

70% DRAFT FINAL DRAINAGE REPORT

LAS VEGAS BOULEVARD WIDENING PROJECT

STEWART AVENUE TO WASHINGTON AVENUE

PREPARED FOR:



CITY OF LAS VEGAS DEPARTMENT OF PUBLIC WORKS
333 NORTH RANCHO DRIVE
LAS VEGAS, NV 89106

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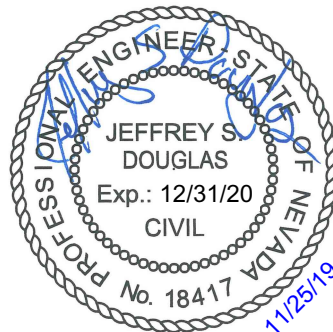


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GEOTECHNICAL REPORT
HEC-1 ELECTRONIC FILES
WSPGW ELECTRONIC FILES
70% IMPROVEMENT PLANS
70% COST ESTIMATE

Executive Summary

The City of Las Vegas (CLV) contracted with Louis Berger, a WSP Company, to provide engineering and design services for grading, drainage, right-of-way (ROW), lighting, utilities, traffic design and construction phasing for improvements to Las Vegas Boulevard (LV Blvd) from Stewart Avenue to Washington Avenue. The Project is located in the central part of the Las Vegas Valley, within the City of Las Vegas Cultural Corridor that crosses under the I-515 Freeway Bridge. The roadway design encompasses 85- to 162-foot wide full-street improvements measured from back of curb to back of curb within the 100- to 200-foot ROW. The full street improvements include development of six (6) to nine (9) lanes of traffic with curb and gutter, bus turnouts and various medians, as well as all project aspects listed above.

This Draft Final Design Report summarizes the hydrologic and hydraulic (H&H) analyses prepared to design storm drain facilities in accordance with the Clark County Regional Flood Control District (CCRFCD) Hydrologic Criteria and Drainage Design Manual (CCRFCD, 1999). Hydrologic information from the *2005 City of Las Vegas Central Neighborhood Flood Control Master Plan*, *2018 Las Vegas Valley Master Plan Update*, and *90% Drainage Design Report for Las Vegas Boulevard Improvements from Charleston Boulevard to Stewart Avenue* were reviewed to ensure the Project design accommodates existing and pending improvements in the area.

The Project includes installing approximately 2,850 linear feet of 30-inch to 36-inch diameter RCP storm drain main line on the west side of Las Vegas Boulevard. The proposed storm drain main line will be connected to an existing 12-foot wide by 8-foot high RCB regional facility.

Drop inlets and storm drain laterals are provided at key locations along the west and east sides of Las Vegas Boulevard. Additionally, drop inlets and lateral storm drains will be included in the I-515 southbound off-ramp, a gore area adjacent to the I-515 northbound on-ramp, Bonanza Road, Friends of the Library parking lot and Bell Drive. The majority of the proposed drop inlets and storm drain laterals along the east side of Las Vegas Boulevard will be connected to an existing 48-inch storm drain currently located under the east curb between Stewart Avenue and Washington Avenue. Due to the proposed roadway widening, existing drop inlets will be removed and replaced by new drop inlets located along the new curb location.

This Project is being coordinated with the *Las Vegas Boulevard Improvements from Sahara Boulevard to Stewart Avenue Project* designed by the CA Group, Inc. and VTN-Nevada. CA Group and VTN-Nevada have completed Pre-final Improvement plans and 90% drainage report to connect a new 48-inch storm drain to the existing 48-inch storm drain within the Stewart Avenue and Las Vegas Boulevard intersection. To accommodate the roadway widening, this project will remove a portion of the existing 48-inch storm drain. A new connection to the 12-foot wide by 8-foot high RCB regional facility will be made south of Washington Avenue.



At the time of this writing, design of this Project is at a 70% level of completion. Topographical and pothole surveys were completed by the City of Las Vegas. Louis Berger's subconsultants performed and prepared utility potholes and geotechnical investigations. Louis Berger integrated survey, utility, geotechnical, and flood control design information to prepare 70% Plans. The 70% drainage improvements for this project are estimated to cost 1.8 million dollars to be funded by RTC.

1.0 Introduction and Purpose

1.1 Project Overview

This report was prepared by Louis Berger, a WSP Company, for the City of Las Vegas (CLV) and presents drainage engineering design and analysis for the Las Vegas Boulevard Widening Project, Stewart Avenue to Washington Avenue. The Project is located in the central part of the Las Vegas Valley, within the City of Las Vegas Cultural Corridor that crosses under the I-515 Freeway Bridge (see Figure 1.1).

The Project includes full-street improvements for approximately 4,500 linear feet of Las Vegas Boulevard from Stewart Avenue to Washington Avenue, including curb, gutter, and sidewalk; reconfiguring the median islands; new pavement; drainage improvements; and utility relocations.

Project improvements will be maintained by the CLV, including the storm drain facilities within NDOT right-of-way. Therefore, this Project will be coordinated with CLV and NDOT.

This report addresses the 70% design level for the drainage improvements for this Project segment of Las Vegas Boulevard. The intent of this report is to provide detailed hydrologic and hydraulic analyses in support of the drainage recommendations for the project. The following tasks were performed in the preparation of this report:

- Identified and reviewed previous drainage studies and plans for the Project and offsite areas adjacent to the Project.
- Identified existing and proposed CCRFCD drainage facilities adjacent to or within the Project limits.
- Identified the Federal Emergency Management Agency (FEMA) floodplain designations within the Project limits.
- Estimated runoff generated from onsite and offsite subbasins during 10-, 25- and 100-year 6-hour storm events.
- Determined design flows for recommended drainage facilities.
- Perform hydraulic calculations for design of drainage facilities to meet local and CCRFCD street flow criteria.

1.2 Report Organization

This Report is submitted in conjunction with the 70% Improvement Plans and Cost Estimate, and presents an overview of the drainage design for the Project, hydrologic methods, parameters, design flow rates, hydraulic grade line for the proposed main line storm drain and hydraulic modeling results, and drainage facility design. A Data CD is included at the end of this Report that contains the following documentation to support Project design to date:

- Geotechnical Report – electronic copy of report dated August 9, 2012.
- 70% Design Plans – as submitted with this Report.
- Hydrologic Calculations
- Hydraulic Calculations for the Las Vegas Boulevard West Side Main Line Storm Drain – electronic files as submitted with this Report.

This report is organized as follows:

Section 1 provides general project background;

Section 2 presents previous studies related to the project;

Section 3 discusses hydrologic design and analysis;

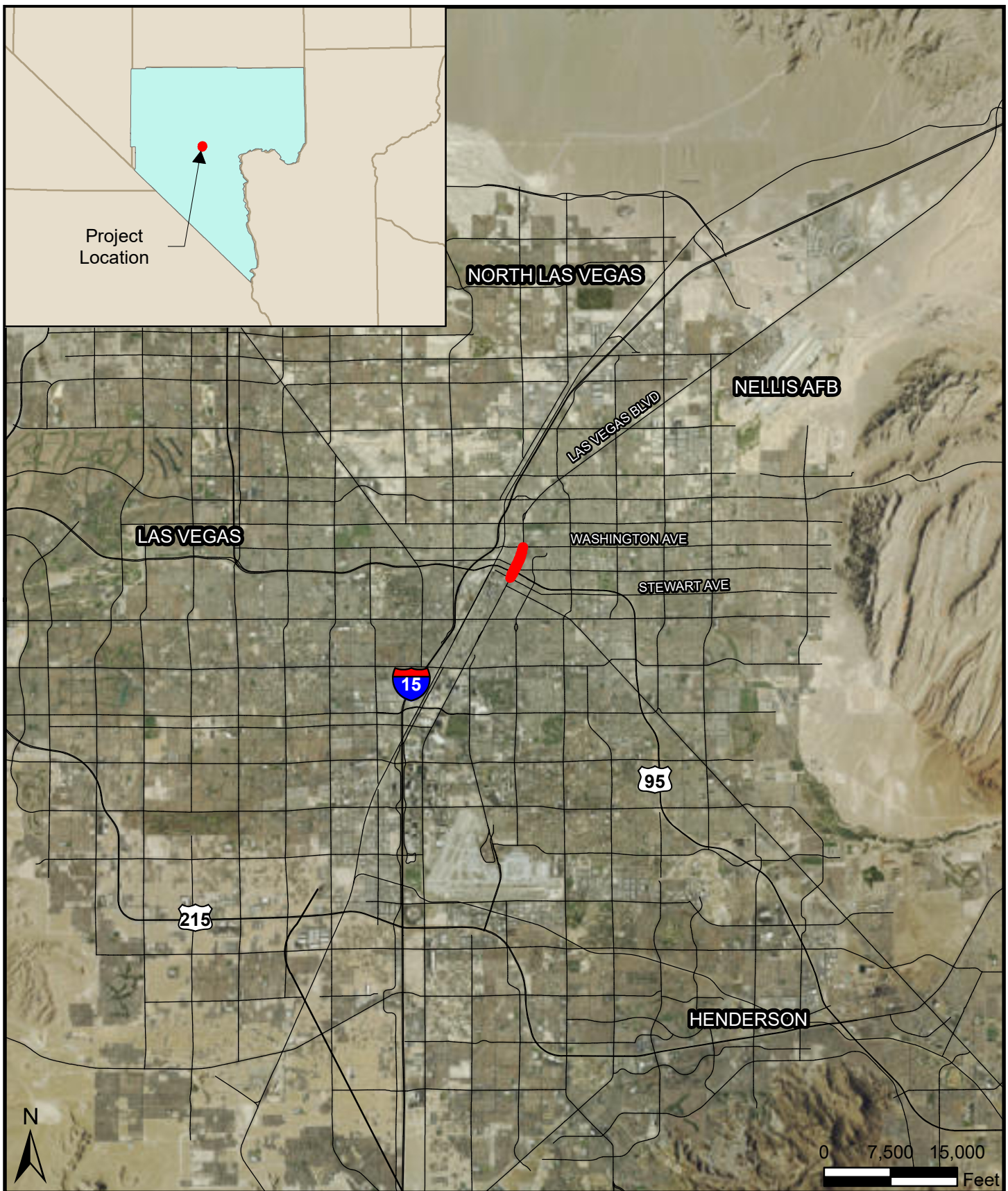
Section 4 presents results of hydrologic analysis;

Section 5 discusses hydraulic design and analysis and street capacity calculation;

Section 6 provides a cost estimate;

Section 7 provides conclusions and recommendations; and

Section 8 includes references.



**LAS VEGAS BOULEVARD WIDENING PROJECT
STEWART AVENUE TO WASHINGTON AVENUE**

VICINITY MAP
FIGURE 1.1



2.0 Previous Studies

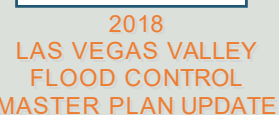
2.1 Las Vegas Valley Flood Control Facilities Master Plan Update

In 1985, the Nevada Legislature passed legislation allowing local entities the opportunity to create the CCRFCD. The CCRFCD is responsible for developing and implementing a comprehensive flood control master plan to alleviate flooding. In 1986, the original flood control master plan was developed in accordance with Nevada state law that covered the entire CCRFCD service area, Clark County. The Master Plan has been updated several times since, with the most recent update occurring in 2018. The 2018 Las Vegas Valley Flood Control Facilities Master Plan Update (CCRFCD, 2018) includes information on existing and planned flood control facilities within the entire valley. Hydrologic information and subbasin boundaries from the *2018 Las Vegas Valley Flood Control Facilities Master Plan Update* were reviewed and utilized for this report.

Figures 2.1a and 2.1b are reproductions of CCRFCD, 2018 MPU Figure F-25 for the project area. Storm drains proposed with this Project will be connected to the Washington Avenue Channel, CCRFCD Facilities LVWH 0305 and 0361, south of Washington Avenue. The Washington Avenue Channel enters Las Vegas Boulevard approximately 520 linear feet south of Washington Avenue and runs north to the Washington Avenue and Las Vegas Boulevard intersection, and then east in Washington Avenue parallel to the Washington Avenue Parallel CCRFCD Facility (WAPR 0000 and 0037). The proposed storm drain connections will not adversely affect the hydraulic performance of the Washington Avenue Channel System. The Washington Avenue System was analyzed in the *Las Vegas Creek Letter of Map Revision (LOMR) from Las Vegas Boulevard to the Las Vegas Wash* (CLV, 1998).

2.2 Las Vegas Creek Letter of Map Revision (LOMR) from Las Vegas Boulevard to the Las Vegas Wash

The CLV, 1998 included a hydraulic analysis for the existing Washington Avenue Channel CCRFCD Facility. The hydraulic analysis is based on a flow rate of 1,600 cfs, which is consistent with the 100-year storm event flow rate of 1,562 cfs included in the CCRFCD, 2018. The model results included in the CLV, 1998 show the Washington Avenue Channel has open-channel flow with a minimum 2.27 feet of freeboard. Therefore, the proposed storm drain connections will not adversely affect the hydraulic performance of the Washington Avenue Channel System. Pertinent referenced information from the CLV, 1998 has been included in Appendix C.



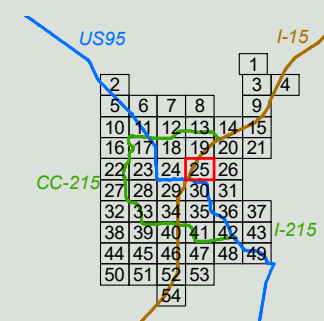
LEGEND

- Remove & Replace/Parallel Facilities**
- | Category A | Category B |
|--|--|
|  Channel |  Channel |
|  Stormdrain |  Stormdrain |
|  Crossing |  Crossing |



Scale: 1 inch = 2,000 feet

Aerial Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the



ATKINS
Member of the SNC-Lavalin Group



Louis Berger

Figure 2.1a

ID / Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
CABZ 0010	E	CEDAR AVENUE - BONANZA 60" RCP	1450					0.30
LCCH 0013	E	LAS VEGAS CREEK CHANNEL 2: 12' X 6' RCB	2035	3050	CLC20-C	MEADOWS4	9.60	0.82
LV15		FREEWAY CHANNEL						
0000	E	CONC CHNL 20'W 10'D 1.5:1 SS (REPLACE W/ LV150001)	1759	5012	2CLV1E-3	CWEST4	11.19	0.12
0001	P0	CONC CHNL 55'W 11'D 0:1 SS (REPLACES LV150000)	1759	5012	2CLV1E-3	CWEST4	11.19	0.12
0035	E	CONC CHNL 20'W 10'D 1.5: SS	899	1404*	2CLV1D-5*	CWEST4	10.29	0.16
0050	E	2: 8' X 10' RCB	1504	1404*	2CLV1D-5*	CLVMD4	10.29	0.75
0051	E	12' X 10' RCB	2524	3275*	2CLV1D-5*	CLVMD4	10.29	5.20
0078	E	CONC CHNL 20'W 10'D 1.5:1 SS (REPLACE W/ LV150079)	1608	4679	2CLV1D-5	CWEST4	10.29	0.14
0079	P0	CONC CHNL 50'W 11'D 0:1 SS (REPLACES LV150078)	1608	4679	2CLV1D-5	CWEST4	10.29	0.14
0109	E	CONC CHNL 15-20'W 10'D 1.5:1 SS (REPLACE W/ LV150110)	1576	4353	CLV1D-4	CWEST4	9.49	0.11
0110	P0	CONC CHNL 45'W 11:5D 0:1 SS (REPLACES LV150109)	1576	4353	CLV1D-4	CWEST4	9.49	0.11
0139	E	CONC CHNL 15'W 10'D 1.5:1 SS (REPLACE W/ LV150140)	3665	4353	CLV1D-4	CWEST4	9.49	0.18
0140	P0	CONC CHNL 45'W 11'D 0:1 SS (REPLACES LV150139)	3665	4353	CLV1D-4	CWEST4	9.49	0.18
0206	E	CONC CHNL 48'W 13'D 0:1 SS	329	4081	OW1C2	NW4SC	8.92	0.46
0208	E	CONFLUENCE STRUCTURE 64" 48'W 10-13'D 0:1 SS	298	4081	OW1C2	NW4SC	8.92	0.42
0210	E	3: 12' X 9' RCB	725	3689	CCVG24	NW3SC	7.14	0.25
0223	E	CONFLUENCE STRUCTURE 40'W 9'D 0:1 S:1	185	3689	CCVG24	NW3SC	7.14	0.25
0230	E	12' X 4.5' RCB @ LAKE MEAD	177	1265	DRAILRD	NW3	5.30	1.16
0231	E	CONC CHNL 8'W 8'D 0:1 SS	900	1265	DRAILRD	NW3	5.30	2.50
0248	E	8' X 8' RCB @ UPRR	300	1265	DRAILRD	NW3	5.30	1.34
0255	E	CONC CHNL 8'W 8'D 0:1 SS	1330	1265	DRAILRD	NW3	5.30	2.00
0280	E	CONC CHNL 21'W 8'D 0:1 SS	550	2530	CCVG10	NW3	5.30	2.00
0284	E	14' X 6' RCB	1790	1444	CVG10-C	NW3	4.91	0.50
0316	E	11' X 6' RCB	3010	1152	CWA20-C	NW3	4.52	0.59
0372	E	8' X 6' RCB	1970	1152	CWA20-C	NW3	4.52	0.66
LVBR		LAS VEGAS - BROOK						
0000	E	96" CMPC @ UPRR	107	346*	CLV1D-5*	WEST3	0.80	0.35
0001	E	8' X 4' RCB @ UPRR	107	530*	CLV1D-5*	WEST3	0.80	0.93
0002	E	CONC CHNL 27'W 9'D 0:1 SS	125	876	CLV1D-5	WEST3	0.80	1.57
0005	E	CONC CHNL 18'W 4.75D 0:1 SS	367	876	CLV1D-5	WEST3	0.80	2.43
0011	E	2: 9' X 3' RCB @ LOSEE	135	876	CLV1D-5	WEST3	0.80	0.71
0013	E	CONC CHNL 12'W 4.5D 2:1 SS	750	876	CLV1D-5	WEST3	0.80	1.50
0014	E	12' X 4' RCB @ N. 5TH ST	100	876	CLV1D-5	WEST3	0.80	2.60
LVBZ		LAS VEGAS WASH - BONANZA						
0000	P	2: 12' X 7' RCB	1760	1753	CBN15-C	SW3	2.15	0.40
0025	P	2: 12' X 7' RCB	2700	1753	CBN15-C	SW3	2.15	0.40
0064	P	2: 12' X 7' RCB	2630	1603	CBN12-C	SW3	1.87	0.40
0114	P	2: 12' X 6' RCB	2740	1311	CBN10-C	SW3	1.54	0.40
0166	E	54" RCP (REPLACE W/ LVB20167)	930	1106	CBN09	SW3	1.29	0.45
0167	P0	10' X 9' RCB (REPLACES LVB20166)	930	1106	CBN09	SW3	1.29	0.45
0187	E	48" RCP (REPLACE W/ LVB20188)	1235	1106	CBN09	SW3	1.29	0.71
0188	P0	9' X 9' RCB (REPLACES LVB20187)	1235	1106	CBN09	SW3	1.29	0.71
0210	E	42" RCP (REPLACE W/ LVB20211)	704	1004	CBN08	SW3	1.05	1.37
0211	P0	8' X 8' RCB (REPLACES LVB20210)	704	1004	CBN08	SW3	1.05	1.37
0223	E	36" RCP (REPLACE W/ LVB20224)	2275	856	CBN03	SW3	0.84	0.72
0224	P0	8' X 8' RCB (REPLACES LVB20223)	2275	856	CBN03	SW3	0.84	0.72
LVCC		LAS VEGAS WASH CARTIER CHANNEL						
0000	P	CONC CHNL 12'W 9.5D 0:1 SS	1900	995	CLW1A-3	CCWEST3	1.00	0.40
0035	P	10' X 5' RCB	6750	417	A-C	WEST3	0.40	0.32
LVCL		LAS VEGAS WASH - COLTON						
0000	E	CONC CHNL 9'W 13'D 0:1 SS	102	1071	QLV1E-3	WEST3	0.90	0.63
0002	E	102" RCP	157	1071	QLV1E-3	WEST3	0.90	0.62
0005	E	9' X 8' RCB	1320	1071	QLV1E-3	WEST3	0.90	0.94
0030	E	7' X 6' RCB	2148	1071	QLV1E-3	WEST3	0.90	2.22
LVCS		LAS VEGAS WASH - COMMERCE STREET						
0000	E	12' X 5' RCB	290	1590	CVG24	NW3	5.78	1.64
0004	E	10' X 6' RCB	100	1590	CVG24	NW3	5.78	4.84
0015	E	10' X 8' RCB	1700	1590	CVG24	NW3	5.78	0.97
0050	E	CONC CHNL 10'W 8'D 0:1 SS	200	1265	DDCVG10	NW3	5.30	2.27

ID / Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
LVCK		LAS VEGAS WASH - KING CHARLES CHANNEL						
0000	E	CONC CHNL 35'W 10'D 0:1 SS	592	5518	CLV99B-7	CWEST5	14.74	0.40
0009	E	CONC CHNL 21.8'W 10'D 1.5:1 SS	3280	5518	CLV99B-7	CWEST5	14.74	0.40
LVLA		LAS VEGAS WASH - LAMB						
0000	P	2: 13' X 9' RCB	2200	2461	CLW03	WEST3	3.30	0.30
0041	P	13' X 11' RCB	2600	2320	COA02	WEST3	3.07	0.58
0090	P	13' X 11' RCB	2700	2047	CLW64-3	WEST3	2.65	0.44
0141	P	13' X 10' RCB	2650	1693	CLW64-2	WEST3	2.12	0.38
0191	P	12' X 9' RCB	2700	1452	CLW64-1	WEST3	1.61	0.56
LVLE		LAKE MEAD DRAIN TO LAS VEGAS WASH						
0000	P	12' X 6' RCB	2600	660	CLV1B-2	WEST3	0.78	0.40
0047	P	12' X 4' RCB	2400	458	LV1B-1	WEST3	0.49	0.50
LVLM		LAS VEGAS WASH - LAKE MEAD						
0000	E	43"X 68" HERCP (REPLACE W/ LVLM0001)	847	1159	CLM20-C	NW3SC	1.36	4.60
0001	P0	12' X 4' RCB (REPLACES LVLM0000)	847	1159	CLM20-C	NW3SC	1.36	4.60
0016	E	54" RCP (REPLACE W/ LVLM0017)	965	1159	CLM20-C	NW3SC	1.36	4.38
0017	P0	12' X 4' RCB (REPLACES LVLM0016)	965	1159	CLM20-C	NW3SC	1.36	4.38
0033	E	60" RCP (REPLACE W/ LVLM0034)	1186	1159	CLM20-C	NW3SC	1.36	1.62
0034	P0	12' X 5' RCB (REPLACES LVLM0033)	1186	1159	CLM20-C	NW3SC	1.36	1.62
0059	E	72" RCP (REPLACE W/ LVLM0060)	5952	1159	CLM20-C	NW3SC	1.36	0.66
0060	P0	12' X 7' RCB (REPLACES LVLM0059)	5952	1159	CLM20-C	NW3SC	1.36	0.66
LVLV		LAS VEGAS BLVD DRAIN						
0000	P	2: 10' X 8' RCB	2600	823	CLW075-4	WEST3	1.03	0.10
LVMD		LAS VEGAS WASH - MIDDLE						
1178	E	EARTH CHNL 30'W 18'-20'D 2:1 SS (REPLACE W/ LVMD1179)	1500	13206	CLVW04-C	CLVWASH5	109.77	0.57
1179	P	CONC CHNL 60'W 9.5D 2:1 SS (REPLACES LVMD1178)	1500	13206	CLVW04-C	CLVWASH5	109.77	0.57
1208	E	BANK-STAB. CHNL 65'W 15D 2:1 SS (REPLACE W/ LVMD1209)	1420	13206	CLVW04-C	CLVWASH5	109.77	0.32
1209	P	CONC CHNL 60'W 11'D 2:1 SS (REPLACES LVMD1208)	1420	13206	CLVW04-C	CLVWASH5	109.77	0.32
1230	E	4 SPAN BRIDGE 162'W 13'D @ WASHINGTON	105	13172	CCLVW03	CLVWASH5	109.50	0.73
1232	E	BANK-STAB. CHNL 48'W 8'D 2:1 SS (REPLACE W/ LVMD1233)	1900	13172	CCLVW03	CLVWASH5	109.50	0.73
1233	P	CONC CHNL 90'W 8'D 0:1 SS (REPLACES LVMD1232)	1900	13172	CCLVW03	CLVWASH5	109.50	0.73
1271	E	4 SPAN BRIDGE 94'W 10'-12'D 2:1 SS @ LAMB	120	12412	OCLVW01C	CLVWASH5	106.21	0.38
1272	E	EARTH CHNL 80'W 10D 2:1 SS (REPLACE W/ LVMD1273)	2400	12412	OCLVW01C	CLVWASH5	106.21	0.38
1273	P	CONC CHNL 80'W 9'D 2:1 SS (REPLACES LVMD1272)	2400	12412	OCLVW01C	CLVWASH5	106.21	0.38
1230	E	GABION CHNL 100'W 10'D 2:1 SS (REPLACE W/ LVMD1321)	1950	9070	OCK-C1	CLVWASH5	103.98	0.38
1321	P	CONC CHNL 80'W 8.5D 2:1 SS (REPLACES LVMD1320)	1950	9070	OCK-C1	CLVWASH5	103.98	0.38
1354	E	5 SPAN BRIDGE 110'W 7'-8D 2:1 SS @ OWENS	120	7810	2CLV1B-2	CLVWASH5	169.06	0.58
1355	E	GABION CHNL 100'W 10'D 2:1 SS	3122	7810	2CLV1B-2	CLVWASH5	169.06	0.58
1390	E	ENERGY DISSIPATOR	137	7692	CLW64-4	CLVWASH5	168.27	0.10
1400	E	CONC CHNL 90' W 12D 0:1	173	7692	CLW64-4	CLVWASH5	168.27	5.00
1421	E	2 SPAN BRIDGE 84'W 8'D @ LAKE MEAD	200	8906	CLW64-4	CCWEST5	80.53	0.60
1424	E	CONC CHNL 78'W 8.5D 0:1 SS	1615	8906	CLW64-4	CCWEST5	80.53	0.34
1444	E	CONC CHNL 84'W 8'D 0:1 SS	1450	8906	CLW64-4	CCWEST5	80.53	0.34
1482	E	1 SPAN BRIDGE 84'W 7'D @ CAREY	72	8906	CLW64-4	CCWEST5	80.53	1.00
1484	E	CONC CHNL 84'W 8'-9D 0:1 SS	1880	8906	CLW64-4	CCWEST5	80.53	0.37
1522	E	CONC CHNL 90'W 10'D 0:1 SS	376	8866	2CLW1A-3	CCWEST5	80.16	0.53
1529	E	CONC CHNL 90'W 9'8D 0:1 SS	360	8866	2CLW1A-3	CCWEST5	80.16	0.53
1534	E	1 SPAN BRIDGE 72.5'W 7.5D @ LAS VEGAS BLVD	120	8742	CLW1A-4	CCWEST5	78.13	0.88
1536	E	CONC CHNL 70'W 8'D 0:1 SS	455	8742	CLW1A-4	CCWEST5	78.13	0.49
1543	E	CONFLUENCE STRUCTURE	393	8742	CLW1A-4	CCWEST5	78.13	1.44
1550	E	CONC CHNL 90'W 7.5'-9D 0:1 SS	2150	8260	CHYPKOT	CCWEST5	77.19	0.45
1594	E	1 SPAN BRIDGE 90'W 5'D @ CHEYENNE	124	8260	CHYPKOT	CCWEST5	77.19	0.71
1595	E	CONC CHNL 90'W 7'D 0:1 SS	580	8260	CHYPKOT	CCWEST5	77.19	0.40
1606	E	TRANSITION STRUCTURE	144	8260	CHYPKOT	CCWEST5	77.19	0.40
1609	E	60' X 7.25' RCB WITH 2' CENTER PIER	221	8260	CHYPKOT	CCWEST5	77.19	0.40
1614	E	CONC CHNL 60'W 9'-11D 0:1 SS	703	13796	CHYPKIN	CCWEST5	77.19	0.15
1626	E	TRANSITION STRUCTURE	227	13796	CHYPKIN	CCWEST5	77.19	2.46
1643	E	64,000 CFS PMF SPILLWAY (REPLACE W/ LVMD1644)		64000	CHYPKIN	CCWEST5	77.19	
1644	P	MODIFY 64,000 CFS PMF SPILLWAY, RAISE BY 1' (REPL LVMD1643)		64000	CHYPKIN	CCWEST5	77.19	
1645	E	456 AC-FT CHEYENNE PEAKING BASIN		13796	CHYPKIN	CCWEST5	77.19	
1646	P	UPGRADE TO 590 AC-FT CHEYENNE PEAKING BASIN		13796	CHYPKIN	CCWEST5	77.19	
1647	E	CONC CHNL 120'D 10'W 0:1 SS	800	13796	CHYPKIN	CCWEST5	77.19	0.40

ID / Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
LVMD		LAS VEGAS WASH - MIDDLE						
1648	E	3 SPAN BRIDGE 95'W 8'-10'D 2:1 SS @ CIVIC CENTER	120	13796	CHYPKIN	CCWEST5	77.19	0.70
1663	E	CONC CHNL 80'W 10'D 2:1 SS	700	13715	3C99B-7	CCWEST5	76.87	0.70
1664	E	3 SPAN BRIDGE 75'W 10'D 2:1 SS @ I-15	120	13715	3C99B-7	CCWEST5	76.87	0.70
1665	E	TRANSITION STRUCTURE	200	8157	CLV99B-5	WEST5	48.36	0.36
1669	E	FREE SPAN BRIDGE 55'W 12'D @ UPRR	40	8157	CLV99B-5	WEST5	48.36	0.36
1670	E	CONC CHNL 82'W 10'D 0:1 SS	370	8157	CLV99B-5	WEST5	48.36	1.69
1677	E	CONC CHNL 80'W 10'D 2:1 SS	119	8157	CLV99B-5	WEST5	48.36	0.37
1679	E	4 SPAN BRIDGE 100'W 12'D 2:1 SS @ LOSEE	120	8157	CLV99B-5	WEST5	48.36	0.37
LVNC		LAS VEGAS WASH - N CHANNEL						
0001	E	18' X 7' RCB	150	1059	CLW100	CWEST5	14.59	0.33
0004	E	CONC CHNL 18'W 8.5'D 0:1 SS	200	1059	CLW100	CWEST5	14.59	0.33
0007	E	DROP STRUCTURE 18'W 2.8'D 3:1 SS	200	1059	CLW100	CWEST5	14.59	0.70
0008	E	CONC CHNL 18'W 10'D 2:1 SS	1250	1059	CLW100	CWEST5	14.59	0.70
0037	E	2. 14' X 7'-6" CMAP @ CHEYENNE	120	1059	CLW100	CWEST5	14.59	0.70
0038	E	CONC CHNL 32'W 8.5'D 2:1 SS	363	1059	CLW100	CWEST5	14.59	0.30
0043	E	CONC CHNL 12'W 6'-8"D 2:1 SS	1930	1059	CLW100	CWEST5	14.59	0.50
0079	E	TRANSITION CONC CHNL	350	1059	CLW100	CWEST5	14.59	1.00
0090	E	3. 12' X 6' RCB	120	1059	CLW100	CWEST5	14.59	0.70
0091	E	14' X 6' RCAP	1324	1059	CLW100	CWEST5	14.59	0.52
LVOE		OWENS AVENUE - EAST						
0000	P	15' X 12' RCB	4700	3018	OK-C1	SW5	24.06	0.47
0085	P	14' X 12' RCB	2540	2908	CG	SW5	23.74	0.62
0134	P	12' X 11' RCB	5380	2833	CE-C	SW5	23.51	1.00
0236	P	13' X 9' RCB	5000	2643	CH-C1	SW5	22.90	1.50
0331	P	13' X 12' RCB	1940	2576	DLVOE	SW5	22.61	0.60
0345	P	13' X 12' RCB	990	2576	DLVOE	SW5	22.61	0.60
LVOW		OWENS AVENUE SYSTEM						
0000	E	10' X 6' RCB	145	1219	CLM16B-C	NW3	2.43	0.76
0003	E	96" RCP	7500	1219	CLM16B-C	NW3	2.43	0.70
LVSR		LAS VEGAS WASH - SMOKE RANCH						
0000	E	CONC CHNL 22'W 8'D 0:1 SS	79	1086	CS1-C	NW3SC	1.42	2.32
0001	E	FREE SPAN BRIDGE 22'W 10'D	50	1086	CS1-C	NW3SC	1.42	2.32
0002	E	CONC CHNL 22'W 8'D 0:1 SS	468	1086	CS1-C	NW3SC	1.42	2.32
0009	E	72" RCP (REPLACE W/ LVSR00010)	702	1086	CS1-C	NW3SC	1.42	2.32
0010	P	10' X 5' RCB (REPLACES LVSR0009)	702	1086	CS1-C	NW3SC	1.42	2.32
0020	E	60" RCP (REPLACE W/ LVSR00021)	1320	1086	CS1-C	NW3SC	1.42	3.03
0021	P	10' X 5' RCB (REPLACES LVSR00020)	1320	1086	CS1-C	NW3SC	1.42	3.03
0045	E	54" RCP (REPLACE W/ LVSR00046)	1180	1086	CS1-C	NW3SC	1.42	3.41
0046	P	10' X 5' RCB (REPLACES LVSR00045)	1180	1086	CS1-C	NW3SC	1.42	3.41
0070	E	66" RCP (REPLACE W/ LVSR00071)	4118	1086	CS1-C	NW3SC	1.42	0.73
0071	P	10' X 8' RCB (REPLACES LVSR00070)	4118	1086	CS1-C	NW3SC	1.42	0.73
LVWH		WASHINGTON AVENUE CHANNEL						
0086	E	3. 12' X 8' RCB	1210	3825	CLVW01-C	SW5SC	16.58	0.35
0087	E	3. 12' X 8' RCB	1560	3825	CLVW01-C	SW5SC	16.58	0.33
0136	E	3. 12' X 8' RCB	2063	3728	QC-C	SW5SC	16.35	0.33
0155	E	3. 10' X 8' RCB	3630	3168	CP-C	SW5SC	16.09	0.68
0234	E	2. 12' X 8' RCB	600	3502	CN-C	SW5SC	15.78	0.71
0240	E	2. 12' X 8' RCB	3240	3502	CN-C	SW5SC	15.78	1.50
0305	E	12' X 8' RCB	2950	1562 ^A	CV1-C ^A	SW5SC	14.95	2.93
0361	E	12' X 8' RCB	548	1562 ^A	CV1-C ^A	SW5SC	14.95	0.90
0371	E	12' X 8' RCB	590	1562 ^A	CV1-C ^A	SW5SC	14.95	2.62
0382	E	CONC CHNL 50'W 10'D 0:1 SS	260	3124	CV1-C	SW5SC	14.95	0.80
0387	E	12' X 8' RCB	125	1562 ^A	CV1-C ^A	SW5SC	14.95	7.43
0389	E	12' X 8' RCB	2110	1562 ^A	CV1-C ^A	SW5SC	14.95	0.90
0426	E	16' X 8' RCB	150	1562 ^A	CV1-C ^A	SW5SC	14.95	1.08
0429	E	SPLITTER STRUCTURE (2. 12' X 8' RCB)	190	2870	DCLC21	SW5	22.61	1.90
0431	E	3. 14.33' X 10' RCB	665	2870	DCLC21	SW5	22.61	0.15
0446	E	JUNCTION STRUCTURE	69	2870	DCLC21	SW5	22.61	0.15
0447	E	3. 14.33' X 10' RCB	1955	5193	CCAL93	SW5	22.05	0.15
RWSL		RANGE WASH - SLOAN						
0694	E	CONC CHNL 10'W 8'D 1.5:1 SS	1500	1686	C47C4	RW3SC	2.40	0.56

2.3 Las Vegas Boulevard Improvements from Stewart Avenue to Sahara Avenue

This Project is being coordinated with the Las Vegas Boulevard Improvements from Stewart Avenue to Sahara Avenue Project (CLV, 2019) to determine storm drain and surface flow conveyed north to the Project at the Las Vegas Boulevard and Stewart Avenue intersection. At the time of this writing, the CLV, 2019 pre-final plans and 90% drainage report show a 48-inch RCP connection to the existing 48-inch storm drain currently located under the east curb of Las Vegas Boulevard. According to the drainage report, a 10-year and 100-year 6-hour storm event flow of 20.3 cfs and 42.3 cfs, respectively, will be conveyed within the west side of Las Vegas Boulevard and no flow during the 10-year and 100-year 6-hour storm event will remain within the east side of Las Vegas Boulevard after the flow split at Stewart Avenue. Additionally, the 48-inch RCP storm drain will discharge 77.6 cfs to the existing 48-inch storm drain during the 10-year and 100-year storm events. A copy of the relevant drainage report excerpts and plan sheet showing the connection to the existing 48-inch storm drain has been included in Appendix C.

2.4 2005 City of Las Vegas Central Neighborhood Flood Control Master Plan

The 2005 City of Las Vegas Central Neighborhood Flood Control Master Plan (CLV, 2005) shows the existing 48-inch storm drain currently under the east curb has a capacity of 144 cfs to 167 cfs within the limits of the Project. Pertinent referenced information from the CLV, 2005 has been included in Appendix C.

2.5 Flood Insurance Rate Maps

The Federal Emergency Management Agency (FEMA) publishes Flood Insurance Rate Maps (FIRM) that delineate special flood hazard areas (SFHAs) subject to flooding by the 1% annual chance (100-year) flood and Other Flood Areas Zone X (shaded) defined by FEMA as an area of 0.2% annual chance (500-year) flood; areas of 1% annual change flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual change flood.

Figure 2.2 is a reproduction of the FIRM for Clark County, Nevada and Incorporated Areas (Community 320003) Panel 2170F, effective date November 16, 2011. The project is identified as unshaded Zone X, areas outside the 0.2% annual chance floodplain.

2.6 Geotechnical Report

Geotechnical evaluations have been prepared by Ninyo & Moore for the Project. Copies of the Geotechnical Evaluation Report dated August 9, 2012 is provided in Appendix E on the Data CD.

NOTES TO USERS

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

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

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

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

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

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 11. The horizontal datum was NAD83. GR159000 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

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

NGS Information Services
NOAA, NNGS12
National Geodetic Survey
SSM-C-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

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

Base map information shown on this FIRM was provided in digital format by the Clark County GIS Management Office (GISMO).

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

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

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

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at <http://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

The Digital Flood Insurance Rate Map (DFIRM) was produced through a unique partnership between Clark County and the Federal Emergency Management Agency (FEMA). Clark County has developed a long-term approach of floodplain management to decrease the costs associated with flooding. This is demonstrated by the Clark County commitment to share and maintain floodplain layers within their Geographic Information System Management Office (GISMO).

This DFIRM reflects several innovative features. These include:

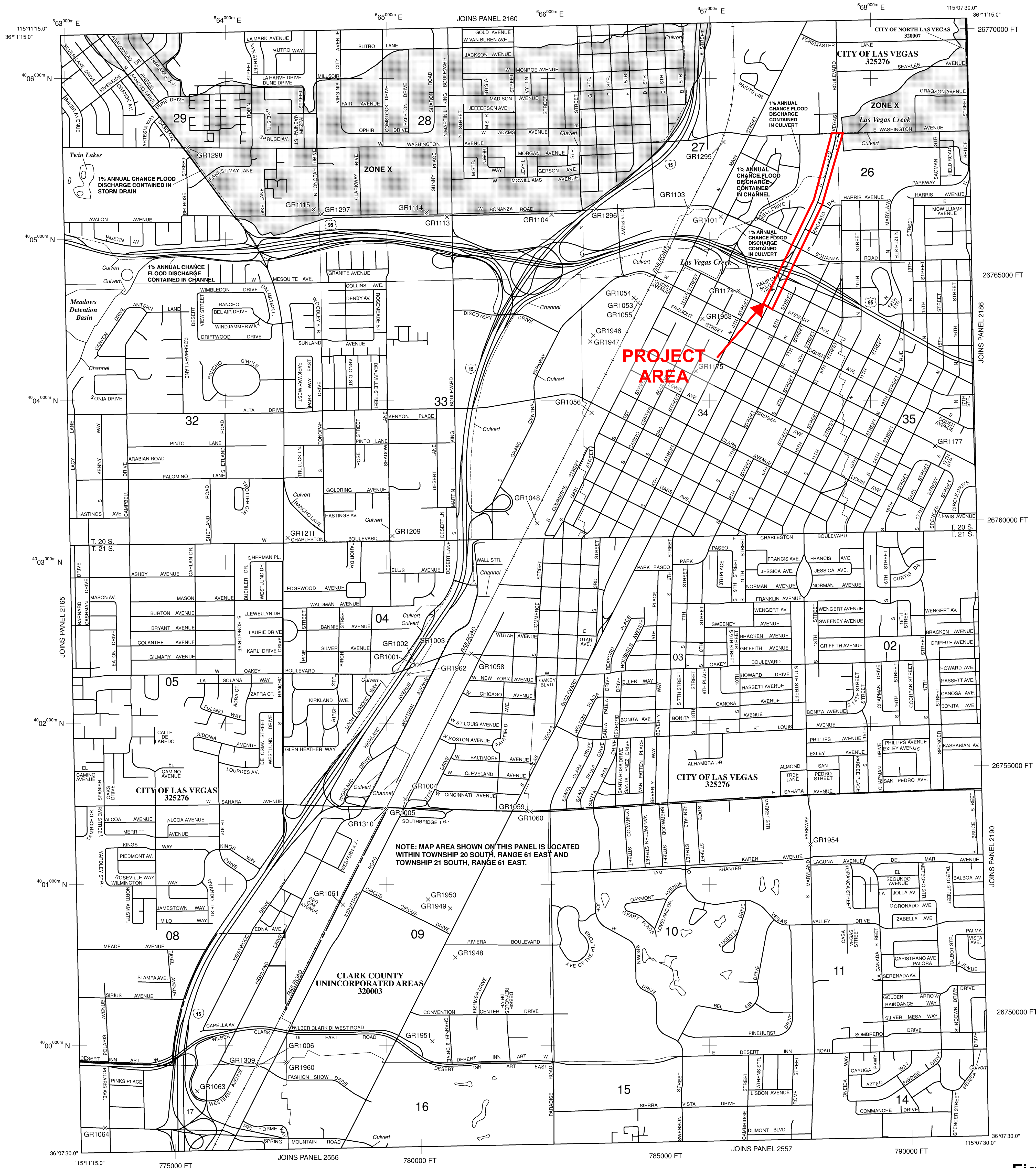
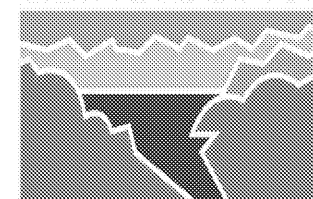
+ Southern Nevada GIS - Cooperation among local government agencies throughout Clark County. The foundation of cooperation is the GIS Interlocal Agreements formed between fourteen regional participants. In part, the agreements specify that the Clark County GIS Management Office (GISMO) will be responsible for maintaining a GIS data warehouse and associated Southern Nevada GIS metadata.

+ The GISMO's responsibilities go beyond maintaining the GIS data warehouse. GISMO also maintains the Street Centerline Database used by 911 dispatch services. This centerline database serves as the base map for this DFIRM.

DIGITAL DATA AVAILABILITY: <http://www.co.clark.nv.us/ceit/gismo/gismo.htm>



REGIONAL FLOOD
CONTROL DISTRICT



LEGEND

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

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

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

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

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

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

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

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A A Cross section line

23 23 Transect line

97°07'30" 32°22'30" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)

42°15'00"N State Plane coordinate system, east zone (FIPSZONE 2701), Transverse Mercator

6000000 FT 1000-meter Universal Transverse Mercator grid ticks, zone 11

DX5510 x 5000-foot grid ticks: Nevada State Plane coordinate system, east zone (FIPSZONE 2701), Transverse Mercator

M1.5 Bench mark (see explanation in Notes to Users section of this FIRM panel)

MAP REPOSITORIES

Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP

August 16, 1995

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

November 16, 2011 - to reflect updated topographic information, to change floodway, to add Base Flood Elevations, to update corporate limits, to change Base Flood Elevations, to add Special Flood Hazard Areas, to change Special Flood Hazard Areas, to delete Special Flood Hazard Areas, to change zone designations, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

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

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

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 METERS

PANEL 2170F

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

NOTES 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 2.2

3.0 Hydrologic and Hydraulic Design and Analysis

This section addresses hydrologic and hydraulic design criteria implemented for design of the proposed *Las Vegas Boulevard Widening* Project. This Project was designed in accordance with the CCRFCD Hydrologic Criteria and Drainage Design Manual (CCRFCD, 1999). The following sections describe the relevant methods and design criteria that were applied to this Report. Results of the hydrologic modeling and hydraulic calculations are presented in Section 4 of this Report.

3.1 Hydrologic Criteria

3.1.1 CCRFCD Hydrologic Criteria and Drainage Design Manual

The Project adheres to the HCDDM design guidelines as outlined in Table 3.1.

TABLE 3.1 APPLICABLE HCDDM GUIDELINES

TOPIC	DESIGN MANUAL SECTION OR SUBSECTIONS	MANUAL PAGE(S)	COMMENTS
Design Storm	304.2	315	The storm drain was designed to collect and convey the 10-year frequency storm event. Inlets within NDOT ROW were designed for a 25-year event. Inlets in sumps and those that drain to a regional facility were designed to capture 100-year flows.
Rainfall	500	501 -506	Rainfall depth, duration and distribution were applied as outlined in the Soil Conservation Service (SCS) Unit Hydrograph Method.
Time of Concentration	602	603 - 606	Time of concentration was calculated using procedures outlined in these sections as applicable to urban and non-urban drainage areas.
Precipitation Losses	603	607 - 610	SCS Curve Number method was employed as described.
SCS Unit Hydrograph Method	606	617 - 619	Rainfall-runoff modeling was performed using HEC-1 Flood Hydrograph Package, SCS Unit Hydrograph procedure, and procedures for calculating lag time as presented in Section 606.
Channel Routing of Hydrographs	608.3	624	Muskingum-Cunge Method was utilized for hydrograph routing.
Storm Sewer Systems	800	803 thru 819	Parameters, standards, hydraulics, and design criteria in this section were applied to the storm drain and laterals.
Streets Hydraulic Evaluation	304.4 / 906	317-318 and 905 - 906	Parameters, standards, hydraulics, and design criteria in this section were applied to the street normal depth and capacity calculations.
City of Las Vegas	1602	1605-1607	Fifty percent clogging factor in the capacity for all proposed drop inlets have been provided as presented in Section 805.

3.2 Hydrologic and Hydraulic Methods

This Report addresses 10-, 25-, and 100-year 6-hour storm event flows for proposed condition related to the *Las Vegas Boulevard Widening Project*. The proposed condition model was not broken down further into interim and future conditions models since the tributary watershed is fully developed and major flood control facilities within the project area have been constructed.

Design flow for the proposed storm drain is controlled by CCRFCD's 10-year, 12-foot dry lane criteria and criteria discussed with CLV to limit 10-year flow depths to the top of curb, i.e., not impacting adjacent properties. Proposed storm drain laterals that will connect to the 12-foot wide by 8-foot high RCB south of Washington Avenue are sized to convey 100-year storm flow. Since this section of the report concentrates on the assumptions and data used for preparing the hydrologic model, further detailed discussion of the model results as they relate to the design is reserved for later sections of the Report.

This study utilized the US Army Corps of Engineers' Hydrologic Engineering Center, Flood Hydrograph Package, HEC-1 (USACE, 1998), SCS Unit Hydrograph Method. This section discusses the development of the proposed condition hydrologic model. The model results are provided in Appendix A.4 and electronic files of the input and output are contained on the enclosed CD in Appendix E of this report. A discussion of the results is provided in Section 4.0 of this report.

3.2.1 Design Storm

The design events evaluated for this project were the 6-hour duration, 10-, 25-, and 100-year return period storms. One hydrologic model was prepared using 100-year precipitation with two additional DARFs to determine 10-year and 25-year flows.

3.2.2 Watershed Area

The proposed condition watershed for the proposed project is delineated on Figure 3.1. The drainage boundaries were determined based on information contained in the upcoming 2018 Flood Control Master Plan Update, a review of regional topography included in the figure, and field observations.

Flow Patterns South I-515

The watershed south of I-515 is bounded by Main Street on the west, Las Vegas Boulevard on the east, and Charleston Boulevard on the south. Surface runoff in the Project watershed generally follows the terrain, flowing from west to east. A portion of the flow generated within the watershed south of Stewart Avenue is conveyed north in Las Vegas Boulevard to the Project limit. Flow generated within the watershed north of Stewart Avenue and west of Las Vegas Boulevard will combine with flow in Las Vegas Boulevard and be conveyed north to combine with minor runoff from the I-515 on- and off-ramps. The total combined flow is conveyed north toward the Bonanza Road and Las Vegas Boulevard intersection.

Flow Patterns North of I-515

For the watershed north of I-515, Las Vegas Boulevard plays a similar role of a runoff collector redirecting flow from the west to the north. Between I-515 and Washington Avenue, Veterans Memorial Drive serves as a cutoff for flows from the west due in large part to the presence of the Washington Avenue Channel in Veterans Memorial Drive, that continues to Washington Avenue and then conveys flow east to the Las Vegas Wash.

3.2.3 Rainfall

The Project and tributary watershed were modeled using a Storm Distribution Number (SDN) 3 pattern for watersheds less than eight square miles. The appropriate rainfall distribution for the storm event was entered on the PC lines of the HEC-1 model in accordance with the CCRFCD, 1999 Table 503.

The Project and tributary watershed are located within the McCarran Rainfall Area. The rainfall depth value for the 100-year 6-hour storm event is 2.77 inches (CCRFCD, 1999).

3.2.4 Soil Group, Curve Numbers, and Land Use

The SCS method uses a combination of soil conditions and land uses to assign a runoff factor to an area. These runoff factors, called runoff curve numbers, indicate the runoff potential of an area. Soil properties influence the relationship between runoff and rainfall since soils have differing rates of infiltration. Based on infiltration rates, the SCS has divided soils into four hydrologic soil groups:

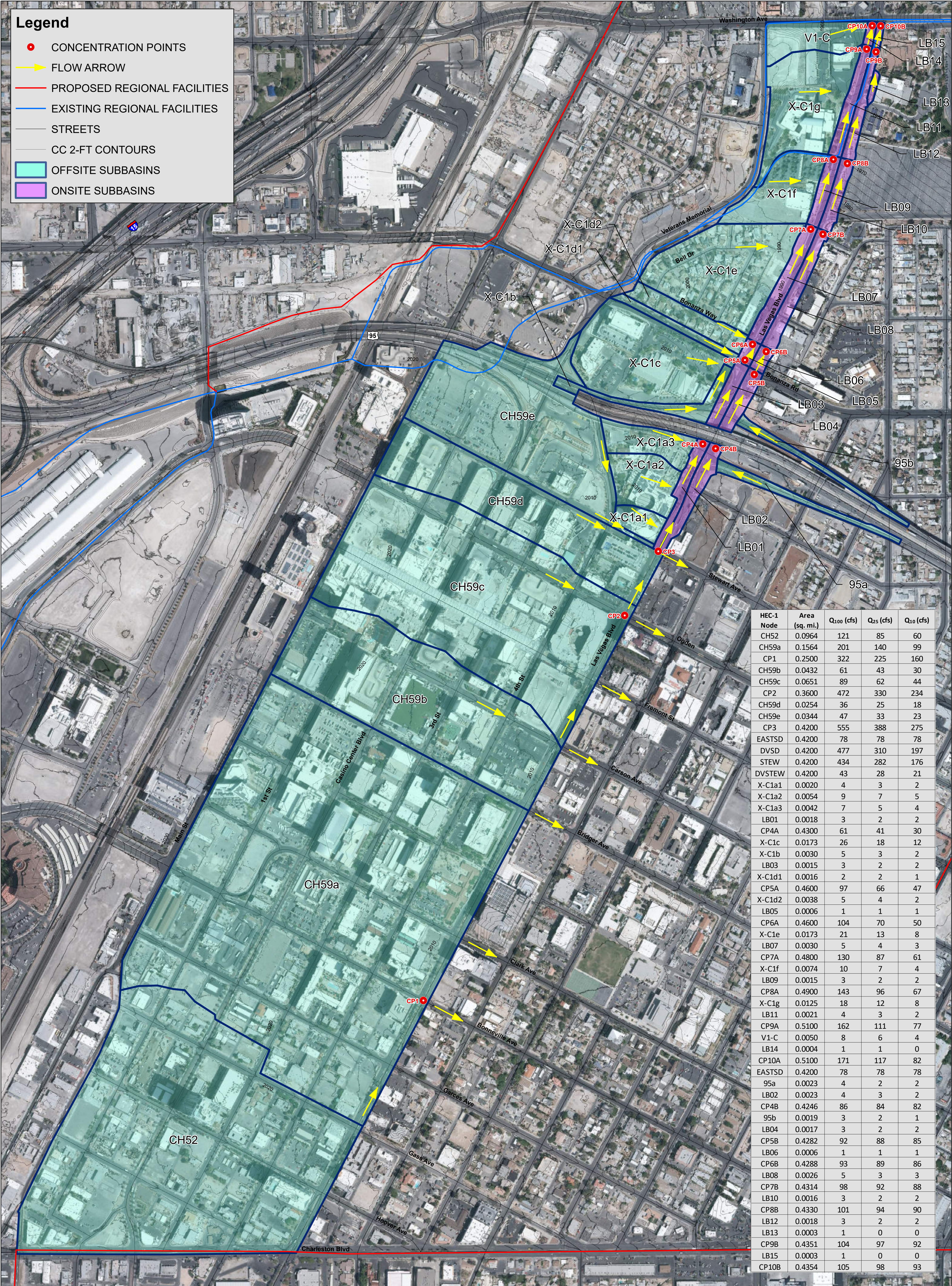
Hydrologic Soil Group A – Soils having a low runoff potential due to high infiltration rates. These soils consist primarily of deep, well-drained sands and gravels.

Hydrologic Soil Group B – Soils having a moderately low runoff potential due to moderate infiltration rates. These soils consist primarily of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures.

Hydrologic Soil Group C – Soils having a moderately high runoff potential due to slow infiltration rates. These soils consist primarily of soils in which a layer exists near the surface that impedes the downward movement of water or soils with moderately fine to fine texture.

Hydrologic Soil Group D – Soils having a high runoff potential due to very slow infiltration rates. These soils consist primarily of clays with high swelling potential, soils with permanently high water tables, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious parent material.

Soils information for the project area and offsite subbasins were referenced from the Soil Survey for the Las Vegas Valley Area, Nevada, Part of Clark County Version 12, September 15, 2017. A custom soils report for the Project area and offsite subbasins were created from the database of GIS coverage prepared by the Natural Resources Conservation Service (NRCS, 2018). A copy of the custom soils report and soil and land use map are included in Appendix A.2. Based on the report, the Project area and offsite subbasins



consist of Soil Type 236 (Glencarb very fine sandy loam, saline), Soil Type 270 (Land silt loam, drained), Soil Type 341 (Paradise silt loam), and Soil Type 615 (Urban Land). Soil Types 236, 270, and 615 are classified as Hydrologic Soil Group Type “C”. Soil Type 341 is classified as Hydrologic Soil Group Type “B”.

Curve Number (CN) values for offsite subbasins were determined using the CN matrix and GIS land use information from the upcoming 2018 MPU. A CN of 98 for streets and roads was used for onsite subbasins based on Table 602 in the CCRFCD, 1999, which shows a CN of 98 for streets and roads. The CN calculations, CN matrix, and a copy of Table 602 are included in Appendix A.2.

3.2.5 Time of Concentration and Lag Time

The lag time (T_{LAG}) for subbasin areas less than 1 square mile is described as the time between the center of mass of rainfall and the time of peak discharge from a basin. Lag time for subbasins less than 1 square mile in area can be related to time of concentration (T_C) by the following relationship: $T_{LAG} = 0.6 (T_C)$. The time of concentration (T_C) is defined as the time required for runoff to flow from the most hydraulically distant area of the basin to the outlet of the basin or a design point. The procedure for calculating (T_C) is outlined in Section 602 of the CCRFCD HCDDM. Times of concentration (T_C) and lag times (T_{LAG}) were calculated using the Clark County’s Standard Form 4 and are provided in Appendix A.3, Table A.3.1.

3.2.6 Street Capacity Analysis

Street flow calculations were performed using FlowMaster V8i (Bentley, 2009), which utilizes Manning’s equation to determine the flow depth and average velocity for user-defined sections. A Manning’s “n” of 0.016 was used in the street flow calculations per Section 906 of the CCRFCD, 1999.

3.2.7 Drop inlet and Lateral Pipe Sizing

Drop inlets have been analyzed using FlowMaster V8i, which is in accordance with HEC-22 (FHWA, 2001) methodology for inlet computations. FlowMaster V8i was also used for sizing lateral pipes based on normal depth calculations. The drop inlet and lateral pipe sizing calculations are included in Appendix B.5.

3.2.8 Water Surface Pressure Gradient for Windows (WSPGW) Analysis

Hydraulic analyses for the proposed Las Vegas Boulevard local storm drain main line was performed using the Water Surface Pressure Gradient for Windows Computer Program (WSPGW, 2012), distributed by Civil Design Software Corporation, that was prepared originally by the Los Angeles Flood Control District.

The following WSPG model was prepared (see Appendix B.1):

1) Las Vegas Boulevard West Side Main Line Storm Drain

The downstream boundary conditions for the Las Vegas Boulevard West Side Main Line Storm Drain WSPGW models was set at top of pipe elevation. According to the CLV, 1998, the 100-year hydraulic grade line in the Washington Avenue Channel 12-foot wide by 8-foot high RCB is a minimum 2.27 feet below the top of box. The WSPGW input and output electronic files are provided on the enclosed CD.

4.0 Hydrologic Analysis Results

This section presents the results of the proposed condition 10-, 25-, and 100-year hydrologic models.

4.1 Hydrologic Analysis Future Conditions Flow Rates

Figure 3.1 shows the proposed condition onsite and offsite subbasins and 10-, 25-, and 100-year flow rates that drain to Las Boulevard within the Project limits.

For the majority of the Project, design of the proposed storm drain is controlled by CCRFCD's 10-year, 12-foot dry lane criteria and criteria discussed with CLV to limit 10-year flow depths to back of sidewalk to avoid impacting adjacent properties. Therefore, drop inlets and storm drain laterals that will be connected to the proposed local storm drain main line and existing local storm drain main line are sized to convey 10-year flow rates unless the inlet is located within NDOT ROW. Inlets located within NDOT ROW were designed for 25-year flow rates per the NDOT Drainage Manual.

Proposed storm drain laterals that will connect to the 12-foot wide by 8-foot high RCB south of Washington Avenue are sized to convey 100-year flow rates.

The results of the proposed conditions HEC-1 models are summarized in Table 4.1.

TABLE 4.1 PROPOSED CONDITION FLOW RATES

HEC-1 Node	Area (sq. mi.)	Q ₁₀₀ (cfs)	Q ₂₅ (cfs)	Q ₁₀ (cfs)	HEC-1 Node	Area (sq. mi.)	Q ₁₀₀ (cfs)	Q ₂₅ (cfs)	Q ₁₀ (cfs)
CH52	0.0964	121	85	60	CP7A	0.4800	130	87	61
CH59a	0.1564	201	140	99	X-C1f	0.0074	10	7	4
CP1	0.2500	322	225	160	LB09	0.0015	3	2	2
CH59b	0.0432	61	43	30	CP8A	0.4900	143	96	67
CH59c	0.0651	89	62	44	X-C1g	0.0125	18	12	8
CP2	0.3600	472	330	234	LB11	0.0021	4	3	2
CH59d	0.0254	36	25	18	CP9A	0.5100	162	111	77
CH59e	0.0344	47	33	23	V1-C	0.0050	8	6	4
CP3	0.4200	555	388	275	LB14	0.0004	1	1	0
EASTSD	0.4200	78	78	78	CP10A	0.5100	171	117	82
DVSD	0.4200	477	310	197	EASTSD	0.4200	78	78	78
STEW	0.4200	434	282	176	95a	0.0023	4	2	2
DVSTEW	0.4200	43	28	21	LB02	0.0023	4	3	2
X-C1a1	0.0020	4	3	2	CP4B	0.4246	86	84	82
X-C1a2	0.0054	9	7	5	95b	0.0019	3	2	1
X-C1a3	0.0042	7	5	4	LB04	0.0017	3	2	2
LB01	0.0018	3	2	2	CP5B	0.4282	92	88	85
CP4A	0.4300	61	41	30	LB06	0.0006	1	1	1
X-C1c	0.0173	26	18	12	CP6B	0.4288	93	89	86
X-C1b	0.0030	5	3	2	LB08	0.0026	5	3	3
LB03	0.0015	3	2	2	CP7B	0.4314	98	92	88
X-C1d1	0.0016	2	2	1	LB10	0.0016	3	2	2
CP5A	0.4600	97	66	47	CP8B	0.4330	101	94	90
X-C1d2	0.0038	5	4	2	LB12	0.0018	3	2	2
LB05	0.0006	1	1	1	LB13	0.0003	1	0	0
CP6A	0.4600	104	70	50	CP9B	0.4351	104	97	92
X-C1e	0.0173	21	13	8	LB15	0.0003	1	0	0
LB07	0.0030	5	4	3	CP10B	0.4354	105	98	93

Regarding the proposed condition flow patterns and rates depicted on Figure 3.1, the following should be noted:

- A storm drain in Las Vegas Boulevard south of Stewart Avenue is designed by CA Group and VTN-Nevada as part of the CLV, 2019 project to replace the existing storm drain in Las Vegas Boulevard south of Stewart Avenue. Improvements proposed with the CLV, 2019 project will be constructed prior to this Project and are assumed to be built for the purposes of this Report. According to the Las Vegas Boulevard Improvements from Stewart Avenue to Sahara Avenue 90% drainage report, a portion of flow is conveyed north as surface flow within the west side and east side of Las Vegas Boulevard. The remaining flow is conveyed by the existing 48-inch storm drain at the Stewart Avenue and Las Vegas Boulevard intersection.
- A flow split has been included in the HEC-1 models after Concentration Point CP3 to account for the total flow split traveling east on Stewart Avenue (STEW) out of Las Vegas Boulevard south of Stewart Avenue. An additional flow split (EASTSD) is included in the model to account for flow discharged to the existing 48-inch storm drain located under the east curb north of Stewart Avenue. The remaining flow (DVSTEW) of 21, 28, and 43 cfs, during the 10-, 25-, and 100-year 6-hour storm event, respectively, is conveyed north in the west side of Las Vegas Boulevard. These flows are consistent with the flows reported in VTN's Drainage Study for Las Vegas Boulevard Improvements from Stewart Avenue to Sahara Avenue.
- The total flow conveyed north within the west side of Las Vegas Boulevard throughout the project limits are labeled in the HEC-1 models and shown on Figure 3.1 as CP4A, CP5A, CP6A, CP7A, CP8A, CP9A, and CP10A. The total flow conveyed north within the east side of Las Vegas Boulevard through the project limits are labeled in the HEC-1 models and shown on Figure 3.1 as CP4B, CP5B, CP6B, CP7B, CP8B, CP9B, and CP10B.

5.0 Hydraulic Analysis and Design and Street Capacity Calculations

This section discusses the proposed facility design and supporting hydraulic analyses for the Project. The Las Vegas Boulevard Widening Project from Stewart Avenue to Washington Avenue 70% Improvement Plans, in Appendix D, present the recommended storm drain improvements.

5.1 Las Vegas Boulevard West Side Main Line Storm Drain

The Project includes installing approximately 2,850 linear feet of 30-inch to 36-inch diameter RCP storm drain main line in the west side of Las Vegas Boulevard. The storm drain main line will extend from approximately 340 feet north of Stewart Avenue and will be connected to the existing Washington Avenue Channel 12-foot wide by 8-foot high RCB regional facility approximately 500 feet south of Washington Avenue.

5.1.1 Horizontal and Vertical Alignment

The horizontal alignment for the Las Vegas Boulevard West Side Main Line Storm Drain was dictated by existing utilities within the right-of-way corridor and keeping manholes out of wheel paths and the roadway median.

Topographic constraints from Stewart Avenue to McWilliams Avenue are as follows: The design slope of the pipe is set as flat as possible to minimize excessive excavation and trench depth, while maintaining a large enough RCP slope to provide sufficient flow capacity. From McWilliams Avenue to Washington Avenue, the grade of Las Vegas Boulevard is steeper so that storm drain slope is no longer controlled by conveyance requirements.

A minimum of 1 foot of cover above the hydraulic grade line is maintained in the design (see design plans for RCP profile). The pipe invert at the downstream end is controlled by the existing invert of the Washington Avenue System at the tie-in point. The storm drain will not be downsized at McWilliams Avenue in order to minimize potential clogging at the choke point, although this would be possible from a purely hydraulic standpoint due to the steeper slope north of McWilliams.

5.1.2 Collection System

The storm drain main line proposed on the west side of Las Vegas Boulevard is designed to convey 10-year flow collected by proposed drop inlets at key locations along Las Vegas Boulevard. Drop inlets are also proposed in the I-515 southbound off-ramp, a gore area adjacent to the I-515 northbound on-ramp, Bonanza Road, Friends of the Library parking lot and Bell Drive. The results of the 10-, 25-, and 100-year drop inlet calculations, respectively, are summarized in Tables B.4.1 through B.4.3 in Appendix B and Tables 5.1 through 5.3 below. The storm drain laterals were sized using normal depth calculations in FlowMaster V8i based on slope, Manning's "n", and intercepted flow from the drop inlet. The proposed storm drain facilities sizes and flow rates are labeled and shown on Figure 5.1. Pipe sizing calculations for the lateral storm drains are included in Appendix B.5. The west side drop inlets are labeled with a "W" in the suffix of the label for ease of review.

5.1.3 Hydraulic Grade Line

As shown in the storm drain profile (Appendix D), the hydraulic grade line for the proposed Las Vegas Boulevard West Side Main Line Storm Drain is more than one foot below the finished grade at all locations as required by HCDDM.

5.2 Las Vegas Boulevard East Side Existing 48-inch Storm Drain Main Line

Based on review of survey shots from Tri State Surveying, as-built plans for the existing 48-inch storm drain, and field reconnaissance, it has been determined that several existing manholes for the 48-inch storm drain have been paved over. The manholes will need to be surveyed to provide lateral profiles and connection details. Coordination with the City and Tri State Surveying will be required to schedule pavement removal for survey access to the manhole locations.

According to the CLV, 2005, the existing 48-inch storm drain has a capacity of 144 cfs to 167 cfs within the limits of the project. The CLV, 2019 project is currently proposing to discharge 78 cfs to the existing 48-inch storm drain. Flow that will be collected by proposed drop inlets within the east side of Las Vegas Boulevard for this Project are minor and will not adversely impact the existing 48-inch storm drain. This Project shows a combined maximum 100-year flow of 104 cfs at Concentration Point CP9B in the storm drain south of Washington Avenue, which is less than the capacity of the existing 48-inch storm drain.

5.2.1 Horizontal and Vertical Alignment

Approximately 750 linear feet of the existing east side 48-inch storm drain south of Washington Avenue will be removed with this Project. The removed storm drain will be replaced with approximately 200 linear feet of realigned 48-inch storm drain that will be connected to the Washington Avenue Channel approximately 550 linear feet south of Washington Avenue.

The pipe invert at the downstream end of the realigned 48-inch storm drain is controlled by the existing invert of the Washington Avenue System at the tie-in point.

5.2.2 Collection System

Due to the proposed roadway widening, this Project will remove existing drop inlets and replace with proposed drop inlets along the new curb location. Storm drain laterals and manhole connections to the existing 48-inch storm drain will be provided. The results of the 10-, 25- and 100-year drop inlet calculations, respectively, are summarized in Tables B.4.1 through B.4.3 in Appendix B and Tables 5.1 through 5.3. Drop inlets located south of the existing regional facility are sized to intercept 10-year design flows. Drop inlets DI04S and DI03E are sized for 25-year flows and drop inlets DI14W, DI15W, DI16W, DI17S and DI11E are sized to intercept 100-year flows. Nuisance flows will be collected by DI04A, DI04B, DI05A, and DI16A using NDOT type 2B drop inlets with an “A” of 2.5’ and “L” of 2’. Tables 5.1 through 5.3 summarize the 10-, 25- and 100-year flows approaching, intercepted, and bypassed at the drop inlet locations. Tables 5.1 through 5.3 also include the drop inlet label, street slope, depth of flow, and type of drop inlet proposed at each location. The storm drain laterals were sized using normal depth calculations in FlowMaster V8i based on slope, Manning’s “n”, and intercepted flow from the drop inlet. The proposed storm drain facilities sizes and flow rates are labeled and shown on Figure 5.1. Pipe sizing calculations for

the lateral storm drains are included in Appendix B.5. The proposed storm drain facilities are labeled and shown on Figure 5.1. The east side drop inlets are labeled with an “E” in the suffix of the label for ease of review.

TABLE 5.1 10-YEAR DROP INLET SUMMARY

DI Label	Q ₁₀	Slope %	Depth (ft)	Q _{INT} (cfs)	Q _{BYP} (cfs)	DI Type
DI01W	24.0	0.93	0.74	22.50	1.5	Type DM2 L=20-ft
DI03W	9.5	SAG	0.57	9.50	0.0	Type DM2 L=20-ft
DI04A	NUISANCE					2.5'x2' NDOT Type 2B
DI04B	NUISANCE					2.5'x2' NDOT Type 2B
DI05W	4.0	SAG	0.40	4.00	0.0	Type DM2 L=10-ft
DI05A	NUISANCE					2.5'x2' NDOT Type 2B
DI06S	12.0	0.52	0.37	11.30	0.7	Type DM2 L=20-ft
DI07N	1.0	0.97	0.16	1.00	0.0	Type DM2 L=5-ft
DI09W	5.2	0.86	0.43	4.30	0.9	Type DM2 L=7.5-ft
DI10W	6.4	SAG	0.43	6.40	0.0	Type DM2 L=17.5-ft
DI11N	2.0	1.43	0.27*	1.90	0.1	Type DM2 L=5-ft
DI11W	4.5	1.43	0.38	4.00	0.5	Type DM2 L=10-ft
DI13N	4.0	2.82	0.28*	3.60	0.4	Type DM2 L=10-ft
DI14W	12.5	4.45	0.43	10.70	1.8	Type DM2 L=20-ft
DI15W	2.8	1.52	0.29	2.80	0.0	Type DM2 L=20-ft
DI16A	NUISANCE					2.5'x2' NDOT Type 2B
DI16W**	N/A					Type DM2 L=20-ft
DI17S	4.0	1.15	0.36	3.60	0.4	Type DM2 L=10-ft
DI01E	1.0	0.57	0.29	1.00	0.0	Type DM2 L=5-ft
DI02E	0.5	SAG	0.24	0.50	0.0	Type DM2 L=5-ft
DI03E	2.5	0.87	0.20	1.70	0.8	5'x4' NDOT Type 2B
DI04E	2.8	SAG	0.35	2.80	0.0	Type DM2 L=10-ft
DI05E	0.5	1.12	0.22	0.50	0.0	Type DM2 L=5-ft
DI06E	2.0	0.61	0.36	1.90	0.1	Type DM2 L=5-ft
DI07E	1.5	1.07	0.30	1.40	0.1	Type DM2 L=5-ft
DI07A	NUISANCE					2.5'x2' NDOT TYPE 2
DI08E	1.6	0.73	0.29	1.40	0.2	Type DM2 L=5-ft
DI09E	2.2	4.97	0.27	2.00	0.2	Type DM2 L=5-ft
DI10E	1.2	4.97	0.23	1.20	0.0	Type DM2 L=5-ft
DI11E	1.0	1.46	0.26	1.00	0.0	Type DM2 L=20-ft

*Depth at inlet

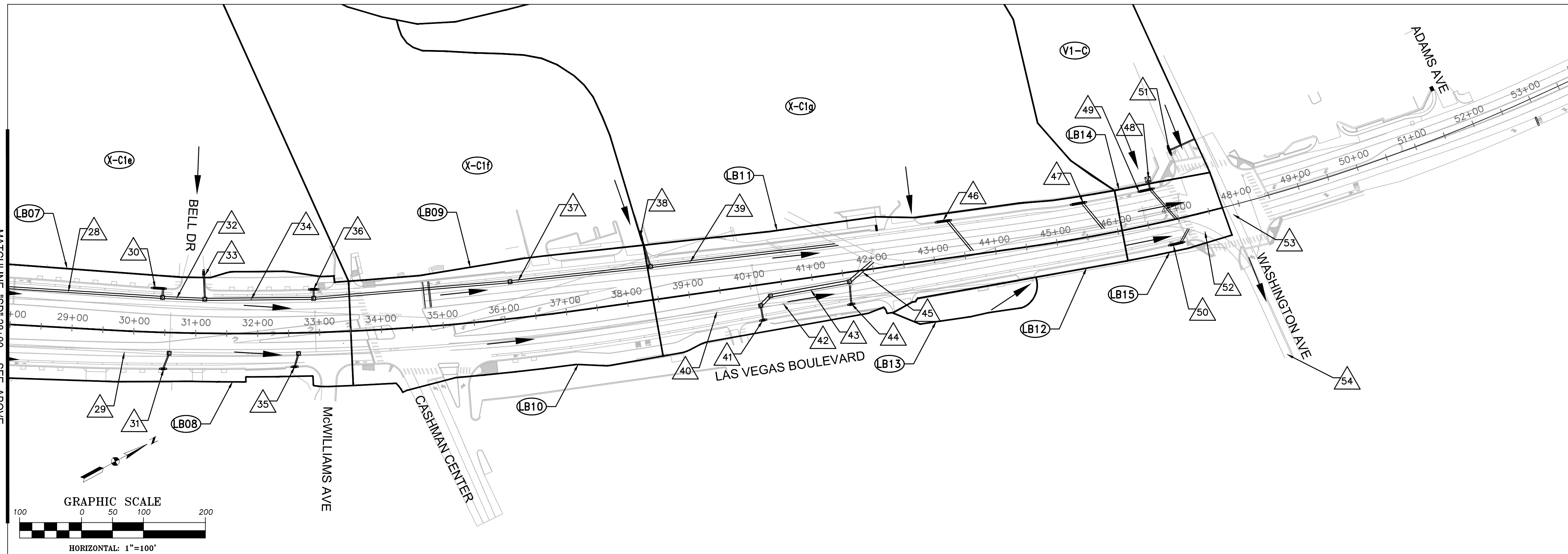
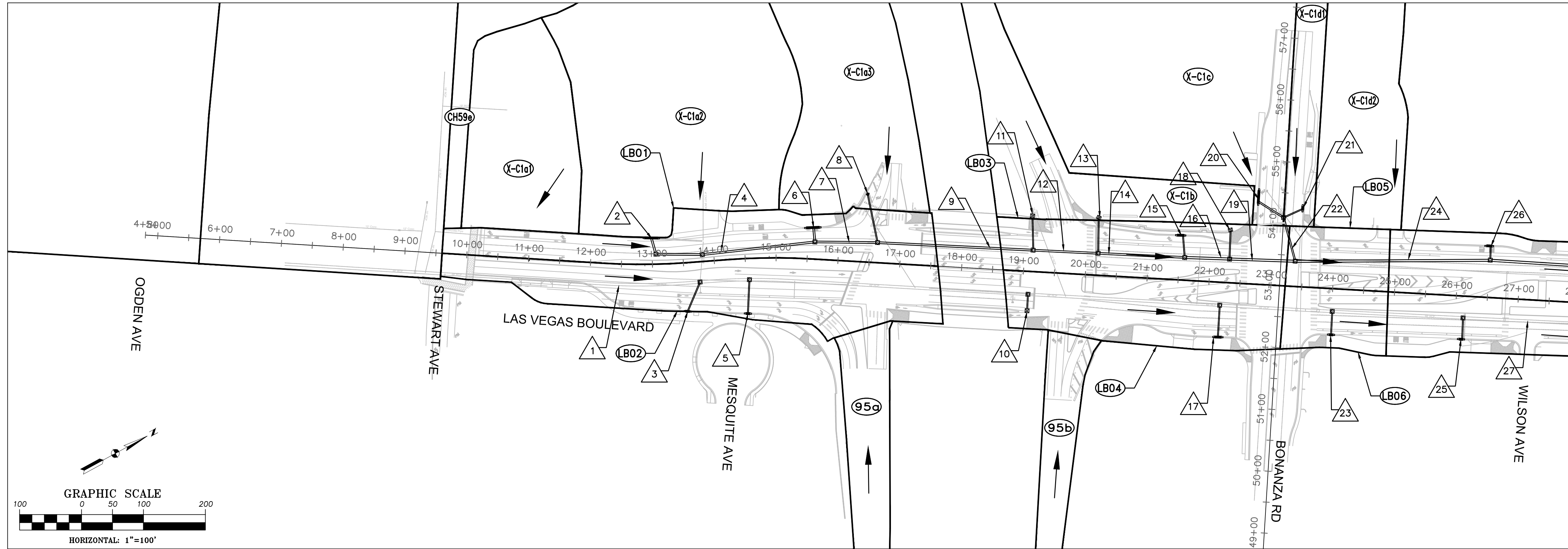
**Inlet used for 100-year flow

TABLE 5.2 25-YEAR DROP INLET SUMMARY

DI Label	Q ₂₅	Slope %	Depth (ft)	Q _{INT} (cfs)	Q _{BYP} (cfs)	DI Type
DI04S	2.5	SAG	0.25	2.50	0.0	5'x6' NDOT Type 2B

TABLE 5.3 100-YEAR DROP INLET SUMMARY

DI Label	Q ₁₀₀	Slope %	Depth (ft)	Q _{INT} (cfs)	Q _{BYP} (cfs)	DI Type
DI14W	37.4	4.45	0.60	23.9	13.5	Type DM2 L=20-ft
DI15W	15.5	1.52	0.54	13.9	1.6	Type DM2 L=20-ft
DI16W	2.6	1.54	0.33	2.6	0.0	Type DM2 L=20-ft
DI17S	8.0	1.15	0.44	5.9	2.1	Type DM2 L=10-ft
DI11E	7.0	1.46	0.43	6.9	0.1	Type DM2 L=20-ft



LEGEND

→ Flow Arrow 1 Facility ID (LB02) Subbasin Label

FLOOD CONTROL FACILITIES				
LOCATION	Q ₁₀₀ (cfs)	Q ₁₀ (cfs)	REMARKS	FACILITY
1	78.0		REFERENCED OFFSITE FLOW	EX 48" RCP
2	N/A	22.5	D101W WITH 30" LATERAL	20" TYPE DM2
3	N/A	1.0	D101E WITH 18" LATERAL	5" TYPE DM2
4	N/A	22.5		30" RCP
5	N/A	0.5	D102E WITH 18" LATERAL	5" TYPE DM2
6	N/A	9.5	D103W WITH 30" LATERAL	20" TYPE DM2
7	N/A	32.0		30" RCP
8	N/A	2.0	D104S WITH 18" LATERAL	5" x 6" NDOT TYPE 2B
9	N/A	34.0		30" RCP
10	N/A	1.7	D105E WITH 18" LATERAL	5" x 4" NDOT TYPE 2B
11	Nuisance		D104A WITH 18" LATERAL	2.5' x 2' NDOT TYPE 2B
12	N/A	34.0		30" RCP
13	Nuisance		D106S WITH 18" LATERAL	2.5' x 2' NDOT TYPE 2B
14	N/A	34.0		30" RCP
15	N/A	4.0	D106W WITH 18" LATERAL	10" TYPE DM2
16	N/A	38.0		36" RCP
17	N/A	2.8	D108E WITH 18" LATERAL	10" TYPE DM2
18	Nuisance		D105A WITH 18" LATERAL	2.5' x 2' NDOT TYPE 2B
19	N/A	38.0		36" RCP
20	N/A	11.3	D108S WITH 24" LATERAL	20" TYPE DM2
21	N/A	1.0	D107N WITH 24" LATERAL	5" TYPE DM2
22	N/A	12.3		24" RCP
23	N/A	0.5	D108E WITH 18" LATERAL	5" TYPE DM2
24	N/A	50.3		36" RCP
25	N/A	1.8	D108E WITH 18" LATERAL	5" TYPE DM2
26	N/A	4.3	D109W WITH 18" LATERAL	7.5" TYPE DM2
27	N/A	86.3	REFERENCED OFFSITE FLOW+D101E THRU D108E	EX 48" RCP
28	N/A	54.8		36" RCP
29	N/A	86.3	REFERENCED OFFSITE FLOW+D101E THRU D108E	EX 48" RCP
30	N/A	6.4	D110W WITH 24" LATERAL	17.5" TYPE DM2
31	N/A	1.4	D107E WITH 18" LATERAL	5" TYPE DM2
32	N/A	61.0		36" RCP
33	N/A	1.9	D111N WITH 18" LATERAL	5" TYPE DM2
34	N/A	62.9		36" RCP
35	N/A	1.4	D108E WITH 18" LATERAL	5" TYPE DM2
36	N/A	4.0	D111W WITH 18" LATERAL	10" TYPE DM2
37	N/A	66.9		36" RCP
38	N/A	3.6	D113N WITH 18" LATERAL	10" TYPE DM2
39	N/A	70.5		36" RCP
40	N/A	89.1	REFERENCED OFFSITE FLOW+D101E THRU D108E	EX 48" RCP
41	N/A	2.0	D108E WITH 18" LATERAL	5" TYPE DM2
42	N/A	N/A	EXISTING PIPE TO BE REMOVED	EX 48" RCP
43	N/A	91.1		48" RCP
44	N/A	1.2	D110E WITH 18" LATERAL	5" TYPE DM2
45	N/A	92.3		48" RCP
46	23.9	10.7	D114W WITH 36" LATERAL	20" TYPE DM2
47	13.9	2.8	D116W WITH 24" LATERAL	20" TYPE DM2
48	Nuisance		D116A WITH 18" LATERAL	2.5' x 2' NDOT TYPE 2B
49	2.6	0.0	D116W WITH 30" LATERAL	20" TYPE DM2
50	6.9	1.0	D111E WITH 30" LATERAL	20" TYPE DM2
51	8.1	3.7	D117S WITH 18" LATERAL (REMOVE AND REPLACE)	10" TYPE DM2
52	1562	N/A	LVWH 0305	EX 12' x 8' RCB
53	1562	N/A	WARP 0037	EX 12' x 8' RCB
54	1562	N/A	LVWH 0305	EX 12' x 8' RCB

5.3 Street Capacity

Rating tables for the street sections based on pavement widths, maximum flow depths to meet dry lane criteria, cross slope, sidewalk widths, vertical curve grades, and longitudinal slope were used to determine maximum street capacity and drop inlet spacing. The results of the street flow calculations are summarized in Tables B.2.1 and B.2.2 in Appendix B and Tables 5.3 and 5.4. Tables 5.3 and 5.4 summarize the 10-year flow and 100-year flow, depth (D) of flow, velocity (V), and depth (D) and velocity (V) product ($D \cdot V$), and street slope at the cross section locations. The cross sections, which are located just upstream of drop inlet locations, are shown on Figure 5.2.

