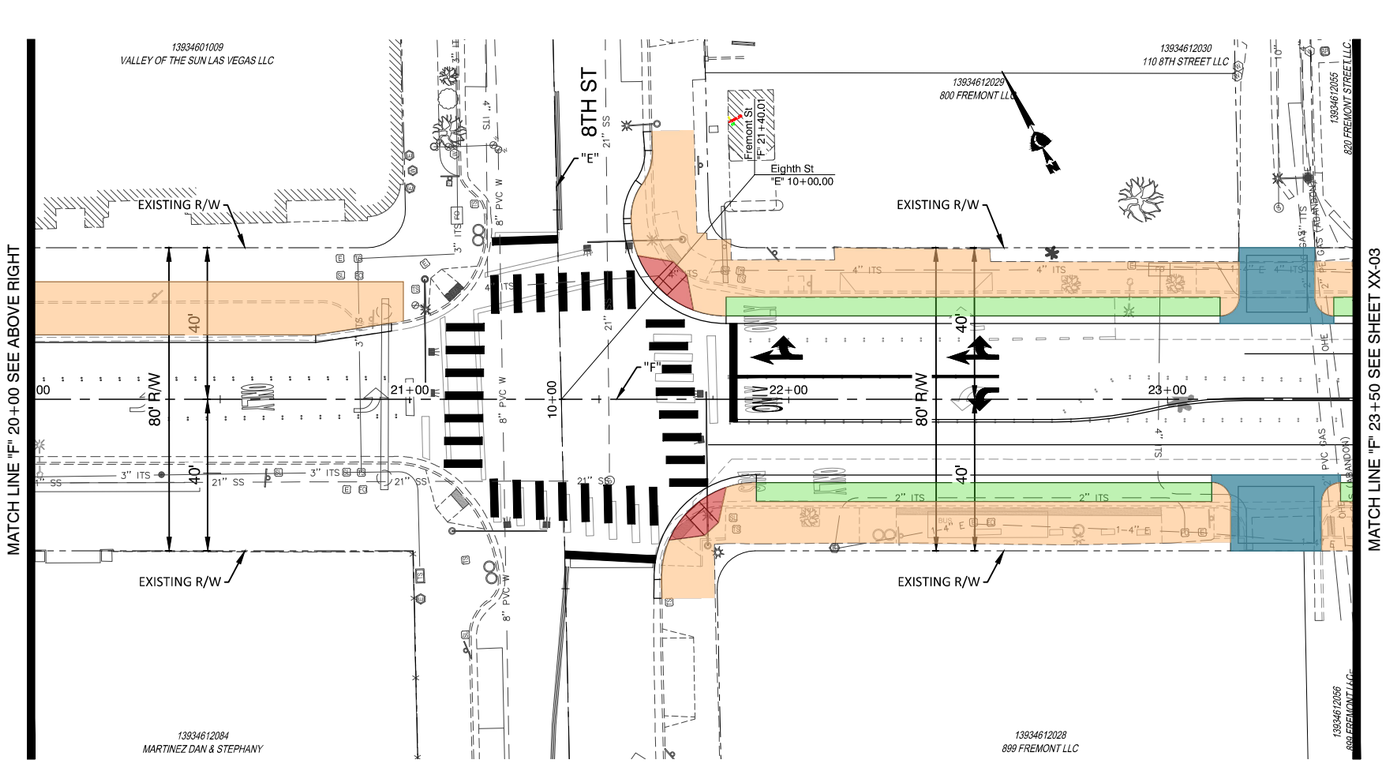
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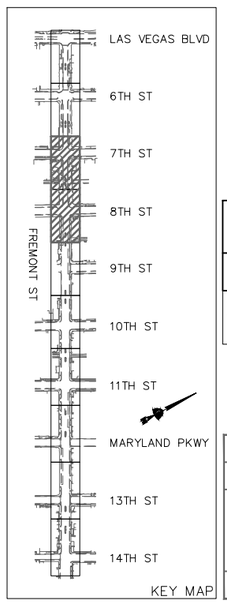
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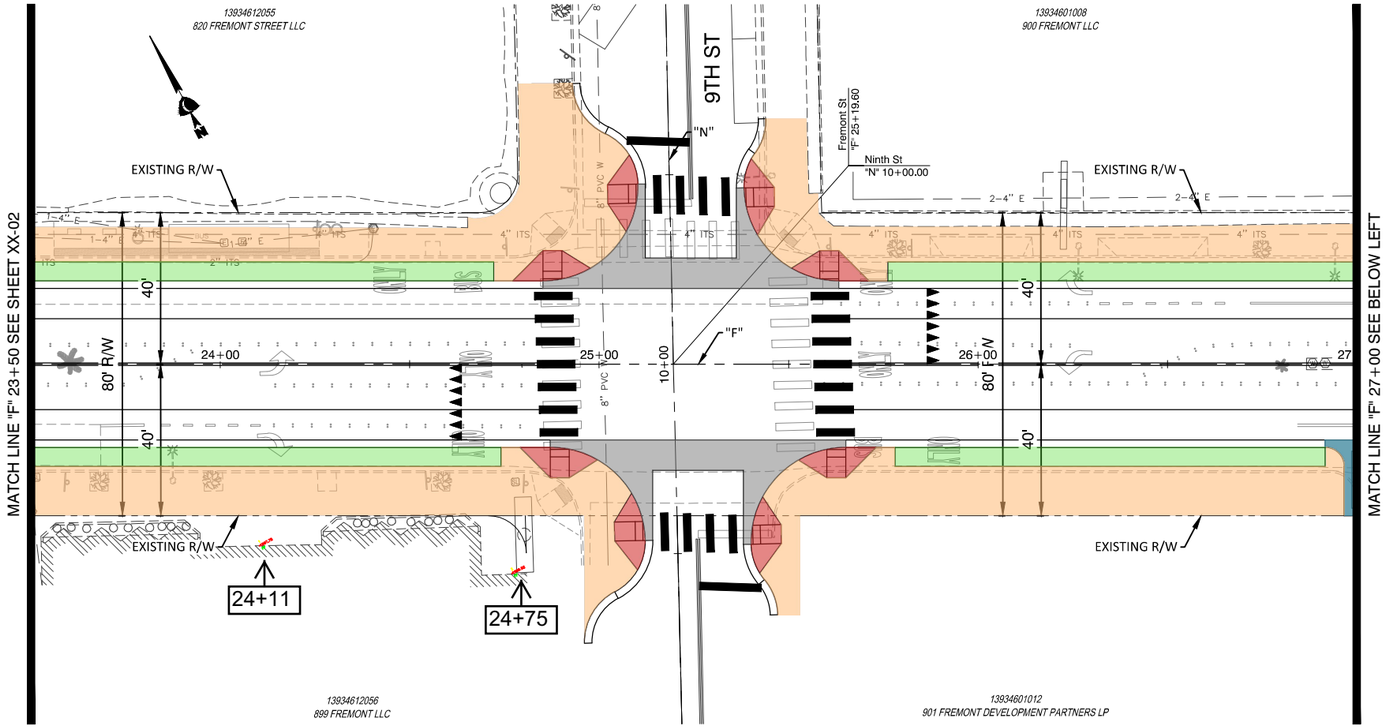
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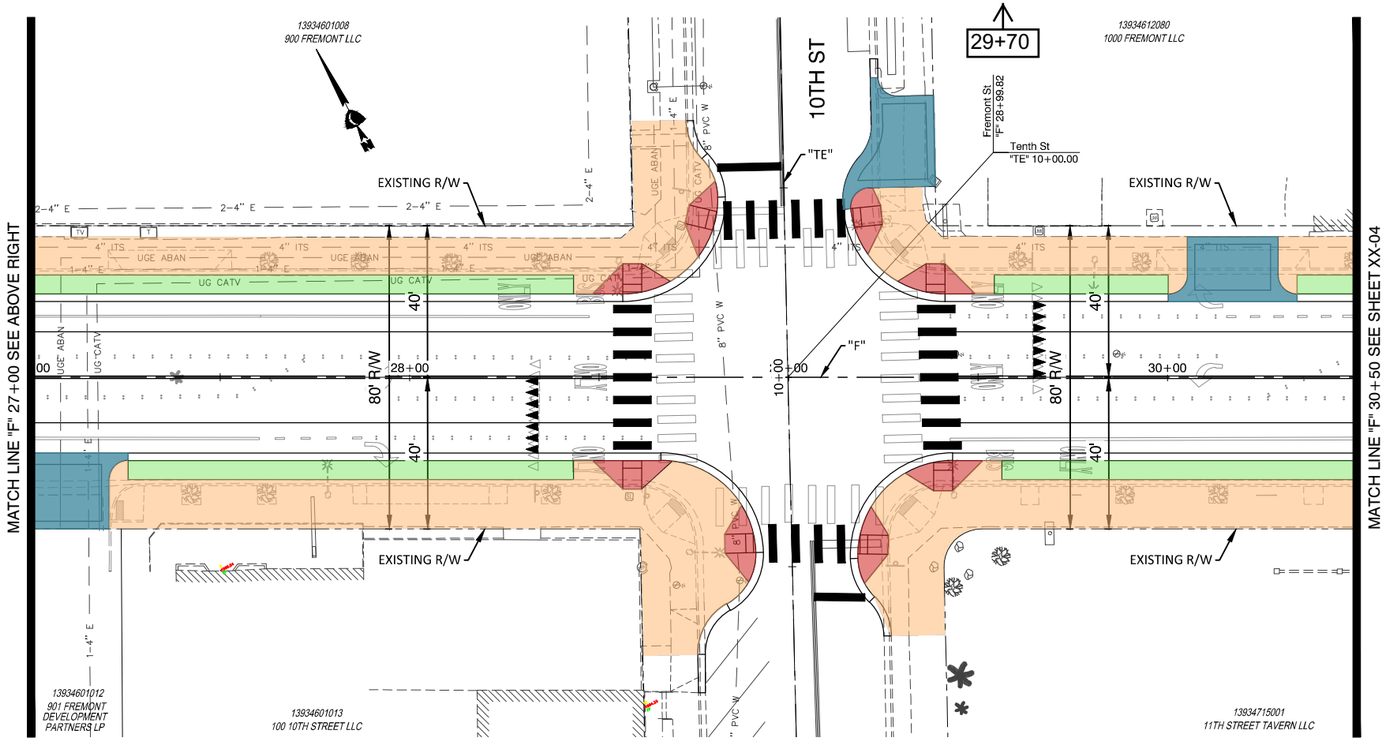
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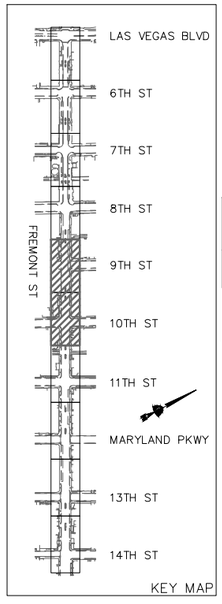
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1" = 20'

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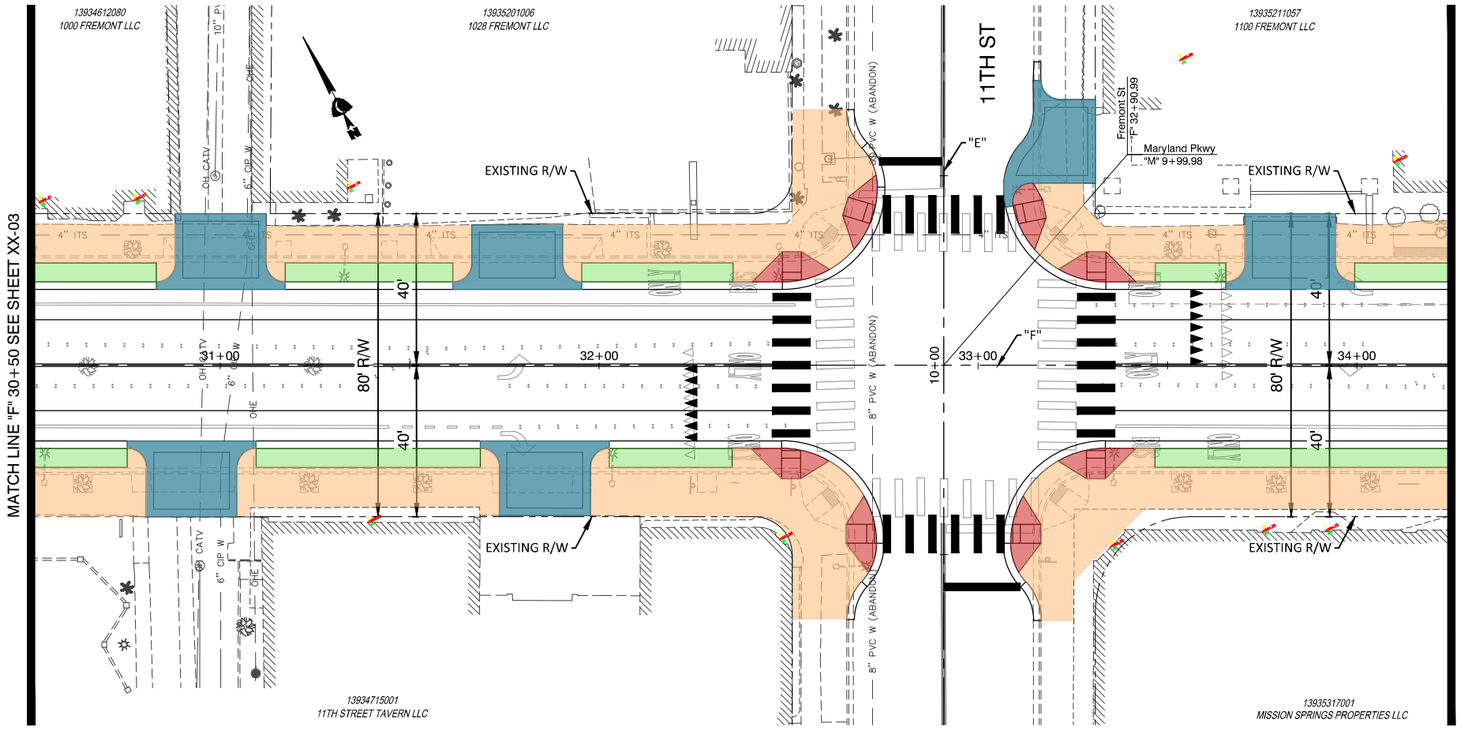
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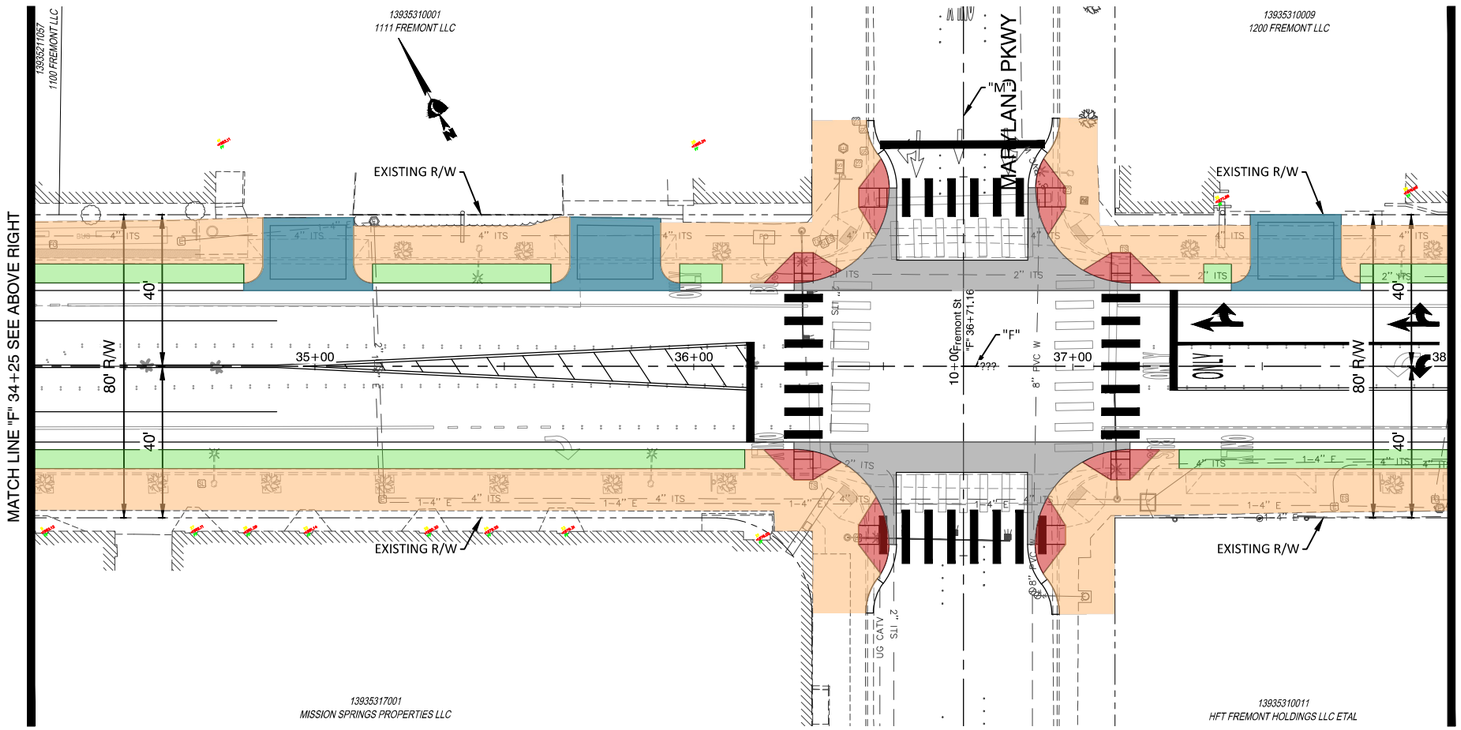
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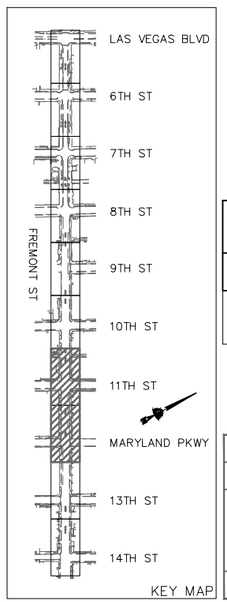
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GRAPHIC SCALE

20 0 10 20 40

1" = 20'

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PROJECT
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LAS VEGAS BLVD TO 14TH ST