The Project includes full-street improvements for Las Vegas Boulevard and approximately 370 linear feet of Bonanza Road west of Las Vegas Boulevard. Las Vegas Boulevard and Bonanza Road have right-of-way widths greater than or equal to 80 feet. For streets with right-of-way widths greater than 80 feet, Section 304.4 of the CCRFCD, 1999 requires the depth (D) and velocity (V) product ($D \cdot V$) during the 100-year storm event to be less than or equal to 8. Additionally, the depth of flow during the 100-year and 10-year storm events will be less than one foot and curb height, respectively, through major street intersections as required by CCRFCD, 1999. Section 304.4 requires $D \cdot V$ during the 10-year storm event to be less than or equal to 6. Las Vegas Boulevard and Bonanza Road will meet the 100-year and 10-year criteria stated above.

Additionally, Section 304.4 requires a 12-foot wide dry lane in addition to dry turning lanes to be maintained in either direction during the 10-year storm event. Table B.2.3 in Appendix B provides a summary of the maximum street flow depth required to maintain a minimum 12-foot dry lane at each street section.

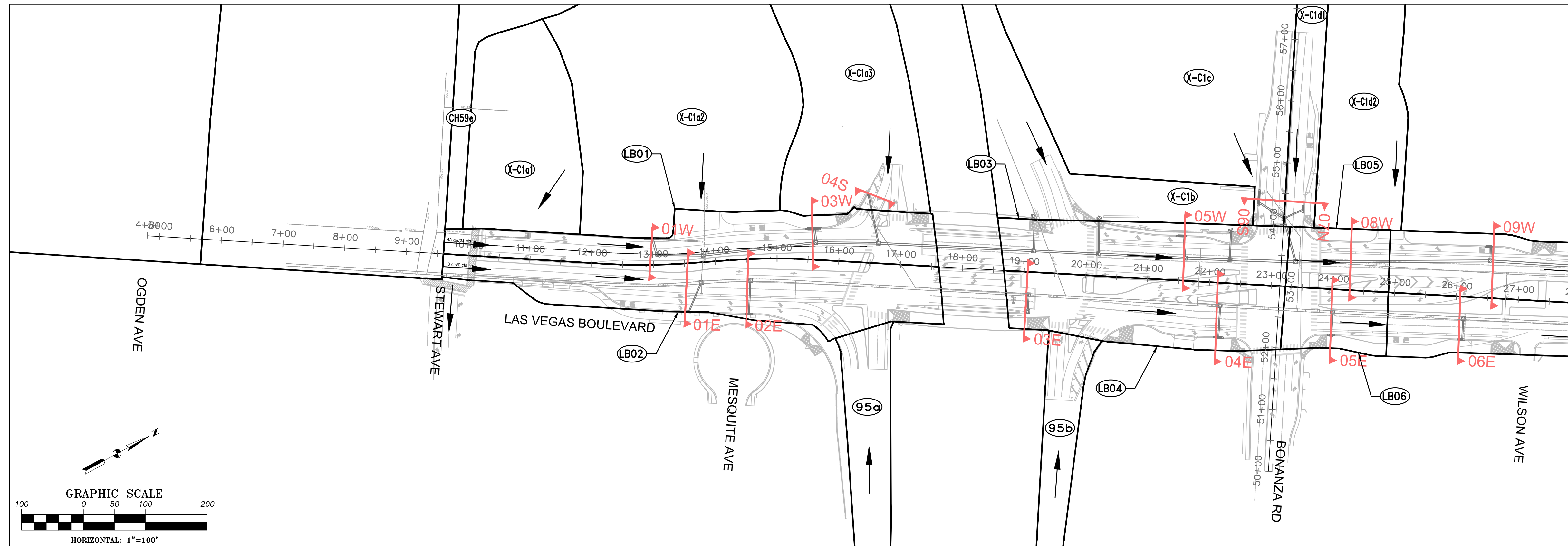
The 10-year dry lane criteria will be met in all sections of roadway, both on the west and east sides of Las Vegas Boulevard. Louis Berger was instructed by the CLV to limit flow depths to below the top of curb. This was accomplished in all roadway sections except for Cross Section 01W. This is near the southern project limit, approximately 340 feet north of Stewart Avenue, where the first drop inlet is located. A 20' Type DM drop inlet is proposed at this location. Given the size and location restrictions on this inlet, additional flow cannot be captured to reduce flow depth below curb height. Cross Section 03W contains a localized low spot with a small ridge immediately to the north. Water will pond at this location until the flow depth exceeds 0.2', at which point the water will pass over the ridge and flow north in Las Vegas Blvd. This water will be collected by DI04S. Therefore, at this location, flow depth is still maintained below curb height and max dry lane criteria is met.

TABLE 5.3 10-YEAR STREET FLOW CROSS SECTION SUMMARY

Location	Q ₁₀ (cfs)	Slope (%)	Depth (ft)	Velocity (ft/s)	D*V
01W	24.0	0.93	0.74	3.8	2.8
03W	9.5	0.73	0.57	2.6	1.5
04W	2.0	0.38	0.25	1.4	0.4
05W	4.0	0.87	0.40	2.3	0.9
06S	12.0	0.52	0.37	2.6	1.0
07N	1.0	0.97	0.16	1.7	0.3
08W	1.7	0.90	0.35	2.3	0.8
09W	5.2	0.86	0.43	2.4	1.0
10W	6.4	1.11	0.43	2.8	1.2
11W	4.5	1.43	0.38	2.8	1.1
12W	1.5	3.00	0.26	3.0	0.8
13W	3.5	4.90	0.30	4.3	1.3
14W	12.5	4.45	0.43	5.5	2.4
15W	2.8	1.52	0.29	2.6	0.8
16W	0.0	1.54	0.00	0.0	0.0
17S	4.0	1.15	0.36	2.4	0.9
01E	1.0	0.57	0.29	1.4	0.4
02E	0.5	0.56	0.24	1.2	0.3
03E	2.5	0.87	0.14	2.2	0.3
04E	2.8	1.02	0.35	2.2	0.8
05E	0.5	1.12	0.22	1.7	0.4
06E	2.0	0.61	0.36	1.8	0.6
07E	1.5	1.07	0.30	2.0	0.6
08E	1.6	0.73	0.29	1.5	0.4
09E	2.2	4.97	0.27	3.9	1.1
10E	1.2	4.97	0.23	3.5	0.8
11E	1.0	1.46	0.26	2.1	0.5

TABLE 5.4 100-YEAR STREET FLOW CROSS SECTION SUMMARY

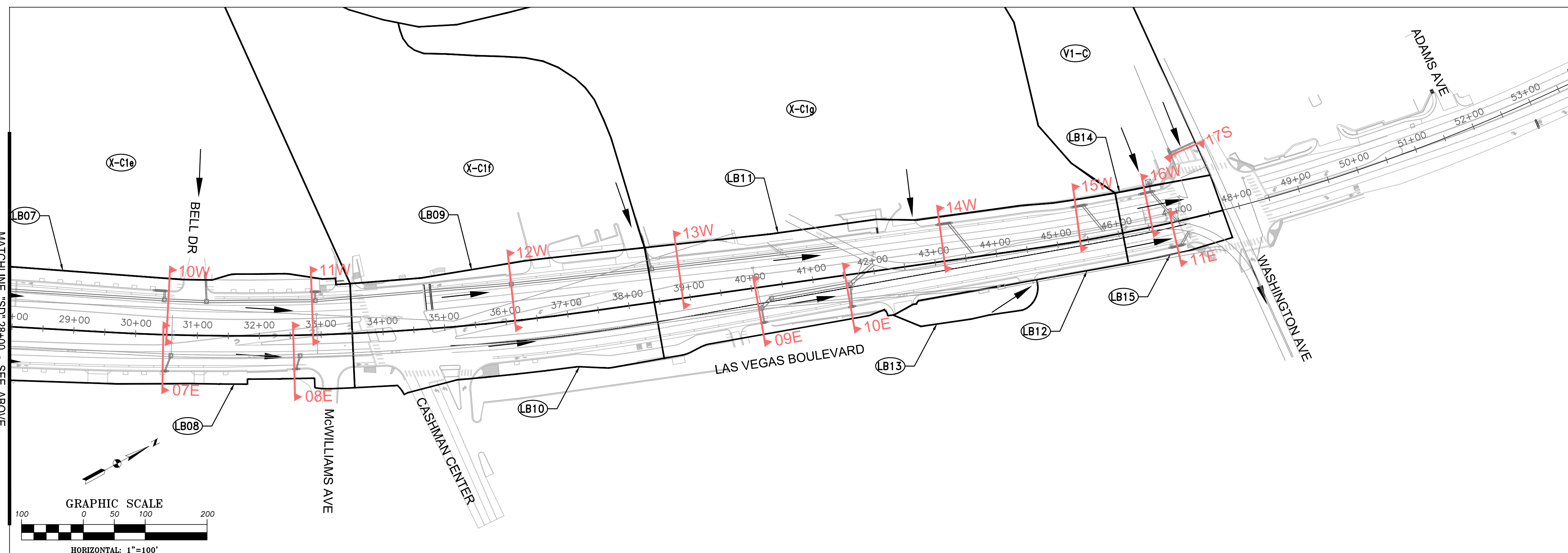
Location	Q ₁₀₀ (cfs)	Slope (%)	Depth (ft)	Velocity (ft/s)	D*V
01W	48.5	0.93	0.91	4.7	4.3
03W	40.0	0.73	0.84	3.9	3.2
04S	3.5	0.38	0.31	1.6	0.5
05W	9.0	0.87	0.49	2.8	1.4
06S	26.0	0.52	0.54	3.1	1.7
07N	2.0	0.97	0.20	2.0	0.4
08W	16.7	0.90	0.60	3.0	1.8
09W	24.2	0.86	0.66	3.3	2.2
10W	32.9	1.11	0.69	3.9	2.7
11W	12.0	1.43	0.50	3.5	1.8
12W	9.5	3.00	0.42	4.5	1.9
13W	17.4	4.90	0.46	6.2	2.8
14W	37.4	4.45	0.60	6.6	4.0
15W	15.5	1.52	0.54	3.7	2.0
16W	2.6	1.54	0.33	2.6	0.8
17S	8.0	1.15	0.44	2.8	1.2
01E	2.0	0.57	0.35	1.7	0.6
02E	2.0	0.56	0.35	1.6	0.6
03E	5.0	0.87	0.30	2.5	0.8
04E	9.3	1.02	0.49	3.0	1.4
05E	0.5	1.12	0.22	1.7	0.4
06E	3.0	0.61	0.40	2.0	0.8
07E	2.5	1.07	0.34	2.2	0.8
08E	3.6	0.73	0.35	1.8	0.6
09E	5.2	4.97	0.34	4.7	1.6
10E	4.7	4.97	0.33	4.6	1.5
11E	7.0	1.46	0.43	3.2	1.4



LEGEND

- LB02 Subbasin Label
- ↗ Cross Section
- Flow Arrow
- Q_{100}/Q_{10} Flow Rate Arrow

Location	Q_{10} (cfs)	Slope (%)	Depth (ft)	Velocity (ft/s)	D/V
01W	24.0	0.93	0.74	3.8	2.8
03W	9.5	0.73	0.57	2.6	1.5
04W	2.0	0.38	0.25	1.4	0.4
05W	4.0	0.87	0.40	2.3	0.9
06S	12.0	0.52	0.37	2.6	0.9
07N	1.0	0.97	0.16	1.7	0.3
08W	1.7	0.90	0.35	2.3	0.8
09W	5.2	0.86	0.43	2.4	1.0
10W	6.4	1.11	0.43	2.8	1.2
11W	4.5	1.43	0.38	2.8	1.1
12W	1.5	3.00	0.36	3.3	1.2
13W	3.5	4.90	0.42	4.6	1.9
14W	12.5	4.45	0.43	5.5	2.4
15W	2.8	1.52	0.33	2.9	0.9
16W	0.0	1.54	0.00	0.0	0.0
17S	4.0	1.15	0.36	2.4	0.8
01E	1.0	0.57	0.29	1.4	0.4
02E	0.5	0.56	0.24	1.2	0.3
03E	2.5	0.87	0.14	2.2	0.3
04E	2.8	1.00	0.36	2.1	0.8
05E	0.5	1.12	0.22	1.7	0.4
06E	2.0	0.61	0.36	1.8	0.6
07E	1.5	1.07	0.3	2.0	0.6
08E	1.6	0.73	0.29	1.5	0.4
09E	2.2	4.97	0.34	3.9	1.3
10E	1.2	4.97	0.23	3.5	0.8
11E	1.0	1.46	0.26	2.1	0.5



Location	Q_{100} (cfs)	Slope (%)	Depth (ft)	Velocity (ft/s)	D/V
01W	48.5	0.93	0.91	4.7	4.3
03W	40.0	0.73	0.84	3.9	3.2
04S	3.5	0.38	0.31	1.6	0.5
05W	9.0	0.87	0.49	2.8	1.3
06S	26.0	0.52	0.54	3.1	1.7
07N	2.0	0.97	0.20	2.0	0.4
08W	16.7	0.90	0.58	3.2	1.9
09W	24.2	0.86	0.66	3.3	2.2
10W	32.9	1.11	0.71	4.0	2.8
11W	12.0	1.43	0.50	3.5	1.8
12W	9.5	3.00	0.42	4.5	1.9
13W	17.4	4.90	0.50	5.0	2.5
14W	37.4	4.45	0.60	6.6	4.0
15W	15.5	1.52	0.54	3.7	2.0
16W	2.6	1.54	0.33	2.6	0.8
17S	8.0	1.15	0.44	3.0	1.3
01E	2.0	0.57	0.35	1.6	0.6
02E	2.0	0.56	0.35	1.6	0.6
03E	5.0	0.87	0.30	2.5	0.8
04E	9.3	1.00	0.49	2.9	1.4
05E	0.5	1.12	0.22	1.7	0.4
06E	3.0	0.61	0.40	2.0	0.8
07E	2.5	1.07	0.34	2.2	0.7
08E	3.6	0.73	0.35	1.8	0.6
09E	5.2	4.97	0.34	4.7	1.6
10E	4.7	4.97	0.33	4.6	1.5
11E	7.0	1.46	0.43	3.2	1.4

6.0 Construction Cost Estimate

This Section presents the construction cost estimate for drainage improvements based on the 70% level of design completion presented in the Report.

6.1 Cost Estimate

Table 6.1 provides an estimate of probable construction cost for drainage improvements on the 70% design documents for the Project:

The 70% level of construction cost estimate for drainage improvements is \$1,632,530; with a 10% contingency, the total comes to \$1,795,783. The estimate will be updated as project design progresses.



TABLE 6.1 CONSTRUCTION COST ESTIMATE

Item	Description	Quantity	Unit	Unit Price	Bid Amount
202.72	Removal of Drop Inlet	23	EA	\$1,400.00	\$32,200.00
202.73	Removal of Storm Drain Manhole	1	EA	\$1,400.00	\$1,400.00
202.74	Removal of 15-Inch Storm Drain Pipe	459	LF	\$35.00	\$16,065.00
202.75	Removal of 18-Inch Storm Drain Pipe	596	LF	\$35.00	\$20,860.00
202.76	Removal of 24-Inch Storm Drain Pipe	106	LF	\$35.00	\$3,710.00
202.77	Removal of 30-Inch Storm Drain Pipe	21	LF	\$45.00	\$945.00
202.78	Removal of 48-Inch Storm Drain Pipe	385	LF	\$60.00	\$23,100.00
202.79	Abandon 60-Inch Storm Drain Pipe	365	LF	\$150.00	\$54,750.00
603.01	18-Inch Reinforced Concrete Pipe (Class III)	930	LF	\$125.00	\$116,250.00
603.02	24-Inch Reinforced Concrete Pipe (Class III)	179	LF	\$175.00	\$31,325.00
603.03	30-Inch Reinforced Concrete Pipe (Class III)	995	LF	\$215.00	\$213,925.00
603.04	36-Inch Reinforced Concrete Pipe (Class III)	2,040	LF	\$225.00	\$459,000.00
603.05	48-Inch Reinforced Concrete Pipe (Class III)	200	LF	\$290.00	\$58,000.00
609.01	5-Foot Type DM2 Drop Inlet	10	EA	\$5,000.00	\$50,000.00
609.02	7.5-Foot Type DM2 Drop Inlet	1	EA	\$7,500.00	\$7,500.00
609.03	10-Foot Type DM2 Drop Inlet	5	EA	\$10,000.00	\$50,000.00
609.04	17.5-Foot Type DM2 Drop Inlet	1	EA	\$17,500.00	\$17,500.00
609.05	20-Foot Type DM2 Drop Inlet	7	EA	\$20,000.00	\$140,000.00
609.06	NDOT Type 2 Drop Inlet	2	EA	\$6,000.00	\$12,000.00
609.07	NDOT Type 2B Drop Inlet	5	EA	\$8,000.00	\$40,000.00
609.08	Concrete Apron	4	EA	\$500.00	\$2,000.00
609.09	60-Inch NDOT Type 4 Storm Drain Manhole	26	EA	\$10,000.00	\$260,000.00
609.10	60-Inch Type III Storm Drain Manhole	2	EA	\$8,000.00	\$16,000.00
609.11	Replace Existing Drop Inlet Frame & Grate with Manhole Cover	2	EA	\$750.00	\$1,500.00
609.12	Adjust Storm Drain Cover	3	EA	\$500.00	\$1,500.00
613.19	Sidewalk Underdrain	2	EA	\$1,500.00	\$3,000.00
Subtotal =					\$1632,530.00
Contingency (10%) =					\$163,253.00
Grand Total =					\$1,795,783.00

7.0 Conclusions and Recommendations

The Project includes full-street improvements for approximately 4,500 linear feet of Las Vegas Boulevard from Stewart Avenue to Washington Avenue, including curb, gutter, and sidewalk; reconfiguring the median islands; new pavement; drainage improvements; and utility relocations. This report addresses the 70% design level for the drainage improvements for this Project segment of Las Vegas Boulevard. The proposed recommended storm drain facilities labeled and shown on Figure 5.1 include the following:

Las Vegas Boulevard West Side Storm Drain Mainline:

The installation of approximately 2,850 linear feet of 30-inch to 36-inch diameter RCP storm drain main line in the west side of Las Vegas Boulevard. The storm drain main line will extend from approximately 340 feet north of Stewart Avenue and will be connected to the existing Washington Avenue Channel 12-foot wide by 8-foot high RCB regional facility approximately 500 feet south of Washington Avenue.

The storm drain main line proposed on the west side of Las Vegas Boulevard is designed to convey 10-year flow collected by proposed drop inlets at key locations along Las Vegas Boulevard. Drop inlets are also proposed in the I-515 southbound off-ramp, a gore area adjacent to the I-515 northbound on-ramp, Bonanza Road, Friends of the Library parking lot and Bell Drive.

Las Vegas Boulevard East Side Existing 48-inch Storm Drain Main Line:

Due to the proposed roadway widening, this Project will remove existing drop inlets and replace with proposed drop inlets and along the new curb location. Storm drain laterals and manhole connections to the existing 48-inch storm drain have been provided with this project.

This Project is being coordinated with the *Las Vegas Boulevard Improvements from Charleston Boulevard to Stewart Avenue Project* designed by the CA Group, Inc. and VTN-Nevada. CA Group and VTN-Nevada completed their pre-final improvement plans and 90% drainage report and are proposing to connect a new 48-inch storm drain to the existing 48-inch storm drain within the Stewart Avenue and Las Vegas Boulevard intersection.

The drainage improvements for this project will cost 1.80 million dollars to be funded by RTC. A copy of the 70% cost estimate is included in Appendix E on the Data CD.

8.0 References

1. Bentley, 2009. FlowMaster, V8i, distributed by Bentley Systems Inc., November 2009.
2. CCRFCD, 1999. Hydrologic Criteria and Drainage Design Manual, prepared by WRC Engineering and updated by Montgomery Watson for the Clark County Regional Flood Control District, August 1999, available at <http://www.ccrfcd.org>.
3. CCRFCD, 2018. Las Vegas Valley 2018 Master Plan Update, prepared by the Clark County Regional Flood Control District, December 2018, available at <http://www.ccrfcd.org>.
4. CLV, 1998. Las Vegas Creek Application For Letter of Map Revision From Las Vegas Boulevard to the Las Vegas Wash, prepared by Carter Burgess for the City of Las Vegas, February 1998.
5. CLV, 2005. City of Las Vegas Central Neighborhood Flood Control Master Plan, prepared by PBS&J for the City of Las Vegas Flood Control, March 2005.
6. CLV, 2019. Las Vegas Boulevard Improvements from Stewart Avenue to Sahara Avenue, prepared by VTN-Nevada for the City of Las Vegas, June 2019.
7. NDOT, 2006. Drainage Manual, prepared by the Nevada Department of Transportation Hydraulics Section, December 2006, available at <http://nevadadot.com>.
8. NDOT, 2017. Standard Plans for Road and Bridge Construction, prepared by the Nevada Department of Transportation, 2017, available at <http://www.nevadadot.com>.
9. NRCS, 2017. Soil Survey of the Las Vegas Valley, Nevada, Part of Clark County prepared by US Department of Agriculture, National Resource Conservation Service, September 2017.
10. FHWA, 2001. Hydraulic Engineering Circular No. 22, published by Federal Highway Administration, August 2001.
11. WSPGW, 2012. Water Surface Pressure Gradient Computer Program, Version 14.07, distributed by Civil Design, 2012.
12. USACE, 1998. Flood Hydrograph Package (HEC-1) Computer Program and User's Manual, Version 4.1, prepared by U.S. Army Corps of Engineers Hydrologic Engineering Center, 1998.

APPENDIX A – HYDROLOGIC PARAMETERS AND ANALYSIS

- A.1 Rainfall Data
- A.2 Curve Number Calculations
- A.3 Lag Time Calculations
- A.4 HEC-1 Models



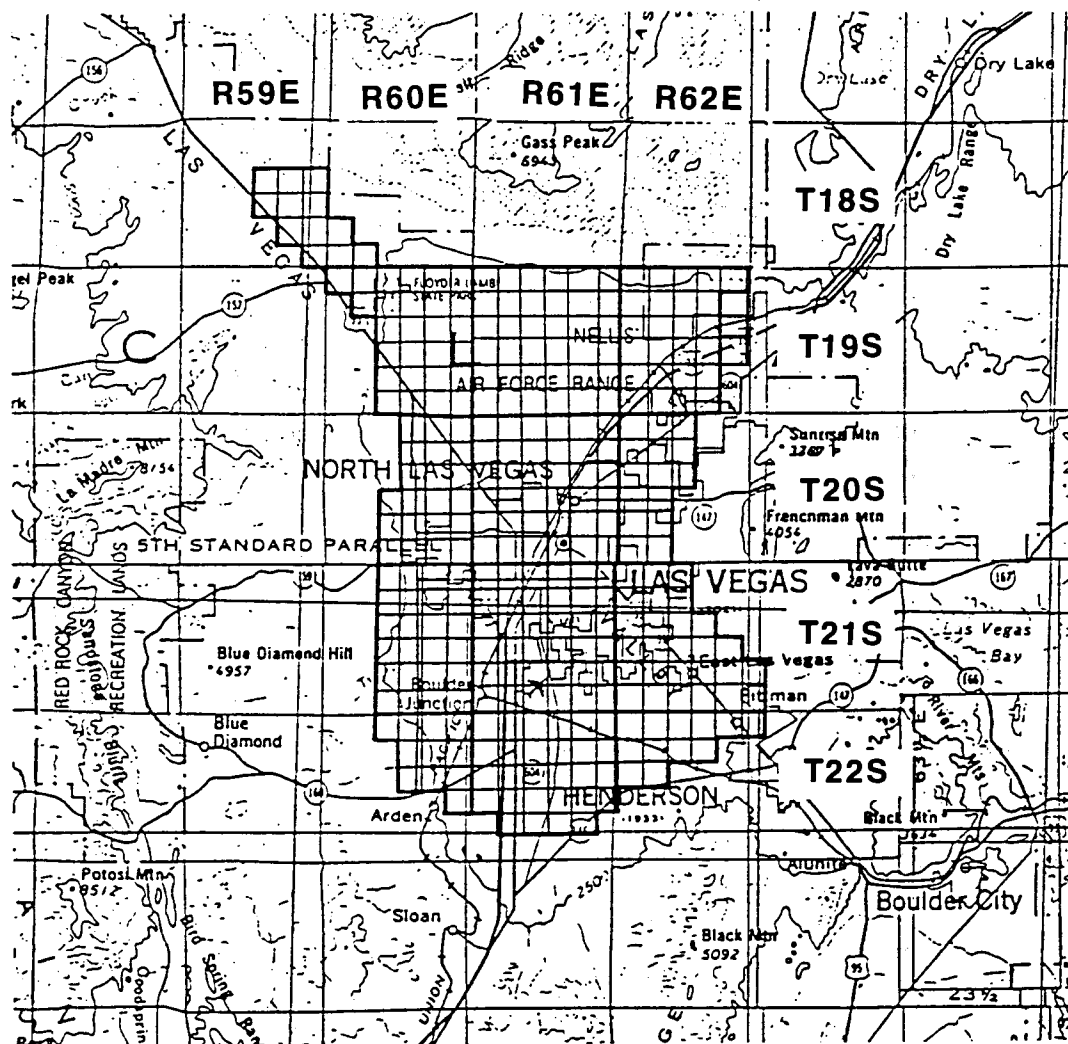
A.1 Rainfall Data

- A.1.1 - HCDDM Figure 513 McCarran Airport Rainfall Area Exhibit
- A.1.2 - HCDDM Table 505 McCarran Airport Rainfall Area Depths
- A.1.3 - HCDDM Table 503 6-Hour Storm Distribution

A.1.1 HCDDM Figure 513 McCarran Airport Rainfall Area
Exhibit

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

McCARRAN AIRPORT RAINFALL AREA



TOWNSHIP RANGE SECTIONS

18 South 59 East 13-15,22-26,36
 18 South 60 East 30-32
 19 South 60 East 1-6,8-16,21-28,33-36
 19 South 61 East ALL SECTIONS
 19 South 62 East 2-11,14-23,27-34
 20 South 60 East 1-3,10-15,21-28,33-36
 20 South 61 East ALL SECTIONS

TOWNSHIP RANGE SECTIONS

20 South 62 East 4-9,16-20,29-32
 21 South 60 East 1-4,9-16,21-28,33-36
 21 South 61 East ALL SECTIONS
 21 South 62 East 4-9,15-23, 25-36
 22 South 60 East 1-4,10-15,24
 22 South 61 East 1-24,26-29
 22 South 62 East 1-10,17-18

Notes:

1. Refer to Table 505 and Figure 516 Depth-Duration- Frequency values in the McCarran Airport Rainfall Area.
2. Refer to Table 506 and Figure 517 for Time-Intensity-Frequency values on the McCarran Airport Rainfall Area.

Revision	Date

A.1.2 HCDDM Table 505 McCarran Airport Rainfall Area
Depths

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DEPTH-DURATION-FREQUENCY VALUES FOR McCARRAN AIRPORT RAINFALL AREA (IN INCHES)

TIME	RECURRENCE INTERVAL					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
5 min.	0.15	0.27	0.35	0.46	0.54	0.63
10 min.	0.25	0.44	0.57	0.74	0.89	1.02
15 min.	0.33	0.57	0.74	0.97	1.15	1.32
30 min.	0.44	0.78	1.01	1.31	1.55	1.79
1 hour	0.52	0.89	1.15	1.50	1.78	2.06
2 hour	0.59	1.01	1.30	1.70	2.01	2.30
3 hour	0.64	1.08	1.39	1.82	2.15	2.48
6 hour	0.72	1.22	1.58	2.05	2.41	2.77
24 hour (TR-55)	1.20	1.60	1.80	2.40	2.70	2.96

- NOTE: 1. Refer to Figure 513 for a description and drawing of the area included in the McCarran Airport Rainfall Area.
2. The 24 hour values presented above are for use with TR-55 only.
3. Table 501 adjustments not required.

Revision	Date

A.1.3 HCDDM Table 503 6-Hour Storm Distribution

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

SIX-HOUR STORM DISTRIBUTIONS

Percent of Total Storm Depth				Percent of Total Storm Depth			
Storm Time (In Minutes)	SDN3	SDN4	SDN5	Storm Time (In Minutes)	SDN3	SDN4	SDN5
0	0.0	0.0	0.0	185	32.2	37.6	43.0
5	2.0	2.0	2.0	190	35.2	41.5	47.7
10	5.7	5.8	5.9	195	40.9	46.2	51.4
15	7.0	7.5	8.0	200	49.9	53.0	56.1
20	8.7	9.9	11.0	205	59.0	61.0	63.0
25	10.8	12.6	14.4	210	71.0	71.0	71.0
30	12.4	13.7	15.0	215	74.4	73.2	72.0
35	13.0	14.5	16.0	220	78.1	75.6	73.1
40	13.0	14.9	16.8	225	81.2	78.2	75.2
45	13.0	15.1	17.1	230	81.9	79.9	77.9
50	13.0	15.5	18.0	235	83.5	81.3	79.0
55	13.0	15.6	18.2	240	85.1	82.3	79.5
60	13.0	15.9	18.7	245	85.6	83.0	80.4
65	13.3	16.2	19.0	250	86.0	83.5	81.0
70	14.0	16.9	19.7	255	86.8	84.4	82.0
75	14.2	17.2	20.2	260	87.6	85.1	82.6
80	14.8	17.9	21.0	265	88.8	86.4	84.0
85	15.8	18.9	22.0	270	91.0	88.5	85.9
90	17.2	20.1	23.0	275	92.6	90.8	88.9
95	18.1	21.1	24.1	280	93.7	92.4	91.0
100	19.0	22.0	25.0	285	95.0	94.4	93.8
105	19.7	22.8	25.9	290	97.0	96.8	96.6
110	19.9	23.2	26.5	295	97.6	97.3	97.0
115	20.0	24.0	28.0	300	98.2	97.8	97.4
120	20.1	24.6	29.0	305	98.5	98.2	97.9
125	20.4	25.2	30.0	310	98.7	98.4	98.1
130	21.4	26.0	30.5	315	98.9	98.6	98.3
135	22.9	26.9	30.9	320	99.0	98.8	98.5
140	24.1	27.6	31.0	325	99.3	99.1	98.9
145	24.9	28.3	31.7	330	99.3	99.2	99.0
150	25.1	28.6	32.1	335	99.4	99.3	99.2
155	25.6	29.2	32.7	340	99.5	99.4	99.3
160	27.0	30.2	33.3	345	99.8	99.7	99.6
165	27.8	31.2	34.6	350	99.8	99.8	99.7
170	28.1	32.1	36.1	355	99.9	99.9	99.9
175	28.3	33.2	38.1	360	100.0	100.0	100.0
180	29.5	35.2	40.8				

- Notes: 1. For drainage areas less than 8 square miles in size, use SDN 3.
 2. For drainage areas greater than or equal to 8 square miles and less than 12 square miles in size, use SDN 4.
 3. For drainage areas greater than or equal to 12 square miles, use SDN 5.
 4. A graphical representation of these values is presented on **Figure 515**.

Revision	Date

REFERENCE:

TABLE 503

A.2 Curve Number Calculations

- A.2.1 - Soils Report
- A.2.2 - Soil and Land Use Map
- A.2.3 - Curve Number Matrix
- A.2.4 - HCDDM Runoff Curve Numbers Table 602 1 of 4
- A.2.5 - Curve Number Calculations

A.2.1 Soils Report



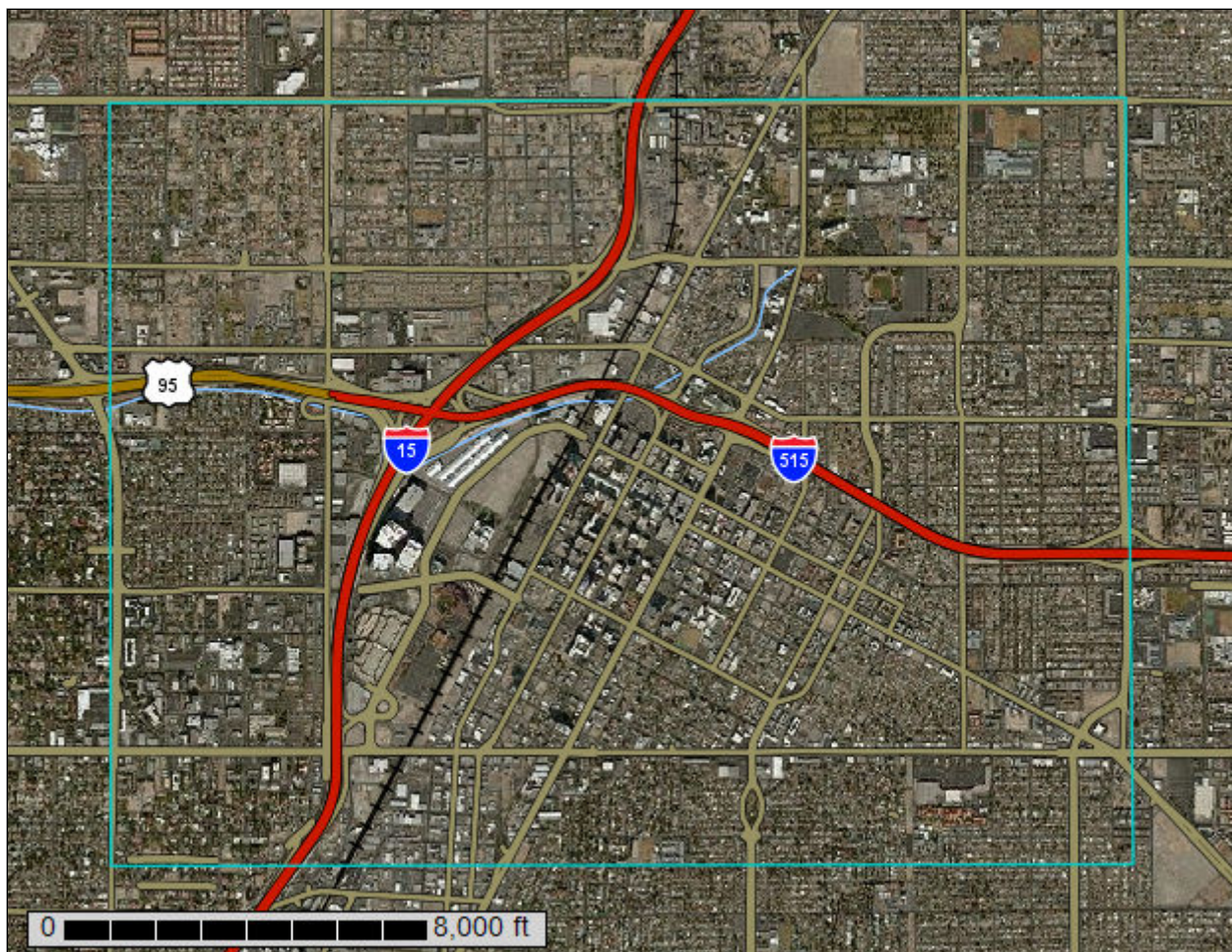
United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

A product of the National
Cooperative Soil Survey,
a joint effort of the United
States Department of
Agriculture and other
Federal agencies, State
agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for Las Vegas Valley Area, Nevada, Part of Clark County



June 11, 2018

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<https://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

Custom Soil Resource Report

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report Soil Map



Custom Soil Resource Report

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features

 Blowout

 Borrow Pit

 Clay Spot

 Closed Depression

 Gravel Pit

 Gravelly Spot

 Landfill

 Lava Flow

 Marsh or swamp

 Mine or Quarry

 Miscellaneous Water

 Perennial Water

 Rock Outcrop

 Saline Spot

 Sandy Spot

 Severely Eroded Spot

 Sinkhole

 Slide or Slip

 Sodic Spot

 Spoil Area

 Stony Spot

 Very Stony Spot

 Wet Spot

 Other

 Special Line Features

Water Features

 Streams and Canals

Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL:

Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Las Vegas Valley Area, Nevada, Part of Clark County

Survey Area Data: Version 12, Sep 15, 2017

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

Date(s) aerial images were photographed: May 7, 2011—Feb 25, 2014

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
200	Glencarb silt loam	369.0	7.5%
236	Glencarb very fine sandy loam, saline	876.1	17.8%
270	Land silt loam, drained	519.5	10.6%
300	Las Vegas gravelly fine sandy loam, 0 to 2 percent slopes	133.4	2.7%
325	McCarran fine sandy loam, 0 to 4 percent slopes	242.7	4.9%
341	Paradise silt loam	704.6	14.3%
380	Skyhaven very fine sandy loam, 0 to 4 percent slopes	7.7	0.2%
390	Spring clay loam	1,045.5	21.3%
615	Urban land	1,014.8	20.7%
Totals for Area of Interest		4,913.4	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit

descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Las Vegas Valley Area, Nevada, Part of Clark County

200—Glencarb silt loam

Map Unit Setting

National map unit symbol: hrb6
Elevation: 1,500 to 2,400 feet
Mean annual precipitation: 4 to 6 inches
Mean annual air temperature: 64 to 70 degrees F
Frost-free period: 180 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Glencarb and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Glencarb

Setting

Landform: Alluvial flats
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 6 inches: silt loam
H2 - 6 to 60 inches: stratified very fine sandy loam to silty clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 60 percent
Gypsum, maximum in profile: 5 percent
Salinity, maximum in profile: Slightly saline to moderately saline (4.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 12.0
Available water storage in profile: High (about 10.9 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 7c
Hydrologic Soil Group: C
Other vegetative classification: LOAMY BOTTOM (030XB020NV)
Hydric soil rating: No

236—Glencarb very fine sandy loam, saline

Map Unit Setting

National map unit symbol: hrb9
Elevation: 1,500 to 2,400 feet
Mean annual precipitation: 3 to 7 inches
Mean annual air temperature: 63 to 70 degrees F
Frost-free period: 240 to 300 days
Farmland classification: Not prime farmland

Map Unit Composition

Glencarb and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Glencarb

Setting

Landform: Alluvial flats
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 6 inches: very fine sandy loam
H2 - 6 to 60 inches: stratified very fine sandy loam to silty clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 60 percent
Gypsum, maximum in profile: 5 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 32.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 60.0
Available water storage in profile: High (about 10.7 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Ecological site: SODIC TERRACE (R030XY040NV)
Hydric soil rating: No

270—Land silt loam, drained

Map Unit Setting

National map unit symbol: hrbl
Elevation: 1,200 to 2,400 feet
Mean annual precipitation: 4 to 6 inches
Mean annual air temperature: 66 to 70 degrees F
Frost-free period: 230 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Land and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Land

Setting

Landform: Alluvial flats
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 6 inches: silt loam
H2 - 6 to 60 inches: stratified silt loam to silty clay

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 0.57 in/hr)
Depth to water table: About 42 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Gypsum, maximum in profile: 10 percent
Salinity, maximum in profile: Strongly saline (16.0 to 32.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 90.0
Available water storage in profile: High (about 9.8 inches)

Interpretive groups

Land capability classification (irrigated): 6w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: C
Ecological site: SODIC TERRACE (R030XY040NV)
Hydric soil rating: No

300—Las Vegas gravelly fine sandy loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: hrbp
Elevation: 1,800 to 2,600 feet
Mean annual precipitation: 4 to 6 inches
Mean annual air temperature: 63 to 68 degrees F
Frost-free period: 220 to 260 days
Farmland classification: Not prime farmland

Map Unit Composition

Las Vegas and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Las Vegas

Setting

Landform: Basin-floor remnants
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from limestone

Typical profile

H1 - 0 to 1 inches: gravelly fine sandy loam
H2 - 1 to 7 inches: fine sandy loam
H3 - 7 to 11 inches: gravelly sandy clay loam
H4 - 11 to 15 inches: indurated

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 3 to 14 inches to petrocalcic
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 85 percent
Gypsum, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 12.0
Available water storage in profile: Very low (about 1.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Other vegetative classification: LIMY 3-5" P.Z. (030XB019NV_3)
Hydric soil rating: No

325—McCarran fine sandy loam, 0 to 4 percent slopes

Map Unit Setting

National map unit symbol: hrbv
Elevation: 1,600 to 2,400 feet
Mean annual precipitation: 4 to 6 inches
Mean annual air temperature: 63 to 66 degrees F
Frost-free period: 235 to 260 days
Farmland classification: Not prime farmland

Map Unit Composition

Mccarran and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mccarran

Setting

Landform: Alluvial flats
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from limestone

Typical profile

H1 - 0 to 9 inches: fine sandy loam
H2 - 9 to 48 inches: gypsiferous material
H3 - 48 to 62 inches: gypsiferous material

Properties and qualities

Slope: 0 to 4 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Very low to high (0.00 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 70 percent
Gypsum, maximum in profile: 40 percent
Salinity, maximum in profile: Slightly saline to moderately saline (4.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 12.0
Available water storage in profile: Very low (about 1.3 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Other vegetative classification: SHALLOW LIMY 5-8 P.Z. (030XB031NV_2)
Hydric soil rating: No

341—Paradise silt loam

Map Unit Setting

National map unit symbol: hrbx
Elevation: 1,800 to 2,100 feet
Mean annual precipitation: 4 to 6 inches
Mean annual air temperature: 64 to 68 degrees F
Frost-free period: 240 to 260 days
Farmland classification: Not prime farmland

Map Unit Composition

Paradise and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Paradise

Setting

Landform: Alluvial flats
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 10 inches: silt loam
H2 - 10 to 39 inches: loam
H3 - 39 to 61 inches: silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 36 to 60 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 60 percent
Gypsum, maximum in profile: 5 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 12.0
Available water storage in profile: High (about 10.5 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: B
Ecological site: SALINE MEADOW (R030XY023NV)
Hydric soil rating: No

380—Skyhaven very fine sandy loam, 0 to 4 percent slopes

Map Unit Setting

National map unit symbol: hrbz
Elevation: 1,800 to 2,300 feet
Mean annual precipitation: 4 to 6 inches
Mean annual air temperature: 63 to 68 degrees F
Frost-free period: 220 to 260 days
Farmland classification: Not prime farmland

Map Unit Composition

Skyhaven and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Skyhaven

Setting

Landform: Alluvial flats
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 1 inches: very fine sandy loam
H2 - 1 to 8 inches: clay loam
H3 - 8 to 37 inches: gravelly silty clay loam
H4 - 37 to 41 inches: indurated

Properties and qualities

Slope: 0 to 4 percent
Depth to restrictive feature: 24 to 39 inches to petrocalcic
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 90 percent
Gypsum, maximum in profile: 5 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Other vegetative classification: SHALLOW LIMESTONE SLOPE 5-8 P.Z.
(030XB030NV_2)
Hydric soil rating: No

390—Spring clay loam

Map Unit Setting

National map unit symbol: hrc0
Elevation: 1,600 to 2,000 feet
Mean annual precipitation: 4 to 6 inches
Mean annual air temperature: 66 to 68 degrees F
Frost-free period: 240 to 260 days
Farmland classification: Not prime farmland

Map Unit Composition

Spring and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Spring

Setting

Landform: Alluvial flats
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Lacustrine deposits derived from gypsum

Typical profile

H1 - 0 to 11 inches: clay loam
H2 - 11 to 43 inches: gypsiferous material
H3 - 43 to 60 inches: silty clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Gypsum, maximum in profile: 30 percent
Salinity, maximum in profile: Strongly saline (16.0 to 32.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 30.0
Available water storage in profile: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): 6s
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Ecological site: SALINE BOTTOM (R030XY024NV)
Hydric soil rating: No

615—Urban land

Map Unit Composition

Urban land: 100 percent

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

Description of Urban Land

Setting

Landform: Valleys

Down-slope shape: Convex

Across-slope shape: Convex

Properties and qualities

Frequency of flooding: Rare

Soil Information for All Uses

Soil Reports

The Soil Reports section includes various formatted tabular and narrative reports (tables) containing data for each selected soil map unit and each component of each unit. No aggregation of data has occurred as is done in reports in the Soil Properties and Qualities and Suitabilities and Limitations sections.

The reports contain soil interpretive information as well as basic soil properties and qualities. A description of each report (table) is included.

Soil Physical Properties

This folder contains a collection of tabular reports that present soil physical properties. The reports (tables) include all selected map units and components for each map unit. Soil physical properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

Engineering Properties

This table gives the engineering classifications and the range of engineering properties for the layers of each soil in the survey area.

Hydrologic soil group is a group of soils having similar runoff potential under similar storm and cover conditions. The criteria for determining Hydrologic soil group is found in the National Engineering Handbook, Chapter 7 issued May 2007(<http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba>). Listing HSGs by soil map unit component and not by soil series is a new concept for the engineers. Past engineering references contained lists of HSGs by soil series. Soil series are continually being defined and redefined, and the list of soil series names changes so frequently as to make the task of maintaining a single national list virtually impossible. Therefore, the criteria is now used to calculate the HSG using the component soil properties and no such national series lists will be maintained. All such references are obsolete and their use should be discontinued. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to a seasonal high water table, saturated hydraulic conductivity after prolonged wetting, and depth to a layer with a very slow water transmission

rate. Changes in soil properties caused by land management or climate changes also cause the hydrologic soil group to change. The influence of ground cover is treated independently. There are four hydrologic soil groups, A, B, C, and D, and three dual groups, A/D, B/D, and C/D. In the dual groups, the first letter is for drained areas and the second letter is for undrained areas.

The four hydrologic soil groups are described in the following paragraphs:

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

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

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

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

Depth to the upper and lower boundaries of each layer is indicated.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

Classification of the soils is determined according to the Unified soil classification system (ASTM, 2005) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 2004).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group

Custom Soil Resource Report

index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Percentage of rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Liquid limit and plasticity index (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

References:

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

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Absence of an entry indicates that the data were not estimated. The asterisk '*' denotes the representative texture; other possible textures follow the dash. The criteria for determining the hydrologic soil group for individual soil components is found in the National Engineering Handbook, Chapter 7 issued May 2007(<http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba>). Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Engineering Properties—Las Vegas Valley Area, Nevada, Part of Clark County														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
200—Glencarb silt loam														
Glencarb	100	C	0-6	Silt loam	CL-ML, ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	90-95-100	70-80-90	20-25-30	NP-5-10
			6-60	Stratified very fine sandy loam to silty clay loam	CL, CL-ML	A-4, A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	95-98-100	75-80-85	25-30-35	5-10-15
236—Glencarb very fine sandy loam, saline														
Glencarb	100	C	0-6	Very fine sandy loam	CL-ML, ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	85-90-95	55-60-65	20-25-30	NP-5-10
			6-60	Stratified very fine sandy loam to silty clay loam	CL, CL-ML	A-4, A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	95-98-100	75-80-85	20-25-30	5-10-15
270—Land silt loam, drained														
Land	100	C	0-6	Silt loam	CL, CL-ML	A-4, A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	90-95-100	70-80-90	25-30-35	5-10-15
			6-60	Stratified silt loam to silty clay	CL	A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	95-98-100	85-90-95	25-33-40	10-15-20

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Engineering Properties—Las Vegas Valley Area, Nevada, Part of Clark County														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
300—Las Vegas gravelly fine sandy loam, 0 to 2 percent slopes														
Las vegas	100	D	0-1	Gravelly fine sandy loam	SM	A-1, A-2	0- 0- 0	0- 0- 0	60-70-80	50-63-75	40-53-65	20-25-30	15-20-25	NP-3 -5
			1-7	Fine sandy loam	SM	A-4	0- 0- 0	0- 0- 0	80-90-100	75-85-95	65-73-80	40-45-50	0-7 -14	NP
			7-11	Gravelly sandy clay loam, gravelly loam	GC, SC	A-2, A-6	0- 0- 0	0- 0- 0	60-70-80	50-63-75	30-40-50	25-35-45	25-30-35	10-13-15
			11-15	Indurated	—	—	—	—	—	—	—	—	—	—
325—McCarran fine sandy loam, 0 to 4 percent slopes														
Mccarran	100	A	0-9	Fine sandy loam	SM	A-2	0- 0- 0	0- 0- 0	85-90-95	80-85-90	60-65-70	25-30-35	15-20-25	NP-3 -5
			9-48	Gypsiferous material	GP	A-1	—	—	—	—	—	—	—	—
			48-62	Gypsiferous material	GP	A-1	—	—	—	—	—	—	—	—
341—Paradise silt loam														
Paradise	100	B	0-10	Silt loam	CL-ML, ML, CL	A-4	0- 0- 0	0- 0- 0	95-98-100	95-98-100	85-93-100	65-75-85	25-30-35	5-8 -10
			10-39	Sandy loam, loam, silt loam	ML, SM	A-4	0- 0- 0	0- 0- 0	85-93-100	85-93-100	65-78-90	45-58-70	20-23-25	NP-3 -5
			39-61	Silt loam	CL-ML, ML, CL	A-4	0- 0- 0	0- 0- 0	85-93-100	85-93-100	75-85-95	60-73-85	25-30-35	5-8 -10

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Engineering Properties—Las Vegas Valley Area, Nevada, Part of Clark County														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
380—Skyhaven very fine sandy loam, 0 to 4 percent slopes														
Skyhaven	100	C	0-1	Very fine sandy loam	ML, SM	A-4	0- 0- 0	0- 0- 0	80-90-100	75-88-100	70-83-95	40-55-70	15-20-25	NP-3 -5
			1-8	Clay loam	CL	A-6	0- 0- 0	0- 0- 0	80-90-100	75-88-100	70-83-95	55-68-80	35-38-40	15-18-20
			8-37	Gravelly silty clay loam, gravelly loam, gravelly clay loam	CL, GC	A-6	0- 0- 0	0- 3- 5	60-70-80	50-63-75	45-58-70	35-50-65	30-35-40	10-15-20
			37-41	Indurated	—	—	—	—	—	—	—	—	—	—
390—Spring clay loam														
Spring	100	C	0-11	Clay loam	CL	A-6, A-7	0- 0- 0	0- 0- 0	100-100-100	100-100-100	90-95-100	70-75-80	35-40-45	15-20-25
			11-43	Gypsiferous material	GP	A-1	—	—	—	—	—	—	—	—
			43-60	Silty clay loam, silt loam	CL-ML, CL	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	90-95-100	75-80-85	20-25-30	5-8 -10

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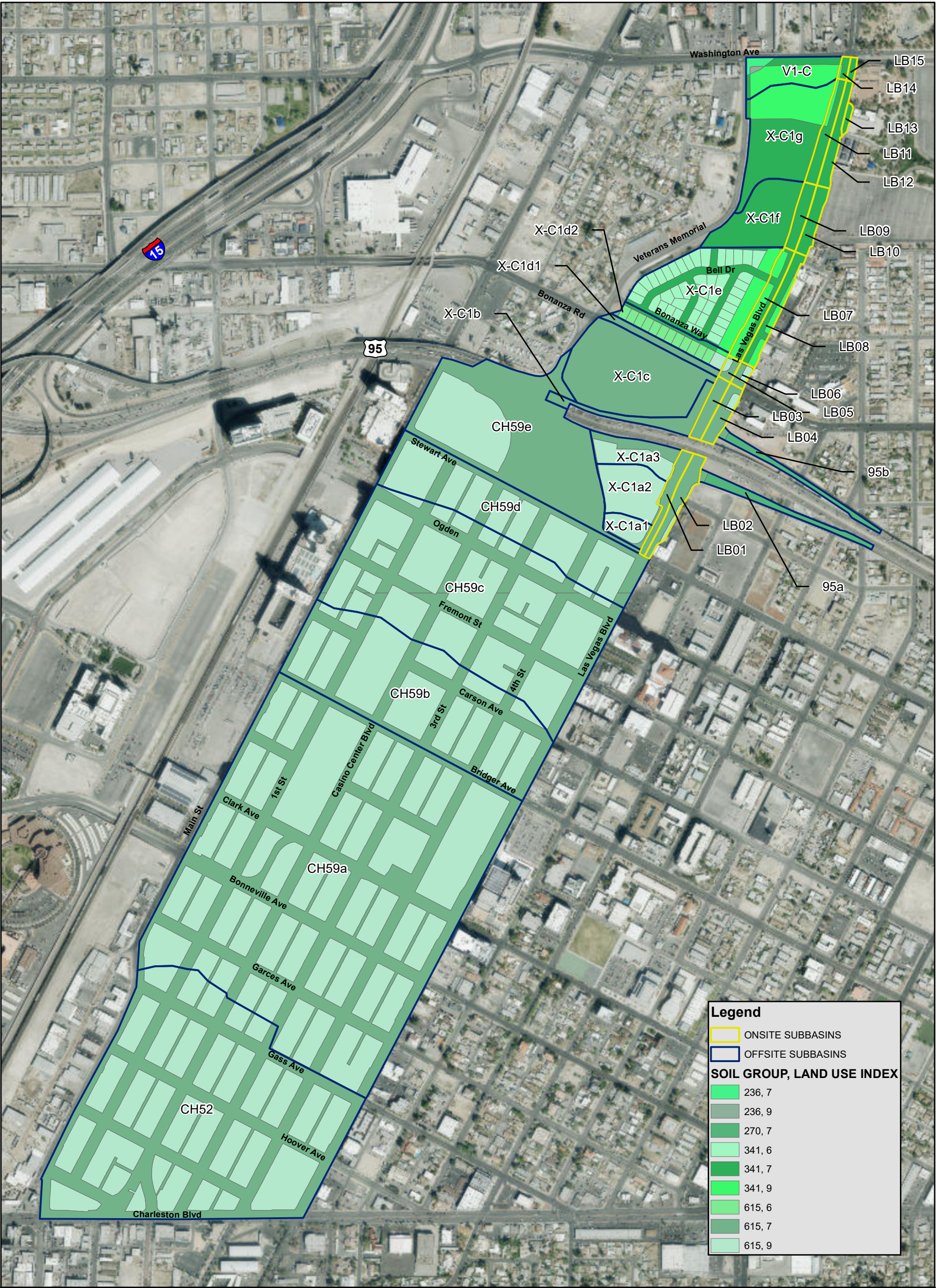
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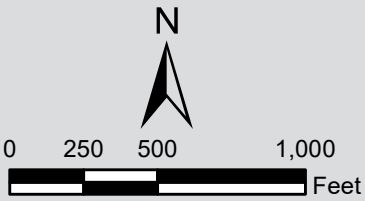
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A.2.2 Soils and Land Use Map



LAS VEGAS BLVD WIDENING

SOIL AND LAND USE MAP



A.2.3 Curve Number Matrix

Curve Number Matrix																
MAP #	COMPONENTS			LAND USE CLASSIFICATION INDEX NUMBER												
	OPEN DESERT	OPEN GOOD	% IMP	1	2	3	4	5	6	7	8	9	10	11	12	13
	% --->			100	28.5	40	37.5	35	24	14	20	15	28	15	15	0
			% --->	0	66.5	40	37.5	35	24	14	0	0	0	0	35	0
			% --->	0	5	20	25	30	52	72	80	85	72	85	50	0
	CN	CN	CN	SOIL TYPE COMPOSITE CN FOR LAND USE TYPE												
236	81	74	98	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
270	81	74	98	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
341	72	61	98	77.0	66.0	73.0	74.0	76.0	83.0	89.0	93.0	94.0	91.0	94.0	81.0	30.0
615	81	74	98	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0

A.2.4 HCDDM Runoff Curve Numbers Table 602 1 of 4

RUNOFF CURVE NUMBERS (URBAN AREAS¹)

Cover description		Curve numbers for hydrologic soil group—			
Cover type and hydrologic condition	Average percent impervious area ²	A	B	C	D
<i>Fully developed urban areas (vegetation established)</i>					
Open space (lawns, parks, golf courses, cemeteries, etc.) ³ :					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved: curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved: open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) ⁴ ...		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					

See Table 602A

Developing urban areas

Newly graded areas (pervious areas only, no vegetation) ⁵	77	86	91	94
--	----	----	----	----

1 Average runoff condition, and $I_p = 0.2S$.

2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system. Impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using Figure 603.

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

4 Composite CN's for natural desert landscaping should be computed using Figure 603 based on the impervious area percentage (CN #98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using Figure 603 based on the degree of development impervious area percentage) and the CN's for the newly graded pervious areas.

Revision	Date

A.2.5 Curve Number Calculations

Table A.1.1 Las Vegas Blvd. Widening

Curve Number Calculations - Future Conditions								BY: ANS		CHKD BY: JAM
								DATE: 8/17/2018		DATE: 8/17/2018
Basin Name	Land Use	MUSYM	Subregion CN	Subregion Area (Acres)	Subbasin Area (Acres)	Percent of Subbasin	Cumulative Percent	Area Weighted CN	Cumulative CN	Composite CN
95a	7	615	92	0.1	1.5	6.4%	6.4%	5.86	5.86	92.0
95a	7	270	92	1.4	1.5	93.6%	100.0%	86.14	92.00	
95b	7	615	92	0.1	1.2	7.6%	7.6%	6.96	6.96	92.0
95b	7	270	92	1.1	1.2	92.4%	100.0%	85.04	92.00	
CH52	9	615	95	34.7	61.7	56.2%	56.2%	53.39	53.39	93.7
CH52	7	615	92	27.0	61.7	43.8%	100.0%	40.30	93.69	
CH59a	9	615	95	61.8	100.1	61.7%	61.7%	58.61	58.61	93.9
CH59a	7	615	92	38.3	100.1	38.3%	100.0%	35.24	93.85	
CH59b	9	615	95	17.4	27.6	63.1%	63.1%	59.94	59.94	93.9
CH59b	7	615	92	10.2	27.6	36.9%	100.0%	33.95	93.89	
CH59c	9	615	95	25.8	41.7	61.9%	61.9%	58.78	58.78	93.9
CH59c	7	615	92	15.9	41.7	38.1%	100.0%	35.07	93.86	
CH59d	9	615	95	10.6	16.2	65.3%	65.3%	62.00	62.00	94.0
CH59d	7	615	92	5.6	16.2	34.7%	100.0%	31.96	93.96	
CH59e	9	615	95	6.3	22.0	28.8%	28.8%	27.35	27.35	92.9
CH59e	7	615	92	15.7	22.0	71.2%	100.0%	65.51	92.86	
V1-C	9	341	94	2.1	3.2	64.8%	64.8%	60.88	60.88	92.6
V1-C	7	341	89	0.8	3.2	24.0%	88.8%	21.38	82.26	
V1-C	9	236	95	0.1	3.2	2.2%	91.0%	2.07	84.33	
V1-C	7	236	92	0.3	3.2	9.0%	100.0%	8.31	92.64	
X-C1a1	9	615	95	1.1	1.3	84.8%	84.8%	80.56	80.56	94.5
X-C1a1	7	615	92	0.2	1.3	15.2%	100.0%	13.98	94.54	
X-C1a2	9	615	95	3.3	3.5	96.5%	96.5%	91.65	91.65	94.9
X-C1a2	7	615	92	0.1	3.5	3.5%	100.0%	3.24	94.89	

Table A.1.1 Las Vegas Blvd. Widening

Curve Number Calculations - Future Conditions								BY: ANS	CHKD BY: JAM	
								DATE: 8/17/2018	DATE: 8/17/2018	
Basin Name	Land Use	MUSYM	Subregion CN	Subregion Area (Acres)	Subbasin Area (Acres)	Percent of Subbasin	Cumulative Percent	Area Weighted CN	Cumulative CN	Composite CN
X-C1a3	9	615	95	1.7	2.7	61.5%	61.5%	58.45	58.45	93.8
X-C1a3	7	615	92	1.0	2.7	38.5%	100.0%	35.40	93.85	
X-C1b	7	615	92	1.9	1.9	100.0%	100.0%	92.00	92.00	92.0
X-C1c	7	615	92	11.1	11.1	100.0%	100.0%	92.00	92.00	92.0
X-C1d1	6	615	88	0.0	1.1	2.6%	2.6%	2.31	2.31	91.9
X-C1d1	9	615	95	0.0	1.1	0.0%	2.6%	0.00	2.31	
X-C1d1	7	615	92	1.0	1.1	97.4%	100.0%	89.58	91.90	
X-C1d2	6	615	88	1.7	2.4	68.7%	68.7%	60.45	60.45	89.1
X-C1d2	9	615	95	0.2	2.4	9.3%	78.0%	8.86	69.31	
X-C1d2	7	615	92	0.1	2.4	2.3%	80.3%	2.08	71.39	
X-C1d2	6	341	83	0.0	2.4	0.0%	80.3%	0.01	71.39	
X-C1d2	9	341	94	0.1	2.4	3.3%	83.6%	3.08	74.47	
X-C1d2	7	341	89	0.4	2.4	16.4%	100.0%	14.63	89.10	
X-C1e	6	341	83	6.5	11.1	58.8%	58.8%	48.79	48.79	86.2
X-C1e	9	341	94	1.7	11.1	15.0%	73.8%	14.09	62.88	
X-C1e	7	341	89	2.9	11.1	26.2%	100.0%	23.34	86.22	
X-C1f	7	341	89	4.8	4.8	100.0%	100.0%	89.00	89.00	89.0
X-C1g	9	341	94	3.0	8.0	37.9%	37.9%	35.61	35.61	90.9
X-C1g	7	341	89	5.0	8.0	62.1%	100.0%	55.28	90.89	

A.3 Lag Time Calculations

Table A.3.1: Standard Form 4 Lag Time Calculations

Project: Las Vegas Blvd. Widening														BY: ANS		CHKD BY: JAM	
LBG Project No.:														DATE: 8/17/2018		DATE: 8/17/2018	
SUB-BASIN DATA						INITIAL / OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					Tc	Tc Check	Tlag	REMARKS
BASIN	DEV./UN. (D or U)	CN	K	AREA Ac	AREA (mi2)	Lo INITIAL LENGTH (ft)	S SLOPE %	Ti (min)	TRAVEL LENGTH (ft)	SLOPE %	V1 VELOCITY (ft/s)	V2 VELOCITY (ft/s)	Tt (min)	(min)	(min)	Tlag= 0.6Tc/60 (hours)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
95a	D	92.0	0.8244	1.5	0.002	25	0.02	9.1	1307	3.30	3.7	5.6	4.7	13.8	17.4	0.138	
95b	D	92.0	0.8244	1.2	0.002	25	0.02	9.1	1330	3.10	3.6	5.4	4.9	14.0	17.5	0.140	
CH52	D	93.7	0.8467	61.70	0.096	36	0.02	10.1	3435	0.43	1.3	2.0	30.5	40.6	29.3	0.293	
CH59a	D	93.9	0.8488	100.12	0.156	28	0.02	8.8	3311	0.45	1.4	2.1	28.9	37.7	28.6	0.286	
CH59b	D	93.9	0.8494	27.62	0.043	35	0.02	9.8	2319	0.60	1.6	2.4	18.1	27.9	23.1	0.231	
CH59c	D	93.9	0.8489	41.68	0.065	28	0.02	8.8	2758	0.65	1.6	2.5	20.3	29.1	25.5	0.255	
CH59d	D	94.0	0.8502	16.2	0.025	39	0.02	10.3	2228	0.64	1.6	2.5	16.9	27.2	22.6	0.226	
CH59e	D	92.9	0.8358	22.0	0.034	20	0.02	7.8	2218	0.62	1.6	2.4	17.2	25.0	22.4	0.224	
LB01	D	98.0	0.9036	1.2	0.002	39	0.02	8.1	796	0.48	1.4	2.1	8.3	16.4	14.6	0.146	
LB02	D	98.0	0.9036	1.5	0.002	32	0.02	7.4	812	0.54	1.5	2.2	7.9	15.3	14.7	0.147	
LB03	D	98.0	0.9036	1.0	0.002	54	0.02	9.6	464	0.84	1.8	2.8	4.2	13.8	12.9	0.129	
LB04	D	98.0	0.9036	1.1	0.002	62	0.02	10.3	444	0.90	1.9	2.9	3.9	14.1	12.8	0.128	
LB05	D	98.0	0.9036	0.4	0.001	90	0.02	12.4	116	1.72	2.7	4.0	0.7	13.1	11.1	0.111	
LB06	D	98.0	0.9036	0.4	0.001	80	0.02	11.6	168	1.00	2.0	3.1	1.4	13.0	11.4	0.114	
LB07	D	98.0	0.9036	1.9	0.003	78	0.02	11.5	854	0.82	1.8	2.8	6.7	18.2	15.2	0.152	
LB08	D	98.0	0.9036	1.7	0.003	81	0.02	11.7	863	1.14	2.2	3.3	5.7	17.4	15.2	0.152	
LB09	D	98.0	0.9036	1.0	0.002	69	0.02	10.8	477	3.53	3.8	5.7	2.1	12.9	13.0	0.129	
LB10	D	98.0	0.9036	1.0	0.002	66	0.02	10.6	498	3.51	3.8	5.7	2.2	12.8	13.1	0.128	
LB11	D	98.0	0.9036	1.4	0.002	68	0.02	10.7	764	3.23	3.6	5.5	3.1	13.8	14.6	0.138	
LB12	D	98.0	0.9036	1.1	0.002	70	0.02	10.9	765	3.62	3.8	5.8	2.9	13.8	14.6	0.138	
LB13	D	98.0	0.9036	0.2	0.000	33	0.02	7.5	195	2.21	3.0	4.5	1.1	8.6	11.3	0.086	
LB14	D	98.0	0.9036	0.2	0.000	54	0.02	9.6	155	3.99	4.0	6.1	0.6	10.2	11.2	0.102	
LB15	D	98.0	0.9036	0.2	0.000	38	0.02	8.0	167	1.45	2.4	3.7	1.1	9.2	11.1	0.092	
V1-C	D	92.6	0.8328	3.2	0.005	21	0.02	8.1	701	6.50	5.1	7.8	2.0	10.2	14.0	0.102	
X-C1a1	D	94.5	0.8580	1.3	0.002	15	0.02	6.2	392	0.84	1.9	2.8	3.5	9.7	12.3	0.097	
X-C1a2	D	94.9	0.8626	3.5	0.005	21	0.02	7.2	528	1.01	2.0	3.1	4.3	11.5	13.1	0.115	
X-C1a3	D	93.8	0.8488	2.7	0.004	15	0.02	6.5	606	1.44	2.4	3.7	3.9	10.4	13.5	0.104	
X-C1b	D	92.0	0.8244	1.9	0.003	20	0.02	8.2	1365	1.04	2.1	3.1	8.7	16.8	17.7	0.168	
X-C1c	D	92.0	0.8244	11.1	0.017	24	0.02	9.0	1162	1.20	2.2	3.4	7.0	16.0	16.6	0.160	

Table A.3.1: Standard Form 4 Lag Time Calculations

Project: Las Vegas Blvd. Widening															BY: ANS		CHKD BY: JAM	
LBG Project No.:															DATE: 8/17/2018		DATE: 8/17/2018	
SUB-BASIN DATA						INITIAL / OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					Tc	Tc Check	Tlag	REMARKS	
BASIN	DEV./UN.	CN	K	AREA	AREA	Lo INITIAL	S	Ti	TRAVEL	SLOPE	V1	V2	Tt			Tlag=		
(1)	(2)	(3)	(4)	Ac	(mi2)	LENGTH	%	(min)	LENGTH	%	VELOCITY	VELOCITY	(min)	(min)	(min)	0.6Tc/60	(18)	
(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	
X-C1d1	D	91.9	0.8230	1.1	0.002	90	0.02	17.4	859	1.31	2.3	3.5	5.3	22.7	15.3	0.153		
X-C1d2	D	89.1	0.7862	2.4	0.004	15	0.02	8.1	819	1.41	2.4	3.6	4.9	13.0	14.6	0.130		
X-C1e	D	86.2	0.7481	11.1	0.017	30	0.02	12.8	1103	1.55	2.5	3.8	6.0	18.7	16.3	0.163		
X-C1f	D	89.0	0.7848	4.8	0.007	40	0.02	13.2	829	2.00	2.9	4.3	4.2	17.4	14.8	0.148		
X-C1g	D	90.9	0.8098	8.0	0.013	64	0.02	15.4	1065	2.54	3.2	4.9	4.5	19.9	16.3	0.163		
For Developed basins V1 = 20.2 (Slope/100)^0.5 and V2 = 30.6 (Slope/100)^0.5																		
For Existing basins V1 = 14.8 (Slope/100)^0.5 and V2 = 29.4 (Slope/100)^0.5																		
If the Travel Length is greater than 500 ft then Tt = 500/(60 V1) + (Travel Length - 500)/(60 V2)																		
If the Travel Length is less than 500 ft then Tt = Travel Length/(60 V2)																		
Tc = Ti + Tt																		

A.4 HEC-1 Models

- A.4.1 - 10-Year HEC-1 Model
- A.4.2 - 100-Year and 25-Year HEC-1 Model

A.4.1 10-Year HEC-1 Model

```
1*****
*
*   FLOOD HYDROGRAPH PACKAGE   (HEC-1)
*           JUN   1998
*           VERSION 4.1
*
*   RUN DATE   04NOV19   TIME   10:47:16
*
*****
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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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X      X  XXXXXXX  XXXX      X
X      X  X      X      X    XX
X      X  X      X      X    X
XXXXXXX XXXX      X      XXXXX X
X      X  X      X      X    X
X      X  X      X      X    X
X      X  XXXXXXX  XXXX      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 LVB WIDENING STEWART TO WASHINGTON	
	2	ID PROPOSED CONDITIONS	
	3	ID INPUT FILE = LVB_WIDE10.DAT	
	4	ID INPUT FILE DATE = OCTOBER 28, 2019	
	5	ID DESIGN STORM = 10-YEAR 6-HR STORM	
	6	ID STORM DISTRIBUTION = SDN #3	
	7	ID MODELED BY WSP (JILL REILLY, P.E. AND ASHLEY SELVY, E.I.)	
	8	ID STORM CENTERING = ENTIRE WATERSHED	
	9	ID	
	10	ID	
	11	ID JR CARDS CONTAIN DARF'S BASED ON THE FOLLOWING VALUES:	

12	ID										
13	ID	AREA	DARF								
14	ID	SQ.MI.									
15	ID										
16	ID	10-YR	0.57								
17	ID										
18	IT	5	0	0	500						
19	IO	5	0	0							
20	IN	5	0	0							
21	JR	PREC	0.570								
22	KK	CH52									
23	KM	OFFSITE SUBBASIN CH52									
24	KM	FOR AREA BETWEEN GASS AND CHARLESTON									
25	BA	0.0964									
26	PB	2.77									
27	PC	0.000	0.020	0.057	0.070	0.087	0.108	0.124	0.130	0.130	0.130
28	PC	0.130	0.130	0.130	0.133	0.140	0.142	0.148	0.158	0.172	0.181
29	PC	0.190	0.197	0.199	0.200	0.201	0.204	0.214	0.229	0.241	0.249
30	PC	0.251	0.256	0.270	0.278	0.281	0.283	0.295	0.322	0.352	0.409
31	PC	0.499	0.590	0.710	0.744	0.781	0.812	0.819	0.835	0.851	0.856
32	PC	0.860	0.868	0.876	0.888	0.910	0.926	0.937	0.950	0.970	0.976
33	PC	0.982	0.985	0.987	0.989	0.990	0.993	0.993	0.994	0.995	0.998
34	PC	0.998	0.999	1.000							
35	LS	0	93.7								
36	UD	0.293									
	*										
37	KK	CH59a									
38	KM	OFFSITE SUBBASIN CH59a									
39	KM	FOR AREA BETWEEN GASS AND BRIDGER									
40	BA	0.1564									
41	PB	2.77									
42	LS	0	93.9								
43	UD	0.286									
	*										

1

HEC-1 INPUT

PAGE 2

LINE	ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
44	KK CP1
45	KM COMBINE CH52 AND CH59a AT LOW PT IN BONNEVILLE
46	HC 2
	*
47	KK CH59b
48	KM OFFSITE SUBBASIN CH59b
49	KM FOR AREA BETWEEN BRIDGER AND CARSON
50	BA 0.0432
51	PB 2.77

52	LS	0	93.9
53	UD	0.231	
	*		
54	KK	CH59c	
55	KM	OFFSITE SUBBASIN CH59c	
56	KM	FOR AREA BETWEEN CARSON AND OGDEN	
57	BA	0.0651	
58	PB	2.77	
59	LS	0	93.9
60	UD	0.255	
	*		
61	KK	CP2	
62	KM	COMBINE CP1, CH59b, AND CH59c AT OGDEN	
63	HC	3	
	*		
64	KK	CH59d	
65	KM	OFFSITE SUBBASIN CH59d	
66	KM	FOR AREA BETWEEN OGDEN AND STEWART	
67	BA	0.0254	
68	PB	2.77	
69	LS	0	94.0
70	UD	0.226	
	*		
71	KK	CH59e	
72	KM	OFFSITE SUBBASIN CH59e	
73	KM	FOR AREA BETWEEN STEWART AND US95 EB OFF RAMP AND WEST OF 4TH ST	
74	BA	0.0344	
75	PB	2.77	
76	LS	0	92.9
77	UD	0.224	
	*		
78	KK	CP3	
79	KM	COMBINE CP2, CH59d, AND CH59e AT STEWART	
80	KM	FLOW IN STEWART WEST OF LVB	
81	HC	3	
	*		

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

82	KK	DVSD		
83	KM	FLOW DIVERTED INTO 48" STORM DRAIN IN EAST LVB		
84	DT	EASTSD		
85	DI	0	78	275
86	DQ	0	78	78

	*
87	KK DVSTEW
88	KM FLOW DIVERTED EAST IN STEWART
89	DT STEW
90	DI 0 197
91	DQ 0 176
	*
92	KK X-C1a1
93	KM OFFSITE SUBBASIN X-C1a1
94	KM FOR AREA EAST OF 4TH BETWEEN STEWART & SOUTHERN PORTION OF ZAPPOS BLDG
95	BA 0.0020
96	PB 2.77
97	LS 0 94.5
98	UD 0.097
	*
99	KK X-C1a2
100	KM OFFSITE SUBBASIN X-C1a2
101	KM FOR AREA EAST OF 4TH BETWEEN SOUTHERN & NORTHERN PORTION ZAPPOS BLDG
102	BA 0.0054
103	PB 2.77
104	LS 0 94.9
105	UD 0.115
	*
106	KK X-C1a3
107	KM OFFSITE SUBBASIN X-C1a3
108	KM FOR AREA EAST OF 4TH BETWEEN NORTHERN PORTION ZAPPOS BLDG & US95 EB OFF RAMP
109	BA 0.0042
110	PB 2.77
111	LS 0 93.8
112	UD 0.104
	*
113	KK LB01
114	KM ONSITE SUBBASIN LB01
115	KM W HALF LVB BETWEEN STEWART AND US95 EB OFF RAMP
116	BA 0.0018
117	PB 2.77
118	LS 0 98.0
119	UD 0.146
	*

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1                                     HEC-1  INPUT                                     PAGE   4

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LINE	ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
------	---

120	KK	CP4A
121	KM	COMBINE WESTST, X-C1a1, X-C1a2, X-C1a3, AND LB01

122 KM TOTAL FLOW IN W HALF LVB AT US95 EB OFF RAMP
123 HC 5
*

124 KK X-C1c
125 KM OFFSITE SUBBASIN X-C1c
126 KM FOR AREA BETWEEN US95 WB ON RAMP AND BONANZA
127 KM FLOW IN BONANZA WEST OF LVB
128 BA 0.0173
129 PB 2.77
130 LS 0 92.0
131 UD 0.160
*

132 KK X-C1b
133 KM OFFSITE SUBBASIN X-C1b
134 KM US95 WB ON RAMP AREA
135 BA 0.0030
136 PB 2.77
137 LS 0 92.0
138 UD 0.168
*

139 KK LB03
140 KM ONSITE SUBBASIN LB03
141 KM W HALF LVB BETWEEN US95 WB ON RAMP AND BONANZA
142 BA 0.0015
143 PB 2.77
144 LS 0 98.0
145 UD 0.129
*

146 KK X-C1d1
147 KM OFFSITE SUBBASIN X-C1d1
148 KM FOR AREA ON N HALF OF BONANZA RD
149 BA 0.0016
150 PB 2.77
151 LS 0 91.9
152 UD 0.153
*

153 KK CP5A
154 KM COMBINE CP4A, X-C1b, X-C1c, X-C1d, AND LB03
155 KM FLOW IN W HALF LVB AT BONANZA
156 HC 5
*

157	KK	X-C1d2
158	KM	OFFSITE SUBBASIN X-C1d2
159	KM	FOR AREA BETWEEN BONANZA AND BONANZA WAY
160	BA	0.0038
161	PB	2.77
162	LS	0 89.1
163	UD	0.130
	*	
164	KK	LB05
165	KM	ONSITE SUBBASIN LB05
166	KM	W HALF LVB BETWEEN BONANZA AND BONANZA WAY
167	BA	0.0006
168	PB	2.77
169	LS	0 98.0
170	UD	0.111
	*	
171	KK	CP6A
172	KM	COMBINE CP5A, X-C1d2, AND LB05
173	KM	FLOW IN W HALF LVB AT BONANZA WAY
174	HC	3
	*	
175	KK	X-C1e
176	KM	OFFSITE SUBBASIN X-C1e
177	KM	FOR AREA BETWEEN BONANZA WAY AND BELL
178	BA	0.0173
179	PB	2.77
180	LS	0 86.2
181	UD	0.163
	*	
182	KK	LB07
183	KM	ONSITE SUBBASIN LB07
184	KM	W HALF LVB BETWEEN BONANZA WAY AND BELL
185	BA	0.0030
186	PB	2.77
187	LS	0 98.0
188	UD	0.152
	*	
189	KK	CP7A
190	KM	COMBINE CP6A, X-C1e, AND LB07
191	KM	FLOW IN W HALF LVB AT BELL
192	HC	3
	*	
193	KK	X-C1f
194	KM	OFFSITE SUBBASIN X-C1f
195	KM	FOR AREA BETWEEN BELL AND SOUTH PORTION OF LVYO PROPERTY

1

196 BA 0.0074
197 PB 2.77
198 LS 0 89.0

HEC-1 INPUT

PAGE 6

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

199 UD 0.148
*

200 KK LB09
201 KM ONSITE SUBBASIN LB09
202 KM W HALF LVB BETWEEN BELL AND SOUTH PORTION OF LVYO PROPERTY
203 BA 0.0015
204 PB 2.77
205 LS 0 98.0
206 UD 0.129
*

207 KK CP8A
208 KM COMBINE CP7A, X-C1f, AND LB09
209 KM FLOW IN W HALF LVB AT SOUTH PORTION OF LVYO PROPERTY
210 HC 3
*

211 KK X-C1g
212 KM OFFSITE SUBBASIN X-C1g
213 KM FOR AREA BETWEEN SOUTH & NORTH PORTIONS OF LVYO PROPERTY
214 BA 0.0125
215 PB 2.77
216 LS 0 90.9
217 UD 0.163
*

218 KK LB11
219 KM ONSITE SUBBASIN LB11
220 KM W HALF LVB BETWEEN SOUTH & NORTH PORTIONS OF LVYO PROPERTY
221 BA 0.0021
222 PB 2.77
223 LS 0 98.0
224 UD 0.138
*

225 KK CP9A
226 KM COMBINE CP8A, X-C1g, AND LB11
227 KM FLOW IN W HALF LVB AT NORTH PORTION OF LVYO PROPERTY
228 HC 3
*

229 KK V1-C
230 KM OFFSITE SUBBASIN V1-C

231 KM FOR AREA BETWEEN NORTH PORTION OF LVYO PROPERTY & WASHINGTON
 232 BA 0.0050
 233 PB 2.77
 234 LS 0 92.6
 235 UD 0.102
 *

1

HEC-1 INPUT

PAGE 7

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

236 KK LB14
 237 KM ONSITE SUBBASIN LB11
 238 KM W HALF LVB BETWEEN NORTH PORTION OF LVYO PROPERTY & WASHINGTON
 239 BA 0.0004
 240 PB 2.77
 241 LS 0 98.0
 242 UD 0.102
 *

243 KK CP10A
 244 KM COMBINE CP9A, V1-C, AND LB14
 245 KM FLOW IN W HALF LVB AT WASHINGTON
 246 HC 3
 *

247 KK EASTSD
 248 DR EASTSD
 *

249 KK 95a
 250 KM OFFSITE SUBBASIN 95a
 251 KM AREA FOR US95 EB ON RAMP
 252 BA 0.0023
 253 PB 2.77
 254 LS 0 92.0
 255 UD 0.138
 *

256 KK LB02
 257 KM ONSITE SUBBASIN LB02
 258 KM E HALF LVB BETWEEN STEWART & US95 EB ON RAMP
 259 BA 0.0023
 260 PB 2.77
 261 LS 0 98.0
 262 UD 0.147
 *

263 KK CP4B
 264 KM COMBINE EASTSD, 95a, AND LB02
 265 KM FLOW IN E HALF LVB AT US95 EB ON RAMP

266 HC 3
 *
 267 KK 95b
 268 KM OFFSITE SUBBASIN 95b
 269 KM AREA FOR US95 WB OFF RAMP
 270 BA 0.0019
 271 PB 2.77
 272 LS 0 92.0
 273 UD 0.140
 *

1

HEC-1 INPUT

PAGE 8

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

274 KK LB04
 275 KM ONSITE SUBBASIN LB04
 276 KM E HALF LVB BETWEEN US95 WB OFF RAMP AND BONANZA
 277 BA 0.0017
 278 PB 2.77
 279 LS 0 98.0
 280 UD 0.128
 *

281 KK CP5B
 282 KM COMBINE CP4B, 95b, AND LB04
 283 KM FLOW IN E HALF LVB AT BONANZA
 284 HC 3
 *

285 KK LB06
 286 KM ONSITE SUBBASIN LB06
 287 KM E HALF LVB BETWEEN BONANZA AND BONANZA WAY
 288 BA 0.0006
 289 PB 2.77
 290 LS 0 98.0
 291 UD 0.114
 *

292 KK CP6B
 293 KM COMBINE CP5B AND LB06
 294 KM FLOW IN E HALF LVB AT BONANZA WAY
 295 HC 2
 *

296 KK LB08
 297 KM ONSITE SUBBASIN LB08
 298 KM E HALF LVB BETWEEN BONANZA WAY AND BELL
 299 BA 0.0026
 300 PB 2.77

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301      LS      0      98.0
302      UD      0.152
        *

303      KK      CP7B
304      KM      COMBINE CP6B AND LB08
305      KM      FLOW IN E HALF LVB AT BELL
306      HC      2
        *

307      KK      LB10
308      KM      ONSITE SUBBASIN LB10
309      KM      E HALF LVB BETWEEN BELL AND SOUTH PORTION OF LVYO PROPERTY
310      BA      0.0016
311      PB      2.77
312      LS      0      98.0
313      UD      0.128
        *

```

1

HEC-1 INPUT

PAGE 9

```

LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

314      KK      CP8B
315      KM      COMBINE CP7B AND LB10
316      KM      FLOW IN E HALF LVB AT SOUTH PORTION OF LVYO PROPERTY
317      HC      2
        *

318      KK      LB12
319      KM      ONSITE SUBBASIN LB12
320      KM      E HALF LVB BETWEEN SOUTH & NORTH PORTIONS OF LVYO PROPERTY
321      BA      0.0018
322      PB      2.77
323      LS      0      98.0
324      UD      0.138
        *

325      KK      LB13
326      KM      ONSITE SUBBASIN LB13
327      KM      E HALF LVB BETWEEN SOUTH & NORTH PORTIONS OF LVYO PROPERTY
328      BA      0.0003
329      PB      2.77
330      LS      0      98.0
331      UD      0.086
        *

332      KK      CP9B
333      KM      COMBINE CP8B, LB12, AND LB13
334      KM      E HALF FLOW IN E HALF LVB AT NORTH PORTION OF LVYO PROPERTY
335      HC      3

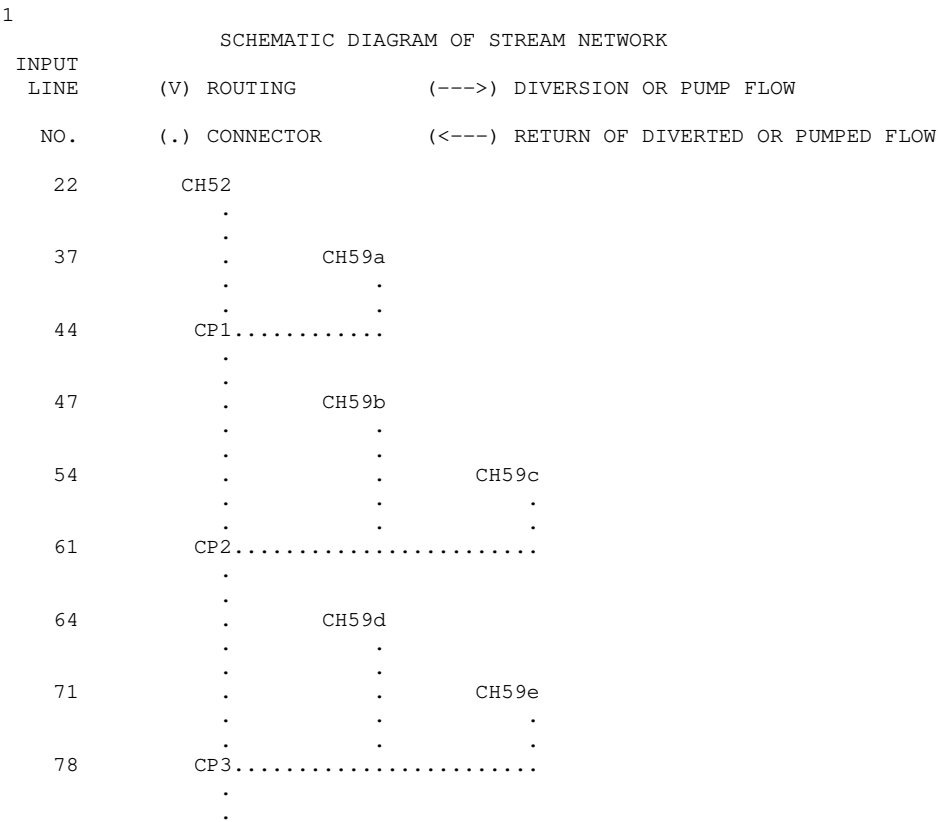
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*
336      KK      LB15
337      KM      ONSITE SUBBASIN LB15
338      KM      E HALF LVB BETWEEN NORTH PORTION OF LVYO PROPERTY & WASHINGTON
339      BA      0.0003
340      PB      2.77
341      LS      0      98.0
342      UD      0.092
*
343      KK      CP10B
344      KM      COMBINE CP9B AND LB15
345      KM      FLOW IN E HALF LVB AT WASHINGTON
346      HC      2
*
347      ZZ

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84      .-----> EASTSD
82      DVSD
      .
      .
89      .-----> STEW
87      DVSTEW
      .
92      .      X-C1a1
      .      .
99      .      .      X-C1a2
      .      .      .
106     .      .      .      X-C1a3
      .      .      .      .
113     .      .      .      .      LB01
      .      .      .      .      .
120     CP4A.....
      .
124     .      X-C1c
      .      .
132     .      .      X-C1b
      .      .      .
139     .      .      .      LB03
      .      .      .      .
146     .      .      .      .      X-C1d1
      .      .      .      .      .
153     CP5A.....
      .
157     .      X-C1d2
      .      .
164     .      .      LB05
      .      .      .
171     CP6A.....
      .
175     .      X-C1e
      .      .
182     .      .      LB07

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      .      .      .
189    CP7A.....
      .
193      .      X-C1f
      .      .
200      .      .      LB09
      .      .      .
207    CP8A.....
      .
211      .      X-C1g
      .      .
218      .      .      LB11
      .      .      .
225    CP9A.....
      .
229      .      V1-C
      .      .
236      .      .      LB14
      .      .      .
243    CP10A.....
      .
248      .      .<----- EASTSD
247      .      EASTSD
      .      .
249      .      .      95a
      .      .      .
256      .      .      .      LB02
      .      .      .      .
263      .      CP4B.....
      .      .
267      .      .      95b
      .      .      .
274      .      .      .      LB04
      .      .      .      .
      .      .      .      .