TITLE
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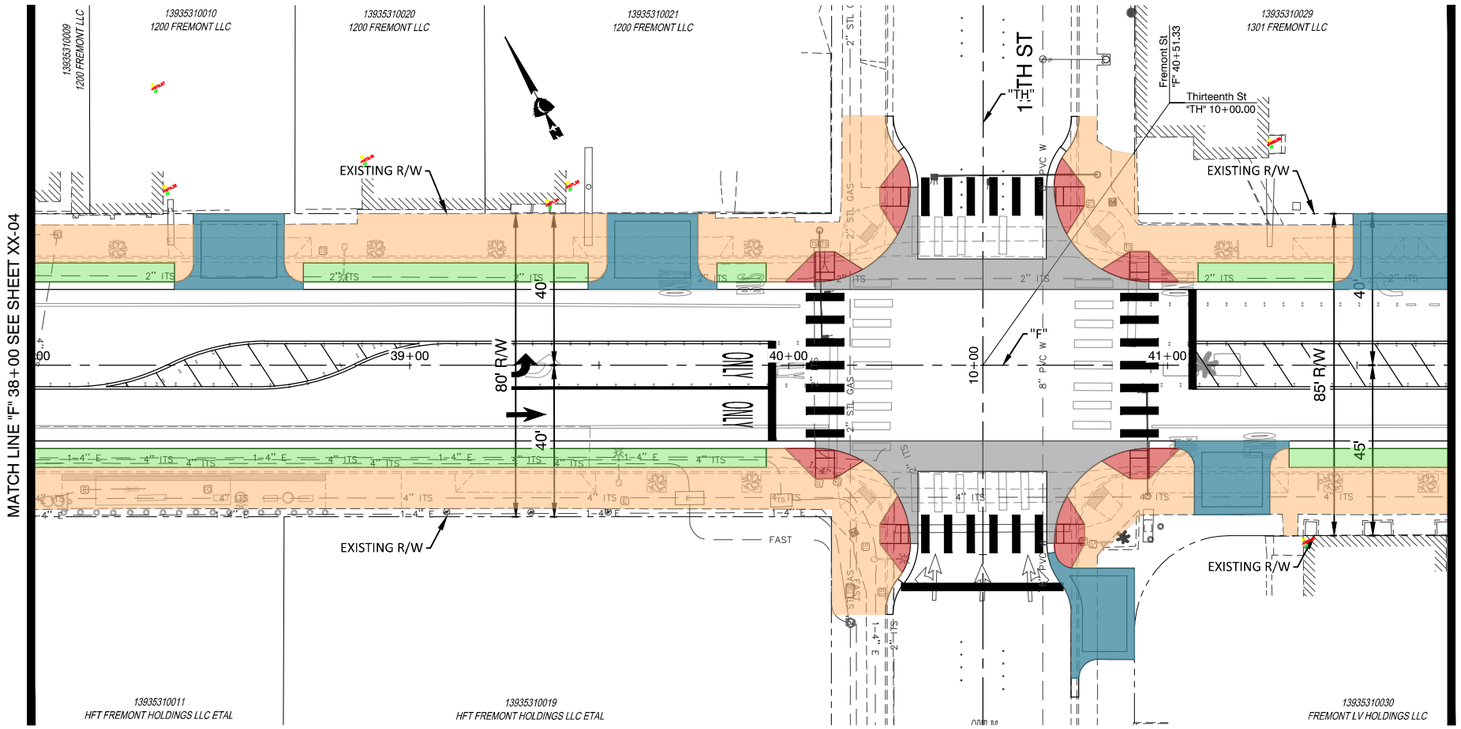
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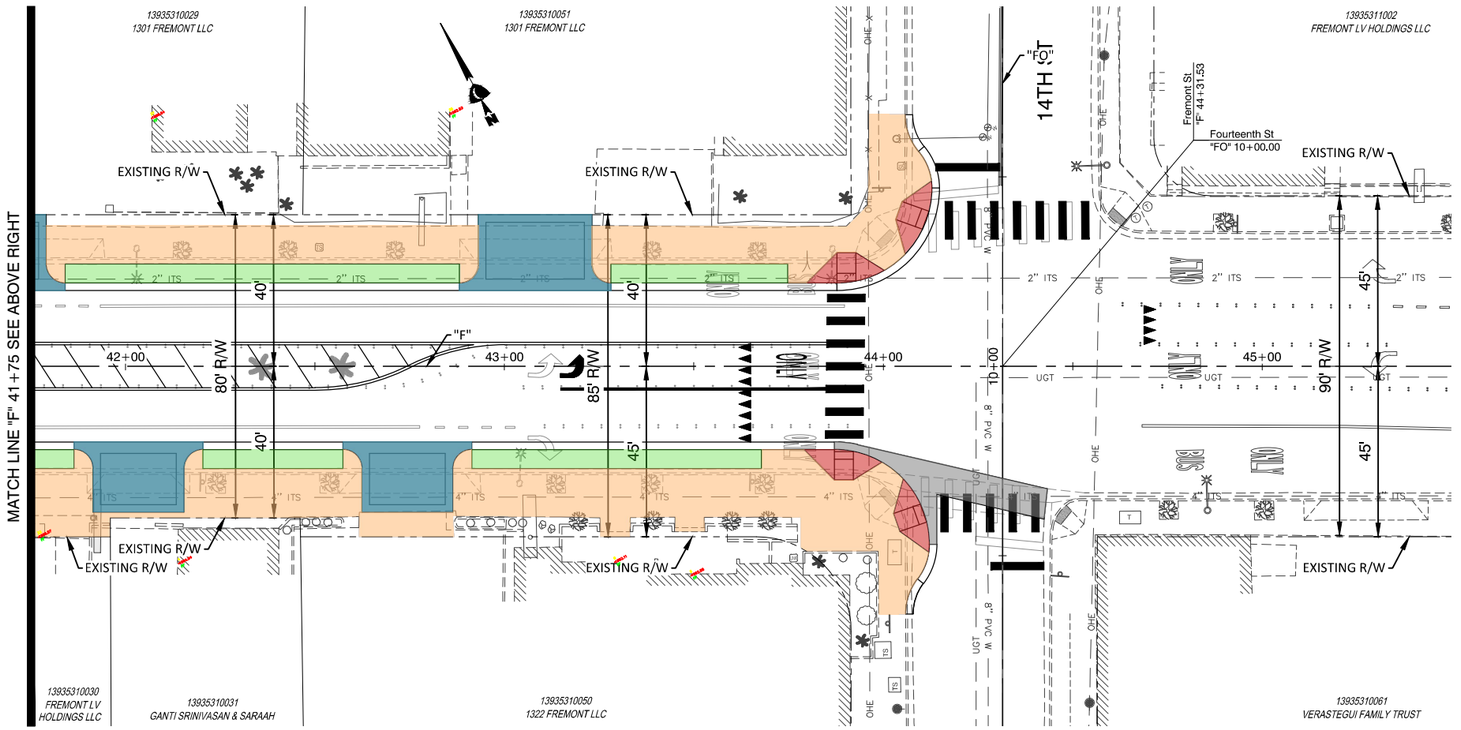
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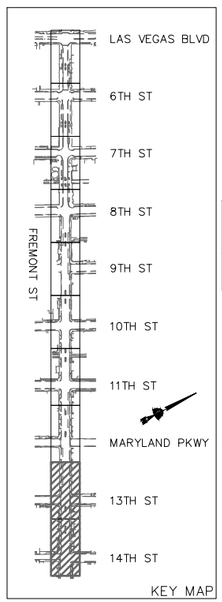
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GRAPHIC SCALE

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1" = 20'

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LAS VEGAS BLVD TO 14TH ST

TITLE
TEMPLATE PLAN
"F" 38+00.00 TO "F" 45+50.00

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Appendix C2:
Flamingo - Boulder Hwy North, Charleston – Maryland To Boulder Hwy And Maryland Pkwy System, Preliminary Design Report (Charleston/Maryland Drainage Report) & Maryland Stormdrain Improvement Plans

Flamingo – Boulder Hwy North Charleston – Maryland to Boulder Hwy and Maryland Parkway System
(Charleston/Maryland Storm Drain)

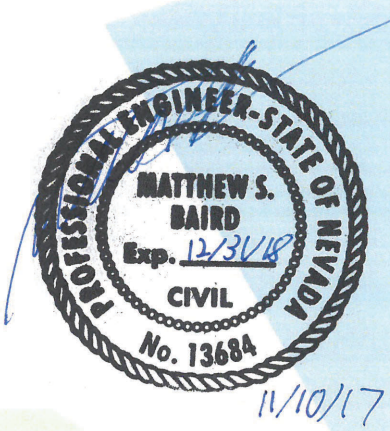
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Preliminary Design Report (Volume 1)
30% Plans (Volume 2)

November 10, 2017

Prepared for the City of Las Vegas





2.5.6. Las Vegas Blvd. Flow Diversion

There is a diversion in the hydrologic models for MPU subbasin CH59-C. This diversion was included in the 2008 MPU model. The diversion was based on the estimated capacity of the existing storm drain facilities in the downtown area, which convey flow north in Las Vegas Boulevard to the Washington Avenue Channel (LVWH 0305). Therefore, flow in this storm drain is not tributary to the CMSD. The flow not collected by this local storm drain is conveyed on the roadway surface into the CMSD watershed.

During the design process CLV informed Atkins that the Las Vegas Boulevard storm drain is being redesigned/reconstructed and upgraded. The new design/configuration for the storm drain is to collect the 10-year flow impacting Las Vegas Boulevard from the west. The new storm drain will collect the 10-year flow between Carson Avenue and Charleston Boulevard. The existing storm drain north of Carson will continue to collect flow and convey in north out of the CMSD watershed. The new storm drain in Las Vegas Boulevard from Carson to Charleston will have two outfalls to the east in Bonneville Avenue and Bridger Avenue. These storm drains are to be connected to the Maryland Parkway System at Maryland Parkway and 9th Street respectively.

As part of this project, the flow diversion for MPU subbasin CH59-C is updated to reflect the construction of the planned Las Vegas Boulevard storm drain. The 10-year flows in Las Vegas Boulevard at Fremont Street, Ogden Avenue, and Stewart Avenue are diverted out the hydrologic model to reflect the collection of flow by the existing storm drain north of Carson Ave. The new diverted flow is 83 cfs. The original 2008 MPU diversion was 222 cfs.

The design report from the Las Vegas Boulevard storm drain improvements was not complete at the time of this report. The diversion and design flows will be reassessed and updated as more information is made available on the new Las Vegas Boulevard storm drain.

2.6. Hydrologic Analysis Results

The 100-year peak flows from the ultimate condition HEC-1 model for the subbasins, diversions, and combination points are summarized on the Hydrologic Summary Maps (**Figure 4** and **Figure 5**) at the end of this section. **Table 1** below summarizes the main design flows at key locations. It is important to note that there are several differences between the ultimate condition design flow developed for this project and the 2008 MPU as discussed in the sections above. The primary differences are summarized as follows:

1. Design hydrology is using the 2014 soils consistent with 2018 MPU and generally produces a minor decrease in peak flows for the CMSD watershed when compared to the 2008 MPU.
2. Design hydrology is using the 2018 MPU land use categories and associated breakdown of % impervious, grass and desert, which generally produces a decrease in peak flows for the CMSD watershed.
3. Design hydrology has incorporated the proposed Las Vegas Boulevard storm drain, see **Section 2.5.6.**, which produces an increase in peak flows for the CMSD watershed.

Items 1 through 3 above are included in the Ultimate Condition Design Flow in the table below and these are the flows used for the design and associated 30% plans included in this submittal. The

Charleston/Maryland Storm Drain
Figure 5: Hydrology Summary Map - Collection

Legend

- Combination Point
- Proposed Lateral Storm Drain
- Proposed Main Line
- Mainline Designed with PH 1
- Future Mainline Storm Drain PH 3
- Existing MPU Facilities
- Future MPU Facilites
- Subbasins
- Existing 5' Contours

Diversions

- BONN
- BRIDGER
- LEAVES
- BONN
- BRIDGER
- LEAVES

MainlineSubbasins

Collection

- To Boulder Highway Storm Drain (Phase 1)
- To Charleston Storm Drain
- To Eastern North Lateral
- To Eastern South Lateral
- To Maryland Storm Drain

0 600 1,200 Feet

1 inch = 600 feet

N

ATKINS

Subbasin	Area (sq mi)	100-yr Flow (cfs)
CH51	0.27	287
52-6	0.14	173
52-4	0.01	17
52-5	0.11	147
56-7	0.02	28
56-1	0.01	18
56-2	0.02	33
52-2	0.03	44
52-3	0.02	26
60A-11	0.01	19
56-3	0.65	38
52-1	0.04	56
60A-10	0.02	31
56-4	0.03	37
59-8	0.04	61
60A-8	0.06	90
59-9	0.03	42
60A-9	0.04	52
59-7	0.03	37
60A-7	0.05	65
59-6	0.03	46
60A-6	0.04	54
59-5	0.04	55
60A-5	0.05	76
59-1	0.05	76
60A-1	0.05	72
59-2	0.03	45
60A-2	0.03	43
59-3	0.03	49
60A-3	0.03	46
59-4	0.03	50
60A-4	0.06	77
68A	0.03	32
56-8	0.05	63
56-9	0.07	82
56-6	0.05	65
56-5	0.06	79
63-1	0.01	23
63-2	0.04	49
63-6	0.05	60
68-7	0.01	22
63-3	0.02	18
63-5	0.05	36
63-6	<0.01	36
67-5	0.03	23
68-3	0.04	43
68-5	0.02	13
68-3A	0.01	18
68-8	0.01	14
68-4	0.03	24
68-6	0.02	18
68-9	0.01	14
63-4	0.03	53
67-3	0.05	34
67-2	0.04	41
63-4A	0.01	22
67-1	0.04	37
68-2	0.04	60
68-1	0.04	66
68-10	0.05	84
68-11	0.02	27
68-12	0.01	9
FR04-C1	<0.01	7

Combination Point	Area (sq mi)	100-yr Flow (cfs)
CSC7	0.42	450
CSC8	0.54	585
CSC1	0.57	616
52-23	0.05	70
CSC2A	0.06	51
CSC2	0.65	686
CSC3A	0.06	50
CSC3	0.74	752
CSC4	0.77	771
C60A-8	0.17	177
C60A-7	0.07	87
ALL	<0.01	115
BONN	0.24	366
C60A-5	0.09	87
C60A-1	0.10	99
C60A-2	0.06	59
CC60A-2	0.16	156
C60A-3	0.06	61
CC60A-3	0.23	216
C60A-4	0.09	90
CC60A-4	0.32	296
MDBRGR	<0.01	93
BRIDGER	0.41	473
LEWIS	0.49	516
BONN2	0.75	887
CSC5	0.18	198
CSC5A	0.24	258
CSC6	1.76	1818
C63-2	1.88	1849
C67-5	0.03	55
C67-5A	0.08	55
C63-5A	1.98	1872
C68-5	0.08	71
C63-5	2.06	1857
C68-6	0.06	40
CC68-9	2.13	1881
C63-4	2.16	1900
C67-3	0.05	65
C67-2	0.09	102
C63A	0.05	58
C67-1A	0.14	151
C68-2	0.08	126
C68-10	0.13	195
C67-1	2.45	2155
CFINAL	2.46	2151

Diversion	Area (sq mi)	100-yr Flow (cfs)
DC52-2	0.05	36
DC52-1	0.04	29
DC9	0.03	21
DC8	0.04	30
DC7	0.03	18
DC6	0.03	23
DC5	0.04	27
DC4	0.03	25
DC3	0.03	24
DC2	0.03	22
DC1	0.05	38

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1****************************************                    ****************************************
 *                                      *                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                    *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1               *                    *          609 SECOND STREET           *
 *                                      *                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   10NOV17  TIME  10:24:05  *                    *           (916) 756-1104             *
 *                                      *                    *                                      *
 ****************************************                    ****************************************

                                        X     X  XXXXXXX   XXXXX           X
                                        X     X  X        X     X         XX
                                        X     X  X        X               X
                                        XXXXXXX  XXXX     X        XXXXX   X
                                        X     X  X        X               X
                                        X     X  X        X     X         X
                                        X     X  XXXXXXX   XXXXX          XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                  HEC-1 INPUT                                                  PAGE  1

          LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

                         *DIAGRAM
 *** FREE ***
              1          ID  CHARLESTON STORM DRAIN
              2          ID  WASH
              3          ID  INPUT FILE ULT.PRN (SERIES A)
              4          ID  DESIGN STORM 100-YEAR 6 HOUR
              5          ID  MODELED BY ATKINS (DREW MCINNIS)
              6          ID
              7          ID    AREA (SQUARE MILES)       DARF
              8          ID
              9          ID         0 - 0.5              0.99
             10          ID         0.5 - 1              0.975
             11          ID         1 - 2                0.95
             12          ID         2 - 3                0.925
             13          ID
             14          IT       5       0       0     300
             15          IO       5       0       0
             16          IN       5       0       0
             17          JR    PREC    0.99   0.975    0.95   0.925    0.57
                         *

             18          KK    CH51
             19          BA 0.27275
             20          PB    2.77
             21          PC   0.000   0.020   0.057   0.070   0.087   0.108   0.124   0.130   0.130   0.130
             22          PC   0.130   0.130   0.130   0.133   0.140   0.142   0.148   0.158   0.172   0.181
             23          PC   0.190   0.197   0.199   0.200   0.201   0.204   0.214   0.229   0.241   0.249
             24          PC   0.251   0.256   0.270   0.278   0.281   0.283   0.295   0.322   0.352   0.409
             25          PC   0.499   0.590   0.710   0.744   0.781   0.812   0.819   0.835   0.851   0.856
             26          PC   0.860   0.868   0.876   0.888   0.910   0.926   0.937   0.950   0.970   0.976
             27          PC   0.982   0.985   0.987   0.989   0.990   0.993   0.993   0.994   0.995   0.998
             28          PC   0.998   0.999   1.000
             29          LS       0    92.3
             30          UD   0.392
                         *

             31          KK   RCH51
             32          KM  ROUTE TO CSC7
             33          RD    2448   0.010   0.015       0    TRAP       7       0
                         *

             34          KK    52-6
             35          BA 0.14266
             36          PB    2.77
             37          LS       0    94.1
             38          UD   0.337
                         *

             39          KK    CSC7
             40          HC       2
                         *
1                                                  HEC-1 INPUT                                                  PAGE  2
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  41          KK   RCSC7
  42          KM  ROUTE TO CSC8
  43          RD    1306   0.010   0.016       0    TRAP       7       0
              *

  44          KK    52-4
  45          BA 0.01105
  46          PB    2.77
  47          LS       0    93.7
  48          UD   0.193
              *

  49          KK    52-5
  50          BA 0.11460
  51          PB    2.77
  52          LS       0    93.9
  53          UD   0.286
              *

  54          KK    CSC8
  55          HC       3
              *

  56          KK   RCSC8
  57          KM  ROUTE TO CSC1
  58          RD     854   0.010   0.015       0    TRAP       7       0
              *

  59          KK    56-7
  60          BA 0.01940
  61          PB    2.77
  62          LS       0    94.1
  63          UD   0.210
              *

  64          KK   R56-7
  65          KM  ROUTE TO CSC1
  66          RD    1124   0.009   0.015       0    TRAP       7       0
              *

  67          KK    56-1
  68          BA 0.01074
  69          PB    2.77
  70          LS       0    94.1
  71          UD   0.122
              *

  72          KK    CSC1
  73          HC       3
              *
1                                        HEC-1 INPUT                                          PAGE  3

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  74          KK   RCSC1
  75          KM  ROUTE TO CSC2
  76          RD     413   0.009   0.015       0    TRAP       7       0
              *

  77          KK    56-2
  78          BA 0.02410
  79          PB    2.77
  80          LS       0    92.1
  81          UD   0.204
              *

  82          KK    52-2
  83          BA 0.02959
  84          PB    2.77
  85          LS       0    95.0
  86          UD   0.213
              *

  87          KK    52-3
  88          BA 0.01761
  89          PB    2.77
  90          LS       0    94.9
  91          UD   0.207
              *

  92          KK   R52-3
  93          KM  ROUTE TO 52-23
  94          RD     514   0.010   0.016       0    TRAP       0      50
              *
```

```
             95          KK   52-23
             96          HC       2
                         *

             97          KK   D52-2
             98          KM  DIVERT 10 YEAR FLOW BONNEVILLE
             99          DT  DC52-2
            100          DI       0      36     200
            101          DQ       0      36      36
                         *

            102          KK   R52-2
            103          KM  ROUTE 52-2 TO CSC2
            104          RD     947   0.011   0.016       0    TRAP       0      50
                         *

            105          KK  60A-11
            106          BA 0.01126
            107          PB    2.77
            108          LS       0    94.0
            109          UD   0.111
                         *
1                                        HEC-1 INPUT                                        PAGE  4

           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            110          KK   CSC2A
            111          HC       2
                         *

            112          KK    CSC2
            113          HC       3
                         *

            114          KK   RCSC2
            115          KM  ROUTE TO CSC3
            116          RD     703   0.009   0.016       0    TRAP       0      50
                         *

            117          KK    56-3
            118          BA 0.02923
            119          PB    2.77
            120          LS       0    90.4
            121          UD   0.198
                         *

            122          KK    52-1
            123          BA 0.03804
            124          PB    2.77
            125          LS       0    95.0
            126          UD   0.214
                         *

            127          KK   D52-1
            128          KM  DIVERT 10 YEAR FLOW BONNEVILLE
            129          DT  DC52-1
            130          DI       0      29     200
            131          DQ       0      29      29
                         *

            132          KK   R52-1
            133          KM  ROUTE 52-1 TO CSC3
            134          RD    1716   0.014   0.016       0    TRAP       0      50
                         *

            135          KK  60A-10
            136          BA 0.01959
            137          PB    2.77
            138          LS       0    93.8
            139          UD   0.170
                         *

            140          KK   CSC3A
            141          KM  COMBINE  R52-1 AND 60A-10
            142          HC       2
                         *
1                                        HEC-1 INPUT                                        PAGE  5

           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            143          KK    CSC3
            144          KM  COMBINE RCSC2, 56-3, AND CSC3A
            145          HC       3
                         *

            146          KK   RCSC3
            147          KM  ROUTE TO CSC4
            148          RD     659   0.011   0.016       0    TRAP       0      50
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                *
149             KK    56-4
150             BA 0.02833
151             PB    2.77
152             LS       0    89.5
153             UD   0.191
                *

154             KK    CSC4
155             HC       2
                *

156             KK   RCSC4
157             KM  ROUTE TO CSC6
158             RD    1152   0.018   0.016       0    TRAP       0      50
                *

159             KK    59-8
160             BA 0.04137
161             PB    2.77
162             LS       0    93.9
163             UD   0.203
                *

164             KK   D59-8
165             KM  DIVERT 10 YEAR FLOW BONNEVILLE
166             DT     DC8
167             DI       0      30     200
168             DQ       0      30      30
                *

169             KK   R59-8
170             KM  ROUTE 59-8 TO C60A-8
171             RD    2638   0.012   0.015       0    TRAP       0      50
                *

172             KK   60A-8
173             BA 0.06413
174             PB    2.77
175             LS       0    92.4
176             UD   0.201
                *
1                                       HEC-1 INPUT                                          PAGE  6

            LINE        ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

177             KK    59-9
178             BA 0.02696
179             PB    2.77
180             LS       0    94.3
181             UD   0.189
                *

182             KK   D59-9
183             KM  DIVERT 10 YEAR FLOW GARCES TO BONNEVILLE
184             DT     DC9
185             DI       0      21     200
186             DQ       0      21      21
                *

187             KK   R59-9
188             KM  ROUTE 59-9 TO CSC4
189             RD    2267   0.012   0.015       0    TRAP       0      50
                *

190             KK   60A-9
191             BA 0.03644
192             PB    2.77
193             LS       0    92.6
194             UD   0.198
                *

195             KK  C60A-8
196             KM  COMBINE R59-8 AND 60A-8
197             KM  SURFACE FLOW AT MARYLAND/BONNEVILLE
198             HC       4
                *

199             KK    59-7
200             BA 0.02574
201             PB    2.77
202             LS       0    93.8
203             UD   0.211
                *

204             KK   D59-7
205             KM  DIVERT 10 YEAR FLOW CLARK TO BRIDGER
206             DT     DC7
```

```
          207          DI       0      18     200
          208          DQ       0      18      18
                       *

          209          KK   R59-7
          210          KM  ROUTE 59-7 TO C60A-7
          211          RD    2638   0.014   0.016       0    TRAP       0      50
                       *
1                                        HEC-1 INPUT                                                PAGE  7

          LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


          212          KK    59-6
          213          BA 0.03196
          214          PB    2.77
          215          LS       0    94.1
          216          UD   0.217
                       *

          217          KK   D59-6
          218          KM  DIVERT 10 YEAR FLOW BRIDGER
          219          DT     DC6
          220          DI       0      23     200
          221          DQ       0      23      23
                       *

          222          KK   R59-6
          223          KM  ROUTE 59-6 TO C60A-6
          224          RD    2685   0.014   0.016       0    TRAP       0      50
                       *

          225          KK   60A-7
          226          BA 0.04898
          227          PB    2.77
          228          LS       0    89.7
          229          UD   0.187
                       *

          230          KK  C60A-7
          231          KM  COMBINE R59-7 AND 60A-7
          232          KM  SURFACE FLOW AT MARYLAND/CLARK
          233          HC       3
                       *

          234          KK  RCLARK
          235          KM  48RCP TO BONNEVILLE
          236          RD     462   0.010   0.014       0    CIRC       4       0
                       *

          237          KKBONNEVILLE
          238          DR     DC8
                       *

          239          KK  GARCES
          240          DR     DC9
                       *

          241          KK    GASS
          242          DR  DC52-1
                       *
1                                        HEC-1 INPUT                                                PAGE  8

          LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


          243          KK  HOOVER
          244          DR  DC52-2
                       *

          245          KK     ALLBONNEVILLE
          246          KM  ALL FLOW IN FUTURE 10-YR
          247          KM  BONNEVILLE STORM DRAIN
          248          HC       4
                       *

          249          KK    BONN
          250          KM  TOTAL FLOW AT BONNEVILLE
          251          HC       3
                       *

          252          KK   RBONN
          253          KM  ROUTET TO BONN2
          254          RD     373   0.010   0.014       0    TRAP       6       0
                       *

          255          KK   60A-6
          256          KM  SURFACE FLOW AT MARYLAND/LEWIS
          257          BA 0.04128
          258          PB    2.77
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```
 259          LS       0    89.7
 260          UD   0.192
              *

 261          KK    59-5
 262          BA 0.03797
 263          PB    2.77
 264          LS       0    94.1
 265          UD   0.214
              *

 266          KK   D59-5
 267          KM  DIVERT 10 YEAR FLOW BRIDGER
 268          DT     DC5
 269          DI       0      27     200
 270          DQ       0      27      27
              *

 271          KK   R59-5
 272          KM  ROUTE 59-5 TO C60A-5
 273          RD    2663   0.015   0.016       0    TRAP       0      50
              *

 274          KK   60A-5
 275          BA 0.05469
 276          PB    2.77
 277          LS       0    90.6
 278          UD   0.181
              *
1                                        HEC-1 INPUT                                        PAGE  9

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 279          KK  C60A-5
 280          KM  BRIDGER SURFACE FLOW
 281          KM  COMBINE R59-5 AND 60A-5
 282          HC       2
              *

 283          KK    59-1
 284          BA 0.05386
 285          PB    2.77
 286          LS       0    93.6
 287          UD   0.218
              *

 288          KK   D59-1
 289          KM  DIVERT 10 YEAR FLOW NORTH
 290          DT     DC1
 291          DI       0      38     200
 292          DQ       0      38      38
              *

 293          KK   R59-1
 294          KM  ROUTE 59-1 TO C60A-1
 295          RD    2653   0.010   0.016       0    TRAP       0      50
              *

 296          KK   60A-1
 297          BA 0.04930
 298          PB    2.77
 299          LS       0    94.8
 300          UD   0.225
              *

 301          KK  C60A-1
 302          KM  COMBINE R59-1 AND 60A-1
 303          HC       2
              *

 304          KK RC60A-1
 305          KM  ROUTE C60A-1 TO CC60A-2
 306          RD     486   0.008   0.013       0    CIRC     4.5       0
              *

 307          KK    59-2
 308          BA 0.03076
 309          PB    2.77
 310          LS       0    93.8
 311          UD   0.203
              *
1                                        HEC-1 INPUT                                        PAGE 10

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 312          KK   D59-2
 313          KM  DIVERT 10 YEAR FLOW NORTH
 314          DT     DC2
```

```
 315           DI       0      22     200
 316           DQ       0      22      22
               *

 317           KK   R59-2
 318           KM  ROUTE 59-2 TO C60A-2
 319           RD    2655   0.009   0.016       0    TRAP       0      50
               *

 320           KK   60A-2
 321           BA 0.02992
 322           PB    2.77
 323           LS       0    94.3
 324           UD   0.232
               *

 325           KK  C60A-2
 326           KM  COMBINE R59-2 AND 60A-2
 327           HC       2
               *

 328           KK CC60A-2
 329           KM  COMBINE C60A-2 AND C60A-1
 330           HC       2
               *

 331           KKRCC60A-2
 332           KM  ROUTE CC60A-2 CC60A-3
 333           RD     315   0.008   0.015       0    TRAP       7       0
 334           RD     165   0.003   0.015       0    TRAP       7       0
               *

 335           KK    59-3
 336           BA 0.03367
 337           PB    2.77
 338           LS       0    93.9
 339           UD   0.210
               *

 340           KK   D59-3
 341           KM  DIVERT 10 YEAR FLOW NORTH
 342           DT     DC3
 343           DI       0      24     200
 344           DQ       0      24      24
               *
1                                        HEC-1 INPUT                                                PAGE 11

 LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 345           KK   R59-3
 346           KM  ROUTE 59-3 TO C60A-3
 347           RD    2640   0.012   0.016       0    TRAP       0      50
               *

 348           KK   60A-3
 349           BA 0.03114
 350           PB    2.77
 351           LS       0    93.6
 352           UD   0.198
               *

 353           KK  C60A-3
 354           KM  COMBINE R59-3 AND 60A-3
 355           HC       2
               *

 356           KK CC60A-3
 357           KM  COMBINE C60A-3 AND RCC60A-2
 358           HC       2
               *

 359           KKRCC60A-3
 360           KM  ROUTE CC60A-3 TO CC60A-4
 361           RD     480   0.003   0.015       0    TRAP      12       0
               *

 362           KK    59-4
 363           BA 0.03386
 364           PB    2.77
 365           LS       0    94.0
 366           UD   0.200
               *

 367           KK   D59-4
 368           KM  DIVERT 10 YEAR FLOW CARSON
 369           DT     DC4
 370           DI       0      25     200
 371           DQ       0      25      25
               *
```

```
          372          KK   R59-4
          373          KM  ROUTE 59-4 TO C60A-4
          374          RD    2643   0.013   0.016       0    TRAP       0      50
                       *

          375          KK   60A-4
          376          BA 0.05659
          377          PB    2.77
          378          LS       0    91.0
          379          UD   0.193
                       *
1                                        HEC-1 INPUT                                                PAGE 12

         LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


          380          KK  C60A-4
          381          KM  COMBINE R59-4 AND 60A-4
          382          HC       2
                       *

          383          KK CC60A-4
          384          KM  COMBINE RCC60A-3 AND C60A-4
          385          HC       2
                       *

          386          KKRCC60A-4
          387          KM  ROUTE CC60A-4 TO C101B
          388          RD     480   0.009   0.015       0    TRAP      12       0
                       *

          389          KK  CARSON
          390          DR     DC4
                       *

          391          KK BRIDGER
          392          DR     DC5
                       *

          393          KK  DUMMY1
          394          KM  DIVERTED 10 YR FLOW IN FUTURE BRIDGER STORM DRAIN
          395          HC       2
                       *

          396          KK   LEWIS
          397          DR     DC6
                       *

          398          KK   CLARK
          399          DR     DC7
                       *

          400          KK  MDBRGR
          401          KM  DIVERTED 10 YR FLOW IN FUTURE BRIDGER STORM DRAIN
          402          HC       3
                       *

          403          KK BRIDGER
          404          KM  TOTAL FLOW AT BRIDGER
          405          HC       3
                       *

          406          KK   LEWIS
          407          KM  TOTAL FLOW AT LEWIS
          408          HC       2
                       *
1                                        HEC-1 INPUT                                                PAGE 13

         LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


          409          KK  RLEWIS
          410          KM  14X4 ROUTE TO BONN2
          411          RD    1314   0.003   0.015       0    TRAP      14       0
                       *

          412          KK     68A
          413          BA 0.02536
          414          PB    2.77
          415          LS       0    89.8
          416          UD   0.205
                       *

          417          KK   BONN2
          418          KM  CHECK FOR THE LEWIS AND CLARK
          419          HC       3
                       *

          420          KK    56-8
```

```
 421          BA 0.05075
 422          PB    2.77
 423          LS       0    90.1
 424          UD   0.228
              *

 425          KK   R56-8
 426          KM  ROUTE TO CSC5
 427          RD    2722   0.009   0.016       0    TRAP       0      50
              *

 428          KK    56-9
 429          BA 0.07137
 430          PB    2.77
 431          LS       0    89.3
 432          UD   0.258
              *

 433          KK   R56-9
 434          KM  ROUTE TO CSC5
 435          RD     791   0.004   0.016       0    TRAP       0      50
              *

 436          KK    56-6
 437          BA 0.05401
 438          PB    2.77
 439          LS       0    89.4
 440          UD   0.231
              *

 441          KK    CSC5
 442          HC       3
              *
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 443          KK   RCSC5
 444          KM  ROUTE TO CSC6
 445          RD    1276   0.012   0.013       0    CIRC     5.5       0
              *

 446          KK    56-5
 447          BA 0.06029
 448          PB    2.77
 449          LS       0    89.6
 450          UD   0.188
              *

 451          KK   CSC6A
 452          HC       2
              *

 453          KK    CSC6
 454          HC       3
              *

 455          KK   R63-6
 456          KM  ROUTE TO C67-5
 457          RD    1508   0.020   0.016       0    TRAP       0      50
              *

 458          KK    63-1
 459          BA 0.01337
 460          PB    2.77
 461          LS       0    93.8
 462          UD   0.110
              *

 463          KK    63-2
 464          BA 0.04040
 465          PB    2.77
 466          LS       0    86.1
 467          UD   0.157
              *

 468          KK    63-6
 469          BA 0.05438
 470          PB    2.77
 471          LS       0    86.6
 472          UD   0.205
              *

 473          KK   D63-6
 474          KM  DIVERT 60% FLOW
 475          DT   D63-6
 476          DI       0      40      80    1000
 477          DQ       0      24      48     600
              *
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 478          KK   R63-6
 479          KM  ROUTE TO C67-5
 480          RD    1508   0.020   0.016       0    TRAP       0      50
              *

 481          KK    68-7
 482          BA 0.01190
 483          PB    2.77
 484          LS       0    93.0
 485          UD   0.087
              *

 486          KK   C63-2
 487          HC       5
              *

 488          KK  RC63-2
 489          KM  ROUTE TO C63-5
 490          RD    1241   0.023   0.016       0    TRAP       0      50
              *

 491          KK    63-3
 492          BA 0.01892
 493          PB    2.77
 494          LS       0    81.1
 495          UD   0.169
              *

 496          KK    63-5
 497          BA 0.04704
 498          PB    2.77
 499          LS       0    77.4
 500          UD   0.168
              *

 501          KK    63-6
 502          DR   D63-6
              *

 503          KK RDC63-2
 504          KM  ROUTE TO C63-5
 505          RD    1479   0.030   0.016       0    TRAP       0      50
              *

 506          KK    67-5
 507          BA 0.03059
 508          PB    2.77
 509          LS       0    76.0
 510          UD   0.144
              *
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 511          KK   C67-5
 512          HC       2
              *

 513          KK   D67-5
 514          KM  DIVERT 60% FLOW
 515          DT   D67-5
 516          DI       0      22      44     100
 517          DQ       0    13.2    26.4      60
              *

 518          KK  RC67-5
 519          KM  ROUTE TO C67-3
 520          RD    1120   0.011   0.016       0    TRAP       0      50
              *

 521          KK  C67-5A
 522          HC       2
              *

 523          KK  RC67-5
 524          KM  ROUTE TO C67-3
 525          RD     600   0.011   0.013       0    CIRC       5       0
              *

 526          KK  C63-5A
 527          HC       3
              *

 528          KK    68-3
```

```
          529          BA 0.04293
          530          PB    2.77
          531          LS       0    81.4
          532          UD   0.145
                       *

          533          KK   R68-3
          534          KM  ROUTE TO C68-5
          535          RD     778   0.022   0.016       0    TRAP       0      50
                       *

          536          KK    68-5
          537          BA 0.02064
          538          PB    2.77
          539          LS       0    74.1
          540          UD   0.153
                       *

          541          KK   68-3A
          542          BA 0.01322
          543          PB    2.77
          544          LS       0    88.0
          545          UD   0.127
                       *
1                                          HEC-1 INPUT                                                PAGE 17

        LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


          546          KK RC68-3A
          547          KM  ROUTE TO C68-5
          548          RD    1200   0.009   0.013       0    TRAP       3       0
                       *

          549          KK   C68-5
          550          HC       3
                       *

          551          KK  RC68-5
          552          KM  ROUTE TO C63-5 AT SPENCER AND CHARLESTON
          553          RD     700   0.010   0.013       0    CIRC     3.5       0
                       *

          554          KK    68-8
          555          BA 0.00890
          556          PB    2.77
          557          LS       0    91.2
          558          UD   0.111
                       *

          559          KK   C63-5
          560          HC       3
                       *

          561          KK  RC63-5
          562          KM  ROUTE TO C63-4
          563          RD    1054   0.021   0.016       0    TRAP       0      50
                       *

          564          KK    68-4
          565          BA 0.03437
          566          PB    2.77
          567          LS       0    74.9
          568          UD   0.147
                       *

          569          KK   R68-4
          570          KM  ROUTE TO C68-6
          571          RD     888   0.010   0.016       0    CIRC       3       0
                       *

          572          KK    68-6
          573          BA 0.02229
          574          PB    2.77
          575          LS       0    77.3
          576          UD   0.148
                       *
1                                          HEC-1 INPUT                                                PAGE 18

        LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


          577          KK   C68-6
          578          HC       2
                       *

          579          KK  RC68-6
          580          KM  ROUTE TO C68-9
          581          RD     197   0.010   0.016       0    CIRC       3       0
                       *
```

```
582          KK    68-9
583          BA 0.00793
584          PB    2.77
585          LS       0    94.1
586          UD   0.099
             *

587          KK  CC68-9
588          HC       3
             *

589          KK  RC68-9
590          KM  ROUTE TO C63-4
591          RD     500   0.016   0.016       0    TRAP      10       0
             *

592          KK    63-4
593          BA 0.03109
594          PB    2.77
595          LS       0    94.5
596          UD   0.130
             *

597          KK   C63-4
598          HC       2
             *

599          KK  RD67-5
600          KM  ROUTE TO EASTERN LATERALTHROUGH BASIN 67-3
601          RD    1360   0.018   0.016       0    TRAP      10       0
             *

602          KK   D67-5
603          DR   D67-5
             *

604          KK  RD67-5
605          KM  ROUTE TO EASTERN LATERALTHROUGH BASIN 67-3
606          RD    3169   0.018   0.016       0    TRAP       0      50
             *
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