```

```
281      .      CP5B.....
      .      .
      .      .
285      .      .      LB06
      .      .      .
      .      .      .
292      .      CP6B.....
      .      .
      .      .
296      .      .      LB08
      .      .      .
      .      .      .
303      .      CP7B.....
      .      .
      .      .
307      .      .      LB10
      .      .      .
      .      .      .
314      .      CP8B.....
      .      .
      .      .
318      .      .      LB12
      .      .      .
      .      .      .
325      .      .      .      LB13
      .      .      .      .
      .      .      .      .
332      .      CP9B.....
      .      .
      .      .
336      .      .      LB15
      .      .      .
      .      .      .
343      .      CP10B.....
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
*      JUN 1998 *
*      VERSION 4.1 *
*
* RUN DATE 04NOV19 TIME 10:47:16 *
*
*****
```

```
*****
*
* U.S. ARMY CORPS OF ENGINEERS *
* HYDROLOGIC ENGINEERING CENTER *
* 609 SECOND STREET *
* DAVIS, CALIFORNIA 95616 *
* (916) 756-1104 *
*
*****
```

LVB WIDENING STEWART TO WASHINGTON

PROPOSED CONDITIONS
INPUT FILE = LVB_WIDE10.DAT
INPUT FILE DATE = OCTOBER 28, 2019
DESIGN STORM = 10-YEAR 6-HR STORM
STORM DISTRIBUTION = SDN #3
MODELED BY WSP (JILL REILLY, P.E. AND ASHLEY SELVY, E.I.)
STORM CENTERING = ENTIRE WATERSHED

JR CARDS CONTAIN DARFS BASED ON THE FOLLOWING VALUES:

AREA DARF
SQ.MI.

10-YR 0.57

19 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 500 NUMBER OF HYDROGRAPH ORDINATES
 NDDATE 2 0 ENDING DATE
 NDTIME 1735 ENDING TIME
 ICENT 19 CENTURY MARK

 COMPUTATION INTERVAL .08 HOURS
 TOTAL TIME BASE 41.58 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
 .57

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

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO PRECIPITATION	
				RATIO 1	
				.57	
HYDROGRAPH AT					
+	CH52	.10	1	FLOW	60.
				TIME	3.75
HYDROGRAPH AT					
+	CH59a	.16	1	FLOW	99.
				TIME	3.67
2 COMBINED AT					
+	CP1	.25	1	FLOW	160.
				TIME	3.75
HYDROGRAPH AT					
+	CH59b	.04	1	FLOW	30.
				TIME	3.67
HYDROGRAPH AT					
+	CH59c	.07	1	FLOW	44.
				TIME	3.67
3 COMBINED AT					
+	CP2	.36	1	FLOW	234.
				TIME	3.67
HYDROGRAPH AT					
+	CH59d	.03	1	FLOW	18.
				TIME	3.67
HYDROGRAPH AT					
+	CH59e	.03	1	FLOW	23.
				TIME	3.67
3 COMBINED AT					
+	CP3	.42	1	FLOW	275.
				TIME	3.67
DIVERSION TO					
+	EASTSD	.42	1	FLOW	78.
				TIME	3.42
HYDROGRAPH AT					
+	DVSD	.42	1	FLOW	197.

				TIME	3.67
DIVERSION TO					
+	STEW	.42	1	FLOW	176.
				TIME	3.67
HYDROGRAPH AT					
+	DVSTEW	.42	1	FLOW	21.
				TIME	3.67
HYDROGRAPH AT					
+	X-C1a1	.00	1	FLOW	2.
				TIME	3.50
HYDROGRAPH AT					
+	X-C1a2	.01	1	FLOW	5.
				TIME	3.58
HYDROGRAPH AT					
+	X-C1a3	.00	1	FLOW	4.
				TIME	3.50
HYDROGRAPH AT					
+	LB01	.00	1	FLOW	2.
				TIME	3.58
5 COMBINED AT					
+	CP4A	.43	1	FLOW	30.
				TIME	3.58
HYDROGRAPH AT					
+	X-C1c	.02	1	FLOW	12.
				TIME	3.58
HYDROGRAPH AT					
+	X-C1b	.00	1	FLOW	2.
				TIME	3.58
HYDROGRAPH AT					
+	LB03	.00	1	FLOW	2.
				TIME	3.58
HYDROGRAPH AT					
+	X-C1d1	.00	1	FLOW	1.
				TIME	3.58
5 COMBINED AT					
+	CP5A	.46	1	FLOW	47.
				TIME	3.58
HYDROGRAPH AT					

+	X-C1d2	.00	1	FLOW TIME	2. 3.58
	HYDROGRAPH AT				
+	LB05	.00	1	FLOW TIME	1. 3.50
	3 COMBINED AT				
+	CP6A	.46	1	FLOW TIME	50. 3.58
	HYDROGRAPH AT				
+	X-C1e	.02	1	FLOW TIME	8. 3.58
	HYDROGRAPH AT				
+	LB07	.00	1	FLOW TIME	3. 3.58
	3 COMBINED AT				
+	CP7A	.48	1	FLOW TIME	61. 3.58
	HYDROGRAPH AT				
+	X-C1f	.01	1	FLOW TIME	4. 3.58
	HYDROGRAPH AT				
+	LB09	.00	1	FLOW TIME	2. 3.58
	3 COMBINED AT				
+	CP8A	.49	1	FLOW TIME	67. 3.58
	HYDROGRAPH AT				
+	X-C1g	.01	1	FLOW TIME	8. 3.58
	HYDROGRAPH AT				
+	LB11	.00	1	FLOW TIME	2. 3.58
	3 COMBINED AT				
+	CP9A	.51	1	FLOW TIME	77. 3.58
	HYDROGRAPH AT				
+	V1-C	.00	1	FLOW TIME	4. 3.50

HYDROGRAPH AT					
+	LB14	.00	1	FLOW TIME	0. 3.50
3 COMBINED AT					
+	CP10A	.51	1	FLOW TIME	82. 3.58
HYDROGRAPH AT					
+	EASTSD	.00	1	FLOW TIME	78. 3.42
HYDROGRAPH AT					
+	95a	.00	1	FLOW TIME	2. 3.58
HYDROGRAPH AT					
+	LB02	.00	1	FLOW TIME	2. 3.58
3 COMBINED AT					
+	CP4B	.00	1	FLOW TIME	82. 3.58
HYDROGRAPH AT					
+	95b	.00	1	FLOW TIME	1. 3.58
HYDROGRAPH AT					
+	LB04	.00	1	FLOW TIME	2. 3.58
3 COMBINED AT					
+	CP5B	.01	1	FLOW TIME	85. 3.58
HYDROGRAPH AT					
+	LB06	.00	1	FLOW TIME	1. 3.50
2 COMBINED AT					
+	CP6B	.01	1	FLOW TIME	86. 3.58
HYDROGRAPH AT					
+	LB08	.00	1	FLOW TIME	3. 3.58
2 COMBINED AT					
+	CP7B	.01	1	FLOW TIME	88. 3.58

HYDROGRAPH AT					
+	LB10	.00	1	FLOW	2.
				TIME	3.58
2 COMBINED AT					
+	CP8B	.01	1	FLOW	90.
				TIME	3.58
HYDROGRAPH AT					
+	LB12	.00	1	FLOW	2.
				TIME	3.58
HYDROGRAPH AT					
+	LB13	.00	1	FLOW	0.
				TIME	3.50
3 COMBINED AT					
+	CP9B	.02	1	FLOW	92.
				TIME	3.58
HYDROGRAPH AT					
+	LB15	.00	1	FLOW	0.
				TIME	3.50
2 COMBINED AT					
+	CP10B	.02	1	FLOW	93.
				TIME	3.58

*** NORMAL END OF HEC-1 ***

A.4.2 100-Year and 25-Year HEC-1 Model

```
1*****
*
*   FLOOD HYDROGRAPH PACKAGE   (HEC-1)
*           JUN   1998
*           VERSION 4.1
*
*   RUN DATE   04NOV19   TIME   10:38:01
*
*****
```

```
*****
*
*   U.S. ARMY CORPS OF ENGINEERS
*   HYDROLOGIC ENGINEERING CENTER
*   609 SECOND STREET
*   DAVIS, CALIFORNIA 95616
*   (916) 756-1104
*
*****
```

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X      X  XXXXXXX  XXXXX      X
X      X  X      X      X      XX
X      X  X      X      X      X
XXXXXXX XXXX      X      XXXXX  X
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 LVB WIDENING STEWART TO WASHINGTON	
	2	ID PROPOSED CONDITIONS	
	3	ID INPUT FILE = LVB_WIDE.DAT	
	4	ID INPUT FILE DATE = OCTOBER 28, 2019	
	5	ID DESIGN STORM = 100-YEAR 6-HR STORM	
	6	ID STORM DISTRIBUTION = SDN #3	
	7	ID MODELED BY WSP (JILL REILLY, P.E. AND ASHLEY SELVY, E.I.)	
	8	ID STORM CENTERING = ENTIRE WATERSHED	
	9	ID	
	10	ID	
	11	ID JR CARDS CONTAIN DARF'S BASED ON THE FOLLOWING VALUES:	

12	ID										
13	ID	AREA	DARF								
14	ID	SQ.MI.									
15	ID										
16	ID	0 - 0.5	0.990								
17	ID	0.5 - 1	0.975								
18	ID	25-YR	0.74								
19	ID										
20	IT	5	0	0	500						
21	IO	5	0	0							
22	IN	5	0	0							
23	JR	PREC	0.990	0.975	0.740						
24	KK	CH52									
25	KM	OFFSITE SUBBASIN CH52									
26	KM	FOR AREA BETWEEN GASS AND CHARLESTON									
27	BA	0.0964									
28	PB	2.77									
29	PC	0.000	0.020	0.057	0.070	0.087	0.108	0.124	0.130	0.130	
30	PC	0.130	0.130	0.130	0.133	0.140	0.142	0.148	0.158	0.172	0.181
31	PC	0.190	0.197	0.199	0.200	0.201	0.204	0.214	0.229	0.241	0.249
32	PC	0.251	0.256	0.270	0.278	0.281	0.283	0.295	0.322	0.352	0.409
33	PC	0.499	0.590	0.710	0.744	0.781	0.812	0.819	0.835	0.851	0.856
34	PC	0.860	0.868	0.876	0.888	0.910	0.926	0.937	0.950	0.970	0.976
35	PC	0.982	0.985	0.987	0.989	0.990	0.993	0.993	0.994	0.995	0.998
36	PC	0.998	0.999	1.000							
37	LS	0	93.7								
38	UD	0.293									
	*										
39	KK	CH59a									
40	KM	OFFSITE SUBBASIN CH59a									
41	KM	FOR AREA BETWEEN GASS AND BRIDGER									
42	BA	0.1564									
43	PB	2.77									
44	LS	0	93.9								
45	UD	0.286									
	*										

1

HEC-1 INPUT

PAGE 2

LINE	ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
46	KK CP1
47	KM COMBINE CH52 AND CH59a AT LOW PT IN BONNEVILLE
48	HC 2
	*
49	KK CH59b
50	KM OFFSITE SUBBASIN CH59b
51	KM FOR AREA BETWEEN BRIDGER AND CARSON

52	BA	0.0432	
53	PB	2.77	
54	LS	0	93.9
55	UD	0.231	
	*		
56	KK	CH59c	
57	KM	OFFSITE SUBBASIN CH59c	
58	KM	FOR AREA BETWEEN CARSON AND OGDEN	
59	BA	0.0651	
60	PB	2.77	
61	LS	0	93.9
62	UD	0.255	
	*		
63	KK	CP2	
64	KM	COMBINE CP1, CH59b, AND CH59c AT OGDEN	
65	HC	3	
	*		
66	KK	CH59d	
67	KM	OFFSITE SUBBASIN CH59d	
68	KM	FOR AREA BETWEEN OGDEN AND STEWART	
69	BA	0.0254	
70	PB	2.77	
71	LS	0	94.0
72	UD	0.226	
	*		
73	KK	CH59e	
74	KM	OFFSITE SUBBASIN CH59e	
75	KM	FOR AREA BETWEEN STEWART AND US95 EB OFF RAMP AND WEST OF 4TH ST	
76	BA	0.0344	
77	PB	2.77	
78	LS	0	92.9
79	UD	0.224	
	*		
80	KK	CP3	
81	KM	COMBINE CP2, CH59d, AND CH59e AT STEWART	
82	KM	FLOW IN STEWART WEST OF LVB	
83	HC	3	
	*		

LINE	ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
84	KK DVSD
85	KM FLOW DIVERTED INTO 48" STORM DRAIN IN EAST LVB
86	DT EASTSD

87	DI	0	78	555
88	DQ	0	78	78
	*			
89	KK	DVSTEW		
90	KM	FLOW DIVERTED EAST IN STEWART		
91	DT	STEW		
92	DI	0	477	
93	DQ	0	434	
	*			
94	KK	X-C1a1		
95	KM	OFFSITE SUBBASIN X-C1a1		
96	KM	FOR AREA EAST OF 4TH BETWEEN STEWART & SOUTHERN PORTION OF ZAPPOS BLDG		
97	BA	0.0020		
98	PB	2.77		
99	LS	0	94.5	
100	UD	0.097		
	*			
101	KK	X-C1a2		
102	KM	OFFSITE SUBBASIN X-C1a2		
103	KM	FOR AREA EAST OF 4TH BETWEEN SOUTHERN & NORTHERN PORTION ZAPPOS BLDG		
104	BA	0.0054		
105	PB	2.77		
106	LS	0	94.9	
107	UD	0.115		
	*			
108	KK	X-C1a3		
109	KM	OFFSITE SUBBASIN X-C1a3		
110	KM	FOR AREA EAST OF 4TH BETWEEN NORTHERN PORTION ZAPPOS BLDG & US95 EB OFF RAMP		
111	BA	0.0042		
112	PB	2.77		
113	LS	0	93.8	
114	UD	0.104		
	*			
115	KK	LB01		
116	KM	ONSITE SUBBASIN LB01		
117	KM	W HALF LVB BETWEEN STEWART AND US95 EB OFF RAMP		
118	BA	0.0018		
119	PB	2.77		
120	LS	0	98.0	
121	UD	0.146		
	*			

1

HEC-1 INPUT

PAGE 4

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

122 KK CP4A
123 KM COMBINE WESTST, X-C1a1, X-C1a2, X-C1a3, AND LB01
124 KM TOTAL FLOW IN W HALF LVB AT US95 EB OFF RAMP
125 HC 5
*

126 KK X-C1c
127 KM OFFSITE SUBBASIN X-C1c
128 KM FOR AREA BETWEEN US95 WB ON RAMP AND BONANZA
129 KM FLOW IN BONANZA WEST OF LVB
130 BA 0.0173
131 PB 2.77
132 LS 0 92.0
133 UD 0.160
*

134 KK X-C1b
135 KM OFFSITE SUBBASIN X-C1b
136 KM US95 WB ON RAMP AREA
137 BA 0.0030
138 PB 2.77
139 LS 0 92.0
140 UD 0.168
*

141 KK LB03
142 KM ONSITE SUBBASIN LB03
143 KM W HALF LVB BETWEEN US95 WB ON RAMP AND BONANZA
144 BA 0.0015
145 PB 2.77
146 LS 0 98.0
147 UD 0.129
*

148 KK X-C1d1
149 KM OFFSITE SUBBASIN X-C1d1
150 KM FOR AREA ON N HALF OF BONANZA RD
151 BA 0.0016
152 PB 2.77
153 LS 0 91.9
154 UD 0.153
*

155 KK CP5A
156 KM COMBINE CP4A, X-C1b, X-C1c, X-C1d, AND LB03
157 KM FLOW IN W HALF LVB AT BONANZA
158 HC 5
*

159	KK	X-C1d2		
160	KM	OFFSITE SUBBASIN X-C1d2		
161	KM	FOR AREA BETWEEN BONANZA AND BONANZA WAY		
162	BA	0.0038		
163	PB	2.77		
164	LS	0	89.1	
165	UD	0.130		
	*			
166	KK	LB05		
167	KM	ONSITE SUBBASIN LB05		
168	KM	W HALF LVB BETWEEN BONANZA AND BONANZA WAY		
169	BA	0.0006		
170	PB	2.77		
171	LS	0	98.0	
172	UD	0.111		
	*			
173	KK	CP6A		
174	KM	COMBINE CP5A, X-C1d2, AND LB05		
175	KM	FLOW IN W HALF LVB AT BONANZA WAY		
176	HC	3		
	*			
177	KK	X-C1e		
178	KM	OFFSITE SUBBASIN X-C1e		
179	KM	FOR AREA BETWEEN BONANZA WAY AND BELL		
180	BA	0.0173		
181	PB	2.77		
182	LS	0	86.2	
183	UD	0.163		
	*			
184	KK	LB07		
185	KM	ONSITE SUBBASIN LB07		
186	KM	W HALF LVB BETWEEN BONANZA WAY AND BELL		
187	BA	0.0030		
188	PB	2.77		
189	LS	0	98.0	
190	UD	0.152		
	*			
191	KK	CP7A		
192	KM	COMBINE CP6A, X-C1e, AND LB07		
193	KM	FLOW IN W HALF LVB AT BELL		
194	HC	3		
	*			
195	KK	X-C1f		

196	KM	OFFSITE SUBBASIN X-C1f		
197	KM	FOR AREA BETWEEN BELL AND SOUTH PORTION OF LVYO PROPERTY		
198	BA	0.0074		
199	PB	2.77		
200	LS	0	89.0	
		HEC-1 INPUT		
		PAGE 6		
LINE	ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10			
201	UD	0.148		
	*			
202	KK	LB09		
203	KM	ONSITE SUBBASIN LB09		
204	KM	W HALF LVB BETWEEN BELL AND SOUTH PORTION OF LVYO PROPERTY		
205	BA	0.0015		
206	PB	2.77		
207	LS	0	98.0	
208	UD	0.129		
	*			
209	KK	CP8A		
210	KM	COMBINE CP7A, X-C1f, AND LB09		
211	KM	FLOW IN W HALF LVB AT SOUTH PORTION OF LVYO PROPERTY		
212	HC	3		
	*			
213	KK	X-C1g		
214	KM	OFFSITE SUBBASIN X-C1g		
215	KM	FOR AREA BETWEEN SOUTH & NORTH PORTIONS OF LVYO PROPERTY		
216	BA	0.0125		
217	PB	2.77		
218	LS	0	90.9	
219	UD	0.163		
	*			
220	KK	LB11		
221	KM	ONSITE SUBBASIN LB11		
222	KM	W HALF LVB BETWEEN SOUTH & NORTH PORTIONS OF LVYO PROPERTY		
223	BA	0.0021		
224	PB	2.77		
225	LS	0	98.0	
226	UD	0.138		
	*			
227	KK	CP9A		
228	KM	COMBINE CP8A, X-C1g, AND LB11		
229	KM	FLOW IN W HALF LVB AT NORTH PORTION OF LVYO PROPERTY		
230	HC	3		
	*			

231 KK V1-C
 232 KM OFFSITE SUBBASIN V1-C
 233 KM FOR AREA BETWEEN NORTH PORTION OF LVYO PROPERTY & WASHINGTON
 234 BA 0.0050
 235 PB 2.77
 236 LS 0 92.6
 237 UD 0.102
 *

1

HEC-1 INPUT

PAGE 7

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

238 KK LB14
 239 KM ONSITE SUBBASIN LB11
 240 KM W HALF LVB BETWEEN NORTH PORTION OF LVYO PROPERTY & WASHINGTON
 241 BA 0.0004
 242 PB 2.77
 243 LS 0 98.0
 244 UD 0.102
 *

245 KK CP10A
 246 KM COMBINE CP9A, V1-C, AND LB14
 247 KM FLOW IN W HALF LVB AT WASHINGTON
 248 HC 3
 *

249 KK EASTSD
 250 DR EASTSD
 *

251 KK 95a
 252 KM OFFSITE SUBBASIN 95a
 253 KM AREA FOR US95 EB ON RAMP
 254 BA 0.0023
 255 PB 2.77
 256 LS 0 92.0
 257 UD 0.138
 *

258 KK LB02
 259 KM ONSITE SUBBASIN LB02
 260 KM E HALF LVB BETWEEN STEWART & US95 EB ON RAMP
 261 BA 0.0023
 262 PB 2.77
 263 LS 0 98.0
 264 UD 0.147
 *

265 KK CP4B

266 KM COMBINE EASTSD, 95a, AND LB02
 267 KM FLOW IN E HALF LVB AT US95 EB ON RAMP
 268 HC 3
 *

269 KK 95b
 270 KM OFFSITE SUBBASIN 95b
 271 KM AREA FOR US95 WB OFF RAMP
 272 BA 0.0019
 273 PB 2.77
 274 LS 0 92.0
 275 UD 0.140
 *

1

HEC-1 INPUT

PAGE 8

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

276 KK LB04
 277 KM ONSITE SUBBASIN LB04
 278 KM E HALF LVB BETWEEN US95 WB OFF RAMP AND BONANZA
 279 BA 0.0017
 280 PB 2.77
 281 LS 0 98.0
 282 UD 0.128
 *

283 KK CP5B
 284 KM COMBINE CP4B, 95b, AND LB04
 285 KM FLOW IN E HALF LVB AT BONANZA
 286 HC 3
 *

287 KK LB06
 288 KM ONSITE SUBBASIN LB06
 289 KM E HALF LVB BETWEEN BONANZA AND BONANZA WAY
 290 BA 0.0006
 291 PB 2.77
 292 LS 0 98.0
 293 UD 0.114
 *

294 KK CP6B
 295 KM COMBINE CP5B AND LB06
 296 KM FLOW IN E HALF LVB AT BONANZA WAY
 297 HC 2
 *

298 KK LB08
 299 KM ONSITE SUBBASIN LB08
 300 KM E HALF LVB BETWEEN BONANZA WAY AND BELL

301 BA 0.0026
302 PB 2.77
303 LS 0 98.0
304 UD 0.152
*

305 KK CP7B
306 KM COMBINE CP6B AND LB08
307 KM FLOW IN E HALF LVB AT BELL
308 HC 2
*

309 KK LB10
310 KM ONSITE SUBBASIN LB10
311 KM E HALF LVB BETWEEN BELL AND SOUTH PORTION OF LVYO PROPERTY
312 BA 0.0016
313 PB 2.77
314 LS 0 98.0
315 UD 0.128
*

1 HEC-1 INPUT PAGE 9

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

316 KK CP8B
317 KM COMBINE CP7B AND LB10
318 KM FLOW IN E HALF LVB AT SOUTH PORTION OF LVYO PROPERTY
319 HC 2
*

320 KK LB12
321 KM ONSITE SUBBASIN LB12
322 KM E HALF LVB BETWEEN SOUTH & NORTH PORTIONS OF LVYO PROPERTY
323 BA 0.0018
324 PB 2.77
325 LS 0 98.0
326 UD 0.138
*

327 KK LB13
328 KM ONSITE SUBBASIN LB13
329 KM E HALF LVB BETWEEN SOUTH & NORTH PORTIONS OF LVYO PROPERTY
330 BA 0.0003
331 PB 2.77
332 LS 0 98.0
333 UD 0.086
*

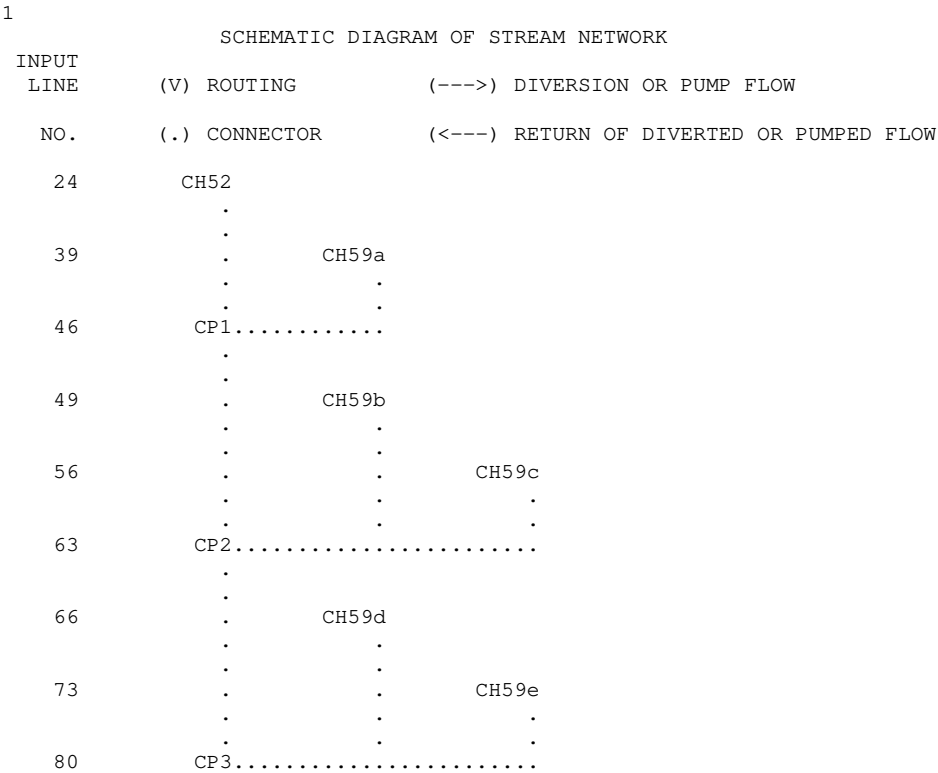
334 KK CP9B
335 KM COMBINE CP8B, LB12, AND LB13


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336      KM      E HALF FLOW IN E HALF LVB AT NORTH PORTION OF LVYO PROPERTY
337      HC          3
          *

338      KK      LB15
339      KM      ONSITE SUBBASIN LB15
340      KM      E HALF LVB BETWEEN NORTH PORTION OF LVYO PROPERTY & WASHINGTON
341      BA      0.0003
342      PB      2.77
343      LS          0      98.0
344      UD      0.092
          *

345      KK      CP10B
346      KM      COMBINE CP9B AND LB15
347      KM      FLOW IN E HALF LVB AT WASHINGTON
348      HC          2
          *

349      ZZ
```



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      .
      .
86    .-----> EASTSD
84    DVSD
      .
      .
91    .-----> STEW
89    DVSTEW
      .
      .
94    .      X-C1a1
      .
101   .      .      X-C1a2
      .      .      .
108   .      .      .      X-C1a3
      .      .      .      .
115   .      .      .      .      LB01
      .      .      .      .      .
122   CP4A.....
      .
126   .      X-C1c
      .      .
134   .      .      X-C1b
      .      .      .
141   .      .      .      LB03
      .      .      .      .
148   .      .      .      .      X-C1d1
      .      .      .      .      .
155   CP5A.....
      .
159   .      X-C1d2
      .      .
166   .      .      LB05
      .      .      .
173   CP6A.....
      .
177   .      X-C1e
      .

```

184	.	.	LB07
	.	.	.
191	CP7A.....	.	.
	.	.	.
195	.	X-C1f	
	.	.	
202	.	.	LB09
	.	.	.
209	CP8A.....	.	.
	.	.	.
213	.	X-C1g	
	.	.	
220	.	.	LB11
	.	.	.
227	CP9A.....	.	.
	.	.	.
231	.	V1-C	
	.	.	
238	.	.	LB14
	.	.	.
245	CP10A.....	.	.
	.	.	.
250	.	.	.
249	EASTSD	.<-----	EASTSD
	.	.	.
251	.	.	95a
	.	.	.
258	.	.	LB02
	.	.	.
265	CP4B.....	.	.
	.	.	.
269	.	.	95b
	.	.	.
276	.	.	LB04

```

      .
      .
      .
283    .      CP5B.....
      .
      .
      .
287    .      .      LB06
      .
      .
      .
294    .      CP6B.....
      .
      .
      .
298    .      .      LB08
      .
      .
      .
305    .      CP7B.....
      .
      .
      .
309    .      .      LB10
      .
      .
      .
316    .      CP8B.....
      .
      .
      .
320    .      .      LB12
      .
      .
      .
327    .      .      .      LB13
      .
      .
      .
334    .      CP9B.....
      .
      .
      .
338    .      .      LB15
      .
      .
      .
345    .      CP10B.....

```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
* JUN 1998 *
* VERSION 4.1 *
*
* RUN DATE 04NOV19 TIME 10:38:01 *
*
*****