607          KK    67-3
608          BA 0.05084
609          PB    2.77
610          LS       0    78.4
611          UD   0.256
             *

612          KK   C67-3
613          HC       2
             *
             * LATERAL ROUTE

614          KK  RC67-3
615          KM  ROUTE TO C67-2
616          RD     155   0.010   0.016       0    TRAP       0      50
             *

617          KK    67-2
618          BA 0.04216
619          PB    2.77
620          LS       0    84.3
621          UD   0.221
             *

622          KK   C67-2
623          HC       2
             *
             * LATERAL ROUTE

624          KK  RC67-2
625          KM  ROUTE TO CFINAL
626          RD     346   0.010   0.016       0    TRAP       0      50
             *

627          KK   63-4A
628          BA 0.01237
629          PB    2.77
630          LS       0    94.7
631          UD   0.113
             *

632          KK  R63-4A
633          KM  ROUTE TO CFINAL
634          RD    1553   0.010   0.016       0    TRAP       0      50
```

```
                *
  635           KK    67-1
  636           BA 0.03866
  637           PB    2.77
  638           LS       0    83.3
  639           UD   0.209
                *
1                                       HEC-1 INPUT                                             PAGE 20

 LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  640           KK    C63A
  641           KM  EASTERN SOUTH LATERAL FLOW
  642           HC       2
                *
  643           KK  C67-1A
  644           KM  EASTERN SOUTH LATERAL FLOW
  645           HC       2
                * LATERAL ROUTE
                *
  646           KK   RC63A
  647           KM  ROUTE TO CFINAL
  648           RD     723   0.010   0.016       0    CIRC       5       0
                *
  649           KK    68-2
  650           BA 0.04018
  651           PB    2.77
  652           LS       0    91.5
  653           UD   0.161
                *
  654           KK    68-1
  655           BA 0.04125
  656           PB    2.77
  657           LS       0    92.5
  658           UD   0.139
                *
  659           KK   C68-2
  660           HC       2
                *
  661           KK  RC68-2
  662           KM  ROUTE TO C68-10
  663           RD    2038   0.016   0.016       0    TRAP       0      50
                *
  664           KK   68-10
  665           BA 0.04890
  666           PB    2.77
  667           LS       0    94.9
  668           UD   0.142
                *
  669           KK  C68-10
  670           KM  EASTERN NORTH LATERAL FLOW
  671           HC       2
                *
1                                       HEC-1 INPUT                                             PAGE 21

 LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  672           KK RC68-10
  673           KM  ROUTE TO C67-1
  674           RD     346   0.010   0.016       0    CIRC       3       0
                *
  675           KK   68-11
  676           BA 0.01589
  677           PB    2.77
  678           LS       0    94.5
  679           UD   0.144
                *
  680           KK   C67-1
  681           HC       4
                *
  682           KK  RC67-1
  683           KM  ROUTE TO CFINAL
  684           RD     664   0.015   0.016       0    TRAP       0      50
                *
  685           KK   68-12
```

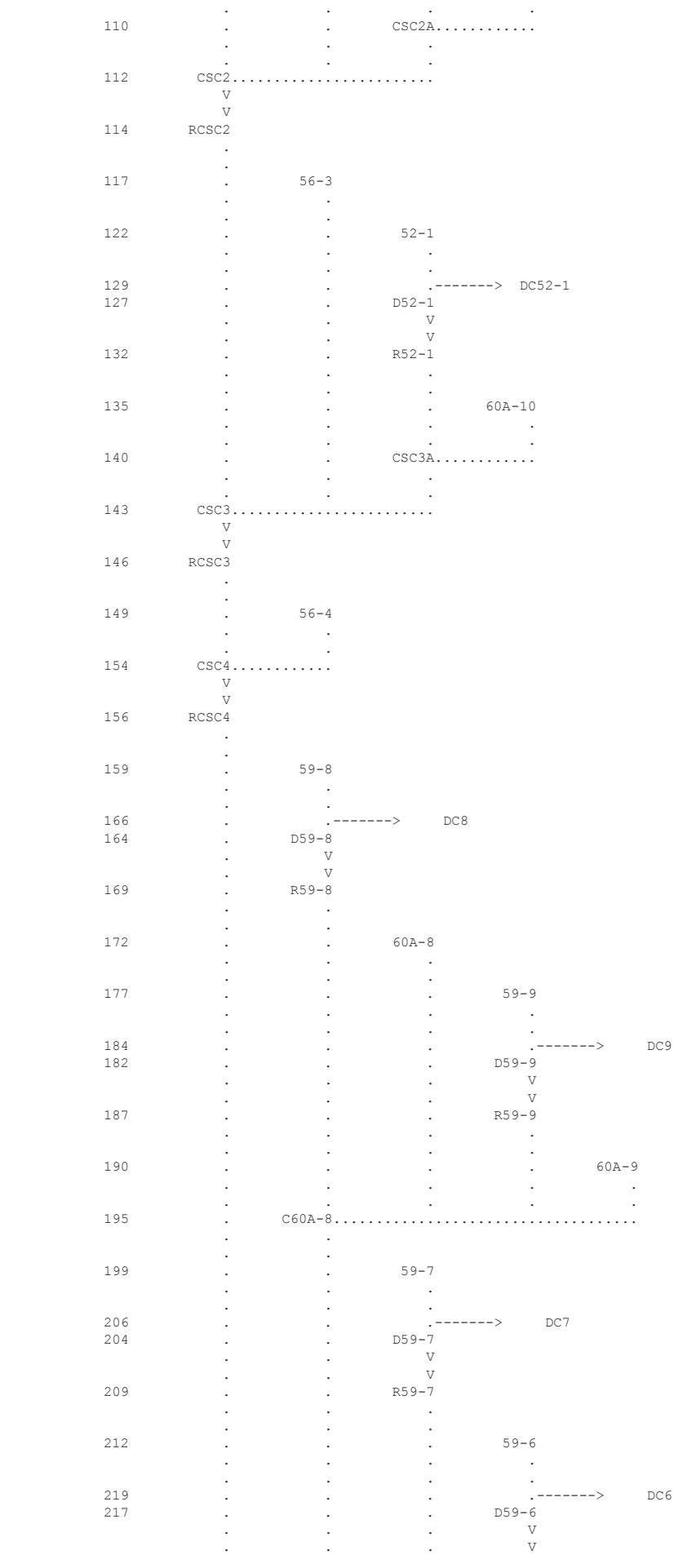
```
            686           BA 0.00557
            687           PB    2.77
            688           LS       0    92.9
            689           UD   0.113
                          *

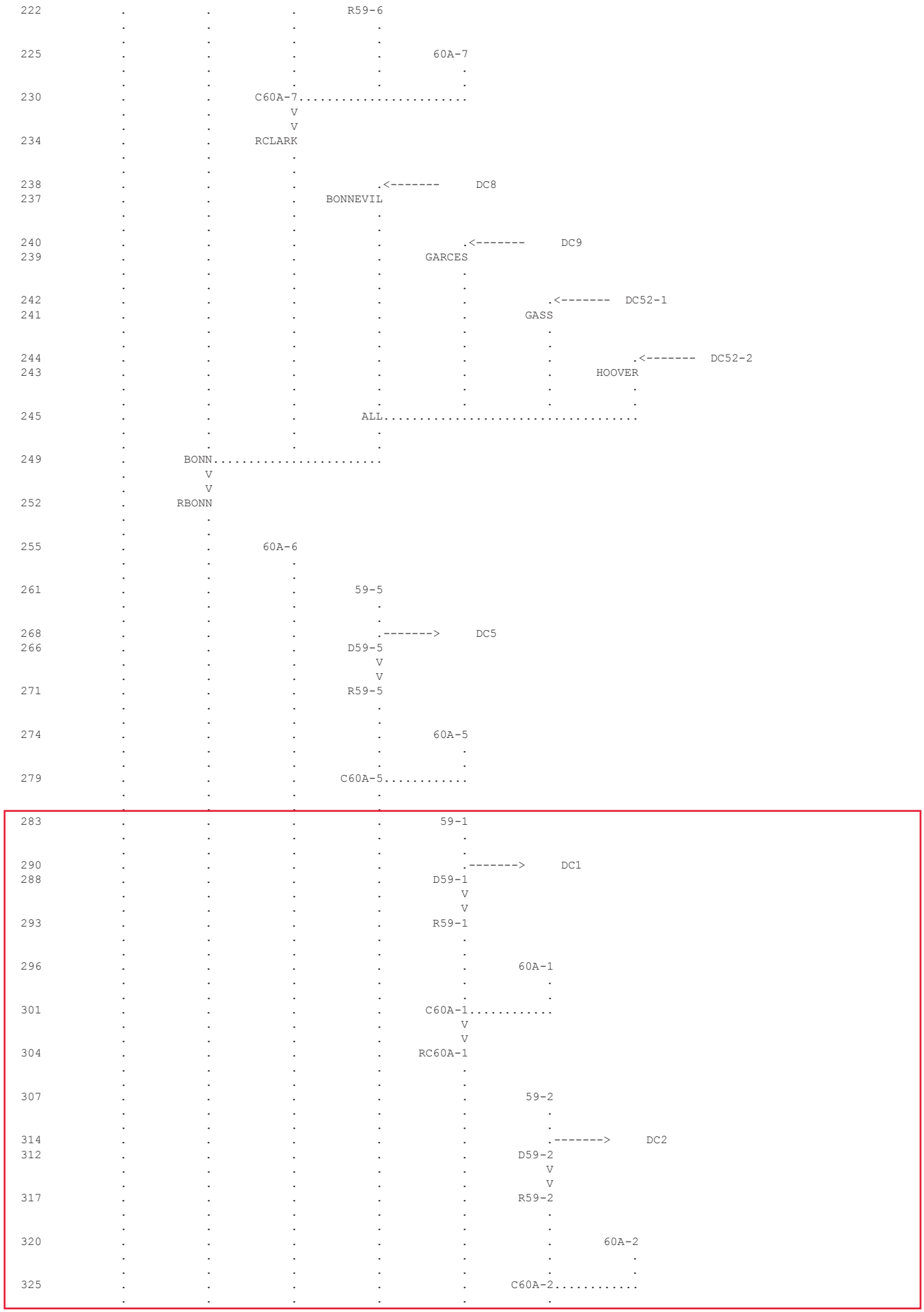
            690           KK FR04-C1
            691           BA 0.00411
            692           PB    2.77
            693           LS       0    93.9
            694           UD   0.094
                          *

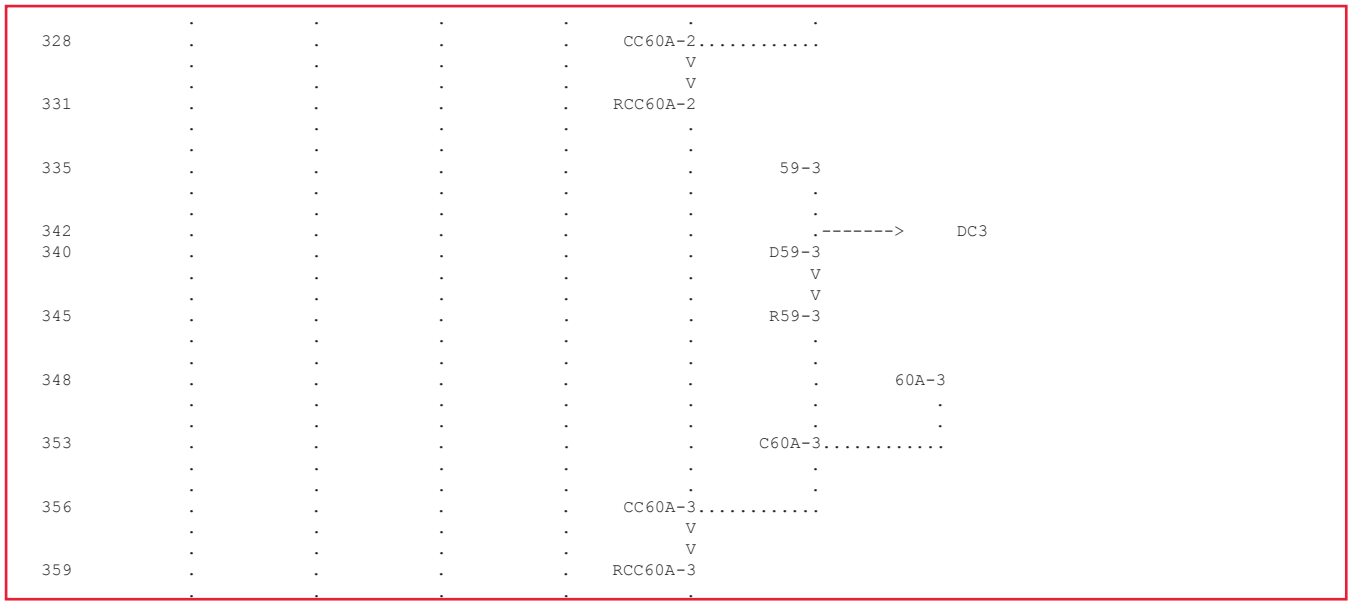
            695           KK  CFINAL
            696           HC       3
                          *
            697           ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

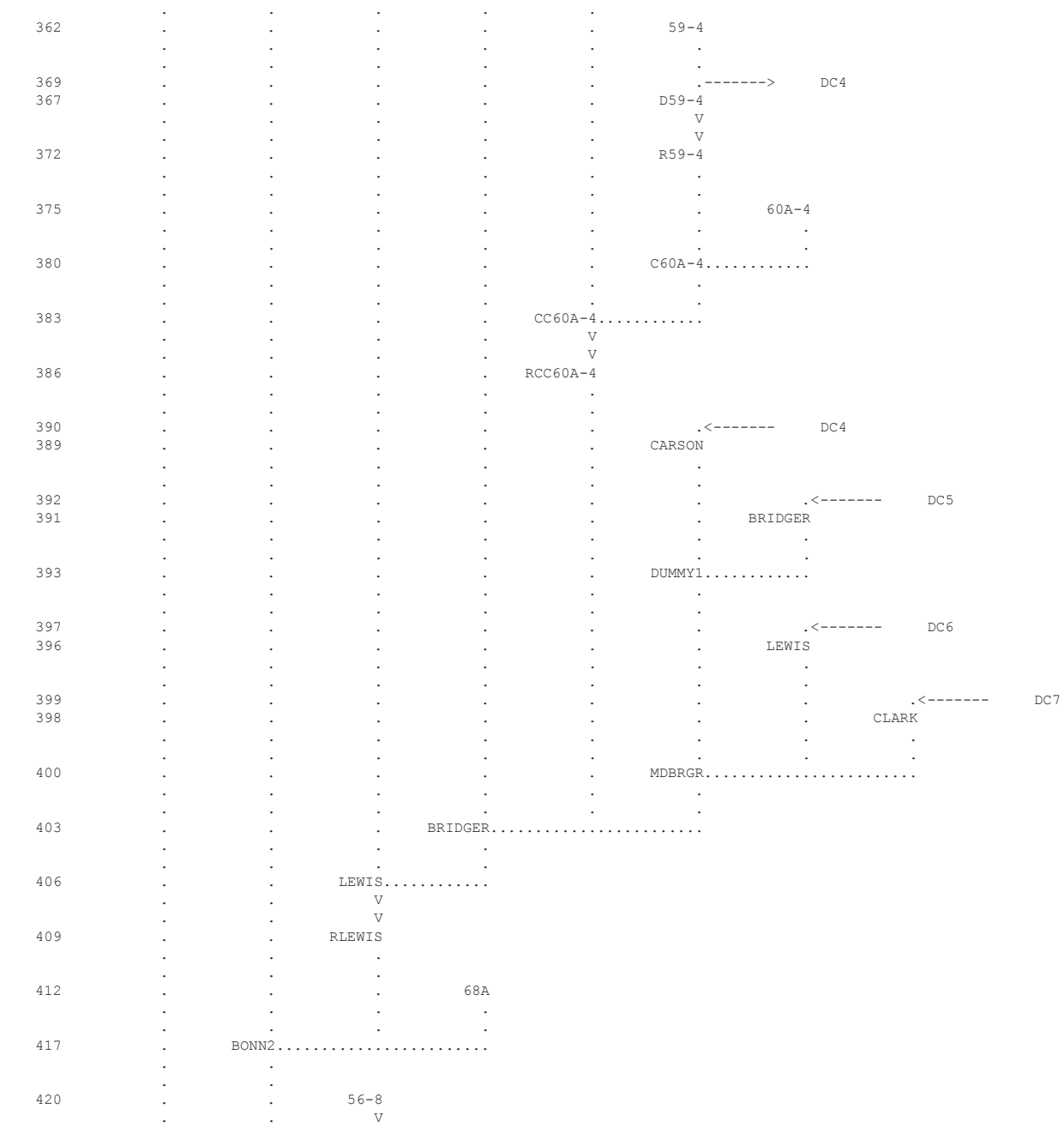
   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

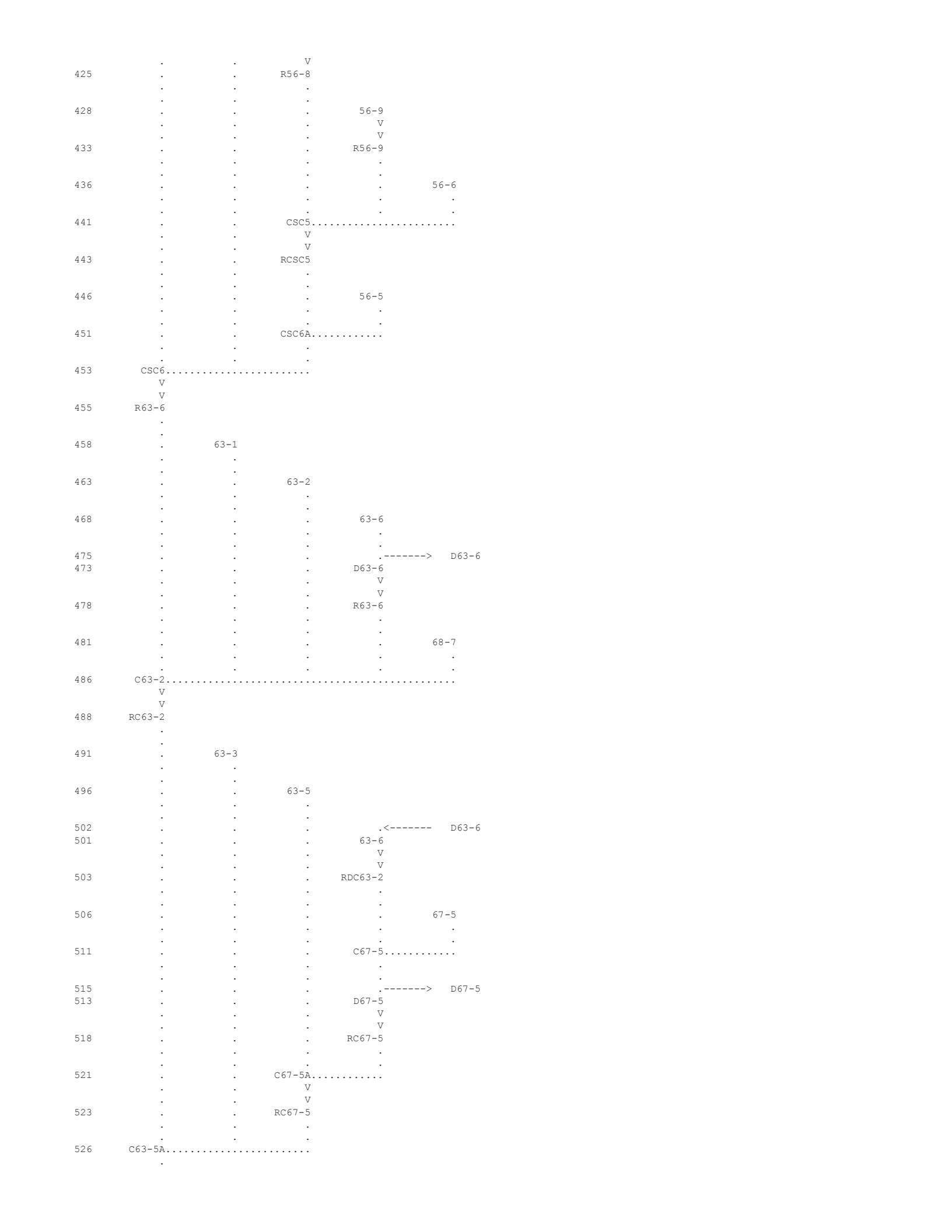
    18        CH51
                 V
                 V
    31       RCH51
                 .
                 .
    34           .        52-6
                 .           .
                 .           .
    39        CSC7............
                 V
                 V
    41       RCSC7
                 .
                 .
    44           .        52-4
                 .           .
                 .           .
    49           .           .        52-5
                 .           .           .
                 .           .           .
    54        CSC8.......................
                 V
                 V
    56       RCSC8
                 .
                 .
    59           .        56-7
                 .           V
                 .           V
    64           .       R56-7
                 .           .
                 .           .
    67           .           .        56-1
                 .           .           .
                 .           .           .
    72        CSC1.......................
                 V
                 V
    74       RCSC1
                 .
                 .
    77           .        56-2
                 .           .
                 .           .
    82           .           .        52-2
                 .           .           .
                 .           .           .
    87           .           .           .        52-3
                 .           .           .           V
                 .           .           .           V
    92           .           .           .       R52-3
                 .           .           .           .
                 .           .           .           .
    95           .           .       52-23............
                 .           .           .
                 .           .           .
    99           .           .           .-------->  DC52-2
    97           .           .       D52-2
                 .           .           V
                 .           .           V
   102           .           .       R52-2
                 .           .           .
                 .           .           .
   105           .           .           .      60A-11
                 .           .           .           .
```

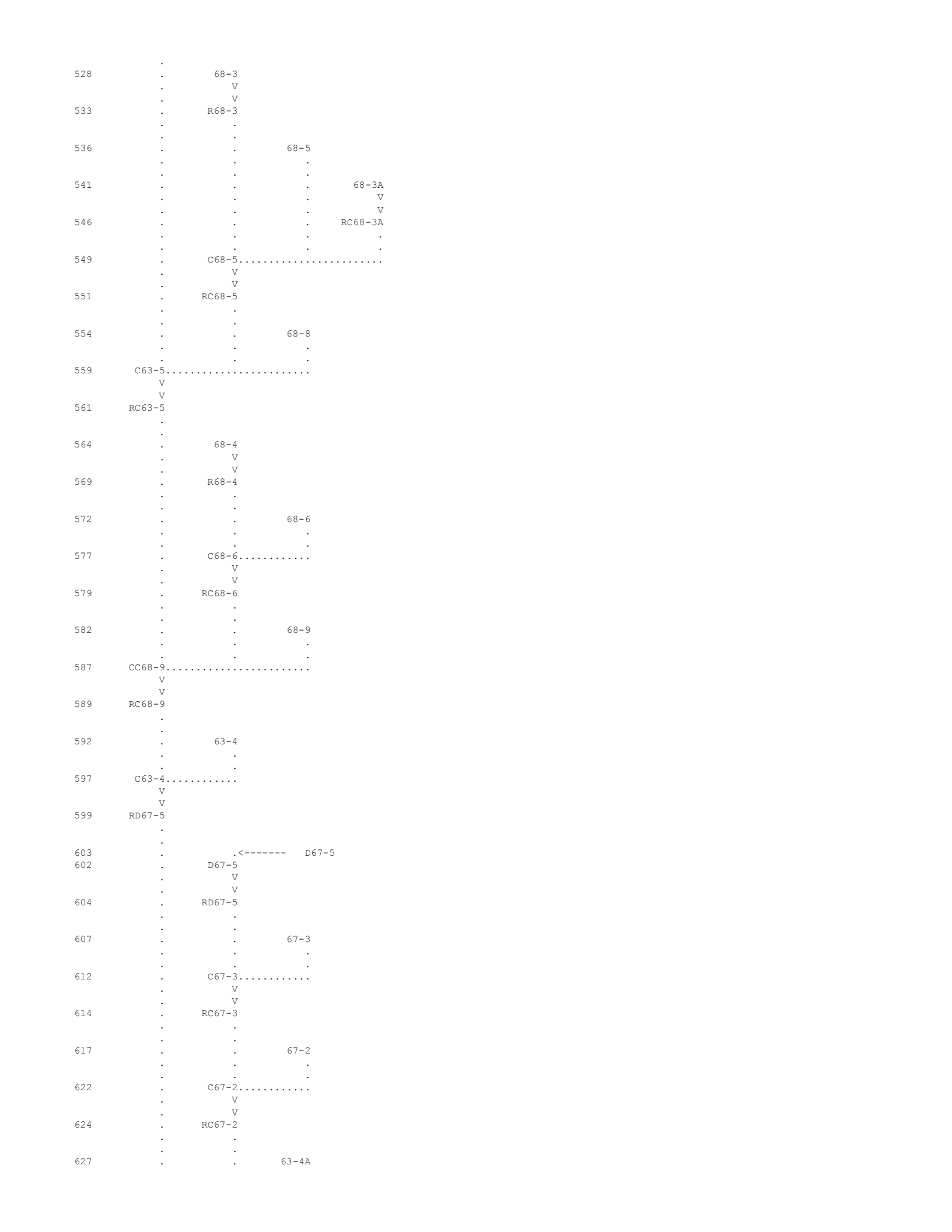

110
CSC2A
112
CSC2
114
RCSC2
117
56-3
122
52-1
129
DC52-1
127
D52-1
132
R52-1
135
60A-10
140
CSC3A
143
CSC3
146
RCSC3
149
56-4
154
CSC4
156
RCSC4
159
59-8
166
DC8
164
D59-8
169
R59-8
172
60A-8
177
59-9
184
DC9
182
D59-9
187
R59-9
190
60A-9
195
C60A-8
199
59-7
206
DC7
204
D59-7
209
R59-7
212
59-6
219
DC6
217
D59-6

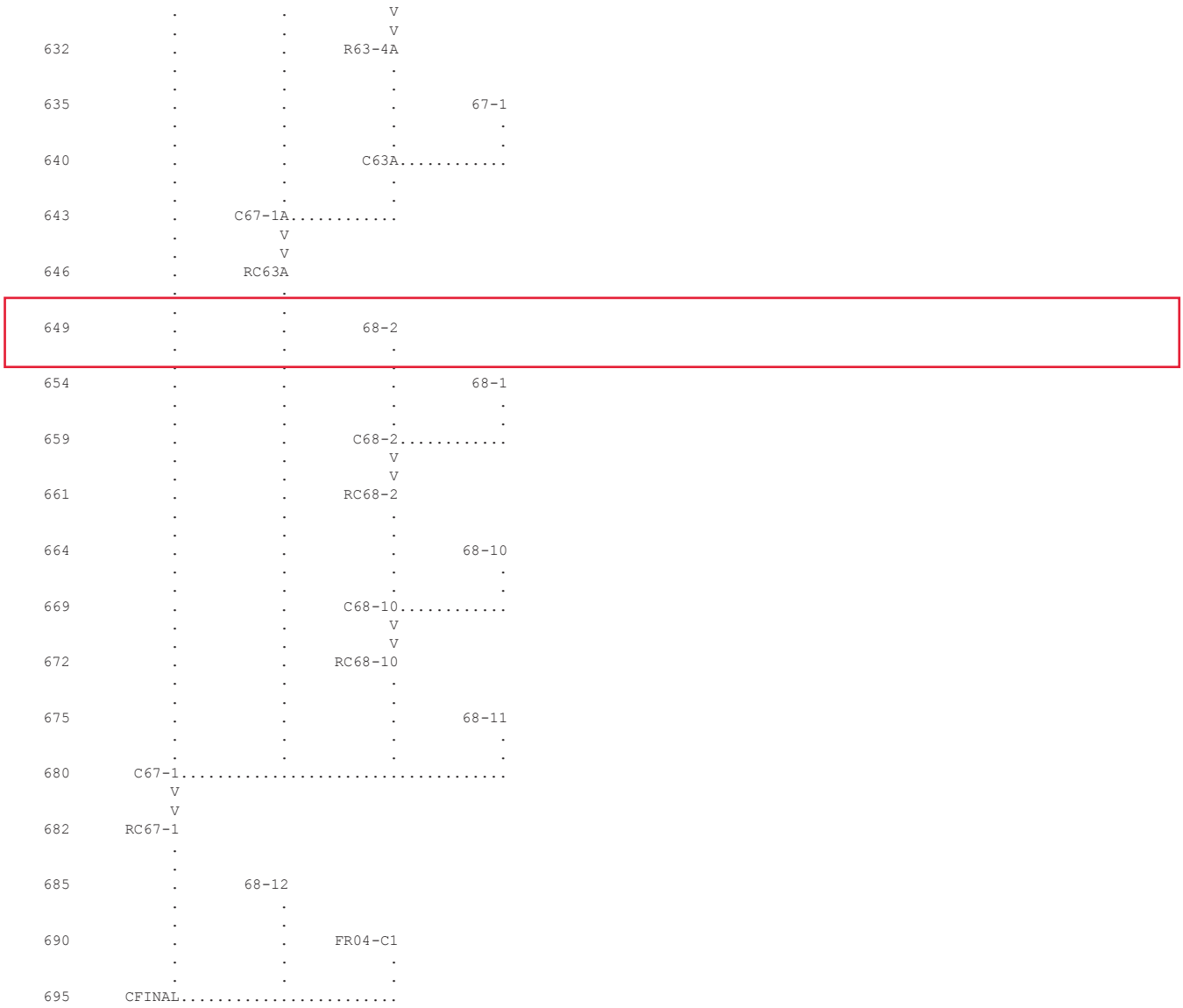

222 R59-6
225 60A-7
230 C60A-7
234 RCLARK
238 DC8
237 BONNEVIL
240 DC9
239 GARCES
242 DC52-1
241 GASS
244 DC52-2
243 HOOVER
245 ALL
249 BONN
252 RBONN
255 60A-6
261 59-5
268 DC5
266 D59-5
271 R59-5
274 60A-5
279 C60A-5
283 59-1
290 DC1
288 D59-1
293 R59-1
296 60A-1
301 C60A-1
304 RC60A-1
307 59-2
314 DC2
312 D59-2
317 R59-2
320 60A-2
325 C60A-2


328
CC60A-2
V
V
331
RCC60A-2
335
59-3
342
DC3
340
D59-3
V
V
345
R59-3
348
60A-3
353
C60A-3
356
CC60A-3
V
V
359
RCC60A-3


362
59-4
369
DC4
367
D59-4
V
V
372
R59-4
375
60A-4
380
C60A-4
383
CC60A-4
V
V
386
RCC60A-4
390
DC4
389
CARSON
392
DC5
391
BRIDGER
393
DUMMY1
397
DC6
396
LEWIS
399
DC7
398
CLARK
400
MDBRGR
403
BRIDGER
406
LEWIS
V
V
409
RLEWIS
412
68A
417
BONN2
420
56-8
V


425 R56-8
428 56-9
433 R56-9
436 56-6
441 CSC5
443 RCSC5
446 56-5
451 CSC6A
453 CSC6
455 R63-6
458 63-1
463 63-2
468 63-6
475 D63-6
473 D63-6
478 R63-6
481 68-7
486 C63-2
488 RC63-2
491 63-3
496 63-5
502 D63-6
501 63-6
503 RDC63-2
506 67-5
511 C67-5
515 D67-5
513 D67-5
518 RC67-5
521 C67-5A
523 RC67-5
526 C63-5A


528 68-3
533 R68-3
536 68-5
541 68-3A
546 RC68-3A
549 C68-5
551 RC68-5
554 68-8
559 C63-5
561 RC63-5
564 68-4
569 R68-4
572 68-6
577 C68-6
579 RC68-6
582 68-9
587 CC68-9
589 RC68-9
592 63-4
597 C63-4
599 RD67-5
603 D67-5
602 D67-5
604 RD67-5
607 67-3
612 C67-3
614 RC67-3
617 67-2
622 C67-2
624 RC67-2
627 63-4A



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*               JUN   1998              *
*            VERSION 4.1                *
*                                       *
*  RUN DATE   10NOV17  TIME  10:24:05   *
*                                       *
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*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
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CHARLESTON STORM DRAIN
WASH
INPUT FILE ULT.PRN (SERIES A)
DESIGN STORM 100-YEAR 6 HOUR
MODELED BY ATKINS (DREW MCINNIS)

AREA (SQUARE MILES)	DARF
0 - 0.5	0.99
0.5 - 1	0.975
1 - 2	0.95
2 - 3	0.925

15 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

```
                      NMIN           5  MINUTES IN COMPUTATION INTERVAL
                     IDATE      1    0  STARTING DATE
                     ITIME         0000  STARTING TIME
                        NQ          300  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      2    0  ENDING DATE
                     NDTIME         0055  ENDING TIME
                     ICENT           19  CENTURY MARK

                  COMPUTATION INTERVAL     .08 HOURS
                       TOTAL TIME BASE   24.92 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
                       NPLAN           1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                     .99       .98       .95       .93       .57
1

               PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
                                FLOWS IN CUBIC FEET PER SECOND,  AREA IN SQUARE MILES
                                          TIME TO PEAK IN HOURS


                                                                                RATIOS APPLIED TO PRECIPITATION
 OPERATION       STATION     AREA    PLAN                    RATIO 1  RATIO 2  RATIO 3  RATIO 4  RATIO 5
                                                                .99      .98      .95      .93      .57

 HYDROGRAPH AT
+                  CH51       .27     1   FLOW                287.     281.     272.     263.     136.
                                           TIME                3.83     3.83     3.83     3.83     3.83

 ROUTED TO
+                 RCH51       .27     1   FLOW                284.     279.     270.     261.     134.
                                           TIME                3.83     3.83     3.83     3.83     3.83

 HYDROGRAPH AT
+                  52-6       .14     1   FLOW                173.     170.     164.     159.      86.
                                           TIME                3.75     3.75     3.75     3.75     3.75

  2 COMBINED AT
+                  CSC7       .42     1   FLOW                450.     441.     428.     414.     218.
                                           TIME                3.83     3.83     3.83     3.83     3.83

 ROUTED TO
+                 RCSC7       .42     1   FLOW                449.     441.     427.     413.     216.
                                           TIME                3.83     3.83     3.83     3.83     3.83

 HYDROGRAPH AT
+                  52-4       .01     1   FLOW                 17.      16.      16.      15.       8.
                                           TIME                3.58     3.58     3.58     3.58     3.58

 HYDROGRAPH AT
+                  52-5       .11     1   FLOW                147.     145.     140.     136.      73.
                                           TIME                3.67     3.67     3.67     3.67     3.67

  3 COMBINED AT
+                  CSC8       .54     1   FLOW                596.     585.     566.     547.     287.
                                           TIME                3.75     3.75     3.75     3.75     3.83

 ROUTED TO
+                 RCSC8       .54     1   FLOW                592.     581.     562.     544.     287.
                                           TIME                3.75     3.75     3.75     3.75     3.83

 HYDROGRAPH AT
+                  56-7       .02     1   FLOW                 28.      28.      27.      26.      14.
                                           TIME                3.58     3.58     3.58     3.58     3.67

 ROUTED TO
+                 R56-7       .02     1   FLOW                 28.      27.      27.      26.      14.
                                           TIME                3.67     3.67     3.67     3.67     3.67

 HYDROGRAPH AT
+                  56-1       .01     1   FLOW                 18.      18.      17.      17.       9.
                                           TIME                3.58     3.58     3.58     3.58     3.58

  3 COMBINED AT
+                  CSC1       .57     1   FLOW                627.     616.     596.     576.     302.
                                           TIME                3.75     3.75     3.75     3.75     3.83