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*****
*
* U.S. ARMY CORPS OF ENGINEERS *
* HYDROLOGIC ENGINEERING CENTER *
* 609 SECOND STREET *
* DAVIS, CALIFORNIA 95616 *
* (916) 756-1104 *
*
*****

```

LVB WIDENING STEWART TO WASHINGTON
PROPOSED CONDITIONS
INPUT FILE = LVB_WIDE.DAT
INPUT FILE DATE = OCTOBER 28, 2019
DESIGN STORM = 100-YEAR 6-HR STORM
STORM DISTRIBUTION = SDN #3
MODELED BY WSP (JILL REILLY, P.E. AND ASHLEY SELVY, E.I.)
STORM CENTERING = ENTIRE WATERSHED

JR CARDS CONTAIN DARFS BASED ON THE FOLLOWING VALUES:

AREA	DARF
SQ.MI.	
0 - 0.5	0.990
0.5 - 1	0.975
25-YR	0.74

21 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	500 NUMBER OF HYDROGRAPH ORDINATES
	NDDATE	2 0 ENDING DATE
	NDTIME	1735 ENDING TIME
	ICENT	19 CENTURY MARK
	COMPUTATION INTERVAL	.08 HOURS
	TOTAL TIME BASE	41.58 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 .74

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

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION		
					RATIO 1 .99	RATIO 2 .98	RATIO 3 .74
HYDROGRAPH AT +	CH52	.10	1	FLOW TIME	121. 3.67	119. 3.67	85. 3.75
HYDROGRAPH AT +	CH59a	.16	1	FLOW TIME	201. 3.67	197. 3.67	140. 3.67
2 COMBINED AT +	CP1	.25	1	FLOW TIME	322. 3.67	316. 3.67	225. 3.67
HYDROGRAPH AT +	CH59b	.04	1	FLOW TIME	61. 3.67	60. 3.67	43. 3.67
HYDROGRAPH AT +	CH59c	.07	1	FLOW TIME	89. 3.67	87. 3.67	62. 3.67
3 COMBINED AT +	CP2	.36	1	FLOW TIME	472. 3.67	463. 3.67	330. 3.67
HYDROGRAPH AT +	CH59d	.03	1	FLOW TIME	36. 3.67	35. 3.67	25. 3.67
HYDROGRAPH AT +	CH59e	.03	1	FLOW TIME	47. 3.67	46. 3.67	33. 3.67
3 COMBINED AT +	CP3	.42	1	FLOW TIME	555. 3.67	545. 3.67	388. 3.67
DIVERSION TO +	EASTSD	.42	1	FLOW	78.	78.	78.

				TIME	3.25	3.25	3.33
HYDROGRAPH AT							
+	DVSD	.42	1	FLOW	477.	467.	310.
				TIME	3.67	3.67	3.67
DIVERSION TO							
+	STEW	.42	1	FLOW	434.	425.	282.
				TIME	3.67	3.67	3.67
HYDROGRAPH AT							
+	DVSTEW	.42	1	FLOW	43.	42.	28.
				TIME	3.67	3.67	3.67
HYDROGRAPH AT							
+	X-C1a1	.00	1	FLOW	4.	4.	3.
				TIME	3.50	3.50	3.50
HYDROGRAPH AT							
+	X-C1a2	.01	1	FLOW	9.	9.	7.
				TIME	3.50	3.50	3.50
HYDROGRAPH AT							
+	X-C1a3	.00	1	FLOW	7.	7.	5.
				TIME	3.50	3.50	3.50
HYDROGRAPH AT							
+	LB01	.00	1	FLOW	3.	3.	2.
				TIME	3.58	3.58	3.58
5 COMBINED AT							
+	CP4A	.43	1	FLOW	61.	60.	41.
				TIME	3.58	3.58	3.58
HYDROGRAPH AT							
+	X-C1c	.02	1	FLOW	26.	26.	18.
				TIME	3.58	3.58	3.58
HYDROGRAPH AT							
+	X-C1b	.00	1	FLOW	5.	4.	3.
				TIME	3.58	3.58	3.58
HYDROGRAPH AT							
+	LB03	.00	1	FLOW	3.	3.	2.
				TIME	3.58	3.58	3.58
HYDROGRAPH AT							
+	X-C1d1	.00	1	FLOW	2.	2.	2.
				TIME	3.58	3.58	3.58
5 COMBINED AT							

+	CP5A	.46	1	FLOW TIME	97. 3.58	95. 3.58	66. 3.58
HYDROGRAPH AT							
+	X-C1d2	.00	1	FLOW TIME	5. 3.58	5. 3.58	4. 3.58
HYDROGRAPH AT							
+	LB05	.00	1	FLOW TIME	1. 3.50	1. 3.50	1. 3.50
3 COMBINED AT							
+	CP6A	.46	1	FLOW TIME	104. 3.58	102. 3.58	70. 3.58
HYDROGRAPH AT							
+	X-C1e	.02	1	FLOW TIME	21. 3.58	20. 3.58	13. 3.58
HYDROGRAPH AT							
+	LB07	.00	1	FLOW TIME	5. 3.58	5. 3.58	4. 3.58
3 COMBINED AT							
+	CP7A	.48	1	FLOW TIME	130. 3.58	127. 3.58	87. 3.58
HYDROGRAPH AT							
+	X-C1f	.01	1	FLOW TIME	10. 3.58	10. 3.58	7. 3.58
HYDROGRAPH AT							
+	LB09	.00	1	FLOW TIME	3. 3.58	3. 3.58	2. 3.58
3 COMBINED AT							
+	CP8A	.49	1	FLOW TIME	143. 3.58	140. 3.58	96. 3.58
HYDROGRAPH AT							
+	X-C1g	.01	1	FLOW TIME	18. 3.58	18. 3.58	12. 3.58
HYDROGRAPH AT							
+	LB11	.00	1	FLOW TIME	4. 3.58	4. 3.58	3. 3.58
3 COMBINED AT							
+	CP9A	.51	1	FLOW TIME	165. 3.58	162. 3.58	111. 3.58

HYDROGRAPH AT +	V1-C	.00	1	FLOW TIME	8. 3.50	8. 3.50	6. 3.50
HYDROGRAPH AT +	LB14	.00	1	FLOW TIME	1. 3.50	1. 3.50	1. 3.50
3 COMBINED AT +	CP10A	.51	1	FLOW TIME	174. 3.58	171. 3.58	117. 3.58
HYDROGRAPH AT +	EASTSD	.00	1	FLOW TIME	78. 3.25	78. 3.25	78. 3.33
HYDROGRAPH AT +	95a	.00	1	FLOW TIME	4. 3.58	4. 3.58	2. 3.58
HYDROGRAPH AT +	LB02	.00	1	FLOW TIME	4. 3.58	4. 3.58	3. 3.58
3 COMBINED AT +	CP4B	.00	1	FLOW TIME	86. 3.58	86. 3.58	84. 3.58
HYDROGRAPH AT +	95b	.00	1	FLOW TIME	3. 3.58	3. 3.58	2. 3.58
HYDROGRAPH AT +	LB04	.00	1	FLOW TIME	3. 3.58	3. 3.58	2. 3.58
3 COMBINED AT +	CP5B	.01	1	FLOW TIME	92. 3.58	92. 3.58	88. 3.58
HYDROGRAPH AT +	LB06	.00	1	FLOW TIME	1. 3.50	1. 3.50	1. 3.50
2 COMBINED AT +	CP6B	.01	1	FLOW TIME	93. 3.58	93. 3.58	89. 3.58
HYDROGRAPH AT +	LB08	.00	1	FLOW TIME	5. 3.58	5. 3.58	3. 3.58

2 COMBINED AT							
+	CP7B	.01	1	FLOW	98.	97.	92.
				TIME	3.58	3.58	3.58
HYDROGRAPH AT							
+	LB10	.00	1	FLOW	3.	3.	2.
				TIME	3.58	3.58	3.58
2 COMBINED AT							
+	CP8B	.01	1	FLOW	101.	100.	94.
				TIME	3.58	3.58	3.58
HYDROGRAPH AT							
+	LB12	.00	1	FLOW	3.	3.	2.
				TIME	3.58	3.58	3.58
HYDROGRAPH AT							
+	LB13	.00	1	FLOW	1.	1.	0.
				TIME	3.50	3.50	3.50
3 COMBINED AT							
+	CP9B	.02	1	FLOW	104.	104.	97.
				TIME	3.58	3.58	3.58
HYDROGRAPH AT							
+	LB15	.00	1	FLOW	1.	1.	0.
				TIME	3.50	3.50	3.50
2 COMBINED AT							
+	CP10B	.02	1	FLOW	105.	104.	98.
				TIME	3.58	3.58	3.58

*** NORMAL END OF HEC-1 ***

APPENDIX B – HYDRAULIC DESIGN AND ANALYSIS

- B.1 WSPGW Analysis for LV Blvd West Side Main Line Storm Drain
- B.2 Street Flow Summary Tables
- B.3 Street Normal Depth Calculations
- B.4 Drop Inlet Calculations
- B.5 Lateral Storm Drain Calculations



B.1 WSPGW Analysis for LV Blvd West Side of Main Line Storm Drain

WATER SURFACE PROFILE LISTING
 Date:11-20-2019 Time:12:19:16
 LAS VEGAS BLVD WEST SIDE MAIN LINE
 Start HGL = Washington Chnl 2.27'BELOW TOP OF RCB
 BY: LDN CHECKED:11/19/2019 BY:LAM

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
-4071.750	1945.060	4.640	1949.700	70.50	9.97	1.54	1951.24	.00	2.66	.00	3.000	.000	.00	1 .0
26.179	.0297					.0112	.29	4.64	.00	1.70	.013	.00	.00	PIPE
-4045.571	1945.837	4.161	1949.998	70.50	9.97	1.54	1951.54	.00	2.66	.00	3.000	.000	.00	1 .0
HYDRAULIC JUMP														
-4045.571	1945.837	1.687	1947.524	70.50	17.22	4.60	1952.13	.00	2.66	2.98	3.000	.000	.00	1 .0
120.642	.0297					.0311	3.75	1.69	2.59	1.70	.013	.00	.00	PIPE
-3924.929	1949.416	1.662	1951.078	70.50	17.54	4.78	1955.85	.00	2.66	2.98	3.000	.000	.00	1 .0
97.571	.0297					.0339	3.31	1.66	2.66	1.70	.013	.00	.00	PIPE
-3827.358	1952.311	1.600	1953.910	70.50	18.39	5.25	1959.16	.00	2.66	2.99	3.000	.000	.00	1 .0
52.969	.0297					.0385	2.04	1.60	2.86	1.70	.013	.00	.00	PIPE
-3774.390	1953.882	1.540	1955.422	70.50	19.29	5.78	1961.20	.00	2.66	3.00	3.000	.000	.00	1 .0
JUNCT STR	.0296					.0459	.23	1.54	3.08		.013	.00	.00	PIPE
-3769.390	1954.030	1.401	1955.431	66.90	20.67	6.63	1962.07	.00	2.61	2.99	3.000	.000	.00	1 .0
18.646	.0528					.0507	.95	1.40	3.50	1.39	.013	.00	.00	PIPE
-3750.743	1955.014	1.404	1956.418	66.90	20.61	6.59	1963.01	.00	2.61	2.99	3.000	.000	.00	1 .0
103.762	.0528					.0475	4.93	1.40	3.49	1.39	.013	.00	.00	PIPE
-3646.982	1960.489	1.457	1961.946	66.90	19.65	5.99	1967.94	.00	2.61	3.00	3.000	.000	.00	1 .0
44.671	.0528					.0418	1.87	1.46	3.25	1.39	.013	.00	.00	PIPE

WATER SURFACE PROFILE LISTING
 Date:11-20-2019 Time:12:19:16
 LAS VEGAS BLVD WEST SIDE MAIN LINE
 Start HGL = Washington Chnl 2.27'BELOW TOP OF RCB
 BY: LDN CHECKED:11/19/2019 BY:LAM

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
-3602.310	1962.846	1.512	1964.358	66.90	18.73	5.45	1969.81	.00	2.61	3.00	3.000	.000	.00	1 .0
27.431	.0528					.0368	1.01	1.51	3.03	1.39	.013	.00	.00	PIPE
-3574.879	1964.294	1.570	1965.864	66.90	17.86	4.95	1970.82	.00	2.61	3.00	3.000	.000	.00	1 .0
19.172	.0528					.0325	.62	1.57	2.82	1.39	.013	.00	.00	PIPE
-3555.707	1965.305	1.631	1966.937	66.90	17.03	4.50	1971.44	.00	2.61	2.99	3.000	.000	.00	1 .0
14.307	.0528					.0286	.41	1.63	2.62	1.39	.013	.00	.00	PIPE
-3541.400	1966.060	1.696	1967.756	66.90	16.24	4.09	1971.85	.00	2.61	2.97	3.000	.000	.00	1 .0
97.198	.0273					.0264	2.57	1.70	2.43	1.69	.013	.00	.00	PIPE
-3444.202	1968.716	1.714	1970.430	66.90	16.03	3.99	1974.42	.00	2.61	2.97	3.000	.000	.00	1 .0
102.608	.0273					.0245	2.51	1.71	2.38	1.69	.013	.00	.00	PIPE
-3341.595	1971.519	1.783	1973.302	66.90	15.28	3.63	1976.93	.00	2.61	2.95	3.000	.000	.00	1 .0
45.183	.0273					.0216	.98	1.78	2.21	1.69	.013	.00	.00	PIPE
-3296.412	1972.753	1.856	1974.609	66.90	14.57	3.30	1977.91	.00	2.61	2.91	3.000	.000	.00	1 .0
27.274	.0273					.0192	.52	1.86	2.05	1.69	.013	.00	.00	PIPE

LVB_Main.OUT

-3269.138	1973.498	1.933	1975.432	66.90	13.89	3.00	1978.43	.00	2.61	2.87	3.000	.000	.00	1	.0
18.435	.0273					.0170	.31	1.93	1.89	1.69	.013	.00	.00	PIPE	
-3250.703	1974.002	2.016	1976.018	66.90	13.25	2.72	1978.74	.00	2.61	2.82	3.000	.000	.00	1	.0
13.067	.0273					.0151	.20	2.02	1.74	1.69	.013	.00	.00	PIPE	

FILE: LVB_Main.WSW
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 WATER SURFACE PROFILE LISTING
 LAS VEGAS BLVD WEST SIDE MAIN LINE
 Start HGL = Washington Chnl 2.27'BELOW TOP OF RCB
 BY: LDN CHECKED:11/19/2019 BY:LAM
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Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/Dia.-FT	Base Wt/or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
-3237.636	1974.359	2.104	1976.463	66.90	12.63	2.48	1978.94	.00	2.61	2.75	3.000	.000	.00	1 .0
9.376	.0273					.0135	.13	2.10	1.60	1.69	.013	.00	.00	PIPE
-3228.260	1974.615	2.200	1976.815	66.90	12.04	2.25	1979.07	.17	2.61	2.65	3.000	.000	.00	1 .0
JUNCT STR	.0270					.0151	.08	2.37	1.47		.013	.00	.00	PIPE
-3223.260	1974.750	1.875	1976.625	62.90	13.53	2.84	1979.47	.00	2.55	2.90	3.000	.000	.00	1 .0
68.903	.0187					.0167	1.15	1.88	1.89	1.83	.013	.00	.00	PIPE
-3154.357	1976.036	1.932	1977.967	62.90	13.07	2.65	1980.62	.00	2.55	2.87	3.000	.000	.00	1 .0
44.417	.0187					.0151	.67	1.93	1.78	1.83	.013	.00	.00	PIPE
-3109.939	1976.864	2.014	1978.878	62.90	12.47	2.41	1981.29	.00	2.55	2.82	3.000	.000	.00	1 .0
24.985	.0187					.0134	.34	2.01	1.64	1.83	.013	.00	.00	PIPE
-3084.955	1977.330	2.103	1979.433	62.90	11.89	2.19	1981.63	.00	2.55	2.75	3.000	.000	.00	1 .0
15.536	.0187					.0120	.19	2.10	1.51	1.83	.013	.00	.00	PIPE
-3069.418	1977.620	2.198	1979.818	62.90	11.33	1.99	1981.81	.00	2.55	2.66	3.000	.000	.00	1 .0
9.708	.0187					.0107	.10	2.20	1.38	1.83	.013	.00	.00	PIPE
-3059.711	1977.801	2.303	1980.104	62.90	10.80	1.81	1981.92	.00	2.55	2.53	3.000	.000	.00	1 .0
5.458	.0187					.0097	.05	2.30	1.26	1.83	.013	.00	.00	PIPE
-3054.253	1977.903	2.418	1980.321	62.90	10.30	1.65	1981.97	.00	2.55	2.37	3.000	.000	.00	1 .0
1.823	.0187					.0088	.02	2.42	1.13	1.83	.013	.00	.00	PIPE

FILE: LVB_Main.WSW
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 WATER SURFACE PROFILE LISTING
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 Start HGL = Washington Chnl 2.27'BELOW TOP OF RCB
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Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/Dia.-FT	Base Wt/or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
-3052.430	1977.937	2.551	1980.488	62.90	9.82	1.50	1981.99	.07	2.55	2.14	3.000	.000	.00	1 .0
JUNCT STR	.0180					.0079	.04	2.62	1.00		.013	.00	.00	PIPE
-3047.430	1978.027	2.900	1980.927	61.00	8.72	1.18	1982.11	.00	2.52	1.07	3.000	.000	.00	1 .0
49.896	.0093					.0074	.37	2.90	.60	2.32	.013	.00	.00	PIPE
-2997.534	1978.493	2.684	1981.177	61.00	9.14	1.30	1982.48	.00	2.52	1.84	3.000	.000	.00	1 .0
13.344	.0093					.0076	.10	2.68	.85	2.32	.013	.00	.00	PIPE
-2984.190	1978.618	2.553	1981.171	61.00	9.52	1.41	1982.58	.02	2.52	2.14	3.000	.000	.00	1 .0
JUNCT STR	.0084					.0073	.04	2.57	.97		.013	.00	.00	PIPE
-2979.190	1978.660	3.278	1981.938	54.60	7.72	.93	1982.86	.00	2.40	.00	3.000	.000	.00	1 .0
165.621	.0085					.0066	1.10	3.28	.00	2.20	.013	.00	.00	PIPE
-2813.569	1980.068	3.000	1983.068	54.60	7.72	.93	1983.99	.00	2.40	.00	3.000	.000	.00	1 .0

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81.320	.0085						.0062	.51	3.00	.00	2.20	.013	.00	.00	PIPE
-2732.249	1980.759	2.722	1983.481	54.60	8.10	1.02	1984.50	.00	2.40	1.74	3.000	.000	.00	1	.0
18.765	.0085						.0060	.11	2.72	.73	2.20	.013	.00	.00	PIPE
-2713.484	1980.918	2.609	1983.527	54.60	8.37	1.09	1984.61	.00	2.40	2.02	3.000	.000	.00	1	.0
HYDRAULIC JUMP															
-2713.484	1980.918	2.200	1983.118	54.60	9.83	1.50	1984.62	.00	2.40	2.65	3.000	.000	.00	1	.0
32.238	.0085						.0085	.27	2.20	1.20	2.20	.013	.00	.00	PIPE

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 WATER SURFACE PROFILE LISTING
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Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/Dia.-FT	Base Wt/or I.D.	ZL	No Wth Prs/Pip	
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch	
-2681.246	1981.192	2.200	1983.392	54.60	9.83	1.50	1984.89	.00	2.40	2.65	3.000	.000	.00	1 .0	
77.284	.0085					.0081	.63	2.20	1.20	2.20	.013	.00	.00	PIPE	
-2603.962	1981.849	2.284	1984.133	54.60	9.46	1.39	1985.52	.00	2.40	2.56	3.000	.000	.00	1 .0	
11.652	.0085					.0074	.09	2.28	1.11	2.20	.013	.00	.00	PIPE	
-2592.310	1981.948	2.399	1984.347	54.60	9.01	1.26	1985.61	.08	2.40	2.40	3.000	.000	.00	1 .0	
JUNCT STR	.0084					.0064	.03	2.48	1.00	.013	.00	.00	PIPE		
-2587.310	1981.990	3.023	1985.013	50.30	7.12	.79	1985.80	.00	2.31	.00	3.000	.000	.00	1 .0	
8.539	.0085					.0056	.05	3.02	.00	2.06	.013	.00	.00	PIPE	
-2578.771	1982.063	3.000	1985.063	50.30	7.12	.79	1985.85	.00	2.31	.00	3.000	.000	.00	1 .0	
61.884	.0085					.0053	.33	3.00	.00	2.06	.013	.00	.00	PIPE	
-2516.888	1982.588	2.722	1985.310	50.30	7.46	.86	1986.17	.00	2.31	1.74	3.000	.000	.00	1 .0	
21.070	.0085					.0052	.11	2.72	.67	2.06	.013	.00	.00	PIPE	
-2495.818	1982.767	2.560	1985.328	50.30	7.83	.95	1986.28	.00	2.31	2.12	3.000	.000	.00	1 .0	
HYDRAULIC JUMP															
-2495.818	1982.767	2.064	1984.831	50.30	9.70	1.46	1986.29	.00	2.31	2.78	3.000	.000	.00	1 .0	
78.744	.0085					.0085	.67	2.06	1.25	2.06	.013	.00	.00	PIPE	
-2417.074	1983.436	2.064	1985.500	50.30	9.70	1.46	1986.96	.00	2.31	2.78	3.000	.000	.00	1 .0	
96.746	.0085					.0083	.80	2.06	1.25	2.06	.013	.00	.00	PIPE	

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64.049	.0085					.0032	.21	3.33	.00	1.71	.013	.00	.00	PIPE
-2208.381	1985.205	3.000	1988.205	38.00	5.38	.45	1988.65	.00	2.01	.00	3.000	.000	.00	1 .0
42.302	.0085					.0030	.13	3.00	.00	1.71	.013	.00	.00	PIPE
-2166.080	1985.565	2.722	1988.287	38.00	5.64	.49	1988.78	.00	2.01	1.74	3.000	.000	.00	1 .0
20.139	.0085					.0029	.06	2.72	.50	1.71	.013	.00	.00	PIPE
-2145.941	1985.736	2.560	1988.297	38.00	5.91	.54	1988.84	.00	2.01	2.12	3.000	.000	.00	1 .0
14.833	.0085					.0032	.05	2.56	.60	1.71	.013	.00	.00	PIPE
-2131.108	1985.862	2.427	1988.290	38.00	6.20	.60	1988.89	.00	2.01	2.36	3.000	.000	.00	1 .0
11.358	.0085					.0035	.04	2.43	.68	1.71	.013	.00	.00	PIPE
-2119.750	1985.959	2.311	1988.270	38.00	6.50	.66	1988.93	.00	2.01	2.52	3.000	.000	.00	1 .0
8.522	.0085					.0039	.03	2.31	.75	1.71	.013	.00	.00	PIPE

FILE: LVB_Main.WSW
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 WATER SURFACE PROFILE LISTING
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Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope				SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch	
-2111.228	1986.032	2.205	1988.237	38.00	6.82	.72	1988.96	.00	2.01	2.65	3.000	.000	.00	1 .0
3.485	.0085				.0042	.01	2.21	.83	1.71	.013	.00	.00	PIPE	
-2107.744	1986.061	2.149	1988.210	38.00	7.01	.76	1988.97	.00	2.01	2.70	3.000	.000	.00	1 .0
HYDRAULIC JUMP														
-2107.744	1986.061	1.846	1987.907	38.00	8.33	1.08	1988.98	.00	2.01	2.92	3.000	.000	.00	1 .0
6.393	.0085				.0063	.04	1.85	1.17	1.71	.013	.00	.00	PIPE	
-2101.351	1986.115	1.923	1988.039	38.00	7.94	.98	1989.02	.00	2.01	2.88	3.000	.000	.00	1 .0
2.411	.0085				.0056	.01	1.92	1.08	1.71	.013	.00	.00	PIPE	
-2098.940	1986.136	2.006	1988.142	38.00	7.57	.89	1989.03	.02	2.01	2.82	3.000	.000	.00	1 .0
JUNCT STR	.0068				.0038	.02	2.02	1.00		.013	.00	.00	PIPE	
-2093.940	1986.170	2.571	1988.741	34.00	5.27	.43	1989.17	.01	1.89	2.10	3.000	.000	.00	1 .0
-2093.940	1986.170	1.439	1987.609	34.00	11.62	2.10	1989.71	.00	1.98	2.47	2.500	.000	.00	1 .0
.140	.5000				.0168	.00	1.44	1.88	.58	.013	.00	.00	PIPE	
-2093.800	1986.240	1.467	1987.707	34.00	11.36	2.00	1989.71	.00	1.98	2.46	2.500	.000	.00	1 .0
.253	.5000				.0154	.00	1.47	1.82	.58	.013	.00	.00	PIPE	
-2093.548	1986.366	1.526	1987.893	34.00	10.83	1.82	1989.71	.00	1.98	2.44	2.500	.000	.00	1 .0
.210	.5000				.0136	.00	1.53	1.68	.58	.013	.00	.00	PIPE	
-2093.337	1986.471	1.590	1988.061	34.00	10.32	1.66	1989.72	.00	1.98	2.41	2.500	.000	.00	1 .0
.170	.5000				.0121	.00	1.59	1.56	.58	.013	.00	.00	PIPE	

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-2093.035	1986.623	1.729	1988.352	34.00	9.39	1.37	1989.72	.00	1.98	2.31	2.500	.000	.00	1	.0
.095	.5000					.0096	.00	1.73	1.32	.58	.013	.00	.00	PIPE	
-2092.940	1986.670	1.807	1988.477	34.00	8.95	1.24	1989.72	.00	1.98	2.24	2.500	.000	.00	1	.0
421.114	.0090					.0090	3.80	1.81	1.21	1.81	.013	.00	.00	PIPE	
-1671.826	1990.474	1.807	1992.281	34.00	8.95	1.24	1993.52	.00	1.98	2.24	2.500	.000	.00	1	.0
61.518	.0090					.0086	.53	1.81	1.21	1.81	.013	.00	.00	PIPE	
-1610.308	1991.029	1.889	1992.918	34.00	8.55	1.13	1994.05	.00	1.98	2.15	2.500	.000	.00	1	.0
7.808	.0090					.0077	.06	1.89	1.11	1.81	.013	.00	.00	PIPE	
-1602.500	1991.100	1.983	1993.083	34.00	8.14	1.03	1994.11	.03	1.98	2.03	2.500	.000	.00	1	.0
JUNCT STR	.0100					.0063	.03	2.01	1.00		.013	.00	.00	PIPE	
-1597.500	1991.150	2.417	1993.567	32.00	6.59	.67	1994.24	.00	1.93	.90	2.500	.000	.00	1	.0
34.968	.0086					.0054	.19	2.42	.50	1.76	.013	.00	.00	PIPE	
-1562.532	1991.451	2.236	1993.687	32.00	6.91	.74	1994.43	.00	1.93	1.54	2.500	.000	.00	1	.0
17.940	.0086					.0056	.10	2.24	.70	1.76	.013	.00	.00	PIPE	
-1544.593	1991.605	2.108	1993.713	32.00	7.24	.82	1994.53	.00	1.93	1.82	2.500	.000	.00	1	.0
3.963	.0086					.0058	.02	2.11	.82	1.76	.013	.00	.00	PIPE	

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WATER SURFACE PROFILE LISTING

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LAS VEGAS BLVD WEST SIDE MAIN LINE

Start HGL = Washington Chnl 2.27'BELOW TOP OF RCB

BY: LDN CHECKED:11/19/2019 BY:LAM

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
-1540.630	1991.639	2.108	1993.747	32.00	7.24	.82	1994.56	.00	1.93	1.82	2.500	.000	.00	1 .0
HYDRAULIC JUMP														
-1540.630	1991.639	1.758	1993.397	32.00	8.68	1.17	1994.57	.00	1.93	2.28	2.500	.000	.00	1 .0
32.470	.0086					.0081	.26	1.76	1.20	1.76	.013	.00	.00	PIPE
-1508.160	1991.918	1.838	1993.756	32.00	8.27	1.06	1994.82	.00	1.93	2.21	2.500	.000	.00	1 .0
6.840	.0086					.0073	.05	1.84	1.10	1.76	.013	.00	.00	PIPE
-1501.320	1991.977	1.927	1993.904	32.00	7.88	.97	1994.87	.10	1.93	2.10	2.500	.000	.00	1 .0
JUNCT STR	.0086					.0049	.02	2.03	1.00		.013	.00	.00	PIPE
-1496.320	1992.020	2.928	1994.948	22.50	4.58	.33	1995.27	.00	1.61	.00	2.500	.000	.00	1 .0
87.327	.0081					.0030	.26	2.93	.00	1.41	.013	.00	.00	PIPE
-1408.993	1992.726	2.500	1995.226	22.50	4.58	.33	1995.55	.00	1.61	.00	2.500	.000	.00	1 .0
37.463	.0081					.0028	.10	2.50	.00	1.41	.013	.00	.00	PIPE
-1371.530	1993.029	2.268	1995.297	22.50	4.81	.36	1995.66	.00	1.61	1.45	2.500	.000	.00	1 .0
18.416	.0081					.0027	.05	2.27	.47	1.41	.013	.00	.00	PIPE
-1353.115	1993.178	2.134	1995.312	22.50	5.04	.39	1995.71	.00	1.61	1.77	2.500	.000	.00	1 .0
8.097	.0081					.0029	.02	2.13	.56	1.41	.013	.00	.00	PIPE
-1345.017	1993.243	2.072	1995.315	22.50	5.17	.42	1995.73	.00	1.61	1.88	2.500	.000	.00	1 .0
HYDRAULIC JUMP														

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LAS VEGAS BLVD WEST SIDE MAIN LINE

Start HGL = Washington Chnl 2.27'BELOW TOP OF RCB

BY: LDN CHECKED:11/19/2019 BY:LAM

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

LVB_Main.OUT														
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
-1345.017	1993.243	1.243	1994.486	22.50	9.24	1.33	1995.81	.00	1.61	2.50	2.500	.000	.00	1 .0
16.730	.0081					.0131	.22	1.24	1.65	1.41	.013	.00	.00	PIPE
-1328.287	1993.379	1.197	1994.576	22.50	9.69	1.46	1996.03	.00	1.61	2.50	2.500	.000	.00	1 .0
15.017	.0081					.0149	.22	1.20	1.77	1.41	.013	.00	.00	PIPE
-1313.270	1993.500	1.154	1994.654	22.50	10.16	1.60	1996.26	.00	1.61	2.49	2.500	.000	.00	1 .0
6.266	.0080					.0163	.10	1.15	1.90	1.41	.013	.00	.00	PIPE
-1307.005	1993.550	1.135	1994.685	22.50	10.39	1.68	1996.36	.00	1.61	2.49	2.500	.000	.00	1 .0
12.719	.0080					.0180	.23	1.13	1.96	1.41	.013	.00	.00	PIPE
-1294.285	1993.652	1.094	1994.746	22.50	10.89	1.84	1996.59	.00	1.61	2.48	2.500	.000	.00	1 .0
11.657	.0080					.0205	.24	1.09	2.10	1.41	.013	.00	.00	PIPE
-1282.628	1993.745	1.055	1994.800	22.50	11.43	2.03	1996.83	.00	1.61	2.47	2.500	.000	.00	1 .0
10.811	.0080					.0233	.25	1.06	2.25	1.41	.013	.00	.00	PIPE
-1271.818	1993.832	1.018	1994.850	22.50	11.98	2.23	1997.08	.00	1.61	2.46	2.500	.000	.00	1 .0
10.098	.0080					.0266	.27	1.02	2.42	1.41	.013	.00	.00	PIPE
-1261.719	1993.913	.982	1994.895	22.50	12.57	2.45	1997.35	.00	1.61	2.44	2.500	.000	.00	1 .0
9.476	.0080					.0303	.29	.98	2.59	1.41	.013	.00	.00	PIPE
-1252.243	1993.989	.948	1994.937	22.50	13.18	2.70	1997.63	.00	1.61	2.43	2.500	.000	.00	1 .0
8.943	.0080					.0345	.31	.95	2.77	1.41	.013	.00	.00	PIPE
FILE: LVB_Main.WSW														PAGE 11
W S P G W - CIVILDESIGN Version 14.07														
Program Package Serial Number: 7100														

WATER SURFACE PROFILE LISTING														
LAS VEGAS BLVD WEST SIDE MAIN LINE														
Start HGL = Washington Chnl 2.27'BELOW TOP OF RCB														
BY: LDN CHECKED:11/19/2019 BY:LAM														

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/Dia.-FT	Base Wt/ I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
-1243.300	1994.060	.915	1994.975	22.50	13.82	2.97	1997.94	.00	1.61	2.41	2.500	.000	.00	1 .0
5.000	.0080					.0382	.19	.92	2.96	1.42	.013	.00	.00	PIPE
-1238.300	1994.100	.897	1994.997	22.50	14.22	3.14	1998.14	.00	1.61	2.40	2.500	.000	.00	1 .0
3.756	.0080					.0379	.14	.90	3.08	.73	.013	.00	.00	PIPE
-1234.544	1994.431	.920	1995.350	22.50	13.73	2.93	1998.28	.00	1.61	2.41	2.500	.000	.00	1 .0
4.309	.0080					.0339	.15	.92	2.94	.73	.013	.00	.00	PIPE
-1230.236	1994.810	.953	1995.763	22.50	13.09	2.66	1998.42	.00	1.61	2.43	2.500	.000	.00	1 .0
3.562	.0080					.0297	.11	.95	2.74	.73	.013	.00	.00	PIPE
-1226.674	1995.123	.987	1996.110	22.50	12.48	2.42	1998.53	.00	1.61	2.44	2.500	.000	.00	1 .0
2.973	.0080					.0261	.08	.99	2.56	.73	.013	.00	.00	PIPE
-1223.701	1995.385	1.023	1996.408	22.50	11.90	2.20	1998.61	.00	1.61	2.46	2.500	.000	.00	1 .0
2.496	.0080					.0229	.06	1.02	2.39	.73	.013	.00	.00	PIPE
-1221.205	1995.605	1.061	1996.665	22.50	11.35	2.00	1998.67	.00	1.61	2.47	2.500	.000	.00	1 .0
2.104	.0080					.0201	.04	1.06	2.23	.73	.013	.00	.00	PIPE
-1219.101	1995.790	1.100	1996.889	22.50	10.82	1.82	1998.71	.00	1.61	2.48	2.500	.000	.00	1 .0
1.770	.0080					.0177	.03	1.10	2.08	.73	.013	.00	.00	PIPE
-1217.331	1995.946	1.140	1997.086	22.50	10.32	1.65	1998.74	.00	1.61	2.49	2.500	.000	.00	1 .0
1.484	.0080					.0155	.02	1.14	1.94	.73	.013	.00	.00	PIPE
FILE: LVB_Main.WSW														PAGE 12
W S P G W - CIVILDESIGN Version 14.07														
Program Package Serial Number: 7100														

WATER SURFACE PROFILE LISTING

Date:11-20-2019 Time:12:19:16

LAS VEGAS BLVD WEST SIDE MAIN LINE
 Start HGL = Washington Chnl 2.27'BELOW TOP OF RCB
 BY: LDN CHECKED:11/19/2019 BY:LAM

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/Dia.-FT	Base Wt/or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
-1215.847	1996.076	1.183	1997.259	22.50	9.84	1.50	1998.76	.00	1.61	2.50	2.500	.000	.00	1 .0
-1215.847	1996.076	1.183	1997.259	22.50	9.84	1.50	1998.76	.00	1.61	2.50	2.500	.000	.00	1 .0
1.236	.0880					.0137	.02	1.18	1.81	.73	.013	.00	.00	PIPE
-1214.611	1996.185	1.228	1997.413	22.50	9.38	1.37	1998.78	.00	1.61	2.50	2.500	.000	.00	1 .0
-1214.611	1996.185	1.228	1997.413	22.50	9.38	1.37	1998.78	.00	1.61	2.50	2.500	.000	.00	1 .0
1.019	.0880					.0120	.01	1.23	1.69	.73	.013	.00	.00	PIPE
-1213.592	1996.275	1.275	1997.549	22.50	8.94	1.24	1998.79	.00	1.61	2.50	2.500	.000	.00	1 .0
-1213.592	1996.275	1.275	1997.549	22.50	8.94	1.24	1998.79	.00	1.61	2.50	2.500	.000	.00	1 .0
.823	.0880					.0106	.01	1.27	1.57	.73	.013	.00	.00	PIPE
-1212.769	1996.347	1.324	1997.671	22.50	8.53	1.13	1998.80	.00	1.61	2.50	2.500	.000	.00	1 .0
-1212.769	1996.347	1.324	1997.671	22.50	8.53	1.13	1998.80	.00	1.61	2.50	2.500	.000	.00	1 .0
.648	.0880					.0093	.01	1.32	1.46	.73	.013	.00	.00	PIPE
-1212.121	1996.404	1.375	1997.779	22.50	8.13	1.03	1998.81	.00	1.61	2.49	2.500	.000	.00	1 .0
-1212.121	1996.404	1.375	1997.779	22.50	8.13	1.03	1998.81	.00	1.61	2.49	2.500	.000	.00	1 .0
.488	.0880					.0082	.00	1.38	1.36	.73	.013	.00	.00	PIPE
-1211.634	1996.447	1.430	1997.877	22.50	7.75	.93	1998.81	.00	1.61	2.47	2.500	.000	.00	1 .0
-1211.634	1996.447	1.430	1997.877	22.50	7.75	.93	1998.81	.00	1.61	2.47	2.500	.000	.00	1 .0
.339	.0880					.0073	.00	1.43	1.26	.73	.013	.00	.00	PIPE
-1211.295	1996.477	1.487	1997.964	22.50	7.39	.85	1998.81	.00	1.61	2.45	2.500	.000	.00	1 .0
-1211.295	1996.477	1.487	1997.964	22.50	7.39	.85	1998.81	.00	1.61	2.45	2.500	.000	.00	1 .0
.199	.0880					.0065	.00	1.49	1.17	.73	.013	.00	.00	PIPE
-1211.096	1996.494	1.548	1998.042	22.50	7.05	.77	1998.81	.00	1.61	2.43	2.500	.000	.00	1 .0
-1211.096	1996.494	1.548	1998.042	22.50	7.05	.77	1998.81	.00	1.61	2.43	2.500	.000	.00	1 .0
.066	.0880					.0057	.00	1.55	1.08	.73	.013	.00	.00	PIPE
-1211.030	1996.500	1.614	1998.114	22.50	6.71	.70	1998.81	.00	1.61	2.39	2.500	.000	.00	1 .0
-1211.030	1996.500	1.614	1998.114	22.50	6.71	.70	1998.81	.00	1.61	2.39	2.500	.000	.00	1 .0

T1 LAS VEGAS BLVD WEST SIDE MAIN LINE

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T2 Start HGL = Washington Chnl 2.27'BELOW TOP OF RCB

T3 BY: LDN CHECKED:11/19/2019 BY:LAM

SO	-4071.750	1945.060	36				1949.790			
R	-3774.390	1953.882	36	.013				.000	.000	1
JX	-3769.390	1954.030	36 18	.013	3.600		1954.080	79.0		0.000
R	-3541.400	1966.060	36	.013				.000	1.000	1
R	-3228.260	1974.615	36	.013				.000	.000	1
JX	-3223.260	1974.750	36 18	.013	4.000		1974.800	90.0		4.000
R	-3052.430	1977.937	36	.013				.000	.000	1
JX	-3047.430	1978.027	36 18	.013	1.900		1978.080	85.0		3.000
R	-2984.190	1978.618	36	.013				.000	.000	1
JX	-2979.190	1978.660	36 24	.013	6.400		1978.660	89.0		1.000
R	-2592.310	1981.948	36	.013				.000	.000	1
JX	-2587.310	1981.990	36 18	.013	4.300		1981.990	90.0		-4.000
R	-2277.940	1984.618	36	.013				.000	.000	1
JX	-2272.430	1984.660	36 24	.013	12.300		1984.660	73.0		2.000
R	-2098.940	1986.136	36	.013				.000	.000	1
JX	-2093.940	1986.170	36 18	.013	4.000		1986.670	83.0		1.000
R	-2092.940	1986.670	30	.013				.000	.000	1
R	-1602.500	1991.100	30	.013				.000	.000	1
JX	-1597.500	1991.150	30 18	.013	2.000		1991.200	79.0		-2.000
R	-1501.320	1991.977	30	.013				.000	.000	1
JX	-1496.320	1992.020	30 30	.013	9.500		1992.020	84.0		-7.000
R	-1313.270	1993.500	30	.013				.000	7.000	1
R	-1243.300	1994.060	30	.013				.000	.000	1
R	-1238.300	1994.100	30	.013				.000	.000	1
R	-1211.030	1996.500	30	.013				.000	74.000	1
SH	-1211.030	1996.500	30							

CD	18	4	1	.000	1.500	.000	.000	.000	.00
CD	24	4	1	.000	2.000	.000	.000	.000	.00
CD	30	4	1	.000	2.500	.000	.000	.000	.00
CD	36	4	1	.000	3.000	.000	.000	.000	.00
CD	42	4	1	.000	3.500	.000	.000	.000	.00
Q				22.500	.0				

B.2 Street Flow Summary Tables

- B.2.1 - 10-Year Street Flow Summary
- B.2.2 - 100-Year Street Flow Summary
- B.2.3 - 10-Year Dry Lane Maximum Depth Calculations

B.2.1 10-Year Street Flow Summary

Table B.2.1 Las Vegas Boulevard Widening Project 10-Year Street Flow Summary

Cross Section #	Basin(s)/Tributaries	10-Year Design Flows			Longitudinal Slope	Drop Inlet Size	Drop Inlet Station Location	Max Dry Lane Depth (ft)	Depth (ft)	Velocity (ft/s)	D*V
		Q ₁₀ (cfs)	Q _{10INT} (cfs)	Q _{10BYP} (cfs)							
01W	Street Street Flow (21 cfs Referenced from VTN) + X-C1a1 (2 cfs) + 1/2 LB01 (1 cfs)	24.0	22.5	1.5	0.93	20' Type"DM2"	"L" 12+95	1.62	0.74	3.83	2.83
03W	BYP CROSS SECTION 01W (1.5 cfs) + X-C1a2 (5 cfs) + 1/2 LB01 (1 cfs) + 1/2 X-C1a3 (2 cfs)	9.5	9.5	0.0	0.73	20' Type"DM2"	"L" 15+60	1.05	0.57	2.58	1.47
04S	1/2 X-C1a3 (2 cfs)	2.0	2.0	0.0	0.38	5'x6' NDOT Type 2B	"L" 16+50	0.41	0.25	1.41	0.35
05W	X-C1b (2 cfs) + LB03 (2 cfs)	4.0	4.0	0.0	0.87	10' Type"DM2"	"L" 21+60	1.15	0.40	2.26	0.90
06S	X-C1c (12 cfs)	12.0	11.3	0.7	0.52	20' Type"DM2"	"BR" 54+40	0.44	0.37	2.56	0.95
07N	X-C1d1 (1 cfs)	1.0	1.0	0.0	0.97	5' Type"DM2"	"BR" 54+27	0.30	0.16	1.65	0.26
08W	BYP CROSS SECTION 06S (0.7 cfs) + BYP 07N (0 cfs) + LB05 (1 cfs)	1.7	0.0	1.7	0.90	N/A	"L" 24+30	0.60	0.32	1.88	0.60
09W	BYP CROSS SECTION 8W (1.7 cfs) + X-C1d2 (2 cfs) + 1/2 LB07 (1.5 cfs)	5.2	4.3	0.9	0.86	7.5' Type"DM2"	"L" 26+60	0.95	0.43	2.40	1.03
10W	BYP CROSS SECTION 9W (0.9 cfs) + 1/2 X-C1e (4 cfs) + 1/2 LB07 (1.5 cfs)	6.4	6.4	0.0	1.11	17.5' Type"DM2"	"L" 30+50	0.75	0.43	2.78	1.20
11W	BYP DI11N (1 cfs) + 1/2 LB07 (1.5 cfs) + 1/4 X-C1e (2 cfs)	4.5	4.0	0.5	1.43	10' Type"DM2"	"L" 32+95	0.75	0.38	2.81	1.07
12W	BYP CROSS SECTION 11W (0.5 cfs) + 1/2 LB09 (1 cfs)	1.5	0.0	1.5	3.00	N/A	"L" 36+25	0.75	0.26	2.97	0.77
13W	BYP CROSS SECTION 12W (1.5 cfs) +BYP DI13N (1 cfs) + 1/2 LB09 (1 cfs)	3.5	0.0	3.5	4.90	N/A	"L" 38+70	0.75	0.30	4.26	1.28
14W	BYP CROSS SECTION 13W (3.5 cfs) + 1/2 LB11 (1 cfs) + X-C1g (8 cfs)	12.5	10.7	1.8	4.45	20' Type"DM2"	"L" 43+29	0.75	0.43	5.53	2.38
15W	BYP CROSS SECTION14W (1.8 cfs) + 1/2 LB11 (1 cfs)	2.8	2.8	0.0	1.52	20' Type"DM2"	"L" 45+50	0.69	0.29	2.55	0.74
16W	BYP CROSS SECTION 15W (0 cfs) + LB14 (0 cfs)	0.0	0.0	0.0	1.54	20' Type"DM2"	"L" 46+66	0.69	0.00	0.00	0.00
17S	V1-C (4 cfs)	4.0	3.6	0.4	1.15	10' Type"DM2"	"L" 47+11	0.38	0.36	2.36	0.85
01E	Street Flow (0 cfs Referenced from VTN) + 1/2 LB02 (1 cfs)	1.0	1.0	0.0	0.57	5' Type"DM2"	"L" 13+51	1.18	0.29	1.41	0.41
02E	BYP CROSS SECTION 01E (0 cfs) + 1/4 LB02 (0.5 cfs)	0.5	0.5	0.0	0.56	5' Type"DM2"	"L" 14+50	1.34	0.24	1.21	0.29
03E	1/4 LB02 (0.5 cfs) + 95a (2 cfs)	2.5	1.7	0.8	0.87	5'x4' NDOT Type 2	"L" 19+09	0.81	0.20	2.41	0.48
04E	BYP CROSS SECTION 03E (0.8 cfs) + 95b (1 cfs) + LB04 (2 cfs)	2.8	2.8	0.0	1.02	10' Type"DM2"	"L" 22+19	1.04	0.35	2.21	0.77
05E	1/2 LB06 (0.5 cfs)	0.5	0.5	0.0	1.12	5' Type"DM2"	"L" 24+01	0.75	0.22	1.66	0.37
06E	BYP CROSS SECTION 05E (0 cfs) + 1/2 LB06 (0.5 cfs) + 1/2 LB08 (1.5 cfs)	2.0	1.9	0.1	0.61	5' Type"DM2"	"L" 26+11	0.91	0.36	1.78	0.64
07E	1/2 LB08 (1.5 cfs)	1.5	1.4	0.1	1.07	5' Type"DM2"	"L" 30+57	0.75	0.30	1.96	0.59
08E	BYP CROSS SECTION 07E (0.1 cfs) + 1/2 LB08 (1.5 cfs)	1.6	1.4	0.2	0.73	5' Type"DM2"	"L" 32+58	0.44	0.29	1.46	0.42
09E	BYP CROSS SECTION 08E (0.2 cfs) + LB10 (2 cfs)	2.2	2.0	0.2	4.97	5' Type"DM2"	"L" 40+13	0.75	0.27	3.91	1.06
10E	BYP CROSS SECTION 09E (0.2 cfs) + 1/2 LB12 (1 cfs)	1.2	1.2	0.0	4.97	5' Type"DM2"	"L" 41+57	0.75	0.23	3.54	0.81
11E	BYP CROSS SECTION 10E (0 cfs) + 1/2 LB12 (1 cfs) + LB13 (0 cfs) + LB15 (0 cfs)	1.0	1.0	0.0	1.46	20' Type"DM2"	"L" 46+88	0.75	0.26	2.05	0.53

B.2.2 100-Year Street Flow Summary

Table B.2.2 Las Vegas Boulevard Widening Project 100-Year Street Flow Summary

Cross Section #	Basin(s)/Tributaries	100-Year Design Flows			Longitudinal Slope	Drop Inlet Size	Drop Inlet Station Location	Depth (ft)	Velocity (ft/s)	D*V
		Q ₁₀₀ (cfs)	Q _{10INT} (cfs)	Q _{100BYP} (cfs)						
01W	Street Street Flow (43 cfs Referenced from VTN) + X-C1a1 (4 cfs) + 1/2 LB01 (1.5 cfs)	48.5	22.5	26.0	0.93	20' Type"DM2"	"L" 12+95	0.91	4.72	4.30
03W	BYP CROSS SECTION 01W (26 cfs) +X-C1a2 (9 cfs) + 1/2 LB01 (1.5 cfs) + 1/2 X-C1a3 (3.5 cfs)	40.0	40.0	0.0	0.73	20' Type"DM2"	"L" 15+60	0.84	3.86	3.24
04S	1/2 X-C1a3 (3.5 cfs)	3.5	3.5	0.0	0.38	5'x6' NDOT Type 2B	"L" 16+50	0.31	1.62	0.50
05W	X-C1b (5 cfs) + LB03 (4 cfs)	9.0	9.0	0.0	0.87	10' Type"DM2"	"L" 21+60	0.49	2.75	1.35
06S	X-C1c (26 cfs)	26.0	11.3	14.7	0.52	20' Type"DM2"	"BR" 54+40	0.54	3.13	1.69
07N	X-C1d1 (2 cfs)	2.0	1.0	1.0	0.97	5' Type"DM2"	"BR" 54+27	0.20	1.96	0.39
08W	BYP CROSS SECTION 06S (14.7 cfs) + BYP 07N (1 cfs) + LB05 (1 cfs)	16.7	0.0	16.7	0.90	N/A	"L" 24+30	0.60	2.97	1.78
09W	BYP CROSS SECTION 8W (16.7 cfs) + X-C1d2 (5 cfs) + 1/2 LB07 (2.5 cfs)	24.2	4.3	19.9	0.86	7.5' Type"DM2"	"L" 26+60	0.66	3.26	2.15
10W	BYP CROSS SECTION 9W (19.9 cfs) + 1/2 X-C1e (10.5 cfs) + 1/2 LB07 (2.5 cfs)	32.9	32.9	0.0	1.11	17.5' Type"DM2"	"L" 30+50	0.69	3.90	2.69
11W	BYP DI11N (4 cfs) + 1/2 LB07 (2.5 cfs) + 1/4 X-C1e (5.5 cfs)	12.0	4.0	8.0	1.43	10' Type"DM2"	"L" 32+95	0.50	3.51	1.76
12W	BYP CROSS SECTION 11W (8 cfs) + 1/2 LB09 (1.5 cfs)	9.5	0.0	9.5	3.00	N/A	"L" 36+25	0.42	4.46	1.87
13W	BYP CROSS SECTION 12W (9.5 cfs) +BYP DI13N (6.4 cfs) + 1/2 LB09 (1.5 cfs)	17.4	0.0	17.4	4.90	N/A	"L" 38+70	0.46	6.18	2.84
14W*	BYP CROSS SECTION 13W (17.4 cfs) + 1/2 LB11 (2 cfs) + X-C1g (18 cfs)	37.4	23.9	13.5	4.45	20' Type"DM2"	"L" 43+29	0.60	6.62	3.97
15W*	BYP CROSS SECTION14W (13.5 cfs) + 1/2 LB11 (2 cfs)	15.5	13.9	1.6	1.52	20' Type"DM2"	"L" 45+50	0.54	3.68	1.99
16W*	BYP CROSS SECTION 15W (2.6 cfs) + LB14 (1 cfs)	2.6	2.6	0.0	1.54	20' Type"DM2"	"L" 46+66	0.33	2.55	0.84
17S*	V1-C (8 cfs)	8.0	5.9	2.1	1.15	10' Type"DM2"	"L" 47+11	0.44	2.79	1.23
01E	1/2 Street Street Flow (0 cfs Referenced from VTN) + 1	2.0	1.0	1.0	0.57	5' Type"DM2"	"L" 13+51	0.35	1.65	0.58
02E	BYP CROSS SECTION 01E (1 cfs) + 1/4 LB02 (1 cfs)	2.0	2.0	0.0	0.56	5' Type"DM2"	"L" 14+50	0.35	1.61	0.56
03E	1/4 LB02 (1 cfs) + 95a (4 cfs)	5.0	1.7	3.3	0.87	NDOT TYPE 2B	"L" 19+09	0.30	2.53	0.76
04E	BYP CROSS SECTION 02E (3.3 cfs) + 95b (3 cfs) + LB04 (3	9.3	9.3	0.0	1.02	10' Type"DM2"	"L" 22+19	0.49	2.95	1.45
05E	1/2 LB06 (0.5 cfs)	0.5	0.5	0.0	1.12	5' Type"DM2"	"L" 24+01	0.22	1.66	0.37
06E	BYP CROSS SECTION 05E (0 cfs) + 1/2 LB06 (0.5 cfs) + 1	3.0	1.9	1.1	0.61	5' Type"DM2"	"L" 26+11	0.40	1.95	0.78
07E	1/2 LB08 (2.5 cfs)	2.5	1.4	1.1	1.07	5' Type"DM2"	"L" 30+57	0.34	2.20	0.75
08E	BYP CROSS SECTION 07E (1.1 cfs) + 1/2 LB08 (2.5 cfs)	3.6	1.4	2.2	0.73	5' Type"DM2"	"L" 32+58	0.35	1.76	0.62
09E	BYP CROSS SECTION 08E (2.2 cfs) + LB10 (3 cfs)	5.2	2.0	3.2	4.97	5' Type"DM2"	"L" 40+13	0.34	4.71	1.60
10E	BYP CROSS SECTION 09E (3.2 cfs) + 1/2 LB12 (1.5 cfs)	4.7	1.2	3.5	4.97	5' Type"DM2"	"L" 41+57	0.33	4.59	1.51
11E*	BYP CROSS SECTION 10E (3.5 cfs) + 1/2 LB12 (1.5 cfs) +	7.0	6.9	0.1	1.46	20' Type"DM2"	"L" 46+88	0.43	3.15	1.35

*Drop Inlets at these locations are sized to intercept 100-year flows. The 100-year flow intercepted is shown in the Table.

B.2.3 10-Year Dry Lane Maximum Depth Calculations

Table B.2.3 10-year Dry Lane Maximum Depth Calculations

Cross Section #	Station Location	Total Width of Center Turning Lanes	Total Width of Minimum Dry Lane (ft)	Crown Elevation (ft)	Dry Lane Max Depth (ft)
01W	"L" 12+95	0	12	1.86	1.62
03W	"L" 15+60	0	12	1.29	1.05
04S	"L" 16+50	0	12	0.65	0.41
05W	"L" 21+60	0	12	1.39	1.15
06S	"BR" 54+40	7	19	0.82	0.44
07N	"BR" 54+27	7	19	0.68	0.30
08W	"L" 24+30	20	32	1.24	0.60
09W	"L" 26+60	0	12	1.59	1.35
10W	"L" 30+50	0	12	0.99	0.75
11W	"L" 32+95	0	12	0.99	0.75
12W	"L" 36+25	0	12	0.99	0.75
13W	"L" 38+70	0	12	0.99	0.75
14W	"L" 43+25	0	12	0.99	0.75
15W	"L" 45+50	0	12	0.93	0.69
16W	"L" 46+66	0	12	0.93	0.69
17S	"L" 47+11	0	12	0.52	0.28
01E	"L" 13+51	0	12	1.42	1.18
02E	"L" 14+50	0	12	1.58	1.34
03E	"L" 19+09	20	32	1.451	0.811
04E	"L" 22+19	0	12	1.28	1.04
05E	"L" 24+01	0	12	0.99	0.75
06E	"L" 26+11	0	12	1.22	0.98
07E	"L" 30+57	0	12	0.99	0.75
08E	"L" 32+58	0	12	0.56	0.32
09E	"L" 40+13	0	12	0.99	0.75
10E	"L" 41+57	0	12	0.99	0.75
11E	"L" 46+88	10	22	1.19	0.75

B.3 Street Normal Depth Calculations

- B.3.1 - 10-Year Street Normal Depth Calculations
- B.3.2 - 100-Year Street Normal Depth Calculations

B.3.1 10-Year Street Normal Depth Calculations

Worksheet for Cross Section 01W_LV Blvd_West 1/2 St_12+95

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.93 %
Discharge 24.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.60
0+05.0	0.50
0+05.5	0.50
0+05.5	0.00
0+07.0	0.13
0+07.0	0.17
0+50.5	1.86
0+50.5	2.36

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.60)	(0+50.5, 2.36)	0.016

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 0.74 ft
Elevation Range 0.00 to 2.36 ft
Flow Area 6.26 ft²
Wetted Perimeter 22.37 ft
Hydraulic Radius 0.28 ft

Worksheet for Cross Section 01W_LV Blvd_West 1/2 St_12+95

Results

Top Width	21.67	ft
Normal Depth	0.74	ft
Critical Depth	0.79	ft
Critical Slope	0.00567	ft/ft
Velocity	3.83	ft/s
Velocity Head	0.23	ft
Specific Energy	0.97	ft
Froude Number	1.26	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.74	ft
Critical Depth	0.79	ft
Channel Slope	0.93	%
Critical Slope	0.00567	ft/ft

Cross Section for Cross Section 01W_LV Blvd West 1/2 St_12+95

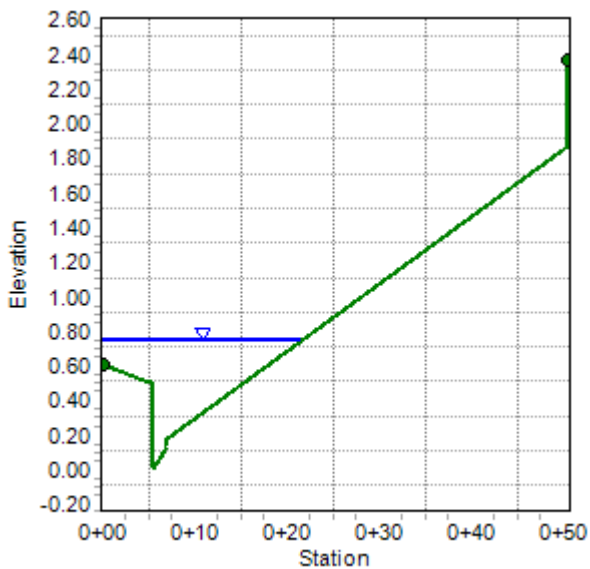
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.93	%
Normal Depth	0.74	ft
Discharge	24.00	ft ³ /s

Cross Section Image



Worksheet for Cross Section 03W_LV Blvd_West 1/2 St_15+60

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.73 %
Discharge 9.50 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.60
0+05.0	0.50
0+05.5	0.50
0+05.5	0.00
0+07.0	0.13
0+07.0	0.17
0+45.0	1.29
0+45.0	1.79

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.60)	(0+45.0, 1.79)	0.016

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 0.00 to 1.79 ft
Flow Area 3.68 ft²
Wetted Perimeter 19.85 ft
Hydraulic Radius 0.19 ft

Worksheet for Cross Section 03W_LV Blvd_West 1/2 St_15+60

Results

Top Width	19.30	ft
Normal Depth	0.57	ft
Critical Depth	0.58	ft
Critical Slope	0.00671	ft/ft
Velocity	2.58	ft/s
Velocity Head	0.10	ft
Specific Energy	0.68	ft
Froude Number	1.04	
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	0.58	ft
Channel Slope	0.73	%
Critical Slope	0.00671	ft/ft

Cross Section for Cross Section 03W_LV Blvd West 1/2 St_15+60

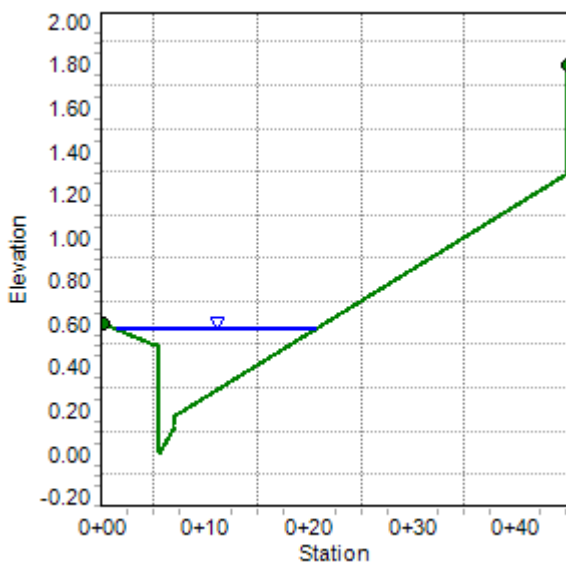
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.73	%
Normal Depth	0.57	ft
Discharge	9.50	ft ³ /s

Cross Section Image



Worksheet for Cross Section 04S_LV Blvd_West 1/2 St_16+50

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.38 %
Discharge 2.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	2.00
0+00.0	0.00
0+01.5	0.03
0+29.7	0.65
0+29.7	1.15

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 2.00)	(0+29.7, 1.15)	0.016

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 0.25 ft
Elevation Range 0.00 to 2.00 ft
Flow Area 1.42 ft²
Wetted Perimeter 11.65 ft
Hydraulic Radius 0.12 ft
Top Width 11.40 ft
Normal Depth 0.25 ft
Critical Depth 0.21 ft

Worksheet for Cross Section 04S_LV Blvd_West 1/2 St_16+50

Results

Critical Slope	0.00806	ft/ft
Velocity	1.41	ft/s
Velocity Head	0.03	ft
Specific Energy	0.28	ft
Froude Number	0.70	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.25	ft
Critical Depth	0.21	ft
Channel Slope	0.38	%
Critical Slope	0.00806	ft/ft

Cross Section for Cross Section 04S_LV Blvd_West 1/2 St_16+50

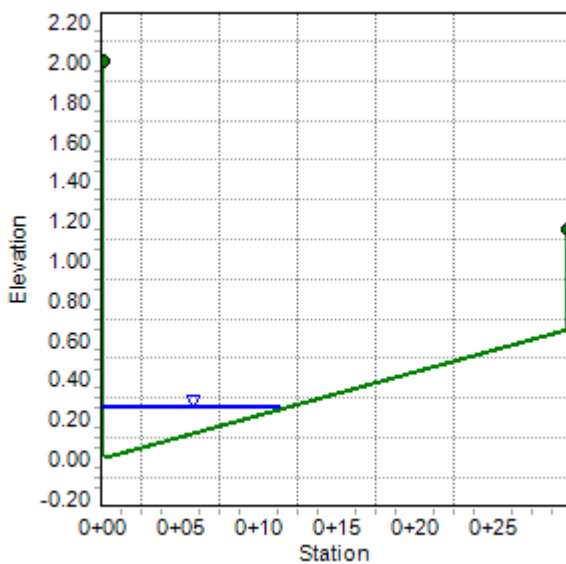
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.38	%
Normal Depth	0.25	ft
Discharge	2.00	ft ³ /s

Cross Section Image



Worksheet for Cross Section 05W_LV Blvd_West 1/2 St_21+60

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.87 %
Discharge 4.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.60
0+05.0	0.50
0+05.5	0.50
0+05.5	0.00
0+07.0	0.13
0+07.0	0.17
0+68.0	1.39
0+68.0	1.89

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.60)	(0+68.0, 1.89)	0.016

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 0.00 to 1.89 ft
Flow Area 1.77 ft²
Wetted Perimeter 13.22 ft
Hydraulic Radius 0.13 ft

Worksheet for Cross Section 05W_LV Blvd_West 1/2 St_21+60

Results

Top Width	12.77	ft
Normal Depth	0.40	ft
Critical Depth	0.40	ft
Critical Slope	0.00748	ft/ft
Velocity	2.26	ft/s
Velocity Head	0.08	ft
Specific Energy	0.48	ft
Froude Number	1.07	
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	0.40	ft
Critical Depth	0.40	ft
Channel Slope	0.87	%
Critical Slope	0.00748	ft/ft

Cross Section for Cross Section 05W_LV Blvd West 1/2 St_21+60

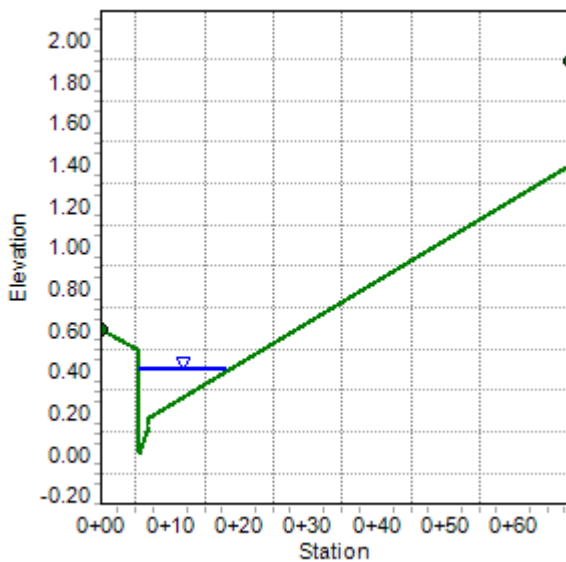
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.87	%
Normal Depth	0.40	ft
Discharge	4.00	ft ³ /s

Cross Section Image



Worksheet for Cross Section 06S_B_Rd_South 1/2 St_54+40

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.52	%
Discharge	12.00	ft ³ /s
Section Definitions		

Station (ft)	Elevation (ft)
0+00.0	0.60
0+05.0	0.50
0+05.5	0.50
0+05.5	0.00
0+21.0	0.19
0+29.8	0.60
0+52.8	0.83

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.60)	(0+52.8, 0.83)	0.016

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	0.37	ft
Elevation Range	0.00 to 0.83	ft
Flow Area	4.69	ft ²
Wetted Perimeter	19.87	ft
Hydraulic Radius	0.24	ft
Top Width	19.49	ft

Worksheet for Cross Section 06S_B_Rd_South 1/2 St_54+40

Results

Normal Depth	0.37	ft
Critical Depth	0.36	ft
Critical Slope	0.00624	ft/ft
Velocity	2.56	ft/s
Velocity Head	0.10	ft
Specific Energy	0.47	ft
Froude Number	0.92	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.37	ft
Critical Depth	0.36	ft
Channel Slope	0.52	%
Critical Slope	0.00624	ft/ft

Cross Section for Cross Section 06S_B_Rd_South 1/2 St_54+40

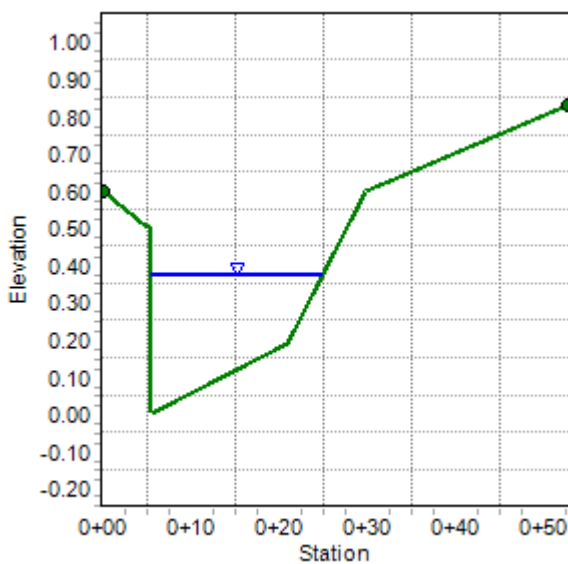
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.52	%
Normal Depth	0.37	ft
Discharge	12.00	ft ³ /s

Cross Section Image



Worksheet for Cross Section 07N_B_Rd_North 1/2 St_54+27

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.97	%
Discharge	1.00	ft ³ /s
Section Definitions		

Station (ft)	Elevation (ft)
0+00.0	0.60
0+05.0	0.50
0+05.5	0.50
0+05.5	0.00
0+17.0	0.23
0+30.3	0.68

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.60)	(0+30.3, 0.68)	0.016

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	0.16	ft
Elevation Range	0.00 to 0.68	ft
Flow Area	0.61	ft ²
Wetted Perimeter	7.94	ft
Hydraulic Radius	0.08	ft
Top Width	7.78	ft
Normal Depth	0.16	ft

Worksheet for Cross Section 07N_B_Rd_North 1/2 St_54+27

Results

Critical Depth	0.16	ft
Critical Slope	0.00893	ft/ft
Velocity	1.65	ft/s
Velocity Head	0.04	ft
Specific Energy	0.20	ft
Froude Number	1.04	
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	0.16	ft
Critical Depth	0.16	ft
Channel Slope	0.97	%
Critical Slope	0.00893	ft/ft

Cross Section for Cross Section 07N_B_Rd_North 1/2 St_54+27

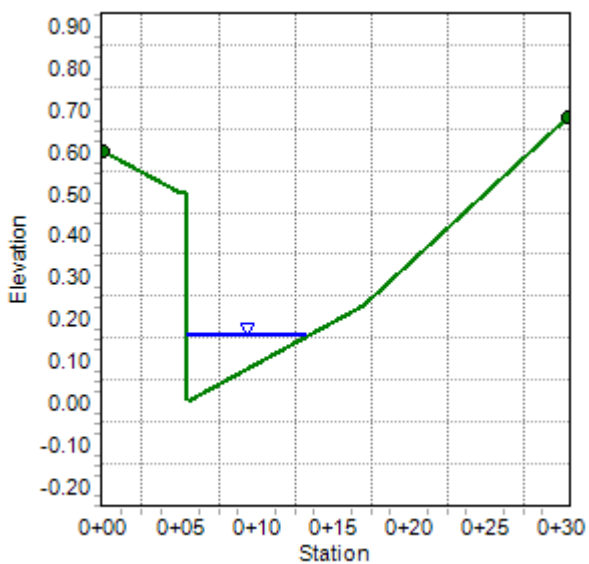
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.97	%
Normal Depth	0.16	ft
Discharge	1.00	ft ³ /s

Cross Section Image



Worksheet for Cross Section 08W_LV Blvd_West 1/2 St_24+30

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.90 %
Discharge 1.70 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.90
0+20.0	0.50
0+20.5	0.50
0+20.5	0.00
0+22.0	0.13
0+22.0	0.17
0+75.5	1.24
0+75.5	1.74

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.90)	(0+75.5, 1.74)	0.016

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 0.32 ft
Elevation Range 0.00 to 1.74 ft
Flow Area 0.90 ft²
Wetted Perimeter 9.12 ft
Hydraulic Radius 0.10 ft

Worksheet for Cross Section 08W_LV Blvd_West 1/2 St_24+30

Results

Top Width	8.76	ft
Normal Depth	0.32	ft
Critical Depth	0.32	ft
Critical Slope	0.00836	ft/ft
Velocity	1.88	ft/s
Velocity Head	0.06	ft
Specific Energy	0.37	ft
Froude Number	1.03	
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	0.32	ft
Critical Depth	0.32	ft
Channel Slope	0.90	%
Critical Slope	0.00836	ft/ft

Cross Section for Cross Section 08W_LV Blvd West 1/2 St_24+30

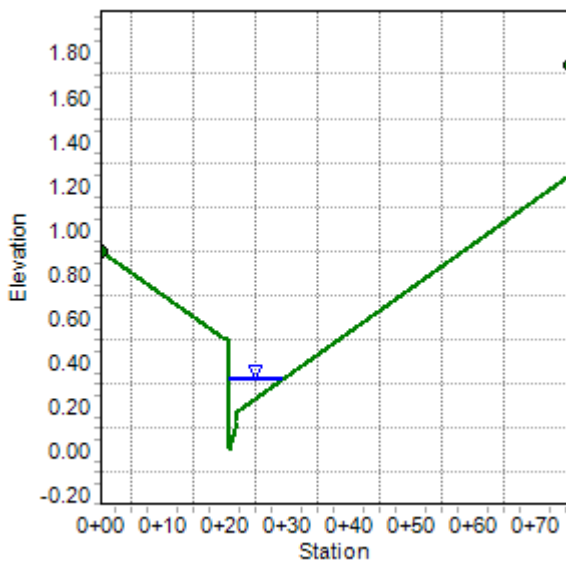
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.90	%
Normal Depth	0.32	ft
Discharge	1.70	ft ³ /s

Cross Section Image



Worksheet for Cross Section 09W_LV Blvd_West 1/2 St_26+60

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.86 %
Discharge 5.20 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.60
0+05.0	0.50
0+05.5	0.50
0+05.5	0.00
0+07.0	0.13
0+07.0	0.17
0+78.0	1.59
0+78.0	2.09

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.60)	(0+78.0, 2.09)	0.016

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 0.00 to 2.09 ft
Flow Area 2.17 ft²
Wetted Perimeter 14.73 ft
Hydraulic Radius 0.15 ft

Worksheet for Cross Section 09W_LV Blvd_West 1/2 St_26+60

Results

Top Width	14.25	ft
Normal Depth	0.43	ft
Critical Depth	0.44	ft
Critical Slope	0.00722	ft/ft
Velocity	2.40	ft/s
Velocity Head	0.09	ft
Specific Energy	0.51	ft
Froude Number	1.09	
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	0.44	ft
Channel Slope	0.86	%
Critical Slope	0.00722	ft/ft

Cross Section for Cross Section 09W_LV Blvd_West 1/2 St_26+60

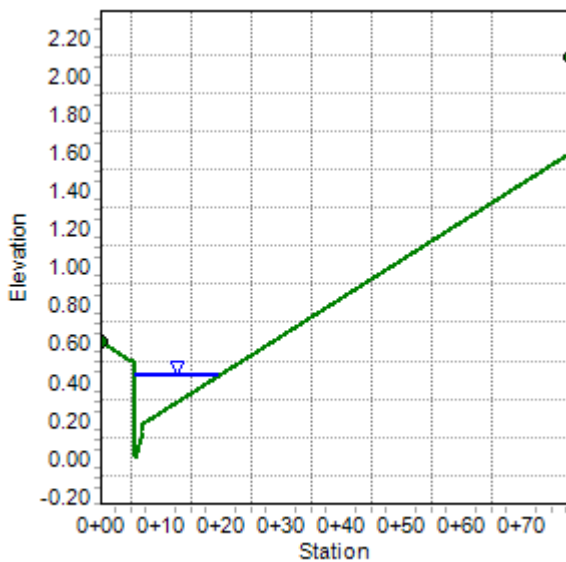
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.86	%
Normal Depth	0.43	ft
Discharge	5.20	ft ³ /s

Cross Section Image



Project Description

Input Data

Station (ft)

Elevation (ft)

Roughness Segment Definitions

Start Station

Ending Station

Roughness Coefficient

(0+00.0, 0.60)

(0+48.0, 1.49)

0.016

Options

Results

Bentley Systems, Inc. Bentley FlowMaster V8i (SELECTseries 1) [08.11.01.03]

Worksheet for Cross Section 10W_LV Blvd_West 1/2 St_30+50

Results

Top Width	14.72	ft
Normal Depth	0.43	ft
Critical Depth	0.46	ft
Critical Slope	0.00702	ft/ft
Velocity	2.78	ft/s
Velocity Head	0.12	ft
Specific Energy	0.55	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	0.43	ft
Critical Depth	0.46	ft
Channel Slope	1.11	%
Critical Slope	0.00702	ft/ft

Cross Section for Cross Section 10W_LV Blvd West 1/2 St_30+50

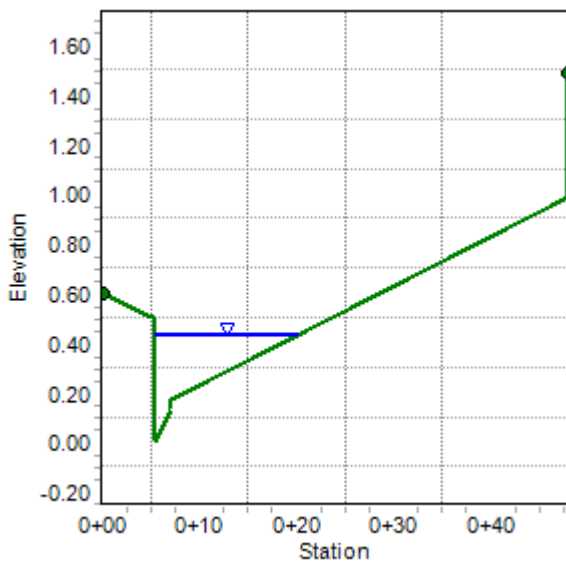
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.11	%
Normal Depth	0.43	ft
Discharge	6.40	ft ³ /s

Cross Section Image



Worksheet for Cross Section 11W_LV Blvd_West 1/2 St_32+95

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 1.43 %
Discharge 4.50 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.60
0+05.0	0.50
0+05.5	0.50
0+05.5	0.00
0+07.0	0.13
0+07.0	0.17
0+48.0	0.99
0+48.0	1.49

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.60)	(0+48.0, 1.49)	0.016

Options

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

Results

Normal Depth 0.38 ft
Elevation Range 0.00 to 1.49 ft
Flow Area 1.60 ft²
Wetted Perimeter 12.53 ft
Hydraulic Radius 0.13 ft

Worksheet for Cross Section 11W_LV Blvd_West 1/2 St_32+95

Results

Top Width	12.10	ft
Normal Depth	0.38	ft
Critical Depth	0.42	ft
Critical Slope	0.00736	ft/ft
Velocity	2.81	ft/s
Velocity Head	0.12	ft
Specific Energy	0.51	ft
Froude Number	1.37	
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	0.38	ft
Critical Depth	0.42	ft
Channel Slope	1.43	%
Critical Slope	0.00736	ft/ft

Cross Section for Cross Section 11W_LV Blvd West 1/2 St_32+95

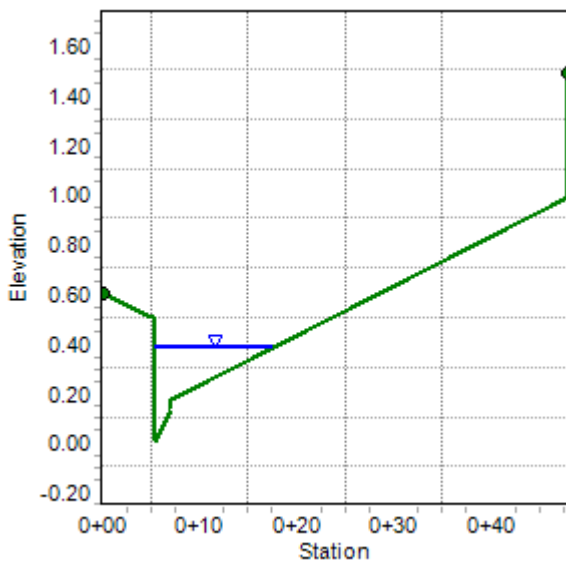
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.43	%
Normal Depth	0.38	ft
Discharge	4.50	ft ³ /s

Cross Section Image



Worksheet for Cross Section 12W_LV Blvd_West 1/2 St_36+25

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 3.00 %
Discharge 1.50 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.60
0+05.0	0.50
0+05.5	0.50
0+05.5	0.00
0+07.0	0.13
0+07.0	0.17
0+48.0	0.99
0+48.0	1.49

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.60)	(0+48.0, 1.49)	0.016

Options

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

Results

Normal Depth 0.26 ft
Elevation Range 0.00 to 1.49 ft
Flow Area 0.50 ft²
Wetted Perimeter 6.39 ft
Hydraulic Radius 0.08 ft

Worksheet for Cross Section 12W_LV Blvd_West 1/2 St_36+25

Results

Top Width	6.08	ft
Normal Depth	0.26	ft
Critical Depth	0.31	ft
Critical Slope	0.00850	ft/ft
Velocity	2.97	ft/s
Velocity Head	0.14	ft
Specific Energy	0.40	ft
Froude Number	1.82	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.26	ft
Critical Depth	0.31	ft
Channel Slope	3.00	%
Critical Slope	0.00850	ft/ft

Cross Section for Cross Section 12W_LV Blvd West 1/2 St 36+25

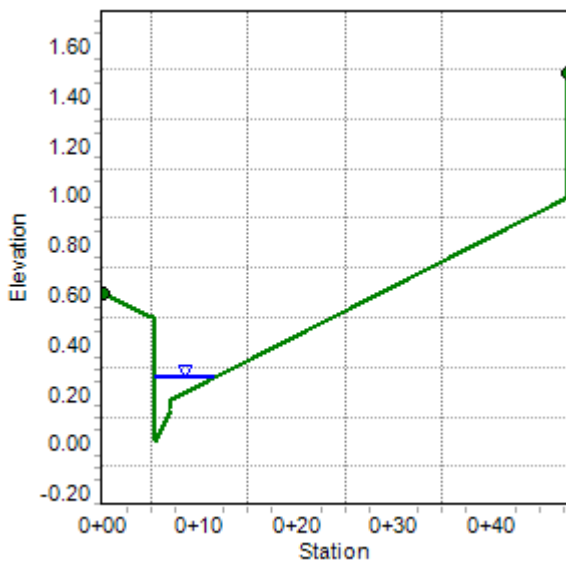
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	3.00	%
Normal Depth	0.26	ft
Discharge	1.50	ft ³ /s

Cross Section Image



Worksheet for Cross Section 13W_LV Blvd_West 1/2 St_38+70

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 4.90 %
Discharge 3.50 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	1.00
0+00.0	0.50
0+00.5	0.50
0+00.5	0.00
0+02.0	0.13
0+02.0	0.17
0+48.0	1.07
0+48.0	1.57

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 1.00)	(0+48.0, 1.57)	0.016

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 0.30 ft
Elevation Range 0.00 to 1.57 ft
Flow Area 0.82 ft²
Wetted Perimeter 8.73 ft
Hydraulic Radius 0.09 ft

Worksheet for Cross Section 13W_LV Blvd_West 1/2 St_38+70

Results

Top Width	8.38	ft
Normal Depth	0.30	ft
Critical Depth	0.39	ft
Critical Slope	0.00763	ft/ft
Velocity	4.26	ft/s
Velocity Head	0.28	ft
Specific Energy	0.59	ft
Froude Number	2.40	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.30	ft
Critical Depth	0.39	ft
Channel Slope	4.90	%
Critical Slope	0.00763	ft/ft

Cross Section for Cross Section 13W_LV Blvd West 1/2 St_38+70

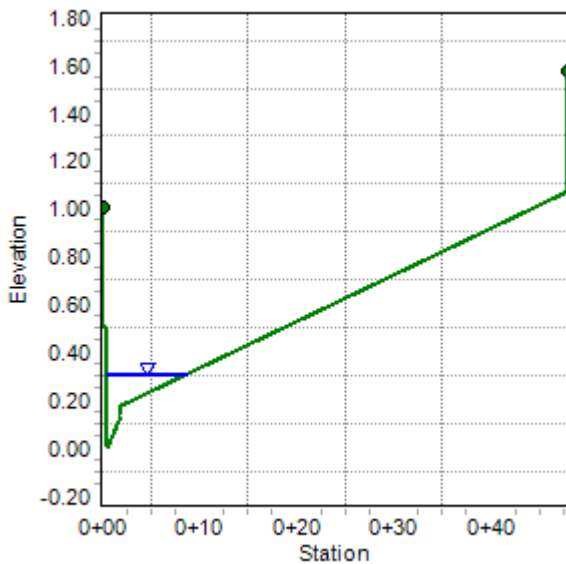
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	4.90	%
Normal Depth	0.30	ft
Discharge	3.50	ft ³ /s

Cross Section Image



Worksheet for Cross Section 14W_LV Blvd_West 1/2 St_43+29

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 4.45 %
Discharge 12.50 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.70
0+10.0	0.50
0+10.5	0.50
0+10.5	0.00
0+12.0	0.13
0+12.0	0.17
0+53.0	0.99
0+53.0	1.49

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.70)	(0+53.0, 1.49)	0.016

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 0.00 to 1.49 ft
Flow Area 2.26 ft²
Wetted Perimeter 15.05 ft
Hydraulic Radius 0.15 ft

Worksheet for Cross Section 14W_LV Blvd_West 1/2 St_43+29

Results

Top Width	14.57	ft
Normal Depth	0.43	ft
Critical Depth	0.57	ft
Critical Slope	0.00663	ft/ft
Velocity	5.53	ft/s
Velocity Head	0.48	ft
Specific Energy	0.91	ft
Froude Number	2.48	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.43	ft
Critical Depth	0.57	ft
Channel Slope	4.45	%
Critical Slope	0.00663	ft/ft

Cross Section for Cross Section 14W_LV Blvd West 1/2 St_43+29

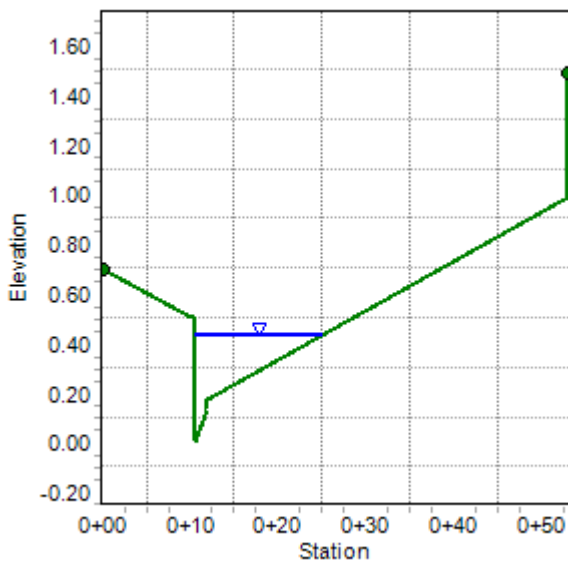
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	4.45	%
Normal Depth	0.43	ft
Discharge	12.50	ft ³ /s

Cross Section Image



Worksheet for Cross Section 15W_LV Blvd_West 1/2 St_45+45

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 1.52 %
Discharge 2.80 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.70
0+10.0	0.50
0+10.5	0.50
0+10.5	0.00
0+12.0	0.12
0+50.0	0.88
0+50.0	1.43

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.70)	(0+50.0, 1.43)	0.016

Options

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

Results

Normal Depth 0.29 ft
Elevation Range 0.00 to 1.43 ft
Flow Area 1.10 ft²
Wetted Perimeter 10.45 ft
Hydraulic Radius 0.11 ft
Top Width 10.15 ft

Worksheet for Cross Section 15W_LV Blvd_West 1/2 St_45+45

Results

Normal Depth	0.29	ft
Critical Depth	0.32	ft
Critical Slope	0.00781	ft/ft
Velocity	2.55	ft/s
Velocity Head	0.10	ft
Specific Energy	0.39	ft
Froude Number	1.37	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.29	ft
Critical Depth	0.32	ft
Channel Slope	1.52	%
Critical Slope	0.00781	ft/ft

Cross Section for Cross Section 15W_LV Blvd West 1/2 St_45+45

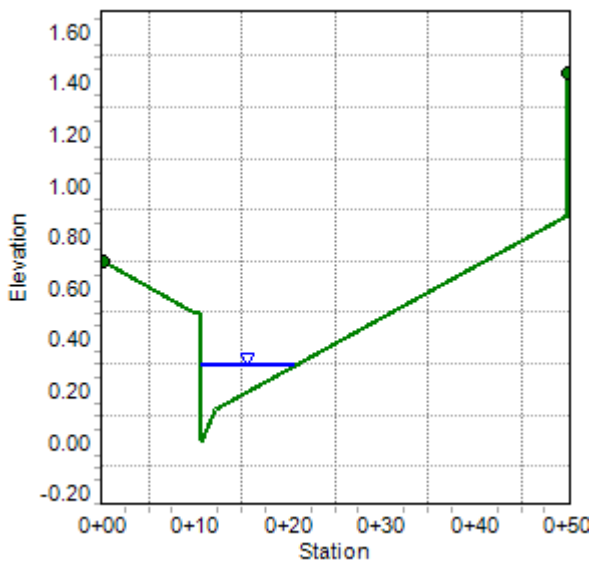
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.52	%
Normal Depth	0.29	ft
Discharge	2.80	ft ³ /s

Cross Section Image



Worksheet for Cross Section 16W_LV Blvd_West 1/2 St_46+66

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 1.54 %
Discharge 0.01 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.70
0+10.0	0.50
0+10.5	0.50
0+10.5	0.00
0+12.0	0.13
0+12.0	0.17
0+50.0	0.93
0+50.0	1.43

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.70)	(0+50.0, 1.43)	0.016

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 0.04 ft
Elevation Range 0.00 to 1.43 ft
Flow Area 0.01 ft²
Wetted Perimeter 0.56 ft
Hydraulic Radius 0.02 ft

Worksheet for Cross Section 16W_LV Blvd_West 1/2 St_46+66

Results

Top Width	0.52	ft
Normal Depth	0.04	ft
Critical Depth	0.05	ft
Critical Slope	0.01482	ft/ft
Velocity	0.87	ft/s
Velocity Head	0.01	ft
Specific Energy	0.06	ft
Froude Number	1.02	
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	0.04	ft
Critical Depth	0.05	ft
Channel Slope	1.54	%
Critical Slope	0.01482	ft/ft

Cross Section for Cross Section 16W_LV Blvd West 1/2 St_46+66

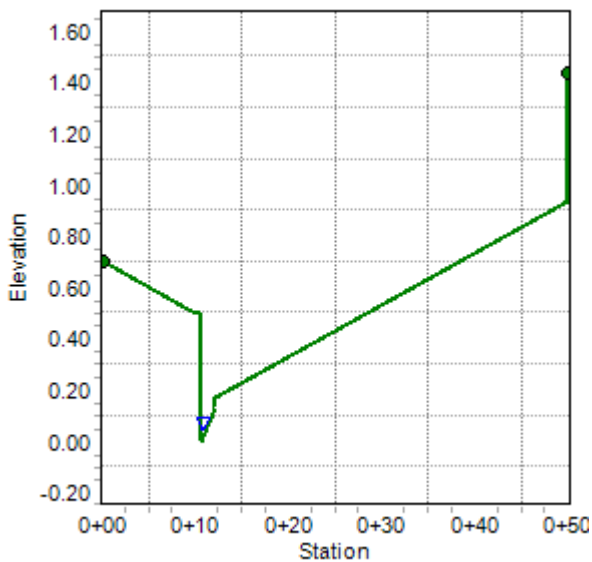
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.54	%
Normal Depth	0.04	ft
Discharge	0.01	ft ³ /s

Cross Section Image



Project Description

Input Data

Elevation (ft)

Roughness Segment Definitions

Roughness Coefficient

Options

Results

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Worksheet for Cross Section 17S_Wash_South 1/2 St_47+11

Results

Normal Depth	0.36	ft
Critical Depth	0.38	ft
Critical Slope	0.00769	ft/ft
Velocity	2.36	ft/s
Velocity Head	0.09	ft
Specific Energy	0.45	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	0.36	ft
Critical Depth	0.38	ft
Channel Slope	1.15	%
Critical Slope	0.00769	ft/ft

Cross Section for Cross Section 17S_Wash_South 1/2 St_47+11

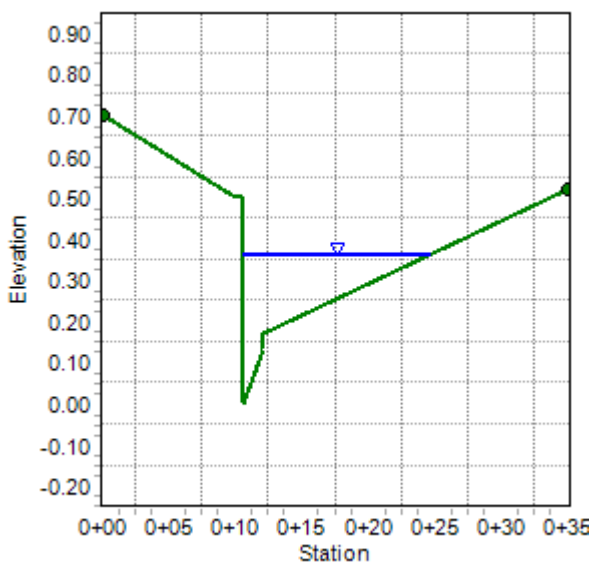
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.15	%
Normal Depth	0.36	ft
Discharge	4.00	ft ³ /s

Cross Section Image



Worksheet for Cross Section 01E_LV Blvd_East 1/2 St_13+51

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.57 %
Discharge 1.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.70
0+10.0	0.50
0+10.5	0.50
0+10.5	0.00
0+12.0	0.13
0+12.0	0.17
0+77.0	1.50
0+77.0	2.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.70)	(0+77.0, 2.00)	0.016

Options

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

Results

Normal Depth 0.29 ft
Elevation Range 0.00 to 2.00 ft
Flow Area 0.71 ft²
Wetted Perimeter 7.84 ft
Hydraulic Radius 0.09 ft

Worksheet for Cross Section 01E_LV Blvd_East 1/2 St_13+51

Results

Top Width	7.50	ft
Normal Depth	0.29	ft
Critical Depth	0.28	ft
Critical Slope	0.00892	ft/ft
Velocity	1.41	ft/s
Velocity Head	0.03	ft
Specific Energy	0.32	ft
Froude Number	0.81	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.29	ft
Critical Depth	0.28	ft
Channel Slope	0.57	%
Critical Slope	0.00892	ft/ft

Cross Section for Cross Section 01E_LV Blvd_East 1/2 St_13+51

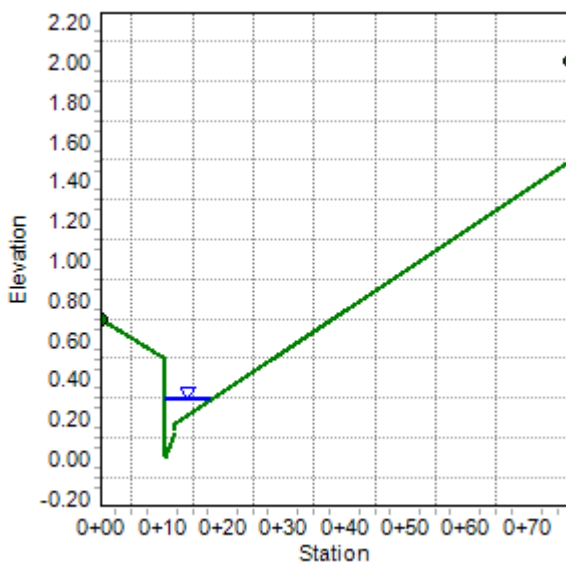
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.57	%
Normal Depth	0.29	ft
Discharge	1.00	ft ³ /s

Cross Section Image



Worksheet for Cross Section 02E_LV Blvd_East 1/2 St_14+50

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.56 %
Discharge 0.50 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.70
0+10.0	0.50
0+10.5	0.50
0+10.5	0.00
0+12.0	0.13
0+12.0	0.17
0+86.5	1.58
0+86.5	2.08

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.70)	(0+86.5, 2.08)	0.016

Options

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

Results

Normal Depth 0.24 ft
Elevation Range 0.00 to 2.08 ft
Flow Area 0.41 ft²
Wetted Perimeter 5.71 ft
Hydraulic Radius 0.07 ft

Worksheet for Cross Section 02E_LV Blvd_East 1/2 St_14+50

Results

Top Width	5.42	ft
Normal Depth	0.24	ft
Critical Depth	0.23	ft
Critical Slope	0.00967	ft/ft
Velocity	1.21	ft/s
Velocity Head	0.02	ft
Specific Energy	0.27	ft
Froude Number	0.77	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.24	ft
Critical Depth	0.23	ft
Channel Slope	0.56	%
Critical Slope	0.00967	ft/ft

Cross Section for Cross Section 02E_LV Blvd_East 1/2 St_14+50

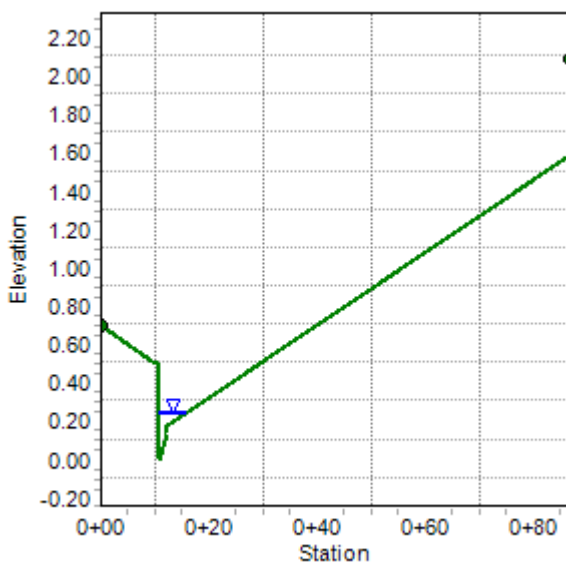
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.56	%
Normal Depth	0.24	ft
Discharge	0.50	ft ³ /s

Cross Section Image



Worksheet for Cross Section 03E_LV Blvd_East 1/2 St_19+09

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.87 %
Discharge 2.50 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	1.43
0+20.0	0.83
0+20.5	0.83
0+20.5	0.33
0+27.5	0.17
0+27.5	0.00
0+32.5	0.00
0+32.5	0.17
0+34.0	0.31
0+94.0	1.45

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 1.43)	(0+94.0, 1.45)	0.016

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 0.20 ft
Elevation Range 0.00 to 1.45 ft
Flow Area 1.04 ft²

Worksheet for Cross Section 03E_LV Blvd_East 1/2 St_19+09

Results

Wetted Perimeter	7.05	ft
Hydraulic Radius	0.15	ft
Top Width	6.71	ft
Normal Depth	0.20	ft
Critical Depth	0.22	ft
Critical Slope	0.00742	ft/ft
Velocity	2.41	ft/s
Velocity Head	0.09	ft
Specific Energy	0.29	ft
Froude Number	1.08	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.20	ft
Critical Depth	0.22	ft
Channel Slope	0.87	%
Critical Slope	0.00742	ft/ft

Cross Section for Cross Section 03E_LV Blvd_East 1/2 St_19+09

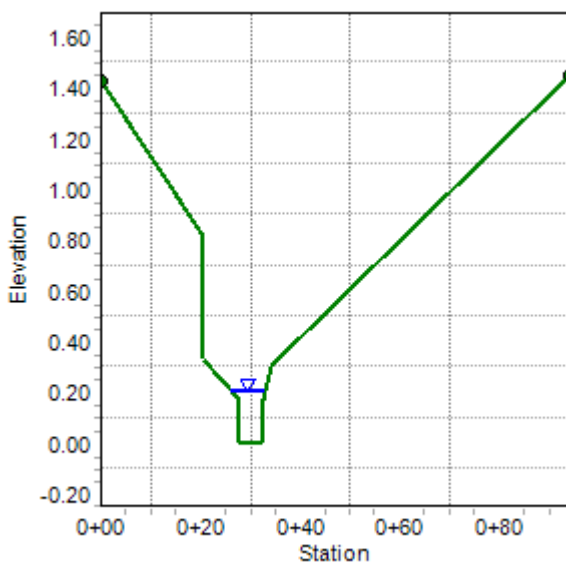
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.87	%
Normal Depth	0.20	ft
Discharge	2.50	ft ³ /s

Cross Section Image



Worksheet for Cross Section 04E_LV Blvd_East 1/2 St_22+19

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.02	%
Discharge	2.80	ft ³ /s
Section Definitions		

Station (ft)	Elevation (ft)
0+00.0	0.66
0+08.0	0.50
0+08.5	0.50
0+08.5	0.00
0+10.0	0.13
0+10.0	0.17
0+65.5	1.28
0+65.5	1.78

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.66)	(0+65.5, 1.78)	0.016

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	0.35	ft
Elevation Range	0.00 to 1.78	ft
Flow Area	1.26	ft ²
Wetted Perimeter	11.03	ft
Hydraulic Radius	0.11	ft

Worksheet for Cross Section 04E_LV Blvd_East 1/2 St_22+19

Results

Top Width	10.63	ft
Normal Depth	0.35	ft
Critical Depth	0.36	ft
Critical Slope	0.00784	ft/ft
Velocity	2.21	ft/s
Velocity Head	0.08	ft
Specific Energy	0.43	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	0.35	ft
Critical Depth	0.36	ft
Channel Slope	1.02	%
Critical Slope	0.00784	ft/ft

Cross Section for Cross Section 04E_LV Blvd_East 1/2 St_22+19

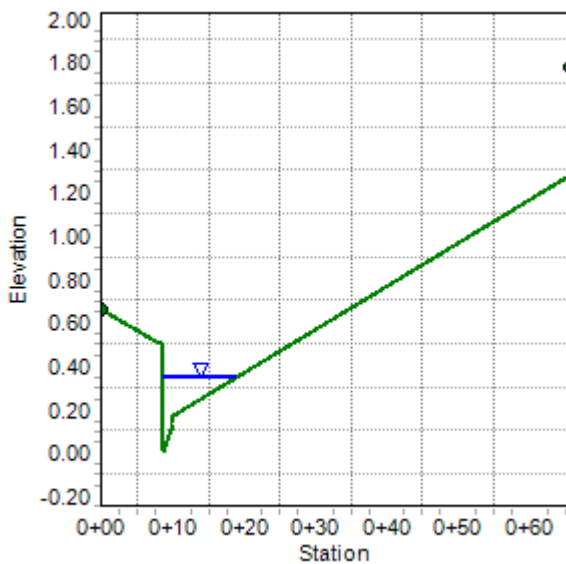
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.02	%
Normal Depth	0.35	ft
Discharge	2.80	ft ³ /s

Cross Section Image



Worksheet for Cross Section 05E_LV Blvd_East 1/2 St_24+01

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 1.12 %
Discharge 0.50 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.66
0+08.0	0.50
0+08.5	0.50
0+08.5	0.00
0+10.0	0.13
0+10.0	0.17
0+51.0	0.99
0+51.0	1.49

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.66)	(0+51.0, 1.49)	0.016

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 0.00 to 1.49 ft
Flow Area 0.30 ft²
Wetted Perimeter 4.35 ft
Hydraulic Radius 0.07 ft

Worksheet for Cross Section 05E_LV Blvd_East 1/2 St_24+01

Results

Top Width	4.08	ft
Normal Depth	0.22	ft
Critical Depth	0.23	ft
Critical Slope	0.00962	ft/ft
Velocity	1.66	ft/s
Velocity Head	0.04	ft
Specific Energy	0.26	ft
Froude Number	1.08	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.22	ft
Critical Depth	0.23	ft
Channel Slope	1.12	%
Critical Slope	0.00962	ft/ft

Cross Section for Cross Section 05E_LV Blvd East 1/2 St 24+01

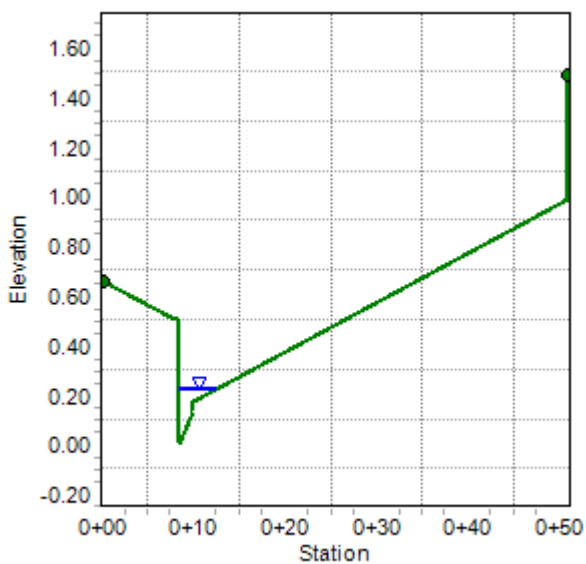
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.12	%
Normal Depth	0.22	ft
Discharge	0.50	ft ³ /s

Cross Section Image



Worksheet for Cross Section 06E_LV Blvd_East 1/2 St_26+11

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.61 %
Discharge 2.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.66
0+08.0	0.50
0+08.5	0.50
0+08.5	0.00
0+10.0	0.13
0+10.0	0.17
0+51.0	1.22
0+51.0	1.72

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.66)	(0+51.0, 1.72)	0.016

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 0.00 to 1.72 ft
Flow Area 1.12 ft²
Wetted Perimeter 9.20 ft
Hydraulic Radius 0.12 ft

Worksheet for Cross Section 06E_LV Blvd_East 1/2 St_26+11

Results

Top Width	8.79	ft
Normal Depth	0.36	ft
Critical Depth	0.34	ft
Critical Slope	0.00800	ft/ft
Velocity	1.78	ft/s
Velocity Head	0.05	ft
Specific Energy	0.41	ft
Froude Number	0.88	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.36	ft
Critical Depth	0.34	ft
Channel Slope	0.61	%
Critical Slope	0.00800	ft/ft

Cross Section for Cross Section 06E_LV Blvd_East 1/2 St_26+11

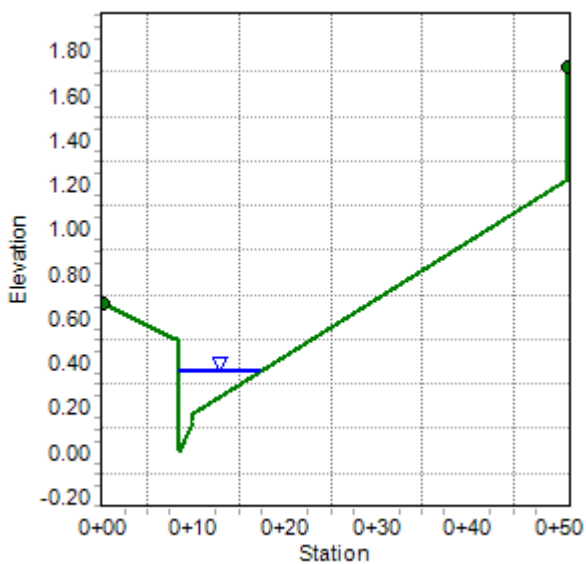
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.61	%
Normal Depth	0.36	ft
Discharge	2.00	ft ³ /s

Cross Section Image



Worksheet for Cross Section 07E_LV Blvd_East 1/2 St_30+57

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 1.07 %
Discharge 1.50 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.66
0+08.0	0.50
0+08.5	0.50
0+08.5	0.00
0+10.0	0.13
0+10.0	0.17
0+51.0	0.99
0+51.0	1.49

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.66)	(0+51.0, 1.49)	0.016

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 0.30 ft
Elevation Range 0.00 to 1.49 ft
Flow Area 0.76 ft²
Wetted Perimeter 8.27 ft
Hydraulic Radius 0.09 ft

Worksheet for Cross Section 07E_LV Blvd_East 1/2 St_30+57

Results

Top Width	7.93	ft
Normal Depth	0.30	ft
Critical Depth	0.31	ft
Critical Slope	0.00850	ft/ft
Velocity	1.96	ft/s
Velocity Head	0.06	ft
Specific Energy	0.36	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	0.30	ft
Critical Depth	0.31	ft
Channel Slope	1.07	%
Critical Slope	0.00850	ft/ft

Cross Section for Cross Section 07E_LV Blvd_East 1/2 St_30+57

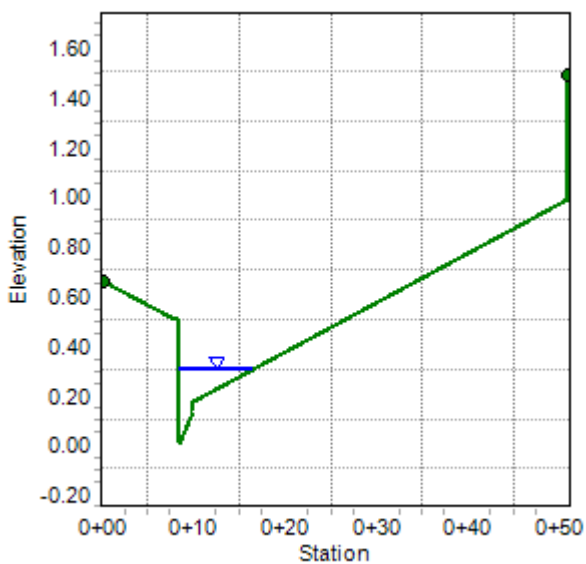
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.07	%
Normal Depth	0.30	ft
Discharge	1.50	ft ³ /s

Cross Section Image



Worksheet for Cross Section 08E_LV Blvd_East 1/2 St_32+58

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.73 %
Discharge 1.60 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.70
0+10.0	0.50
0+10.5	0.50
0+10.5	0.00
0+12.0	0.13
0+12.0	0.17
0+50.0	0.56
0+50.0	1.06

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.70)	(0+50.0, 1.06)	0.016

Options

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

Results

Normal Depth 0.29 ft
Elevation Range 0.00 to 1.06 ft
Flow Area 1.10 ft²
Wetted Perimeter 13.92 ft
Hydraulic Radius 0.08 ft

Worksheet for Cross Section 08E_LV Blvd_East 1/2 St_32+58

Results

Top Width	13.58	ft
Normal Depth	0.29	ft
Critical Depth	0.29	ft
Critical Slope	0.00903	ft/ft
Velocity	1.46	ft/s
Velocity Head	0.03	ft
Specific Energy	0.33	ft
Froude Number	0.90	
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	0.29	ft
Critical Depth	0.29	ft
Channel Slope	0.73	%
Critical Slope	0.00903	ft/ft

Cross Section for Cross Section 08E_LV Blvd_East 1/2 St_32+58

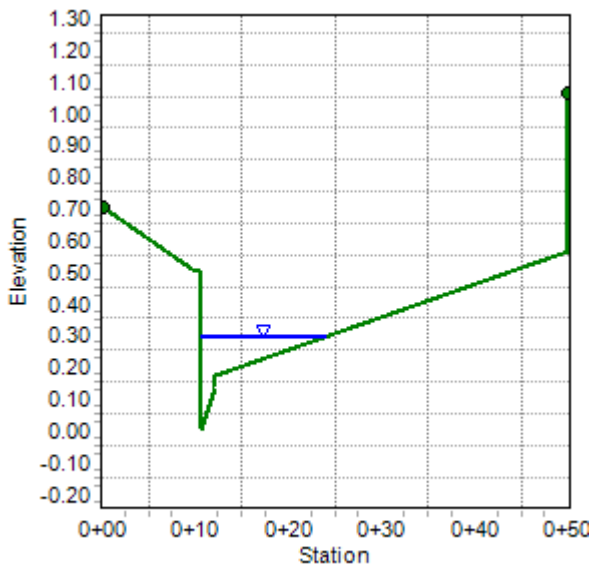
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.73	%
Normal Depth	0.29	ft
Discharge	1.60	ft ³ /s

Cross Section Image



Worksheet for Cross Section 09E_LV Blvd_East 1/2 St_40+13

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	4.97	%
Discharge	2.20	ft ³ /s
Section Definitions		

Station (ft)	Elevation (ft)
0+00.0	0.90
0+20.0	0.50
0+20.5	0.50
0+20.5	0.00
0+22.0	0.13
0+22.0	0.17
0+63.5	1.00
0+63.5	1.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.90)	(0+63.5, 1.50)	0.016

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	0.27	ft
Elevation Range	0.00 to 1.50	ft
Flow Area	0.56	ft ²
Wetted Perimeter	6.86	ft
Hydraulic Radius	0.08	ft

Worksheet for Cross Section 09E_LV Blvd_East 1/2 St_40+13

Results

Top Width	6.54	ft
Normal Depth	0.27	ft
Critical Depth	0.34	ft
Critical Slope	0.00809	ft/ft
Velocity	3.91	ft/s
Velocity Head	0.24	ft
Specific Energy	0.51	ft
Froude Number	2.35	
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	0.27	ft
Critical Depth	0.34	ft
Channel Slope	4.97	%
Critical Slope	0.00809	ft/ft

Cross Section for Cross Section 09E_LV Blvd_East 1/2 St_40+13

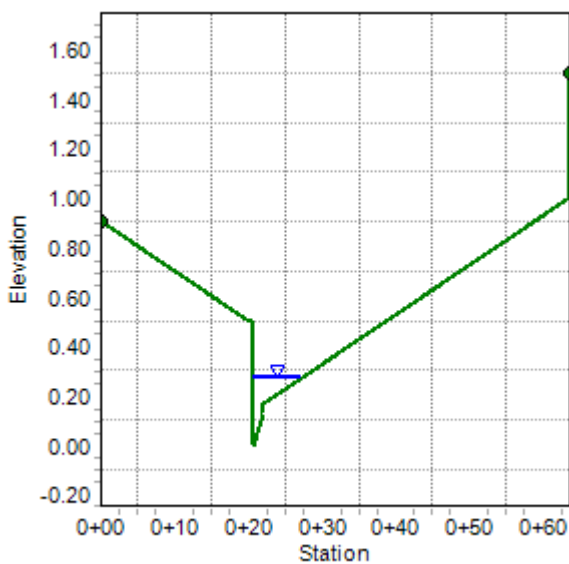
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	4.97	%
Normal Depth	0.27	ft
Discharge	2.20	ft ³ /s

Cross Section Image



Worksheet for Cross Section 10E_LV Blvd_East 1/2 St_41+57

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 4.97 %
Discharge 1.20 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.90
0+20.0	0.50
0+20.5	0.50
0+20.5	0.00
0+22.0	0.13
0+22.0	0.17
0+63.0	0.99
0+63.0	1.49

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.90)	(0+63.0, 1.49)	0.016

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 0.23 ft
Elevation Range 0.00 to 1.49 ft
Flow Area 0.34 ft²
Wetted Perimeter 4.79 ft
Hydraulic Radius 0.07 ft

Worksheet for Cross Section 10E_LV Blvd_East 1/2 St_41+57

Results

Top Width	4.52	ft
Normal Depth	0.23	ft
Critical Depth	0.29	ft
Critical Slope	0.00874	ft/ft
Velocity	3.54	ft/s
Velocity Head	0.19	ft
Specific Energy	0.43	ft
Froude Number	2.28	
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	0.23	ft
Critical Depth	0.29	ft
Channel Slope	4.97	%
Critical Slope	0.00874	ft/ft

Cross Section for Cross Section 10E_LV Blvd_East 1/2 St_41+57

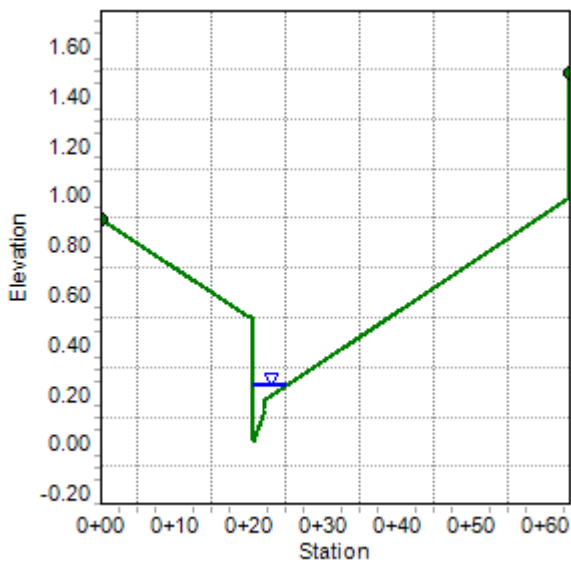
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	4.97	%
Normal Depth	0.23	ft
Discharge	1.20	ft ³ /s

Cross Section Image



Worksheet for Cross Section 11E_LV Blvd_East 1/2 St_46+88

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.46	%
Discharge	1.00	ft ³ /s
Section Definitions		

Station (ft)	Elevation (ft)
0+00.0	0.66
0+08.0	0.50
0+08.5	0.50
0+08.5	0.00
0+10.0	0.13
0+10.0	0.17
0+61.0	1.19
0+61.0	1.69

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.66)	(0+61.0, 1.69)	0.016

Options

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

Results

Normal Depth	0.26	ft
Elevation Range	0.00 to 1.69	ft
Flow Area	0.49	ft ²
Wetted Perimeter	6.24	ft
Hydraulic Radius	0.08	ft

Worksheet for Cross Section 11E_LV Blvd_East 1/2 St_46+88

Results

Top Width	5.94	ft
Normal Depth	0.26	ft
Critical Depth	0.28	ft
Critical Slope	0.00893	ft/ft
Velocity	2.05	ft/s
Velocity Head	0.07	ft
Specific Energy	0.32	ft
Froude Number	1.26	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.26	ft
Critical Depth	0.28	ft
Channel Slope	1.46	%
Critical Slope	0.00893	ft/ft

Cross Section for Cross Section 11E_LV Blvd_East 1/2 St_46+88

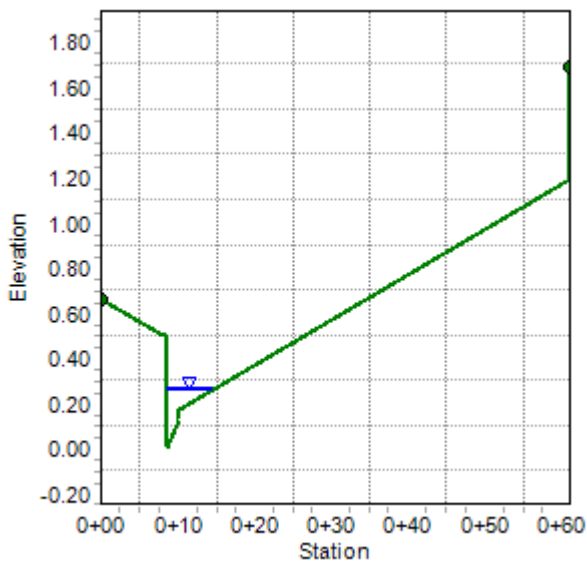
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.46	%
Normal Depth	0.26	ft
Discharge	1.00	ft ³ /s

Cross Section Image



B.3.2 100-Year Street Normal Depth Calculations

Worksheet for Cross Section 01W_LV Blvd_West 1/2 St_12+95_100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.93 %
Discharge 48.50 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.60
0+05.0	0.50
0+05.5	0.50
0+05.5	0.00
0+07.0	0.13
0+07.0	0.17
0+50.5	1.86
0+50.5	2.36

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.60)	(0+50.5, 2.36)	0.016

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 0.91 ft
Elevation Range 0.00 to 2.36 ft
Flow Area 10.28 ft²
Wetted Perimeter 26.88 ft
Hydraulic Radius 0.38 ft

Worksheet for Cross Section 01W_LV Blvd_West 1/2 St_12+95_100

Results

Top Width	26.01	ft
Normal Depth	0.91	ft
Critical Depth	1.00	ft
Critical Slope	0.00509	ft/ft
Velocity	4.72	ft/s
Velocity Head	0.35	ft
Specific Energy	1.25	ft
Froude Number	1.32	
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	0.91	ft
Critical Depth	1.00	ft
Channel Slope	0.93	%
Critical Slope	0.00509	ft/ft

Cross Section for Cross Section 01W_LV Blvd_West 1/2 St_12+95_100

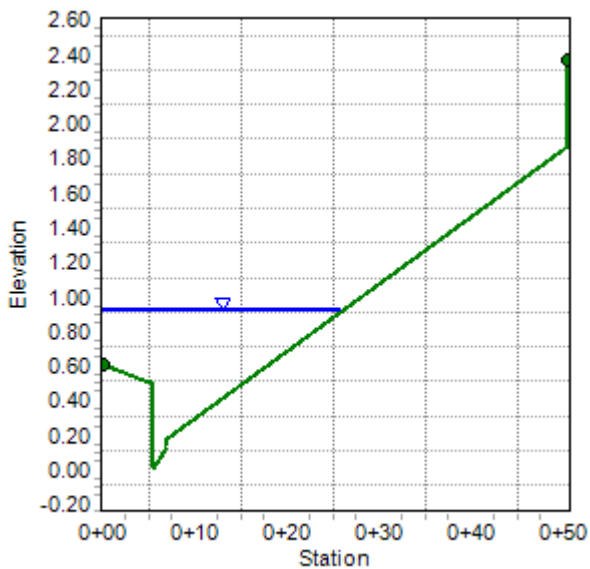
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.93	%
Normal Depth	0.91	ft
Discharge	48.50	ft ³ /s

Cross Section Image



Worksheet for Cross Section 03W_LV Blvd_West 1/2 St_15+60_100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.73 %
Discharge 40.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.60
0+05.0	0.50
0+05.5	0.50
0+05.5	0.00
0+07.0	0.13
0+07.0	0.17
0+45.0	1.29
0+45.0	1.79

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.60)	(0+45.0, 1.79)	0.016

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 0.84 ft
Elevation Range 0.00 to 1.79 ft
Flow Area 10.36 ft²
Wetted Perimeter 30.48 ft
Hydraulic Radius 0.34 ft

Worksheet for Cross Section 03W_LV Blvd_West 1/2 St_15+60_100

Results

Top Width	29.68	ft
Normal Depth	0.84	ft
Critical Depth	0.88	ft
Critical Slope	0.00537	ft/ft
Velocity	3.86	ft/s
Velocity Head	0.23	ft
Specific Energy	1.07	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	0.84	ft
Critical Depth	0.88	ft
Channel Slope	0.73	%
Critical Slope	0.00537	ft/ft

Cross Section for Cross Section 03W_LV Blvd_West 1/2 St_15+60_100

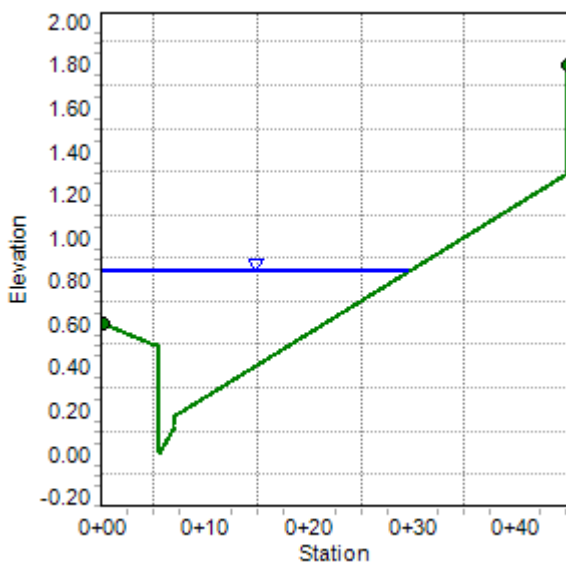
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.73	%
Normal Depth	0.84	ft
Discharge	40.00	ft ³ /s

Cross Section Image



Project Description

Input Data

Station (ft)	Elevation (ft)
100	100
200	100
300	100
400	100
500	100
600	100
700	100
800	100
900	100
1000	100
1100	100
1200	100
1300	100
1400	100
1500	100
1600	100
1700	100
1800	100
1900	100
2000	100
2100	100
2200	100
2300	100
2400	100
2500	100
2600	100
2700	100
2800	100
2900	100
3000	100
3100	100
3200	100
3300	100
3400	100
3500	100
3600	100
3700	100
3800	100
3900	100
4000	100
4100	100
4200	100
4300	100
4400	100
4500	100
4600	100
4700	100
4800	100
4900	100
5000	100
5100	100
5200	100
5300	100
5400	100
5500	100
5600	100
5700	100
5800	100
5900	100
6000	100
6100	100
6200	100
6300	100
6400	100
6500	100
6600	100
6700	100
6800	100
6900	100
7000	100
7100	100
7200	100
7300	100
7400	100
7500	100
7600	100
7700	100
7800	100
7900	100
8000	100
8100	100
8200	100
8300	100
8400	100
8500	100
8600	100
8700	100
8800	100
8900	100
9000	100
9100	100
9200	100
9300	100
9400	100
9500	100
9600	100
9700	100
9800	100
9900	100
10000	100

Roughness Segment Definitions

Options

Results

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Worksheet for Cross Section 04S_LV Blvd_West 1/2 St_16+50_100

Results

Critical Slope	0.00747	ft/ft
Velocity	1.62	ft/s
Velocity Head	0.04	ft
Specific Energy	0.35	ft
Froude Number	0.73	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.31	ft
Critical Depth	0.27	ft
Channel Slope	0.38	%
Critical Slope	0.00747	ft/ft

Cross Section for Cross Section 04S_LV Blvd_West 1/2 St_16+50_100

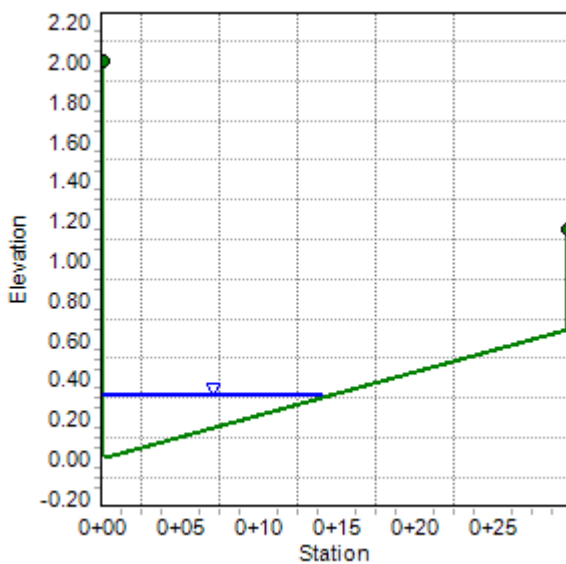
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.38	%
Normal Depth	0.31	ft
Discharge	3.50	ft ³ /s

Cross Section Image



Worksheet for Cross Section 05W_LV Blvd_West 1/2 St_21+60_100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.87 %
Discharge 9.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.60
0+05.0	0.50
0+05.5	0.50
0+05.5	0.00
0+07.0	0.13
0+07.0	0.17
0+68.0	1.39
0+68.0	1.89

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.60)	(0+68.0, 1.89)	0.016

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 0.49 ft
Elevation Range 0.00 to 1.89 ft
Flow Area 3.27 ft²
Wetted Perimeter 18.24 ft
Hydraulic Radius 0.18 ft

Worksheet for Cross Section 05W_LV Blvd_West 1/2 St_21+60_100

Results

Top Width	17.70	ft
Normal Depth	0.49	ft
Critical Depth	0.52	ft
Critical Slope	0.00681	ft/ft
Velocity	2.75	ft/s
Velocity Head	0.12	ft
Specific Energy	0.61	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	0.49	ft
Critical Depth	0.52	ft
Channel Slope	0.87	%
Critical Slope	0.00681	ft/ft

Cross Section for Cross Section 05W_LV Blvd_West 1/2 St_21+60_100

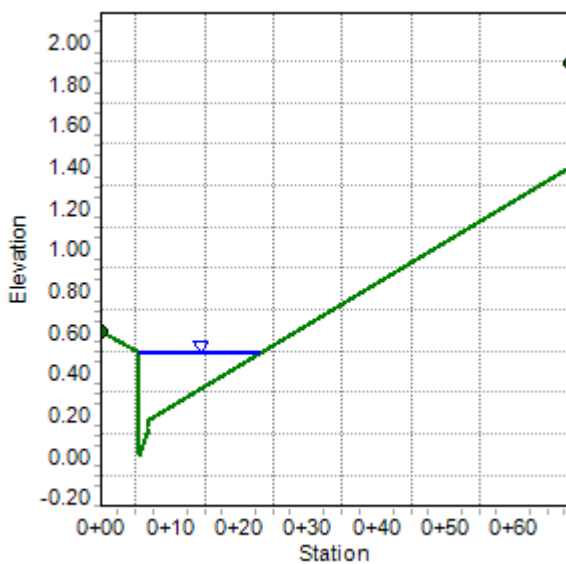
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.87	%
Normal Depth	0.49	ft
Discharge	9.00	ft ³ /s

Cross Section Image



Worksheet for Cross Section 06S_B_Rd_South 1/2 St_54+40_100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.52 %
Discharge 26.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.60
0+05.0	0.50
0+05.5	0.50
0+05.5	0.00
0+21.0	0.19
0+29.8	0.60
0+52.8	0.83

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.60)	(0+52.8, 0.83)	0.016

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 0.00 to 0.83 ft
Flow Area 8.31 ft²
Wetted Perimeter 26.02 ft
Hydraulic Radius 0.32 ft
Top Width 25.51 ft

Worksheet for Cross Section 06S_B_Rd_South 1/2 St_54+40_100

Results

Normal Depth	0.54	ft
Critical Depth	0.53	ft
Critical Slope	0.00558	ft/ft
Velocity	3.13	ft/s
Velocity Head	0.15	ft
Specific Energy	0.69	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	0.54	ft
Critical Depth	0.53	ft
Channel Slope	0.52	%
Critical Slope	0.00558	ft/ft

Cross Section for Cross Section 06S_B_Rd_South 1/2 St_54+40_100

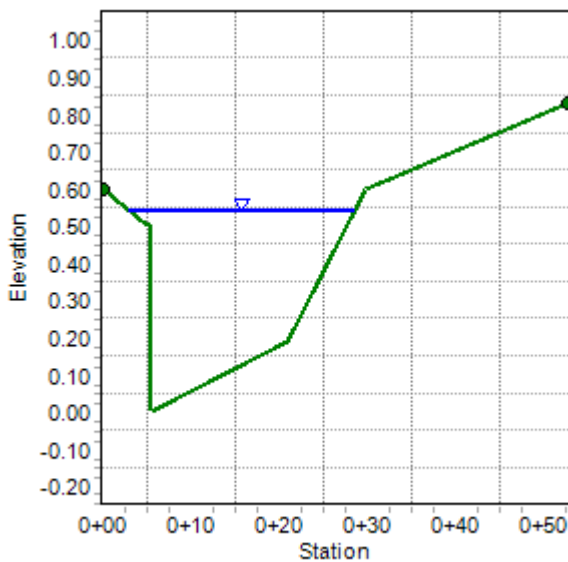
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.52	%
Normal Depth	0.54	ft
Discharge	26.00	ft ³ /s

Cross Section Image



Project Description

Input Data

Elevation (ft)

Roughness Segment Definitions

0.016

Results

Page 1 of 2

Worksheet for Cross Section 07N_B_Rd_North 1/2 St_54+27_100

Results

Critical Depth	0.21	ft
Critical Slope	0.00813	ft/ft
Velocity	1.96	ft/s
Velocity Head	0.06	ft
Specific Energy	0.26	ft
Froude Number	1.09	
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	0.20	ft
Critical Depth	0.21	ft
Channel Slope	0.97	%
Critical Slope	0.00813	ft/ft

Cross Section for Cross Section 07N_B_Rd_North 1/2 St_54+27_100

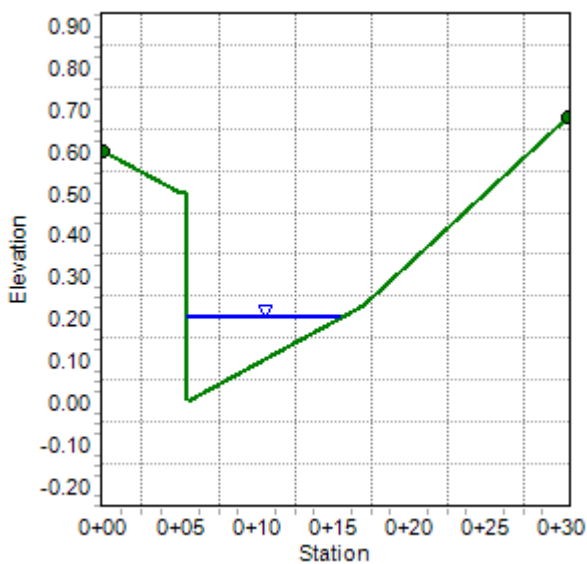
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.97	%
Normal Depth	0.20	ft
Discharge	2.00	ft ³ /s

Cross Section Image



Worksheet for Cross Section 08W_LV Blvd_West 1/2 St_24+30_100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.90 %
Discharge 16.70 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.90
0+20.0	0.50
0+20.5	0.50
0+20.5	0.00
0+22.0	0.13
0+22.0	0.17
0+75.5	1.24
0+75.5	1.74

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.90)	(0+75.5, 1.74)	0.016

Options

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

Results

Normal Depth 0.60 ft
Elevation Range 0.00 to 1.74 ft
Flow Area 5.62 ft²
Wetted Perimeter 28.67 ft
Hydraulic Radius 0.20 ft

Worksheet for Cross Section 08W_LV Blvd_West 1/2 St_24+30_100

Results

Top Width	28.12	ft
Normal Depth	0.60	ft
Critical Depth	0.62	ft
Critical Slope	0.00644	ft/ft
Velocity	2.97	ft/s
Velocity Head	0.14	ft
Specific Energy	0.73	ft
Froude Number	1.17	
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	0.90	%
Critical Slope	0.00644	ft/ft

Cross Section for Cross Section 08W_LV Blvd_West 1/2 St_24+30_100

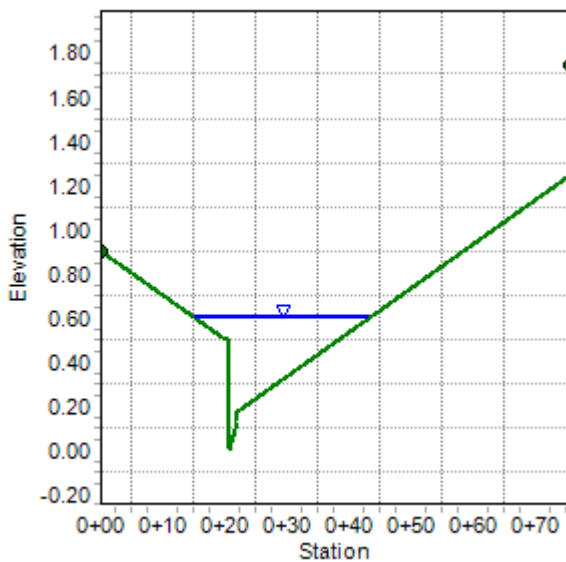
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.90	%
Normal Depth	0.60	ft
Discharge	16.70	ft ³ /s

Cross Section Image



Worksheet for Cross Section 09W_LV Blvd_West 1/2 St_26+60_100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.86 %
Discharge 24.20 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.60
0+05.0	0.50
0+05.5	0.50
0+05.5	0.00
0+07.0	0.13
0+07.0	0.17
0+78.0	1.59
0+78.0	2.09

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.60)	(0+78.0, 2.09)	0.016

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 0.66 ft
Elevation Range 0.00 to 2.09 ft
Flow Area 7.43 ft²
Wetted Perimeter 31.96 ft
Hydraulic Radius 0.23 ft

Worksheet for Cross Section 09W_LV Blvd_West 1/2 St_26+60_100

Results

Top Width	31.35	ft
Normal Depth	0.66	ft
Critical Depth	0.69	ft
Critical Slope	0.00603	ft/ft
Velocity	3.26	ft/s
Velocity Head	0.16	ft
Specific Energy	0.82	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	0.66	ft
Critical Depth	0.69	ft
Channel Slope	0.86	%
Critical Slope	0.00603	ft/ft

Cross Section for Cross Section 09W_LV Blvd_West 1/2 St_26+60_100

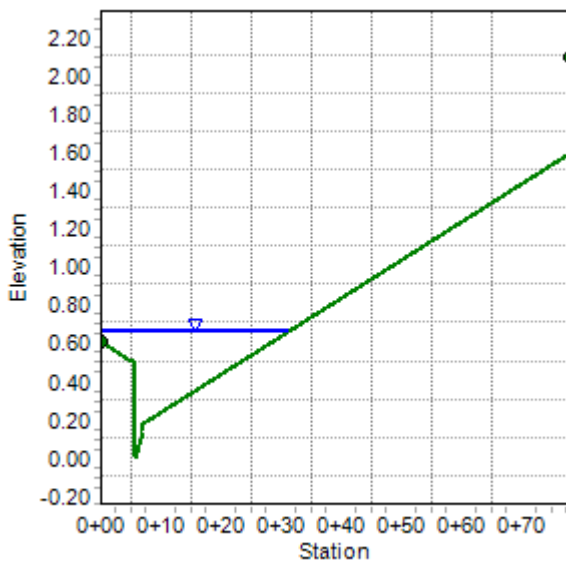
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.86	%
Normal Depth	0.66	ft
Discharge	24.20	ft ³ /s

Cross Section Image



Worksheet for Cross Section 10W_LV Blvd_West 1/2 St_30+50_100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 1.11 %
Discharge 32.90 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.60
0+05.0	0.50
0+05.5	0.50
0+05.5	0.00
0+07.0	0.13
0+07.0	0.17
0+48.0	0.99
0+48.0	1.49

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.60)	(0+48.0, 1.49)	0.016

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 0.00 to 1.49 ft
Flow Area 8.44 ft²
Wetted Perimeter 33.56 ft
Hydraulic Radius 0.25 ft

Worksheet for Cross Section 10W_LV Blvd_West 1/2 St_30+50_100

Results

Top Width	32.92	ft
Normal Depth	0.69	ft
Critical Depth	0.75	ft
Critical Slope	0.00575	ft/ft
Velocity	3.90	ft/s
Velocity Head	0.24	ft
Specific Energy	0.92	ft
Froude Number	1.36	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.69	ft
Critical Depth	0.75	ft
Channel Slope	1.11	%
Critical Slope	0.00575	ft/ft

Cross Section for Cross Section 10W_LV Blvd_West 1/2 St_30+50_100

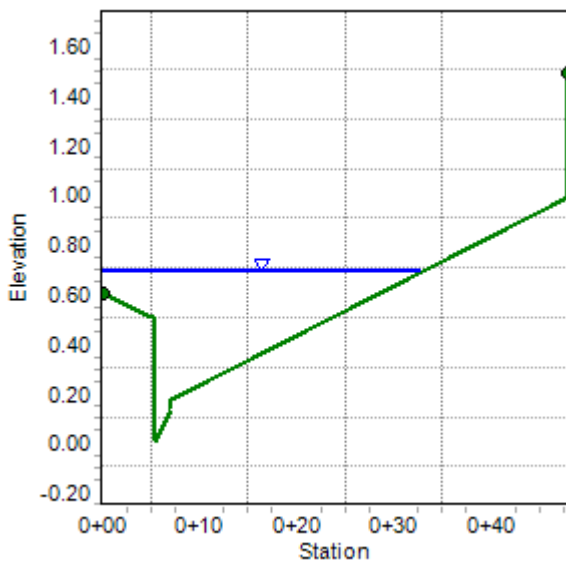
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.11	%
Normal Depth	0.69	ft
Discharge	32.90	ft ³ /s

Cross Section Image



Worksheet for Cross Section 11W_LV Blvd_West 1/2 St_32+95_100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 1.43 %
Discharge 12.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.60
0+05.0	0.50
0+05.5	0.50
0+05.5	0.00
0+07.0	0.13
0+07.0	0.17
0+48.0	0.99
0+48.0	1.49

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.60)	(0+48.0, 1.49)	0.016

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 0.50 ft
Elevation Range 0.00 to 1.49 ft
Flow Area 3.42 ft²
Wetted Perimeter 19.31 ft
Hydraulic Radius 0.18 ft

Worksheet for Cross Section 11W_LV Blvd_West 1/2 St_32+95_100

Results

Top Width	18.76	ft
Normal Depth	0.50	ft
Critical Depth	0.57	ft
Critical Slope	0.00666	ft/ft
Velocity	3.51	ft/s
Velocity Head	0.19	ft
Specific Energy	0.69	ft
Froude Number	1.45	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.50	ft
Critical Depth	0.57	ft
Channel Slope	1.43	%
Critical Slope	0.00666	ft/ft

Cross Section for Cross Section 11W_LV Blvd_West 1/2 St_32+95_100

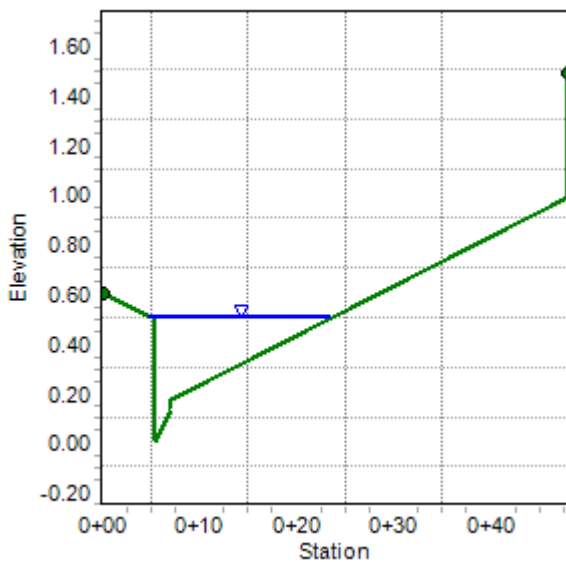
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.43	%
Normal Depth	0.50	ft
Discharge	12.00	ft ³ /s

Cross Section Image



Worksheet for Cross Section 12W_LV Blvd_West 1/2 St_36+25_100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 3.00 %
Discharge 9.50 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.60
0+05.0	0.50
0+05.5	0.50
0+05.5	0.00
0+07.0	0.13
0+07.0	0.17
0+48.0	0.99
0+48.0	1.49

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.60)	(0+48.0, 1.49)	0.016

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 0.00 to 1.49 ft
Flow Area 2.13 ft²
Wetted Perimeter 14.60 ft
Hydraulic Radius 0.15 ft

Worksheet for Cross Section 12W_LV Blvd_West 1/2 St_36+25_100

Results

Top Width	14.13	ft
Normal Depth	0.42	ft
Critical Depth	0.53	ft
Critical Slope	0.00678	ft/ft
Velocity	4.46	ft/s
Velocity Head	0.31	ft
Specific Energy	0.73	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	0.42	ft
Critical Depth	0.53	ft
Channel Slope	3.00	%
Critical Slope	0.00678	ft/ft

Cross Section for Cross Section 12W_LV Blvd_West 1/2 St_36+25_100

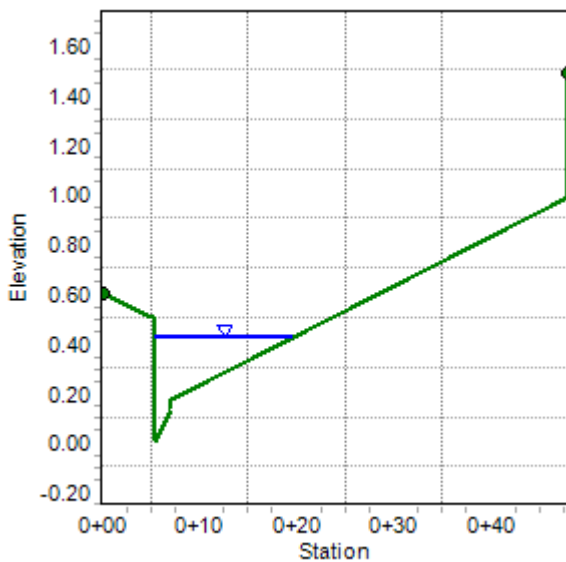
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	3.00	%
Normal Depth	0.42	ft
Discharge	9.50	ft ³ /s

Cross Section Image



Worksheet for Cross Section 13W_LV Blvd_West 1/2 St_38+70_100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 4.90 %
Discharge 17.40 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	1.00
0+00.0	0.50
0+00.5	0.50
0+00.5	0.00
0+02.0	0.13
0+02.0	0.17
0+48.0	1.07
0+48.0	1.57

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 1.00)	(0+48.0, 1.57)	0.016

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
Elevation Range 0.00 to 1.57 ft
Flow Area 2.81 ft²
Wetted Perimeter 17.06 ft
Hydraulic Radius 0.16 ft

Worksheet for Cross Section 13W_LV Blvd_West 1/2 St_38+70_100

Results

Top Width	16.55	ft
Normal Depth	0.46	ft
Critical Depth	0.63	ft
Critical Slope	0.00617	ft/ft
Velocity	6.18	ft/s
Velocity Head	0.59	ft
Specific Energy	1.06	ft
Froude Number	2.64	
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	0.63	ft
Channel Slope	4.90	%
Critical Slope	0.00617	ft/ft

Cross Section for Cross Section 13W_LV Blvd_West 1/2 St_38+70_100

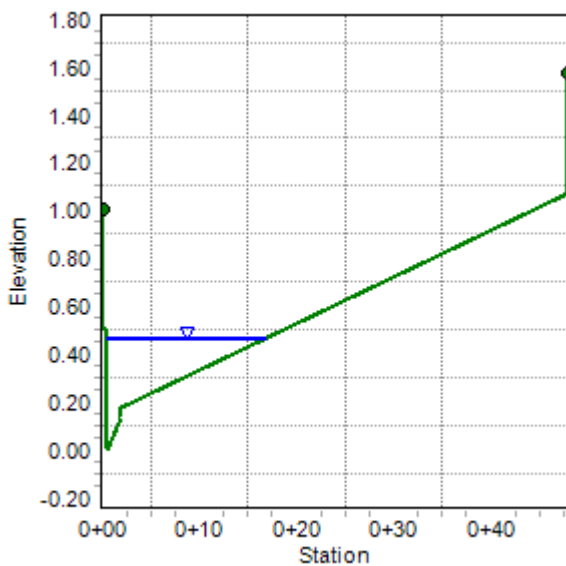
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	4.90	%
Normal Depth	0.46	ft
Discharge	17.40	ft ³ /s

Cross Section Image



Worksheet for Cross Section 14W_LV Blvd_West 1/2 St_43+29_100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 4.45 %
Discharge 37.40 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.70
0+10.0	0.50
0+10.5	0.50
0+10.5	0.00
0+12.0	0.13
0+12.0	0.17
0+53.0	0.99
0+53.0	1.49

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.70)	(0+53.0, 1.49)	0.016

Options

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

Results

Normal Depth 0.60 ft
Elevation Range 0.00 to 1.49 ft
Flow Area 5.65 ft²
Wetted Perimeter 28.78 ft
Hydraulic Radius 0.20 ft

Worksheet for Cross Section 14W_LV Blvd_West 1/2 St_43+29_100

Results

Top Width	28.23	ft
Normal Depth	0.60	ft
Critical Depth	0.78	ft
Critical Slope	0.00575	ft/ft
Velocity	6.62	ft/s
Velocity Head	0.68	ft
Specific Energy	1.28	ft
Froude Number	2.61	
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	0.78	ft
Channel Slope	4.45	%
Critical Slope	0.00575	ft/ft

Cross Section for Cross Section 14W_LV Blvd_West 1/2 St_43+29_100

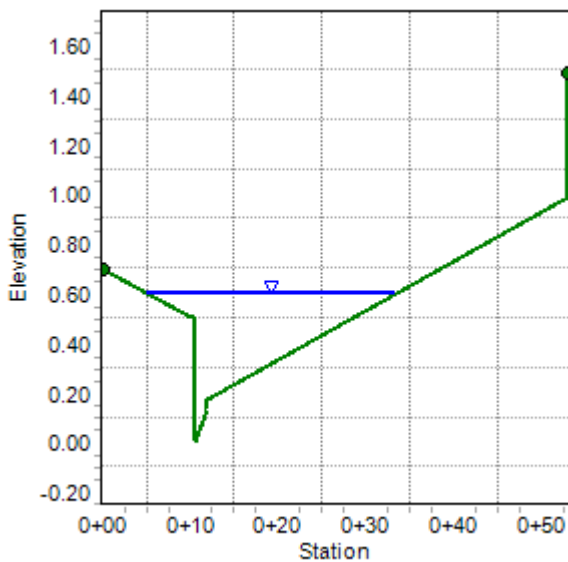
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	4.45	%
Normal Depth	0.60	ft
Discharge	37.40	ft ³ /s

Cross Section Image



Worksheet for Cross Section 15W_LV Blvd_West 1/2 St_45+45_100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 1.52 %
Discharge 15.50 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.70
0+10.0	0.50
0+10.5	0.50
0+10.5	0.00
0+12.0	0.13
0+12.0	0.17
0+50.0	0.93
0+50.0	1.43

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.70)	(0+50.0, 1.43)	0.016

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 0.00 to 1.43 ft
Flow Area 4.21 ft²
Wetted Perimeter 23.13 ft
Hydraulic Radius 0.18 ft

Worksheet for Cross Section 15W_LV Blvd_West 1/2 St_45+45_100

Results

Top Width	22.59	ft
Normal Depth	0.54	ft
Critical Depth	0.61	ft
Critical Slope	0.00649	ft/ft
Velocity	3.68	ft/s
Velocity Head	0.21	ft
Specific Energy	0.75	ft
Froude Number	1.50	
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	0.61	ft
Channel Slope	1.52	%
Critical Slope	0.00649	ft/ft

Cross Section for Cross Section 15W_LV Blvd_West 1/2 St_45+45_100

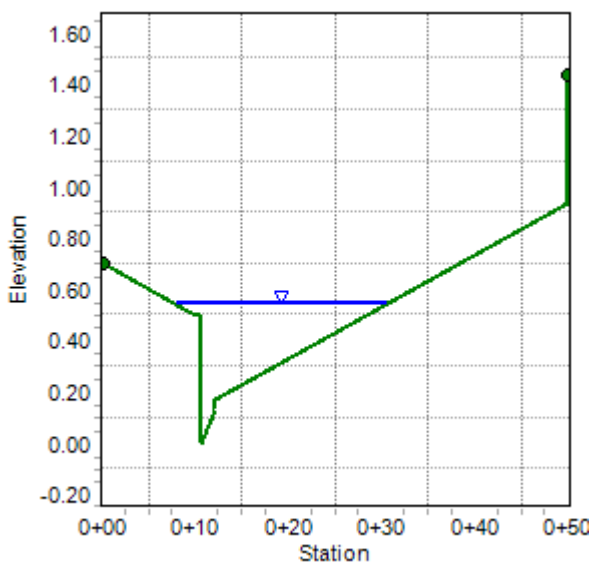
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.52	%
Normal Depth	0.54	ft
Discharge	15.50	ft ³ /s

Cross Section Image



Worksheet for Cross Section 16W_LV Blvd_West 1/2 St_46+66_100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 1.54 %
Discharge 2.60 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.70
0+10.0	0.50
0+10.5	0.50
0+10.5	0.00
0+12.0	0.13
0+12.0	0.17
0+50.0	0.93
0+50.0	1.43

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.70)	(0+50.0, 1.43)	0.016

Options

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

Results

Normal Depth 0.33 ft
Elevation Range 0.00 to 1.43 ft
Flow Area 1.02 ft²
Wetted Perimeter 9.78 ft
Hydraulic Radius 0.10 ft

Worksheet for Cross Section 16W_LV Blvd_West 1/2 St_46+66_100

Results

Top Width	9.40	ft
Normal Depth	0.33	ft
Critical Depth	0.36	ft
Critical Slope	0.00791	ft/ft
Velocity	2.55	ft/s
Velocity Head	0.10	ft
Specific Energy	0.43	ft
Froude Number	1.37	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.33	ft
Critical Depth	0.36	ft
Channel Slope	1.54	%
Critical Slope	0.00791	ft/ft

Cross Section for Cross Section 16W_LV Blvd_West 1/2 St_46+66_100

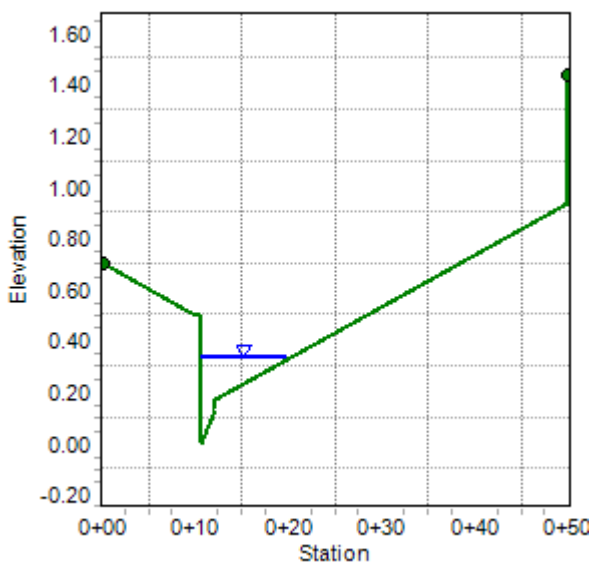
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.54	%
Normal Depth	0.33	ft
Discharge	2.60	ft ³ /s

Cross Section Image



Worksheet for Cross Section 17S_LV Blvd_West 1/2 St_47+11_100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 1.15 %
Discharge 8.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.70
0+10.0	0.50
0+10.5	0.50
0+10.5	0.00
0+12.0	0.13
0+12.0	0.17
0+35.0	0.52

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.70)	(0+35.0, 0.52)	0.016

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 0.44 ft
Elevation Range 0.00 to 0.70 ft
Flow Area 2.87 ft²
Wetted Perimeter 19.43 ft
Hydraulic Radius 0.15 ft
Top Width 18.94 ft

Worksheet for Cross Section 17S_LV Blvd_West 1/2 St_47+11_100

Results

Normal Depth	0.44	ft
Critical Depth	0.47	ft
Critical Slope	0.00701	ft/ft
Velocity	2.79	ft/s
Velocity Head	0.12	ft
Specific Energy	0.56	ft
Froude Number	1.26	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.44	ft
Critical Depth	0.47	ft
Channel Slope	1.15	%
Critical Slope	0.00701	ft/ft

Cross Section for Cross Section 17S_LV Blvd_West 1/2 St_47+11_100

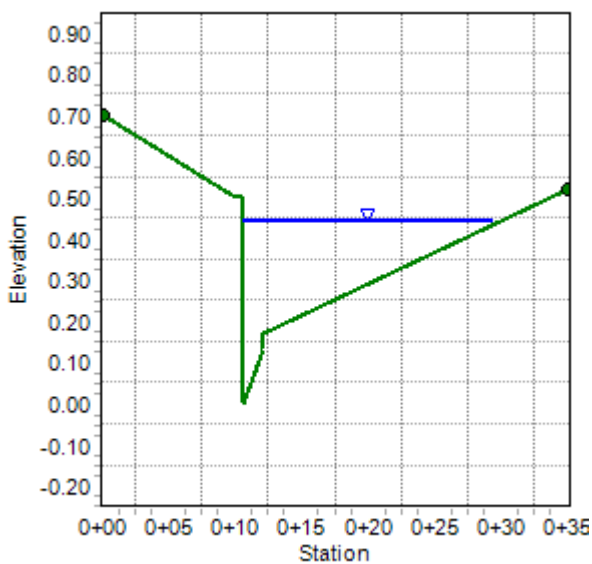
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.15	%
Normal Depth	0.44	ft
Discharge	8.00	ft ³ /s

Cross Section Image



Worksheet for Cross Section 01E_ LV Blvd_East 1/2 St_13+51_100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.57 %
Discharge 2.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.70
0+10.0	0.50
0+10.5	0.50
0+10.5	0.00
0+12.0	0.13
0+12.0	0.17
0+77.0	1.50
0+77.0	2.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.70)	(0+77.0, 2.00)	0.016

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 0.35 ft
Elevation Range 0.00 to 2.00 ft
Flow Area 1.21 ft²
Wetted Perimeter 10.68 ft
Hydraulic Radius 0.11 ft

Worksheet for Cross Section 01E_ LV Blvd_East 1/2 St_13+51_100

Results

Top Width	10.29	ft
Normal Depth	0.35	ft
Critical Depth	0.33	ft
Critical Slope	0.00818	ft/ft
Velocity	1.65	ft/s
Velocity Head	0.04	ft
Specific Energy	0.39	ft
Froude Number	0.85	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.35	ft
Critical Depth	0.33	ft
Channel Slope	0.57	%
Critical Slope	0.00818	ft/ft

Cross Section for Cross Section 01E_ LV Blvd_East 1/2 St_13+51_100

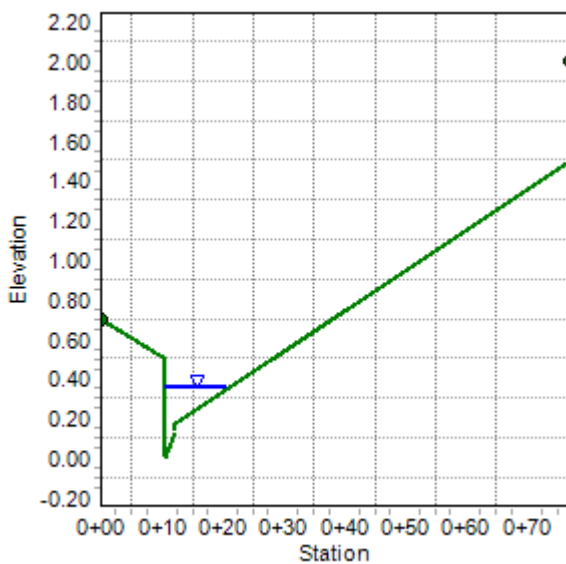
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.57	%
Normal Depth	0.35	ft
Discharge	2.00	ft ³ /s

Cross Section Image



Worksheet for Cross Section 02E_ LV Blvd_East 1/2 St_14+50_100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.56 %
Discharge 2.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.70
0+10.0	0.50
0+10.5	0.50
0+10.5	0.00
0+12.0	0.13
0+12.0	0.17
0+86.5	1.58
0+86.5	2.08

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.70)	(0+86.5, 2.08)	0.016

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 0.35 ft
Elevation Range 0.00 to 2.08 ft
Flow Area 1.24 ft²
Wetted Perimeter 11.21 ft
Hydraulic Radius 0.11 ft

Worksheet for Cross Section 02E_ LV Blvd_East 1/2 St_14+50_100

Results

Top Width	10.82	ft
Normal Depth	0.35	ft
Critical Depth	0.33	ft
Critical Slope	0.00824	ft/ft
Velocity	1.61	ft/s
Velocity Head	0.04	ft
Specific Energy	0.39	ft
Froude Number	0.84	
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	0.33	ft
Channel Slope	0.56	%
Critical Slope	0.00824	ft/ft

Cross Section for Cross Section 02E_ LV Blvd_East 1/2 St_14+50_100

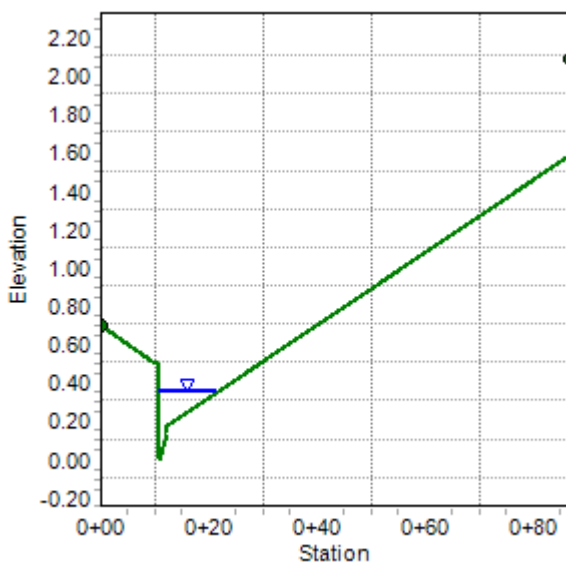
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.56	%
Normal Depth	0.35	ft
Discharge	2.00	ft ³ /s

Cross Section Image



Worksheet for Cross Section 03E_LV Blvd_East 1/2 St_19+09_100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.87 %
Discharge 5.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	1.43
0+20.0	0.83
0+20.5	0.83
0+20.5	0.33
0+27.5	0.17
0+27.5	0.00
0+32.5	0.00
0+32.5	0.17
0+34.0	0.31
0+94.0	1.45

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 1.43)	(0+94.0, 1.45)	0.016

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 0.30 ft
Elevation Range 0.00 to 1.45 ft
Flow Area 1.97 ft²

Worksheet for Cross Section 03E_LV Blvd_East 1/2 St_19+09_100

Results

Wetted Perimeter	12.49	ft
Hydraulic Radius	0.16	ft
Top Width	12.14	ft
Normal Depth	0.30	ft
Critical Depth	0.32	ft
Critical Slope	0.00706	ft/ft
Velocity	2.53	ft/s
Velocity Head	0.10	ft
Specific Energy	0.40	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	0.30	ft
Critical Depth	0.32	ft
Channel Slope	0.87	%
Critical Slope	0.00706	ft/ft

Cross Section for Cross Section 03E_LV Blvd_East 1/2 St_19+09_100

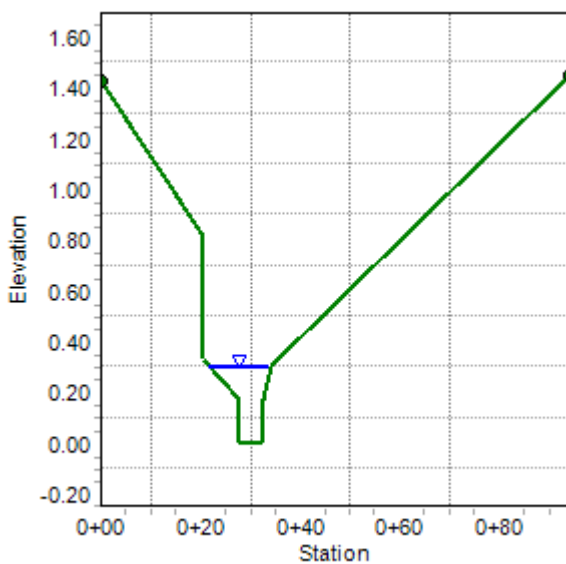
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.87	%
Normal Depth	0.30	ft
Discharge	5.00	ft ³ /s

Cross Section Image



Worksheet for Cross Section 04E_LV Blvd_East 1/2 St_22+19_100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 1.02 %
Discharge 9.30 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.66
0+08.0	0.50
0+08.5	0.50
0+08.5	0.00
0+10.0	0.13
0+10.0	0.17
0+65.5	1.28
0+65.5	1.78

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.66)	(0+65.5, 1.78)	0.016

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 0.49 ft
Elevation Range 0.00 to 1.78 ft
Flow Area 3.15 ft²
Wetted Perimeter 17.91 ft
Hydraulic Radius 0.18 ft

Worksheet for Cross Section 04E_LV Blvd_East 1/2 St_22+19_100

Results

Top Width	17.37	ft
Normal Depth	0.49	ft
Critical Depth	0.52	ft
Critical Slope	0.00679	ft/ft
Velocity	2.95	ft/s
Velocity Head	0.14	ft
Specific Energy	0.62	ft
Froude Number	1.22	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.49	ft
Critical Depth	0.52	ft
Channel Slope	1.02	%
Critical Slope	0.00679	ft/ft

Cross Section for Cross Section 04E_LV Blvd_East 1/2 St_22+19_100

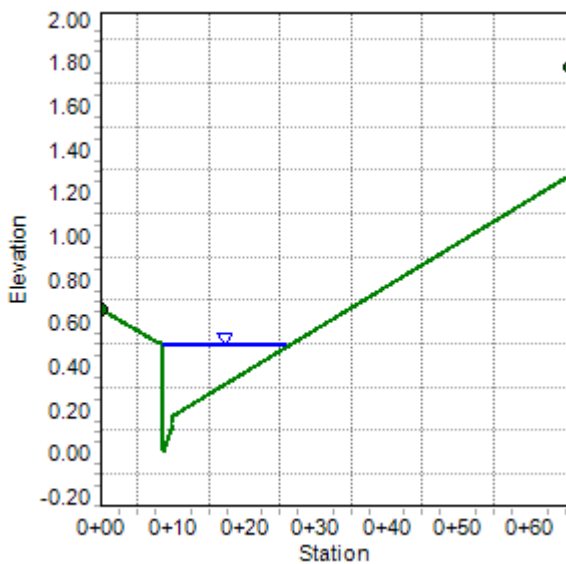
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.02	%
Normal Depth	0.49	ft
Discharge	9.30	ft ³ /s

Cross Section Image



Worksheet for Cross Section 05E_LV Blvd_East 1/2 St_24+01_100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 1.12 %
Discharge 0.50 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.66
0+08.0	0.50
0+08.5	0.50
0+08.5	0.00
0+10.0	0.13
0+10.0	0.17
0+51.0	0.99
0+51.0	1.49

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.66)	(0+51.0, 1.49)	0.016

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 0.00 to 1.49 ft
Flow Area 0.30 ft²
Wetted Perimeter 4.35 ft
Hydraulic Radius 0.07 ft

Worksheet for Cross Section 05E_LV Blvd_East 1/2 St_24+01_100

Results

Top Width	4.08	ft
Normal Depth	0.22	ft
Critical Depth	0.23	ft
Critical Slope	0.00962	ft/ft
Velocity	1.66	ft/s
Velocity Head	0.04	ft
Specific Energy	0.26	ft
Froude Number	1.08	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.22	ft
Critical Depth	0.23	ft
Channel Slope	1.12	%
Critical Slope	0.00962	ft/ft

Cross Section for Cross Section 05E_LV Blvd_East 1/2 St_24+01_100

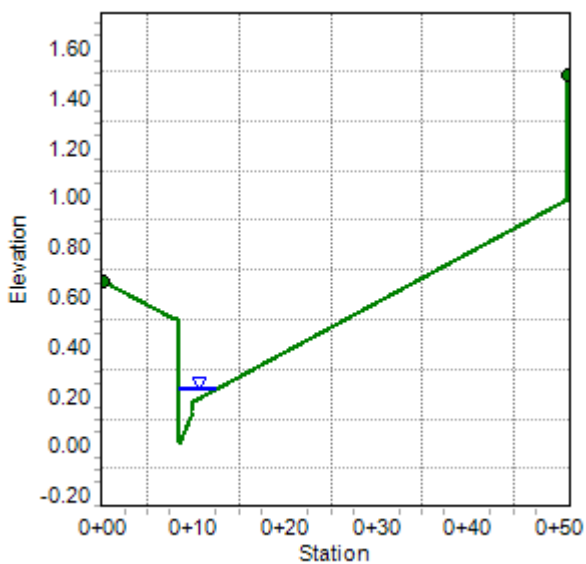
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.12	%
Normal Depth	0.22	ft
Discharge	0.50	ft ³ /s

Cross Section Image



Project Description

Input Data

Station (ft)	Elevation (ft)
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Roughness Segment Definitions

Options

Results

11/20/2019 10:30:28 AM Bentley Systems, Inc. Bentley FlowMaster V8i (SELECTseries 1) [08.11.01.03] 27 Siemens Company Drive Suite 200 W Watertown, CT 06795 USA +1-203-755-1666 Page 1 of 2

Worksheet for Cross Section 06E_LV Blvd_East 1/2 St_26+11_100

Results

Top Width	10.47	ft
Normal Depth	0.40	ft
Critical Depth	0.39	ft
Critical Slope	0.00759	ft/ft
Velocity	1.96	ft/s
Velocity Head	0.06	ft
Specific Energy	0.46	ft
Froude Number	0.90	
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	0.40	ft
Critical Depth	0.39	ft
Channel Slope	0.61	%
Critical Slope	0.00759	ft/ft

Cross Section for Cross Section 06E_LV Blvd_East 1/2 St_26+11_100

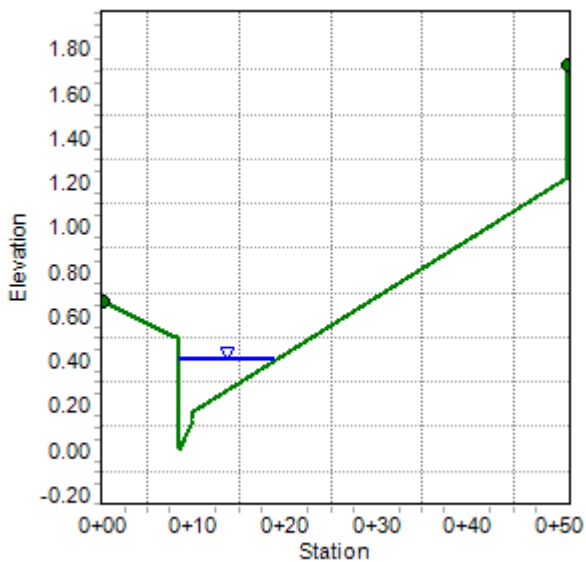
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.61	%
Normal Depth	0.40	ft
Discharge	3.00	ft ³ /s

Cross Section Image



Project Description

Input Data

Station (ft)	Elevation (ft)
--------------	----------------

Roughness Segment Definitions

Options

Results

11/20/2019 10:30:28 AM Bentley Systems, Inc. Bentley FlowMaster V8i (SELECTseries 1) [08.11.01.03] 27 Siemens Company Drive Suite 200 W Watertown, CT 06795 USA +1-203-755-1666 Page 1 of 2

Worksheet for Cross Section 07E_LV Blvd_East 1/2 St_30+57_100

Results

Top Width	10.01	ft
Normal Depth	0.34	ft
Critical Depth	0.35	ft
Critical Slope	0.00796	ft/ft
Velocity	2.20	ft/s
Velocity Head	0.08	ft
Specific Energy	0.42	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	0.34	ft
Critical Depth	0.35	ft
Channel Slope	1.07	%
Critical Slope	0.00796	ft/ft

Cross Section for Cross Section 07E_LV Blvd_East 1/2 St_30+57_100

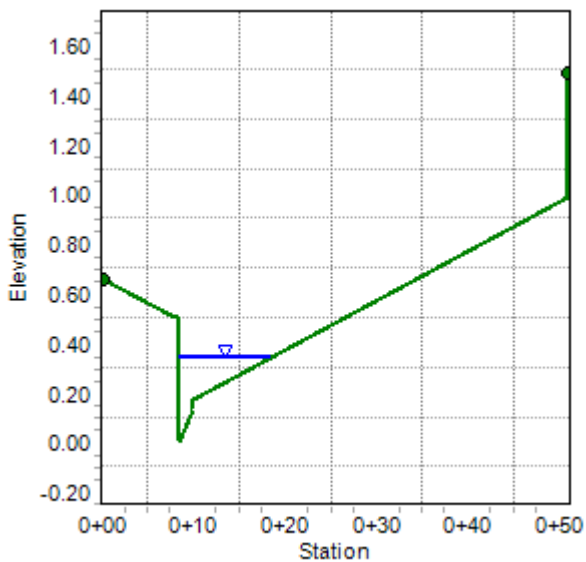
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.07	%
Normal Depth	0.34	ft
Discharge	2.50	ft ³ /s

Cross Section Image



Worksheet for Cross Section 08E_LV Blvd_East 1/2 St_32+58_100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.73 %
Discharge 3.60 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.70
0+10.0	0.50
0+10.5	0.50
0+10.5	0.00
0+12.0	0.13
0+12.0	0.17
0+50.0	0.56
0+50.0	1.06

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.70)	(0+50.0, 1.06)	0.016

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 0.35 ft
Elevation Range 0.00 to 1.06 ft
Flow Area 2.04 ft²
Wetted Perimeter 19.56 ft
Hydraulic Radius 0.10 ft

Worksheet for Cross Section 08E_LV Blvd_East 1/2 St_32+58_100

Results

Top Width	19.16	ft
Normal Depth	0.35	ft
Critical Depth	0.35	ft
Critical Slope	0.00814	ft/ft
Velocity	1.76	ft/s
Velocity Head	0.05	ft
Specific Energy	0.40	ft
Froude Number	0.95	
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	0.73	%
Critical Slope	0.00814	ft/ft

Cross Section for Cross Section 08E_LV Blvd_East 1/2 St_32+58_100

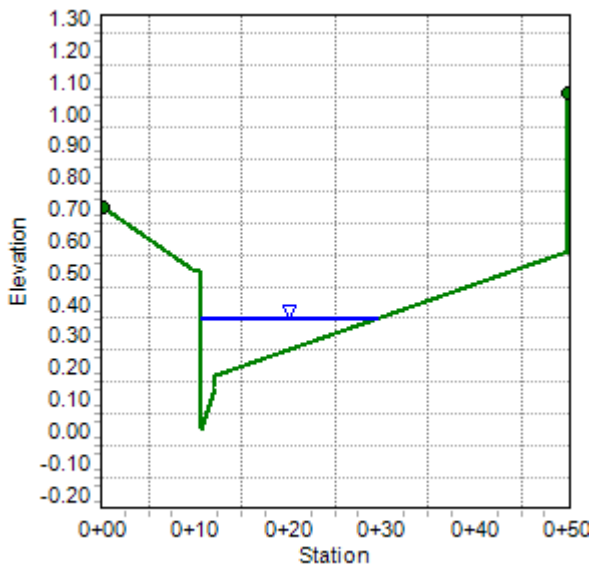
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.73	%
Normal Depth	0.35	ft
Discharge	3.60	ft ³ /s

Cross Section Image



Worksheet for Cross Section 09E_LV Blvd_East 1/2 St_40+13_100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 4.97 %
Discharge 5.20 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.90
0+20.0	0.50
0+20.5	0.50
0+20.5	0.00
0+22.0	0.13
0+22.0	0.17
0+63.0	0.99
0+63.0	1.49

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.90)	(0+63.0, 1.49)	0.016

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 0.34 ft
Elevation Range 0.00 to 1.49 ft
Flow Area 1.10 ft²
Wetted Perimeter 10.23 ft
Hydraulic Radius 0.11 ft

Worksheet for Cross Section 09E_LV Blvd_East 1/2 St_40+13_100

Results

Top Width	9.85	ft
Normal Depth	0.34	ft
Critical Depth	0.44	ft
Critical Slope	0.00722	ft/ft
Velocity	4.71	ft/s
Velocity Head	0.34	ft
Specific Energy	0.68	ft
Froude Number	2.48	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.34	ft
Critical Depth	0.44	ft
Channel Slope	4.97	%
Critical Slope	0.00722	ft/ft

Cross Section for Cross Section 09E_LV Blvd_East 1/2 St_40+13_100

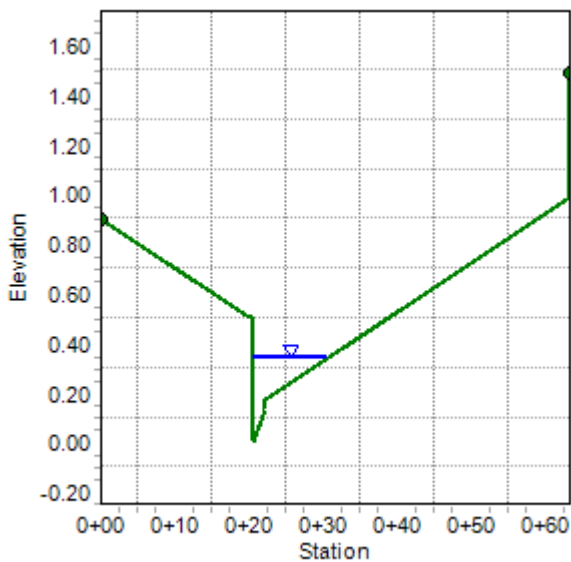
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	4.97	%
Normal Depth	0.34	ft
Discharge	5.20	ft ³ /s

Cross Section Image



Worksheet for Cross Section 10E_LV Blvd_East 1/2 St_41+57_100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 4.97 %
Discharge 4.70 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.90
0+20.0	0.50
0+20.5	0.50
0+20.5	0.00
0+22.0	0.13
0+22.0	0.17
0+63.0	0.99
0+63.0	1.49

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.90)	(0+63.0, 1.49)	0.016

Options

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

Results

Normal Depth 0.33 ft
Elevation Range 0.00 to 1.49 ft
Flow Area 1.02 ft²
Wetted Perimeter 9.80 ft
Hydraulic Radius 0.10 ft

Worksheet for Cross Section 10E_LV Blvd_East 1/2 St_41+57_100

Results

Top Width	9.43	ft
Normal Depth	0.33	ft
Critical Depth	0.42	ft
Critical Slope	0.00732	ft/ft
Velocity	4.59	ft/s
Velocity Head	0.33	ft
Specific Energy	0.66	ft
Froude Number	2.46	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.33	ft
Critical Depth	0.42	ft
Channel Slope	4.97	%
Critical Slope	0.00732	ft/ft

Cross Section for Cross Section 10E_LV Blvd_East 1/2 St_41+57_100

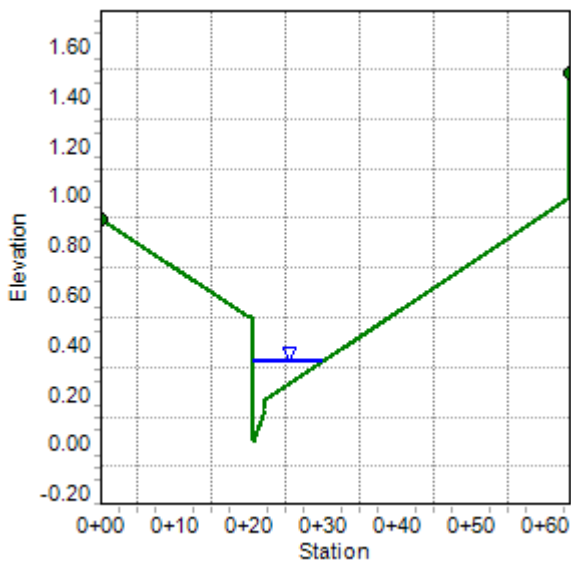
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	4.97	%
Normal Depth	0.33	ft
Discharge	4.70	ft ³ /s

Cross Section Image



Worksheet for Cross Section 11E_LV Blvd_East 1/2 St_46+88_100

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 1.46 %
Discharge 7.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.66
0+08.0	0.50
0+08.5	0.50
0+08.5	0.00
0+10.0	0.13
0+10.0	0.17
0+61.0	1.19
0+61.0	1.69

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.66)	(0+61.0, 1.69)	0.016

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 0.00 to 1.69 ft
Flow Area 2.22 ft²
Wetted Perimeter 14.92 ft
Hydraulic Radius 0.15 ft

Worksheet for Cross Section 11E_LV Blvd_East 1/2 St_46+88_100

Results

Top Width	14.44	ft
Normal Depth	0.43	ft
Critical Depth	0.48	ft
Critical Slope	0.00694	ft/ft
Velocity	3.15	ft/s
Velocity Head	0.15	ft
Specific Energy	0.58	ft
Froude Number	1.42	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.43	ft
Critical Depth	0.48	ft
Channel Slope	1.46	%
Critical Slope	0.00694	ft/ft

Cross Section for Cross Section 11E_LV Blvd_East 1/2 St_46+88_100

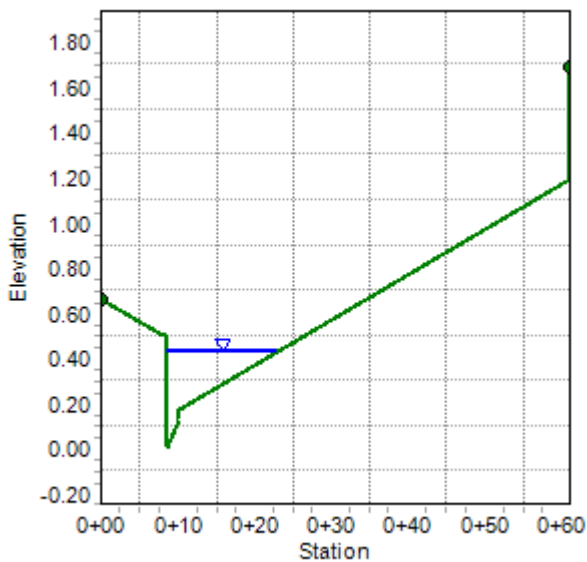
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.46	%
Normal Depth	0.43	ft
Discharge	7.00	ft ³ /s

Cross Section Image



B.4 Drop Inlet Calculations

- B.4.1 - 10-Year Drop Inlet Calculations
- B.4.2 - 25-Year Drop Inlet Calculations
- B.4.3 - 100-Year Drop Inlet Calculations

B.4.1 10-Year Drop Inlet Calculations

Worksheet for DI01W_20.0-ft Type DM2_St "SD" 12+30

Project Description

Solve For Efficiency

Input Data

Discharge	24.00	ft ³ /s
Slope	0.93	%
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	3.88	%
Roughness Coefficient	0.016	
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	17.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	19.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	93.94	%
Intercepted Flow	22.55	ft ³ /s
Bypass Flow	1.45	ft ³ /s
Spread	15.78	ft
Depth	0.68	ft
Flow Area	4.88	ft ²
Gutter Depression	0.07	ft
Total Depression	0.48	ft
Velocity	4.92	ft/s
Splash Over Velocity	25.03	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.68	
Grate Flow Ratio	0.25	
Equivalent Cross Slope	0.09952	ft/ft
Active Grate Length	8.75	ft
Length Factor	0.40	
Total Interception Length	26.74	ft

Worksheet for DI03W_SUMP_20-ft Type DM2_St "SD" 14+95

Project Description

Solve For Spread

Input Data

Discharge	9.50	ft ³ /s
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	2.95	%
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	17.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	19.50	ft
Opening Height	0.50	ft
Curb Throat Type	Horizontal	
Throat Incline Angle	90.00	degrees

Options

Calculation Option Use Both

Results

Spread	5.43	ft
Depth	0.24	ft
Gutter Depression	0.08	ft
Total Depression	0.50	ft
Open Grate Area	11.81	ft ²
Active Grate Weir Length	19.00	ft

Worksheet for DI05W_SUMP_10-ft Type DM2_St "SD" 20+85

Project Description

Solve For Spread

Input Data

Discharge	4.00	ft ³ /s
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	2.19	%
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	7.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	9.50	ft
Opening Height	0.50	ft
Curb Throat Type	Horizontal	
Throat Incline Angle	90.00	degrees

Options

Calculation Option Use Both

Results

Spread	5.06	ft
Depth	0.20	ft
Gutter Depression	0.09	ft
Total Depression	0.51	ft
Open Grate Area	5.06	ft ²
Active Grate Weir Length	9.00	ft

Worksheet for DI06S_20.0-ft Type DM2_St "BR" 54+40

Project Description

Solve For Efficiency

Input Data

Discharge	12.00	ft ³ /s
Slope	0.52	%
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	1.18	%
Roughness Coefficient	0.016	
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	17.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	19.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	94.59	%
Intercepted Flow	11.35	ft ³ /s
Bypass Flow	0.65	ft ³ /s
Spread	28.39	ft
Depth	0.44	ft
Flow Area	4.84	ft ²
Gutter Depression	0.11	ft
Total Depression	0.52	ft
Velocity	2.48	ft/s
Splash Over Velocity	25.03	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.69	
Grate Flow Ratio	0.17	
Equivalent Cross Slope	0.05577	ft/ft
Active Grate Length	8.75	ft
Length Factor	0.45	
Total Interception Length	23.76	ft

Worksheet for DI07N_5-ft Type DM2_St "BR" 54+27

Project Description

Solve For Efficiency

Input Data

Discharge	1.00	ft ³ /s
Slope	0.97	%
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	1.42	%
Roughness Coefficient	0.016	
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	2.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	4.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	100.00	%
Intercepted Flow	1.00	ft ³ /s
Bypass Flow	0.00	ft ³ /s
Spread	7.81	ft
Depth	0.21	ft
Flow Area	0.51	ft ²
Gutter Depression	0.10	ft
Total Depression	0.52	ft
Velocity	1.96	ft/s
Splash Over Velocity	6.35	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.05	
Grate Flow Ratio	0.61	
Equivalent Cross Slope	0.17350	ft/ft
Active Grate Length	1.25	ft
Length Factor	0.64	
Total Interception Length	5.11	ft

Worksheet for DI09W_7.5-ft Type DM2_St "SD" 25+86

Project Description

Solve For Efficiency

Input Data

Discharge	5.20	ft ³ /s
Slope	0.86	%
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	2.00	%
Roughness Coefficient	0.016	
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	2.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	7.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	83.18	%
Intercepted Flow	4.33	ft ³ /s
Bypass Flow	0.87	ft ³ /s
Spread	13.33	ft
Depth	0.36	ft
Flow Area	1.85	ft ²
Gutter Depression	0.09	ft
Total Depression	0.51	ft
Velocity	2.82	ft/s
Splash Over Velocity	6.35	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.03	
Grate Flow Ratio	0.34	
Equivalent Cross Slope	0.10572	ft/ft
Active Grate Length	1.25	ft
Length Factor	0.43	
Total Interception Length	13.25	ft

Worksheet for DI10W_SUMP_17.5-ft Type DM2_St "SD" 29+72

Project Description

Solve For Spread

Input Data

Discharge	6.40	ft ³ /s
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	2.09	%
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	15.00	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	17.00	ft
Opening Height	0.50	ft
Curb Throat Type	Horizontal	
Throat Incline Angle	90.00	degrees

Options

Calculation Option Use Both

Results

Spread	5.24	ft
Depth	0.20	ft
Gutter Depression	0.09	ft
Total Depression	0.51	ft
Open Grate Area	10.13	ft ²
Active Grate Weir Length	16.50	ft

Worksheet for DI11N_5-ft Type DM2_St "SD" 30+44

Project Description

Solve For Efficiency

Input Data

Discharge	2.00	ft ³ /s
Slope	1.43	%
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	3.28	%
Roughness Coefficient	0.016	
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	2.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	4.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	95.08	%
Intercepted Flow	1.90	ft ³ /s
Bypass Flow	0.10	ft ³ /s
Spread	5.96	ft
Depth	0.27	ft
Flow Area	0.64	ft ²
Gutter Depression	0.08	ft
Total Depression	0.49	ft
Velocity	3.13	ft/s
Splash Over Velocity	6.35	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.04	
Grate Flow Ratio	0.62	
Equivalent Cross Slope	0.18605	ft/ft
Active Grate Length	1.25	ft
Length Factor	0.44	
Total Interception Length	7.36	ft

Worksheet for DI11W_10-ft Type DM2_St "SD" 32+24

Project Description

Solve For Efficiency

Input Data

Discharge	4.50	ft ³ /s
Slope	1.43	%
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	2.00	%
Roughness Coefficient	0.016	
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	7.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	9.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	89.79	%
Intercepted Flow	4.04	ft ³ /s
Bypass Flow	0.46	ft ³ /s
Spread	11.33	ft
Depth	0.32	ft
Flow Area	1.36	ft ²
Gutter Depression	0.09	ft
Total Depression	0.51	ft
Velocity	3.32	ft/s
Splash Over Velocity	11.14	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.24	
Grate Flow Ratio	0.39	
Equivalent Cross Slope	0.12088	ft/ft
Active Grate Length	3.75	ft
Length Factor	0.43	
Total Interception Length	13.40	ft

Worksheet for DI13N_10.0-ft Type DM2_St "SD" 37+59

Project Description

Solve For Efficiency

Input Data

Discharge	4.00	ft ³ /s
Slope	2.82	%
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	2.00	%
Roughness Coefficient	0.016	
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	7.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	9.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	90.18	%
Intercepted Flow	3.61	ft ³ /s
Bypass Flow	0.39	ft ³ /s
Spread	9.36	ft
Depth	0.28	ft
Flow Area	0.95	ft ²
Gutter Depression	0.09	ft
Total Depression	0.51	ft
Velocity	4.23	ft/s
Splash Over Velocity	11.14	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.17	
Grate Flow Ratio	0.47	
Equivalent Cross Slope	0.14138	ft/ft
Active Grate Length	3.75	ft
Length Factor	0.40	
Total Interception Length	14.24	ft

Worksheet for DI14W_20.0-ft Type DM2_St "L" 43+29

Project Description

Solve For Efficiency

Input Data

Discharge	12.50	ft ³ /s
Slope	4.45	%
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	2.00	%
Roughness Coefficient	0.016	
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	17.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	19.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	86.19	%
Intercepted Flow	10.77	ft ³ /s
Bypass Flow	1.73	ft ³ /s
Spread	13.62	ft
Depth	0.37	ft
Flow Area	1.93	ft ²
Gutter Depression	0.09	ft
Total Depression	0.51	ft
Velocity	6.49	ft/s
Splash Over Velocity	25.03	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.40	
Grate Flow Ratio	0.33	
Equivalent Cross Slope	0.10381	ft/ft
Active Grate Length	8.75	ft
Length Factor	0.34	
Total Interception Length	31.71	ft

Worksheet for DI15W_20.0-ft Type DM2_St "L" 45+45

Project Description

Solve For Efficiency

Input Data

Discharge	2.80	ft ³ /s
Slope	1.52	%
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	2.00	%
Roughness Coefficient	0.016	
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	17.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	19.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	100.00	%
Intercepted Flow	2.80	ft ³ /s
Bypass Flow	0.00	ft ³ /s
Spread	9.17	ft
Depth	0.28	ft
Flow Area	0.91	ft ²
Gutter Depression	0.09	ft
Total Depression	0.51	ft
Velocity	3.07	ft/s
Splash Over Velocity	25.03	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.72	
Grate Flow Ratio	0.48	
Equivalent Cross Slope	0.14372	ft/ft
Active Grate Length	8.75	ft
Length Factor	1.07	
Total Interception Length	10.08	ft

Worksheet for DI17S_10-ft Type DM2_St "L" 47+11

Project Description

Solve For Efficiency

Input Data

Discharge	4.00	ft ³ /s
Slope	1.15	%
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	1.50	%
Roughness Coefficient	0.016	
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	7.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	9.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	89.98	%
Intercepted Flow	3.60	ft ³ /s
Bypass Flow	0.40	ft ³ /s
Spread	13.50	ft
Depth	0.30	ft
Flow Area	1.44	ft ²
Gutter Depression	0.10	ft
Total Depression	0.52	ft
Velocity	2.77	ft/s
Splash Over Velocity	11.14	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.25	
Grate Flow Ratio	0.36	
Equivalent Cross Slope	0.10756	ft/ft
Active Grate Length	3.75	ft
Length Factor	0.45	
Total Interception Length	12.82	ft

Worksheet for DI01E_5-ft Type DM2_St "L" 13+51

Project Description

Solve For Efficiency

Input Data

Discharge	1.00	ft ³ /s
Slope	0.57	%
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	2.04	%
Roughness Coefficient	0.016	
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	2.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	4.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	100.00	%
Intercepted Flow	1.00	ft ³ /s
Bypass Flow	0.00	ft ³ /s
Spread	7.12	ft
Depth	0.24	ft
Flow Area	0.59	ft ²
Gutter Depression	0.09	ft
Total Depression	0.51	ft
Velocity	1.70	ft/s
Splash Over Velocity	6.35	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.08	
Grate Flow Ratio	0.60	
Equivalent Cross Slope	0.17387	ft/ft
Active Grate Length	1.25	ft
Length Factor	0.75	
Total Interception Length	4.35	ft

Worksheet for DI02E_SUMP_5-ft Type DM2_St "L" 14+50

Project Description

Solve For Spread

Input Data

Discharge	0.50	ft ³ /s
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	1.89	%
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	2.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	4.50	ft
Opening Height	0.50	ft
Curb Throat Type	Horizontal	
Throat Incline Angle	90.00	degrees

Options

Calculation Option Use Both

Results

Spread	1.48	ft
Depth	0.02	ft
Gutter Depression	0.10	ft
Total Depression	0.51	ft
Open Grate Area	1.69	ft ²
Active Grate Weir Length	4.00	ft

Worksheet for DI03E_5x4 NDOT Type 2_St "L" 19+09

Project Description

Solve For Efficiency

Input Data

Roughness Coefficient	0.016	
Slope	0.87	%
Left Side Slope	9.00	%
Right Side Slope	2.35	%
Bottom Width	5.00	ft
Discharge	2.50	ft ³ /s
Grate Width	5.00	ft
Grate Length	4.00	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%

Options

Grate Flow Option Exclude None

Results

Efficiency	68.17	%
Intercepted Flow	1.70	ft ³ /s
Bypass Flow	0.80	ft ³ /s
Flow Area	1.32	ft ²
Wetted Perimeter	12.92	ft
Top Width	12.91	ft
Velocity	1.89	ft/s
Splash Over Velocity	8.13	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.28	
Grate Flow Ratio	0.56	
Active Grate Length	2.00	ft
Critical Depth	0.15	ft
Critical Slope	0.00793	ft/ft
Froude Number	1.04	
Flow Type	Supercritical	
Specific Energy	0.20	ft
Velocity Head	0.06	ft
Depth	0.15	ft

Worksheet for DI04E_SUMP_10-ft Type DM2_St "L" 22+19

Project Description

Solve For Spread

Input Data

Discharge	2.80	ft ³ /s
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	2.00	%
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	7.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	9.50	ft
Opening Height	0.50	ft
Curb Throat Type	Horizontal	
Throat Incline Angle	90.00	degrees

Options

Calculation Option Use Both

Results

Spread	1.98	ft
Depth	0.16	ft
Gutter Depression	0.09	ft
Total Depression	0.51	ft
Open Grate Area	5.06	ft ²
Active Grate Weir Length	9.00	ft

Worksheet for DI05E_5-ft Type DM2_St "L" 24+01

Project Description

Solve For Efficiency

Input Data

Discharge	0.50	ft ³ /s
Slope	1.12	%
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	1.91	%
Roughness Coefficient	0.016	
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	2.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	4.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	100.00	%
Intercepted Flow	0.50	ft ³ /s
Bypass Flow	0.00	ft ³ /s
Spread	4.27	ft
Depth	0.18	ft
Flow Area	0.25	ft ²
Gutter Depression	0.10	ft
Total Depression	0.51	ft
Velocity	2.03	ft/s
Splash Over Velocity	6.35	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.06	
Grate Flow Ratio	0.85	
Equivalent Cross Slope	0.23673	ft/ft
Active Grate Length	1.25	ft
Length Factor	0.98	
Total Interception Length	3.31	ft

Worksheet for DI06E_5-ft Type DM2_St "L" 26+11

Project Description

Solve For Efficiency

Input Data

Discharge	2.00	ft ³ /s
Slope	0.61	%
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	2.57	%
Roughness Coefficient	0.016	
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	2.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	4.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	94.28	%
Intercepted Flow	1.89	ft ³ /s
Bypass Flow	0.11	ft ³ /s
Spread	8.28	ft
Depth	0.30	ft
Flow Area	0.95	ft ²
Gutter Depression	0.09	ft
Total Depression	0.50	ft
Velocity	2.12	ft/s
Splash Over Velocity	6.35	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.07	
Grate Flow Ratio	0.50	
Equivalent Cross Slope	0.15124	ft/ft
Active Grate Length	1.25	ft
Length Factor	0.50	
Total Interception Length	6.46	ft

Worksheet for DI07E_5-ft Type DM2_St "L" 30+57

Project Description

Solve For Efficiency

Input Data

Discharge	1.50	ft ³ /s
Slope	1.07	%
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	2.00	%
Roughness Coefficient	0.016	
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	2.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	4.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	97.19	%
Intercepted Flow	1.46	ft ³ /s
Bypass Flow	0.04	ft ³ /s
Spread	7.51	ft
Depth	0.25	ft
Flow Area	0.64	ft ²
Gutter Depression	0.09	ft
Total Depression	0.51	ft
Velocity	2.36	ft/s
Splash Over Velocity	6.35	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.05	
Grate Flow Ratio	0.58	
Equivalent Cross Slope	0.16766	ft/ft
Active Grate Length	1.25	ft
Length Factor	0.51	
Total Interception Length	6.37	ft

Worksheet for DI08E_5-ft Type DM2_St "L" 32+58

Project Description

Solve For Efficiency

Input Data

Discharge	1.60	ft ³ /s
Slope	0.73	%
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	1.02	%
Roughness Coefficient	0.016	
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	2.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	4.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	90.93	%
Intercepted Flow	1.45	ft ³ /s
Bypass Flow	0.15	ft ³ /s
Spread	12.80	ft
Depth	0.24	ft
Flow Area	0.92	ft ²
Gutter Depression	0.11	ft
Total Depression	0.53	ft
Velocity	1.74	ft/s
Splash Over Velocity	6.35	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.04	
Grate Flow Ratio	0.43	
Equivalent Cross Slope	0.12259	ft/ft
Active Grate Length	1.25	ft
Length Factor	0.46	
Total Interception Length	7.04	ft

Worksheet for DI09E_5-ft Type DM2_St "L" 40+13

Project Description

Solve For Efficiency

Input Data

Discharge	2.20	ft ³ /s
Slope	4.97	%
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	2.00	%
Roughness Coefficient	0.016	
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	2.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	4.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	90.95	%
Intercepted Flow	2.00	ft ³ /s
Bypass Flow	0.20	ft ³ /s
Spread	6.26	ft
Depth	0.22	ft
Flow Area	0.46	ft ²
Gutter Depression	0.09	ft
Total Depression	0.51	ft
Velocity	4.76	ft/s
Splash Over Velocity	6.35	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.01	
Grate Flow Ratio	0.67	
Equivalent Cross Slope	0.19076	ft/ft
Active Grate Length	1.25	ft
Length Factor	0.30	
Total Interception Length	10.97	ft

Worksheet for DI10E_5-ft Type DM2_St "L" 41+57

Project Description

Solve For Efficiency

Input Data

Discharge	1.20	ft ³ /s
Slope	4.97	%
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	2.00	%
Roughness Coefficient	0.016	
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	2.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	4.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	99.88	%
Intercepted Flow	1.20	ft ³ /s
Bypass Flow	0.00	ft ³ /s
Spread	4.51	ft
Depth	0.19	ft
Flow Area	0.27	ft ²
Gutter Depression	0.09	ft
Total Depression	0.51	ft
Velocity	4.37	ft/s
Splash Over Velocity	6.35	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.02	
Grate Flow Ratio	0.82	
Equivalent Cross Slope	0.22987	ft/ft
Active Grate Length	1.25	ft
Length Factor	0.43	
Total Interception Length	7.60	ft

Worksheet for DI11E_20.0-ft Type DM2_St "L" 46+88

Project Description

Solve For Efficiency

Input Data

Discharge	1.00	ft ³ /s
Slope	1.46	%
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	2.00	%
Roughness Coefficient	0.016	
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	17.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	19.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	100.00	%
Intercepted Flow	1.00	ft ³ /s
Bypass Flow	0.00	ft ³ /s
Spread	5.72	ft
Depth	0.21	ft
Flow Area	0.40	ft ²
Gutter Depression	0.09	ft
Total Depression	0.51	ft
Velocity	2.51	ft/s
Splash Over Velocity	25.03	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.79	
Grate Flow Ratio	0.71	
Equivalent Cross Slope	0.20195	ft/ft
Active Grate Length	8.75	ft
Length Factor	2.04	
Total Interception Length	5.27	ft

B.4.2 25-Year Drop Inlet Calculations

Project Description

Input Data

Results

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B.4.3 100-Year Drop Inlet Calculations

Worksheet for DI03W_SUMP_20.0-ft Type DM2_St "SD" 14+95_100

Project Description

Solve For Spread

Input Data

Discharge		40.00	ft ³ /s
Gutter Width		1.50	ft
Gutter Cross Slope		8.33	%
Road Cross Slope		2.95	%
Local Depression		5.00	in
Local Depression Width		2.00	ft
Grate Width		1.50	ft
Grate Length		17.50	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%
Curb Opening Length		19.50	ft
Opening Height		0.50	ft
Curb Throat Type	Horizontal		
Throat Incline Angle		90.00	degrees

Options

Calculation Option Use Both

Results

Spread	17.88	ft
Depth	0.61	ft
Gutter Depression	0.08	ft
Total Depression	0.50	ft
Open Grate Area	11.81	ft ²
Active Grate Weir Length	19.00	ft

Worksheet for DI04S_SUMP_5x6 NDOT TYPE 2B_St "SD" 15+82_100

Project Description

Solve For Spread

Input Data

Discharge		3.50	ft ³ /s
Gutter Width		0.00	ft
Gutter Cross Slope		0.00	%
Road Cross Slope		2.19	%
Grate Width		5.00	ft
Grate Length		6.00	ft
Local Depression		0.00	in
Local Depression Width		0.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%

Results

Spread	14.06	ft
Depth	0.31	ft
Gutter Depression	0.00	ft
Total Depression	0.00	ft
Open Grate Area	13.50	ft ²
Active Grate Weir Length	11.00	ft

Worksheet for DI05W_SUMP_10-ft Type DM2_St "SD"20+85_100

Project Description

Solve For Spread

Input Data

Discharge	9.00	ft ³ /s
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	2.19	%
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	7.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	9.50	ft
Opening Height	0.50	ft
Curb Throat Type	Horizontal	
Throat Incline Angle	90.00	degrees

Options

Calculation Option Use Both

Results

Spread	11.62	ft
Depth	0.35	ft
Gutter Depression	0.09	ft
Total Depression	0.51	ft
Open Grate Area	5.06	ft ²
Active Grate Weir Length	9.00	ft

Worksheet for DI10W_SUMP_17.5-ft Type DM2_St "SD" 29+72_100

Project Description

Solve For Spread

Input Data

Discharge		32.90	ft ³ /s
Gutter Width		1.50	ft
Gutter Cross Slope		8.33	%
Road Cross Slope		2.09	%
Local Depression		5.00	in
Local Depression Width		2.00	ft
Grate Width		1.50	ft
Grate Length		15.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%
Curb Opening Length		17.00	ft
Opening Height		0.50	ft
Curb Throat Type	Horizontal		
Throat Incline Angle		90.00	degrees

Options

Calculation Option Use Both

Results

Spread	23.38	ft
Depth	0.58	ft
Gutter Depression	0.09	ft
Total Depression	0.51	ft
Open Grate Area	10.13	ft ²
Active Grate Weir Length	16.50	ft

Worksheet for DI14W_20.0-ft Type DM2_St "L" 43+29_100

Project Description

Solve For Efficiency

Input Data

Discharge	37.40	ft ³ /s
Slope	4.45	%
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	2.00	%
Roughness Coefficient	0.016	
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	17.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	19.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	63.94	%
Intercepted Flow	23.91	ft ³ /s
Bypass Flow	13.49	ft ³ /s
Spread	20.92	ft
Depth	0.51	ft
Flow Area	4.45	ft ²
Gutter Depression	0.09	ft
Total Depression	0.51	ft
Velocity	8.41	ft/s
Splash Over Velocity	25.03	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.30	
Grate Flow Ratio	0.21	
Equivalent Cross Slope	0.07360	ft/ft
Active Grate Length	8.75	ft
Length Factor	0.17	
Total Interception Length	61.76	ft

Worksheet for DI15W_20.0-ft Type DM2_St "L" 45+45_100

Project Description

Solve For Efficiency

Input Data

Discharge	15.50	ft ³ /s
Slope	1.52	%
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	2.00	%
Roughness Coefficient	0.016	
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	17.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	19.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	89.85	%
Intercepted Flow	13.93	ft ³ /s
Bypass Flow	1.57	ft ³ /s
Spread	18.32	ft
Depth	0.46	ft
Flow Area	3.43	ft ²
Gutter Depression	0.09	ft
Total Depression	0.51	ft
Velocity	4.52	ft/s
Splash Over Velocity	25.03	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.56	
Grate Flow Ratio	0.24	
Equivalent Cross Slope	0.08163	ft/ft
Active Grate Length	8.75	ft
Length Factor	0.37	
Total Interception Length	29.04	ft

Worksheet for DI16W_20.0-ft Type DM2_St "L" 46+66_100

Project Description

Solve For Efficiency

Input Data

Discharge	2.60	ft ³ /s
Slope	1.54	%
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	2.00	%
Roughness Coefficient	0.016	
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	17.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	19.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	100.00	%
Intercepted Flow	2.60	ft ³ /s
Bypass Flow	0.00	ft ³ /s
Spread	8.85	ft
Depth	0.27	ft
Flow Area	0.85	ft ²
Gutter Depression	0.09	ft
Total Depression	0.51	ft
Velocity	3.04	ft/s
Splash Over Velocity	25.03	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.73	
Grate Flow Ratio	0.50	
Equivalent Cross Slope	0.14777	ft/ft
Active Grate Length	8.75	ft
Length Factor	1.11	
Total Interception Length	9.65	ft

Worksheet for DI17S_10.0-ft Type DM2_St "L" 47+11_100

Project Description

Solve For Efficiency

Input Data

Discharge	8.00	ft ³ /s
Slope	1.15	%
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	1.50	%
Roughness Coefficient	0.016	
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	7.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	9.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	73.15	%
Intercepted Flow	5.85	ft ³ /s
Bypass Flow	2.15	ft ³ /s
Spread	17.86	ft
Depth	0.37	ft
Flow Area	2.47	ft ²
Gutter Depression	0.10	ft
Total Depression	0.52	ft
Velocity	3.24	ft/s
Splash Over Velocity	11.14	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.20	
Grate Flow Ratio	0.26	
Equivalent Cross Slope	0.08363	ft/ft
Active Grate Length	3.75	ft
Length Factor	0.29	
Total Interception Length	19.94	ft

Worksheet for DI02E_SUMP_5-ft Type DM2_St "L" 14+50_100

Project Description

Solve For Spread

Input Data

Discharge	2.00	ft ³ /s
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	1.89	%
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	2.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	4.50	ft
Opening Height	0.50	ft
Curb Throat Type	Horizontal	
Throat Incline Angle	90.00	degrees

Options

Calculation Option Use Both

Results

Spread	4.37	ft
Depth	0.18	ft
Gutter Depression	0.10	ft
Total Depression	0.51	ft
Open Grate Area	1.69	ft ²
Active Grate Weir Length	4.00	ft

Worksheet for DI04E_SUMP_10-ft Type DM2_St "L" 22+19_100

Project Description

Solve For Spread

Input Data

Discharge	9.30	ft ³ /s
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	2.00	%
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	7.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	9.50	ft
Opening Height	0.50	ft
Curb Throat Type	Horizontal	
Throat Incline Angle	90.00	degrees

Options

Calculation Option Use Both

Results

Spread	12.99	ft
Depth	0.35	ft
Gutter Depression	0.09	ft
Total Depression	0.51	ft
Open Grate Area	5.06	ft ²
Active Grate Weir Length	9.00	ft

Worksheet for DI11E_20.0-ft Type DM2_St "L" 46+88_100

Project Description

Solve For Efficiency

Input Data

Discharge	7.00	ft ³ /s
Slope	1.46	%
Gutter Width	1.50	ft
Gutter Cross Slope	8.33	%
Road Cross Slope	2.00	%
Roughness Coefficient	0.016	
Local Depression	5.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	17.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	19.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	98.52	%
Intercepted Flow	6.90	ft ³ /s
Bypass Flow	0.10	ft ³ /s
Spread	13.50	ft
Depth	0.36	ft
Flow Area	1.89	ft ²
Gutter Depression	0.09	ft
Total Depression	0.51	ft
Velocity	3.70	ft/s
Splash Over Velocity	25.03	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.65	
Grate Flow Ratio	0.33	
Equivalent Cross Slope	0.10459	ft/ft
Active Grate Length	8.75	ft
Length Factor	0.61	
Total Interception Length	17.71	ft

B.5 Lateral Storm Drain Calculations

Worksheet for DI01W_30-in

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	8.79	%
Diameter	2.5	ft
Discharge	22.50	ft³/s

Results

Normal Depth	0.73	ft
Flow Area	1.19	ft²
Wetted Perimeter	2.85	ft
Hydraulic Radius	0.42	ft
Top Width	2.27	ft
Critical Depth	1.61	ft
Percent Full	29.1	%
Critical Slope	0.00536	ft/ft
Velocity	18.92	ft/s
Velocity Head	5.56	ft
Specific Energy	6.29	ft
Froude Number	4.61	
Maximum Discharge	130.81	ft³/s
Discharge Full	121.60	ft³/s
Slope Full	0.00301	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	29.14	%
Downstream Velocity	Infinity	ft/s

Worksheet for DI03W_30-in

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	11.00	%
Diameter	2.5	ft
Discharge	40.00	ft ³ /s

Results

Normal Depth	0.93	ft
Flow Area	1.66	ft ²
Wetted Perimeter	3.28	ft
Hydraulic Radius	0.51	ft
Top Width	2.42	ft
Critical Depth	2.13	ft
Percent Full	37.2	%
Critical Slope	0.00893	ft/ft
Velocity	24.09	ft/s
Velocity Head	9.02	ft
Specific Energy	9.95	ft
Froude Number	5.12	
Maximum Discharge	146.33	ft ³ /s
Discharge Full	136.03	ft ³ /s
Slope Full	0.00951	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	37.16	%
Downstream Velocity	Infinity	ft/s

Worksheet for DI04S_18-in_100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013
Channel Slope	7.98 %
Diameter	1.5 ft
Discharge	3.50 ft ³ /s

Results

Normal Depth	0.35 ft
Flow Area	0.31 ft ²
Wetted Perimeter	1.51 ft
Hydraulic Radius	0.21 ft
Top Width	1.27 ft
Critical Depth	0.71 ft
Percent Full	23.2 %
Critical Slope	0.00526 ft/ft
Velocity	11.26 ft/s
Velocity Head	1.97 ft
Specific Energy	2.32 ft
Froude Number	4.01
Maximum Discharge	31.92 ft ³ /s
Discharge Full	29.67 ft ³ /s
Slope Full	0.00111 ft/ft
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
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	23.20 %
Downstream Velocity	Infinity ft/s

Worksheet for DI05W_18-in_100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.015
Channel Slope	10.33 %
Diameter	1.5 ft
Discharge	9.00 ft ³ /s

Results

Normal Depth	0.57 ft
Flow Area	0.62 ft ²
Wetted Perimeter	2.00 ft
Hydraulic Radius	0.31 ft
Top Width	1.46 ft
Critical Depth	1.16 ft
Percent Full	38.1 %
Critical Slope	0.01096 ft/ft
Velocity	14.56 ft/s
Velocity Head	3.30 ft
Specific Energy	3.87 ft
Froude Number	3.94
Maximum Discharge	31.47 ft ³ /s
Discharge Full	29.26 ft ³ /s
Slope Full	0.00977 ft/ft
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
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	38.08 %
Downstream Velocity	Infinity ft/s

Worksheet for DI06S_24-in

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.015	
Channel Slope	6.10	%
Diameter	2.0	ft
Discharge	11.30	ft³/s

Results

Normal Depth	0.66	ft
Flow Area	0.90	ft²
Wetted Perimeter	2.44	ft
Hydraulic Radius	0.37	ft
Top Width	1.88	ft
Critical Depth	1.21	ft
Percent Full	32.9	%
Critical Slope	0.00725	ft/ft
Velocity	12.57	ft/s
Velocity Head	2.46	ft
Specific Energy	3.11	ft
Froude Number	3.20	
Maximum Discharge	52.09	ft³/s
Discharge Full	48.42	ft³/s
Slope Full	0.00332	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	32.86	%
Downstream Velocity	Infinity	ft/s

Worksheet for DI07N_18-in

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	9.18	%
Diameter	1.5	ft
Discharge	1.00	ft ³ /s

Results

Normal Depth	0.18	ft
Flow Area	0.12	ft ²
Wetted Perimeter	1.07	ft
Hydraulic Radius	0.11	ft
Top Width	0.98	ft
Critical Depth	0.37	ft
Percent Full	12.2	%
Critical Slope	0.00493	ft/ft
Velocity	8.15	ft/s
Velocity Head	1.03	ft
Specific Energy	1.22	ft
Froude Number	4.07	
Maximum Discharge	34.23	ft ³ /s
Discharge Full	31.82	ft ³ /s
Slope Full	0.00009	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	12.17	%
Downstream Velocity	Infinity	ft/s

Worksheet for MH-108A_24-in

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	4.43	%
Diameter	2.0	ft
Discharge	12.30	ft ³ /s

Results

Normal Depth	0.69	ft
Flow Area	0.97	ft ²
Wetted Perimeter	2.52	ft
Hydraulic Radius	0.38	ft
Top Width	1.90	ft
Critical Depth	1.26	ft
Percent Full	34.7	%
Critical Slope	0.00565	ft/ft
Velocity	12.71	ft/s
Velocity Head	2.51	ft
Specific Energy	3.21	ft
Froude Number	3.14	
Maximum Discharge	51.22	ft ³ /s
Discharge Full	47.61	ft ³ /s
Slope Full	0.00296	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	34.67	%
Downstream Velocity	Infinity	ft/s

Worksheet for DI09W_18-in

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	10.00	%
Diameter	1.5	ft
Discharge	4.30	ft ³ /s

Results

Normal Depth	0.36	ft
Flow Area	0.33	ft ²
Wetted Perimeter	1.55	ft
Hydraulic Radius	0.21	ft
Top Width	1.29	ft
Critical Depth	0.80	ft
Percent Full	24.3	%
Critical Slope	0.00551	ft/ft
Velocity	12.96	ft/s
Velocity Head	2.61	ft
Specific Energy	2.97	ft
Froude Number	4.50	
Maximum Discharge	35.73	ft ³ /s
Discharge Full	33.22	ft ³ /s
Slope Full	0.00168	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	24.30	%
Downstream Velocity	Infinity	ft/s

Worksheet for DI10W_18-in_100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013
Channel Slope	11.00 %
Diameter	1.5 ft
Discharge	32.90 ft ³ /s

Results

Normal Depth	1.16 ft
Flow Area	1.47 ft ²
Wetted Perimeter	3.23 ft
Hydraulic Radius	0.45 ft
Top Width	1.26 ft
Critical Depth	1.50 ft
Percent Full	77.4 %
Critical Slope	0.09368 ft/ft
Velocity	22.42 ft/s
Velocity Head	7.81 ft
Specific Energy	8.97 ft
Froude Number	3.66
Maximum Discharge	37.47 ft ³ /s
Discharge Full	34.84 ft ³ /s
Slope Full	0.09811 ft/ft
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
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	77.38 %
Downstream Velocity	Infinity ft/s

Worksheet for DI11N_18-in

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	12.39	%
Diameter	1.5	ft
Discharge	1.90	ft ³ /s

Results

Normal Depth	0.23	ft
Flow Area	0.17	ft ²
Wetted Perimeter	1.21	ft
Hydraulic Radius	0.14	ft
Top Width	1.08	ft
Critical Depth	0.52	ft
Percent Full	15.4	%
Critical Slope	0.00493	ft/ft
Velocity	10.99	ft/s
Velocity Head	1.88	ft
Specific Energy	2.11	ft
Froude Number	4.85	
Maximum Discharge	39.77	ft ³ /s
Discharge Full	36.97	ft ³ /s
Slope Full	0.00033	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	15.41	%
Downstream Velocity	Infinity	ft/s

Worksheet for DI11W_18-in

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013
Channel Slope	8.84 %
Diameter	1.5 ft
Discharge	4.00 ft ³ /s

Results

Normal Depth	0.36 ft
Flow Area	0.33 ft ²
Wetted Perimeter	1.54 ft
Hydraulic Radius	0.21 ft
Top Width	1.28 ft
Critical Depth	0.77 ft
Percent Full	24.2 %
Critical Slope	0.00542 ft/ft
Velocity	12.14 ft/s
Velocity Head	2.29 ft
Specific Energy	2.65 ft
Froude Number	4.23
Maximum Discharge	33.59 ft ³ /s
Discharge Full	31.23 ft ³ /s
Slope Full	0.00145 ft/ft
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
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	24.17 %
Downstream Velocity	Infinity ft/s

Worksheet for DI13N_18-in

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	19.03	%
Diameter	1.5	ft
Discharge	3.60	ft³/s

Results

Normal Depth	0.28	ft
Flow Area	0.23	ft²
Wetted Perimeter	1.35	ft
Hydraulic Radius	0.17	ft
Top Width	1.18	ft
Critical Depth	0.72	ft
Percent Full	19.0	%
Critical Slope	0.00529	ft/ft
Velocity	15.43	ft/s
Velocity Head	3.70	ft
Specific Energy	3.99	ft
Froude Number	6.11	
Maximum Discharge	49.29	ft³/s
Discharge Full	45.82	ft³/s
Slope Full	0.00117	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	18.97	%
Downstream Velocity	Infinity	ft/s

Worksheet for DI14W_30-in_100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	7.54	%
Diameter	2.5	ft
Discharge	23.90	ft ³ /s

Results

Normal Depth	0.78	ft
Flow Area	1.31	ft ²
Wetted Perimeter	2.97	ft
Hydraulic Radius	0.44	ft
Top Width	2.32	ft
Critical Depth	1.66	ft
Percent Full	31.3	%
Critical Slope	0.00554	ft/ft
Velocity	18.22	ft/s
Velocity Head	5.16	ft
Specific Energy	5.94	ft
Froude Number	4.27	
Maximum Discharge	121.15	ft ³ /s
Discharge Full	112.62	ft ³ /s
Slope Full	0.00340	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	31.27	%
Downstream Velocity	Infinity	ft/s

Worksheet for DI15W_24-in_100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	6.00	%
Diameter	2.0	ft
Discharge	13.90	ft ³ /s

Results

Normal Depth	0.68	ft
Flow Area	0.95	ft ²
Wetted Perimeter	2.50	ft
Hydraulic Radius	0.38	ft
Top Width	1.90	ft
Critical Depth	1.34	ft
Percent Full	34.1	%
Critical Slope	0.00602	ft/ft
Velocity	14.68	ft/s
Velocity Head	3.35	ft
Specific Energy	4.03	ft
Froude Number	3.66	
Maximum Discharge	59.61	ft ³ /s
Discharge Full	55.41	ft ³ /s
Slope Full	0.00378	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	34.14	%
Downstream Velocity	Infinity	ft/s

Worksheet for DI16W_30-in_100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	6.01	%
Diameter	2.5	ft
Discharge	2.60	ft ³ /s

Results

Normal Depth	0.28	ft
Flow Area	0.30	ft ²
Wetted Perimeter	1.70	ft
Hydraulic Radius	0.17	ft
Top Width	1.57	ft
Critical Depth	0.53	ft
Percent Full	11.1	%
Critical Slope	0.00422	ft/ft
Velocity	8.76	ft/s
Velocity Head	1.19	ft
Specific Energy	1.47	ft
Froude Number	3.55	
Maximum Discharge	108.16	ft ³ /s
Discharge Full	100.55	ft ³ /s
Slope Full	0.00004	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	11.08	%
Downstream Velocity	Infinity	ft/s

Worksheet for DI17S_18-in_100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	20.10	%
Diameter	1.5	ft
Discharge	6.17	ft ³ /s

Results

Normal Depth	0.37	ft
Flow Area	0.33	ft ²
Wetted Perimeter	1.55	ft
Hydraulic Radius	0.22	ft
Top Width	1.29	ft
Critical Depth	0.96	ft
Percent Full	24.4	%
Critical Slope	0.00630	ft/ft
Velocity	18.43	ft/s
Velocity Head	5.28	ft
Specific Energy	5.65	ft
Froude Number	6.38	
Maximum Discharge	50.66	ft ³ /s
Discharge Full	47.09	ft ³ /s
Slope Full	0.00345	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	24.45	%
Downstream Velocity	Infinity	ft/s

Worksheet for DI01E_18-in

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013
Channel Slope	6.32 %
Diameter	1.5 ft
Discharge	1.00 ft ³ /s

Results

Normal Depth	0.20 ft
Flow Area	0.14 ft ²
Wetted Perimeter	1.12 ft
Hydraulic Radius	0.12 ft
Top Width	1.02 ft
Critical Depth	0.37 ft
Percent Full	13.3 %
Critical Slope	0.00493 ft/ft
Velocity	7.17 ft/s
Velocity Head	0.80 ft
Specific Energy	1.00 ft
Froude Number	3.42
Maximum Discharge	28.41 ft ³ /s
Discharge Full	26.41 ft ³ /s
Slope Full	0.00009 ft/ft
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
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	13.29 %
Downstream Velocity	Infinity ft/s

Worksheet for DI02E_18-in_100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013
Channel Slope	5.18 %
Diameter	1.5 ft
Discharge	2.00 ft ³ /s

Results

Normal Depth	0.29 ft
Flow Area	0.24 ft ²
Wetted Perimeter	1.37 ft
Hydraulic Radius	0.18 ft
Top Width	1.19 ft
Critical Depth	0.53 ft
Percent Full	19.6 %
Critical Slope	0.00495 ft/ft
Velocity	8.21 ft/s
Velocity Head	1.05 ft
Specific Energy	1.34 ft
Froude Number	3.20
Maximum Discharge	25.72 ft ³ /s
Discharge Full	23.91 ft ³ /s
Slope Full	0.00036 ft/ft
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
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	19.55 %
Downstream Velocity	Infinity ft/s

Worksheet for DI03E_18-in

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	15.59	%
Diameter	1.5	ft
Discharge	1.70	ft ³ /s

Results

Normal Depth	0.21	ft
Flow Area	0.15	ft ²
Wetted Perimeter	1.14	ft
Hydraulic Radius	0.13	ft
Top Width	1.04	ft
Critical Depth	0.49	ft
Percent Full	13.8	%
Critical Slope	0.00491	ft/ft
Velocity	11.53	ft/s
Velocity Head	2.07	ft
Specific Energy	2.27	ft
Froude Number	5.38	
Maximum Discharge	44.61	ft ³ /s
Discharge Full	41.47	ft ³ /s
Slope Full	0.00026	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	13.81	%
Downstream Velocity	Infinity	ft/s

Worksheet for DI04E_18-in_100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	5.00	%
Diameter	1.5	ft
Discharge	9.30	ft³/s

Results

Normal Depth	0.66	ft
Flow Area	0.74	ft²
Wetted Perimeter	2.17	ft
Hydraulic Radius	0.34	ft
Top Width	1.49	ft
Critical Depth	1.18	ft
Percent Full	43.7	%
Critical Slope	0.00851	ft/ft
Velocity	12.51	ft/s
Velocity Head	2.43	ft
Specific Energy	3.09	ft
Froude Number	3.12	
Maximum Discharge	25.27	ft³/s
Discharge Full	23.49	ft³/s
Slope Full	0.00784	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	43.74	%
Downstream Velocity	Infinity	ft/s

Worksheet for DI05E_18-in

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	6.02	%
Diameter	1.5	ft
Discharge	0.50	ft ³ /s

Results

Normal Depth	0.14	ft
Flow Area	0.09	ft ²
Wetted Perimeter	0.95	ft
Hydraulic Radius	0.09	ft
Top Width	0.89	ft
Critical Depth	0.26	ft
Percent Full	9.7	%
Critical Slope	0.00514	ft/ft
Velocity	5.72	ft/s
Velocity Head	0.51	ft
Specific Energy	0.65	ft
Froude Number	3.21	
Maximum Discharge	27.72	ft ³ /s
Discharge Full	25.77	ft ³ /s
Slope Full	0.00002	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	9.66	%
Downstream Velocity	Infinity	ft/s

Worksheet for DI06E_18-in

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013
Channel Slope	8.40 %
Diameter	1.5 ft
Discharge	1.80 ft ³ /s

Results

Normal Depth	0.25 ft
Flow Area	0.19 ft ²
Wetted Perimeter	1.25 ft
Hydraulic Radius	0.15 ft
Top Width	1.11 ft
Critical Depth	0.51 ft
Percent Full	16.5 %
Critical Slope	0.00491 ft/ft
Velocity	9.43 ft/s
Velocity Head	1.38 ft
Specific Energy	1.63 ft
Froude Number	4.02
Maximum Discharge	32.75 ft ³ /s
Discharge Full	30.44 ft ³ /s
Slope Full	0.00029 ft/ft
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
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	16.50 %
Downstream Velocity	Infinity ft/s

Worksheet for DI07E_18-in

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013
Channel Slope	8.65 %
Diameter	1.5 ft
Discharge	1.40 ft ³ /s

Results

Normal Depth	0.22 ft
Flow Area	0.16 ft ²
Wetted Perimeter	1.17 ft
Hydraulic Radius	0.14 ft
Top Width	1.06 ft
Critical Depth	0.44 ft
Percent Full	14.5 %
Critical Slope	0.00490 ft/ft
Velocity	8.85 ft/s
Velocity Head	1.22 ft
Specific Energy	1.43 ft
Froude Number	4.03
Maximum Discharge	33.23 ft ³ /s
Discharge Full	30.89 ft ³ /s
Slope Full	0.00018 ft/ft
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
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	14.50 %
Downstream Velocity	Infinity ft/s

Worksheet for DI08E_18-in

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013
Channel Slope	8.50 %
Diameter	1.5 ft
Discharge	1.40 ft ³ /s

Results

Normal Depth	0.22 ft
Flow Area	0.16 ft ²
Wetted Perimeter	1.17 ft
Hydraulic Radius	0.14 ft
Top Width	1.06 ft
Critical Depth	0.44 ft
Percent Full	14.6 %
Critical Slope	0.00489 ft/ft
Velocity	8.79 ft/s
Velocity Head	1.20 ft
Specific Energy	1.42 ft
Froude Number	4.00
Maximum Discharge	32.94 ft ³ /s
Discharge Full	30.62 ft ³ /s
Slope Full	0.00018 ft/ft
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
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	14.56 %
Downstream Velocity	Infinity ft/s

Worksheet for DI09E_18-in

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013
Channel Slope	14.56 %
Diameter	1.5 ft
Discharge	2.00 ft ³ /s

Results

Normal Depth	0.23 ft
Flow Area	0.17 ft ²
Wetted Perimeter	1.20 ft
Hydraulic Radius	0.14 ft
Top Width	1.08 ft
Critical Depth	0.53 ft
Percent Full	15.2 %
Critical Slope	0.00494 ft/ft
Velocity	11.81 ft/s
Velocity Head	2.17 ft
Specific Energy	2.40 ft
Froude Number	5.25
Maximum Discharge	43.11 ft ³ /s
Discharge Full	40.08 ft ³ /s
Slope Full	0.00036 ft/ft
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
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	15.19 %
Downstream Velocity	Infinity ft/s

Worksheet for DI10E_18-in

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013
Channel Slope	13.25 %
Diameter	1.5 ft
Discharge	1.20 ft ³ /s

Results

Normal Depth	0.18 ft
Flow Area	0.12 ft ²
Wetted Perimeter	1.07 ft
Hydraulic Radius	0.11 ft
Top Width	0.98 ft
Critical Depth	0.41 ft
Percent Full	12.2 %
Critical Slope	0.00490 ft/ft
Velocity	9.79 ft/s
Velocity Head	1.49 ft
Specific Energy	1.67 ft
Froude Number	4.88
Maximum Discharge	41.13 ft ³ /s
Discharge Full	38.23 ft ³ /s
Slope Full	0.00013 ft/ft
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
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	12.16 %
Downstream Velocity	Infinity ft/s

Worksheet for DI11E_30-in_100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013
Channel Slope	11.19 %
Diameter	2.5 ft
Discharge	6.90 ft ³ /s

Results

Normal Depth	0.38 ft
Flow Area	0.47 ft ²
Wetted Perimeter	2.01 ft
Hydraulic Radius	0.24 ft
Top Width	1.80 ft
Critical Depth	0.87 ft
Percent Full	15.3 %
Critical Slope	0.00416 ft/ft
Velocity	14.59 ft/s
Velocity Head	3.31 ft
Specific Energy	3.69 ft
Froude Number	5.01
Maximum Discharge	147.59 ft ³ /s
Discharge Full	137.20 ft ³ /s
Slope Full	0.00028 ft/ft
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
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	15.25 %
Downstream Velocity	Infinity ft/s

Worksheet for PROP_48-in_100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	2.96	%
Diameter	4.0	ft
Discharge	100.00	ft ³ /s

Results

Normal Depth	1.77	ft
Flow Area	5.37	ft ²
Wetted Perimeter	5.82	ft
Hydraulic Radius	0.92	ft
Top Width	3.97	ft
Critical Depth	3.03	ft
Percent Full	44.3	%
Critical Slope	0.00570	ft/ft
Velocity	18.63	ft/s
Velocity Head	5.39	ft
Specific Energy	7.16	ft
Froude Number	2.83	
Maximum Discharge	265.83	ft ³ /s
Discharge Full	247.12	ft ³ /s
Slope Full	0.00485	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

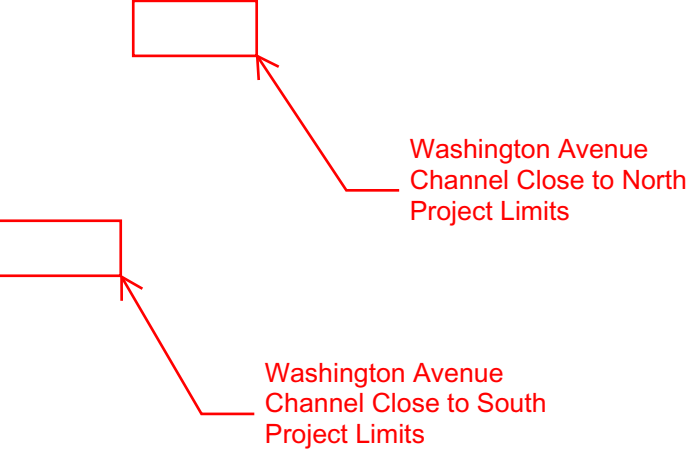
Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	44.27	%
Downstream Velocity	Infinity	ft/s

APPENDIX C – REFERENCES

- C.1 Las Vegas Creek LOMR Excerpts
- C.2 2005 CLV Central Neighborhood Flood Control Master Plan Excerpts
- C.3 Las Vegas Boulevard Improvements Stewart Ave to Sahara Ave Excerpts



C.1 Las Vegas Creek LOMR Excerpts



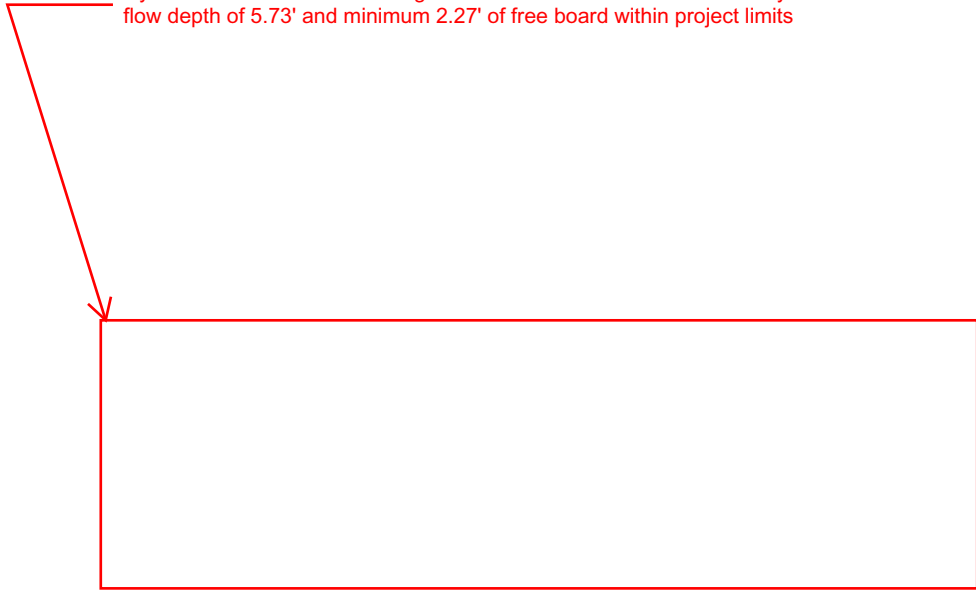


Hydraulic model results for the Washington Avenue Channel within the project limits.

Hydraulic model results for the Washington Avenue Channel within the project limits.



Hydraulic results show Washington Avenue Channel CCRFCD Facility has a maximum flow depth of 5.73' and minimum 2.27' of free board within project limits



C.2 2005 CLV Central Neighborhood Flood Control Master Plan Excerpts

- C.2.1 - 2005 CLV Central Neighborhood Flood Control Master Plan Drainage Exhibits
- C.2.2 - 2005 CLV Central Neighborhood Flood Control Master Plan HEC-1 Exhibits

C.2.1 2005 CLV Central Neighborhood Flood Control
Master Plan Drainage Exhibits



City of Las Vegas

CENTRAL NEIGHBORHOOD FLOOD CONTROL MASTER PLAN

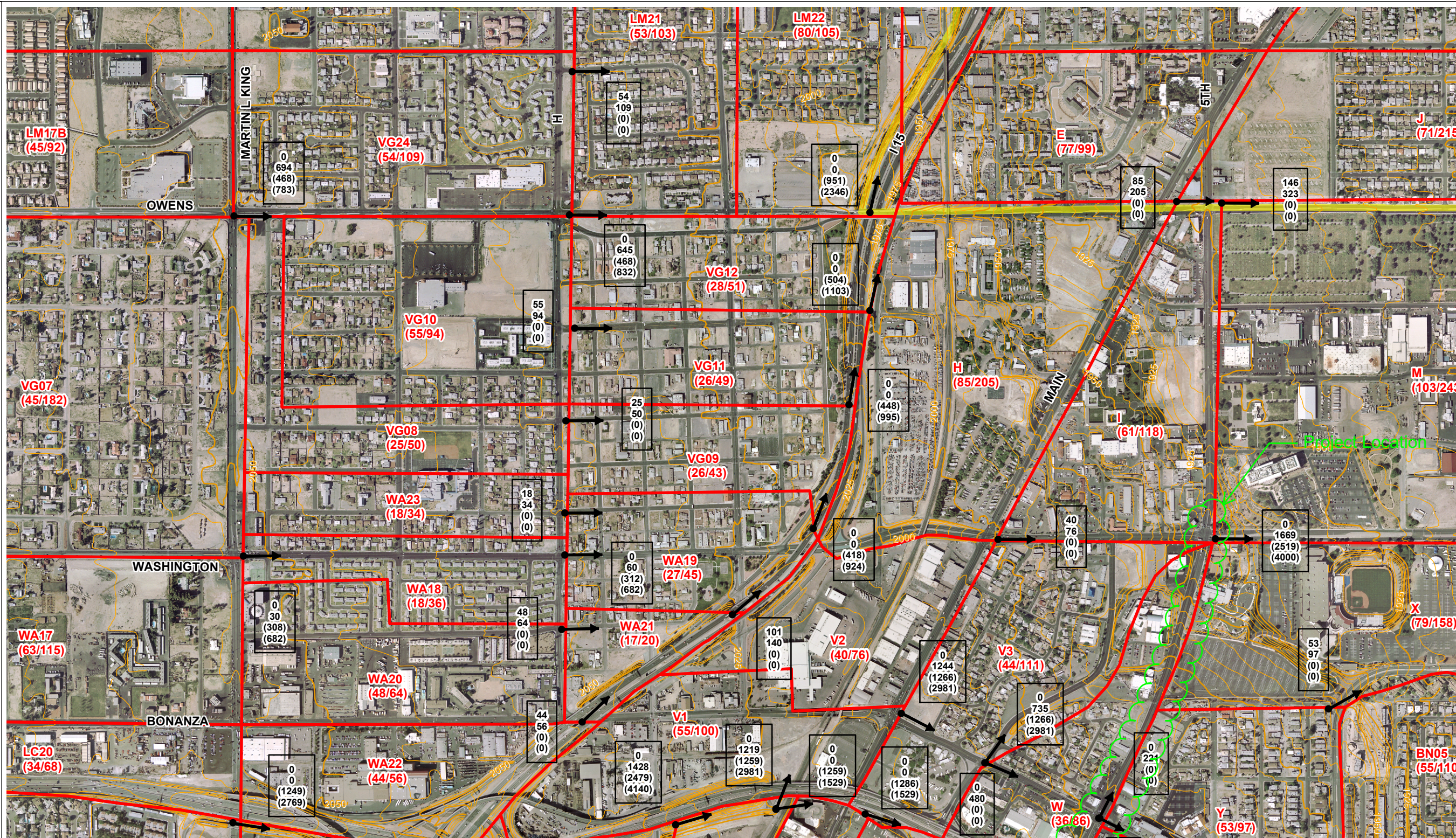
LEGEND

- Sub-basin Boundary
- LV12** Basin ID
- (10yr./100yr.)** Contributing flow from the basin (cfs)
- Flow Arrow
- | | |
|-------|------------------------|
| 250 | 10-Year Street Flow |
| 500 | 100-Year Street Flow |
| (300) | 10-Year Facility Flow |
| (800) | 100-Year Facility Flow |

(Flows in CFS)
- Study Area Limit

PHOTO DATE: SPRING 2004

FIGURE E-4



EXISTING DRAINAGE CONDITIONS

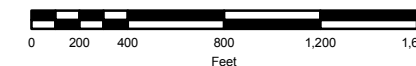
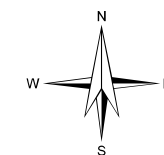


2270 Corporate Circle, Suite 100
Henderson, NV 89074
(702) 263-7275
Fax: (702) 263-7200

	Durango	Rainbow	Decatur	Tonopah	5th	Pecos	Nellis
Lake Mead				1	2		
Washington				3	4	5	6
Charleston	7	8	9	10	11	12	
Sahara	13	14	15	16	17		
Desert Inn		18	19				

NOTE:
Existing conditions are based on future
Curve Number values with only existing local and
CCRFCD facilities in place.

100-Year flows at locations where a 100-Year
subbasin concentration point does not exist in the
hydrology model were based on an area-weighted
ratio of the 100-Year flows from concentration points
upstream and downstream of the location. See
Volume I for a more detailed explanation.



SCALE: 1 inch = 800 feet



City of Las Vegas

CENTRAL NEIGHBORHOOD FLOOD CONTROL MASTER PLAN

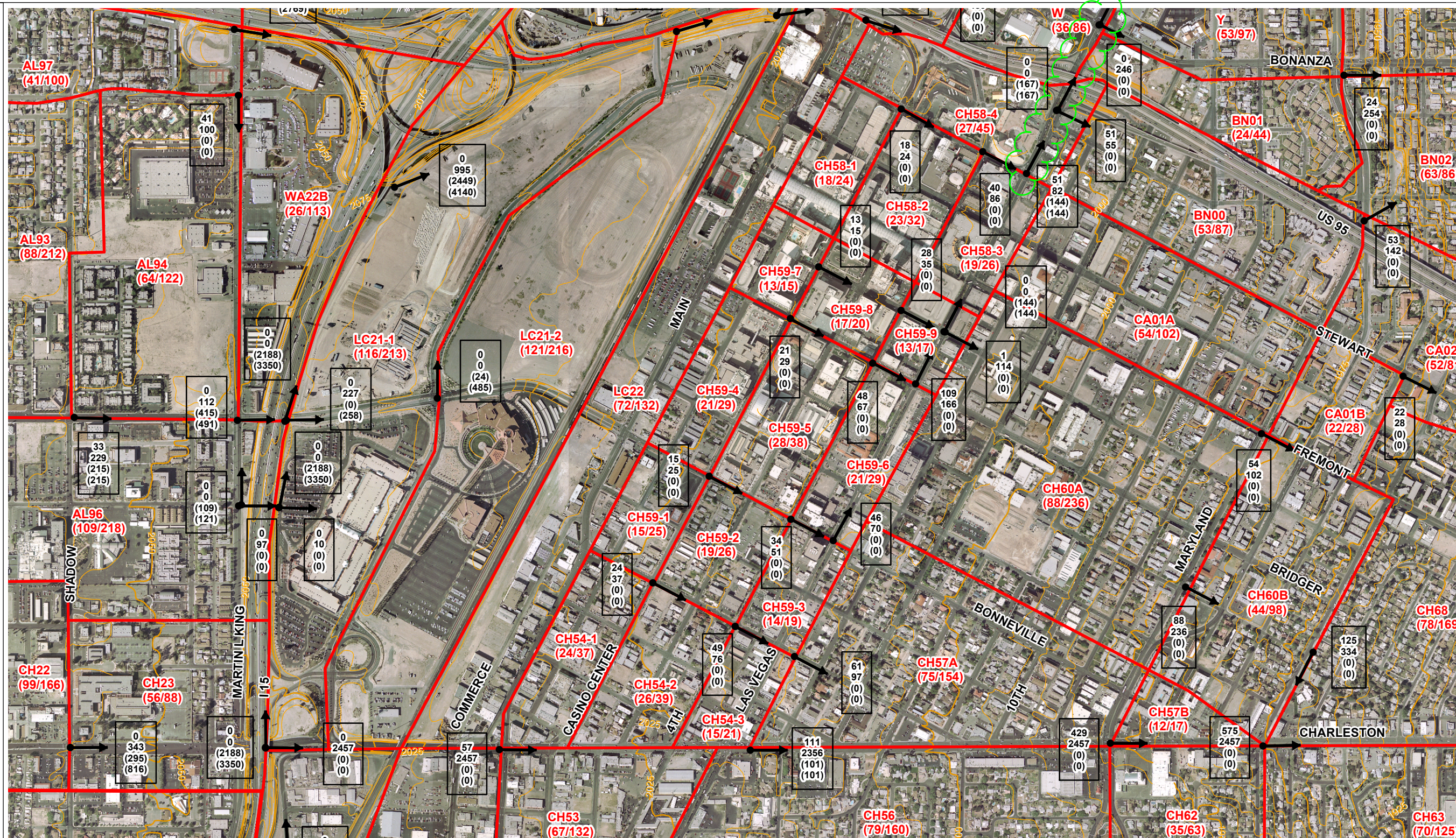
LEGEND

- Sub-basin Boundary
- LV12** Basin ID
- Contributing flow from the basin (cfs)
- Flow Arrow
- | | |
|-------|------------------------|
| 250 | 10-Year Street Flow |
| 500 | 100-Year Street Flow |
| (300) | 10-Year Facility Flow |
| (800) | 100-Year Facility Flow |

(Flows in CFS)
- Study Area Limit

PHOTO DATE: SPRING 2004

FIGURE E- 10



EXISTING DRAINAGE CONDITIONS

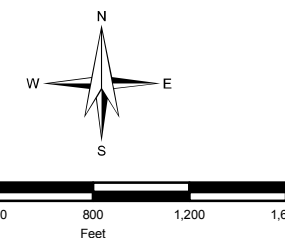


2270 Corporate Circle, Suite 100
Henderson, NV 89074
(702) 263-7275
Fax: (702) 263-7200

	Durango	Rainbow	Decatur	Tonopah	5th	Pecos	Nellis
Lake Mead				1	2		
Washington				3	4	5	6
Charleston	7	8	9	10	11		12
Sahara	13	14	15	16	17		
Desert Inn		18	19				

NOTE:
Existing conditions are based on future
Curve Number values with only existing local and
CCRFCD facilities in place.

100-Year flows at locations where a 100-Year
subbasin concentration point does not exist in the
hydrology model were based on an area-weighted
ratio of the 100-Year flows from concentration points
upstream and downstream of the location. See
Volume I for a more detailed explanation.



SCALE: 1 inch = 800 feet

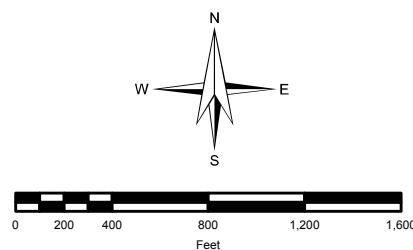
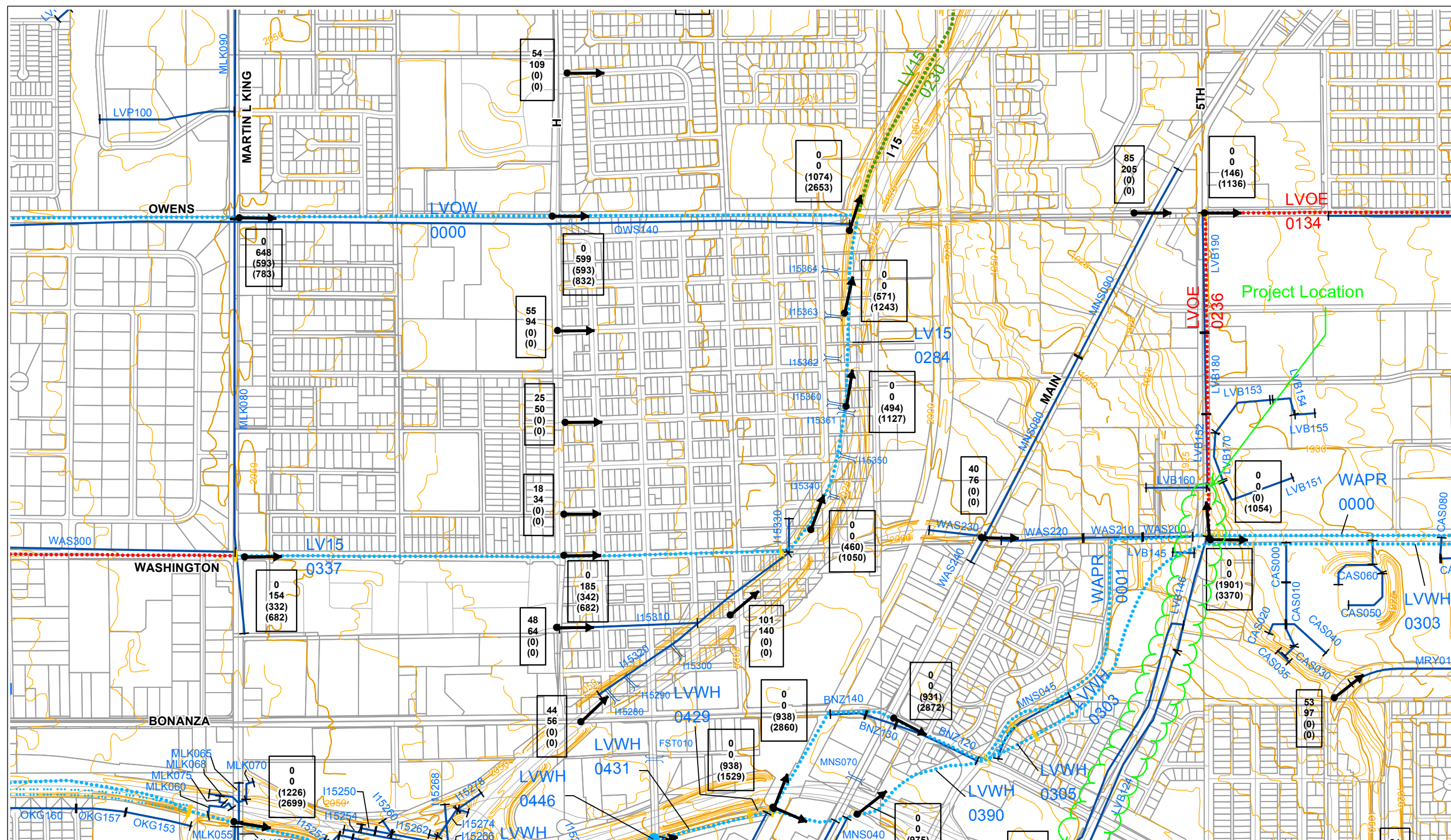


CENTRAL NEIGHBORHOOD FLOOD CONTROL MASTER PLAN

LEGEND

- | | |
|---|---|
|  | Existing Regional Facility |
|  | Category A Proposed Regional Facility (2002 MPU) |
|  | Category B Proposed Regional Facility (2002 MPU) |
|  | Category A Proposed Regional Facility (2004 CNFCMP) |
|  | Existing Local Facility |
|  | Proposed Local Facility |
|  | Regional Culvert |
|  | Regional Bridge |
|  | Regional Pipeline |
|  | Regional Channel |
|  | Regional Levee |
|  | Regional Detention Basin |
|  | Local Storm Drain |
|  | Local Culvert |
|  | Proposed Local Storm Drain |
|  | Regional ID-Mile Separator |
|  | Local Facility Separator |

FIGURE F-4



SCALE: 1 inch = 800 feet



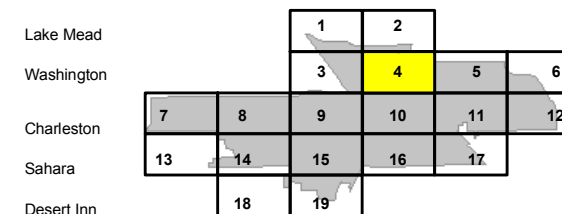
250	10-Year Street Flow
500	100-Year Street Flow
(300)	10-Year Facility Flow
(800)	100-Year Facility Flow

(Flows in CFS)

NOTE:
Ultimate drainage conditions are based on
future Curve Number values with all flood control
facilities in place.

100-Year flows at locations where a 100-Year subbasin concentration point does not exist in the hydrology model were based on an area-weighted ratio of the 100-Year flows from concentration points upstream and downstream of the location. See Volume I for a more detailed explanation.

FUTURE DRAINAGE CONDITIONS



**2270 Corporate Circle, Suite 100
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(702) 263-7275
Fax: (702) 263-7200**

C.2.2 2005 CLV Central Neighborhood Flood Control
Master Plan HEC-1 Excerpts