 ROUTED TO
```

+	RCSC1	.57	1	FLOW	625.	614.	594.	575.	302.
				TIME	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT									
+	56-2	.02	1	FLOW	33.	33.	32.	30.	16.
				TIME	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT									
+	52-2	.03	1	FLOW	44.	43.	42.	41.	23.
				TIME	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT									
+	52-3	.02	1	FLOW	26.	26.	25.	24.	14.
				TIME	3.58	3.58	3.58	3.58	3.58
ROUTED TO									
+	R52-3	.02	1	FLOW	26.	26.	25.	24.	13.
				TIME	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT									
+	52-23	.05	1	FLOW	70.	69.	66.	65.	36.
				TIME	3.67	3.67	3.67	3.67	3.67
DIVERSION TO									
+	DC52-2	.05	1	FLOW	36.	36.	36.	36.	36.
				TIME	3.42	3.42	3.42	3.50	3.67
HYDROGRAPH AT									
+	D52-2	.05	1	FLOW	34.	33.	30.	29.	0.
				TIME	3.67	3.67	3.67	3.67	3.67
ROUTED TO									
+	R52-2	.05	1	FLOW	33.	32.	30.	28.	0.
				TIME	3.67	3.67	3.67	3.67	4.00
HYDROGRAPH AT									
+	60A-11	.01	1	FLOW	19.	19.	18.	18.	10.
				TIME	3.50	3.50	3.50	3.50	3.50
2 COMBINED AT									
+	CSC2A	.06	1	FLOW	47.	45.	42.	40.	10.
				TIME	3.67	3.67	3.67	3.67	3.50
3 COMBINED AT									
+	CSC2	.65	1	FLOW	695.	681.	659.	636.	318.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO									
+	RCSC2	.65	1	FLOW	684.	671.	648.	626.	316.
				TIME	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT									
+	56-3	.03	1	FLOW	38.	38.	36.	35.	17.
				TIME	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT									
+	52-1	.04	1	FLOW	56.	55.	54.	52.	29.
				TIME	3.58	3.58	3.58	3.58	3.67
DIVERSION TO									
+	DC52-1	.04	1	FLOW	29.	29.	29.	29.	29.
				TIME	3.42	3.42	3.42	3.42	3.67
HYDROGRAPH AT									
+	D52-1	.04	1	FLOW	27.	26.	25.	23.	0.
				TIME	3.58	3.58	3.58	3.58	3.67
ROUTED TO									
+	R52-1	.04	1	FLOW	27.	26.	24.	23.	0.
				TIME	3.75	3.75	3.75	3.75	5.25
HYDROGRAPH AT									
+	60A-10	.02	1	FLOW	31.	31.	30.	29.	16.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	CSC3A	.06	1	FLOW	53.	52.	49.	47.	16.
				TIME	3.67	3.67	3.67	3.67	3.58
3 COMBINED AT									
+	CSC3	.74	1	FLOW	765.	749.	723.	698.	336.
				TIME	3.75	3.75	3.75	3.75	3.83
ROUTED TO									
+	RCSC3	.74	1	FLOW	754.	739.	713.	687.	336.
				TIME	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT									
+	56-4	.03	1	FLOW	37.	36.	35.	33.	16.
				TIME	3.58	3.58	3.58	3.58	3.58

2 COMBINED AT									
+	CSC4	.77	1	FLOW	783.	768.	741.	714.	346.
				TIME	3.75	3.75	3.75	3.75	3.83
ROUTED TO									
+	RCSC4	.77	1	FLOW	769.	755.	729.	703.	344.
				TIME	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT									
+	59-8	.04	1	FLOW	61.	60.	58.	56.	30.
				TIME	3.58	3.58	3.58	3.58	3.58
DIVERSION TO									
+	DC8	.04	1	FLOW	30.	30.	30.	30.	30.
				TIME	3.42	3.42	3.42	3.42	3.58
HYDROGRAPH AT									
+	D59-8	.04	1	FLOW	31.	30.	28.	26.	0.
				TIME	3.58	3.58	3.58	3.58	3.58
ROUTED TO									
+	R59-8	.04	1	FLOW	31.	30.	28.	28.	0.
				TIME	3.75	3.75	3.75	3.75	4.25
HYDROGRAPH AT									
+	60A-8	.06	1	FLOW	90.	89.	86.	83.	43.
				TIME	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT									
+	59-9	.03	1	FLOW	42.	41.	40.	38.	21.
				TIME	3.58	3.58	3.58	3.58	3.58
DIVERSION TO									
+	DC9	.03	1	FLOW	21.	21.	21.	21.	21.
				TIME	3.42	3.42	3.42	3.42	3.58
HYDROGRAPH AT									
+	D59-9	.03	1	FLOW	21.	20.	19.	17.	0.
				TIME	3.58	3.58	3.58	3.58	.00
ROUTED TO									
+	R59-9	.03	1	FLOW	19.	19.	18.	17.	0.
				TIME	3.75	3.75	3.75	3.75	.00
HYDROGRAPH AT									
+	60A-9	.04	1	FLOW	52.	51.	49.	48.	25.
				TIME	3.58	3.58	3.58	3.58	3.58
4 COMBINED AT									
+	C60A-8	.17	1	FLOW	176.	171.	166.	152.	67.
				TIME	3.67	3.67	3.67	3.75	3.58
HYDROGRAPH AT									
+	59-7	.03	1	FLOW	37.	36.	35.	34.	18.
				TIME	3.58	3.58	3.58	3.58	3.67
DIVERSION TO									
+	DC7	.03	1	FLOW	18.	18.	18.	18.	18.
				TIME	3.42	3.42	3.42	3.42	3.58
HYDROGRAPH AT									
+	D59-7	.03	1	FLOW	19.	18.	17.	16.	0.
				TIME	3.58	3.58	3.58	3.58	3.67
ROUTED TO									
+	R59-7	.03	1	FLOW	20.	18.	16.	17.	0.
				TIME	3.75	3.83	3.83	3.75	4.17
HYDROGRAPH AT									
+	59-6	.03	1	FLOW	46.	45.	44.	42.	23.
				TIME	3.67	3.67	3.67	3.67	3.67
DIVERSION TO									
+	DC6	.03	1	FLOW	23.	23.	23.	23.	23.
				TIME	3.42	3.42	3.42	3.42	3.67
HYDROGRAPH AT									
+	D59-6	.03	1	FLOW	23.	22.	21.	19.	0.
				TIME	3.67	3.67	3.67	3.67	3.67
ROUTED TO									
+	R59-6	.03	1	FLOW	23.	21.	19.	19.	0.
				TIME	3.75	3.75	3.83	3.83	4.50
HYDROGRAPH AT									
+	60A-7	.05	1	FLOW	65.	63.	61.	59.	28.
				TIME	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT									

+	C60A-7	.11	1	FLOW	94.	89.	80.	78.	28.
				TIME	3.75	3.75	3.75	3.75	3.58
ROUTED TO									
+	RCLARK	.11	1	FLOW	91.	86.	77.	76.	27.
				TIME	3.75	3.75	3.75	3.75	3.67
HYDROGRAPH AT									
+	BONNEVIL	.00	1	FLOW	30.	30.	30.	30.	30.
				TIME	3.42	3.42	3.42	3.42	3.58
HYDROGRAPH AT									
+	GARCES	.00	1	FLOW	21.	21.	21.	21.	21.
				TIME	3.42	3.42	3.42	3.42	3.58
HYDROGRAPH AT									
+	GASS	.00	1	FLOW	29.	29.	29.	29.	29.
				TIME	3.42	3.42	3.42	3.42	3.67
HYDROGRAPH AT									
+	HOOVER	.00	1	FLOW	36.	36.	36.	36.	36.
				TIME	3.42	3.42	3.42	3.50	3.67
4 COMBINED AT									
+	ALL	.00	1	FLOW	116.	116.	116.	116.	115.
				TIME	3.42	3.42	3.42	3.50	3.67
3 COMBINED AT									
+	BONN	.28	1	FLOW	375.	366.	350.	344.	209.
				TIME	3.75	3.75	3.75	3.75	3.58
ROUTED TO									
+	RBONN	.28	1	FLOW	374.	365.	350.	343.	209.
				TIME	3.75	3.75	3.75	3.75	3.67
HYDROGRAPH AT									
+	60A-6	.04	1	FLOW	54.	53.	51.	49.	23.
				TIME	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT									
+	59-5	.04	1	FLOW	55.	54.	52.	50.	27.
				TIME	3.58	3.58	3.58	3.58	3.67
DIVERSION TO									
+	DC5	.04	1	FLOW	27.	27.	27.	27.	27.
				TIME	3.42	3.42	3.42	3.42	3.58
HYDROGRAPH AT									
+	D59-5	.04	1	FLOW	28.	27.	25.	23.	0.
				TIME	3.58	3.58	3.58	3.58	3.67
ROUTED TO									
+	R59-5	.04	1	FLOW	29.	26.	24.	24.	0.
				TIME	3.75	3.75	3.75	3.75	4.25
HYDROGRAPH AT									
+	60A-5	.05	1	FLOW	76.	74.	72.	69.	34.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	C60A-5	.09	1	FLOW	93.	88.	79.	77.	34.
				TIME	3.67	3.67	3.75	3.75	3.58
HYDROGRAPH AT									
+	59-1	.05	1	FLOW	76.	74.	72.	70.	38.
				TIME	3.67	3.67	3.67	3.67	3.67
DIVERSION TO									
+	DC1	.05	1	FLOW	38.	38.	38.	38.	38.
				TIME	3.42	3.42	3.42	3.42	3.67
HYDROGRAPH AT									
+	D59-1	.05	1	FLOW	38.	36.	34.	32.	0.
				TIME	3.67	3.67	3.67	3.67	.00
ROUTED TO									
+	R59-1	.05	1	FLOW	36.	35.	33.	30.	0.
				TIME	3.83	3.83	3.83	3.83	.00
HYDROGRAPH AT									
+	60A-1	.05	1	FLOW	72.	70.	68.	66.	37.
				TIME	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT									
+	C60A-1	.10	1	FLOW	99.	96.	93.	88.	37.
				TIME	3.75	3.75	3.75	3.75	3.67
ROUTED TO									
+	RC60A-1	.10	1	FLOW	97.	94.	90.	85.	37.
				TIME	3.75	3.75	3.75	3.75	3.67

HYDROGRAPH AT									
+	59-2	.03	1	FLOW	45.	44.	43.	42.	22.
				TIME	3.58	3.58	3.58	3.58	3.58
DIVERSION TO									
+	DC2	.03	1	FLOW	22.	22.	22.	22.	22.
				TIME	3.42	3.42	3.42	3.42	3.58
HYDROGRAPH AT									
+	D59-2	.03	1	FLOW	23.	22.	21.	20.	0.
				TIME	3.58	3.58	3.58	3.58	3.58
ROUTED TO									
+	R59-2	.03	1	FLOW	22.	21.	21.	21.	0.
				TIME	3.83	3.83	3.75	3.75	4.33
HYDROGRAPH AT									
+	60A-2	.03	1	FLOW	43.	42.	41.	39.	22.
				TIME	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT									
+	C60A-2	.06	1	FLOW	59.	55.	57.	56.	22.
				TIME	3.75	3.75	3.75	3.75	3.67
2 COMBINED AT									
+	CC60A-2	.16	1	FLOW	156.	149.	147.	141.	58.
				TIME	3.75	3.75	3.75	3.75	3.67
ROUTED TO									
+	RCC60A-2	.16	1	FLOW	155.	148.	146.	140.	58.
				TIME	3.75	3.75	3.75	3.75	3.67
HYDROGRAPH AT									
+	59-3	.03	1	FLOW	49.	48.	46.	45.	24.
				TIME	3.58	3.58	3.58	3.58	3.67
DIVERSION TO									
+	DC3	.03	1	FLOW	24.	24.	24.	24.	24.
				TIME	3.42	3.42	3.42	3.42	3.58
HYDROGRAPH AT									
+	D59-3	.03	1	FLOW	25.	24.	22.	21.	0.
				TIME	3.58	3.58	3.58	3.58	3.67
ROUTED TO									
+	R59-3	.03	1	FLOW	24.	24.	21.	21.	0.
				TIME	3.75	3.75	3.83	3.83	4.42
HYDROGRAPH AT									
+	60A-3	.03	1	FLOW	46.	45.	44.	42.	23.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	C60A-3	.06	1	FLOW	61.	60.	56.	51.	23.
				TIME	3.75	3.75	3.75	3.75	3.58
2 COMBINED AT									
+	CC60A-3	.23	1	FLOW	216.	208.	202.	191.	80.
				TIME	3.75	3.75	3.75	3.75	3.67
ROUTED TO									
+	RCC60A-3	.23	1	FLOW	210.	202.	196.	186.	80.
				TIME	3.75	3.75	3.75	3.75	3.67
HYDROGRAPH AT									
+	59-4	.03	1	FLOW	50.	50.	48.	47.	25.
				TIME	3.58	3.58	3.58	3.58	3.58
DIVERSION TO									
+	DC4	.03	1	FLOW	25.	25.	25.	25.	25.
				TIME	3.42	3.42	3.42	3.42	3.58
HYDROGRAPH AT									
+	D59-4	.03	1	FLOW	25.	25.	23.	22.	0.
				TIME	3.58	3.58	3.58	3.58	3.58
ROUTED TO									
+	R59-4	.03	1	FLOW	25.	23.	21.	20.	0.
				TIME	3.75	3.75	3.75	3.75	4.50
HYDROGRAPH AT									
+	60A-4	.06	1	FLOW	77.	76.	73.	71.	35.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	C60A-4	.09	1	FLOW	90.	84.	80.	77.	35.
				TIME	3.67	3.75	3.75	3.75	3.58
2 COMBINED AT									

+	CC60A-4	.32	1	FLOW	296.	286.	276.	263.	114.
				TIME	3.75	3.75	3.75	3.75	3.67
ROUTED TO									
+	RCC60A-4	.32	1	FLOW	294.	283.	272.	259.	113.
				TIME	3.75	3.75	3.75	3.75	3.67
HYDROGRAPH AT									
+	CARSON	.00	1	FLOW	25.	25.	25.	25.	25.
				TIME	3.42	3.42	3.42	3.42	3.58
HYDROGRAPH AT									
+	BRIDGER	.00	1	FLOW	27.	27.	27.	27.	27.
				TIME	3.42	3.42	3.42	3.42	3.58
2 COMBINED AT									
+	DUMMY1	.00	1	FLOW	52.	52.	52.	52.	52.
				TIME	3.42	3.42	3.42	3.42	3.58
HYDROGRAPH AT									
+	LEWIS	.00	1	FLOW	23.	23.	23.	23.	23.
				TIME	3.42	3.42	3.42	3.42	3.67
HYDROGRAPH AT									
+	CLARK	.00	1	FLOW	18.	18.	18.	18.	18.
				TIME	3.42	3.42	3.42	3.42	3.58
3 COMBINED AT									
+	MDBRGR	.00	1	FLOW	93.	93.	93.	93.	93.
				TIME	3.42	3.42	3.42	3.42	3.58
3 COMBINED AT									
+	BRIDGER	.41	1	FLOW	473.	459.	444.	429.	238.
				TIME	3.75	3.75	3.75	3.75	3.67
2 COMBINED AT									
+	LEWIS	.45	1	FLOW	516.	501.	485.	469.	261.
				TIME	3.75	3.75	3.75	3.75	3.67
ROUTED TO									
+	RLEWIS	.45	1	FLOW	510.	495.	476.	458.	259.
				TIME	3.75	3.75	3.75	3.75	3.67
HYDROGRAPH AT									
+	68A	.03	1	FLOW	32.	31.	30.	29.	14.
				TIME	3.58	3.58	3.58	3.58	3.67
3 COMBINED AT									
+	BONN2	.75	1	FLOW	911.	887.	852.	826.	482.
				TIME	3.75	3.75	3.75	3.75	3.67
HYDROGRAPH AT									
+	56-8	.05	1	FLOW	63.	62.	59.	57.	28.
				TIME	3.67	3.67	3.67	3.67	3.67
ROUTED TO									
+	R56-8	.05	1	FLOW	61.	60.	58.	56.	28.
				TIME	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT									
+	56-9	.07	1	FLOW	82.	80.	77.	74.	35.
				TIME	3.67	3.67	3.67	3.67	3.67
ROUTED TO									
+	R56-9	.07	1	FLOW	80.	78.	76.	73.	34.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT									
+	56-6	.05	1	FLOW	65.	63.	61.	59.	28.
				TIME	3.67	3.67	3.67	3.67	3.67
3 COMBINED AT									
+	CSC5	.18	1	FLOW	198.	193.	188.	180.	84.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO									
+	RCSC5	.18	1	FLOW	196.	191.	185.	177.	84.
				TIME	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT									
+	56-5	.06	1	FLOW	79.	77.	74.	72.	34.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	CSC6A	.24	1	FLOW	258.	253.	244.	235.	110.
				TIME	3.75	3.75	3.75	3.75	3.75
3 COMBINED AT									
+	CSC6	1.76	1	FLOW	1933.	1888.	1818.	1755.	872.
				TIME	3.75	3.75	3.75	3.75	3.75

ROUTED TO									
+	R63-6	1.76	1	FLOW	1890.	1843.	1774.	1708.	872.
				TIME	3.75	3.75	3.75	3.83	3.75
HYDROGRAPH AT									
+	63-1	.01	1	FLOW	23.	23.	22.	21.	11.
				TIME	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT									
+	63-2	.04	1	FLOW	49.	48.	46.	44.	19.
				TIME	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT									
+	63-6	.05	1	FLOW	60.	58.	56.	54.	24.
				TIME	3.67	3.67	3.67	3.67	3.67
DIVERSION TO									
+	D63-6	.05	1	FLOW	36.	35.	34.	32.	14.
				TIME	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT									
+	D63-6	.05	1	FLOW	24.	23.	22.	22.	9.
				TIME	3.67	3.67	3.67	3.67	3.67
ROUTED TO									
+	R63-6	.05	1	FLOW	24.	24.	23.	22.	10.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT									
+	68-7	.01	1	FLOW	22.	21.	21.	20.	11.
				TIME	3.50	3.50	3.50	3.50	3.50
5 COMBINED AT									
+	C63-2	1.88	1	FLOW	1969.	1921.	1849.	1778.	906.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO									
+	RC63-2	1.88	1	FLOW	1935.	1893.	1827.	1765.	892.
				TIME	3.83	3.83	3.83	3.83	3.75
HYDROGRAPH AT									
+	63-3	.02	1	FLOW	18.	17.	16.	16.	5.
				TIME	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT									
+	63-5	.05	1	FLOW	36.	34.	33.	31.	9.
				TIME	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT									
+	63-6	.00	1	FLOW	36.	35.	34.	32.	14.
				TIME	3.67	3.67	3.67	3.67	3.67
ROUTED TO									
+	RDC63-2	.00	1	FLOW	35.	35.	33.	32.	14.
				TIME	3.67	3.67	3.67	3.67	3.75
HYDROGRAPH AT									
+	67-5	.03	1	FLOW	23.	22.	21.	20.	5.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	C67-5	.03	1	FLOW	55.	54.	51.	50.	19.
				TIME	3.67	3.67	3.67	3.67	3.75
DIVERSION TO									
+	D67-5	.03	1	FLOW	33.	33.	31.	30.	11.
				TIME	3.67	3.67	3.67	3.67	3.75
HYDROGRAPH AT									
+	D67-5	.03	1	FLOW	22.	22.	20.	20.	7.
				TIME	3.67	3.67	3.67	3.67	3.75
ROUTED TO									
+	RC67-5	.03	1	FLOW	22.	22.	21.	20.	8.
				TIME	3.75	3.75	3.75	3.75	3.83
2 COMBINED AT									
+	C67-5A	.08	1	FLOW	55.	53.	51.	48.	15.
				TIME	3.67	3.67	3.67	3.67	3.75
ROUTED TO									
+	RC67-5	.08	1	FLOW	54.	53.	50.	48.	15.
				TIME	3.67	3.67	3.67	3.67	3.75
3 COMBINED AT									
+	C63-5A	1.98	1	FLOW	1991.	1945.	1877.	1813.	911.
				TIME	3.75	3.83	3.83	3.83	3.75
HYDROGRAPH AT									

+	68-3	.04	1	FLOW	43.	42.	40.	38.	14.
				TIME	3.58	3.58	3.58	3.58	3.58
ROUTED TO									
+	R68-3	.04	1	FLOW	40.	39.	37.	36.	13.
				TIME	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT									
+	68-5	.02	1	FLOW	13.	13.	12.	11.	3.
				TIME	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT									
+	68-3A	.01	1	FLOW	18.	18.	17.	17.	8.
				TIME	3.58	3.58	3.58	3.58	3.58
ROUTED TO									
+	RC68-3A	.01	1	FLOW	18.	17.	17.	16.	7.
				TIME	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT									
+	C68-5	.08	1	FLOW	71.	69.	66.	63.	23.
				TIME	3.58	3.58	3.58	3.58	3.67
ROUTED TO									
+	RC68-5	.08	1	FLOW	69.	67.	64.	61.	22.
				TIME	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT									
+	68-8	.01	1	FLOW	14.	14.	13.	13.	6.
				TIME	3.50	3.50	3.50	3.50	3.58
3 COMBINED AT									
+	C63-5	2.06	1	FLOW	2055.	2005.	1929.	1857.	935.
				TIME	3.75	3.75	3.75	3.83	3.75
ROUTED TO									
+	RC63-5	2.06	1	FLOW	2041.	1997.	1923.	1855.	915.
				TIME	3.83	3.83	3.83	3.83	3.75
HYDROGRAPH AT									
+	68-4	.03	1	FLOW	24.	23.	22.	20.	5.
				TIME	3.58	3.58	3.58	3.58	3.67
ROUTED TO									
+	R68-4	.03	1	FLOW	22.	21.	20.	19.	5.
				TIME	3.58	3.58	3.58	3.67	3.67
HYDROGRAPH AT									
+	68-6	.02	1	FLOW	18.	17.	16.	15.	4.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	C68-6	.06	1	FLOW	40.	39.	36.	34.	9.
				TIME	3.58	3.58	3.58	3.58	3.67
ROUTED TO									
+	RC68-6	.06	1	FLOW	39.	38.	36.	34.	9.
				TIME	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT									
+	68-9	.01	1	FLOW	14.	14.	14.	13.	7.
				TIME	3.50	3.50	3.50	3.50	3.50
3 COMBINED AT									
+	CC68-9	2.13	1	FLOW	2070.	2025.	1950.	1881.	927.
				TIME	3.83	3.83	3.83	3.83	3.75
ROUTED TO									
+	RC68-9	2.13	1	FLOW	2069.	2025.	1950.	1880.	923.
				TIME	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT									
+	63-4	.03	1	FLOW	53.	52.	51.	49.	27.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	C63-4	2.16	1	FLOW	2092.	2046.	1971.	1900.	939.
				TIME	3.83	3.83	3.83	3.83	3.75
ROUTED TO									
+	RD67-5	2.16	1	FLOW	2090.	2045.	1969.	1897.	935.
				TIME	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT									
+	D67-5	.00	1	FLOW	33.	33.	31.	30.	11.
				TIME	3.67	3.67	3.67	3.67	3.75
ROUTED TO									
+	RD67-5	.00	1	FLOW	34.	33.	32.	30.	12.
				TIME	3.83	3.83	3.83	3.83	3.92

HYDROGRAPH AT									
+	67-3	.05	1	FLOW	34.	33.	31.	30.	9.
				TIME	3.67	3.67	3.67	3.67	3.75
2 COMBINED AT									
+	C67-3	.05	1	FLOW	65.	64.	60.	57.	19.
				TIME	3.75	3.75	3.75	3.75	3.83
ROUTED TO									
+	RC67-3	.05	1	FLOW	65.	63.	60.	57.	19.
				TIME	3.75	3.75	3.83	3.83	3.92
HYDROGRAPH AT									
+	67-2	.04	1	FLOW	41.	40.	38.	37.	15.
				TIME	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT									
+	C67-2	.09	1	FLOW	102.	99.	94.	90.	30.
				TIME	3.75	3.75	3.75	3.75	3.83
ROUTED TO									
+	RC67-2	.09	1	FLOW	101.	98.	93.	89.	30.
				TIME	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT									
+	63-4A	.01	1	FLOW	22.	21.	21.	20.	11.
				TIME	3.50	3.50	3.50	3.50	3.50
ROUTED TO									
+	R63-4A	.01	1	FLOW	21.	21.	20.	20.	11.
				TIME	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT									
+	67-1	.04	1	FLOW	37.	36.	34.	33.	13.
				TIME	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT									
+	C63A	.05	1	FLOW	58.	56.	54.	52.	24.
				TIME	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT									
+	C67-1A	.14	1	FLOW	151.	147.	140.	134.	48.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO									
+	RC63A	.14	1	FLOW	151.	147.	140.	134.	47.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT									
+	68-2	.04	1	FLOW	60.	59.	57.	55.	28.
				TIME	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT									
+	68-1	.04	1	FLOW	66.	65.	63.	61.	32.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	C68-2	.08	1	FLOW	126.	124.	120.	116.	60.
				TIME	3.58	3.58	3.58	3.58	3.58
ROUTED TO									
+	RC68-2	.08	1	FLOW	120.	117.	114.	110.	59.
				TIME	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT									
+	68-10	.05	1	FLOW	84.	82.	80.	77.	43.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	C68-10	.13	1	FLOW	195.	191.	185.	179.	94.
				TIME	3.58	3.58	3.58	3.58	3.67
ROUTED TO									
+	RC68-10	.13	1	FLOW	192.	188.	182.	176.	94.
				TIME	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT									
+	68-11	.02	1	FLOW	27.	26.	26.	25.	14.
				TIME	3.58	3.58	3.58	3.58	3.58
4 COMBINED AT									
+	C67-1	2.45	1	FLOW	2391.	2336.	2245.	2155.	1067.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO									
+	RC67-1	2.45	1	FLOW	2365.	2314.	2228.	2145.	1054.
				TIME	3.75	3.83	3.83	3.83	3.83
HYDROGRAPH AT									

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+                 68-12       .01     1   FLOW           9.       9.       9.       8.       4.
                                          TIME         3.50     3.50     3.50     3.50     3.58

 HYDROGRAPH AT
+                FR04-C1       .00     1   FLOW           7.       7.       7.       7.       4.
                                          TIME         3.50     3.50     3.50     3.50     3.50

  3 COMBINED AT
+                  CFINAL      2.46     1   FLOW        2374.    2320.    2234.    2151.    1057.
                                          TIME         3.75     3.75     3.83     3.83     3.83
1
                                       SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                           (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                 INTERPOLATED TO
                                                                                COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)      (IN)     (MIN)     (CFS)     (MIN)       (IN)

          FOR PLAN = 1  RATIO=  .00
             RCH51  MANE         1.84    284.65    232.45      1.95      5.00    284.50    230.00        1.95

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2830E+02 EXCESS= .0000E+00 OUTFLOW= .2830E+02 BASIN STORAGE= .1985E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RCH51  MANE         1.86    279.50    232.37      1.91      5.00    279.04    230.00        1.91

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2773E+02 EXCESS= .0000E+00 OUTFLOW= .2773E+02 BASIN STORAGE= .1982E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RCH51  MANE         1.88    271.19    231.66      1.84      5.00    270.32    230.00        1.84

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2679E+02 EXCESS= .0000E+00 OUTFLOW= .2679E+02 BASIN STORAGE= .2205E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RCH51  MANE         1.91    261.34    230.99      1.78      5.00    261.22    230.00        1.78

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2584E+02 EXCESS= .0000E+00 OUTFLOW= .2585E+02 BASIN STORAGE= .2017E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RCH51  MANE         2.49    134.73    231.36       .89      5.00    133.98    230.00         .89

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1291E+02 EXCESS= .0000E+00 OUTFLOW= .1291E+02 BASIN STORAGE= .1982E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RCSC7  MANE          .85    448.89    229.88      2.00      5.00    448.87    230.00        2.00

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .4436E+02 EXCESS= .0000E+00 OUTFLOW= .4436E+02 BASIN STORAGE= .1174E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RCSC7  MANE          .86    440.54    229.89      1.96      5.00    440.52    230.00        1.96

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .4349E+02 EXCESS= .0000E+00 OUTFLOW= .4349E+02 BASIN STORAGE= .1151E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RCSC7  MANE          .87    427.01    230.16      1.90      5.00    426.82    230.00        1.90

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .4203E+02 EXCESS= .0000E+00 OUTFLOW= .4204E+02 BASIN STORAGE= .1100E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RCSC7  MANE          .88    412.96    230.58      1.83      5.00    412.73    230.00        1.83

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .4059E+02 EXCESS= .0000E+00 OUTFLOW= .4059E+02 BASIN STORAGE= .1189E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RCSC7  MANE         1.14    216.77    230.81       .93      5.00    216.29    230.00         .93

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2064E+02 EXCESS= .0000E+00 OUTFLOW= .2064E+02 BASIN STORAGE= .1121E-02 PERCENT ERROR=    .0
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[TITLE]
 Charleston/Maryland Storm Drain
 Maryland Parkway Main Line - Stewart Avenue to Charleston Boulevard
 Flow: mainline hydrology and prorated by Collection inflows-- D/S WSE From CSD

[REPORT]
COMPOSITE_ONLY
SKIP_INTERMEDIATE_POINTS

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Node33"
Reach            "Link32"
Reach            "Link23"
Reach            "Link22"
Reach            "Link21"
Reach            "Link20"
Junction         "Node20"
Reach            "Link19"
Reach            "Link30"
Reach            "Link18"
Transition       "Link17"
Reach            "Link24"
Reach            "Link29"
Reach            "Link15"
Reach            "Link14"
Reach            "Link13"
Reach            "Link12"
Junction         "Node12"
Reach            "Link11"
Reach            "Link10"
Junction         "Node10"
Reach            "Link9"
Transition       "Link8"
Reach            "Link7"
Reach            "Link6"
Junction         "Node6"
Reach            "Link5"
Reach            "Link31"
Junction         "Node32"
Reach            "Link4"
Reach            "Link3"
Reach            "Link2"
Junction         "Node2"
Reach            "Link1"
Reach            "Link26"
Reach            "Link25"
Reach            "Link28"
Reach            "Link27"
Headwork         "Node28"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Node33"            -5078.67   1947.68    1964       "12x6"      1956.51

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
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"Node28"            1969.96    1980.1     "42rcp"     77         0

[WALLENTRANCE]
**NAME              INVERT     GROUND     CHANNEL     LOSS
**                  ELEV       ELEV       ID          COEFFICIENT(opt.)
**------------      ---------  ---------- ----------  --------------

[WALLEXIT]
**NAME              INVERT     GROUND     CHANNEL     LOSS
**                  ELEV       ELEV       ID          COEFFICIENT(opt.)
**------------      ---------  ---------- ----------  --------------

[BRIDGEENTRANCE]
**NAME              INVERT     GROUND     CHANNEL     REDUCTION
**                  ELEV       ELEV       ID          FACTOR(opt.)
**------------      ---------  ---------- ----------  --------------

[BRIDGEEXIT]
**NAME              INVERT     GROUND     CHANNEL     REDUCTION
**                  ELEV       ELEV       ID          FACTOR(opt.)
**------------      ---------  ---------- ----------  --------------

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                               BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                               LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Node2"             1967.44    1983.8     "42rcp"     6          0.013      1
"Node2_Lateral1"    1967.44               "36rcp"                                       45         42.5

"Node6"             1964.01    1972.5     "6x4"       5          0.015      1
"Node6_Lateral1"    1964.19               "48rcp"                                       45         61.3

"Node10"            1960.02    1970.5     "12x4"      5          0.015      1
"Node10_Lateral1"   1960.02               "36rcp"                                       90         135.9

"Node12"            1957.79    1971       "12x4"      24         0.015      1
"Node12_Lateral1"   1958.58               "36rcp"                                       45         32.1

"Node20"            1950.6     1968.5     "12x6"      11.61      0.015      1
"Node20_Lateral1"   1950.56               "60rcp"                                       30         255.4

"Node32"            1965.82    1975.4     "6x4"       8          0.015      1
"Node32_Lateral1"   1966.06               "48rcp"                                       30         44.8


[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
"Link8"             1960.35    1971       "6x4"       12         0.015
"Link17"            1952.88    1964       "12x4"      8          0.015

[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Link1"             1968.22    1984.8     "42rcp"     220        0.013      0          0          1
"Link2"             1967.25    1983.8     "6x4"       242.77     0.015      0          0          1
"Link3"             1966.51    1977       "6x4"       5          0.015      0          0          0
```

"Link4"	1966.5	1977	"6x4"	225.7	0.015	0	0	0
"Link5"	1964.59	1974	"6x4"	64.63	0.015	0	0	0
"Link6"	1963.97	1972.2	"6x4"	185.88	0.015	0	0	0
"Link7"	1962.16	1971.4	"6x4"	190.38	0.015	0	0	0
"Link9"	1960.2	1971	"12x4"	42.57	0.015	0	0	0
"Link10"	1960	1971	"12x4"	460.115	0.015	45	0	0
"Link11"	1957.9	1971	"12x4"	24.035	0.015	45	0	0
"Link12"	1957.68	1971	"12x4"	328.31	0.015	22.5	0	0
"Link13"	1956.16	1963.5	"12x4"	16	0.015	22.5	0	0
"Link14"	1956.09	1963.1	"12x4"	16	0.015	22.5	0	0
"Link15"	1956.01	1963.1	"12x4"	16	0.015	22.5	0	0
"Link18"	1952.85	1964.3	"12x6"	293.06	0.015	0	0	0
"Link19"	1950.78	1968	"12x6"	26.14	0.015	13.3	0	0
"Link20"	1950.52	1968.5	"12x6"	32.93	0.015	12	0	0
"Link21"	1950.3	1968.8	"12x6"	55.14	0.015	0	0	0
"Link22"	1949.93	1968.5	"12x6"	183.22	0.015	91	0	0
"Link23"	1948.7	1965.6	"12x6"	24.06	0.015	0	0	0
"Link24"	1953.87	1961.2	"12x4"	142.81	0.015	0	0	0
"Link25"	1969.66	1982.1	"42rcp"	2.5	0.013	0	15	0
"Link26"	1969.56	1982.1	"42rcp"	249	0.013	0	15	0
"Link27"	1969.96	1980.1	"42rcp"	41.97	0.013	0	0	0
"Link28"	1969.76	1982.1	"42rcp"	2.5	0.013	0	15	0
"Link29"	1955.94	1962.99	"12x4"	451.75	0.015	22.5	0	0
"Link30"	1950.88	1968	"12x6"	16	0.015	0	0	0
"Link31"	1965.8	1975.4	"6x4"	402.08	0.015	0	0	0
"Link32"	1948.16	1964.4	"12x6"	24	0.015	0	0	0

[CHANNEL]

**REGULAR TYPES 1-4

**ID	TYPE	HEIGHT	WIDTH	LEFT SLOPE	RIGHT SLOPE	NUMBER PIERS	AVG PIER WIDTH	INVERT CROSS FALL
"12x6"	3	6	12	0	0	0	0	0
"42rcp"	4	3.5	3.5					
"36rcp"	4	3	3					
"6x4"	3	4	6	0	0	0	0	0
"48rcp"	4	4	4					
"12x4"	3	4	12	0	0	0	0	0
"60rcp"	4	5	5					

**IRREGULAR TYPES 5-6

**ID	TYPE	NUMBER PIERS	AVG PIER WIDTH	PIER1 ELEV	PIER2 ELEV	PIER3 ELEV	PIER4 ELEV	PIER5 ELEV	PIER6 ELEV	PIER7 ELEV	PIER8 ELEV	PIER9 ELEV	PIER10 ELEV

[POINT]