```

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
* RUN DATE 11JUN04 TIME 10:07:02
*
*****

esw310

*****
*
* U.S. ARMY CORPS OF ENGINEERS
* HYDROLOGIC ENGINEERING CENTER
* 609 SECOND STREET
* DAVIS, CALIFORNIA 95616
* (916) 756-1104
*
*****

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X X XXXXXX XXXX X
X X X X X XX
X X X X X
XXXXXX XXXX X XXXX X
X X X X X
X X X X X
X X XXXXXX XXXX XXX

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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 CLV CENTRAL NEIGHBORHOOD FLOOD CONTROL MASTER PLAN 2003
2 ID CENTRAL BASIN (SOUTHWEST, SOUTHEAST, NORTHEAST AREAS)
3 ID EXISTING CONDITIONS = EXISTING FACILITIES, FUTURE LAND USE
4 ID INPUT FILE = ESW310.DAT
5 ID INPUT FILE DATE = OCTOBER, 2003
6 ID DESIGN STORM = 10-YEAR 6-HR STORM
7 ID STORM DISTRIBUTION = SDN #3
8 ID MODELED BY PBS&J (STEPHEN C. ALTMAN P.E.)
9 ID STORM CENTERING
10 ID COMPOSITE CURVE NUMBER RUN
11 ID 2002 MPU SUBBASINS USED FOR OFFSITE AREAS EXCEPT WHERE SPECIFIED
12 ID REFERENCED HYDROLOGIC MODELS:
13 ID CITY OF LAS VEGAS CITY WIDE HYDROLOGY ANALYSIS (PBS&J 1997)
14 ID PREDESIGN REPORT FOR I-15 FREEWAY CHANNEL (PARSONS BRINCKERHOFF 1999)
15 ID FINAL CENTRAL BASIN ASSESMENT (CARTER-BURGESS 1998)
16 ID HYDRAULIC DESIGN REPORT FOR I-15 WIDENING (LOUIS BERGER 1999)
17 ID CCRFCD 2002 LAS VEGAS VALLEY MASTER PLAN UPDATE (PBS&J, GCW, LBG)
18 ID
19 ID NOTE: LOCATIONS AND DESCRIPTIONS OF PROPOSED MPU FACILITIES ARE STATED IN
20 ID THE MODEL. HOWEVER, ROUTINGS IN THESE LOCATIONS REFLECT THE EXISTING
21 ID CONDITION.
22 ID
23 ID
24 ID JR CARDS CONTAIN DARFS BASED ON THE FOLLOWING VALUES:
25 ID
26 ID CONCENTRATION AREA DARF
27 ID POINT SQ. MI.
28 ID 0-0.5 0.564
29 ID 0.5-1 0.556
30 ID 1-2 0.542
31 ID 2-3 0.527
32 ID 3-4 0.522
33 ID 4-5 0.518
34 ID 5-6 0.515
35 ID 6-7 0.51
36 ID 7-8 0.504
37 ID
38 ID JR CARD RATIOS REPRESENT DEPTH-AREA REDUCTION FACTORS (DARF'S)
39 ID
40 ID 10-YEAR, 6-HOUR STORM, SDN3
41 ID
42 ID IT 5 0 0 300
43 ID IO 5 0 0
44 ID IN 5 0 0
45 ID JR PREC 0.564 0.556 0.542 0.527 0.522 0.518 0.515 0.51 0.504