**ID	XCOORD	YCOORD

```
************************************
Water Surface Profile Gradient (WSPG)
XP WSPG
Engine Version 1.3         06/09/2010
XP Software        www.xpsoftware.com
************************************

INPUT FILE
************************************
X:\Projects\100055435 - Charleston SD\HH\WSPG\MainLine_Maryland.wsx
Computed  11/09/17  11:25:21

TITLE INFORMATION
************************************
 Charleston/Maryland Storm Drain
 Maryland Parkway Main Line - Stewart Avenue to Charleston Boulevard
 Flow: mainline hydrology and prorated by Collection inflows-- D/S WSE From CSD

WARNING SUMMARY
************************************
 WARNING 47: Junction Node2 has a different channel than its direct downstream element.
 WARNING 45: One of the elevations of junction's Node20 laterals is less than the U/S elevation.
 WARNING 25: Link type element Link2 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link6 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link10 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link12 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link20 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link31 has different invert elevation than its upstream node.
 WARNING 36: D/S processing stopped in junction Node32 because critical momentum is greater than maximum momentum.
 WARNING 36: D/S processing stopped in junction Node6 because critical momentum is greater than maximum momentum.
 WARNING 36: D/S processing stopped in junction Node10 because critical momentum is greater than maximum momentum.
 WARNING 36: D/S processing stopped in junction Node12 because critical momentum is greater than maximum momentum.
 WARNING 36: D/S processing stopped in junction Node20 because critical momentum is greater than maximum momentum.

RESULTS
************************************


============================================================
   Main Line
============================================================

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Node33"	Outlet	-5078.67	1947.68	1964.00	1956.510	8.830	649.00	9.05	1.27	1957.78	0.000	4.496	0.000	0.00000	0.000	Tr./Rect.closed
"Link32"	Reach	-5054.67	1948.16	1964.40	1956.590	8.430	649.00	9.05	1.27	1957.86	0.000	4.496	0.652	0.02000	2.597	Tr./Rect.closed
"Link23"	Reach	-5030.61	1948.70	1965.60	1956.670	7.970	649.00	9.05	1.27	1957.94	0.000	4.496	0.652	0.02244	2.497	Tr./Rect.closed
"Link22"	Reach	-4847.39	1949.93	1968.50	1957.534	7.604	649.00	9.05	1.27	1958.80	0.000	4.496	0.652	0.00671	3.796	Tr./Rect.closed
"Link21"	Reach	-4792.25	1950.30	1968.80	1957.717	7.417	649.00	9.05	1.27	1958.99	0.000	4.496	0.652	0.00671	3.797	Tr./Rect.closed
"Link20"	Reach	-4759.32	1950.52	1968.50	1957.920	7.400	649.00	9.05	1.27	1959.19	0.000	4.496	0.652	0.00668	3.803	Tr./Rect.closed
"Node20"	Junction	-4747.71	1950.60	1968.50	1958.749	8.149	393.60	5.49	0.47	1959.22	0.000	3.221	0.000	0.00689	0.000	Tr./Rect.closed
"Link19"	Reach	-4721.57	1950.78	1968.00	1958.817	8.037	393.60	5.49	0.47	1959.28	0.000	3.221	0.395	0.00689	2.656	Tr./Rect.closed
"Link30"	Reach	-4705.57	1950.88	1968.00	1958.837	7.957	393.60	5.49	0.47	1959.30	0.000	3.221	0.395	0.00625	2.746	Tr./Rect.closed
"Link18"	Reach	-4412.51	1952.85	1964.30	1959.195	6.345	393.60	5.49	0.47	1959.66	0.000	3.221	0.395	0.00672	2.678	Tr./Rect.closed
"Link17"	Transition	-4404.51	1952.88	1964.00	1958.746	5.866	393.60	8.24	1.06	1959.80	0.000	3.221	0.728	0.00375	0.000	Tr./Rect.closed
"Link24"	Reach	-4261.70	1953.87	1961.20	1959.326	5.456	393.60	8.24	1.06	1960.38	0.000	3.221	0.728	0.00693	2.650	Tr./Rect.closed
"Link29"	Reach	-3809.95	1955.94	1962.99	1961.265	5.325	393.60	8.24	1.06	1962.32	0.000	3.221	0.728	0.00458	3.056	Tr./Rect.closed
"Link15"	Reach	-3793.95	1956.01	1963.10	1961.436	5.426	393.60	8.24	1.06	1962.49	0.000	3.221	0.728	0.00437	3.106	Tr./Rect.closed
"Link14"	Reach	-3777.95	1956.09	1963.10	1961.606	5.516	393.60	8.24	1.06	1962.66	0.000	3.221	0.728	0.00500	2.965	Tr./Rect.closed
"Link13"	Reach	-3761.95	1956.16	1963.50	1961.777	5.617	393.60	8.24	1.06	1962.83	0.000	3.221	0.728	0.00438	3.106	Tr./Rect.closed

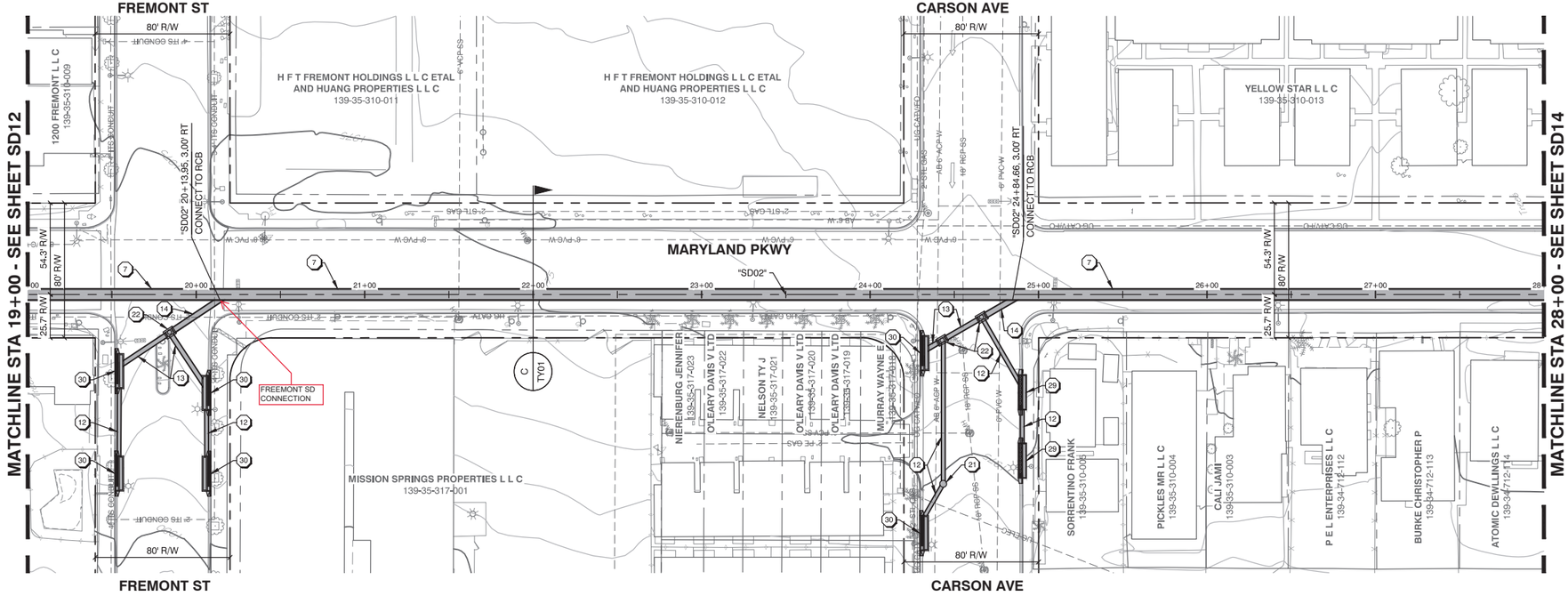
"Link12"	Reach	-3433.64	1957.68	1971.00	1963.215	5.535	393.60	8.24	1.06	1964.27	0.000	3.221	0.728	0.00463	3.045	Tr./Rect.closed
"Node12"	Junction	-3409.64	1957.79	1971.00	1963.568	5.778	361.50	7.57	0.89	1964.46	0.000	3.044	0.000	0.00458	0.000	Tr./Rect.closed
"Link11"	Reach	-3385.60	1957.90	1971.00	1963.776	5.876	361.50	7.57	0.89	1964.67	0.000	3.044	0.669	0.00458	2.883	Tr./Rect.closed
"Link10"	Reach	-2925.49	1960.00	1971.00	1965.478	5.478	361.50	7.57	0.89	1966.37	0.000	3.044	0.669	0.00456	2.885	Tr./Rect.closed
"Node10"	Junction	-2920.49	1960.02	1970.50	1966.577	6.557	225.60	4.72	0.35	1966.92	0.000	2.223	0.000	0.00400	0.000	Tr./Rect.closed
"Link9"	Reach	-2877.92	1960.20	1971.00	1966.634	6.434	225.60	4.72	0.35	1966.98	0.000	2.223	0.417	0.00423	2.149	Tr./Rect.closed
"Link8"	Transition	-2865.92	1960.35	1971.00	1965.842	5.492	225.60	9.50	1.40	1967.24	0.000	3.528	0.841	0.01250	0.000	Tr./Rect.closed
"Link7"	Reach	-2675.54	1962.16	1971.40	1967.234	5.074	225.60	9.50	1.40	1968.63	0.000	3.528	0.841	0.00951	2.978	Tr./Rect.closed
"Link6"	Reach	-2489.66	1963.97	1972.20	1968.593	4.623	225.60	9.50	1.40	1969.99	0.000	3.528	0.841	0.00974	2.951	Tr./Rect.closed
"Node6"	Junction	-2484.66	1964.01	1972.50	1969.660	5.650	164.30	6.92	0.74	1970.40	0.000	2.856	0.000	0.00800	0.000	Tr./Rect.closed
"Link5"	Reach	-2420.03	1964.59	1974.00	1969.911	5.321	164.30	6.92	0.74	1970.65	0.000	2.856	0.613	0.00897	2.406	Tr./Rect.closed
"Link31"	Reach	-2017.95	1965.80	1975.40	1971.470	5.670	164.30	6.92	0.74	1972.21	0.000	2.856	0.613	0.00301	3.622	Tr./Rect.closed
"Node32"	Junction	-2009.95	1965.82	1975.40	1972.013	6.193	119.50	5.03	0.39	1972.41	0.000	2.310	0.000	0.00250	0.000	Tr./Rect.closed
"Link4"	Reach	-1784.25	1966.50	1977.00	1972.476	5.976	119.50	5.03	0.39	1972.87	0.000	2.310	0.446	0.00301	2.846	Tr./Rect.closed
"Link3"	Reach	-1779.25	1966.51	1977.00	1972.486	5.976	119.50	5.03	0.39	1972.88	0.000	2.310	0.446	0.00200	3.320	Tr./Rect.closed
"Link2"	Reach	-1536.48	1967.25	1983.80	1973.004	5.754	119.50	5.03	0.39	1973.40	0.000	2.310	0.446	0.00305	2.833	Tr./Rect.closed
"Node2"	Junction	-1530.48	1967.44	1983.80	1972.662	5.222	77.00	8.00	0.99	1973.66	0.000	2.745	0.000	0.03167	0.000	Pipe
"Link1"	Reach	-1310.48	1968.22	1984.80	1974.000	5.780	77.00	8.00	0.99	1974.99	0.000	2.745	0.000	0.00355	3.500	Pipe
"Link26"	Reach	-1061.48	1969.56	1982.10	1975.508	5.948	77.00	8.00	0.99	1976.50	0.000	2.745	0.000	0.00538	3.028	Pipe
"Link25"	Reach	-1058.98	1969.66	1982.10	1975.572	5.912	77.00	8.00	0.99	1976.57	0.000	2.745	0.000	0.04000	1.502	Pipe
"Link28"	Reach	-1056.48	1969.76	1982.10	1975.636	5.876	77.00	8.00	0.99	1976.63	0.000	2.745	0.000	0.04000	1.502	Pipe
"Link27"	Reach	-1014.51	1969.96	1980.10	1975.881	5.921	77.00	8.00	0.99	1976.88	0.000	2.745	0.000	0.00477	3.500	Pipe
"Node28"	Headwrk	-1014.51	1969.96	1980.10	1975.881	5.921	77.00	8.00	0.99	1976.88	0.000	2.745	0.000	0.00000	0.000	Pipe

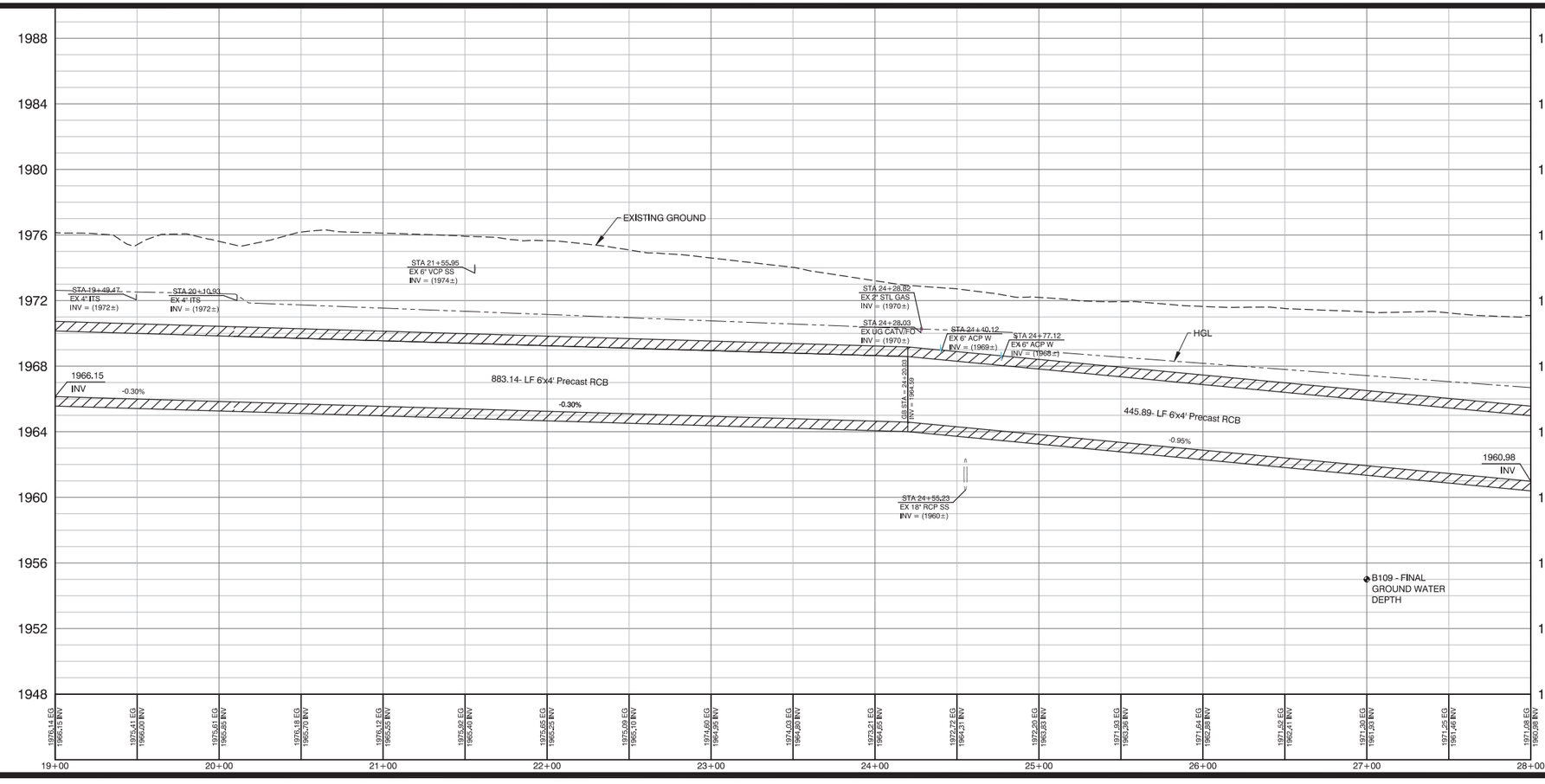
*) in the W.S.ELEV column indicates flooding, it is set whenever W.S.ELEV > GROUND ELEV
i.p. = intermediate point processing results for reaches

1.4 cfs bypass Freemont and Maryland

Charleston/Maryland Storm Drain
Drop Inlet Summary

DI	General Location	Type	Slope (%)/ Sump	Q_{street}	Q_{Source}	$Q_{intercepted}$	Q_{bypass}
A-N-1	Stewart	C: 20' Gr:1.5' x 17.5'	1.19	37.13	half of 75% C60A-1 (for diversions northwest of 9th Street)	28.80	8.32
A-N-2	Stewart	C: 20' Gr:1.5' x 17.5'	1.19	22.73	split in half: (bypass of A-N-1 + half of 75% of C60A-1)	19.41	3.31
A-N-3	Stewart	C: 5' Gr:1.5' x 2.5'	1.19	3.31	bypass of A-N-2	2.60	0.71
A-N-4	Stewart	C: 5' Gr:1.5' x 2.5'	1.19	0.71	bypass of A-N-3	0.71	0.00
A-S-1	Stewart	C: 20' Gr:1.5' x 17.5'	1.00	22.73	split in half: (bypass of A-N-1 + half of 75% of C60A-1)	19.75	2.98
A-S-2	Stewart	C: 20' Gr:1.5' x 17.5'	1.19	2.98	bypass of A-S-1	2.98	0.00
B-N-1	Ogden	C: 20' Gr:1.5' x 17.5'	2.13	29.50	1/2 (C60A-2)	22.22	7.28
B-N-2	Ogden	C: 20' Gr:1.5' x 17.5'	2.13	7.28	bypass of B-N-1	7.04	0.24
B-S-1	Ogden	C: 20' Gr:1.5' x 17.5'	2.13	29.50	1/2 (C60A-2)	22.22	7.28
B-S-2	Ogden	C: 20' Gr:1.5' x 17.5'	2.13	7.28	bypass of B-S-1	7.04	0.24
C-N-1	Fremont	C: 20' Gr:1.5' x 17.5'	3.33	30.50	1/2 (C60A-3)	21.38	9.12
C-N-2	Fremont	C: 20' Gr:1.5' x 17.5'	3.33	9.12	bypass of C-N-1	8.40	0.72
C-S-1	Fremont	C: 20' Gr:1.5' x 17.5'	3.33	30.50	1/2 (C60A-3)	21.38	9.12
C-S-2	Fremont	C: 20' Gr:1.5' x 17.5'	3.33	9.12	bypass of C-S-1	8.40	0.72
D-N-1	Carson	C: 20' Gr:1.5' x 17.5'	2.63	45.00	1/2 (C60A-4)	29.30	15.70
D-N-2	Carson	C: 20' Gr:1.5' x 17.5'	2.63	15.70	bypass of D-N-1	13.31	2.39
D-S-1	Carson	C: 20' Gr:1.5' x 17.5'	2.63	45.00	1/2 (C60A-4)	29.30	15.70
D-S-2	Carson	C: 20' Gr:1.5' x 17.5'	2.63	15.70	bypass of D-S-1	13.31	2.39
E-N-1	Bridger	C: 20' Gr:1.5' x 17.5'	2.92	46.50	1/2 (C60A-5)	29.45	17.05
E-N-2	Bridger	C: 20' Gr:1.5' x 17.5'	2.92	17.05	bypass of E-N-1	14.06	2.99
E-S-1	Bridger	C: 20' Gr:1.5' x 17.5'	2.92	46.50	1/2 (60A-6	29.45	17.05
E-S-2	Bridger	C: 20' Gr:1.5' x 17.5'	2.92	17.05	bypass of E-S-1	14.06	2.99
F-N-1	Lewis	C: 20' Gr:1.5' x 17.5'	2.43	27.00	1/2 (60A-6)	20.42	6.58
F-N-2	Lewis	C: 20' Gr:1.5' x 17.5'	2.43	6.58	bypass of F-N-1	6.40	0.18
F-S-1	Lewis	C: 20' Gr:1.5' x 17.5'	2.43	27.00	1/2 (60A-6)	20.42	6.58
F-S-2	Lewis	C: 20' Gr:1.5' x 17.5'	2.43	6.58	bypass of F-S-1	6.40	0.18
G-N-1	Clark	C: 20' Gr:1.5' x 17.5'	2.87	47.00	1/2 (C60A-7)	29.76	17.24
G-N-2	Clark	C: 20' Gr:1.5' x 17.5'	2.87	17.24	bypass of G-N-1	14.21	3.03
G-S-1	Clark	C: 20' Gr:1.5' x 17.5'	2.87	47.00	1/2 (C60A-7)	29.76	17.24
G-S-2	Clark	C: 20' Gr:1.5' x 17.5'	2.87	17.24	bypass of G-S-1	14.21	3.03
H-N-1	Bonneville	C: 20' Gr:1.5' x 17.5'	2.15	88.00	1/2 (C60A-8)	48.72	39.28
H-N-2	Bonneville	C: 20' Gr:1.5' x 17.5'	2.15	39.28	bypass of H-N-1	27.47	11.81





NORTH

GRAPHIC SCALE
40 0 20 40 80
(IN FEET)
HORIZ 1 inch = 40 ft.
VERTICAL 1 inch = 4 ft.

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

STORM DRAIN CONSTRUCTION NOTES

7. INSTALL 6' X 4' RCB SD
2. INSTALL 10' X 8' RCB SD
3. INSTALL 24' X 6' RCB SD
4. INSTALL 12' X 8' RCB SD
5. INSTALL 14' X 8' RCB SD
6. INSTALL 18' X 8' RCB SD
7. INSTALL 6' X 4' RCB SD
8. NOT USED
9. INSTALL 12' X 4' RCB SD
10. INSTALL 12' X 6' RCB SD
11. INSTALL 18" RCP SD
12. INSTALL 24" RCP SD
13. INSTALL 30" RCP SD
14. INSTALL 36" RCP SD
15. INSTALL 42" RCP SD
16. INSTALL 48" RCP SD
17. INSTALL 54" RCP SD
18. INSTALL 60" RCP SD
19. INSTALL 66" RCP SD
20. INSTALL RCB TRANSITION STRUCTURE
21. INSTALL TYPE I 60" MANHOLE PER USDCCA #403
22. INSTALL TYPE II MANHOLE PER USDCCA #405
23. INSTALL TYPE III MANHOLE PER USDCCA #406
24. INSTALL TYPE I 48" MANHOLE PER USDCCA #403
25. INSTALL 5' TYPE "CM2" DROP INLET PER USDCCA #412.1
26. INSTALL 10' TYPE "CM2" DROP INLET PER USDCCA #412.1
27. INSTALL 12.5' TYPE "CM2" DROP INLET PER USDCCA #412.1
28. INSTALL 15' TYPE "CM2" DROP INLET PER USDCCA #412.1
29. INSTALL 20' TYPE "CM2" DROP INLET PER USDCCA #412.1
30. INSTALL 20' TYPE "CM" DROP INLET PER USDCCA #422
31. CONNECT TO EXISTING DROP INLET
32. REMOVE EXISTING STORM DRAIN MANHOLE
33. REMOVE EXISTING SANITARY SEWER LINE
34. REMOVE EXISTING SANITARY SEWER MANHOLE

NOTE

1. ALL CURB INLETS TO INCLUDE STORM WATER QUALITY MANAGEMENT STAMP PER USDCCA #421.

APPROVED FOR CONSTRUCTION

Las Vegas Valley Water District Engineering Services Manager
Date _____ Project No. _____xxxxxx_____ ESN 018

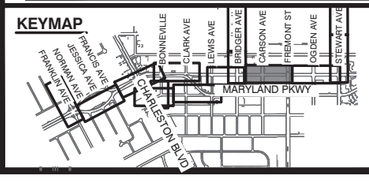
UTILITY NOTE:

ALL EXISTING UTILITY LOCATIONS SHOWN HEREON ARE APPROXIMATE ONLY. IT SHALL BE THE CONTRACTORS RESPONSIBILITY TO DETERMINE THE EXACT VERTICAL AND HORIZONTAL LOCATION OF ALL EXISTING UNDERGROUND UTILITIES PRIOR TO COMMENCING CONSTRUCTION.

NO REPRESENTATION IS MADE THAT ALL UTILITIES ARE SHOWN HEREON. THE ENGINEER ASSUMES NO RESPONSIBILITY FOR UTILITIES NOT SHOWN IN THEIR PROPER LOCATIONS.

THE DEPTH BELOW GRADE OF THE VARIOUS UTILITIES DEPICTED ON THE PLANS VARIES THROUGHOUT THE PROJECT AREA. THE CONTRACTOR SHALL EXERCISE EXTREME CARE WHEN EXCAVATING AND GRADING THE SUBBASE IN THE VICINITY TO AVOID DAMAGE TO THE LATTER.

KEYMAP



	REVISIONS
NO.	DATE

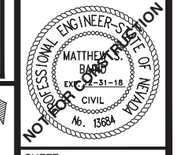
PREPARED BY
ATKINS
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TITLE
CHARLESTON/MARYLAND STORM DRAIN

SHEET
STORM DRAIN PLAN AND PROFILE STA 19+00 TO STA 28+00



SHEET
SD13
34 OF 51
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