46 KK FW01
47 BA 0.324
48 PB 2.77

```

2187 KK CH59-1
 2188 BA 0.020
 2189 PB 2.77
 2190 LS 0 94.0
 2191 UD 0.190
 *

2192 KKRCCH59-1
 2193 KM ROUTE CCH59-1 TO CCH59-2
 2194 KM BONNEVILLE
 2195 RD 760 0.0093 0.013 0 CIRC 3
 *

2196 KK CH59-2
 2197 BA 0.026
 2198 PB 2.77
 2199 LS 0 94.0
 2200 UD 0.196
 *

2201 KK CCH59-2
 2202 KM COMBINE CH59-2 AND RCCH59-1
 2203 KM FOURTH AND BONNEVILLE
 2204 HC 2
 *

2205 KKRCCH59-2
 2206 KM ROUTE CCH59-2 TO CCH59-3
 2207 KM BONNEVILLE
 2208 RD 900 0.013 0.013 0 CIRC 3
 *

1

HEC-1 INPUT

PAGE 61

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

2209 KK CH59-3
 2210 BA 0.019
 2211 PB 2.77
 2212 LS 0 93.1
 2213 UD 0.171
 *

2214 KK CCH59-3
 2215 KM COMBINE CH59-3 AND CCH59-2
 2216 KM LAS VEGAS BOULEVARD AND BONNEVILLE
 2217 HC 2
 *

2218 KKRCCH59-3
 2219 KM ROUTE CCH59-3 TO CCH59-6
 2220 KM LAS VEGAS BOULEVARD
 2221 RD 1360 0.002 0.016 0 TRAP 0 50
 *

2222 KK CH59-4
 2223 BA 0.029
 2224 PB 2.77
 2225 LS 0 94.4
 2226 UD 0.217
 *

2227 KK RCH59-4
 2228 KM ROUTE CH59-4 TO CCH59-5
 2229 KM BRIDGER
 2230 RD 760 0.0079 0.016 0 TRAP 0 50
 *

2231 KK CH59-5
 2232 BA 0.039
 2233 PB 2.77
 2234 LS 0 94.1
 2235 UD 0.227
 *

2236 KK CCH59-5
 2237 KM COMBINE CH59-5 AND RCH59-4
 2238 KM FOURTH AND BRIDGER
 2239 HC 2
 *

2240 KK CH59-6
 2241 BA 0.029
 2242 PB 2.77
 2243 LS 0 94.0
 2244 UD 0.217
 *

1

HEC-1 INPUT

PAGE 62

LINE	ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
2245	KK CCH59-6
2246	KM COMBINE CCH59-5, RCCH59-1 AND CH59-6
2247	KM LAS VEGAS BOULEVARD AND BRIDGER
2248	HC 3
	*
2249	KK CH59-7
2250	BA 0.015
2251	PB 2.77
2252	LS 0 94.6
2253	UD 0.143
	*
2254	KK RCH59-7
2255	KM ROUTE CH59-4 TO CCH59-5
2256	KM BRIDGER
2257	RD 760 0.0079 0.016 0 TRAP 0 50
	*
2258	KK CH59-8
2259	BA 0.020
2260	PB 2.77
2261	LS 0 94.3
2262	UD 0.152
	*
2263	KK CCH59-8
2264	KM COMBINE CH59-8 AND RCH59-7
2265	KM FOURTH AND CARSON
2266	HC 2
	*
2267	KKRCCH59-8
2268	KM ROUTE CCH59-8 TO CCH59-9
2269	KM CARSON
2270	RD 600 0.01 0.016 0 TRAP 0 50
	*
2271	KK CH59-9
2272	BA 0.015
2273	PB 2.77
2274	LS 0 94.0
2275	UD 0.130
	*
2276	KK CCH59-9
2277	KM COMBINE CH59-9, CCH59-6, AND RCCH59-8
2278	KM NEAR LV BOULEVARD AND CARSON
2279	HC 3
	*

1

HEC-1 INPUT

PAGE 63

LINE	ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
------	---

2280	KK DCH59
2281	KM FLOW SPLIT TO CH60A
2282	KM SPLIT TO FLAMINGO WASH SYSTEM
2283	KM DEVELOPED FROM CMH MODEL
2284	KM CAPACITY = 144 CFS
2285	DT DCARSON
2286	DI 0 144 1000
2287	DQ 0 0 856
	*

2288	KKRCCH59-9
2289	KM ROUTE DCH59 TO CCH58 IN LV BLVD DRAIN
2290	KM LINING = RCP
2291	RD 1400 0.002 0.013 0 CIRC 4
	*
2292	KK CH58-1
2293	BA 0.024
2294	PB 2.77
2295	LS 0 94.1
2296	UD 0.202
	*
2297	KK RCH58-1
2298	KM ROUTE CH59-4 TO CCH59-5
2299	KM STEWART
2300	RD 760 0.009 0.016 0 TRAP 0 50
	*
2301	KK CH58-2

esw310

2302	BA	0.032							
2303	PB	2.77							
2304	LS	0	94.2						
2305	UD	0.213							
	*								
2306	KK	CCH58-2							
2307	KM	COMBINE CH58-2 AND RCH58-1							
2308	KM	FOURTH AND STEWART							
2309	HC	2							
	*								
2310	KKRCH58-2								
2311	KM	ROUTE CCH58-2 TO CCH59-3							
2312	KM	STEWART							
2313	RD	630	0.011	0.016	0	TRAP	0	50	
	*								
2314	KK	CH58-3							
2315	BA	0.026							
2316	PB	2.77							
2317	LS	0	94.1						
2318	UD	0.208							
	*								

1

HEC-1 INPUT

PAGE 64

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

2319	KK	CCH58-3							
2320	KM	COMBINE CH58-3, RCCH59-3, AND RCCH58-2							
2321	KM	NEAR LV BOULEVARD AND STEWART							
2322	HC	3							
	*								
2323	KKRCH58-3								
2324	KM	ROUTE DDCH58 TO CW							
2325	KM	LINING = RCP							
2326	RD	700	0.002	0.013	0	CIRC	4		
	*								
2327	KK	CH58-4							
2328	BA	0.046							
2329	PB	2.77							
2330	LS	0	91.9						
2331	UD	0.244							
	*								
2332	KK	CCH58-4							
2333	KM	COMBINE CH58-4 AND RCCH58-3							
2334	KM	NEAR LV BOULEVARD AND STEWART							
2335	HC	2							
	*								

2336	KK	DCCH58							
2337	KM	FLOW SPLIT TO BN00							
2338	KM	DIVERT Q EXCEEDING LAS VEGAS BLVD DRAIN CAPACITY: 48" PIPE, 167 CFS							
2339	KM	DBN00 IN CWH							
2340	DT	DBN00							
2341	DI	0	167	1000					
2342	DQ	0	0	833					
	*								

2343	KK	RDCCH58							
2344	KM	ROUTE DDCH58 TO CW							
2345	KM	LINING = RCP							
2346	RD	3000	0.002	0.013	0	CIRC	4		
	*								
2347	KK	W							
2348	BA	0.070							
2349	PB	2.77							
2350	LS	0	90.2						
2351	UD	0.255							
	*								
2352	KK	CW							
2353	KM	COMBINE RDCCH58 AND W							
2354	KM	WASHINGTON AND LAS VEGAS BLVD							
2355	HC	2							
	*								

1

HEC-1 INPUT

PAGE 65

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

2356	KK	CCW							
2357	KM	COMBINE CV3,RCLC22 AND CW							
2358	KM	WASHINGTON AND LAS VEGAS BLVD							

2359 HC 3 esw310
*

2360 KK RCCW
2361 KM ROUTE CCW TO CCX
2362 KM FACILITY = WASHINGTON AVENUE CHANNEL
2363 KM FACILITY # = LVWH 0240,0303
2364 KM LINING = RCB
2365 RD 2600 0.025 0.015 0 TRAP 24 0
*

2366 KK Y
2367 BA 0.079
2368 PB 2.77
2369 LS 0 93.2
2370 UD 0.215
*

2371 KK RY
2372 KM ROUTE Y TO CX
2373 RD 2600 0.025 0.016 0 TRAP 0 50
*

2374 KK X
2375 BA 0.129
2376 PB 2.77
2377 LS 0 91.0
2378 UD 0.189
*

2379 KK CX
2380 KM COMBINE RY AND X
2381 KM WASHINGTON AND BRUCE
2382 HC 2
*

2383 KK CCX
2384 KM COMBINE CX AND RCCW
2385 KM WASHINGTON AND BRUCE
2386 HC 2
*

2387 KK RCCX
2388 KM ROUTE CCX TO CCO
2389 KM FACILITY = WASHINGTON AVENUE CHANNEL
2390 KM FACILITY # = LVWH 0234,0240
2391 KM LINING = RCB
2392 RD 2600 0.0115 0.015 0 TRAP 24 0
*

2393 KK A-C
2394 BA 0.332
2395 PB 2.77
2396 LS 0 93.8
2397 UD 0.233
*

2398 KK DA-C
2399 KM DIVERT FLOW TO AREA B VIA 21" STORM DRAIN
2400 DT BVIASD
2401 DI 0 50 100 150 500
2402 DQ 0 10 20 35 35
*

2403 KK RDA-C
2404 KM ROUTE CCX TO CCO
2405 KM LAKE MEAD
2406 RD 3800 0.0092 0.016 0 TRAP 0 50
*

2407 KK BVIASD
2408 KM RETRIEVE BVIASD
2409 DR BVIASD
*

2410 KK B-C
2411 BA 0.312
2412 PB 2.77
2413 LS 0 94.1
2414 UD 0.475
*

2415 KK CB-C
2416 KM COMBINE BVIASD AND B-C
2417 KM

1

HEC-1 INPUT

PAGE 66

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

	.	.	V	
	.	.	V	
2218	.	.	RCCH59-3	
	.	.	.	
	.	.	.	
2222	.	.	CH59-4	
	.	.	V	
	.	.	V	
2227	.	.	RCH59-4	
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2231	.	.	.	CH59-5
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2236	.	.	CCH59-5.....	
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2240	.	.	.	CH59-6
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2245	.	.	CCH59-6.....	
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2249	.	.	CH59-7	
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2254	.	.	RCH59-7	
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2258	.	.	.	CH59-8
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2263	.	.	CCH59-8.....	
	.	.	V	
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2267	.	.	RCCH59-8	
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2271	.	.	.	CH59-9
	.	.	.	.
	.	.	.	.
2276	.	.	CCH59-9.....	
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2285	.	.	-----> DCARSON	
2280	.	.	DCH59	
	.	.	V	
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2288	.	.	RCCH59-9	
	.	.	.	
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2292	.	.	CH58-1	
	.	.	V	
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2297	.	.	RCH58-1	
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2301	.	.	.	CH58-2
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2306	.	.	CCH58-2.....	
	.	.	V	
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2310	.	.	RCCH58-2	
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2314	.	.	.	CH58-3
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2319	.	.	CCH58-3.....	
	.	.	V	
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2323	.	.	RCCH58-3	
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2327	.	.	CH58-4	
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2332	.	.	CCH58-4.....	
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2340	.	.	-----> DBN00	
2336	.	.	DCCH58	
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2343	.	.	RDCCH58	
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2352      .      .      CW.....
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2356      CCW.....
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2360      V
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2366      .      .      Y
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2371      .      .      RY
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2374      .      .      .      X
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2379      .      .      CX.....
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2383      CCX.....
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2387      V
RCCX
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2393      .      .      A-C
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2400      .      .      .      BVIASD
2398      .      .      DA-C
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2403      .      .      RDA-C
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2409      .      .      .      .      BVIASD
2407      .      .      .      BVIASD
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2410      .      .      .      .      B-C
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2415      .      .      .      CB-C.....
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2421      .      .      .      .      LVBLVD
2419      .      .      .      DCB-C
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2424      .      .      CDCB-C.....
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2430      .      .      .      .      LMBLVD
2428      .      .      DCDCB-C
.      .      .      V
.      .      .      V
2433      .      .      RDCDCB
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2437      .      .      .      E
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2442      .      .      .      RE
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2446      .      .      .      .      F
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2451      .      .      .      CF.....
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2455      .      .      CCF.....
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2461      .      .      .      .      DTONO
2459      .      .      DCF
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2464      .      .      RDCF
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2468      .      .      .      H
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2473      .      .      .      .      I

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+		LC21-1	.22	1	FLOW TIME	116. 3.92	114. 3.92	110. 3.92	106. 3.92	104. 3.92	103. 3.92	102. 3.92	101. 3.92	99. 3.92
2 COMBINED AT														
+		CLC21-1	22.83	1	FLOW TIME	5140. 4.17	5013. 4.17	4784. 4.17	4549. 4.17	4472. 4.17	4411. 4.17	4362. 4.25	4288. 4.25	4199. 4.25
ROUTED TO														
+		RCLC21-1	22.83	1	FLOW TIME	5122. 4.17	4993. 4.17	4769. 4.25	4542. 4.25	4470. 4.25	4408. 4.25	4359. 4.25	4284. 4.25	4195. 4.25
HYDROGRAPH AT														
+		LC21-2	.23	1	FLOW TIME	121. 3.92	119. 3.92	115. 3.92	111. 3.92	110. 3.92	109. 3.92	108. 3.92	107. 3.92	105. 3.92
2 COMBINED AT														
+		CLC21-2	23.06	1	FLOW TIME	5214. 4.17	5084. 4.17	4852. 4.17	4615. 4.25	4542. 4.25	4479. 4.25	4430. 4.25	4354. 4.25	4264. 4.25
DIVERSION TO														
+		DWAPR	23.06	1	FLOW TIME	3685. 4.17	3555. 4.17	3323. 4.17	3086. 4.25	3013. 4.25	2950. 4.25	2901. 4.25	2825. 4.25	2735. 4.25
HYDROGRAPH AT														
+		DCLC21	23.06	1	FLOW TIME	1529. 3.83	1529. 3.83	1529. 3.92	1529. 3.92	1529. 3.92	1529. 3.92	1529. 3.92	1529. 3.92	1529. 3.92
ROUTED TO														
+		RDCLC21	23.06	1	FLOW TIME	1529. 3.92	1529. 3.92	1529. 4.00	1529. 4.00	1529. 4.00	1529. 4.00	1529. 4.00	1529. 4.00	1529. 4.00
HYDROGRAPH AT														
+		LC22	.14	1	FLOW TIME	72. 3.92	71. 3.92	68. 3.92	66. 3.92	65. 3.92	64. 3.92	64. 3.92	63. 3.92	62. 3.92
2 COMBINED AT														
+		CLC22	23.21	1	FLOW TIME	1601. 3.92	1600. 3.92	1597. 4.00	1594. 4.00	1594. 4.00	1593. 4.00	1592. 4.00	1592. 4.00	1591. 4.00
ROUTED TO														
+		RCLC22	23.21	1	FLOW TIME	1600. 4.00	1599. 4.00	1596. 4.00	1592. 4.00	1591. 4.08	1590. 4.08	1589. 4.08	1588. 4.08	1587. 4.08
HYDROGRAPH AT														
+		DWAPR	.00	1	FLOW TIME	3685. 4.17	3555. 4.17	3323. 4.17	3086. 4.25	3013. 4.25	2950. 4.25	2901. 4.25	2825. 4.25	2735. 4.25
ROUTED TO														
+		RDWAPR	.00	1	FLOW TIME	3674. 4.17	3543. 4.17	3315. 4.25	3085. 4.25	3012. 4.25	2950. 4.25	2900. 4.25	2824. 4.25	2733. 4.25
HYDROGRAPH AT														
+		V1	.10	1	FLOW TIME	55. 3.67	53. 3.67	51. 3.67	49. 3.67	48. 3.67	48. 3.67	47. 3.67	46. 3.67	45. 3.67
2 COMBINED AT														
+		CV1	.10	1	FLOW TIME	3693. 4.17	3561. 4.17	3329. 4.17	3099. 4.25	3025. 4.25	2963. 4.25	2913. 4.25	2837. 4.25	2746. 4.25
ROUTED TO														
+		RCV1	.10	1	FLOW TIME	3681. 4.25	3552. 4.25	3328. 4.25	3098. 4.25	3024. 4.25	2959. 4.25	2911. 4.25	2834. 4.25	2744. 4.25
HYDROGRAPH AT														
+		V2	.08	1	FLOW TIME	40. 3.67	39. 3.67	38. 3.67	36. 3.67	36. 3.67	35. 3.67	35. 3.67	34. 3.67	33. 3.67
ROUTED TO														
+		RV2	.08	1	FLOW TIME	39. 3.75	39. 3.75	37. 3.75	35. 3.75	35. 3.75	34. 3.75	34. 3.75	33. 3.75	33. 3.75
HYDROGRAPH AT														
+		V3	.11	1	FLOW TIME	44. 3.75	43. 3.75	41. 3.75	39. 3.75	38. 3.75	38. 3.75	37. 3.75	37. 3.75	36. 3.75
3 COMBINED AT														
+		CV3	.28	1	FLOW TIME	3707. 4.25	3578. 4.25	3353. 4.25	3122. 4.25	3048. 4.25	2983. 4.25	2935. 4.25	2856. 4.25	2766. 4.25
HYDROGRAPH AT														
+		CH59-1	.02	1	FLOW TIME	15. 3.58	15. 3.58	14. 3.58	14. 3.58	14. 3.58	13. 3.58	13. 3.58	13. 3.58	13. 3.58
ROUTED TO														
+		RCCH59-1	.02	1	FLOW TIME	15. 3.67	14. 3.67	14. 3.67	13. 3.67	13. 3.67	13. 3.67	13. 3.67	13. 3.67	12. 3.67
HYDROGRAPH AT														
+		CH59-2	.03	1	FLOW	19.	19.	18.	18.	17.	17.	17.	17.	16.

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			TIME		3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT													
+	CCH59-2	.05	1	FLOW TIME	34. 3.58	33. 3.58	32. 3.58	31. 3.58	30. 3.58	30. 3.58	30. 3.58	29. 3.58	29. 3.58
ROUTED TO													
+	RCCH59-2	.05	1	FLOW TIME	33. 3.67	33. 3.67	32. 3.67	30. 3.67	30. 3.67	30. 3.67	29. 3.67	29. 3.67	28. 3.67
HYDROGRAPH AT													
+	CH59-3	.02	1	FLOW TIME	14. 3.58	14. 3.58	13. 3.58	13. 3.58	13. 3.58	13. 3.58	12. 3.58	12. 3.58	12. 3.58
2 COMBINED AT													
+	CCH59-3	.06	1	FLOW TIME	46. 3.58	45. 3.58	44. 3.58	42. 3.58	41. 3.67	41. 3.67	41. 3.67	40. 3.67	39. 3.67
ROUTED TO													
+	RCCH59-3	.06	1	FLOW TIME	46. 3.75	45. 3.75	43. 3.75	41. 3.75	41. 3.75	40. 3.75	40. 3.75	40. 3.75	39. 3.75
HYDROGRAPH AT													
+	CH59-4	.03	1	FLOW TIME	21. 3.67	21. 3.67	20. 3.67	19. 3.67	19. 3.67	19. 3.67	19. 3.67	18. 3.67	18. 3.67
ROUTED TO													
+	RCH59-4	.03	1	FLOW TIME	21. 3.67	20. 3.67	19. 3.67	19. 3.67	18. 3.75	18. 3.67	18. 3.67	18. 3.67	18. 3.67
HYDROGRAPH AT													
+	CH59-5	.04	1	FLOW TIME	28. 3.67	27. 3.67	26. 3.67	25. 3.67	25. 3.67	25. 3.67	24. 3.67	24. 3.67	24. 3.67
2 COMBINED AT													
+	CCH59-5	.07	1	FLOW TIME	48. 3.67	47. 3.67	45. 3.67	44. 3.67	43. 3.67	43. 3.67	42. 3.67	42. 3.67	41. 3.67
HYDROGRAPH AT													
+	CH59-6	.03	1	FLOW TIME	21. 3.67	20. 3.67	19. 3.67	19. 3.67	18. 3.67	18. 3.67	18. 3.67	18. 3.67	18. 3.67
3 COMBINED AT													
+	CCH59-6	.16	1	FLOW TIME	109. 3.75	107. 3.75	103. 3.75	99. 3.75	98. 3.75	97. 3.75	96. 3.75	95. 3.75	93. 3.75
HYDROGRAPH AT													
+	CH59-7	.01	1	FLOW TIME	13. 3.58	13. 3.58	12. 3.58	12. 3.58	12. 3.58	12. 3.58	11. 3.58	11. 3.58	11. 3.58
ROUTED TO													
+	RCH59-7	.01	1	FLOW TIME	12. 3.67	12. 3.67	12. 3.67	11. 3.67	11. 3.67	11. 3.67	11. 3.67	11. 3.67	11. 3.67
HYDROGRAPH AT													
+	CH59-8	.02	1	FLOW TIME	17. 3.58	16. 3.58	16. 3.58	15. 3.58	15. 3.58	15. 3.58	15. 3.58	15. 3.58	14. 3.58
2 COMBINED AT													
+	CCH59-8	.04	1	FLOW TIME	28. 3.58	28. 3.58	27. 3.58	26. 3.58	26. 3.58	25. 3.58	25. 3.58	25. 3.58	24. 3.58
ROUTED TO													
+	RCCH59-8	.04	1	FLOW TIME	28. 3.67	27. 3.67	26. 3.67	25. 3.67	25. 3.67	25. 3.67	24. 3.67	24. 3.67	24. 3.67
HYDROGRAPH AT													
+	CH59-9	.01	1	FLOW TIME	13. 3.58	12. 3.58	12. 3.58	12. 3.58	11. 3.58	11. 3.58	11. 3.58	11. 3.58	11. 3.58
3 COMBINED AT													
+	CCH59-9	.21	1	FLOW TIME	145. 3.67	142. 3.67	136. 3.67	131. 3.67	129. 3.67	128. 3.67	127. 3.67	125. 3.67	123. 3.67
DIVERSION TO													
+	DCARSON	.21	1	FLOW TIME	1. 3.67	0. .00	0. .00	0. .00	0. .00	0. .00	0. .00	0. .00	0. .00
HYDROGRAPH AT													
+	DCH59	.21	1	FLOW TIME	144. 3.67	142. 3.67	136. 3.67	131. 3.67	129. 3.67	128. 3.67	127. 3.67	125. 3.67	123. 3.67
ROUTED TO													
+	RCCH59-9	.21	1	FLOW TIME	140. 3.75	137. 3.75	132. 3.75	127. 3.75	125. 3.75	124. 3.75	123. 3.75	121. 3.75	119. 3.75
HYDROGRAPH AT													
+	CH58-1	.02	1	FLOW TIME	18. 3.58	17. 3.58	17. 3.58	16. 3.58	16. 3.58	16. 3.58	15. 3.58	15. 3.58	15. 3.58

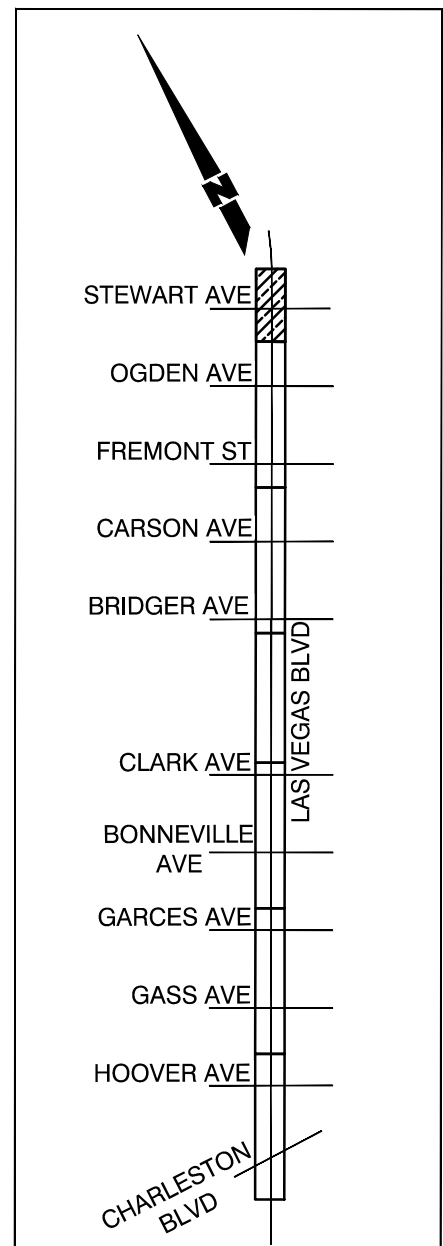
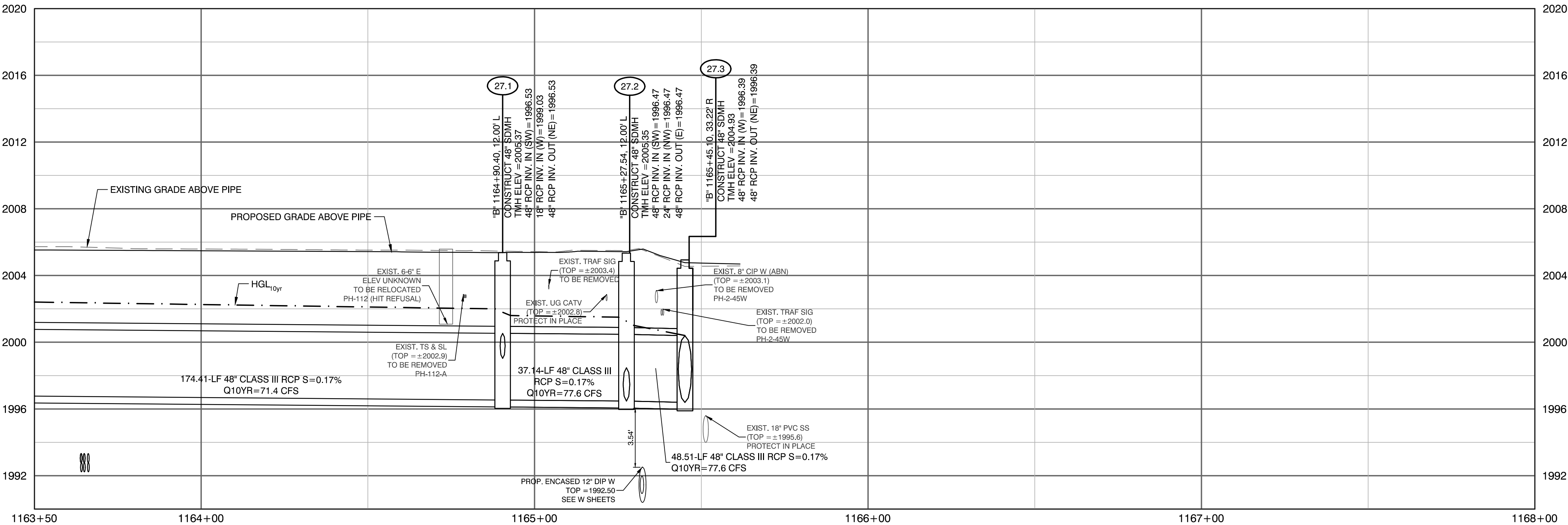
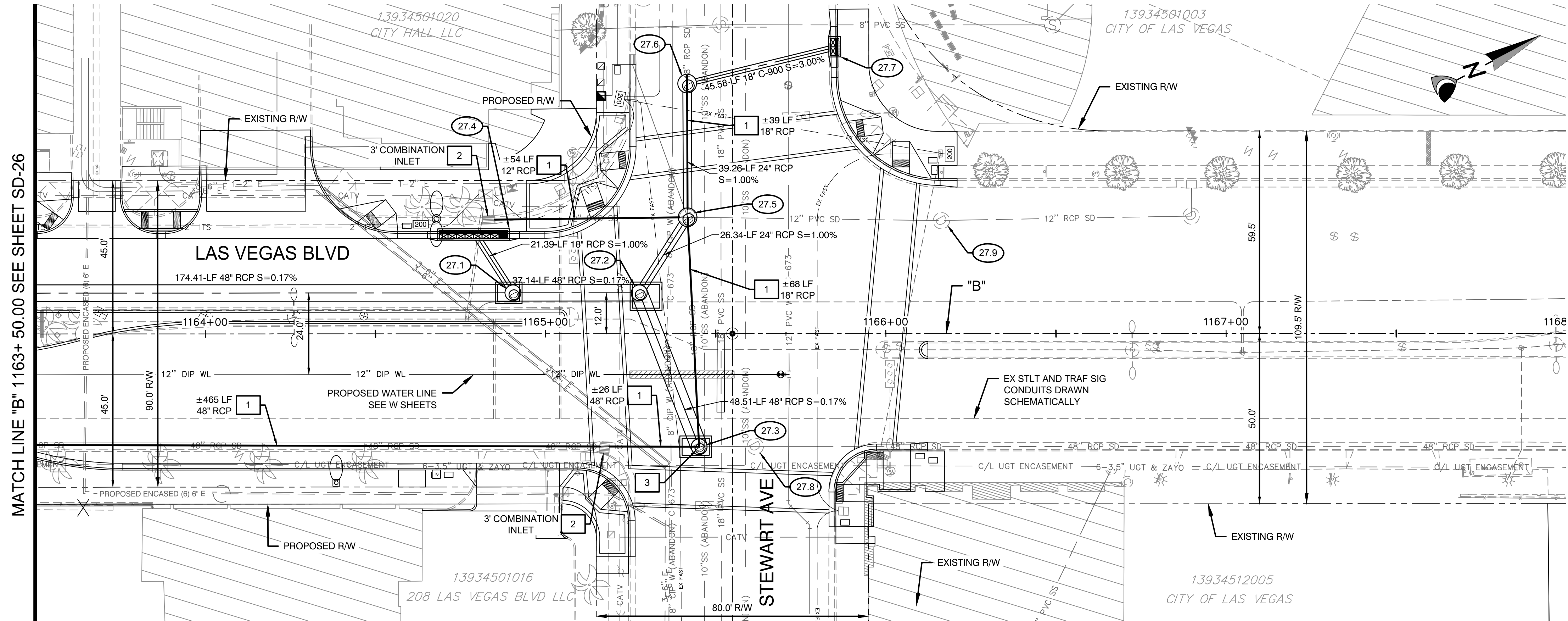
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ROUTED TO													
+	RCH58-1	.02	1	FLOW TIME	17. 3.67	17. 3.67	16. 3.67	16. 3.67	16. 3.67	15. 3.67	15. 3.67	15. 3.67	15. 3.67
HYDROGRAPH AT													
+	CH58-2	.03	1	FLOW TIME	23. 3.67	23. 3.67	22. 3.67	21. 3.67	21. 3.67	21. 3.67	20. 3.67	20. 3.67	20. 3.67
2 COMBINED AT													
+	CCH58-2	.06	1	FLOW TIME	40. 3.67	40. 3.67	38. 3.67	37. 3.67	36. 3.67	36. 3.67	35. 3.67	35. 3.67	35. 3.67
ROUTED TO													
+	RCCH58-2	.06	1	FLOW TIME	40. 3.67	39. 3.67	37. 3.67	36. 3.67	36. 3.67	35. 3.67	35. 3.67	34. 3.67	34. 3.67
HYDROGRAPH AT													
+	CH58-3	.03	1	FLOW TIME	19. 3.58	18. 3.58	18. 3.67	17. 3.67	17. 3.67	17. 3.67	17. 3.67	16. 3.67	16. 3.67
3 COMBINED AT													
+	CCH58-3	.29	1	FLOW TIME	195. 3.75	190. 3.75	184. 3.75	177. 3.75	175. 3.75	173. 3.75	172. 3.75	169. 3.75	166. 3.75
ROUTED TO													
+	RCCH58-3	.29	1	FLOW TIME	192. 3.75	188. 3.75	181. 3.75	175. 3.75	173. 3.75	170. 3.75	169. 3.75	167. 3.75	164. 3.75
HYDROGRAPH AT													
+	CH58-4	.05	1	FLOW TIME	27. 3.67	27. 3.67	26. 3.67	25. 3.67	24. 3.67	24. 3.67	24. 3.67	24. 3.67	23. 3.67
2 COMBINED AT													
+	CCH58-4	.34	1	FLOW TIME	218. 3.75	213. 3.75	205. 3.75	198. 3.75	196. 3.75	193. 3.75	191. 3.75	189. 3.75	186. 3.75
DIVERSION TO													
+	DBN00	.34	1	FLOW TIME	51. 3.75	46. 3.75	38. 3.75	31. 3.75	29. 3.75	26. 3.75	24. 3.75	22. 3.75	19. 3.75
HYDROGRAPH AT													
+	DCCH58	.34	1	FLOW TIME	167. 3.58	167. 3.58	167. 3.67	167. 3.67	167. 3.67	167. 3.67	167. 3.67	167. 3.67	167. 3.67
ROUTED TO													
+	RDCCH58	.34	1	FLOW TIME	167. 3.92	167. 3.92	166. 3.83	166. 3.83	166. 3.83	165. 3.83	165. 3.83	165. 3.83	165. 3.83
HYDROGRAPH AT													
+	W	.07	1	FLOW TIME	36. 3.67	35. 3.67	34. 3.67	32. 3.67	32. 3.67	31. 3.67	31. 3.67	31. 3.67	30. 3.67
2 COMBINED AT													
+	CW	.41	1	FLOW TIME	199. 3.75	198. 3.75	195. 3.75	193. 3.83	193. 3.83	192. 3.83	192. 3.83	191. 3.83	191. 3.83
3 COMBINED AT													
+	CCW	23.90	1	FLOW TIME	5417. 4.17	5282. 4.17	5043. 4.17	4796. 4.25	4720. 4.25	4654. 4.25	4605. 4.25	4525. 4.25	4433. 4.25
ROUTED TO													
+	RCCW	23.90	1	FLOW TIME	5398. 4.17	5263. 4.25	5032. 4.25	4796. 4.25	4719. 4.25	4653. 4.25	4603. 4.25	4523. 4.25	4431. 4.25
HYDROGRAPH AT													
+	Y	.08	1	FLOW TIME	53. 3.67	52. 3.67	50. 3.67	48. 3.67	48. 3.67	47. 3.67	47. 3.67	46. 3.67	45. 3.67
ROUTED TO													
+	RY	.08	1	FLOW TIME	52. 3.75	51. 3.75	50. 3.75	50. 3.75	49. 3.75	48. 3.75	48. 3.75	47. 3.75	46. 3.75
HYDROGRAPH AT													
+	X	.13	1	FLOW TIME	79. 3.58	77. 3.58	74. 3.58	71. 3.58	70. 3.58	69. 3.58	68. 3.58	67. 3.58	66. 3.58
2 COMBINED AT													
+	CX	.21	1	FLOW TIME	125. 3.67	122. 3.67	118. 3.67	114. 3.67	112. 3.67	111. 3.67	110. 3.67	108. 3.67	106. 3.67
2 COMBINED AT													
+	CCX	24.11	1	FLOW TIME	5436. 4.17	5301. 4.17	5061. 4.25	4823. 4.25	4746. 4.25	4679. 4.25	4629. 4.25	4549. 4.25	4456. 4.25
ROUTED TO													
+	RCCX	24.11	1	FLOW TIME	5427. 4.25	5292. 4.25	5059. 4.25	4819. 4.25	4742. 4.25	4675. 4.25	4625. 4.25	4544. 4.25	4451. 4.25

C.3 Las Vegas Boulevard Improvements Stewart Ave to Sahara Ave Excerpts

- C.3.1 - LV Blvd Improvements to Stewart Ave to Sahara Ave Plan Sheet SD-27
- C.3.2 - LV Blvd Improvements to Stewart Ave to Sahara Ave Drainage Report Excerpt

C.3.1 LV Blvd Improvements Stewart Ave to Sahara Ave
Plan Sheet SD-27



CONSTRUCTION NOTES

- 27.1 "B" 1164+90.40, 12.00' LT CONSTRUCT 48" TYPE II SDMH W/ TYPE IA RISER PER USDCCA 405.2 AND 404.1
- 27.2 "B" 1165+27.54, 12.00' LT CONSTRUCT 48" TYPE II SDMH W/ TYPE IA RISER PER USDCCA 405.2 AND 404.1
- 27.3 "B" 1165+45.10, 33.22' RT CONSTRUCT 48" TYPE II SDMH W/ TYPE IA RISER PER USDCCA 405.2 AND 404.1
- 27.4 "B" 1164+78.84, 30.00' LT CONSTRUCT 20" TYPE "DM2" DI PER PER USDCCA 412.1 SEE PROFILE 67 ON SD-47
- 27.5 "B" 1165+41.75, 34.18' LT CONSTRUCT 60" TYPE IA SDMH PER USDCCA 404.1 SEE PROFILE 68 ON SD-47
- 27.6 "B" 1165+41.64, 73.44' LT CONSTRUCT 60" TYPE IA SDMH PER USDCCA 404.1 SEE PROFILE 68 ON SD-47
- 27.7 "B" 1165+85.90, 84.25' LT CONSTRUCT 5' TYPE "DM2" DI PER PER USDCCA 412.1 W/ 2 VANE GRATES SEE PROFILE 76 ON SD-48
- 27.8 "B" 1165+61.62, 33.11' RT ADJUST EXISTING STORM DRAIN MANHOLE TO FINISHED GRADE.
- 27.9 "B" 1166+16.14, 33.21' LT ADJUST EXISTING STORM DRAIN MANHOLE TO FINISHED GRADE.

REMOVAL NOTES

- 1 REMOVE EXISTING STORM DRAIN PIPE.
- 2 REMOVE EXISTING STORM DRAIN INLET.
- 3 REMOVE EXISTING STORM DRAIN MANHOLE.
- 4 ABANDON EXISTING STORM DRAIN PIPE.

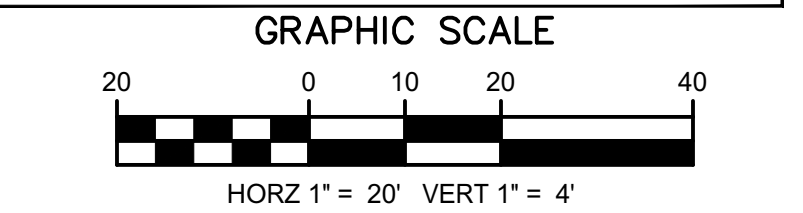
NOTE:
1. CONTRACTOR SHALL INSTALL STORM WATER QUALITY MANAGEMENT STAMP AND SIGN DETAIL, ADJACENT TO ALL NEW DROP INLETS PER USDCCA DWG. NO. 421.
2. AT MANHOLES, ALL PIPE INVERTS PROVIDED AT CENTER OF MANHOLE.
3. AT DROP INLETS, ALL PIPE INVERTS PROVIDED PER DETAIL ON SD-49.

DROP INLET NOTE
WHERE 10 FT PARALLEL SEPARATION IS NOT PRACTICABLE: CAST-IN-PLACE MONOLITHIC POUR WITH WATERSTOP BETWEEN SLAB AND WALLS. BASE, WALLS, AND TOP TO BE CONSTRUCTED WITH WATERSTOPS. CENTER BULB, OR FLAT STRIP (VINYLEX, GREENSTREAK PLASTIC PRODUCTS OR APPROVED EQUAL).

CALL SOUTHWEST GAS AT 702-400-1789 FOR STANDBY WHEN EXCAVATING OVER OR NEAR HIGH PRESSURE GAS LINES.

UTILITY NOTE:
EXISTING UTILITIES SHOWN HEREIN ARE APPROXIMATE ONLY AND MAY NOT SHOW ALL EXISTING FACILITIES WITHIN THE PROJECT AREA. CONTRACTOR MUST FIELD VERIFY AND POTHOLE EXISTING UTILITIES WITHIN THE PROJECT AREA PRIOR TO BEGINNING CONSTRUCTION. ALL EXISTING UTILITIES MUST BE PROTECTED IN PLACE DURING CONSTRUCTION.

APPROVED FOR CONSTRUCTION
LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES
PROJECT NO. 123555 FIRST APPROVED DATE: _____



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

PREPARED BY
CITY OF LAS VEGAS
BID# 19-46330
DATE: 10/11/2019
SUBMITTAL STAGE:
PRE-FINAL SUBMITTAL

DESIGNED BY: JB
DRAWN BY: JB
CHECKED BY: HM

LAS VEGAS BOULEVARD IMPROVEMENTS
STEWART AVE. TO SAHARA AVE.

STORM DRAIN PLAN AND PROFILE
"B" 1163+ 50.00 TO "B" 1168+ 00.00

SD-27
XX OF
DRAWING NO.
107V7871

PRE-FINAL SUBMITTAL
NOT FOR CONSTRUCTION

C.3.2 LV Blvd Improvements Stewart Ave to Sahara Ave
Drainage Report Excerpt

Bridger to Stewart
Street and Storm Drain Summary

Final Flow Routed North in LVB Through Intersection 100 YR

West Side of Street (cfs):	42.3 cfs
East Side of Street (cfs):	0.0 cfs

Final Flow Routed North in LVB Through Intersection 10 YR

West Side of Street(cfs):	20.3 cfs
East Side of Street (cfs):	0.0 cfs

Flow in Storm Drain System 100 YR

Previous segment Q + Qdiw + Qdie:	83.2 cfs
-----------------------------------	----------

Flow in Storm Drain System 10 YR

Qdiw + Qdie:	83.2 cfs
--------------	----------

Flow into Side Street: Stewart 100 YR	2.4 cfs
Flow into Side Street: Stewart 10 YR	0.0 cfs

APPENDIX D – 70% IMPROVEMENT PLANS

11/25/2019 6:\PROJECTWISEBIN8\LBQ2014\LBGUSER\B0280618\2042698-CV01.DWG



11/21/21

**NOT FOR
CONSTRUCTION**

CV

001 OF 163

DRAWING NO.
XXXXX

CITY OF LAS VEGAS FIRE AND RESCUE NOTES

- ALL WORK SHALL BE DONE IN STRICT ACCORDANCE WITH THE LAS VEGAS FIRE AND RESCUE APPROVED FIRE CODE ORDINANCE #6325 FOR HYDRANT SPECIFICATIONS AND HYDRANT INSTALLATION SPECIFICATIONS.
- ONLY FIRE HYDRANTS THAT ARE ON THE LAS VEGAS VALLEY WATER DISTRICT'S APPROVED PRODUCTS LIST ARE ALLOWED TO BE INSTALLED.
- A PERMIT IS REQUIRED FROM LAS VEGAS FIRE AND RESCUE FOR THE INSTALLATION OF ON-SITE WATER LINES AND FIRE HYDRANTS. THE PERMIT AND CONTRACTORS MATERIAL TEST CERTIFICATE FOR UNDERGROUND PIPING FORM SHALL BE OBTAINED FROM THE FIRE PROTECTION ENGINEER BEFORE COMMENCEMENT OF WORK. IFC § 105.7.12
- ON ANY RESIDENTIAL OR COMMERCIAL INSTALLATIONS, FIRE HYDRANTS SHALL BE INSTALLED AND FIRE APPARATUS ACCESS ROADS SHALL BE MAINTAINED BEFORE COMMENCEMENT OF ANY COMBUSTIBLE CONSTRUCTION. ALL FIRE HYDRANTS SHALL BE IN GOOD WORKING ORDER AND SHALL BE CAPABLE OF DELIVERING THE REQUIRED FIRE FLOW. IFC § 3310, § 3312
- TO IDENTIFY THE FIRE HYDRANT LOCATIONS, THE CONTRACTOR SHALL PLACE A BLUE REFLECTIVE MARKER AT THE CENTER LINE OF THE STREET ADJACENT TO THE FIRE HYDRANTS. IFC § 507.5.7.3
- ALL UNDERGROUND INSPECTIONS, PRESSURE AND FLUSH VERIFICATIONS OF ALL FIRE HYDRANTS AND FIRE LINES, SHALL BE CONDUCTED BEFORE COVERING THE LINES. CENTER LOADING IS ACCEPTABLE FOR THE HYDRO TESTS WITH PRIOR FIRE PREVENTION APPROVAL. IFC § 106.3
- ALL ON-SITE UNDERGROUND WATER MAINS AND MATERIALS SHALL BE U.L. LISTED, A.W.W.A APPROVED AND SHALL BE RATED FOR THE APPROPRIATE WORKING PRESSURE. IFC § 507.2.1, NFPA 24
- PAINTING OF CURBS, FIRE HYDRANTS, PADS, PROTECTION OF FIRE HYDRANTS FROM PHYSICAL DAMAGE, AND ALL OTHER WORK NECESSARY PER PLANS SHALL BE COMPLETED BEFORE APPROVAL BY LAS VEGAS FIRE AND RESCUE, FIRE PREVENTION DIVISION. IFC § 507
- PRIVATE HYDRANTS SHALL BE PAINTED RED. IFC § 507.5.7.1
- PRIOR TO THE FINAL OCCUPANCY, A FIRE FLOW TEST SHALL BE WITNESSED BY LAS VEGAS FIRE AND RESCUE, FIRE PREVENTION DIVISION TO VERIFY AVAILABILITY OF THE REQUIRED FIRE FLOW. IFC § 507
- FIRE HYDRANT SPACING SHALL BE AS FOLLOWS: IFC § C102
 - RESIDENTIAL - 500 FT UNSPRINKLERED; 600 FT SPRINKLERED.
 - COMMERCIAL - 300 FT UNSPRINKLERED; 400 FT SPRINKLERED.
- WHERE THE WATER MAINS ARE EXTENDED ALONG STREETS OR NEW STREETS ARE INSTALLED WHERE FIRE HYDRANTS ARE NOT NEEDED FOR PROTECTION OF THE STRUCTURES, FIRE HYDRANTS SHALL BE INSTALLED AT A MAXIMUM OF 1000 FT SPACING, TO PROVIDE FOR TRANSPORTATION HAZARDS. WHERE STREETS ARE PROVIDED WITH MEDIAN DIVIDERS OR HAVE FOUR (4) OR MORE TRAFFIC LANES AND HAVE A TRAFFIC COUNT OF MORE THAN 30,000 PER DAY, HYDRANTS ARE REQUIRED ON EACH SIDE OF THE STREET SPACED AT 500 FT ON AN ALTERNATING BASIS. IFC § C102.8
- NO FIRE HYDRANTS SHALL BE LOCATED WITHIN THE RADIUS OF A CUL-DE-SAC OR WITHIN 20 FT OF THE PERIMETER OF THE RADIUS OF THE CUL-DE-SAC.
- NO FIRE HYDRANTS SHALL BE LOCATED WITHIN 6 FT OF ANY CURB RETURN, DRIVEWAY, POWER POLE, STREETLIGHT OR ANY OTHER OBSTRUCTION. IFC § C102.12
- A MAXIMUM DISTANCE FROM A FIRE HYDRANT TO A ONE-TWO FAMILY DWELLING SHALL NOT EXCEED 300 FT, AS MEASURED BY AN APPROVED ROUTE. IFC § 102.4
- THE MAXIMUM DISTANCE FROM A FIRE HYDRANT TO A FIRE DEPARTMENT CONNECTION (FDC) SHALL NOT EXCEED 100 FT, AS MEASURED BY AN APPROVED ROUTE. IFC § C102.7
- THE MAXIMUM DISTANCE FROM A HYDRANT TO THE END OF A DEAD-END STREET SHALL NOT EXCEED 200 FT. IFC § C102.6
- TWO (2) SOURCES OF SUPPLY ARE REQUIRED WHENEVER THERE IS 4 OR MORE FIRE HYDRANTS/SPRINKLER LEAD-INS ARE INSTALLED ON A SINGLE SYSTEM. SECTIONAL CONTROL VALVES SHALL BE INSTALLED SO THAT NO MORE THAN 2 FIRE HYDRANTS CAN BE OUT OF SERVICE DUE TO A BREAK IN A WATER MAIN. IFC § C104
- ALL FIRE APPARATUS ACCESS ROADS SHALL BE PAVED TO PROVIDE ALL-WEATHER DRIVING CAPABILITIES, AND SHALL BE DESIGNED AND MAINTAINED TO SUPPORT THE IMPOSED LOADS OF THE FIRE APPARATUS. IFC § 503.2.3
- THE GRADIENT FOR THE FIRE APPARATUS ACCESS ROADS SHALL NOT EXCEED 12%. ANGLES OF APPROACH AND ANGLES OF DEPARTURE SHALL NOT EXCEED 6% FOR 25 FT PRIOR TO OR AFTER THE GRADE CHANGE. ADJACENT TO THE STRUCTURES GRADIENT SHALL NOT EXCEED 6%. IFC § 503.2.7, 503.2.8
- THE TURNING RADIUS OF THE FIRE APPARATUS ACCESS ROADS SHALL BE NO LESS THAN 52 FT OUTSIDE AND 28 FT INSIDE TURNING RADIUS. IFC § 503.2.4
- VERTICAL CLEARANCE OF ALL FIRE APPARATUS ACCESS ROADS SHALL NOT BE LESS THAN 13FT 6 INS. IFC § 503.2.1
- FIRE DEPARTMENT ACCESS ROADS SHALL HAVE A MINIMUM UNOBSTRUCTED WIDTH OF NOT LESS THAN 40 FT FLOW LINE TO FLOW LINE WITH PARALLEL PARKING PERMITTED ON BOTH SIDES, NOT LESS THAN 32 FT WIDE, FLOW LINE TO FLOW LINE, WHERE PARKING IS PERMITTED ONLY ON ONE SIDE OF THE FIRE APPARATUS ACCESS ROAD. NOT LESS THAN 24FT WIDE, FLOW LINE TO FLOW LINE, WHERE NO PARKING IS PERMITTED ON EITHER SIDE. FIRE LINES THROUGH PARKING LOTS SHALL BE NOT LESS THAN 24 FT. IFC § 503.2.1.1
- A FIRE APPARATUS ACCESS ROAD SHALL BE REQUIRED WHEN ANY PORTION OF AN EXTERIOR WALL OF THE FIRST STORY IS LOCATED MORE THAN 150 FT FROM A FIRE DEPARTMENT VEHICLE ACCESS. THIS DISTANCE COULD BE INCREASED TO 250 FT IF THE BUILDING IS SPRINKLERED. IFC § 503.1.1
- APPROVED SECONDARY FIRE APPARATUS ACCESS SHALL BE PROVIDED FOR 100 OR MORE DWELLING UNITS, ROAD(S) WITH DEAD-ENDS OR WITH A SINGLE POINT OF ACCESS IN EXCESS OF 600 FT. COMMERCIAL AND INDUSTRIAL DEVELOPMENTS WHERE BUILDINGS EXCEED 2 STORIES OR 30 FEET IN HEIGHT, OR EXCEEDING 62,000 SQUARE FEET IN AREA. IFC § 503.1.2
- ALL DEAD-END FIRE APPARATUS ROADS AND/OR FIRE LINES, PUBLIC OR PRIVATE, IN EXCESS OF 150 FT IN LENGTH SHALL BE PROVIDED WITH AN APPROVED TURN AROUND HAVING A MINIMUM DIAMETER OF 81 FT. IFC § 503.2.5
- ALL FIRE APPARATUS ACCESS ROADS SHALL BE MARKED BY PLACING APPROVED SIGNS AT THE START OF THE DESIGNATED FIRE LANE, ONE SIGN AT THE END OF THE FIRE LANE AND WITH SIGNS AT INTERVALS OF 100 FT ALONG THE DESIGNATED FIRE LINES. SIGNS TO BE PLACED ON BOTH SIDES OF AN ACCESS ROADWAY IF NEEDED TO PREVENT PARKING ON EITHER SIDE. SIGNS TO BE INSTALLED NO HIGHER THAN 10 FT OR LESS THAN 6 FT FROM THE ROADWAY LEVEL. THE CURB ALONG OR ON THE PAVEMENT OR CEMENT (IF NO CURB IS PROVIDED) SHALL BE PAINTED WITH A RED WEATHER RESISTANT PAINT IN ADDITION TO THE SIGNS. IFC § 503.3
- ELECTRICALLY CONTROLLED ACCESS GATES SHALL BE PROVIDED WITH AN APPROVED EMERGENCY VEHICLE DETECTOR/RECEIVER SYSTEM. SAID SYSTEM SHALL BE INSTALLED IN ACCORDANCE WITH THE IFC § 503.6 AND IFC APPENDIX M.

REVISÉ MARCH 1, 2016

SOUTHWEST GAS NOTES

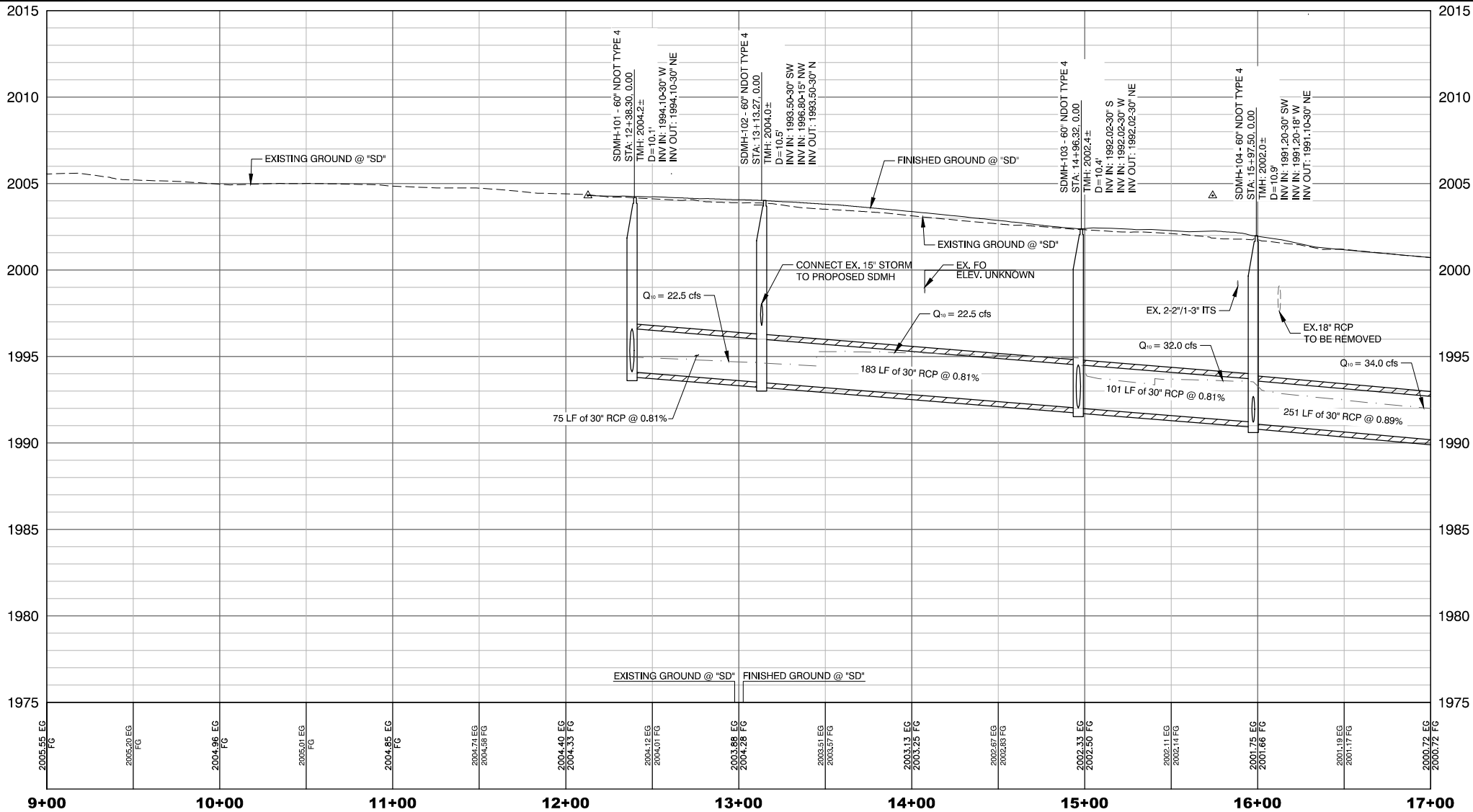
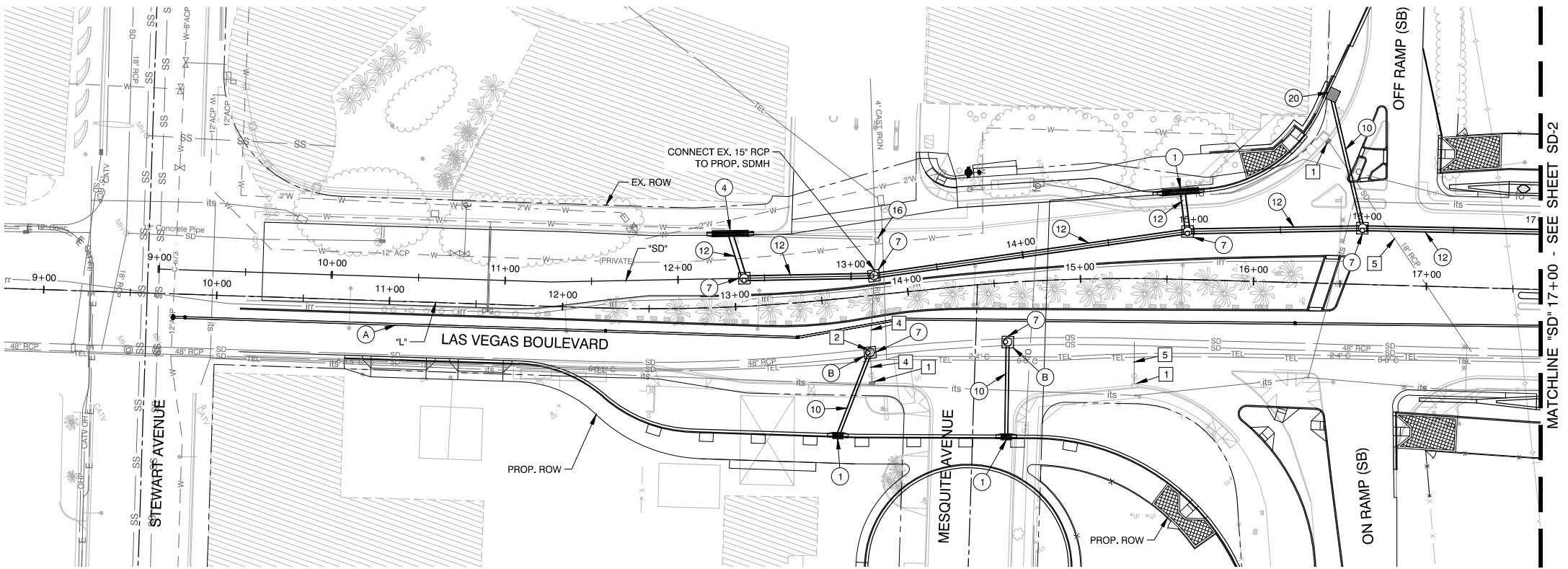
1. IN THE EVENT OF NATURAL GAS EMERGENCIES CALL 911 AND 1-877-860-6020.
2. MINIMUM HORIZONTAL AND VERTICAL CLEARANCES BETWEEN NATURAL GAS FACILITIES AND ANY UNDERGROUND UTILITIES AND/OR STRUCTURES, INCLUDING BUT NOT LIMITED TO WATER, SEWER, STORM DRAIN, COMMUNICATIONS, AND ELECTRIC SHALL BE AT LEAST 12 INCHES OR GREATER AS DICTATED BY LOCAL CODES AND STANDARDS.
 - A) ANY DEVIATION FROM SPECIFIED MINIMUM CLEARANCES MUST BE APPROVED BY ALL AFFECTED UTILITIES AND/OR MUNICIPALITIES.
3. FOR VERTICAL ADJUSTMENTS, CONTACT THE UTILITY AT 724-765-2097 24 HOURS PRIOR TO CONSTRUCTION.
4. IN THE EVENT OF A NATURAL GAS CONFLICT WITH PROPOSED UTILITIES AND STRUCTURES CONTACT 724-365-2099.

CAUTION: HIGH PRESSURE GAS!!!
CONTRACTOR TO CALL SOUTHWEST GAS AT
702-400-1789 FOR STANDBY WHEN
EXCAVATING OVER OR NEAR HIGH PRESSURE
GAS LINES 48 HOURS PRIOR TO CONSTRUCTION

CITY OF LAS VEGAS STREET LIGHT NOTES

1. ALL STREET LIGHTING INSTALLATIONS SHALL BE IN ACCORDANCE WITH THE STREET LIGHTING PLANS, THE "UNIFORM STANDARD SPECIFICATION FOR PUBLIC WORKS CONSTRUCTION OFF-SITE IMPROVEMENTS, CLARK COUNTY AREA, NEVADA," LATEST REVISION (US), AND THE "UNIFORM STANDARD DRAWINGS FOR PUBLIC WORKS CONSTRUCTION OFF-SITE IMPROVEMENTS, CLARK COUNTY AREA, NEVADA" (USD), LATEST REVISION.
 2. DESIGN PROFESSIONAL, AND CONTRACTOR SHALL VERIFY CITY'S LATEST LED FIXTURE SPECIFICATIONS AND APPROVED FIXTURES PER CLV WEBSITE, UNDER BUILDING AND SAFETY FORMS, PRIOR TO ORDERING MATERIALS.
 3. NO DEVIATION OF STREET LIGHT, PULL BOX, CONDUITS, ETC., LOCATIONS SHALL BE PERMITTED WITHOUT WRITTEN APPROVAL OF THE TRAFFIC AND CITY ENGINEER, ANY DEVIATION FROM THE PLAN LOCATION WILL REQUIRE COMPLIANCE WITH SECTION 623 OF THE USS.
 4. ALL EXISTING STREET LIGHTING SHALL REMAIN OPERATIONAL DURING CONSTRUCTION IN ACCORDANCE WITH SECTION 623 G.03.01 OF THE USS.
 5. ALL EMPTY CONDUIT SHALL HAVE AT LEAST ONE GREEN NO. #8 AWG WIRE INSTALLED AS TRACER WIRE IN ACCORDANCE WITH SECTION 623 G.02.01 OF THE USS PRIOR TO BACKFILLING AND FINAL INSPECTION.
 6. ANY STRUCTURE SUCH AS BLOCK WALLS, CHAIN LINK FENCES, RETAINING WALLS, ETC., SHALL LEAVE A MINIMUM CLEARANCE IN COMPLIANCE WITH USD NO. 320A WHEN POLE IS INSTALLED BEHIND SIDEWALK, AND SHALL AT NO TIME COMPLETELY ENCLOSE THE STREET LIGHTING POLE.
 7. AS-BUILT DRAWINGS SHALL BE SUPPLIED TO THE TRAFFIC ENGINEERING DIVISION PRIOR TO ANY PRE-FINAL INSPECTION, THE AS-BUILT DRAWING NEEDS TO BE STAMPED AS-BUILT AND SIGNED BY THE PREPARER.
 8. SERVICE POINTS SHALL BE COORDINATED WITH NV ENERGY, AND WHEREVER POSSIBLE BE LOCATED NEAR THE CENTER OF THE CIRCUIT. SERVICEPOINTS SHALL BE SHOWN ON THE PLANS.
 9. THE CONTRACTOR SHALL FURNISH COMPLETE CONDUIT, WIRE, DELIVERY FROM SERVICE TO TRANSFORMERS AND CONTROL SYSTEMS IF REQUIRED ON THE PLANS OR IN THE SPECIAL PROVISIONS.
 10. ALL STREET LIGHTING AND TRAFFIC SIGNAL EQUIPMENT REMOVED AND / OR DESIGNATED TO BE SALVAGED SHALL BE DELIVERED BY THE CONTRACTOR TO THE APPROPRIATE CLV SERVICE YARD WITH A MEANS TO UNLOAD, A MINIMUM 24-HOUR DELIVERY IS REQUIRED, CALL 229-6331 TO SET UP DELIVERY TIME AND LOCATION. REPAIR OF ANY DAMAGE TO EQUIPMENT DURING THIS PROCESS WILL BE THE CONTRACTOR'S RESPONSIBILITY, AT NO ADDITIONAL COST TO THE CITY.
- REVISED JUNE 4, 2018 (CPM VERSION)

		GN-2 003 OF 163 DRAWING NO. XXXX		SHEET	
NOT FOR CONSTRUCTION		NOTES, LEGEND, KEY MAP AND INDEX		SHEET	
TITLE LAS VEGAS BOULEVARD IMPROVEMENTS FROM STEWART AVENUE TO WASHINGTON AVENUE		CITY OF LAS VEGAS		PREPARED BY	
ENGINEER Vijaykumar Krishnakumar K. Srinivasan Exp. 8/30/2021 CIVIL		DESIGNED BY: MK		BID# XX-XXXX	
DATE: 11/22/2019		DRAWN BY: JPS		H# 38069	
SUBMITTAL STAGE: 70% PRELIMINARY		CHECKED BY: KK		NO. DATE	
PREPARED BY		WSP WSP Group, Inc. A WSP Company 444 East Warm Springs Road, Ste 118 Las Vegas, Nevada 89119 Phone: 702.736.6632 - Fax: 702.407.1305		REVISIONS	



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

CONSTRUCTION KEY NOTES

- 1 CONSTRUCT TYPE "DM2" DROP INLET, L=5' PER USDCCA DWG. NO. 412.1
- 2 CONSTRUCT TYPE "DM2" DROP INLET, L=7.5' PER USDCCA DWG. NO. 412.1
- 3 CONSTRUCT TYPE "DM2" DROP INLET, L=10' PER USDCCA DWG. NO. 412.1
- 4 CONSTRUCT TYPE "DM2" DROP INLET, L=20' PER USDCCA DWG. NO. 412.1
- 5 CONSTRUCT TYPE 2B NDOT DROP INLET WITH CONCRETE APRON PER NDOT STD. DWG. R-4.2.1
- 6 CONNECT TO EX. 12"x8" RCB
- 7 CONSTRUCT 60" NDOT TYPE 4 MH PER NDOT STD. DWG. NO. R-4.3.2
- 8 CONSTRUCT 60" TYPE III MH PER USDCCA DWG. NO. 406
- 9 CONSTRUCT PRECAST MANHOLE TEE PER USDCCA DWG. NO. 407
- 10 INSTALL 18" RCP
- 11 INSTALL 24" RCP
- 12 INSTALL 30" RCP
- 13 INSTALL 36" RCP
- 14 NOT USED
- 15 INSTALL 48" RCP
- 16 EX. MH - ADJUST TO GRADE
- 17 CONSTRUCT TYPE "DM2" DROP INLET, L=17.5' PER USDCCA DWG. NO. 412.1
- 18 CONSTRUCT SIDEWALK DRAIN PER USDCCA DWG. NO. 236
- 19 CONSTRUCT TYPE 2 NDOT DROP INLET PER NDOT STD. DWG. R-4.2.1
- 20 CONSTRUCT TYPE 2B NDOT DROP INLET PER NDOT STD. DWG. R-4.2.1
- 21 REPLACE EX. DI FRAME AND GRATE WITH MANHOLE COVER - ADJUST TO GRADE

REMOVAL KEY NOTES

- 1 REMOVE EXISTING DROP INLET STRUCTURE
- 2 REMOVE EXISTING SDMH
- 3 REMOVE EXISTING 12" RCP
- 4 REMOVE EXISTING 15" RCP
- 5 REMOVE EXISTING 18" RCP
- 6 REMOVE EXISTING 24" RCP
- 7 REMOVE EXISTING 30" RCP
- 8 REMOVE EXISTING 48" RCP
- 9 ABANDON EXISTING 60" RCP

- (A) SEE SHEETS WL-1 THROUGH WL-6 FOR WATERLINE CONSTRUCTION.
- (B) SEE SHEET SD-10 FOR PROFILE.

APPROVED FOR CONSTRUCTION	
LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SVCS	
PROJECT NO. 135561	FIRST APPROVED DATE:

PREPARED BY


WSP
Las Vegas, NV
444 East Warm Springs Road, Ste 118
Las Vegas, Nevada 89119
Phone: 702.736.6632 - Fax: 702.407.1305

PREPARED FOR

CITY OF LAS VEGAS

BID #

XX.XXXX

DESIGNED BY:

JAM

DRAWN BY:

FME

CHECKED BY:

JSD

DATE:

11/22/2019

SUBMITTAL STAGE:

70% PRELIMINARY

TITLE

LAS VEGAS BOULEVARD IMPROVEMENTS FROM STEWART AVENUE TO WASHINGTON AVENUE

SHEET

SD-1

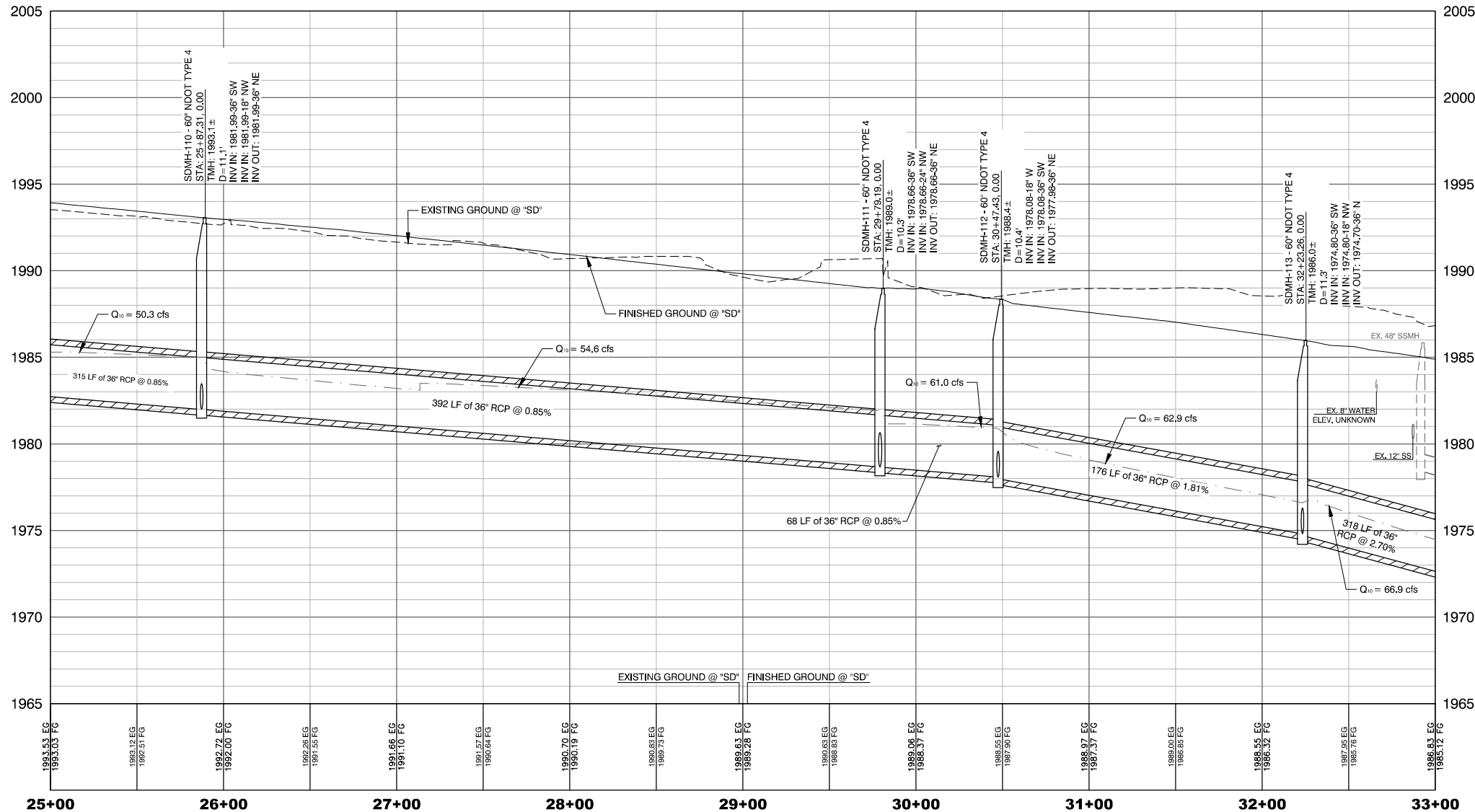
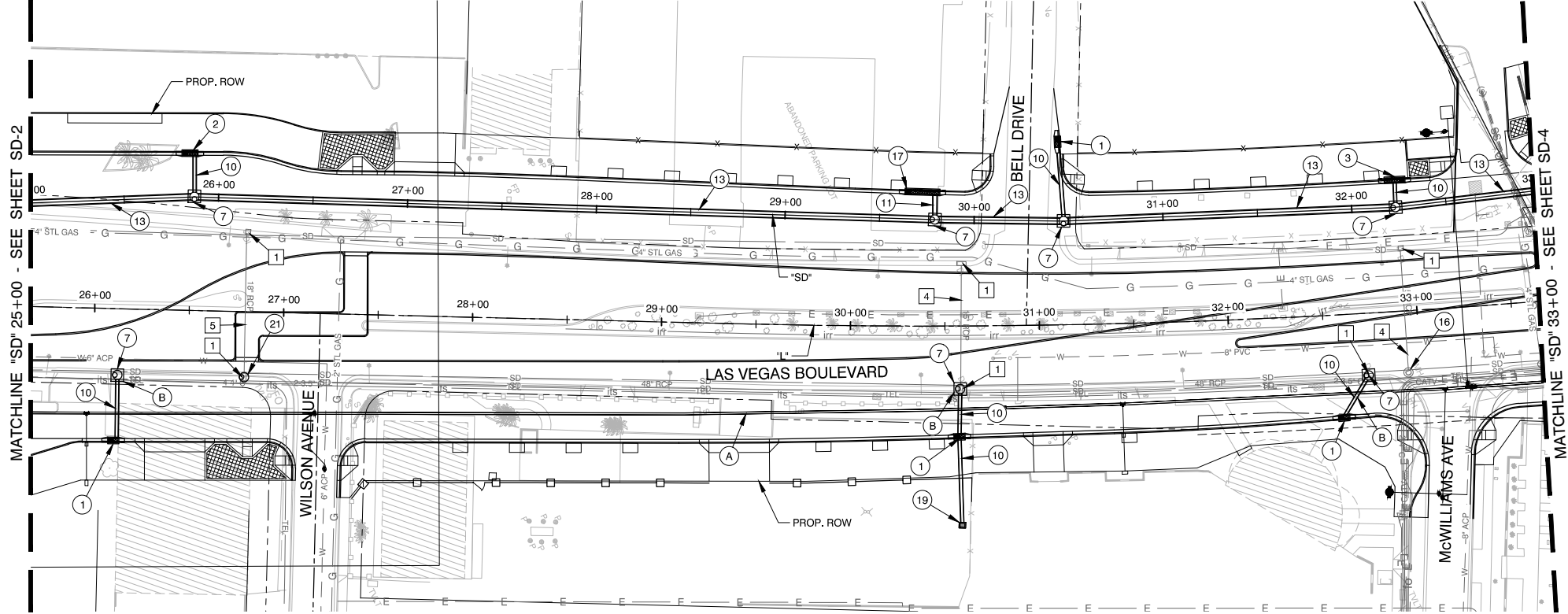
NOT FOR CONSTRUCTION

998 OF 163

DRAWING NO.

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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

CONSTRUCTION KEY NOTES

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- 3 CONSTRUCT TYPE "DM2" DROP INLET, L=10' PER USDOCA DWG. NO. 412.1
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 - 7 REMOVE EXISTING 30" RCP
 - 8 REMOVE EXISTING 48" RCP
 - 9 ABANDON EXISTING 60" RCP
- (A) SEE SHEETS WL-1 THROUGH WL-6 FOR WATERLINE CONSTRUCTION.
- (B) SEE SHEET SD-11 AND SD-12 FOR PROFILE.

APPROVED FOR CONSTRUCTION	
LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES	
PROJECT NO. 135561	FIRST APPROVED DATE:

PREPARED BY


WSP
Las Vegas, NV
444 East Warm Springs Road, Ste 118
Las Vegas, Nevada 89119
Phone: 702.736.6632 - Fax: 702.407.1305

PREPARED FOR

CITY OF LAS VEGAS

BID #

XX.XXXX

DESIGNED BY:

JAM

DRAWN BY:

FME

CHECKED BY:

JSD

DATE:

11/22/2019

SUBMITTAL STAGE:

70% PRELIMINARY

TITLE

LAS VEGAS BOULEVARD IMPROVEMENTS FROM STEWART AVENUE TO WASHINGTON AVENUE

SHEET

SD-3

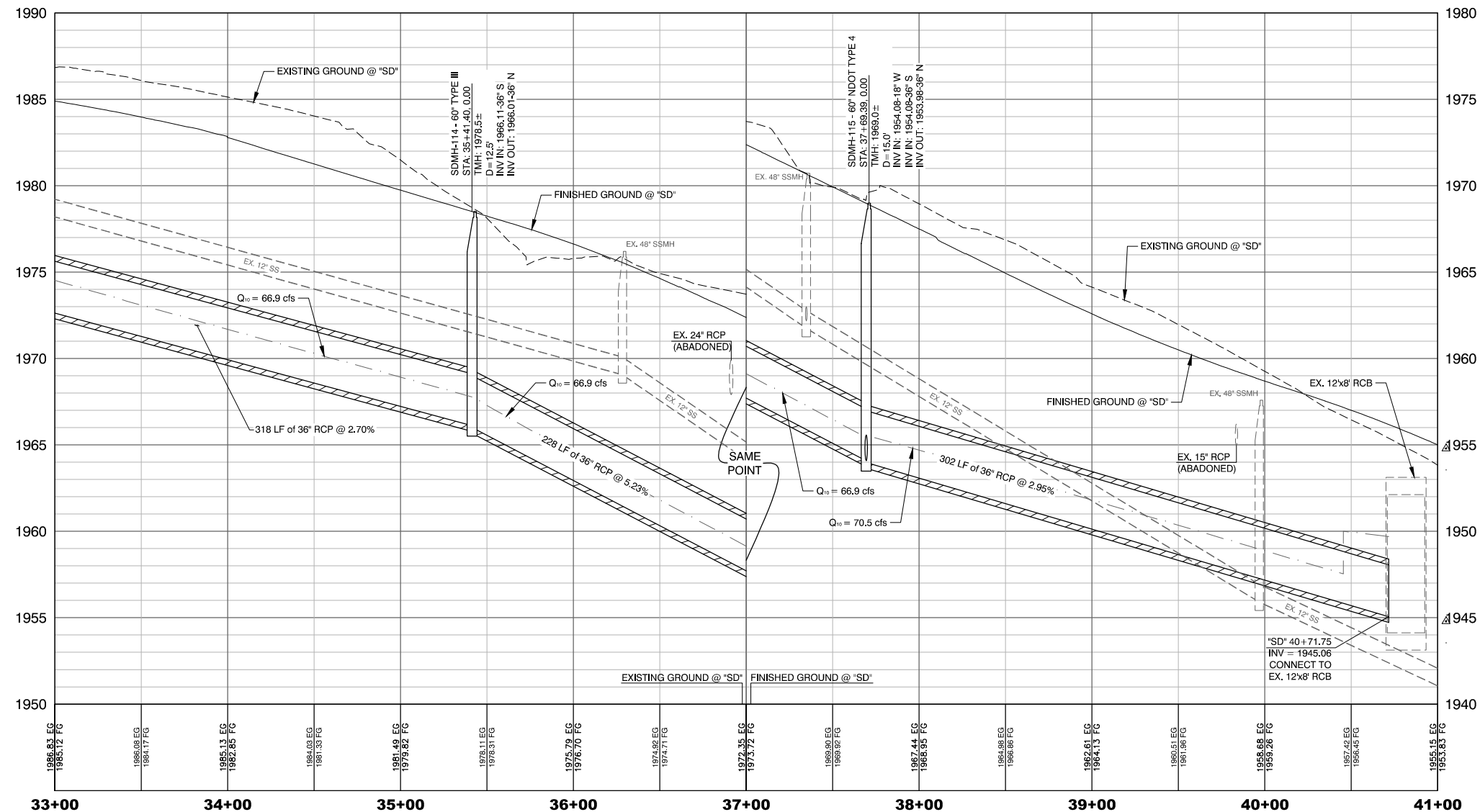
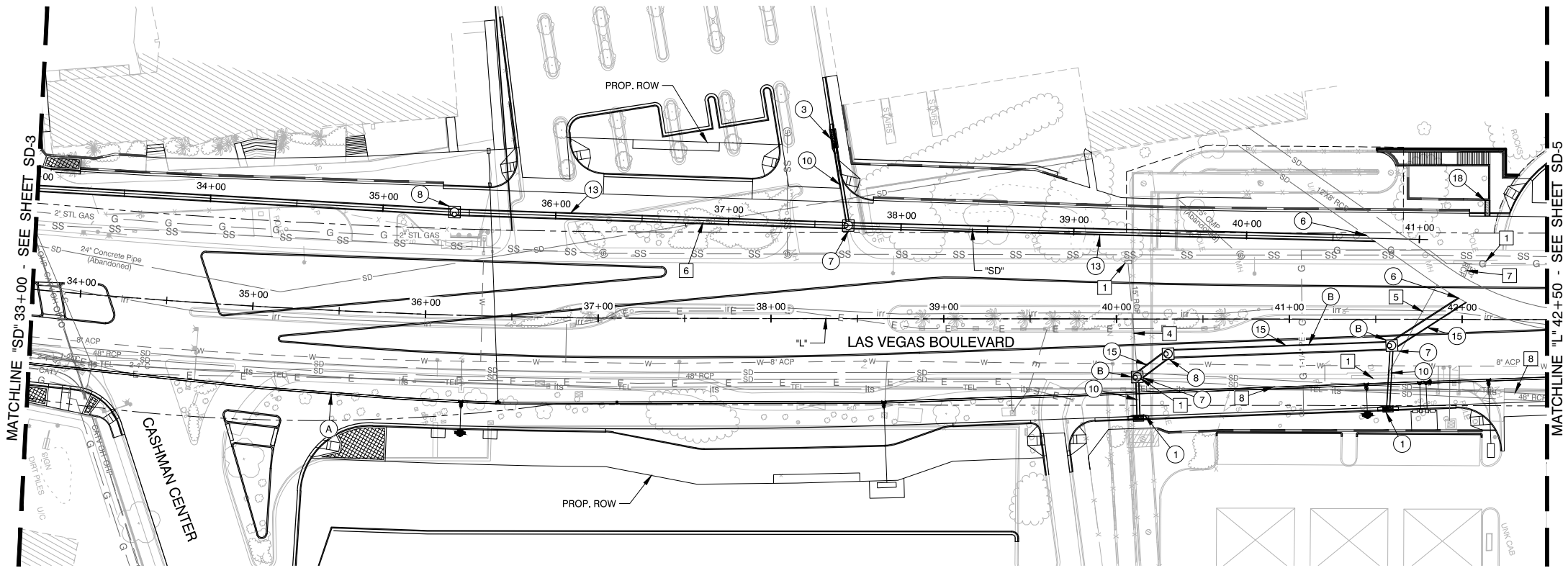
NOT FOR CONSTRUCTION

100 OF 163

DRAWING NO.

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11/25/2019 C:\PROJECT\WISB\N8\LBG2014\LBG\USER\DO235073\20-02698-SD01.DWG



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
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- 3 REMOVE EXISTING 12" RCP
- 4 REMOVE EXISTING 15" RCP
- 5 REMOVE EXISTING 18" RCP
- 6 REMOVE EXISTING 24" RCP
- 7 REMOVE EXISTING 30" RCP
- 8 REMOVE EXISTING 48" RCP
- 9 ABANDON EXISTING 60" RCP

- (A) SEE SHEETS WL-1 THROUGH WL-6 FOR WATERLINE CONSTRUCTION.
- (B) SEE SHEET SD-12 AND SD-13 FOR PROFILE.

APPROVED FOR CONSTRUCTION	
LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES	
PROJECT NO. 135561	FIRST APPROVED DATE:

PREPARED BY


WSP
Las Vegas, NV
A WSP Company

PREPARED FOR

CITY OF LAS VEGAS

BID #

38069

DESIGNED BY

JAM

DRAWN BY

FME

CHECKED BY

JSD

DATE

11/22/2019

SUBMITTAL STAGE

70% PRELIMINARY

TITLE

LAS VEGAS BOULEVARD IMPROVEMENTS FROM STEWART AVENUE TO WASHINGTON AVENUE

SHEET

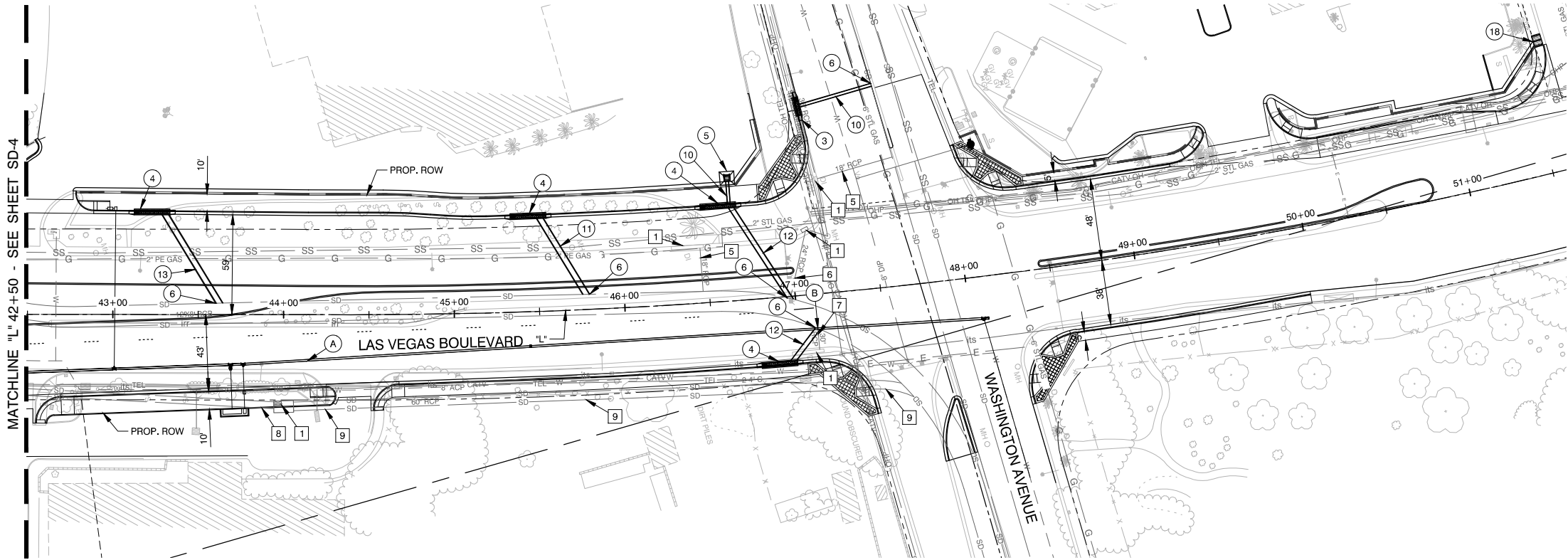
SD-4

NOT FOR CONSTRUCTION

101 OF 163

DRAWING NO.

XXXX



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

CONSTRUCTION KEY NOTES

- 1 CONSTRUCT TYPE "DM2" DROP INLET, L=5' PER USDCCA DWG. NO. 412.1
- 2 CONSTRUCT TYPE "DM2" DROP INLET, L=7.5' PER USDCCA DWG. NO. 412.1
- 3 CONSTRUCT TYPE "DM2" DROP INLET, L=10' PER USDCCA DWG. NO. 412.1
- 4 CONSTRUCT TYPE "DM2" DROP INLET, L=20' PER USDCCA DWG. NO. 412.1
- 5 CONSTRUCT TYPE 2B NDOT DROP INLET WITH CONCRETE APRON PER NDOT STD. DWG. R-4.2.1
- 6 CONNECT TO EX. 12"x8" RCB
- 7 CONSTRUCT 60" NDOT TYPE 4 MH PER NDOT STD. DWG. NO. R-4.3.2
- 8 CONSTRUCT 60" TYPE III MH PER USDCCA DWG. NO. 406
- 9 CONSTRUCT PRECAST MANHOLE TEE PER USDCCA DWG. NO. 407
- 10 INSTALL 18" RCP
- 11 INSTALL 24" RCP
- 12 INSTALL 30" RCP
- 13 INSTALL 36" RCP
- 14 NOT USED
- 15 INSTALL 48" RCP
- 16 EX. MH - ADJUST TO GRADE
- 17 CONSTRUCT TYPE "DM2" DROP INLET, L=17.5' PER USDCCA DWG. NO. 412.1
- 18 CONSTRUCT SIDEWALK DRAIN PER USDCCA DWG. NO. 236
- 19 CONSTRUCT TYPE 2 NDOT DROP INLET PER NDOT STD. DWG. R-4.2.1
- 20 CONSTRUCT TYPE 2B NDOT DROP INLET PER NDOT STD. DWG. R-4.2.1
- 21 REPLACE EX. DI FRAME AND GRATE WITH MANHOLE COVER - ADJUST TO GRADE

REMOVAL KEY NOTES

- 1 REMOVE EXISTING DROP INLET STRUCTURE
- 2 REMOVE EXISTING SDMH
- 3 REMOVE EXISTING 12" RCP
- 4 REMOVE EXISTING 15" RCP
- 5 REMOVE EXISTING 18" RCP
- 6 REMOVE EXISTING 24" RCP
- 7 REMOVE EXISTING 30" RCP
- 8 REMOVE EXISTING 48" RCP
- 9 ABANDON EXISTING 60" RCP

- (A) SEE SHEETS WL-1 THROUGH WL-6 FOR WATERLINE CONSTRUCTION.
- (B) SEE SHEET SD-13 FOR PROFILE.

APPROVED FOR CONSTRUCTION	
LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES	
PROJECT NO. 135561	FIRST APPROVED DATE:

WSP
A WSP Company
444 East Warm Springs Road, Ste 118
Las Vegas, Nevada 89119
Phone: 702.736.6632 - Fax: 702.407.1305

PREPARED FOR
CITY OF LAS VEGAS

BID # XX.XXXX	DESIGNED BY: JAM
DATE: 11/22/2019	DRAWN BY: FME
SUBMITTAL STAGE:	CHECKED BY: JSD
70% PRELIMINARY	

TITLE
LAS VEGAS BOULEVARD IMPROVEMENTS FROM STEWART AVENUE TO WASHINGTON AVENUE

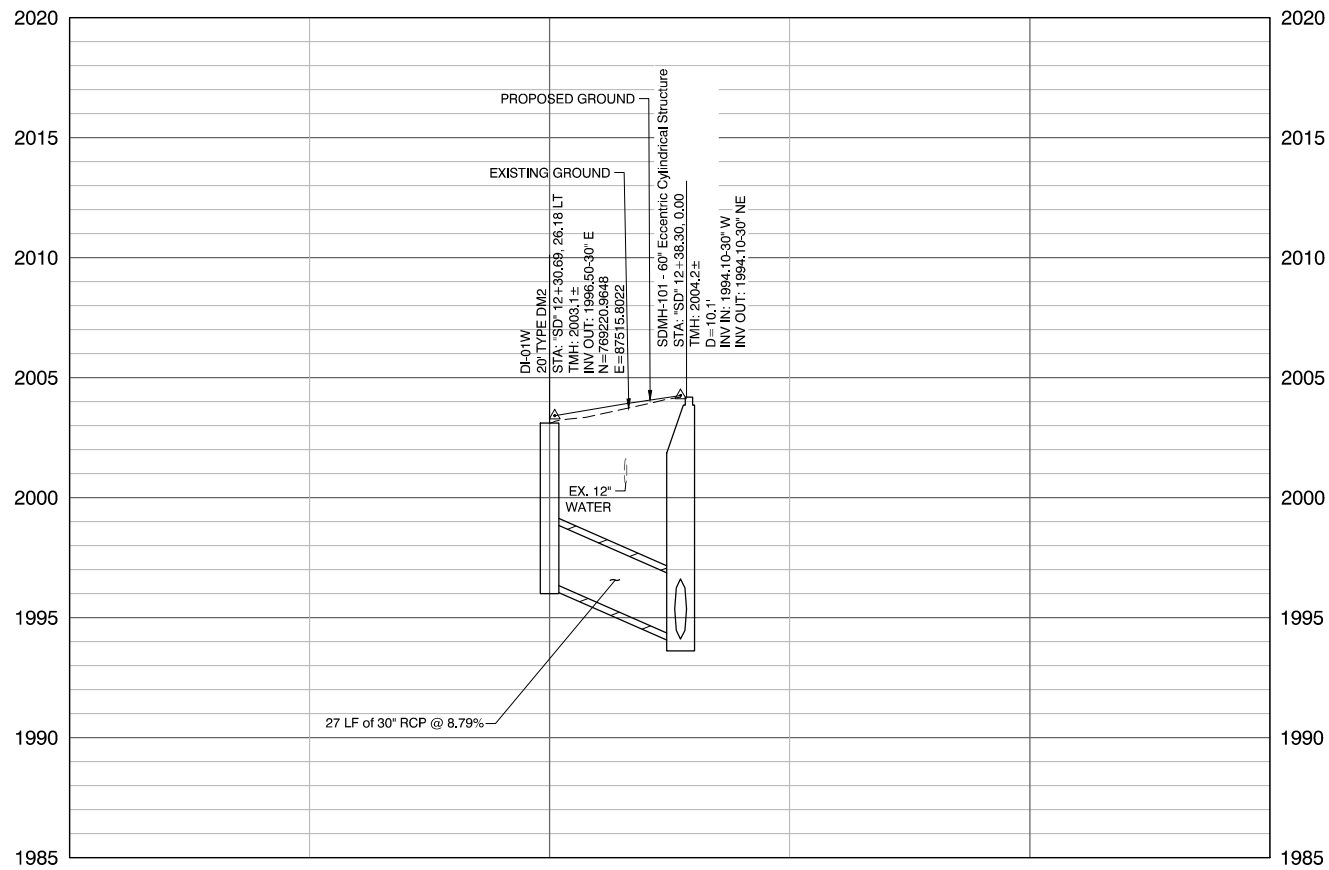
SHEET
STORM DRAIN PLAN AND PROFILE "L" 42+50.00 to "L" 51+00.00



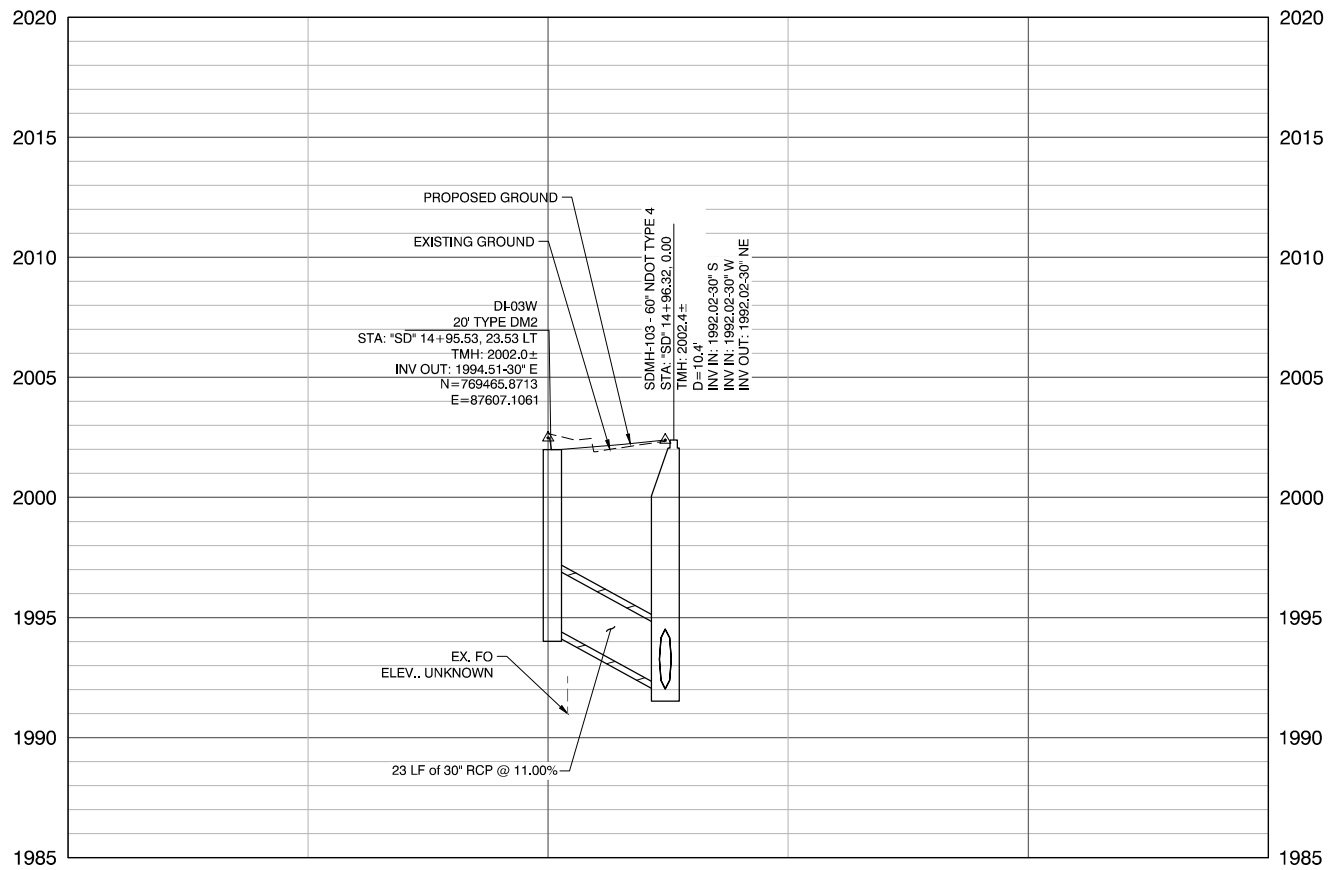
NOT FOR CONSTRUCTION

SHEET
SD-5
102 OF 163
DRAWING NO. XXXX

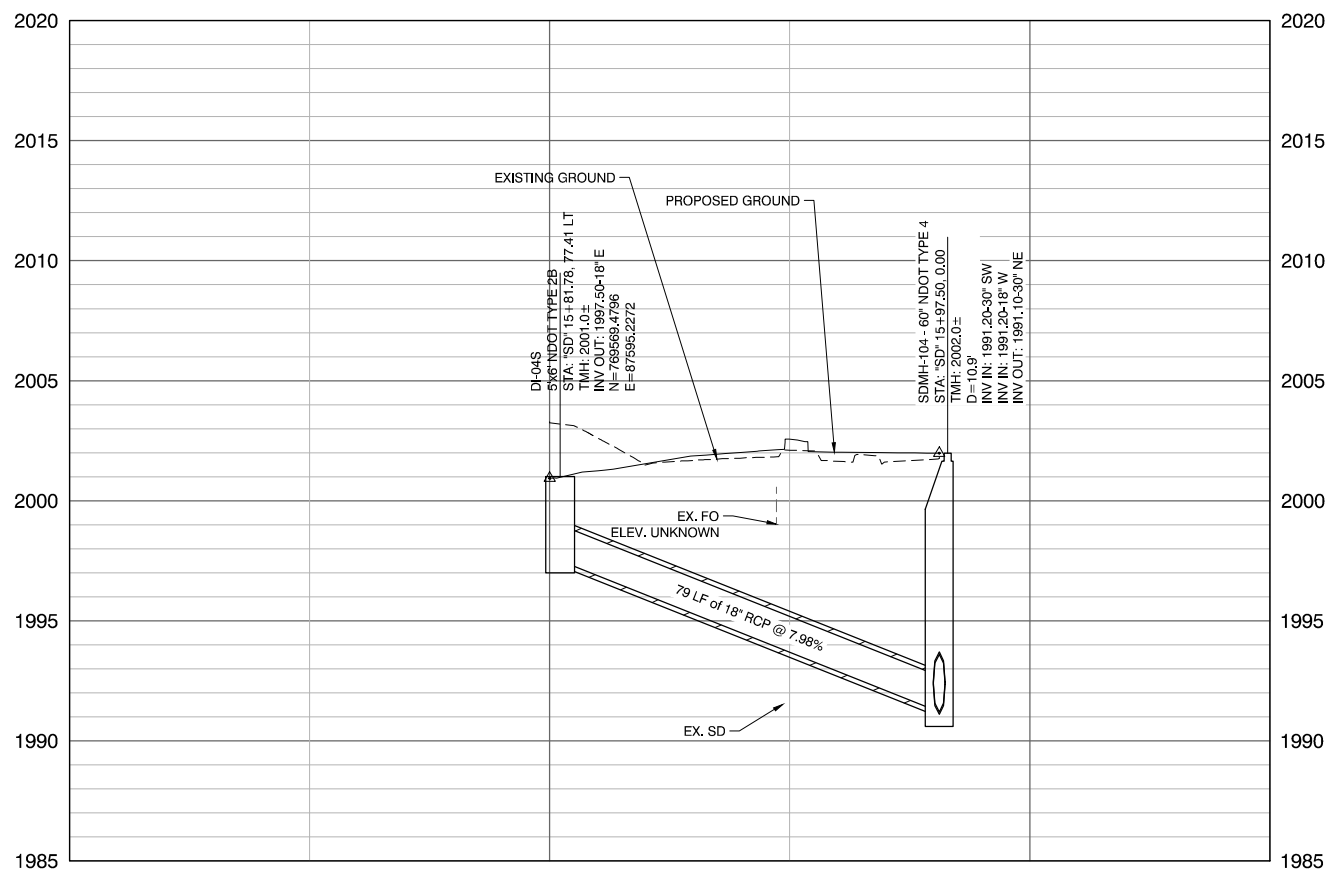
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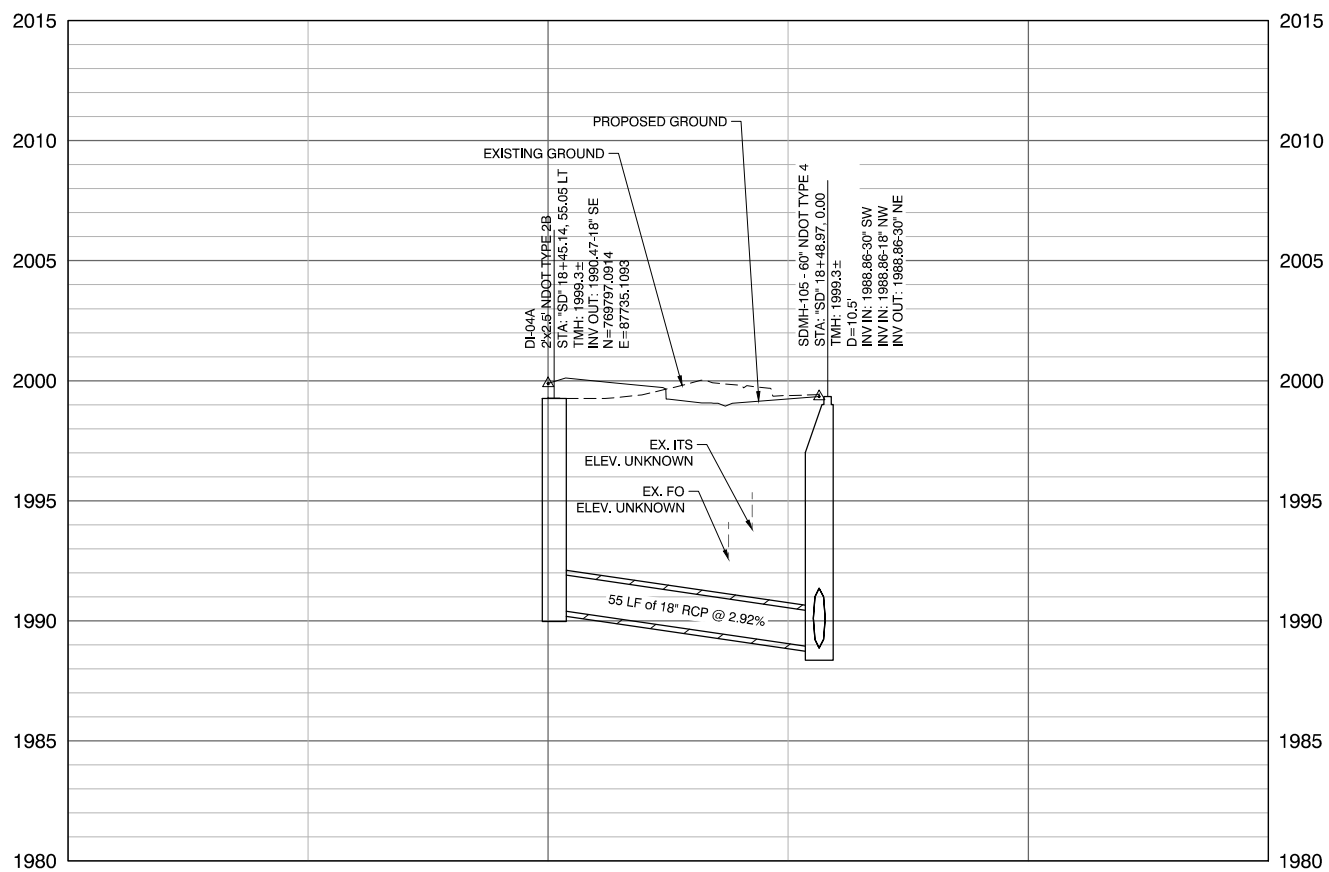
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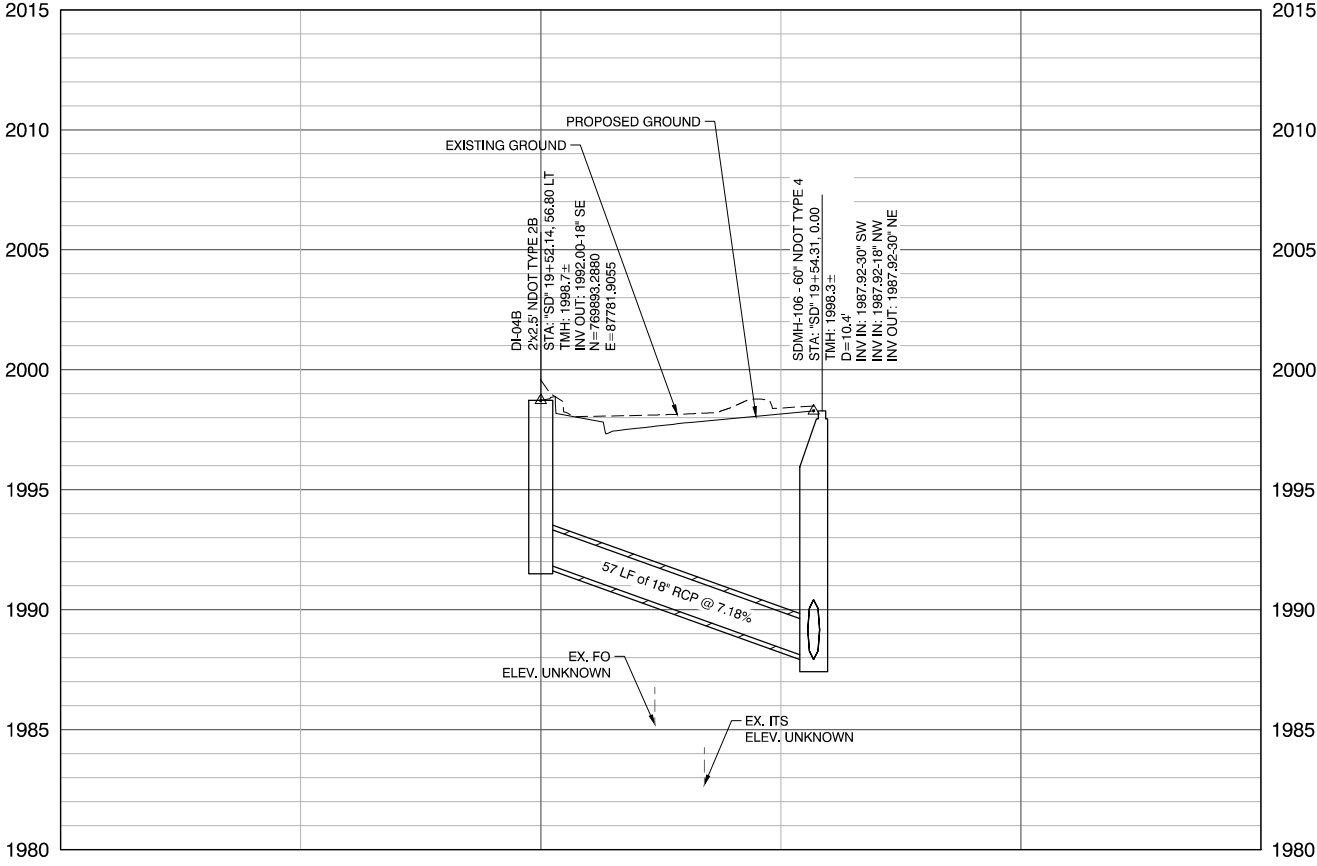
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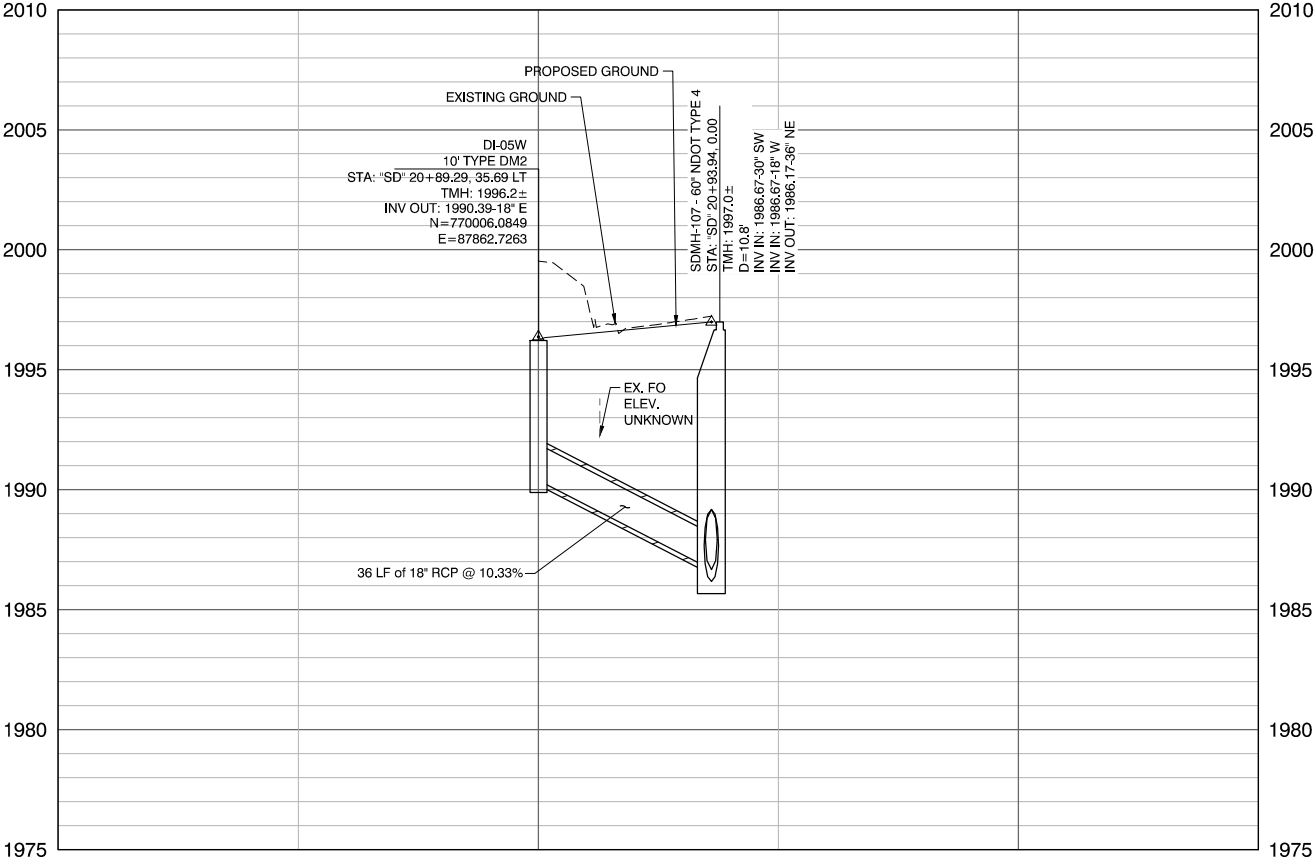
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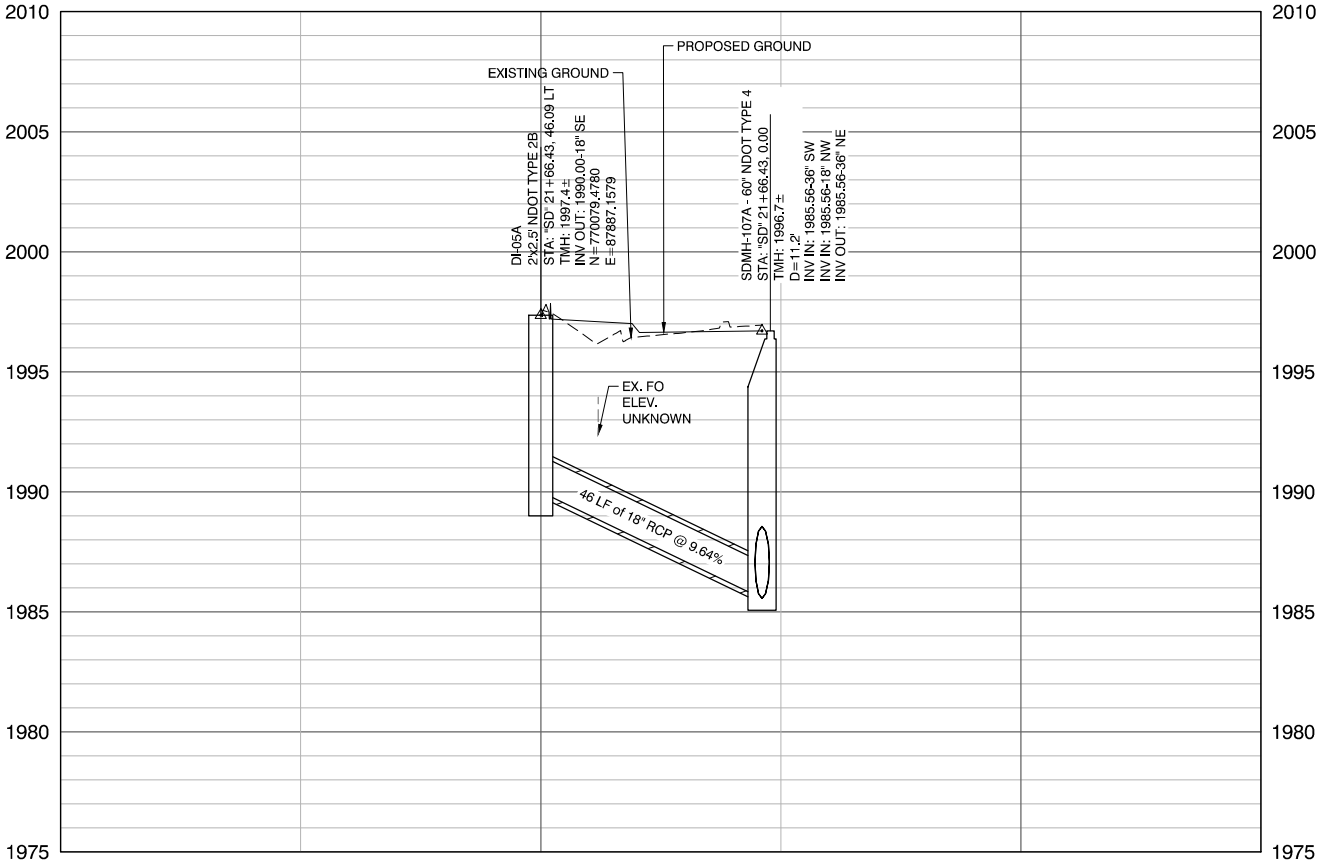
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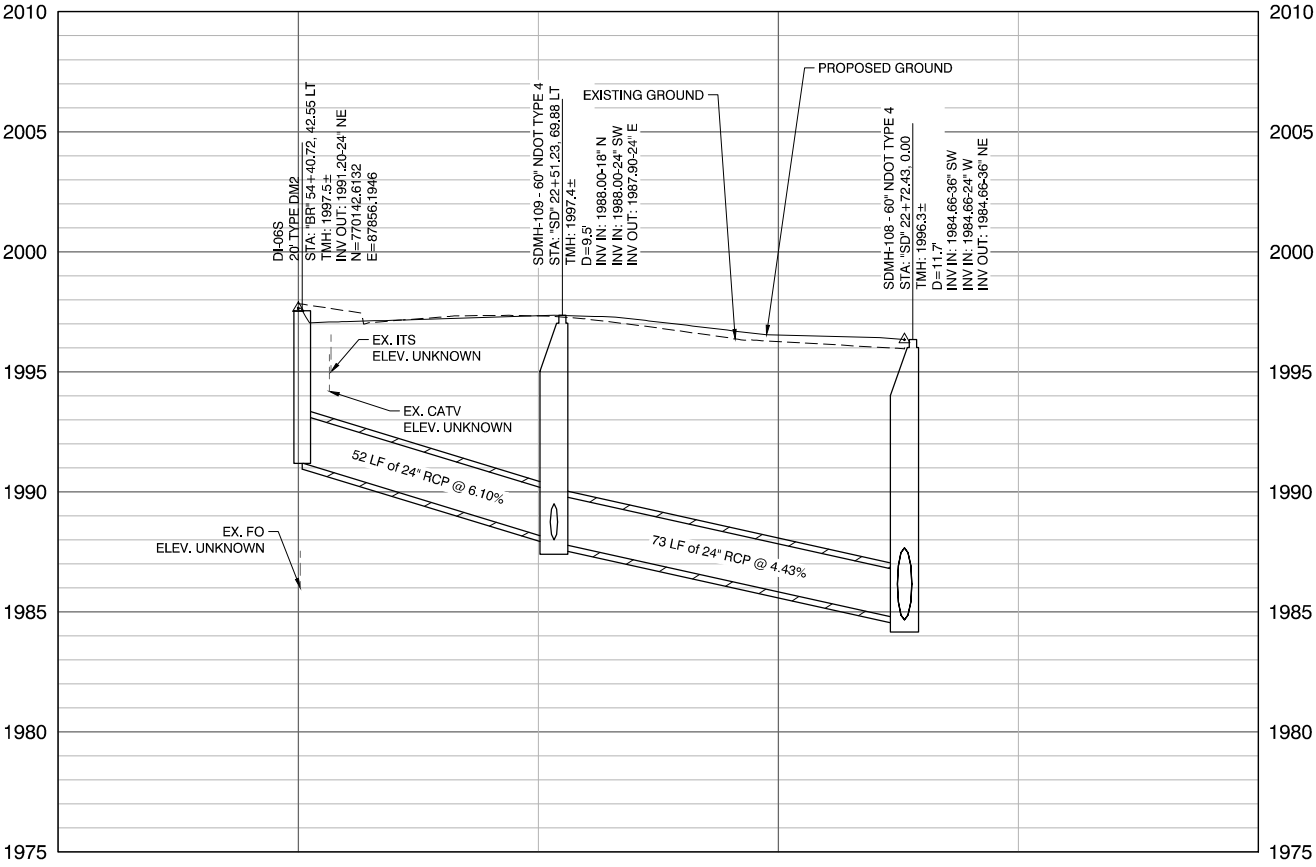
SDMH - 107



MH-107A



SDMH - 108



11/22/2019 C:\PROJECT\WISB\N8\LBG2014\LBG\USER\DO235073\2042698-SD06.DWG

PREPARED BY


WSP
A WSP Company
444 East Warm Springs Road, Ste 118
Las Vegas, Nevada 89119
Phone: 702.736.6632 - Fax: 702.407.1305

PREPARED FOR

CITY OF LAS VEGAS

BID #

XX.XXXX

DESIGNED BY:

JAM

DRAWN BY:

FME

CHECKED BY:

JSD

DATE:

11/22/2019

SUBMITTAL STAGE:

70% PRELIMINARY

TITLE

LAS VEGAS BOULEVARD IMPROVEMENTS FROM STEWART AVENUE TO WASHINGTON AVENUE

SHEET

SD-7

NOT FOR CONSTRUCTION

104 OF 163

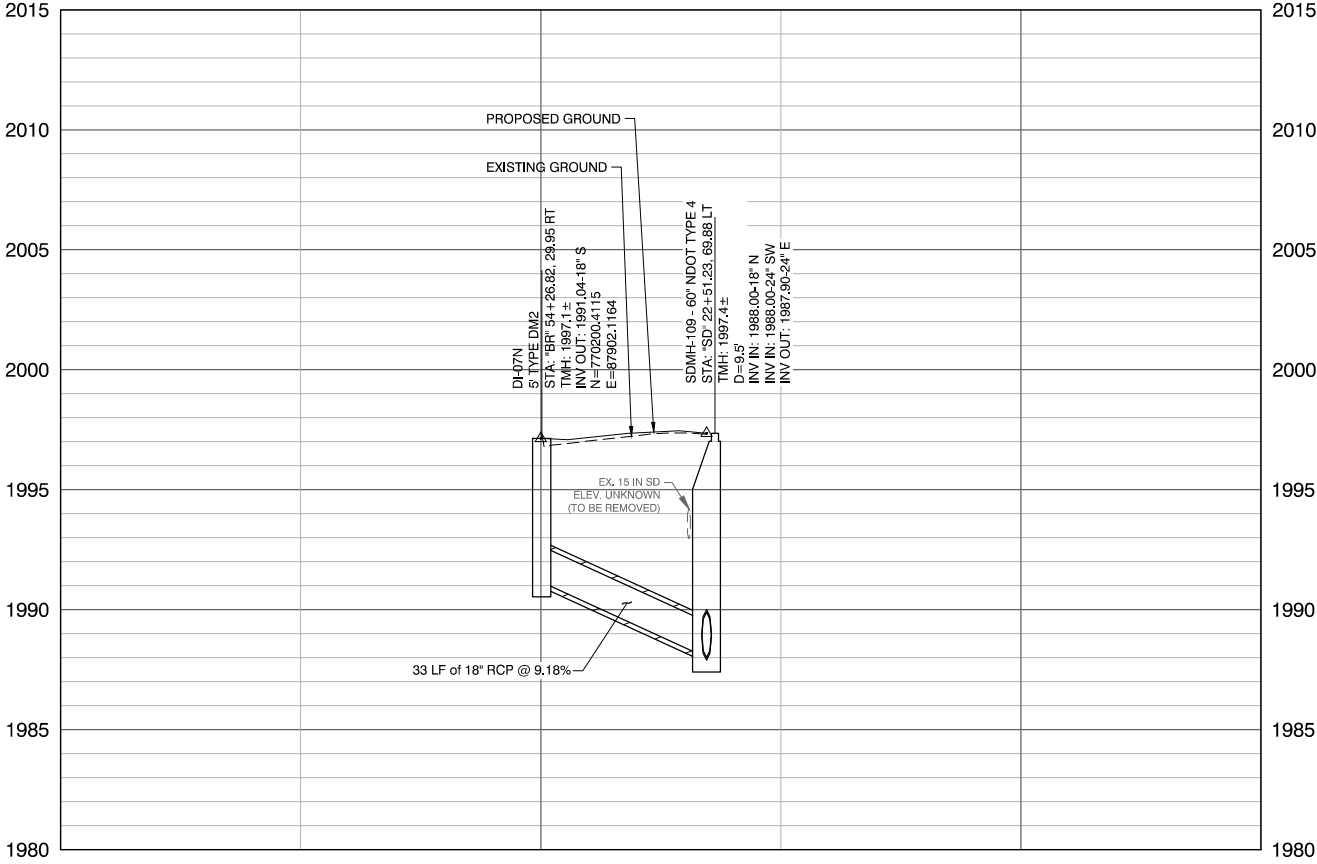
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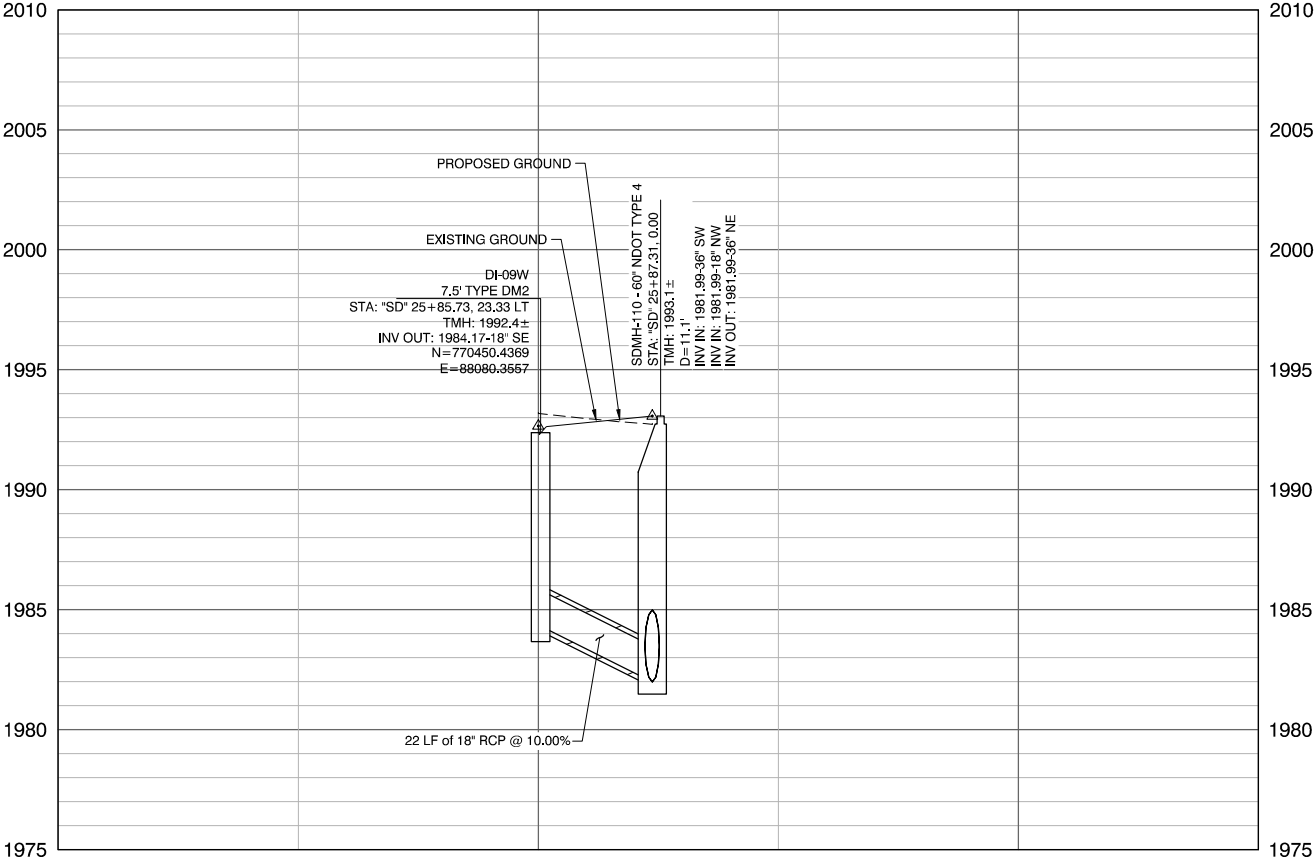
REVISIONS

NO.	DATE
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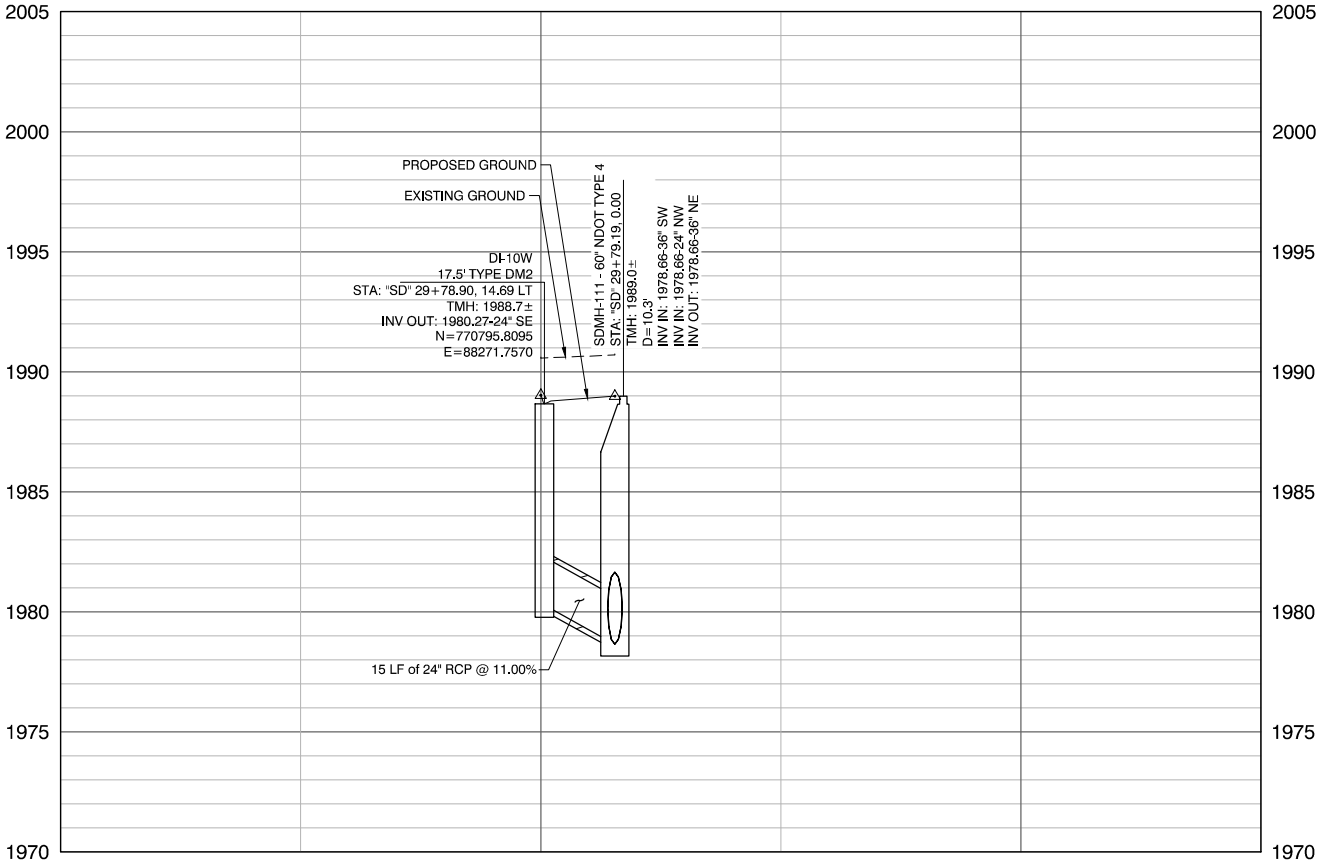
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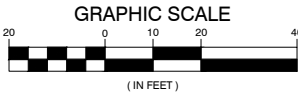
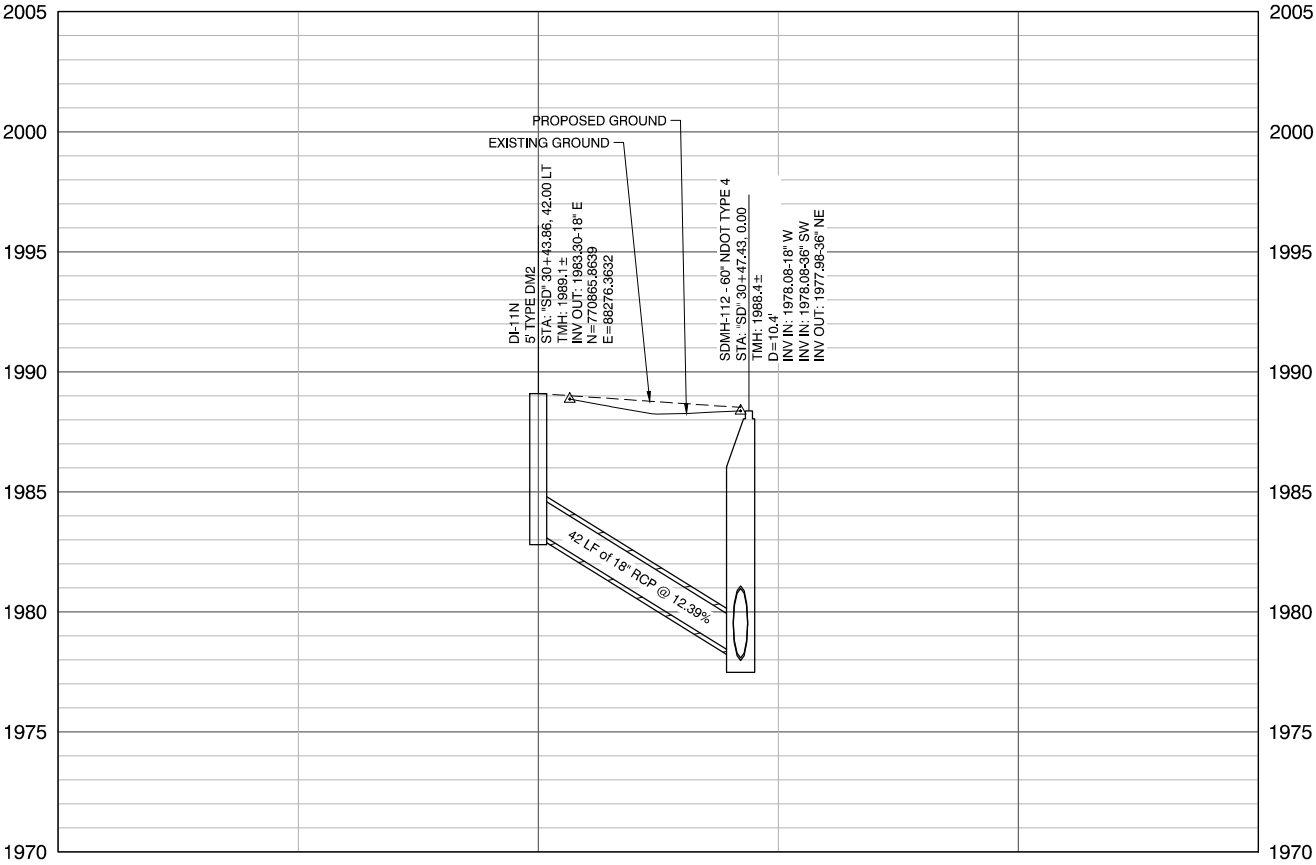
SDMH - 110



SDMH - 111



SDMH - 112



PREPARED BY


WSP
A WSP Company
444 East Warm Springs Road, Ste 118
Las Vegas, Nevada 89119
Phone: 702.736.6632 • Fax: 702.407.1305

PREPARED FOR

CITY OF LAS VEGAS

BID #

XX.XXXX

DESIGNED BY:

JAM

DRAWN BY:

FME

CHECKED BY:

JSD

DATE:

11/22/2019

SUBMITTAL STAGE:

70% PRELIMINARY

TITLE

LAS VEGAS BOULEVARD IMPROVEMENTS FROM STEWART AVENUE TO WASHINGTON AVENUE

SHEET

SD-8

STORM DRAIN PLAN AND PROFILE

NOT FOR CONSTRUCTION

105 OF 163

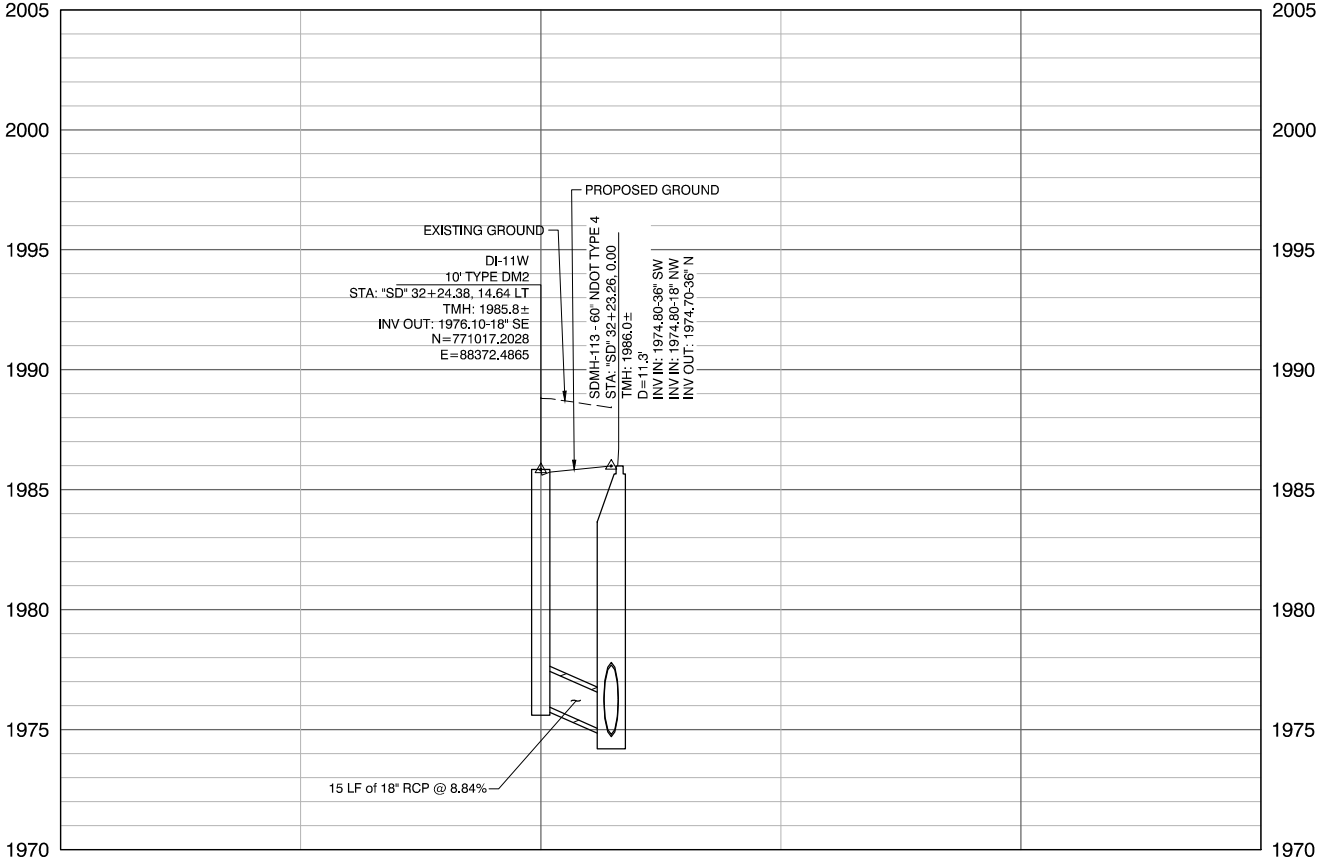
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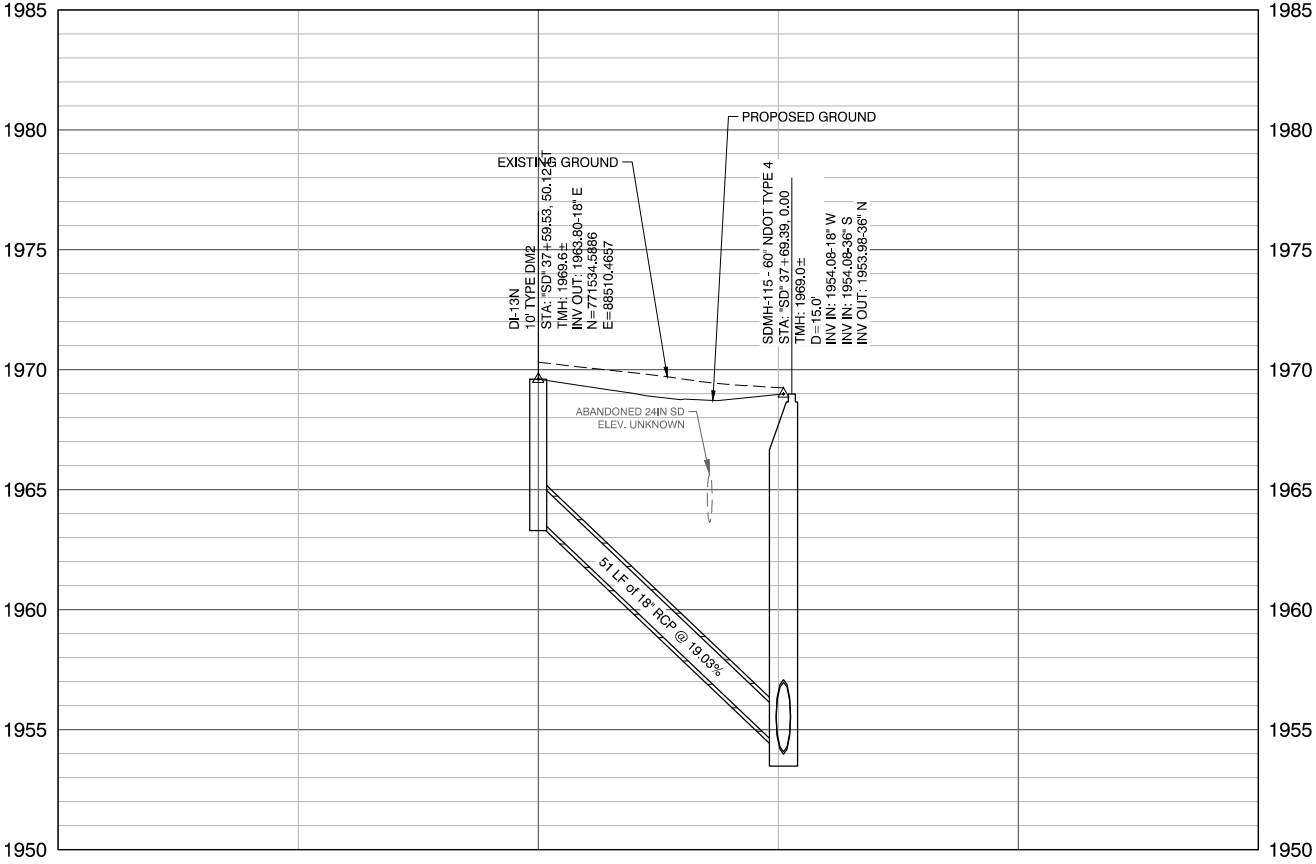
REVISIONS

NO.	DATE	REVISIONS
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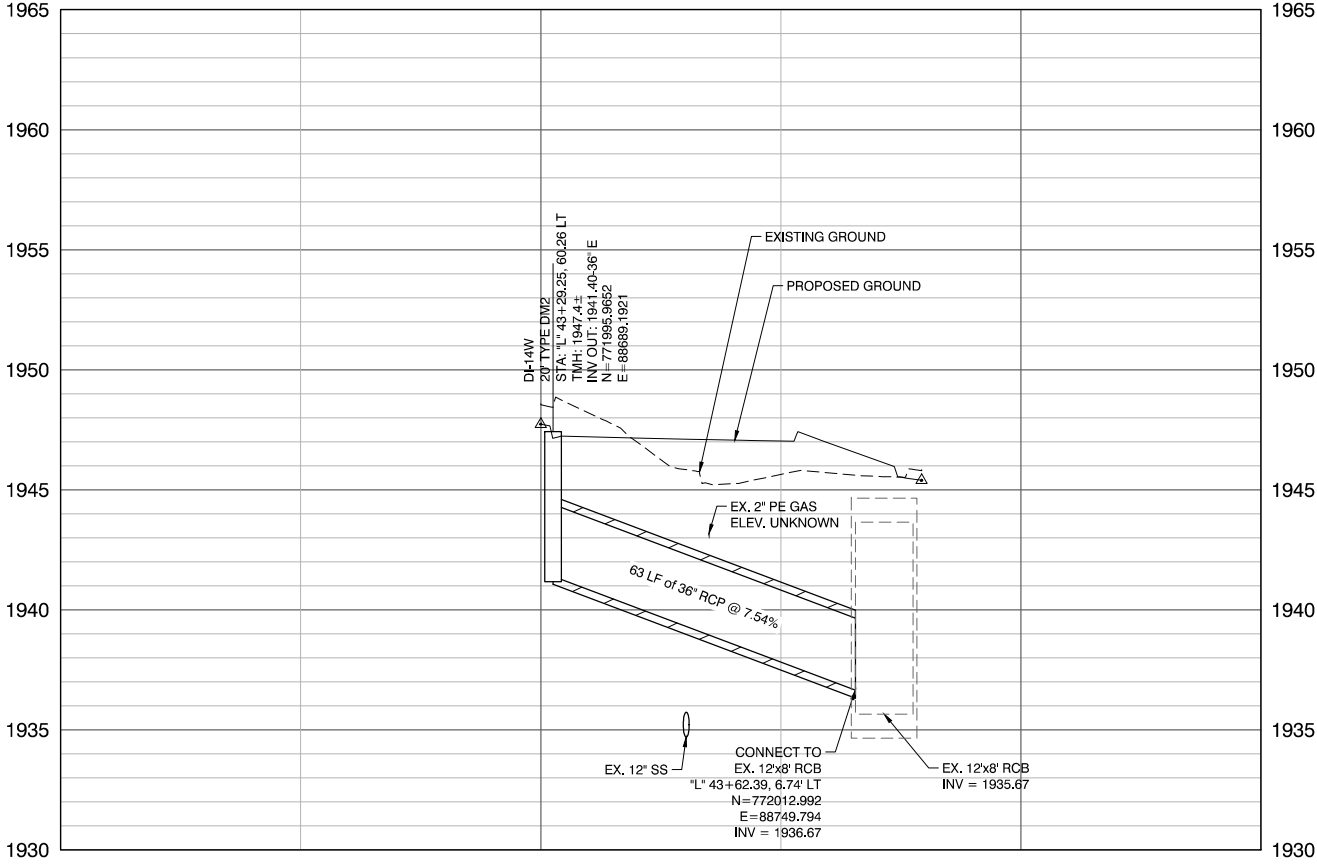
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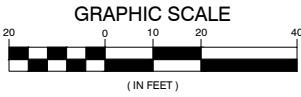
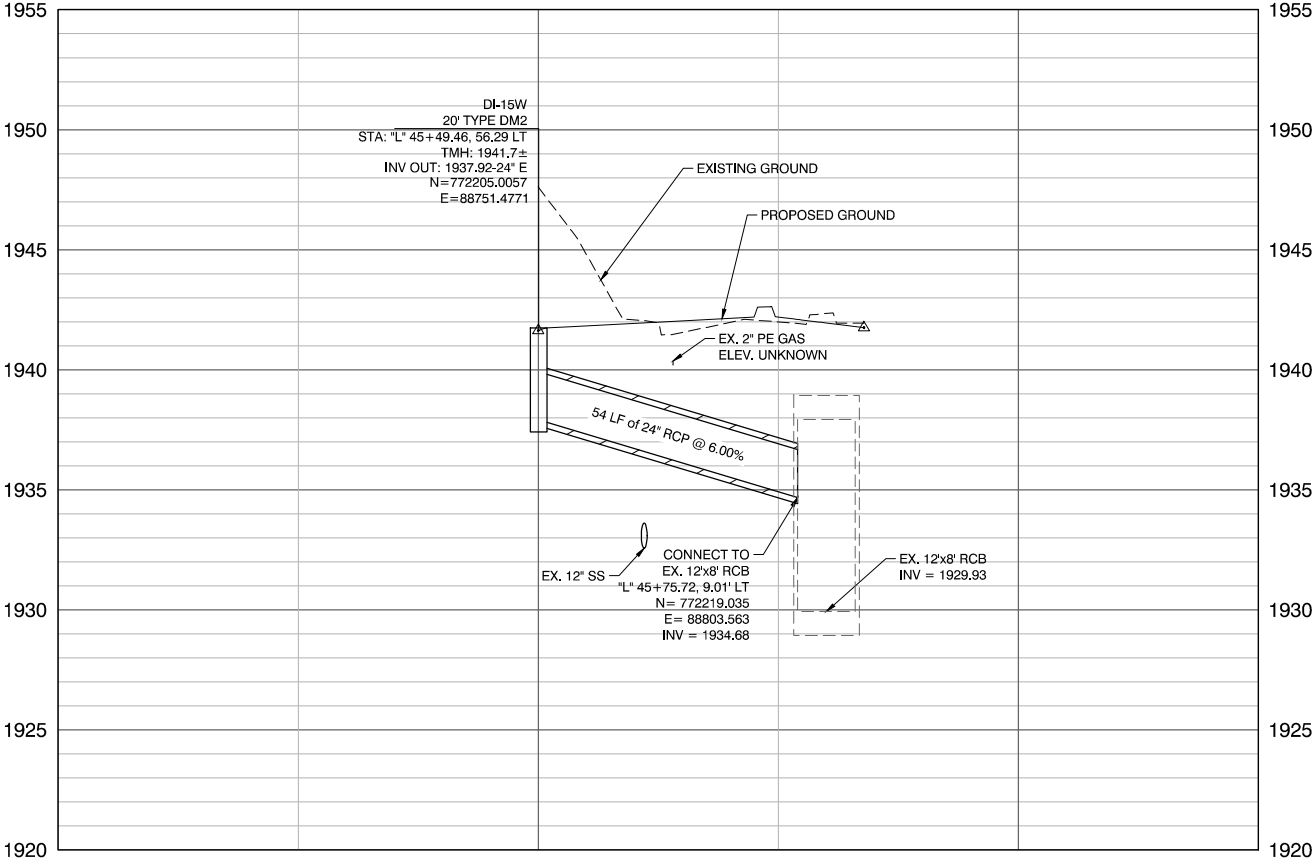
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DI-14W

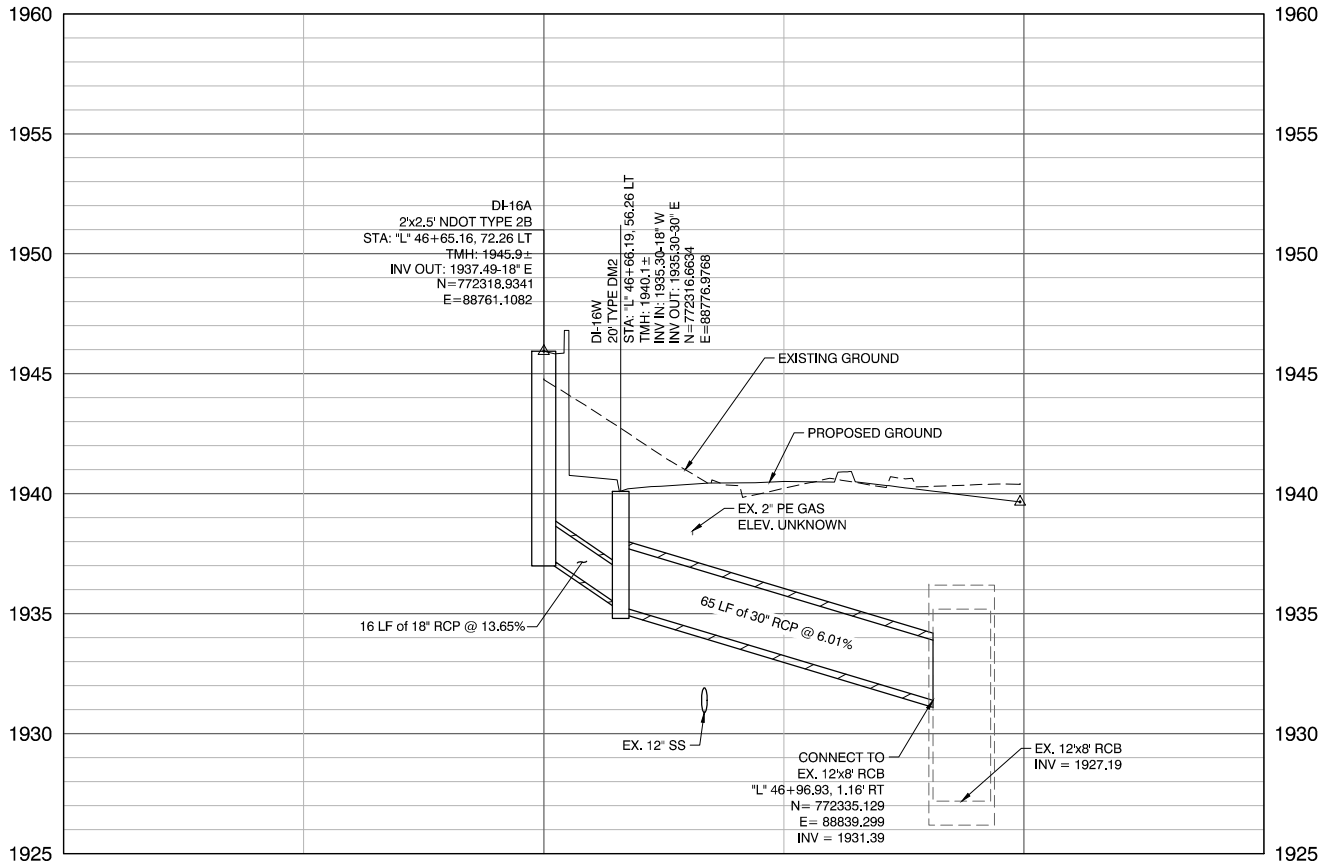


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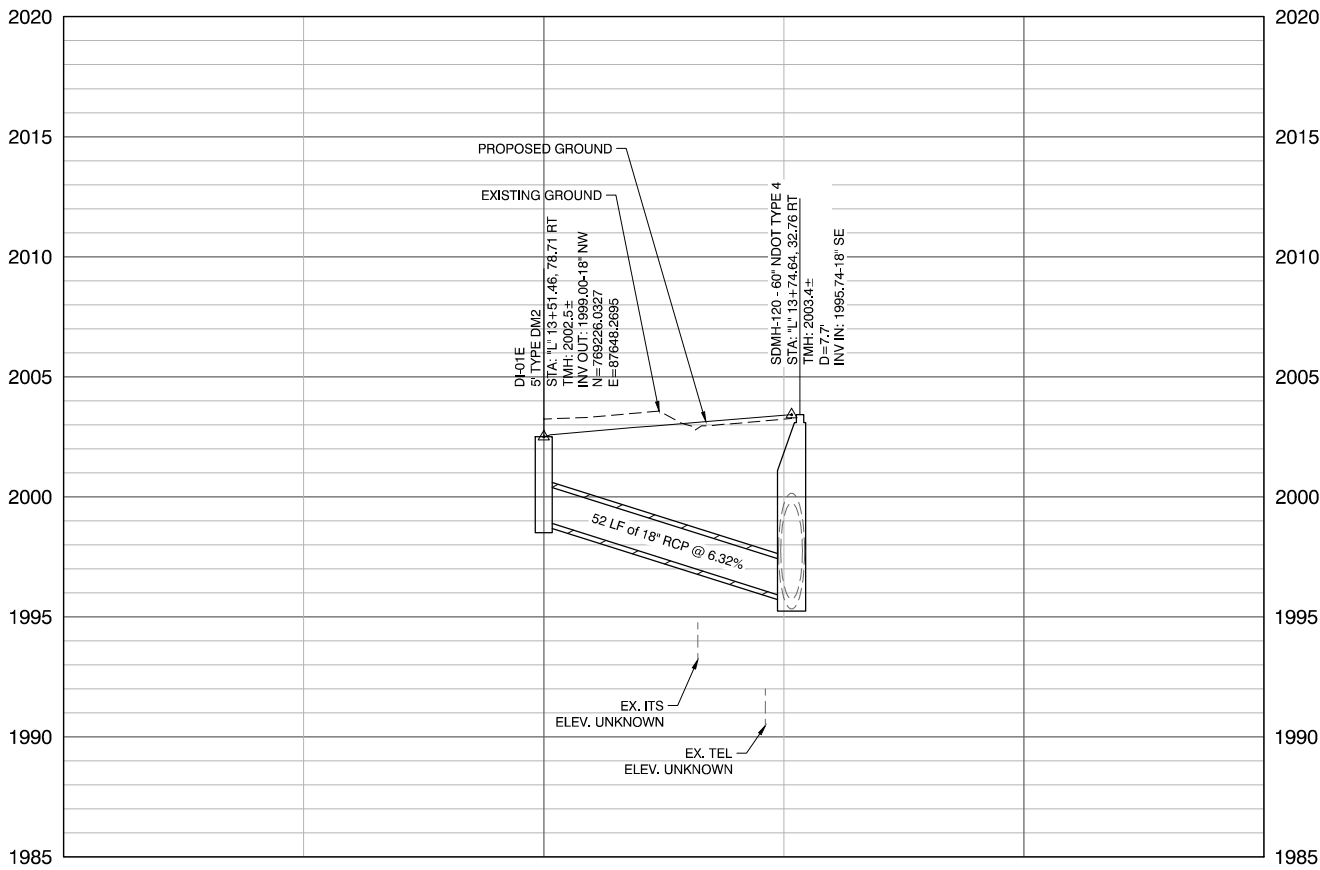


CITY OF LAS VEGAS		DESIGNED BY: JAM		CHECKED BY: JSD	
DATE: 11/22/2019		DRAWN BY: FME		SUBMITTAL STAGE: 70% PRELIMINARY	
H# 38069		BID # XX.XXXX		NO. DATE	
PREPARED FOR		PREPARED BY		REVISIONS	
LAS VEGAS BOULEVARD IMPROVEMENTS FROM STEWART AVENUE TO WASHINGTON AVENUE		wsp			
SHEET		A WSP Company			
NOT FOR CONSTRUCTION		444 East Warm Springs Road, Ste 118 Las Vegas, Nevada 89119 Phone: 702.736.6632 - Fax: 702.407.1305			
SD-9		106 OF 163			
DRAWING NO. XXXX					

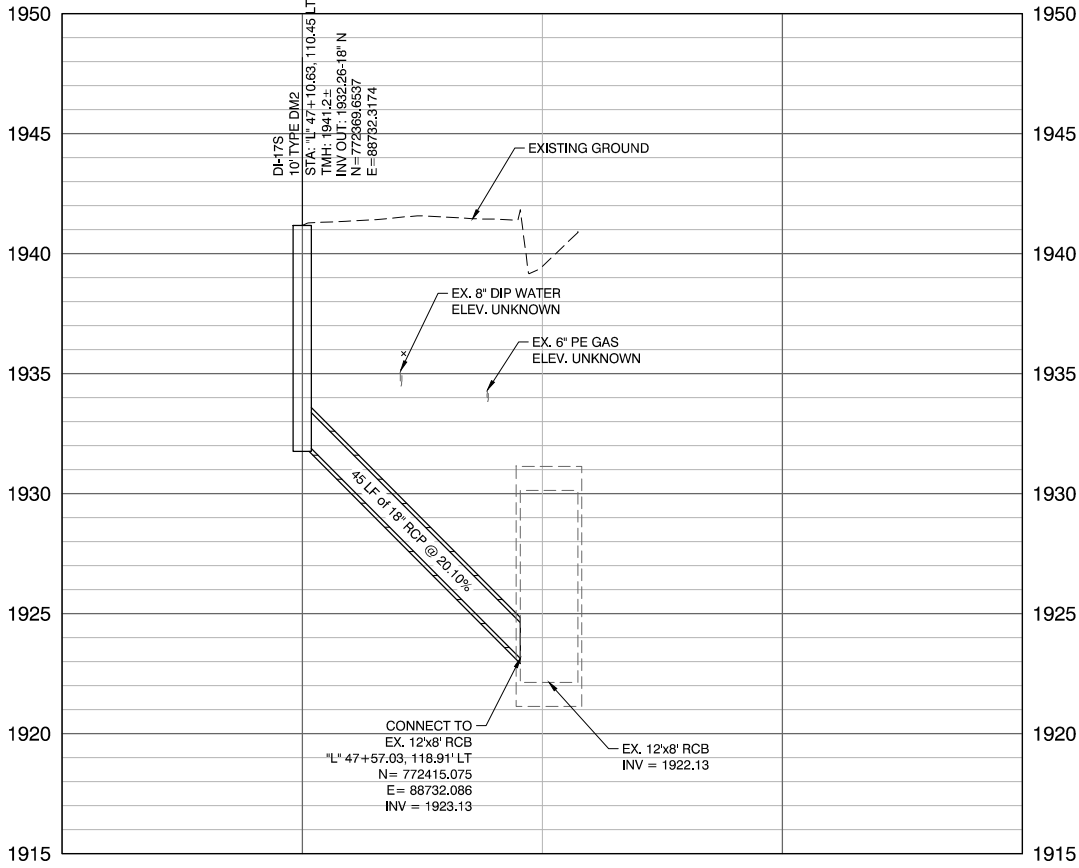
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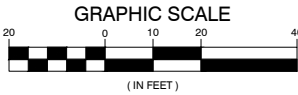
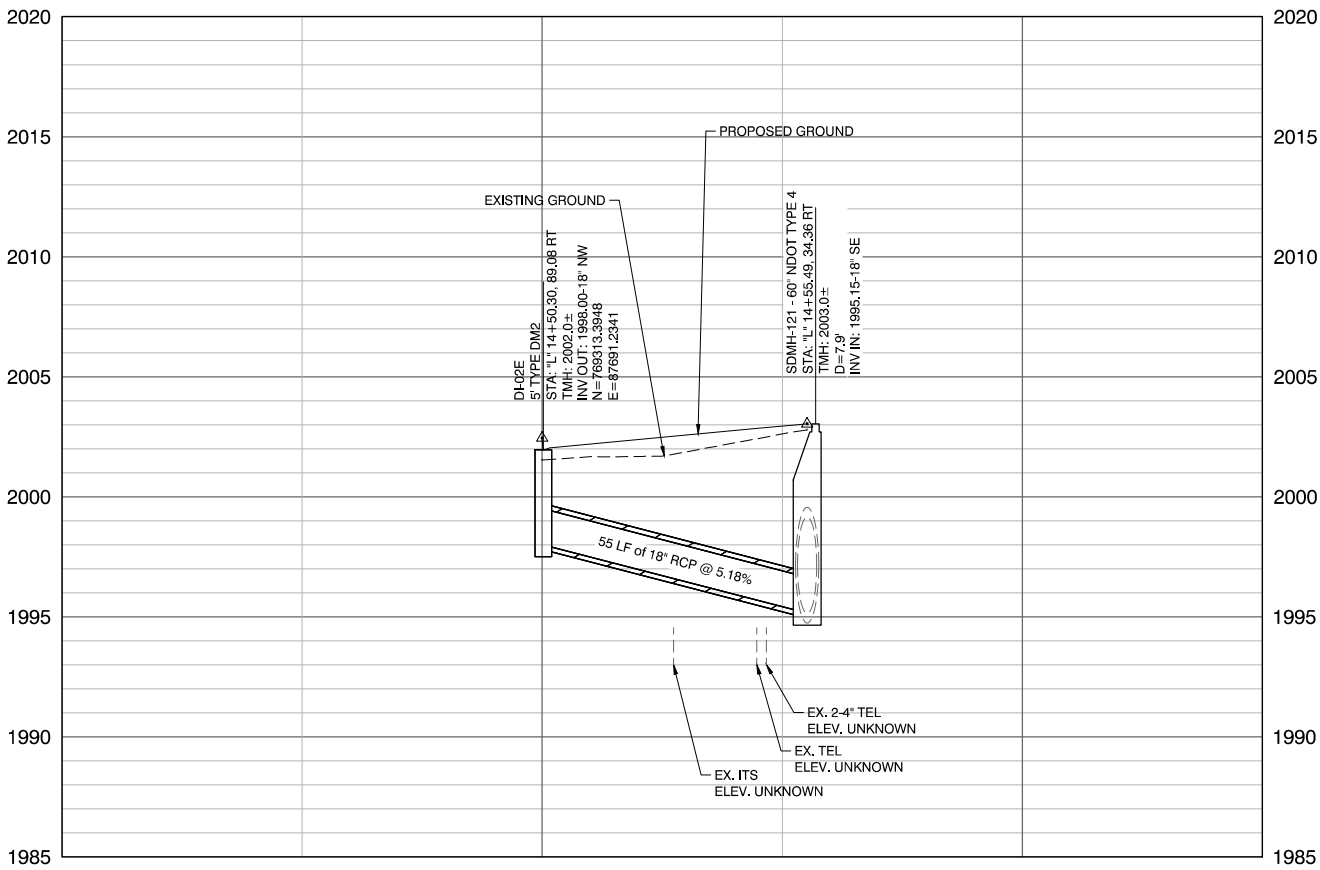
MH-120



DI-17S



MH-121



PREPARED BY

WSP

WSP Group, L.L.C.
A WSP Company

444 East Warm Springs Road, Ste 118
Las Vegas, Nevada 89119
Phone: 702.736.6632 - Fax: 702.407.1305

PREPARED FOR CITY OF LAS VEGAS	BID #	XX.XXXX
	DESIGNED BY:	JAM
DATE: 11/22/2019	DRAWN BY:	FME
	CHECKED BY:	JSD
SUBMITTAL STAGE: 70% PRELIMINARY		

TITLE

**LAS VEGAS BOULEVARD IMPROVEMENTS FROM
STEWART AVENUE TO WASHINGTON AVENUE**

SHEET

**STORM DRAIN PLAN AND PROFILE
"L" 42+50.00 to "L" 51+00.00**

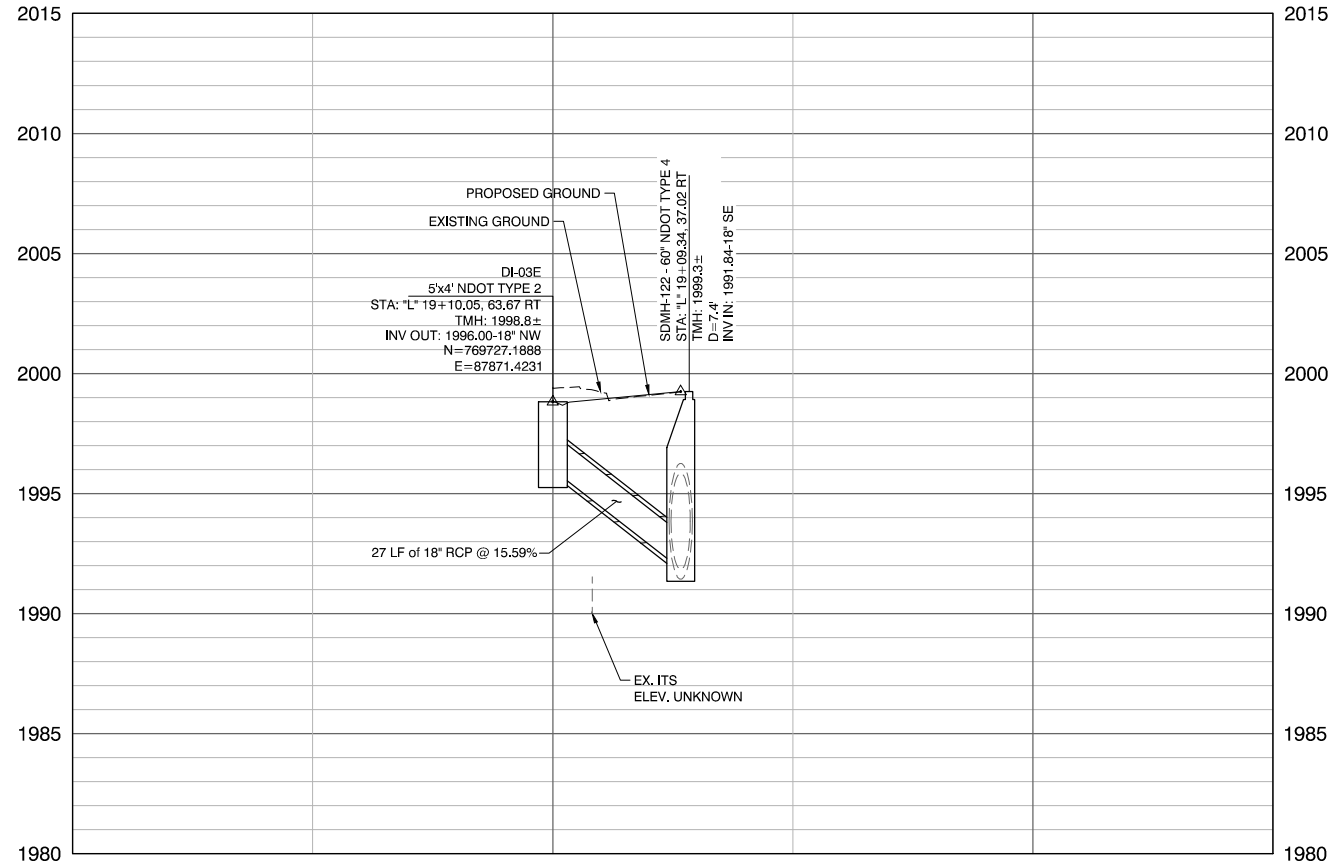
NOT FOR CONSTRUCTION

SD-10

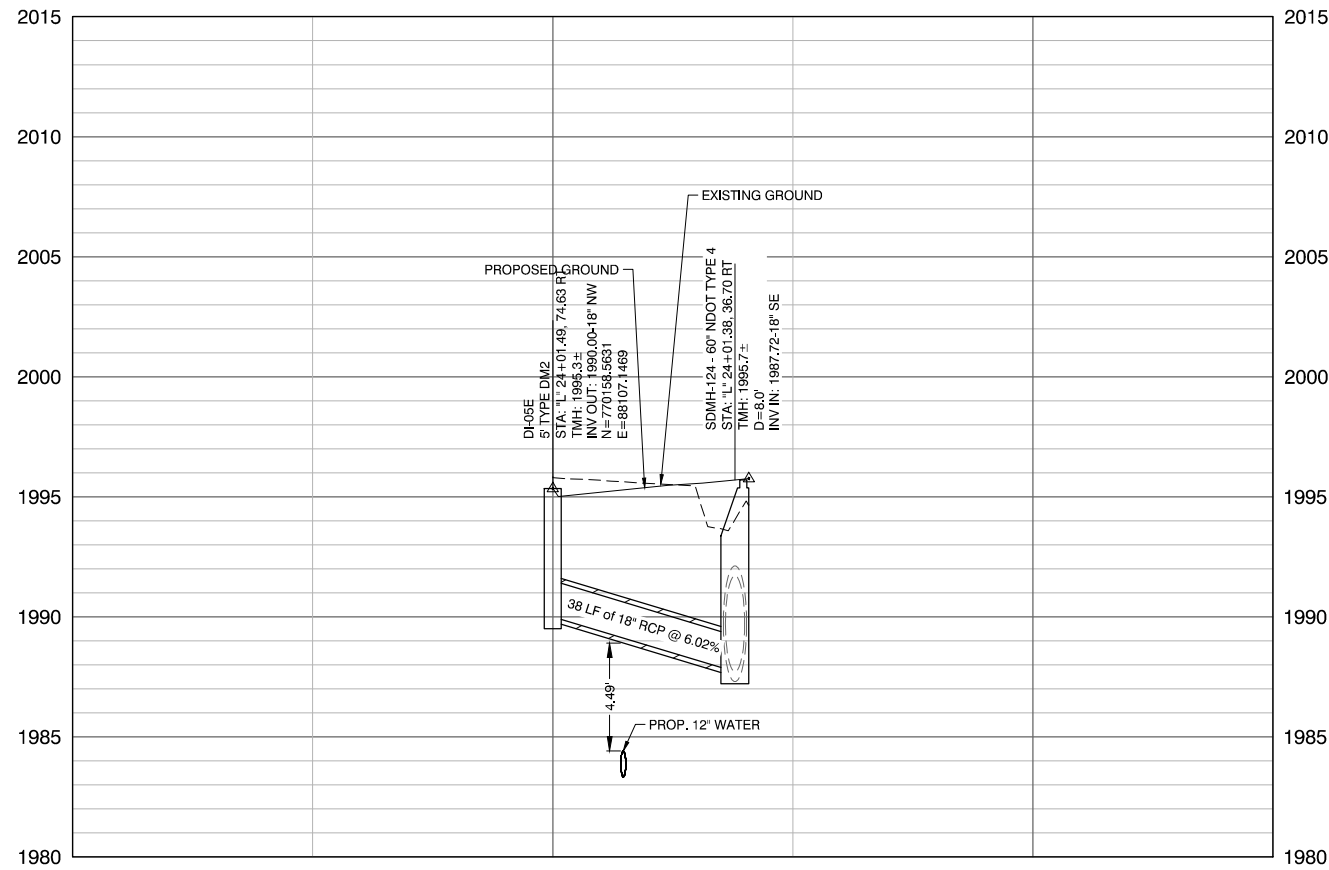
107 OF 163

DRAWING NO.
XXXX

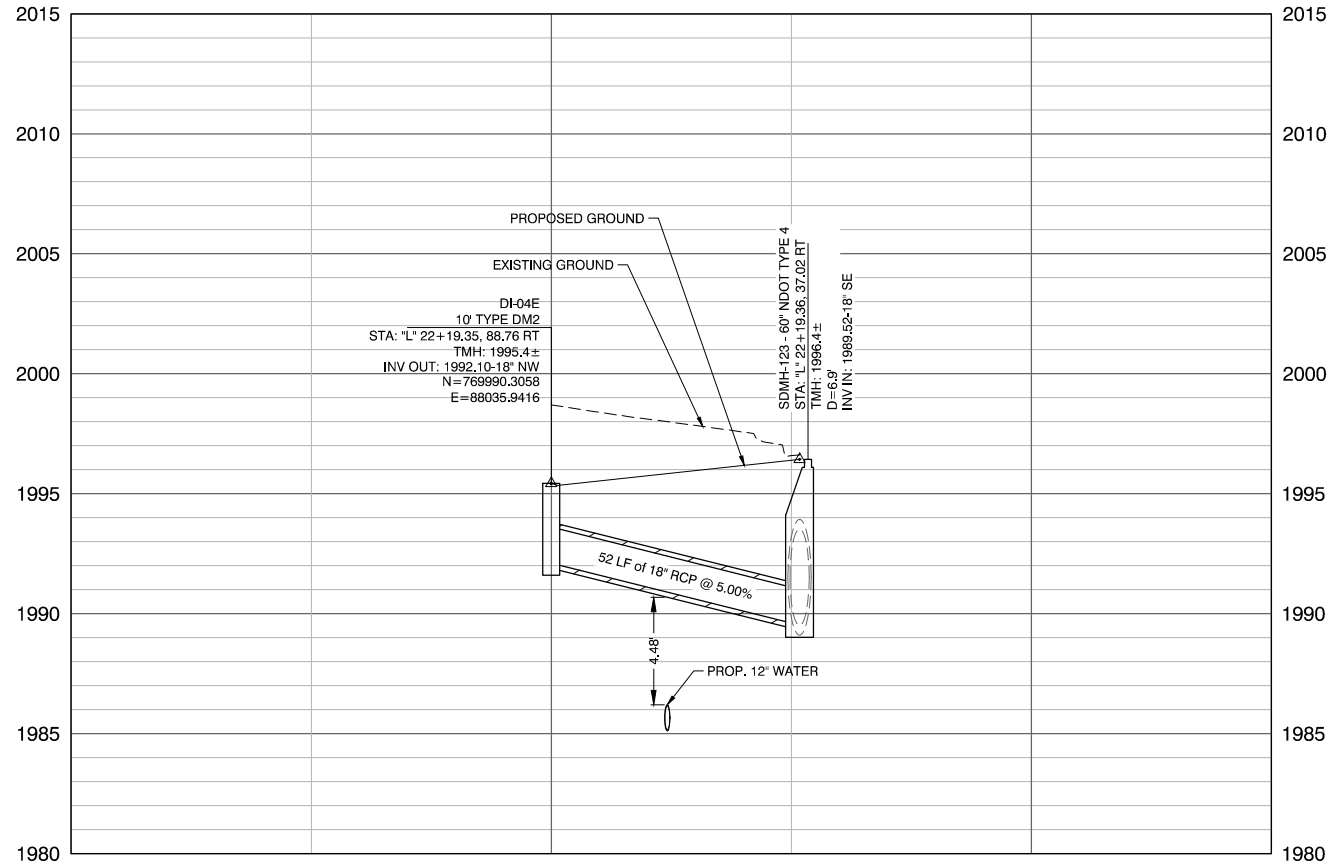
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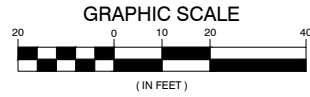
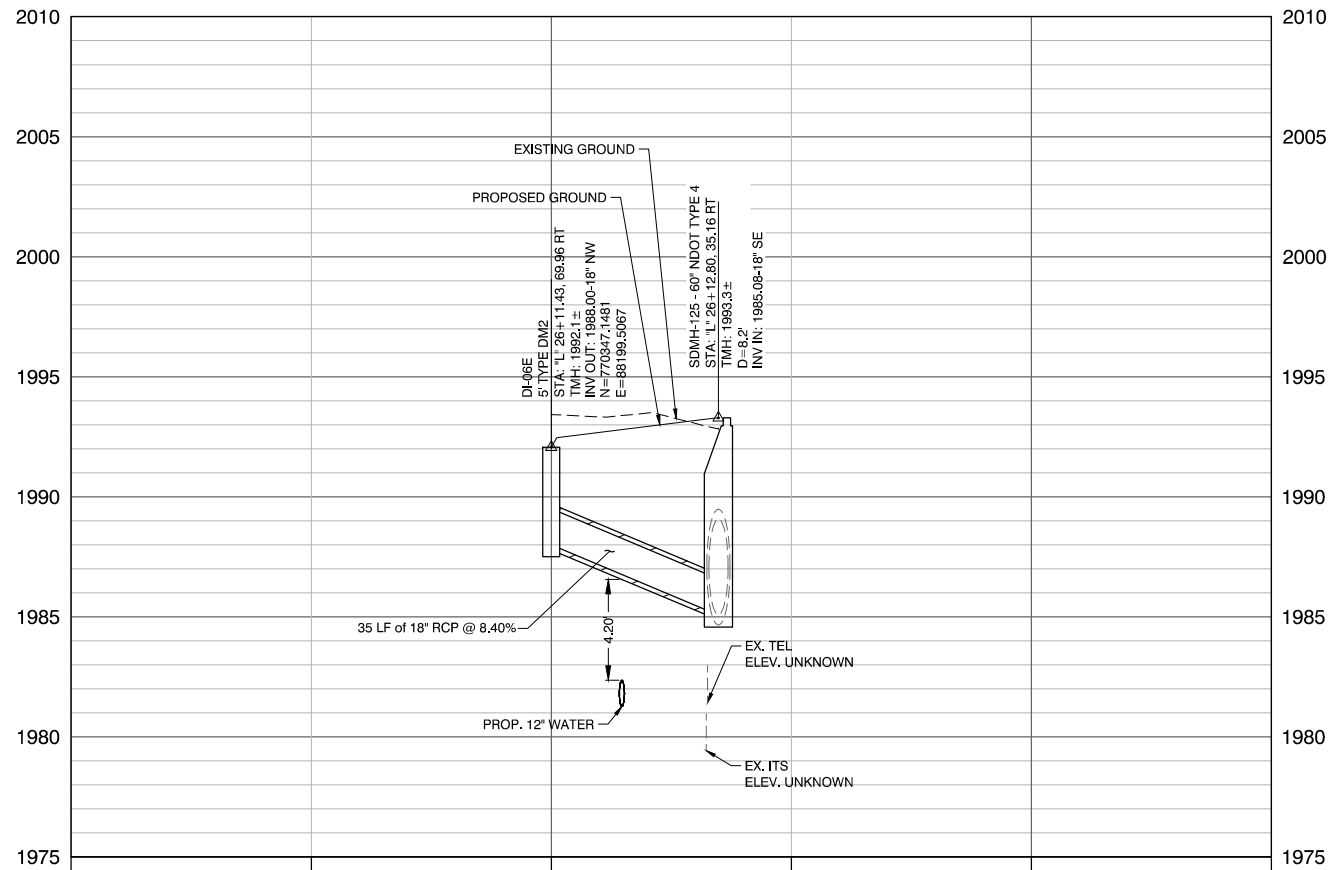
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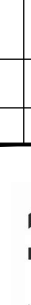
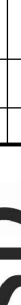


SDMH-123

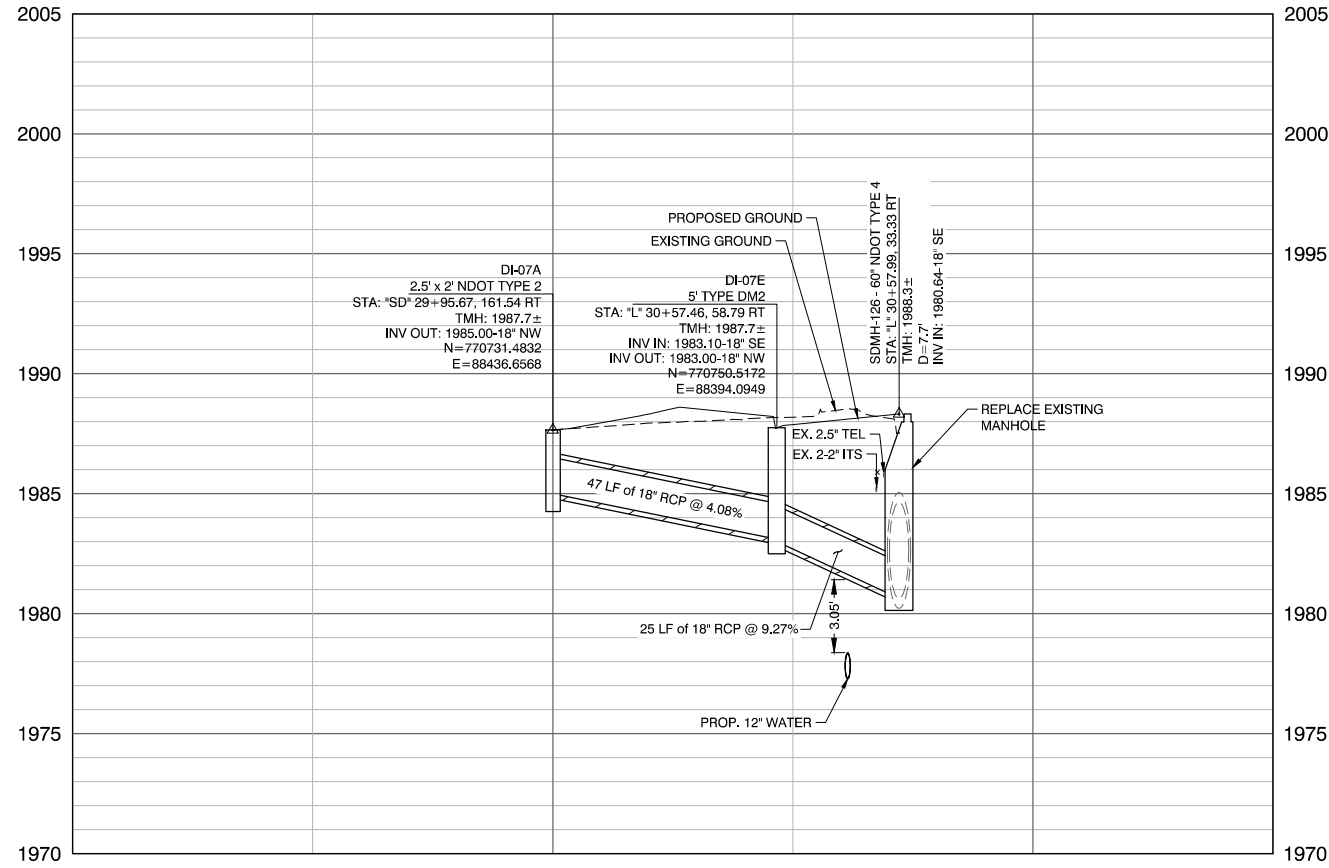


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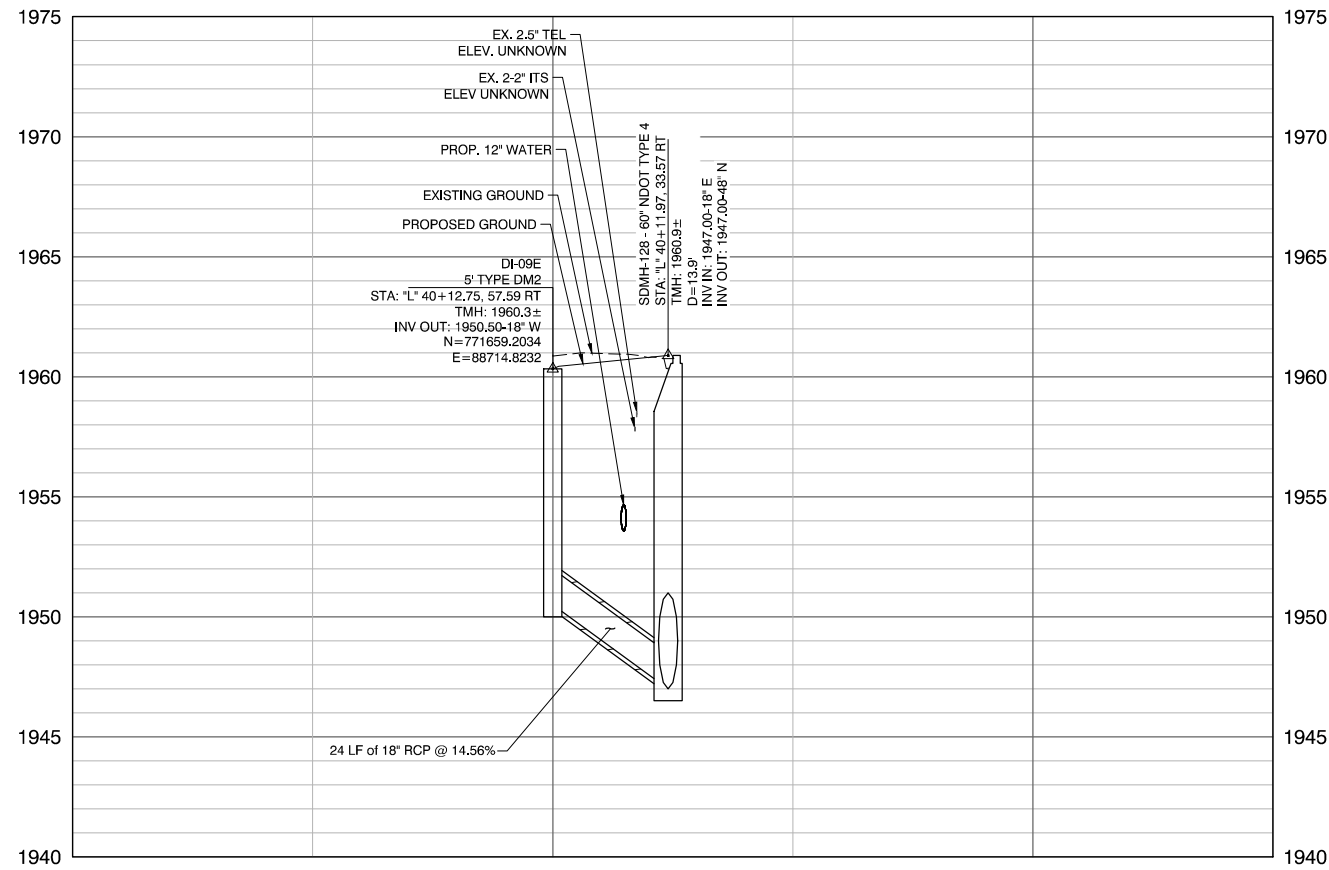


TITLE LAS VEGAS BOULEVARD IMPROVEMENTS FROM STEWART AVENUE TO WASHINGTON AVENUE	SHEET SD-11 108 OF 163	DRAWING NO. XXXX	PREPARED FOR CITY OF LAS VEGAS		DESIGNED BY: JAM	DATE: 11/22/2019	BID# XX-XXXX	DESIGNED BY: JAM	DATE: 11/22/2019	BID# XX-XXXX	DRAWN BY: FME	SUBMITTAL STAGE: 70% PRELIMINARY	CHECKED BY: USD	NO. DATE	REVIEWS
 NOT FOR CONSTRUCTION															
STORM DRAIN PLAN AND PROFILE "L" 42+50.00 to "L" 51+00.00															
PREPARED BY  444 East Warm Springs Road, Ste 118 Las Vegas, Nevada 89119 Phone: 702.736.6632 - Fax: 702.407.1305															

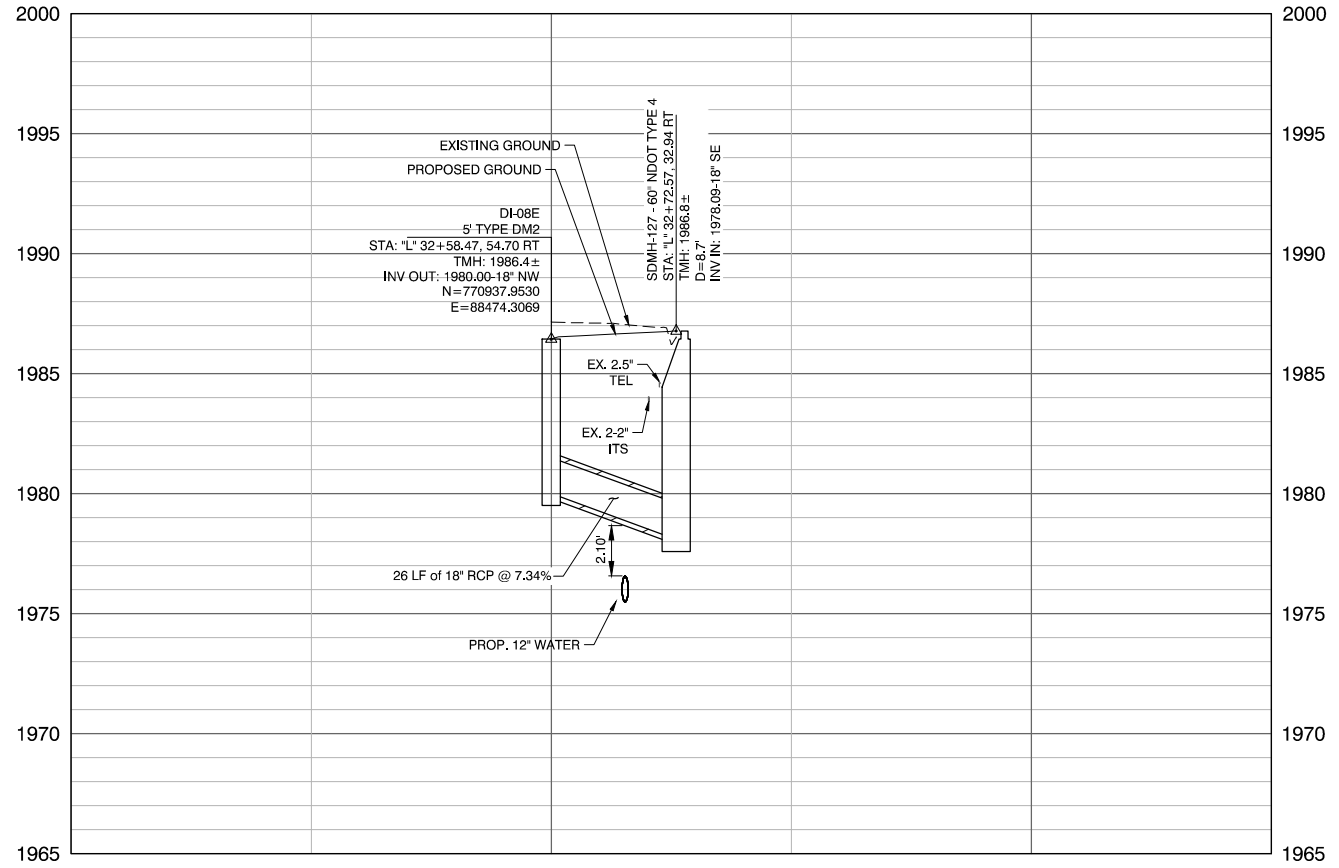
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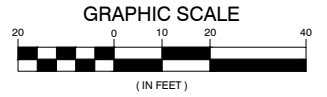
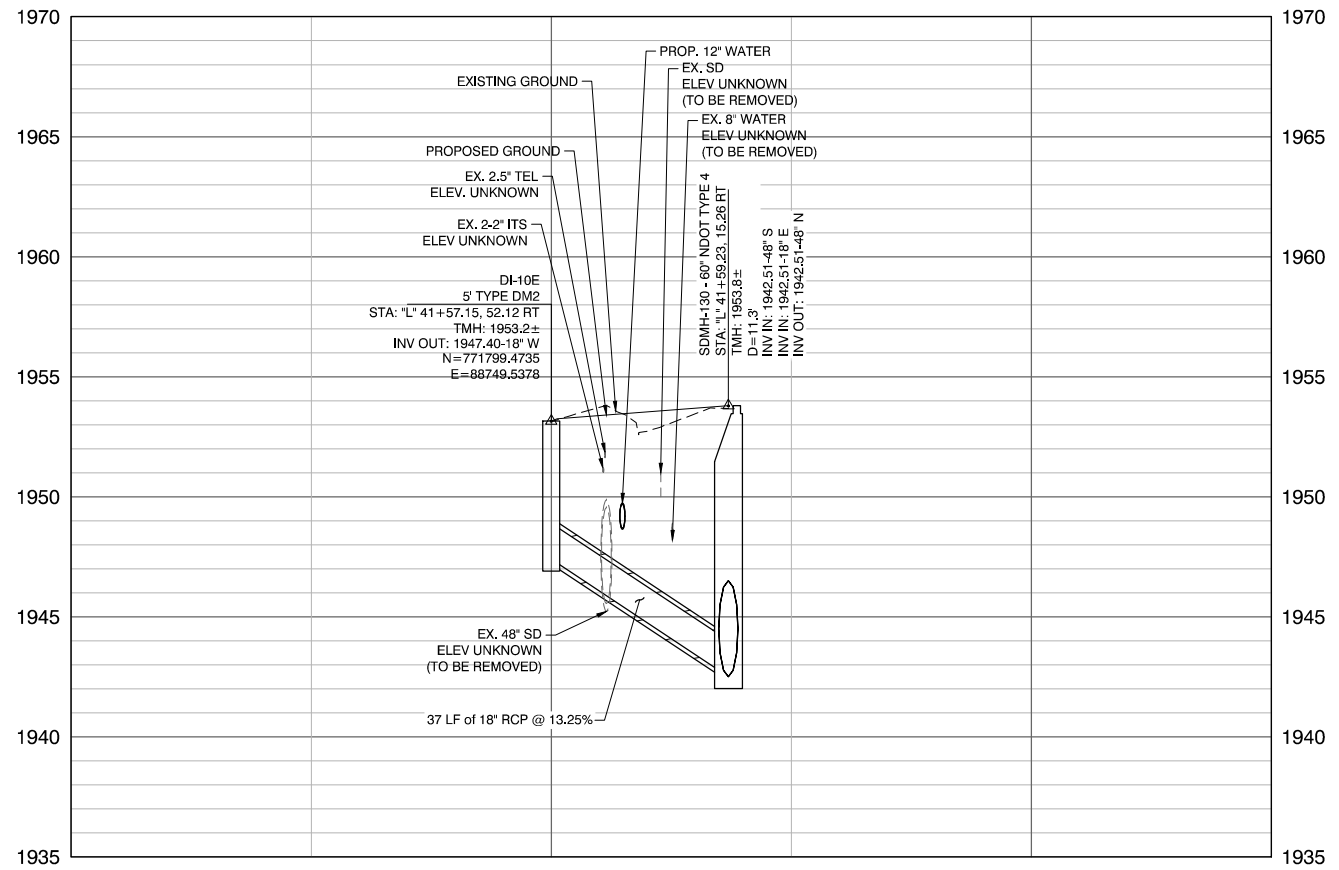
MH-128



MH-127



MH-130

[illegible]

WSP
Luisa Burger U.S., Inc.
A WSP Company
444 East Warm Springs Road, Ste 118
Las Vegas, Nevada 89119
Phone: 702.736.6632 - Fax: 702.407.1301

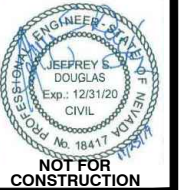
CITY OF LAS VEGAS	H# 38069	BID# XX.XXXXX
	DATE: 11/22/2019	DESIGNED BY: JAM
	SUBMITTAL STAGE:	DRAWN BY: FME
	70% PRELIMINARY	CHECKED BY: JSD

SHEET

**LAS VEGAS BOULEVARD IMPROVEMENTS FROM
STEWART AVENUE TO WASHINGTON AVENUE**

STORM DRAIN PLAN AND PROFILE

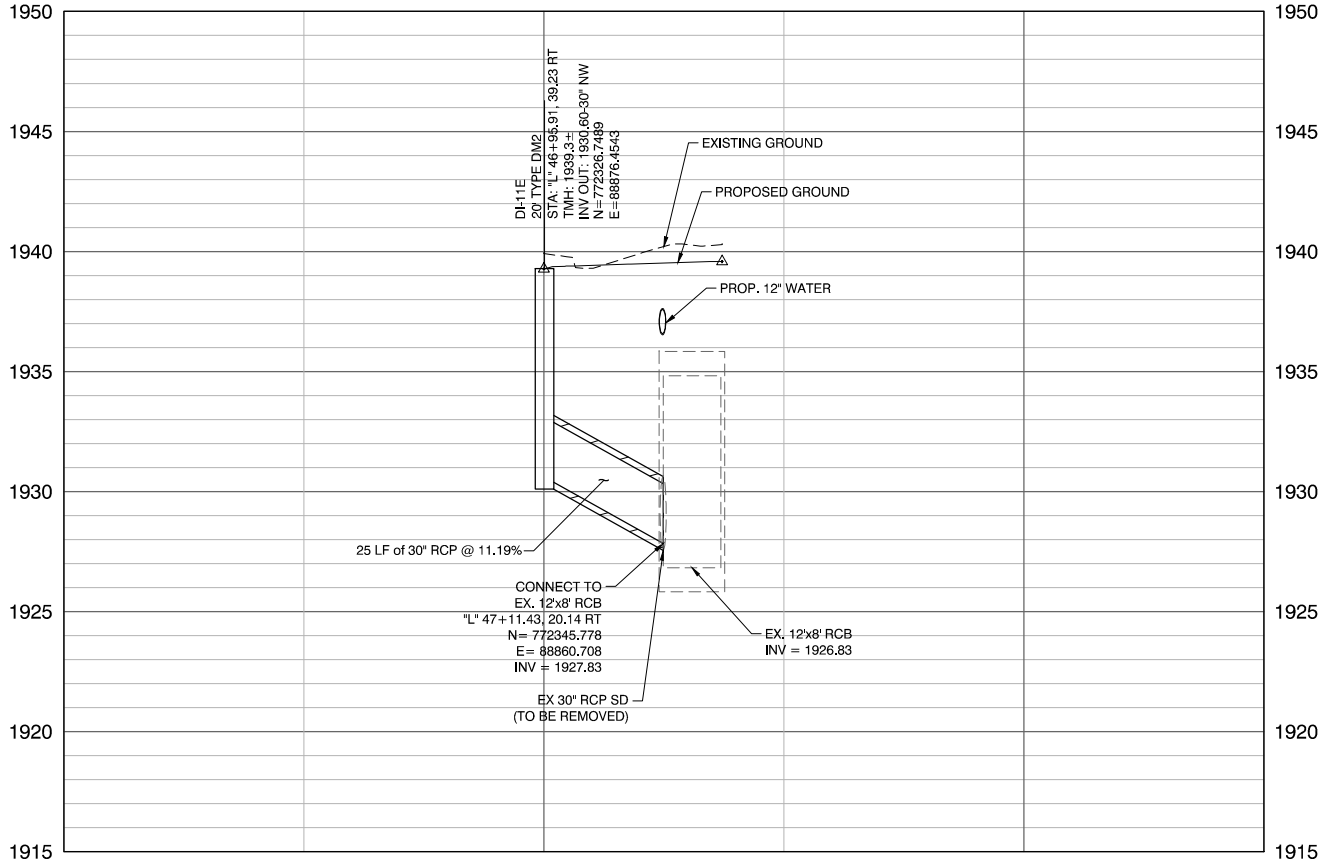
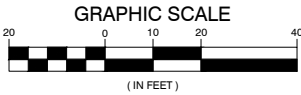
"L" 42+50.00 to "L" 51+00.00



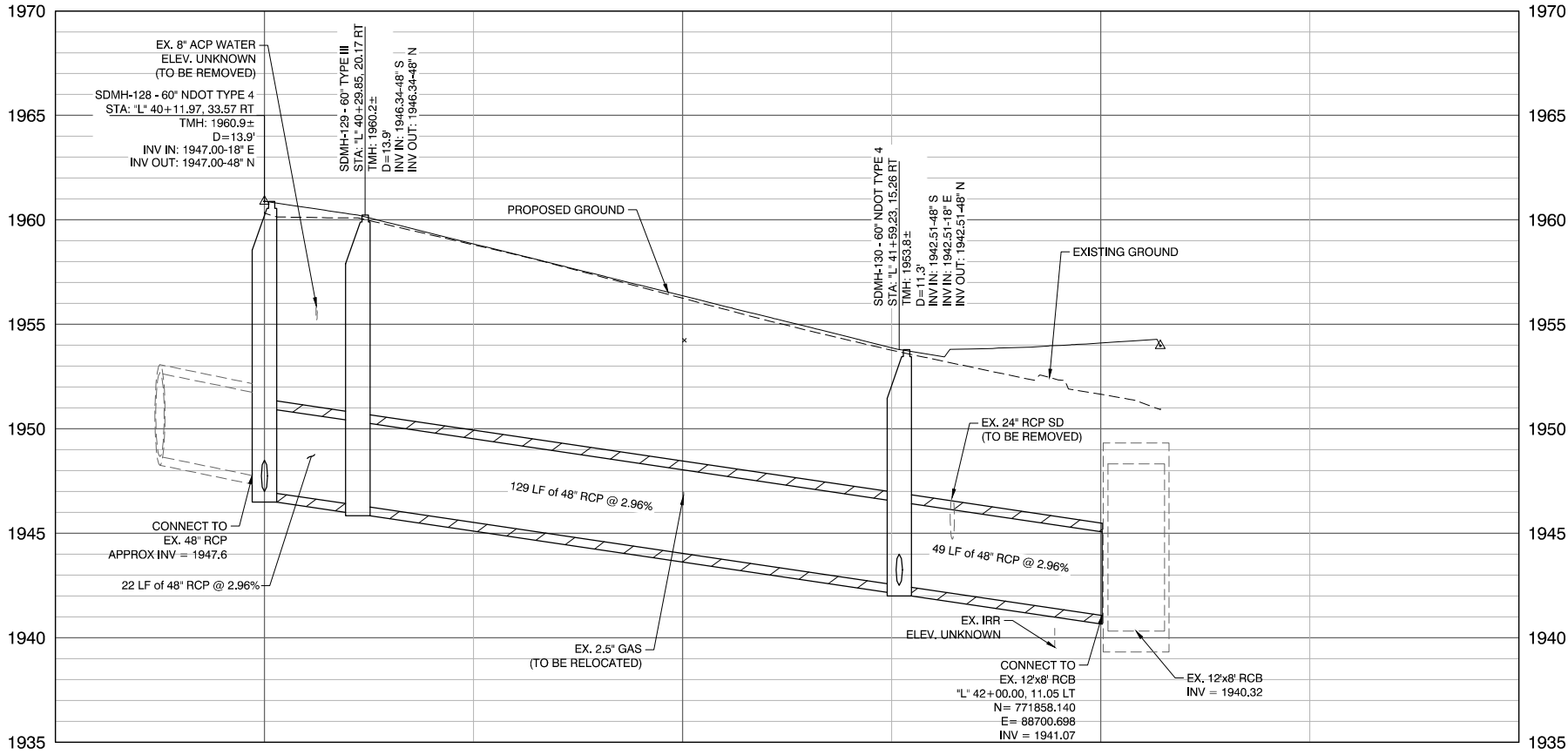
HEET
SD-12
109 OF 163
DRAWING NO.
XXXX

11/22/2019 C:\PROJECT\WSEBIN\LBG2014\LBG\USER\DO235073\2042698-SD06.DWG

DI-11E



PROP 48-IN PROFILE



PREPARED BY		CITY OF LAS VEGAS		DESIGNED BY: JAM		DRAWN BY: FME		CHECKED BY: JSD	
H# 38069		DATE: 11/22/2019		SUBMITTAL STAGE:		70% PRELIMINARY		NO. DATE	
TITLE		LAS VEGAS BOULEVARD IMPROVEMENTS FROM STEWART AVENUE TO WASHINGTON AVENUE		SHEET		STORM DRAIN PLAN AND PROFILE "L" 42+50.00 to "L" 51+00.00		REVISIONS	
SD-13		110 OF 163		DRAWING NO. XXXX					

NOT FOR CONSTRUCTION

JEFFREY S. DOUGLAS
Exp.: 12/31/20
CIVIL

NOT FOR CONSTRUCTION

APPENDIX E – DATA CD

